

Università degli Studi di Napoli Federico II



Scuola Politecnica e delle Scienze di Base
Area didattica di Scienze Matematiche, Fisiche e Naturali

Doctorate of Earth, Environmental and Resources Science

XXXIV Cycle

Bruna Cariddi

**The Cenozoic magmatic activity in Sardinia: chronology and
geodynamic significance**

Tutor

Prof. Leone Melluso

Ph.D. Coordinator

Prof. Vincenzo Morra

Co-Tutors

Dr. Luca G. Costamagna

Prof. Massimo D'Antonio

Dr. Vincenza Guarino

Table of contents

Abstract	5
Introduction	7
1. Geological Setting.....	9
1.1 Igneous activity in Sardinia	12
1.2 Age and genesis of subduction-related magmas in the mantle wedge ...	16
1.3 Igneous activity in Western Mediterranean.....	17
2. Sampling.....	19
2.1 Cixerri, Siliqua and Punta Su Silixianu districts	20
2.2 Monastir district.....	23
2.3 Monte Nureci (Arcuentu) district	24
3. Classification and petrography	25
Petrography of Cixerri lava domes	27
Petrography of Siliqua lava domes	29
Petrography of Monastir rocks	31
Petrography of Punta Su Silixianu lava	33
Petrography of Capo Frasca rocks	33
Petrography of Monte Nureci rocks	34
4. Mineral chemistry	36
4.1 Olivine	36
4.2 Feldspar.....	37
4.3 Pyroxene	40
4.4 Amphibole	43
4.5 Mica	45
4.6 Opaque oxides.....	46

4.7 Accessory phases	48
4.8 Mineral chemistry of the Monastir xenolith	49
5. Bulk Rock chemical composition	50
5.1 Major element composition	50
5.2 Trace element and volatiles composition	53
6. Conditions of magma crystallization	60
7. Age determinations	65
7.1 Previous work	65
7.2 This study	66
8. Isotopic composition	69
9. Discussion	72
9.1 Cixerri district	77
9.2 Siliqua district	81
9.3 Monastir district	87
9.4 Punta Su Silixianu district	89
9.5 Monte Nureci (Arcuentu) district	89
Concluding remarks	93
Analytical techniques	95
Thin section preparation and study, chemical analysis of mineral phases	95
Powder and disk pellets preparation	96
Bulk rock chemical analysis	97
Dating	98
$^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ measurements	101
References	103

Supplementary Materials	121
Thin sections of Cixerri and Punta Su Silixianu samples	121
Thin sections of Siliqua, Monastir and Monte Nureci samples	123
Chemical composition of rocks	124
Chemical composition of olivine	163
Chemical composition of feldspar.....	164
Chemical composition of pyroxene.....	187
Chemical composition of amphibole.....	196
Chemical composition of mica.....	211
Chemical composition of opaque oxides	214
Chemical composition of accessory phases	226
Thermobarometer and hygrometer results	228
$^{40}\text{Ar}/^{39}\text{Ar}$ results.....	230
$^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ results.....	231

Abstract

The Cixerri, Siliqua, Punta Su Silixianu and Monastir lava domes are some of the igneous products with calcalkaline affinity and orogenic features of Cenozoic age cropping out in western Sardinia. The new $^{40}\text{Ar}/^{39}\text{Ar}$ dating performed in this study confirm the wide time span of the subduction-related igneous activity in Sardinia, with a peak at 22-18 Ma when many lava domes were emplaced in the Cixerri half-graben.

The rocks vary from basaltic andesite to dacite. The Monte Nureci intrusive rocks are olivine gabbro-norites and gabbro-norites. The major and trace element variations in the studied rocks of various districts point to a magmatic evolution driven by fractional crystallization of plagioclase, olivine, pyroxenes and opaque oxides. The thermobarometer results and the petrographic study indicate that the evolution took place in polybaric feeding system interested by phenomena like magma recharge/mixing and/or variations of pressure, temperature and H_2O content. Mass balance calculations and trace element variations indicate that amphibole is the main mafic phase crystallizing in the Cixerri magma, due to its high H_2O content (4-9 wt.%). The chemical composition of Acquafredda lava dome (Siliqua district), with high Sr/Y (70-90), $\text{La}_\text{N}/\text{Yb}_\text{N}$ (>20) and low HREE contents ($\text{HREE} < 10$ times chondrite), reveals the occurrence of dacites with adakitic signature, never found on the Island before. The different trace element concentration in the rocks of the various districts is indicative of primitive magmas heterogeneity and of variable fluid flux from the subducted slab and sediments to the mantle wedge under the volcanic arc in Sardinia. The Monte Nureci intrusive rocks are cumulates of the Arcuentu magmas in the basaltic andesite to andesite range, as confirmed by Sr-Nd isotopes and mineral chemistry.

The isotopic variations observed in each district (e.g. Cixerri: $^{87}\text{Sr}/^{86}\text{Sr}_\text{i}=0.70701\text{-}0.70786$ and $^{143}\text{Nd}/^{144}\text{Nd}_\text{i}=0.512328\text{-}0.512436$; Siliqua: $^{87}\text{Sr}/^{86}\text{Sr}_\text{i}=0.70599\text{-}0.70682$ and $^{143}\text{Nd}/^{144}\text{Nd}_\text{i}=0.512379\text{-}0.512482$; Arcuentu:

$^{87}\text{Sr}/^{86}\text{Sr}_i=0.70538-0.71127$ and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.512172-0.51268$) evidence that magma evolution occurred in open systems with crustal assimilation, it was of different intensity due to the independence of magma feeder systems in each district.

Introduction

An intense magmatic activity interested the Western Mediterranean area in the last 40 Ma (southern Spain, Provence, Ligurian Sea, Corsica and Sardinia). This activity was everywhere characterized by the shift from subalkaline to alkaline affinity (Turner et al., 1999; Cebrià et al., 2000; Lustrino et al., 2000; Downes et al., 2001; Conticelli et al., 2002; Coulon et al., 2002; Trua et al., 2002; Beccaluva et al., 2011). In Sardinia two groups of rocks with these affinities can be recognized: the Upper Eocene-Middle Miocene (38-12 Ma) rocks with calcalkaline and high-K calcalkaline affinity and “subduction-related” behaviour (Lustrino et al., 2009) and the Upper Miocene-Quaternary (12-0,1Ma) rocks with geochemical features of intraplate volcanism (Beccaluva et al., 1985; Lustrino et al., 2004, 2007a,b, 2009; Lustrino and Wilson, 2007). The products of the first cycle outcrop in Western Sardinia, mainly in the Sardinian Trough (N-S), in the Cixerri, Narcao and Funtanazza grabens (W-E) (Brotzu et al., 1997a). This magmatism developed in an extensional geodynamic context that induced the opening of the Sardinian Trough, the Sardinia-Corsica microplate separation from Europe, its counter-clockwise rotation and the opening of the Ligurian-Provençal back-arc basin (30-15 Ma; Lustrino et al., 2009 and references therein). The opening of the Ligurian-Provençal back-arc basin had its highest spreading rate at ~22-18 Ma when the magmatic activity reached its peak (Gattacceca et al., 2007).

The aim of this project is the petrographic and chemical study of the igneous products of the first cycle cropping out in the Cixerri half-graben and in Monastir. Moreover, a detailed petrological, geochemical and isotopic study of the Monte Nureci intrusive rocks, which are part of the Arcuentu volcanic complex, was performed. A new data set was added to the previously known volcanic rocks cropping out in the other Sardinian districts, in order to build up a more comprehensive database on the “calcalkaline” volcanic cycle. New $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ were measured to investigate the AFC (Assimilation + Fractional Crystallization) processes that interested all the districts.

Furthermore, new $^{40}\text{Ar}/^{39}\text{Ar}$ ages of representative samples were carried out, in order to obtain an updated age span of the calcalkaline activity in southern Sardinia. The geochemistry of the rocks and the mineral phases will be used to reconstruct the physical conditions of the magmatic reservoirs and to put the Cixerri magmatism in a regional context.

1. Geological Setting

The Sardinia-Corsica microplate was in crustal continuity with the southern European margin (Provence and Catalonia) until Late Oligocene (Cherchi et al., 2008; Dieni et al., 2008; Lustrino et al., 2009; Carminati et al., 2010). It was involved in the Pyrenean orogeny that caused a NW-SE shortening and the deposition of the Cixerri Formation in southern Sardinia (Pecorini and Cherchi, 1969; Cherchi et al., 2008), of the Cuccuru 'e Flores Conglomerate in northern Sardinia (Dieni et al. 2008) and of the Chiappa Conglomerate in southern Corsica (Costamagna and Schäfer, 2017). The Cixerri Formation has a molassic origin, it was formed by the erosion of the Pyrenean chain during middle Eocene (early Lutetian; Agus and Pecorini, 1977; Pittau Demelia, 1979) to early Oligocene (Barca and Costamagna, 2000, 2010; Maxia, 1959), lies on the Variscan metamorphic basement (Carmignani et al., 1994), outcrops on the rims of the Giba and Cixerri sub-basins (Costamagna and Schäfer, 2017), is crosscut by the calcalkaline products of the Oligo-Miocene magmatic cycle (Assorgia et al., 1990, 1992a, 1992b; Lecca et al., 1997) and is covered by the Flumentepido Formation in the Iglesias/Sulcis area (Barca and Costamagna, 2010) and by the Ussana Formation in Campidano/Trexenta area (Pecorini and Cherchi, 1969). During late Oligocene-early Miocene an extensional tectonic phase affected Sardinia (Speranza et al., 2002), leading to the formation of the N-S Sardinian Trough and the opening of the E-W Cixerri, Giba (Casula et al., 2001; Cherchi et al., 2008; Cherchi e Montadert, 1982) and Funtanazza half-graben transtensive basins, which developed on former tectonic lines and are cut by volcanic fractures feeding the lava domes (Barca and Costamagna, 2010). On the same time, the Sardinia-Corsica block rifted toward SE and started to drift counter-clockwise (60°) inducing the opening of the Ligurian-Provençal back-arc basin (Orsini et al., 1980; Fanucci and Morelli, 1995; Cherchi et al., 2008; Dieni et al., 2008; Lustrino et al., 2009; Carminati et al., 2010), related to the Appennine-Maghrebide subduction system.

The rifting of Sardinia from the European margin started ~30 Ma, the drifting took place between 22 and 15 Ma (Vigliotti and Langenheim, 1995; Gueguen et al., 1998; Speranza et al., 2002; Schettino and Turco, 2006; Lustrino et al., 2009; Carminati et al., 2010), when the Island acquired its current position (Fig. 1) and the extensional tectonic moved towards E with the opening of the Tyrrhenean Sea (Speranza et al., 2002; Lustrino et al., 2009; Carminati et al., 2010).

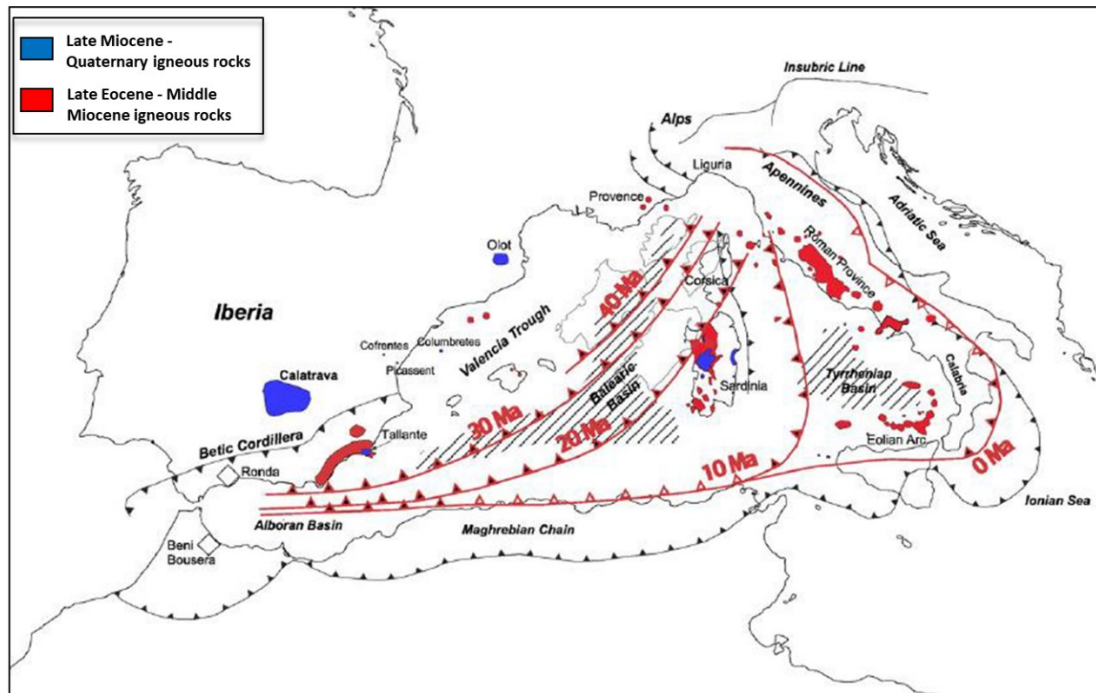


Figure 1 - Sketch map of the Western Mediterranean with the tectonic and magmatic evolution from 40 Ma to 0 Ma: Sardinia-Corsica block rotation and slab retreat of the Apennines-Maghrebian subduction system (from Beccaluva et al., 2011, modified).

During the Eocene period the Alpine-Betic subduction system, related to the subduction of Europe plate towards E under Adria plate, reached the continental stage. Then, the subduction flip (~45 Ma), due to the presence of the Mesomediterranean Terrane (Doglioni, 1991; Doglioni et al., 1998), lead to the end of the Alpine subduction and to the beginning of the NE-SW-oriented Appennine-Maghrebide subduction (Fig. 2; Garzanti and Malusà, 2008, Garzanti et al., 2008, Molli, 2008), with the immediate radial retreated of the new “Appennines” slab (Fig. 1; Carminati et al., 2012). During the first subduction, the Sardinia-Corsica block was part of the European foreland, then

it turned into the hinterland of the Apennine-Maghrebide subduction system (Carminati et al., 2012).

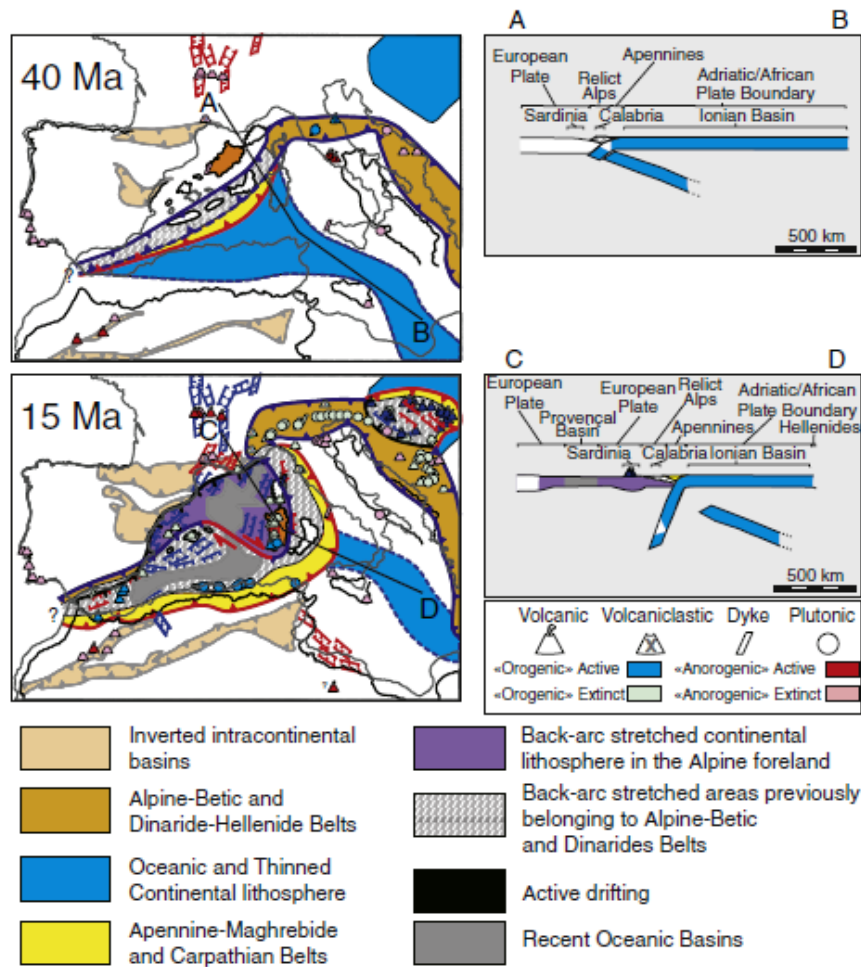


Figure 2 - Sketch maps of Western Mediterranean at 40 and 15 Ma, and cross sections (from Lustrino et al., 2013 and references therein).

How and why the shift from a compressive phase, with the Pyrenean and Alpine orogeny, to an extensional phase at ~30 Ma, with the opening of the Ligurian-Provençal back-arc basin, took place is still debated (Jolivet et al., 1999). According to Rosenbaum et al. (2002) the extension of the back-arc basin was related to the reduction of the convergence velocity between Africa and Europe plates. Other authors (Alvarez, 1974; Beccaluva et al., 1989; Gueguen et al., 1998; Carminati et al., 2012) proposed that the extensional movements of the Oligo-Miocene period were due to the gravitative collapse of the Tethys oceanic lithosphere, in subduction under Europe plate toward NW; the subduction was associated to an E-directed flow in the asthenosphere

that generated the E-SE-directed slab roll-back (Fig. 1) and the opening of the back-arc basins (Doglioni et al., 1999). According to Dewey et al. (1989) Africa plate moved toward N until the early Miocene, when it started to move toward NNE, causing the Sardinia-Corsica block drifting and the migration of the front the Appennine subduction system toward E.

The western part of the island is cut, from north to south, by the Sardinian Trough with ~220 km of length and ~40 km of width (Cherchi et al., 2008; Faccenna et al., 2002; Lecca et al., 1997; Lustrino et al., 2004). Lecca et al. (1997, and references therein) divided its formation in three phases:

- 1) Pre-Rift (late Eocene-Oligocene): the collisional phase was accompanied by a strike-slip and/or transpressive tectonic setting;
- 2) First Rift (Aquitainian-Burdigalian): the extensional regime led to the reactivation of the late-Hercynian N-E faults with the formation of half-grabens, it was accompanied by an increase in the explosivity of the volcanic activity;
- 3) Second Rift (Late Burdigalian-Langhian): the Sardinia-Corsica block rotation and the Appennine front thrust retreat led to a collapse with the development of structural lows in northern Sardinia; this phase is accompanied by chemical variations in the composition of the volcanic products (high-Mg basalts in Monstresta district and peralkaline rhyolites in the Sulcis area).

1.1 Igneous activity in Sardinia

Sardinia was interested by a variable magmatic activity (from subalkaline to alkaline) during the Cenozoic, which can be divided into two phases (Lecca et al., 1997; Lustrino et al., 2004, 2009, 2011):

- 1) the first phase developed during late Eocene- Middle Miocene (~38-12 Ma) with the emplacement of igneous rocks with calcalkaline and high-K calcalkaline affinity and orogenic geochemical features (“subduction-related”;

Lustrino et al., 2009; Fig. 3). The peak of the activity was at ~22-18 Ma, when Sardinia-Corsica block was drifting with its maximum angular velocity and the Ligurian-Provençal back-arc basin was opening with the maximum extension rate (Rollet et al., 2002; Speranza et al., 2002). The products crop out mainly in the Sardinian Trough and in the E-W oriented grabens of Cixerri, Funtanazza and Narcao (Brotzu et al., 1997a) in western Sardinia.

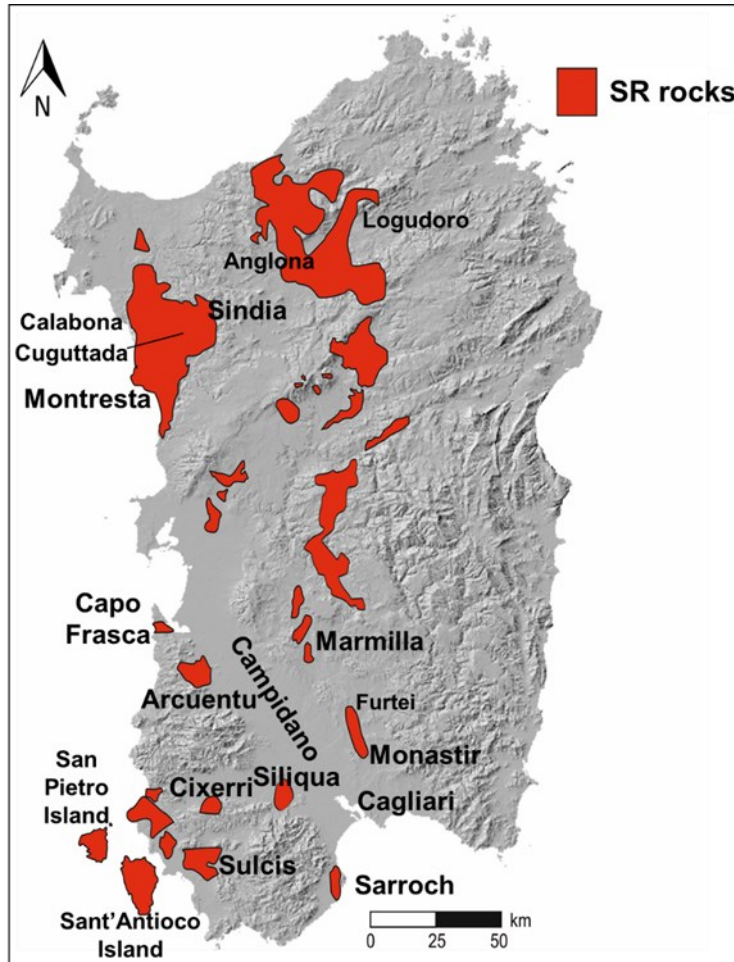


Figure 3 - DEM (Digital Elevation Model, SRTM 90m; Jarvis et al., 2008) of Sardinia with the districts of the subduction-related (SR) igneous products from Lustrino et al. (2009).

2) the second phase is characterized by igneous products with intraplate geochemical features that emplaced during late Miocene- Quaternary (~12-0.1 Ma; Beccaluva et al., 1985; Lustrino et al., 2004, 2007a, b; Lustrino and Wilson, 2007).

The products of the first phase are dacitic and rhyolitic ignimbrites, andesitic lava flows and rare magnesium rich and alumina rich basalts (Morra

et al., 1997; Mattioli et al., 2000; Downes et al., 2001; Franciosi et al., 2003). In detail, ignimbrites crop out in northern Sardinia (Guarino et al., 2011) associated to HABs (High Alumina Basalt) and HMBs (High Magnesium Basalt). The most primitive samples in the Island are the HMBs of Montresta (Morra et al., 1997; Franciosi et al., 2003), indeed the HABs have lower concentrations in Cr and Ni (Dostal et al., 1982). The evolution of the magmas was governed by fractional crystallization in open systems, as testified by the corroded rims of the phenocrysts (Guarino et al., 2011). There are calcalkaline to high-K calcalkaline basalts to andesites (~21 Ma) covered by shoshonitic rocks (19.7-18.4 Ma) such as shoshonites and latites in Anglona district (Beccaluva et al., 2013). The shoshonitic rocks are peculiar of this district and show intermediate chemical affinity between alkaline and subalkaline fields, they were distinguished for the presence of biotite in the basic products and the absence of orthopyroxene. Both calcalkaline and shoshonitic rocks have negative anomalies in Ti, Nb and Ta in the multi-element diagram normalized to the primitive mantle, the shoshonitic rocks have higher concentrations in LFSE (Low Field Strength Elements) such as K, Rb, Sr, Ba, U and Th. The shift from calcalkaline to shoshonitic affinity could be due to the increase of the subduction angle of ~5-10° and a higher amount of subducted terrigenous sediments (Beccaluva et al., 2013).

The Arcuentu district was interested by the emplacement of effusive rocks, with minor gabbroid products, in a long-time span (30-17 Ma); it developed on the intersection between the Sardinian Trough and the E-W Funtanazza half-graben (Brotzu et al., 1997b). The Arcuentu district differs for the higher amount of basaltic products respect to the other Sardinian districts. The effusive (from basalt to andesite) products contain cumulitic clots and pyroxene xenocrysts which represent “recycled” material in the zoned magmatic reservoirs, where the magma evolved for fractional crystallization in the upper crust (Brotzu et al., 1997b).

A lower and an upper volcanic sequence, separated by a sedimentary level, were recognized in the Sulcis area (Brotzu et al., 1997a): the lower sequence is made up of basaltic to andesitic lava domes and flows with calcalkaline affinity and subduction-related signature, cropping out in the Narcao-Carbonia area (Sulcis mainland), on the Sant'Antioco and Vacca Islands (~24-19 Ma; Brotzu et al., 1997a; Ronga, 2011; Lustrino et al., 2013); the upper sequence is constituted by dacitic, rhyolitic and peralkaline ignimbrites (~16.5-15 Ma; Morra et al., 1994; Ronga, 2011) and crop out in Sulcis mainland, San Pietro and Sant'Antioco Islands. The magmatic activity of the lower sequence developed through the NW-SE and W-E faults (Lecca et al., 1987). The predominance of basalts in the lower sequence in Narcao area points to a continuous replenishment of the magmatic reservoir by new primitive magma that evolved for fractional crystallization and crustal assimilation (Brotzu et al., 1997a). The peralkaline ignimbrites of the upper sequence are comendites. Their occurrence in a subduction tectonic context was explained by Morra et al. (1994) with the removal from the calcalkaline magma of plagioclase and clinopyroxene, causing the increase of alkali concentration in the melt. Ronga (2011) proposed a different model for the genesis of the comendites: they were not genetically related to the lower sequence, but resulted from the mixing of a metaluminous rhyolitic magma of the upper sequence and a trachytic magma like that erupted in Toro Island (~11.8 Ma; Lustrino et al., 2007b). According to Gisbert and Gimeno (2019), the source of the peralkaline magmatism is in the depleted mantle which was not influenced by the subduction; the formation of a slab tear under Sardinia caused the shift from calcalkaline to alkaline and peralkaline affinity and the end of the first magmatic phase.

The Sarroch district is in the Campidano graben, which is a structural trough developed during the Plio-Quaternary period in an extensional tectonic regime (Pecorini and Cherchi, 1969). The volcanic products (24.4-22.2 Ma) were divided into two groups: 1) intrusive rocks with two pyroxenes and 2)

effusive rocks with amphibole and orthopyroxene, deriving from two magmatic series (Conte, 1997). The two magmatic series have different isotopic composition due to different degree of crustal contamination or to different composition of the parental magmas. The evolved feature of the rocks hampers investigations about the magma source.

The “recycling” of crystals in the magma reservoirs, its evolution driven by fractional crystallization in polybaric open systems are common features in the various Sardinian districts (e.g. Lonis et al., 1997).

1.2 Age and genesis of subduction-related magmas in the mantle wedge

Previous studies (Beccaluva et al., 1985 and references therein) identified the subduction-related products in a shorter time span (~32-14 Ma), new age determinations enlarged the range from 32-14 Ma to 38-12 Ma (Lustrino et al., 2009). Beccaluva et al. (1985) divided the subduction-related products in two periods (32-26 Ma and 24-14 Ma) and related those of the first period to the Pyrenean orogeny, indeed, their emplacement occurred before the drifting of the Sardinia-Corsica block (Barca et al., 2001). According to Lustrino et al. (2009) the subduction-related magmatic activity is linked to the NW-directed and SE retreating subduction that induced the metasomatism and the partial melting of the mantle wedge under Sardinia. Moreover, the decompression in the extensional tectonic regime favored the partial melting of the mantle wedge (Morra et al., 1997). The subducting slab starts to dehydrate at depth variable from ~70-120 km, for young and hydrated lithosphere, to ~150-200 km for cold and anhydrous slabs (Schmidt and Poli, 1998; Abers, 2000). The W-directed Appennine-Maghrebide subduction system had a low subduction rate (~1cm/yr; Jolivet and Faccenna, 2000). Lustrino et al., (2009) calculated that the beginning of the Appennine subduction should be between ~4 Ma and ~11 Ma before the emplacement of

the first igneous products, so that a $\sim 45^\circ$ dipping slab could reach the dehydration depth of 80-120 km with velocities of 3 and 1 cm/yr, respectively. Considering ~ 38 Ma as the age of the first products, the Appennine subduction began between ~ 42 and ~ 49 Ma. This hypothesis does not explain the high distance between the volcanic arc and the subduction hinge at 42-38 Ma (200-400 km), thus Carminati et al. (2012) proposed a new theory to justify also the paucity of products in the Western Mediterranean area in the first period of the subduction-related activity (43-23 Ma): the W-directed subducting slab pushed the ancient lower crust of the upper plate at higher depths. The partial melting of this material related to the Variscan orogeny generates the first products in Sardinia (Savelli, 2015). The subduction-related volcanic activity reached its peak at 21 Ma, when the W-directed subducting slab of the Appennine subduction system reached the dehydration depth of 120 km (Carminati et al., 2012).

1.3 Igneous activity in Western Mediterranean

The tectonic evolution of the Western Mediterranean area during the Cenozoic period depends on the collision between Africa and Europe plates with the subduction of the Tethys oceanic lithosphere and extensional phases (Beccaluva et al., 2011). The Cenozoic magmatic activity varies from calcalkaline (subduction-related) to alkaline (anorogenic) (Turner et al., 1999; Cebrià et al., 2000; Lustrino et al., 2000, 2017; Downes et al., 2001; Conticelli et al., 2002; Coulon et al., 2002; Trua et al., 2002) due to the presence of slab windows (Beccaluva et al., 2011 and references therein) and to the activation of deeper mantle sources not enriched by the slab derived fluids (Lustrino et al., 2017). Orogenic products of Oligo-Miocene age crop out in southern Spain, in the Betic-Alboran region with the oldest arc-tholeiitic dykes near Malaga (34-27 Ma) and the youngest lamproites in Cartagena (12-6 Ma; Beccaluva et al., 2011 and references therein). Beccaluva et al. (2011) related

these products to the W-directed subduction of the Ionian oceanic lithosphere under Europe paleo-margin and their chemical variation to the steepening of the subduction.

Provence was interested by the emplacement of igneous products with tholeiitic-calcalkaline affinity between 41 and 20 Ma (Lustrino et al., 2017). They are mainly subduction-related andesites and dacites with broadly the same chemical composition of the coeval Sardinian rocks, except for the higher concentration in Na₂O and lower in Y, Pb, Th and U. Their mantle source is a DMM (Depleted MORB Mantle)-like source in the stability field of spinel enriched by ancient subducted sediment-derived fluids.

Lamproitic dykes of ~15 Ma occur in NE Corsica, at Sisco (Féraud et al., 1977), related to the K-rich products in Sardinia (Réhault et al., 2012).

The subduction-related magmatic activity developed also offshore in the Ligurian-Provençal basin mainly in two areas, SW of Corsica (21-7 Ma) as extension of the Sardinian Trough on thinned continental crust and NW of Corsica, in the Ligurian Sea (Réhault et al., 2012 and references therein). The SW Corsica volcanic field and the Sardinian Trough are thought to represent a second aborted rifting stage (Réhault et al., 1984; Thomas and Genesseeux, 1986; Monaghan, 2001; Ferrandini et al., 2003; Oudet et al., 2010). The igneous products occur in a transform fault zone of the northern Ligurian Sea and emplaced during the last phase of the “oceanisation” of the Ligurian Sea (Réhault et al., 2012).

The subduction-related igneous products in the Western Mediterranean have variable isotopic composition due to the different composition of the mantle sources at variable depths and to the different degrees of crustal contamination (Beccaluva et al., 2011).

2. Sampling

The samples (Tab. 1) were collected in different districts of Sardinia (Fig. 4a), interested by the subduction-related igneous activity. Cixerri and Siliqua lava domes crop out in Cixerri half-graben and they had never been studied before, so the most part of the study is focused on these samples. Another lava dome crops out at Punta Su Silixianu, east of Siliqua. In Monastir district there are few igneous products: the dyke, the lava dome and the xenolith found in the lava were collected. Intrusive samples were collected in the Arcuentu volcanic complex (Monte Nureci).

Sample	District
SAR1	Serra Areni (Cixerri)
SAR2	
SAR3	
SAR4	
SAR5	
SAR6	
SAR7	
SAR8	
SAR9	
CSA1	
CSA2 (amph)	
CSA3 (amph)	
SAR10	Monte Limpiu (Cixerri)
SAR11	
SAR12	
SAR13	
SAR16	
SAR17	
SAR18	Punta Pedru Antiogu (Cixerri)
SAR19	
SAR20	
SAR21	Monte Limpiu (Cixerri)
SAR22	
SAR23	
SAR24	Monte Gioiosa Guardia (Cixerri)
SAR25	Punta Fradis Saruis (Cixerri)

Sample	District
MTR1	Monte Truxionis (Siliqua)
MTR2	
MTR3	
MTR4	
SIL1	Acquafredda (Siliqua)
SIL2	
ACQ1	
ACQ2	
ACQ3	Ex Cava Monte Oladri (Monastir)
CMO1 (xenolith)	
CMO2 (lava)	
CMO3 (dyke)	Punta Su Silixianu
PSS1	
MNU1	Monte Nureci (Arcuentu)
MNU2	
MNU3	

Table 1 - Studied samples and provenance districts.

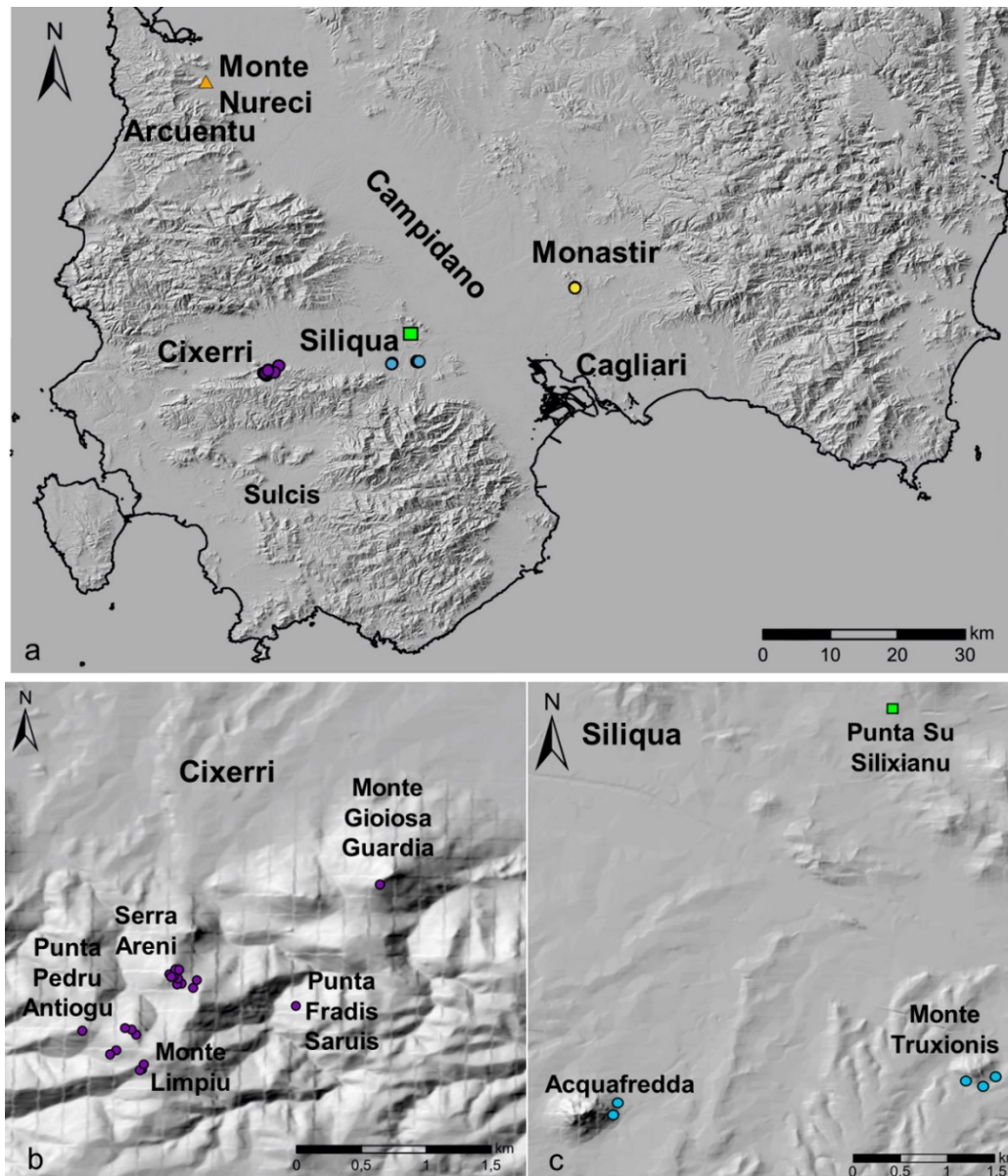


Figure 4 - 10m DEM (Digital Elevation Model; Tarquini et al., 2007) of a) southern Sardinia, b) detail of Cixerri district, c) detail of Siliqua district with the collected samples.

2.1 Cixerri, Siliqua and Punta Su Silixianu districts

In the Cixerri half-graben many lava domes crop out (Fig. 5a). The westernmost, south of Villamassargia village, are considered part of Cixerri district (Fig. 4b), instead the easternmost, south of Siliqua town, belong to Siliqua district (Fig. 4c). The lava domes emplacement took place through the stretching discontinuities caused by the contemporary Cixerri half-graben formation.

In Cixerri district 12 samples were collected from Serra Areni lava dome, 9 from Monte Limpiu, 3 from Punta Pedru Antiogu, 1 from Monte Gioiosa Guardia and one from Punta Fradis Saruis (Fig. 4b). The andesitic lava domes intruded the Paleozoic bedrock (sandstone of Nebida formation) and the Cixerri formation, locally with slight thermo-metamorphic effect. They show cooling joints (Fig. 5b), except for Punta Pedru Antiogu dome that is not fractured, and vary in color from grey-greenish (Fig. 5c-d) to black (Fig. 5e). They have porphyritic texture with euhedral plagioclase and amphibole phenocrysts that reach 3-4 cm in length (Fig. 5f). Some alteration phases like pyrite and chlorite are visible in Monte Limpiu dome.

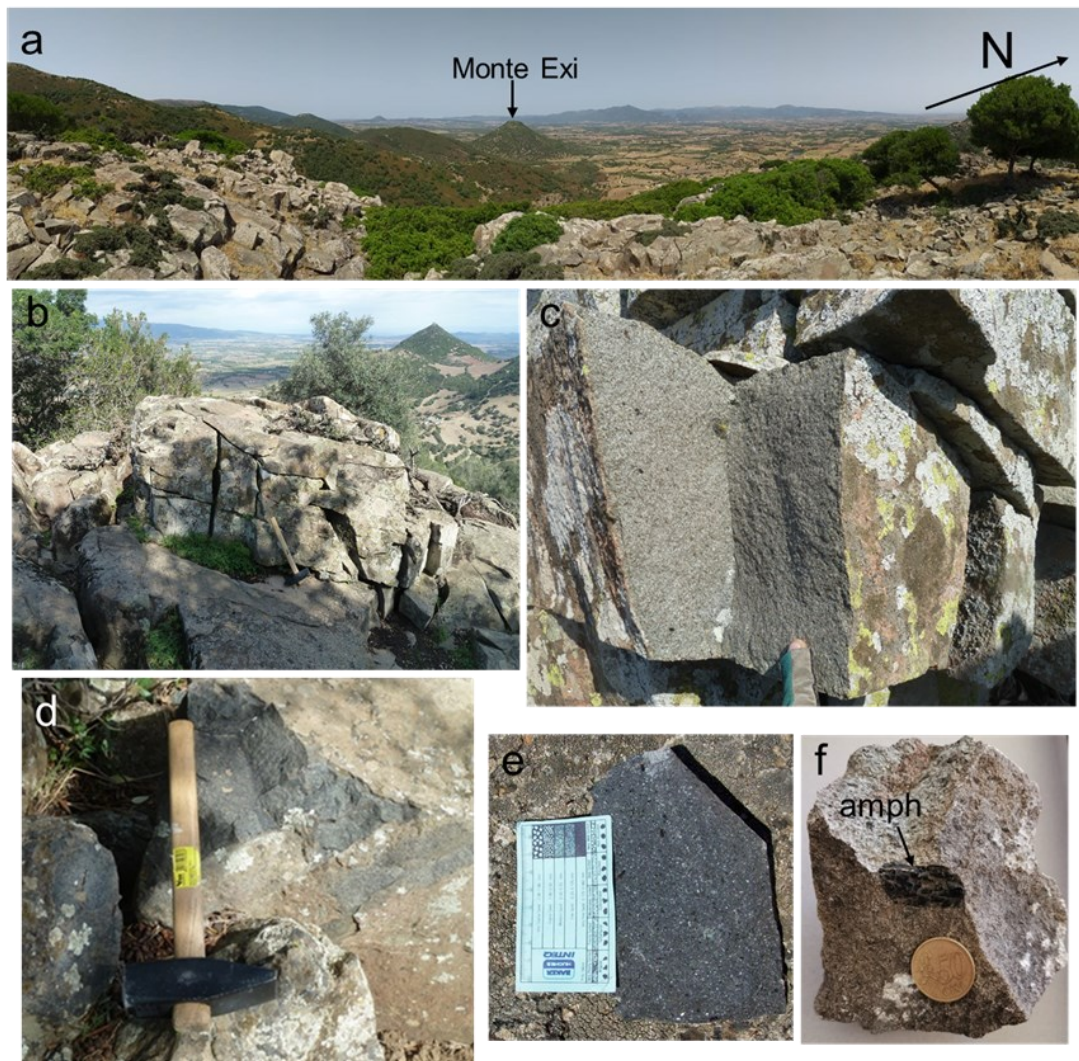


Figure 5 - a) Panoramic view of Cixerri graben from Serra Areni dome; b) Cooling joints in Serra Areni dome; c) View of grey-greenish sample (SAR8) from Serra Areni; d) Grey-black sample (SAR5) from Serra Areni; e) Black sample (SAR21) with porphyritic texture for amphibole and plagioclase phenocrysts from Monte Limpiu; f) View of amphibole megacryst (CSA3) from Serra Areni. Abbreviation from Whitney and Evans (2010).

In Siliqua district (Fig. 4c) 5 samples were collected in Acquafredda lava dome (Fig. 6a) and 4 in Monte Truxionis lava dome (Fig. 6b). They differ from the Cixerri lava domes for the lighter grey colour and for the presence of quartz phenocrysts (Fig. 6c-d).

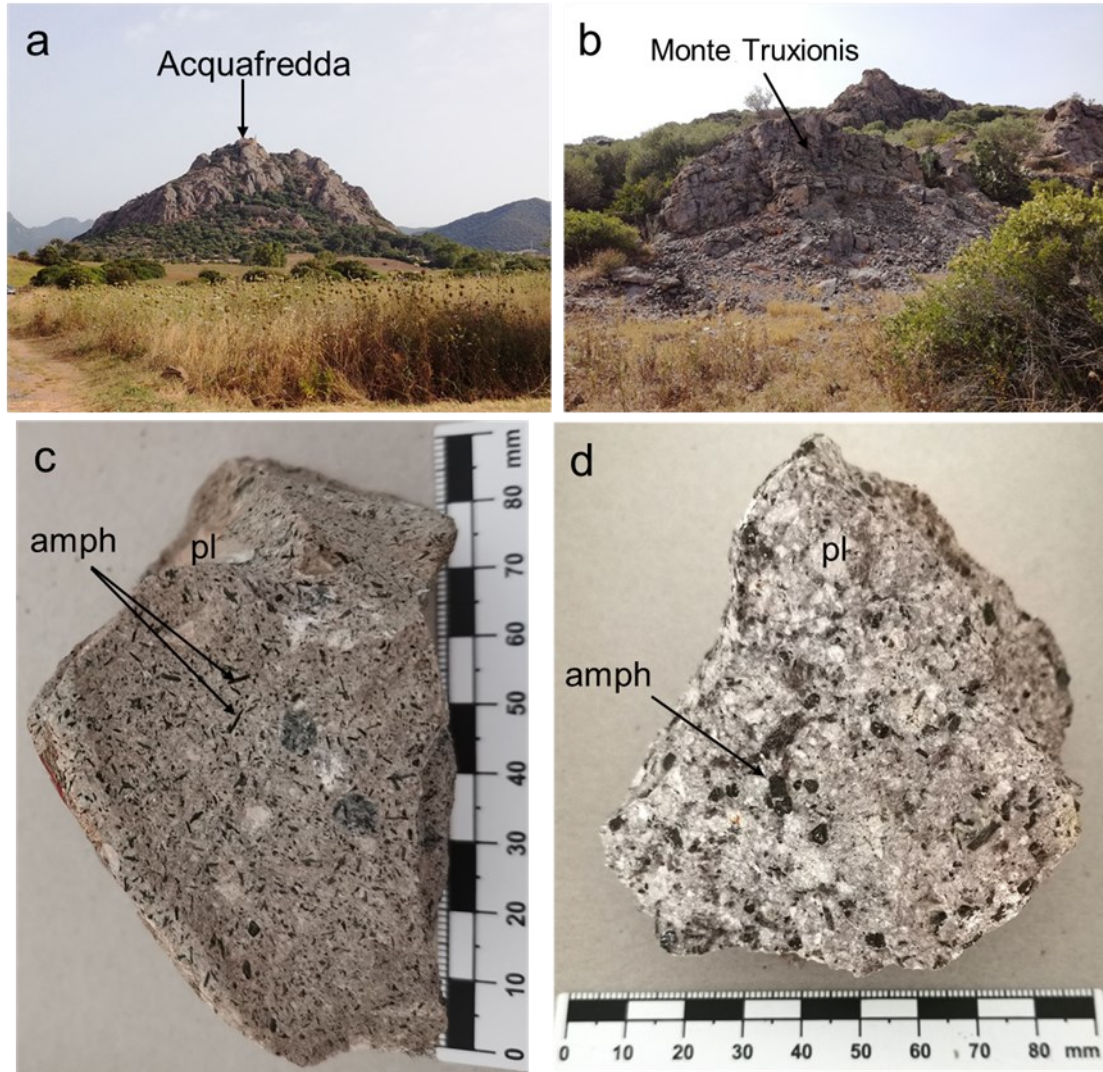


Figure 6 - View of: a) Acquafredda and b) Monte Truxionis lava domes; light grey samples with porphyritic texture for plagioclase, amphibole and minor quartz phenocrysts in ACQ1 (c) and MTR1 (d). Abbreviation from Whitney and Evans (2010).

The sample of Punta Su Silixianu (Fig. 4c) is grey, and has porphyritic texture with plagioclase, amphibole phenocrysts and pyrite.

2.2 Monastir district

In Monte Olandri quarry, SE of Monastir town, an andesitic lava dome crops out (Fig. 7a), it is crossed by a dyke (Fig. 7b) and contains some xenoliths (Fig. 7c) representing the bedrock.



Figure 7 - a) Grey-reddish lava in Monte Olandri quarry; b) dyke that crosses the lava; c) xenolith found in the lava; d) lava with porphyritic texture (CMO2); e) porphyritic dyke with smaller phenocrysts (CMO3).

The lava dome appears reddish because of the alteration of the groundmass, porphyritic with plagioclase and amphibole phenocrysts (Fig. 7d). The dyke is porphyritic with smaller phenocrysts of plagioclase (Fig. 7e).

2.3 Monte Nureci (Arcuentu) district

Monte Nureci (Fig. 8a) represents the intrusive part of the Arcuentu district. Holocrystalline rocks crop out near the bedrock, they vary from coarse- (Fig. 8b) to medium-grained (Fig. 8c).

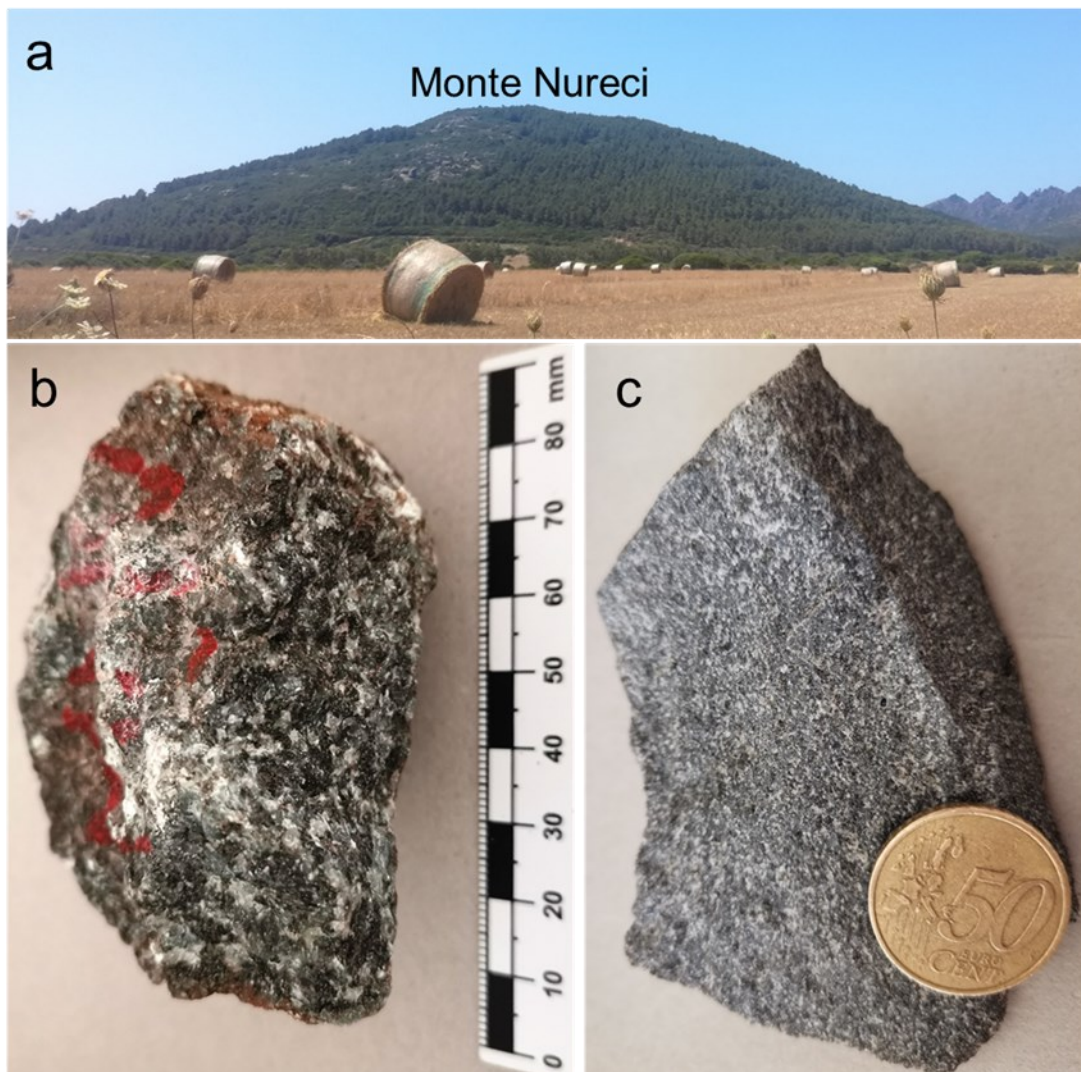


Figure 8 - a) View of Monte Nureci in Arcuentu district; b) MNU3: coarse-grained intrusive sample with plagioclase, olivine and pyroxene; c) MNU1: medium-grained intrusive sample with plagioclase and pyroxene.

3. Classification and petrography

The chemical analysis of the studied samples and of the literature rocks that were re-analysed with XRF in the DiSTAR laboratories, are provided in Supplementary Table 1.

According to the TAS classification diagram (Fig. 9, Le Bas et al., 1986), the studied lava domes cropping out in Cixerri half-graben vary in composition from basaltic andesites to andesites, except for Monte Limpiu dome with andesitic composition. The Siliqua domes are andesitic and dacitic, but one sample of the Acquafredda dome is on the boundary between basaltic andesite and andesite. In Punta Su Silixianu one andesite has been studied. In Monastir the dyke is a basaltic andesite, the lava has andesitic composition and the xenolith found in the lava is a monzodiorite, according to the R1-R2 classification diagram (Fig. 10; De La Roche et al., 1980). The intrusive rocks of Monte Nureci can be classified as gabbonorite in the R1-R2 diagram (Fig. 10).

The coeval rocks cropping out in the other Sardinian districts show a wider chemical composition: they vary from basalt to rhyolite, the more evolved samples (trachydacites and rhyolites) crop out only in the northern districts; the less evolved rocks in Sardinia are the High Magnesium Basalts (HMB) of Montresta (Fig. 9). In Sarroch district there are both effusive and intrusive rocks classified as basaltic andesites and andesites, gabbonorites and gabbrodiorites, respectively (Fig. 9-10).

The studied rocks and those of the other districts show subalkaline affinity in the TAS diagram and fall in the calcalkaline and high-K calcalkaline fields in the SiO_2 vs. K_2O diagram (Fig. 11; Peccerillo and Taylor, 1976), except for some rocks of Anglona district with shoshonitic affinity (Beccaluva et al., 2013). The affinities are partially confirmed in the AFM and SiO_2 vs. FeO_t/MgO diagrams, where some samples of Montresta, Sindia, Sulcis and Arcuentu districts fall in the tholeiitic field (Sup. Fig. 1a-b; Miyashiro, 1974).

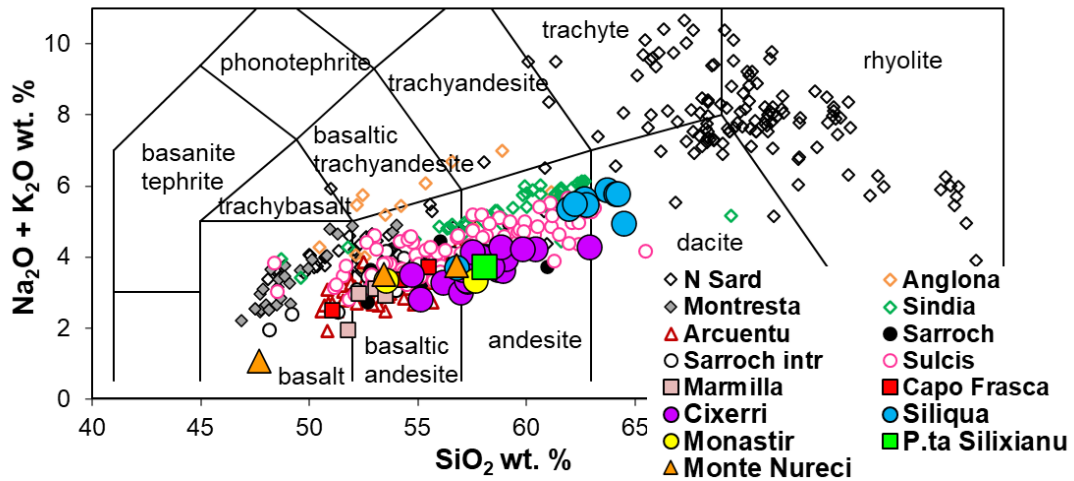


Figure 9 - Total Alkali vs. Silica (TAS; Le Bas et al., 1986) classification diagram for rocks from Cixerri, Siliqua, Monastir, Punta Su Silixianu and Monte Nureci districts, compared to literature data: North Sardinia (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Anglona (Beccaluva et al., 2013), Montresta (Morra et al., 1997; Franciosi et al., 2003), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b; Downes et al., 2001; Franciosi et al., 2003), Sarroch and Sarroch intrusive (Conte, 1997), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011; Lustrino et al., 2013), Marmilla and Capo Frasca (Fedele, 2002; Lustrino et al., 2013).

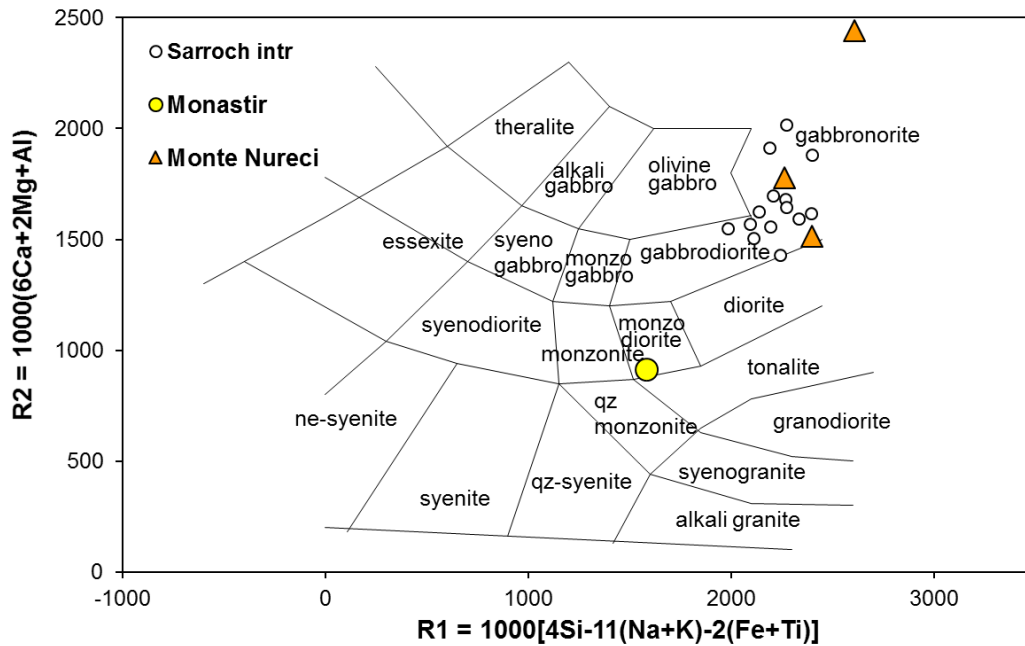


Figure 10 - R1-R2 classification diagram (De La Roche et al., 1980) for intrusive rocks from Monastir, Monte Nureci and Sarroch (Conte, 1997) districts.

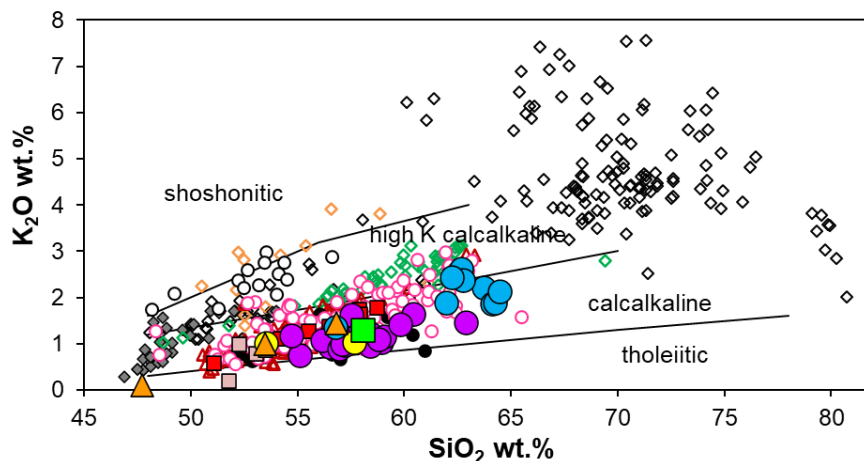
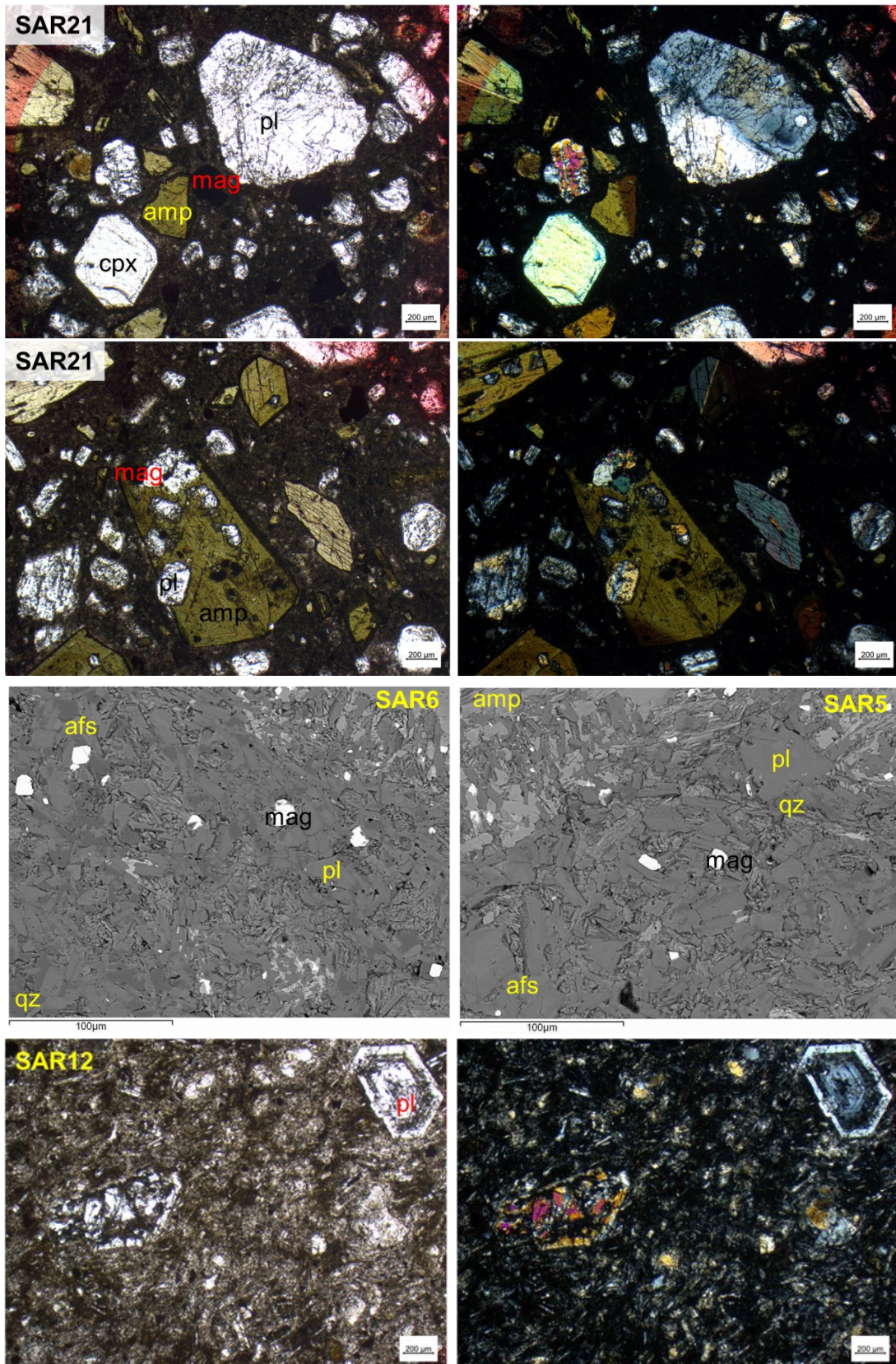


Figure 11 - SiO_2 vs. K_2O diagram (Peccerillo and Taylor, 1976) for rocks from Cixerri, Siliqua, Monastir, Punta Su Silixianu and Monte Nureci districts, compared with literature data: references and symbols as in Fig. 9.

Petrography of Cixerri lava domes

The lava domes show porphyritic and seriate texture with euhedral to subhedral phenocrysts of plagioclase, green or yellow-brown amphibole, rare clinopyroxene (Fig. 12, SAR21) and alkali feldspar. They are included in a groundmass variable from crypto to microcrystalline, made up of the same phases of phenocrysts plus quartz, opaque oxides and apatite (Fig. 12, SAR6-SAR5). An andesitic sample shows pseudo-fluidal texture (Fig. 12, SAR12). No differences are observed between basaltic andesites and andesites except for the presence of quartz phenocrysts, sometimes with amphibole inclusions, in some andesites (SAR4-SAR7-SAR12). Plagioclase phenocrysts show normal, reverse or oscillatory zoning, occasionally sieve texture (Fig. 12, SAR12) and they are sometimes included in amphibole phenocrysts; also amphiboles are often zoned (Fig. 12, SAR18), they sometimes include plagioclase and grow at the expense of clinopyroxene (Fig. 12, SAR17), have opacitic rims (Fig. 12, SAR18) or corroded and altered rims with the growth of new mineral phases like titanite (Fig. 12, SAR11). Some samples have phenocrysts partially or completely altered to chlorite, zeolite, calcite or titanite (SAR11-SAR12). Opaque oxides are often found in the phenocrysts indicating early crystallization. Generally, the order of crystallization is

opaque oxides → plagioclase/ clinopyroxene → amphibole → quartz/ alkali feldspar.



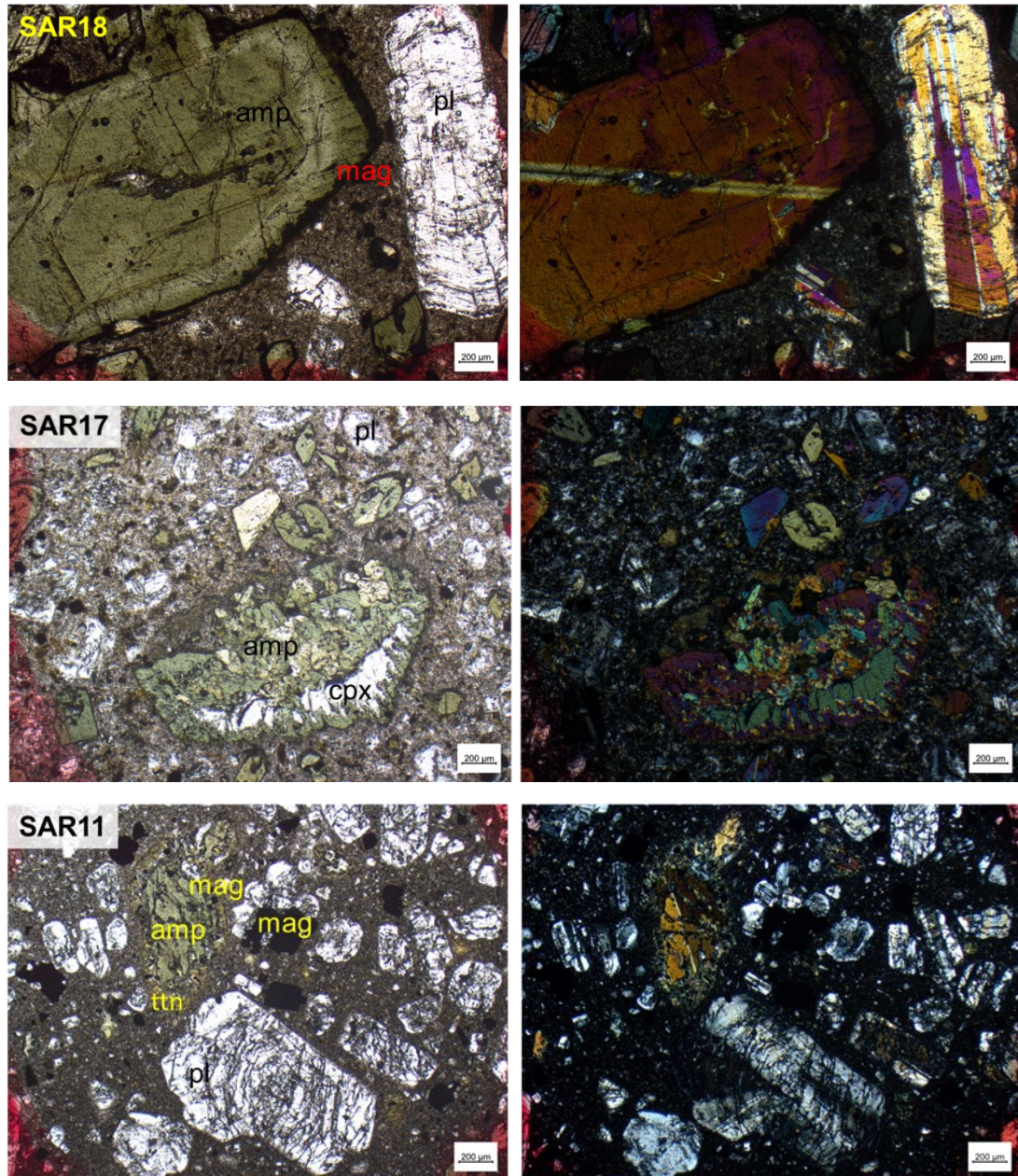


Figure 12 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) for representative samples of the lava domes from Cixerri district. View of plagioclase, clinopyroxene and amphibole phenocrysts, sometimes with plagioclase inside (SAR21), included in a cryptocrystalline groundmass made up of plagioclase, magnetite, alkali feldspar and quartz (Back Scattered Electrons Image of SAR6 and SAR5); zoned plagioclase phenocryst with sieve texture, included in a groundmass with pseudo-fluidal texture (SAR12); zoned amphibole and plagioclase phenocrysts (SAR18); amphibole growth at the expenses of clinopyroxene (SAR17); growth of titanite on amphibole rim (SAR11). Abbreviation from Whitney and Evans (2010).

Petrography of Siliqua lava domes

The Siliqua lava domes show the same texture and petrographic features of the Cixerri ones (Fig. 13, ACQ1). Clinopyroxene occurs in the andesites of

Monte Truxionis. The andesites and dacite of Monte Truxionis contain also abundant euhedral mica and quartz phenocrysts, they include other mineral phases like apatite, magnetite, plagioclase and alkali feldspar (Fig. 13, MTR2). Some plagioclase phenocrysts are completely altered to zeolite (ACQ1-SIL1-MTR2). The observed sequence of crystallization is opaque oxides → plagioclase ± clinopyroxene → amphibole ± mica → alkali feldspar → quartz.

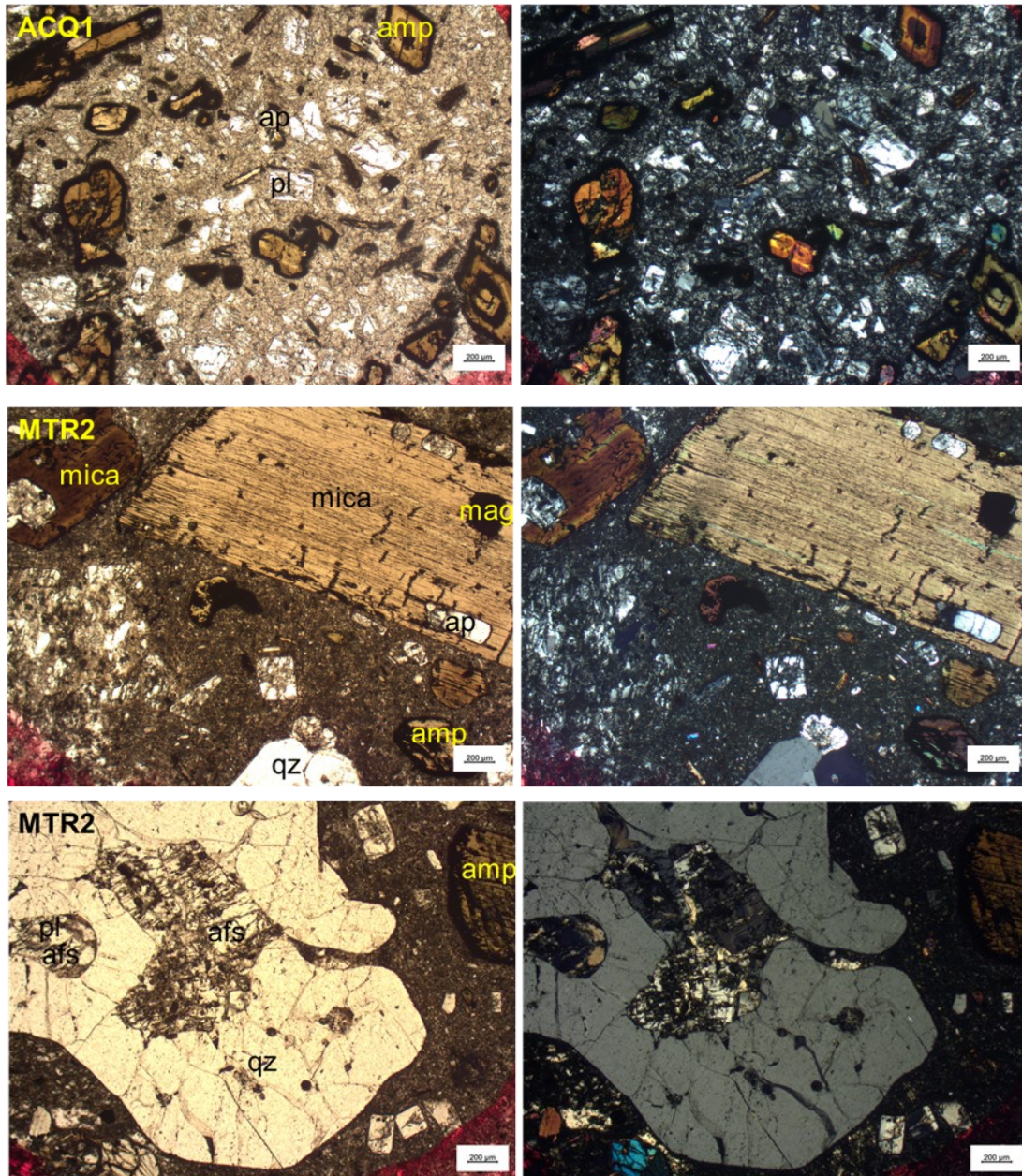
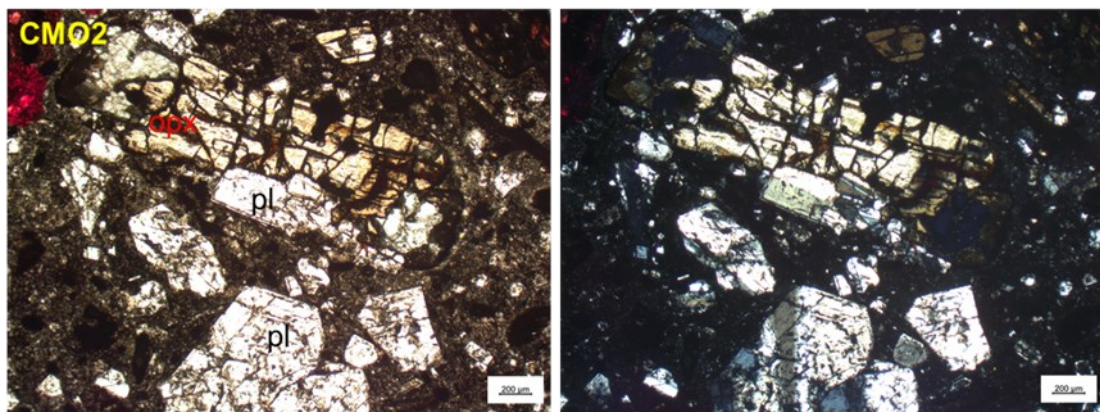


Figure 13 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) for representative samples of the lava domes from Siliqua district. View of zoned amphibole and plagioclase phenocrysts included in a cryptocrystalline groundmass (ACQ1); amphibole, mica phenocrysts including apatite and magnetite, quartz including plagioclase and alkali feldspar (MTR2). Abbreviation from Whitney and Evans (2010).

Petrography of Monastir rocks

The andesitic lava has porphyritic and seriate texture with plagioclase, orthopyroxene and yellow-brown amphibole phenocrysts included in a microcrystalline groundmass. The orthopyroxene crystals occur often as relicts, the other phenocrysts are generally euhedral to subhedral and plagioclase show oscillatory zoning (Fig. 14, CMO2). Some crystals of plagioclase, clinopyroxene, apatite, opaque oxides and quartz occur in the groundmass. The order of crystallization is plagioclase/ opaque oxides → orthopyroxene/ amphibole → clinopyroxene/ quartz. The dyke shows seriate and porphyritic texture with large (up to 5mm) clinopyroxene (Fig. 14, CMO3), plagioclase, orthopyroxene phenocrysts and olivine relicts. Pyroxene and plagioclase have generally euhedral to subhedral habit and normal or oscillatory zoning, olivine relicts sometimes contain spinel and are surrounded by orthopyroxene (Fig. 14, CMO3). The groundmass consists of plagioclase and pigeonite microcrystals. The sequence of crystallization is spinel/ olivine → orthopyroxene → plagioclase → clinopyroxene → pigeonite.

The xenolith sample represents the Sardinian basement. It has holocrystalline structure and is composed by coarse-grained plagioclase, yellow, orange or red mica, minor quartz, alkali feldspar and monazite (Fig. 14, CMO1). The mica occurs sometimes with poikilitic texture.



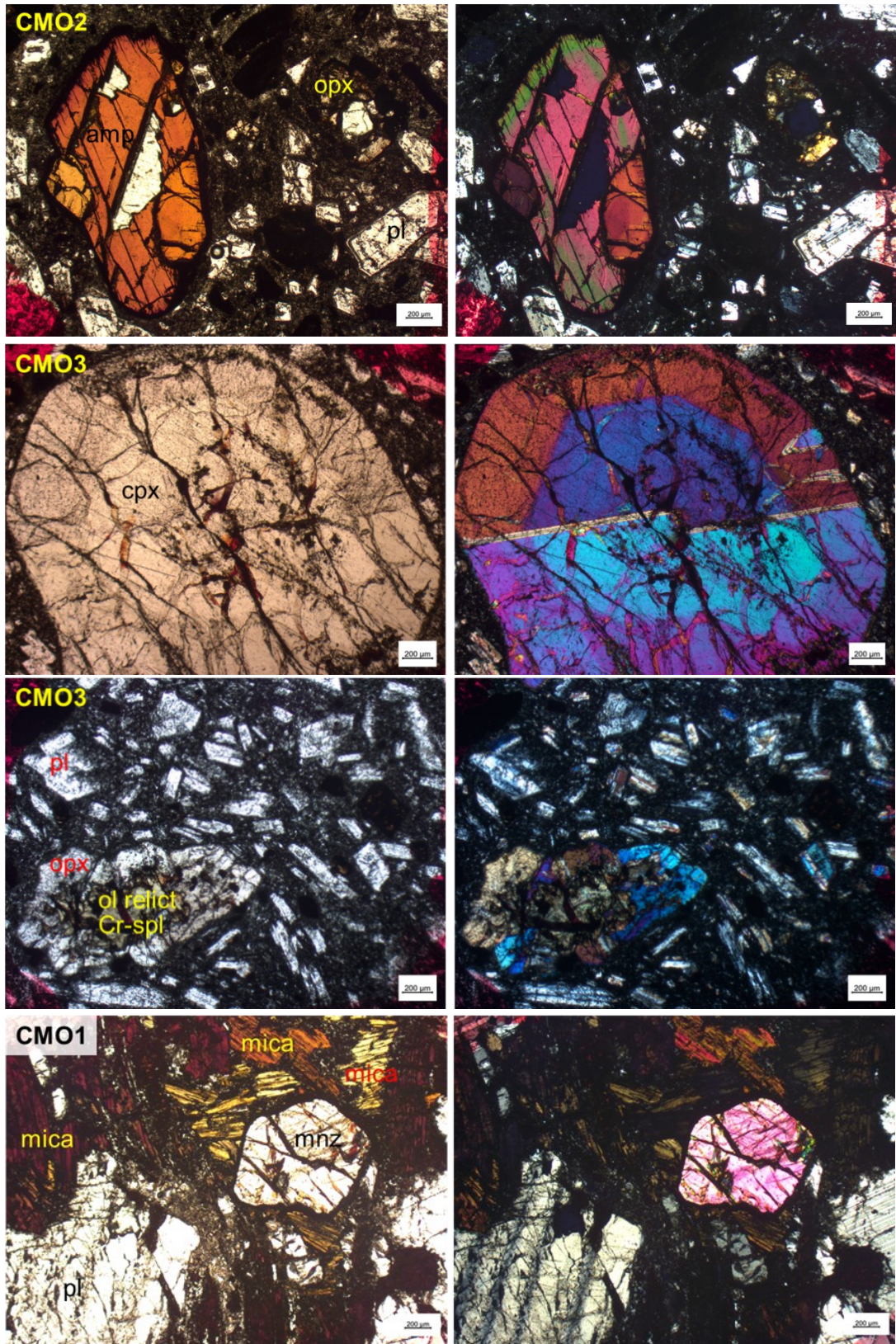


Figure 14 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) for lava (CMO2), dyke (CMO3) and xenolith (CMO1) from Monastir district. View of orthopyroxene relicts, amphibole and zoned plagioclase phenocrysts (CMO2); large clinopyroxene phenocryst, olivine relict with orthopyroxene on the rim and plagioclase phenocrysts (CMO3); plagioclase, monazite, yellow and red mica (CMO1). Abbreviation from Whitney and Evans (2010).

Petrography of Punta Su Silixianu lava

The Punta Su Silixianu andesitic lava has porphyritic texture for plagioclase phenocrysts included in a microcrystalline altered groundmass, with alteration phases such as chlorite, epidote, pyrite and titanite. Plagioclase phenocrysts have subhedral habit, normal and/or oscillatory zoning (Fig. 15).

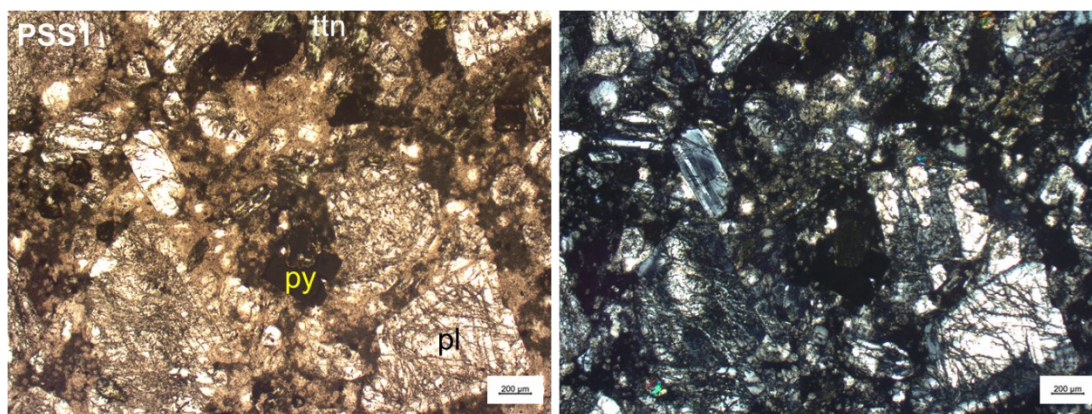


Figure 15 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) of the lava from Punta Su Silixianu district. View of zoned plagioclase phenocrysts and alteration phases like pyrite and titanite. Abbreviation from Whitney and Evans (2010).

Petrography of Capo Frasca rocks

Capo Frasca lavas have porphyritic texture for euhedral to subhedral phenocrysts of plagioclase, clinopyroxene and minor orthopyroxene included in a cryptocrystalline groundmass made up of the same mineral phases plus few opaque oxides. Clinopyroxene phenocrysts form sometimes glomerulus (Fig. 17, MAL38). Some sample are moderately vesiculated (Fig. 17, MAL29). Some orthopyroxene crystals show the reaction rim with clinopyroxene and include opaque oxides (Fedele 2002). The phenocrysts of different mineral phases crystallized almost simultaneously.

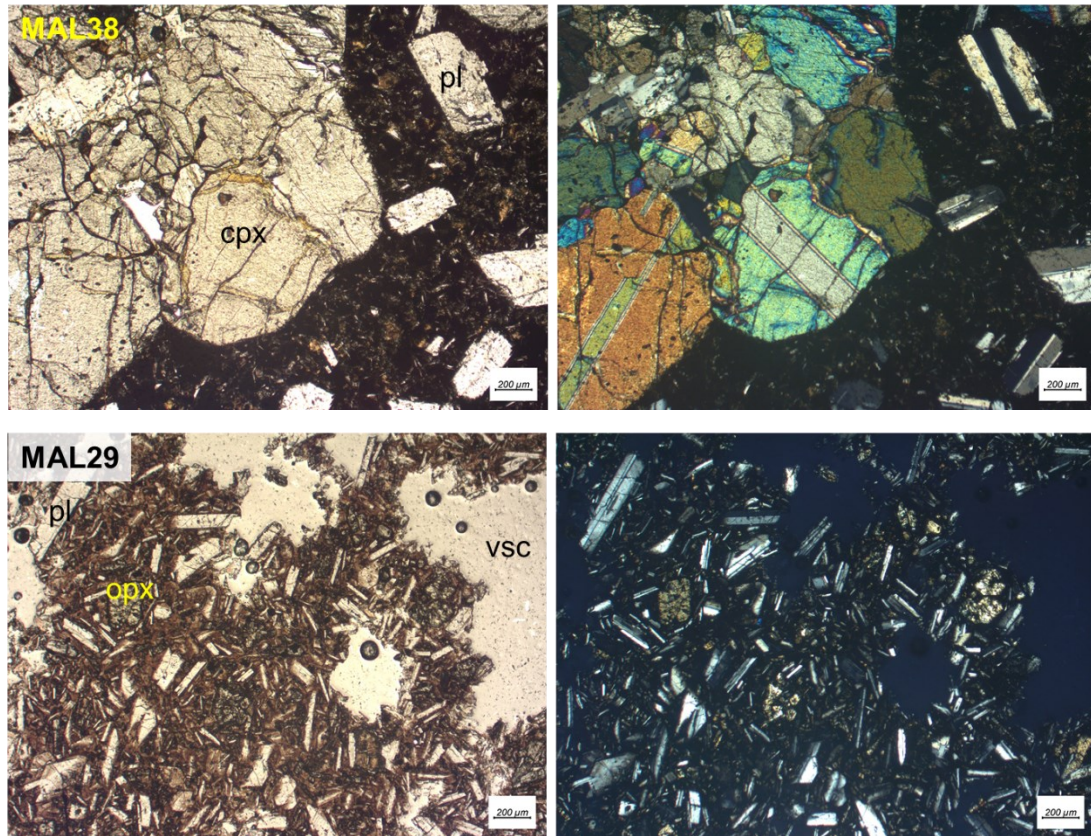


Figure 16 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) for representative samples from Capo Frasca district. View of clinopyroxene glomerocrysts and plagioclase phenocrysts included in a cryptocrystalline groundmass (MAL38); plagioclase and orthopyroxene phenocrysts included in glassy groundmass of a vesiculated lava (MAL29). Abbreviation from Whitney and Evans (2010), vsc=vesicles.

Petrography of Monte Nureci rocks

The Monte Nureci rocks are medium (MNU1) to coarse (MNU2-3) grained with holocrystalline inequigranular structure and xenomorphic texture. The coarse-grained samples are made up of euhedral to subhedral plagioclase, clinopyroxene, orthopyroxene, olivine and accessory amphibole, mica, apatite and opaque oxides (Fig. 16, MNU2). Pyroxene and olivine crystals generally occur as cumulus phases and are not zoned, olivine contain sometimes Cr-spinel inside or is altered to iddingsite (Fig. 16, MNU3). They are classified, on the base of R1-R2 diagram (Fig. 10) and the petrographic study, as olivine gabbronorites. The MNU1 sample is a gabbronorite without olivine, it contains also rare alkali feldspar and quartz, clinopyroxene and plagioclase

with normal zoning (Fig. 16, MNU1). Furthermore, some clinopyroxene crystals show complex zoning patterns with orthopyroxene drops (or clinopyroxene drops occur in orthopyroxene crystals). The order of crystallization is opaque oxides/ spinel/ plagioclase → olivine → orthopyroxene/ clinopyroxene → amphibole/ mica/ alkali feldspar ± quartz.

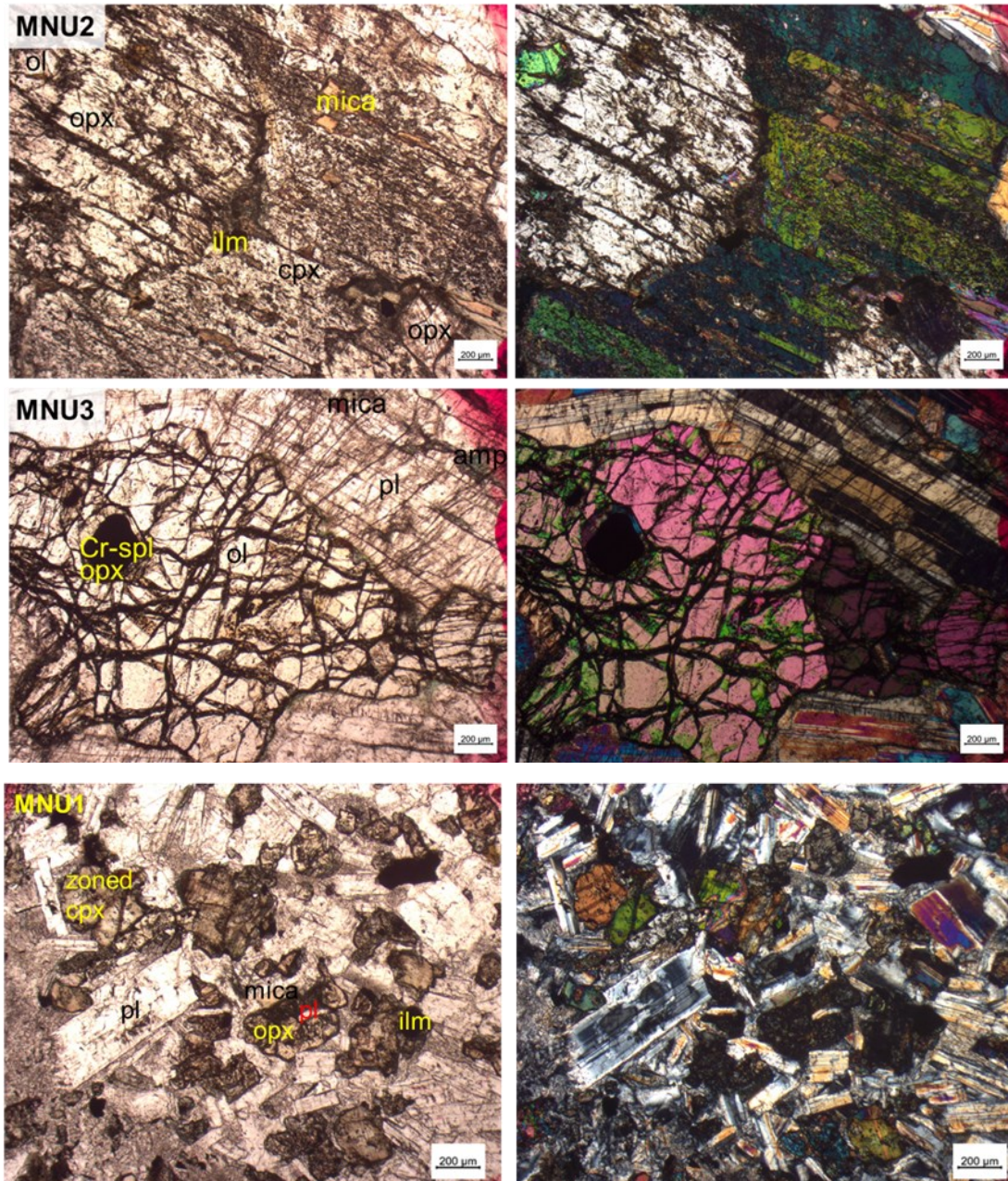


Figure 17 - Thin section microphotographs with plane polarized light (on the left) and crossed polarizers light (on the right) of the gabbronorites from Monte Nureci district. View of coarse grained clinopyroxene, orthopyroxene (MNU2), plagioclase and olivine with Cr-spinel inclusion (MNU3); medium grained gabbronorite with orthopyroxene, mica, ilmenite, zoned plagioclase and clinopyroxene (MNU1). Abbreviation from Whitney and Evans (2010).

4. Mineral chemistry

The analyses of mineral phases of this work are provided in the Supplementary Materials.

4.1 Olivine

Olivine occurs in Monte Nureci olivine gabbronorites and in Capo Frasca basalt. Olivine has the highest forsterite content (82.6 mol%) in Capo Frasca basalt. The forsterite content varies in a narrow range (74-78 mol%) in Monte Nureci olivine (Fig. 18a), with the highest values in MNU3 sample, and it decreases from the core to the rim in zoned crystals. Olivine in Monte Nureci rocks has almost constant Mg (~1.5 apfu) and variable contents in other elements (e.g. Ni=0-0.012 apfu, Cr=0-0.012 apfu, Fe=0.44-0.52 apfu) (Sup. Tab. 2). Considering the Mg# of the analysed olivine crystals and that of their host rocks, olivine is never in equilibrium with the rock (Fig. 18b).

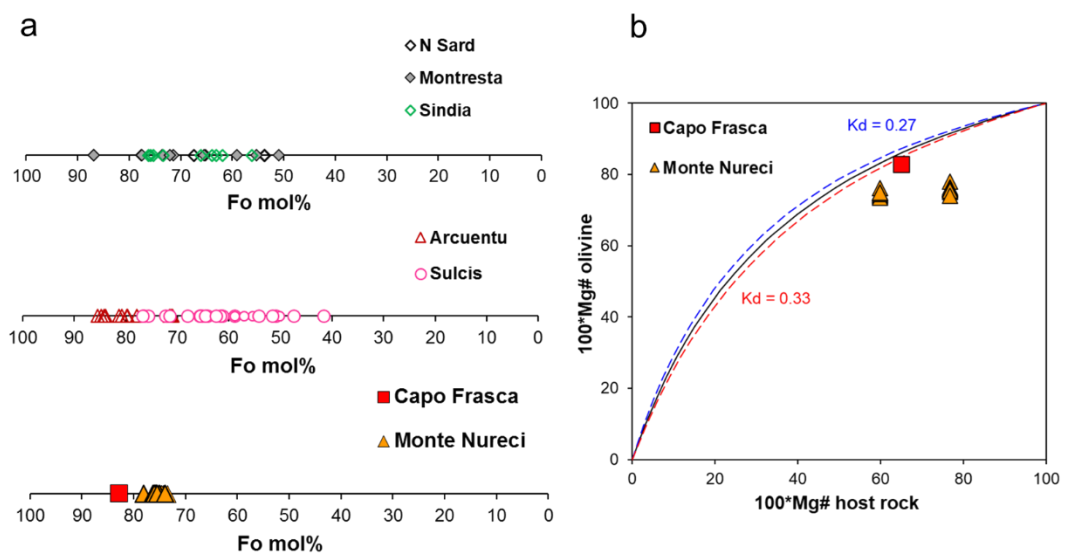


Figure 18 - a) Fo content [$\text{Fo mol\%} = 100 \cdot \text{Mg} / (\text{Mg} + \text{Fe})$] in olivine from Capo Frasca and Monte Nureci rocks, comparison with literature data: N Sard (Marrazzo, 2008; Guarino et al., 2011), Montresta (Morra et al., 1997), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011). b) $100 \cdot \text{Mg\#}$ [$= 100 \cdot \text{Mg} / (\text{Mg} + \text{Fe})$] host rock vs. $100 \cdot \text{Mg\#}$ [$= 100 \cdot \text{Mg} / (\text{Mg} + \text{Fe})$] olivine diagram for Capo Frasca and Monte Nureci.

The chemical composition of olivine in other districts (Fig. 18a) is more variable with Fo=71-85 mol% in Arcuentu basalts and basaltic andesites, Fo=42-77 mol% in Sulcis basalts and basaltic andesites, Fo=51-77 mol% in

the basalts and basaltic andesites of Montresta, Sindia and other northern districts of Sardinia.

4.2 Feldspar

There is feldspar in all the studied rocks (Fig. 19, Sup. Tab. 3). The Cixerri lava domes contain plagioclase as phenocrysts and in the groundmass with all the compositional range from anorthite ($An_{95} Ab_5 Or_0$) to andesine ($An_{44} Ab_{53} Or_3$), without chemical differences between the basaltic andesites and andesites. The plagioclase in Siliqua andesites and dacites has wider compositional range ($An_{85-9} Ab_{15-91} Or_0$ and $An_{73-6} Ab_{26-81} Or_{1-13}$ respectively). The plagioclase phenocrysts in both the districts show strong compositional variation for normal (e.g. core: $An_{92} Ab_8 Or_0$, rim: $An_{58} Ab_{42} Or_0$) and/or oscillatory zoning (Fig. 20), sometimes the Calcium content increases from the core to the rim of the crystals (e.g. core: $An_{44} Ab_{53} Or_3$, rim: $An_{65} Ab_{34} Or_1$). Alkali feldspar occur rarely as phenocryst and often in the groundmass, where there is rarely plagioclase with albitic composition.

The feldspar in Monastir andesite and basaltic andesite occur as zoned plagioclase phenocrysts with variable composition from bytownite ($An_{91} Ab_9 Or_0$) to oligoclase ($An_{23} Ab_{70} Or_7$) and from bytownite ($An_{88} Ab_{11} Or_1$) to labradorite ($An_{41} Ab_{53} Or_6$), respectively. Generally, the content of the anorthite component is lower in the plagioclase of the groundmass. Many phenocrysts in the andesite show strong compositional variation with oscillatory zoning ($An_{91-33} Ab_{9-62} Or_{0-5}$).

The andesite of Punta Su Silixianu contains plagioclase phenocrysts with compositional variation from bytownite ($An_{85} Ab_{15} Or_0$) to andesine ($An_{47} Ab_{50} Or_3$), they are normally and/or oscillatory zoned with strong chemical variation from core to rim (e.g. core: $An_{85} Ab_{15} Or_0$, rim: $An_{47} Ab_{50} Or_3$).

Plagioclase of the Capo Frasca lavas has a narrow compositional range from bytownite ($An_{90} Ab_{10} Or_0$) to labradorite ($An_{57} Ab_{40} Or_3$) with no significative chemical differences between basalts and basaltic andesites.

The Monte Nureci olivine gabbronorites contain plagioclase with high Calcium content ($An_{95-83} Ab_{5-16} Or_{0-1}$). There are both alkali feldspar and plagioclase with almost all the compositional range from bytownite to andesine in the gabbronorite, plagioclase crystals show sometimes normal ($An_{70-36} Ab_{30-61} Or_{0-3}$) or reverse zoning ($An_{50-58} Ab_{49-41} Or_{2-0}$).

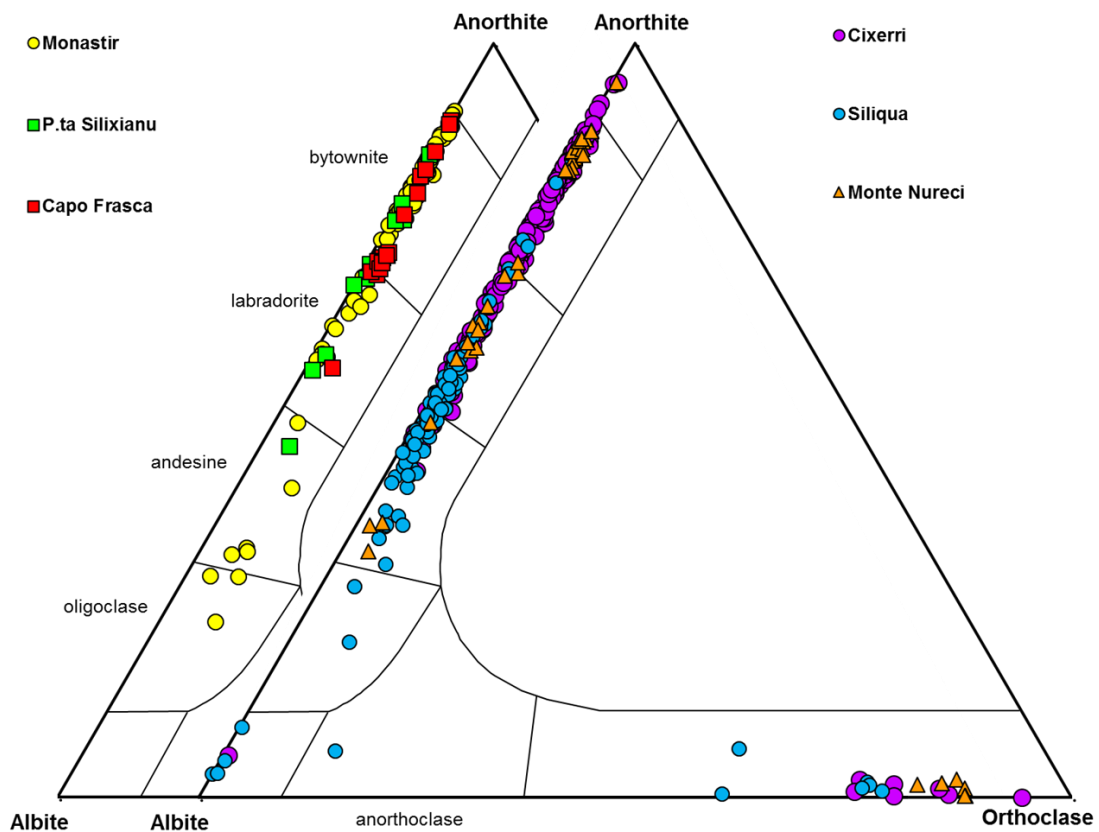


Figure 19 - Classification diagram for feldspar in Cixerri, Siliqua, Monastir, Punta su Silixianu, Capo Frasca and Monte Nureci rocks.

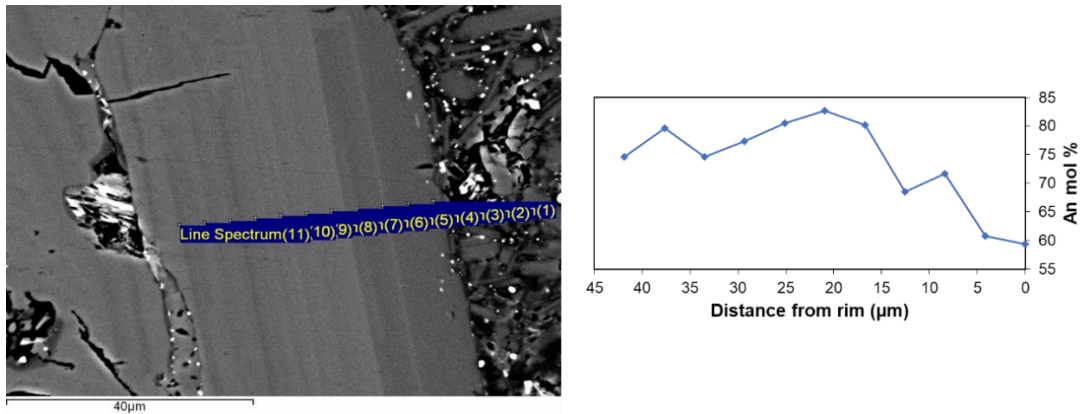


Figure 20 - Example of profile zoning in a plagioclase phenocryst of SAR21 (andesite of Cixerri district) with An mol% $[=100 \cdot \text{Ca}/(\text{Ca}+\text{Na}+\text{K})]$ variation.

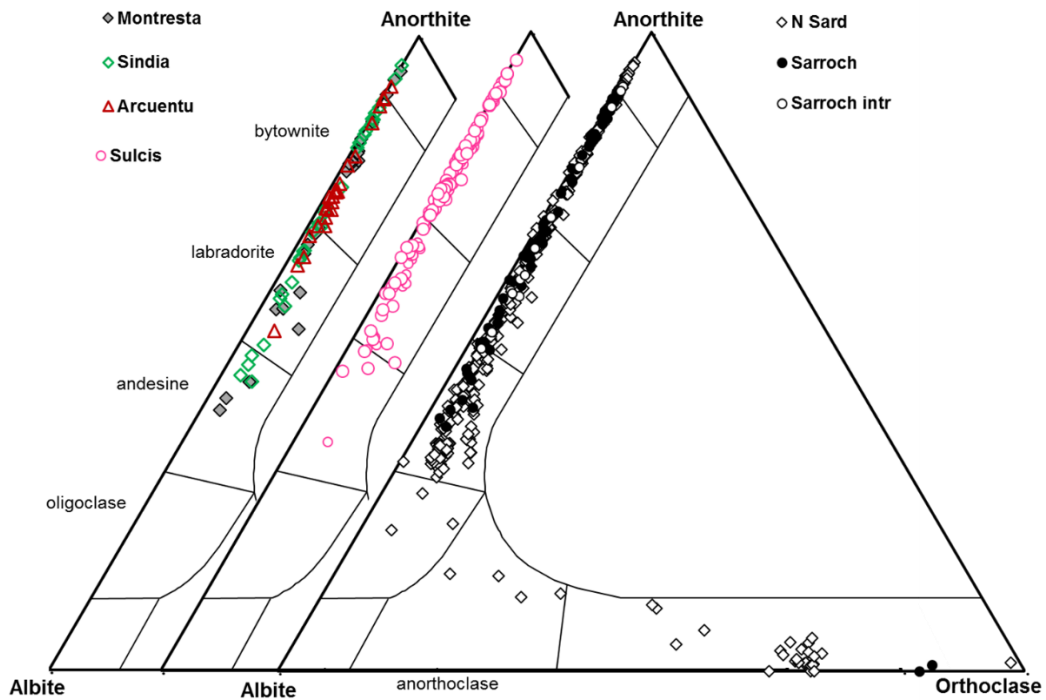


Figure 21 - Classification diagram for feldspar in the rocks of the other districts: N Sard (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Montresta (Morra et al., 1997), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga 2011), Sarroch and Sarroch intrusive (Conte, 1997).

The rocks (from basalts to andesites) of Sulcis, Montresta and Sindia districts contain only plagioclase from anorthite to andesine, instead it ranges in composition from anorthite to labradorite in Arcuentu rocks (from basalts to andesites). There are plagioclase with composition variable from anorthite to andesine and some alkali feldspar in the basaltic andesites and andesites of Sarroch district and only plagioclase in the intrusive samples. The plagioclase

in the less evolved samples of the northern sectors of Sardinia shows the same compositional variation observed in the other districts, instead dacites, trachydacites and rhyolites contain also plagioclase with lower Calcium content, anorthoclase and alkali feldspar (Fig. 21).

4.3 Pyroxene

Diopside and augite occur in basaltic andesites and andesites from Cixerri (Ca₃₉₋₅₀ Mg₃₁₋₄₈ Fe₈₋₂₃) without substantial chemical differences, and in the andesites of Monte Truxionis (Siliqua) lava dome (Ca₄₁₋₄₇ Mg₄₆₋₅₂ Fe₃₋₁₁). Some phenocrysts are zoned, but with slight chemical variation from core (Ca_{48.1} Mg_{42.4} Fe_{9.5}) to rim (Ca_{47.0} Mg_{43.8} Fe_{9.2}). Orthopyroxene is absent (Fig. 22a). Siliqua clinopyroxene has higher Mg# (0.82-0.94) and Cr (up to 0.033 apfu) content than Cixerri one (Mg#=0.60-0.86, Cr up to 0.026 apfu) (Sup. Tab. 4).

The Monastir rocks contain both clinopyroxene and orthopyroxene, pigeonite occurs only in the basaltic andesite (Fig. 22a). Clinopyroxene in the basaltic andesite occurs as augite and diopside (Ca₃₂₋₄₆ Mg₄₁₋₄₉ Fe₅₋₂₃) with Mg#=0.67-0.90 and Cr content up to 0.022 apfu (Sup. Tab. 4), some phenocrysts show normal zoning with strong chemical variation from core (Ca₄₅ Mg₄₉ Fe₆, Mg#=0.90) to rim (Ca₃₂ Mg₄₅ Fe₂₃, Mg#=0.67). There is clinopyroxene in the groundmass of the andesite with augitic composition (Ca₄₀₋₄₃ Mg₄₄₋₄₆ Fe₁₀₋₁₆) and variable Mg# (0.74-0.83). Enstatite phenocrysts are found in both basaltic andesite (Ca₃₋₅ Mg₆₂₋₇₇ Fe₂₀₋₃₃) and andesite (Ca₁₋₃ Mg₅₃₋₆₆ Fe₃₂₋₄₇), with different Mg# (0.63-0.79 basaltic andesite; 0.54-0.68 andesite); orthopyroxene in the basaltic andesite is sometimes zoned with moderate core to rim compositional variation (Ca_{2.5-3.2} Mg_{77.3-74.4} Fe_{20.2-22.3}). Pigeonite occurs on the rim of clinopyroxene and in the groundmass of the Monastir basaltic andesite with homogeneous composition (Ca₇₋₁₁ Mg₅₅₋₅₇ Fe₃₄₋₃₇).

Capo Frasca basalts and basaltic andesites contain both clinopyroxene and orthopyroxene (Fig. 22a), they show narrower compositional variation and higher Mg# in the basalts (Sup. Tab. 4). Clinopyroxene is augitic in the basalts (Ca₃₅₋₃₉ Mg₄₈₋₅₃ Fe₁₁₋₁₃) and basaltic andesites (Ca₃₀₋₄₂ Mg₄₇₋₄₉ Fe₁₀₋₂₂) with Mg#=0.80-0.83 and 0.71-0.83, respectively and higher Cr (up to 0.024 apfu) content in the basaltic andesites. Orthopyroxene in the basalts has homogeneous composition (Ca₄₋₅ Mg₇₈₋₇₉ Fe₁₆₋₁₇, Mg#=0.82-0.83), differently from those in the basaltic andesites (Ca₃₋₅ Mg₅₄₋₇₄ Fe₂₂₋₄₂, Mg#=0.57-0.78), where also rare pigeonite occurs.

Pyroxenes in Monte Nureci rocks are clinopyroxene (diopside and augite) and orthopyroxene (enstatite), with rare pigeonite in the gabbro-norite (Fig. 22a). Clinopyroxene in the olivine gabbro-norites has narrower compositional variation (Ca₃₆₋₄₈ Mg₄₃₋₅₁ Fe₆₋₁₃) and higher Mg# (0.79-0.91) than those in the gabbro-norite (Ca₃₄₋₄₆ Mg₃₇₋₄₉ Fe₆₋₂₅, Mg#=0.63-0.89), which are sometimes zoned with moderate core-to-rim chemical variation (Ca₄₃₋₃₄ Mg₃₉₋₄₀ Fe₁₈₋₂₅) (Sup. Tab. 4). Orthopyroxene is enstatite in all the samples but with chemical differences between the olivine gabbro-norites (Ca₃₋₄ Mg₇₄₋₇₇ Fe₂₀₋₂₃, Mg#=0.76-0.80) and the gabbro-norite (Ca₂₋₅ Mg₅₅₋₅₈ Fe₃₉₋₄₃, Mg#=0.56-0.60). Enstatite in the gabbro-norite has the lowest Mg# value when it occurs as drops in clinopyroxene crystals, as shown in Fig. 23. The gabbro-norite contains also rare pigeonite crystals (Ca₆₋₈ Mg₅₄₋₅₅ Fe₃₇₋₄₀, Mg#=0.58-0.61), it has different chemical composition when included in clinopyroxene crystals (Ca_{19.6} Mg_{46.4} Fe_{34.1}, Mg#=0.58) (Sup. Tab. 4).

Considering the Mg# of the analysed pyroxenes and that of their host rocks, just few clinopyroxenes from Cixerri basaltic andesites and andesites, Siliqua andesites, Monastir basaltic andesite and andesite, Capo Frasca basalts and basaltic andesite, Monte Nureci gabbros are in equilibrium with the rock (Fig. 22b).

Pyroxenes in basalts, basaltic andesites and andesites from other districts (Arcuentu, Sulcis, Montresta, Sarroch and Sindia) are enstatite, augite plus

rare pigeonite and diopside. Pigeonite lacks in Sarroch gabbronorites and gabbrodiorites. Pyroxenes show the same chemical composition of the other districts in the rocks of northern Sardinian districts, with more abundant diopside; pigeonite is absent in more evolved samples and enstatite lacks in the rhyolites (Fig. 24).

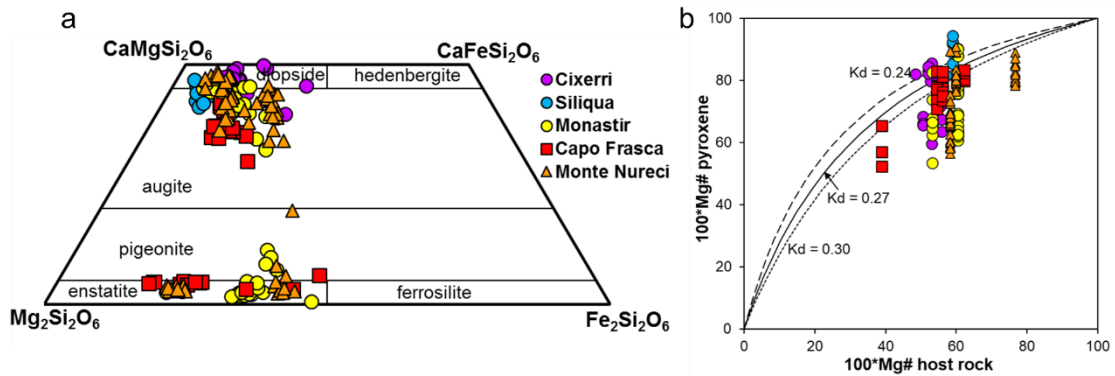


Figure 22 - a) Classification diagram for pyroxenes in Cixerri, Siliqua, Monastir, Capo Frasca and Monte Nureci rocks, according to IMA rules (Morimoto et al., 1988). b) $100 \cdot \text{Mg\#}$ [$=100 \cdot \text{Mg}/(\text{Mg}+\text{Fe})$] host rock vs. $100 \cdot \text{Mg\#}$ [$=100 \cdot \text{Mg}/(\text{Mg}+\text{Fe})$] pyroxene diagram for Cixerri, Siliqua, Monastir, Capo Frasca and Monte Nureci districts.

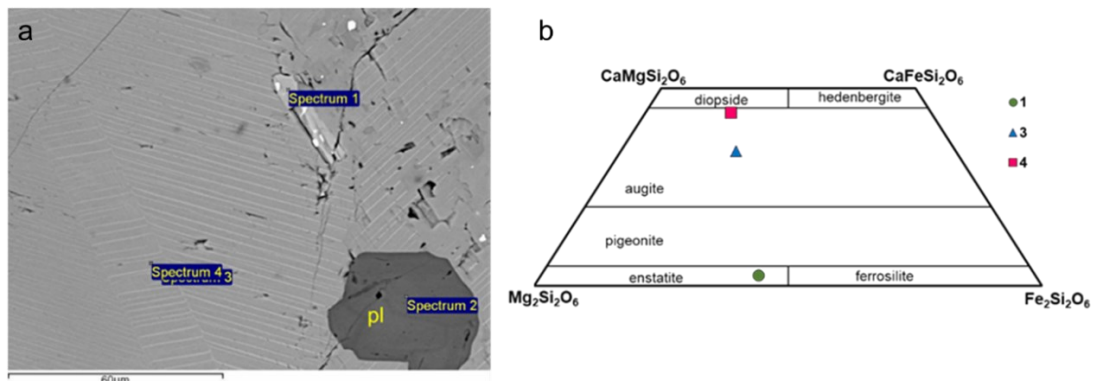


Figure 23 - a) Vision of a clinopyroxene in MNU1 (Gabbronorite of Monte Nureci) with variable chemical composition, plagioclase (pl) and enstatite inside. b) Classification diagram for different points in the clinopyroxene.

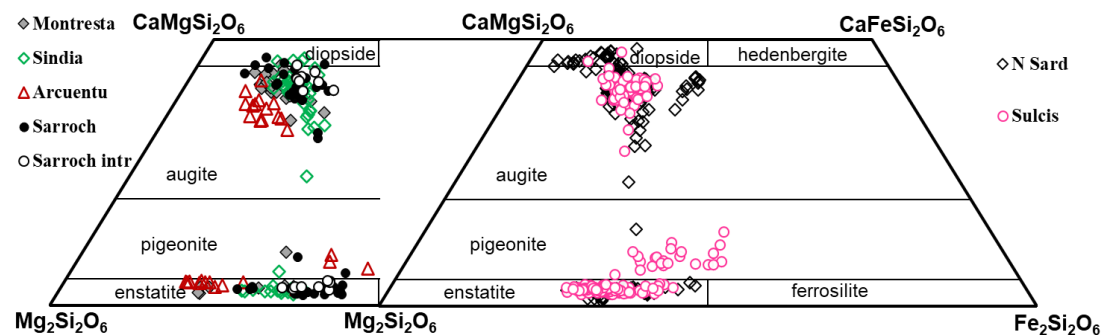


Figure 24 - Classification diagram, according to IMA rules (Morimoto et al., 1988), for pyroxenes in the rocks of the other Sardinian districts: N Sard (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Montresta (Morra et al., 1997), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011), Sarroch and Sarroch intrusive (Conte, 1997).

4.4 Amphibole

Amphibole is an abundant phenocryst in Cixerri and Siliqua lava domes, in Monastir lava and it occurs as minor secondary phase in Monte Nureci gabbros (Sup. Tab. 5). It is always calcic (Fig. 25). It varies from tschermakite to magnesio-hornblende with minor magnesio-hastingsite, rare ferro-hornblende, ferro-actinolite and pargasite (Leake et al., 1997) in both basaltic andesites and andesites of Cixerri; there are tschermakite, minor magnesio-hastingsite, rare magnesio-hornblende and pargasite in Siliqua rocks with no differences between andesite and dacites. Amphibole shows high Ca (1.57-1.99 apfu) and low Ti (0.04-0.32 apfu) contents with variable Mg# [$\text{Mg}/(\text{Mg}+\text{Fe}^{3+}+\text{Fe}^{2+})=0.54-0.78$], that generally decrease, and sometimes increase, from the core to the rim of the phenocrysts and to the groundmass. The zoned phenocrysts show strong compositional variation (e.g. core: magnesio-hastingsite Mg#=0.71, mantle: pargasite Mg#=0.75, rim: tschermakite Mg#=0.63). Most of the amphiboles, particularly in Cixerri rocks, have Fe^{3+} (0.54-1.44 apfu) content higher than Fe^{2+} (0.00-1.31 apfu).

Amphibole phenocrysts in Monastir andesite are not zoned. They are magnesio-hastingsite and rare tschermakite with high Ca (1.67-1.97 apfu) low Ti (0.12-0.21 apfu) contents, Fe^{3+} (0.66-1.31 apfu) always higher than Fe^{2+} (0.13-0.46 apfu); Mg# varies in a narrow range (0.67-0.74).

Amphibole in Monte Nureci gabbro-norite is magnesio-hornblende, there are also magnesio-hastingsite and edenite in the olivine gabbro-norites. It shows high Cl (up to 0.10 apfu) and very low Ti (<0.10 apfu) content. Amphibole in the gabbro-norite has lower Mg# (0.59-0.64) than that in the olivine gabbro-norites (0.64-0.76).

Few amphibole phenocrysts from Cixerri and Siliqua rocks are in equilibrium with the host rock in the diagram $100*\text{Mg\#}_{\text{host rock}}$ vs $100*\text{Mg\#}_{\text{amphibole}}$ considering $K_d=0.24-0.27$ (Fig. 26).

Amphibole is a rare or absent phase in the other districts of Sardinia (Fig. 25). Tschermakite occurs in the basalts, basaltic andesites and dacites of northern Sardinia districts, in Sarroch basaltic andesites and in Sulcis andesites; there is also magnesio-hornblende in Sulcis andesites and dacite. Amphibole in the northern Sardinia rhyolites varies from tschermakite to magnesio-, ferro-hornblende and magnesio-hastingsite, the latter occurs also in basalts, basaltic andesites and dacites. Sarroch basaltic andesites contain also pargasite and magnesio-hastingsite.

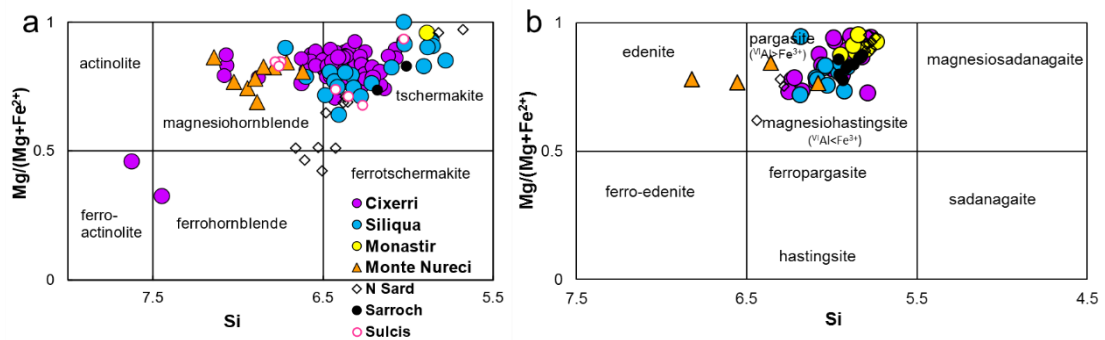


Figure 25 - Classification diagrams for calcic ($\text{Ca} \geq 1.50$ apfu) amphibole (Leake et al., 1997) with a) $(\text{Na}+\text{K}) \geq 0.50$ and $\text{Ti} < 0.50$ and b) $(\text{Na}+\text{K}) < 0.50$ in the rocks from Cixerri, Siliqua, Monastir, Monte Nureci, N Sard (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Sulcis (Brotzu et al., 1997a; Conte et al., 2010) and Sarroch (Conte, 1997) districts.

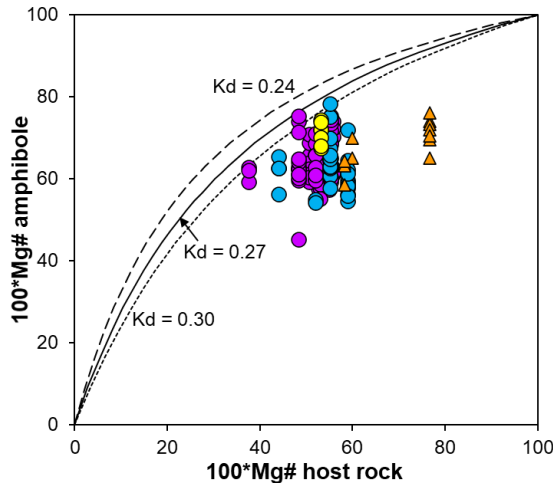


Figure 26 - $100 \cdot \text{Mg\#}$ $[=100 \cdot \text{Mg}/(\text{Mg}+\text{Fe})]$ host rock vs. $100 \cdot \text{Mg\#}$ $[=100 \cdot \text{Mg}/(\text{Mg}+\text{Fe}^{2+}+\text{Fe}^{3+})]$ amphibole diagram for Cixerri, Siliqua, Monastir and Monte Nureci districts. Symbols as in previous figure.

4.5 Mica

Mica only occurs in Monte Truxionis lava dome in Siliqua district and in Monte Nureci rocks (Sup. Tab. 6). It belongs to the phlogopite-annite series (Fig. 27). In Monte Nureci samples $Mg\#$ [$Mg\# = Mg/(Mg+Fe)$] of mica is different between the gabbronorite (0.65-0.67) and the olivine gabbronorites (0.70-0.74); mica in the gabbronorite has lower Ti (<0.3 apfu) content, higher Si (≈ 5.7 apfu) and Fe (≈ 1.9 apfu) contents than those in the olivine gabbronorites ($Ti \approx 0.8$ apfu, $Si \approx 5.4$ apfu, $Fe \approx 1.4$ ap).

Mica in the andesites and dacite of Siliqua has $Mg\# = 0.57-0.78$ and chemical composition like those in the olivine gabbronorites, but with lower Ti content (≈ 0.4 apfu) and sometimes high F content (up to 2.5 wt.%).

Concerning the literature data, mica occurs in the rhyolites and, rarely, in the dacites of the northern Sardinian districts. It belongs to the phlogopite-annite series and has low $Mg\#$ (0.34-0.47 in rhyolites; 0.50 in dacites).

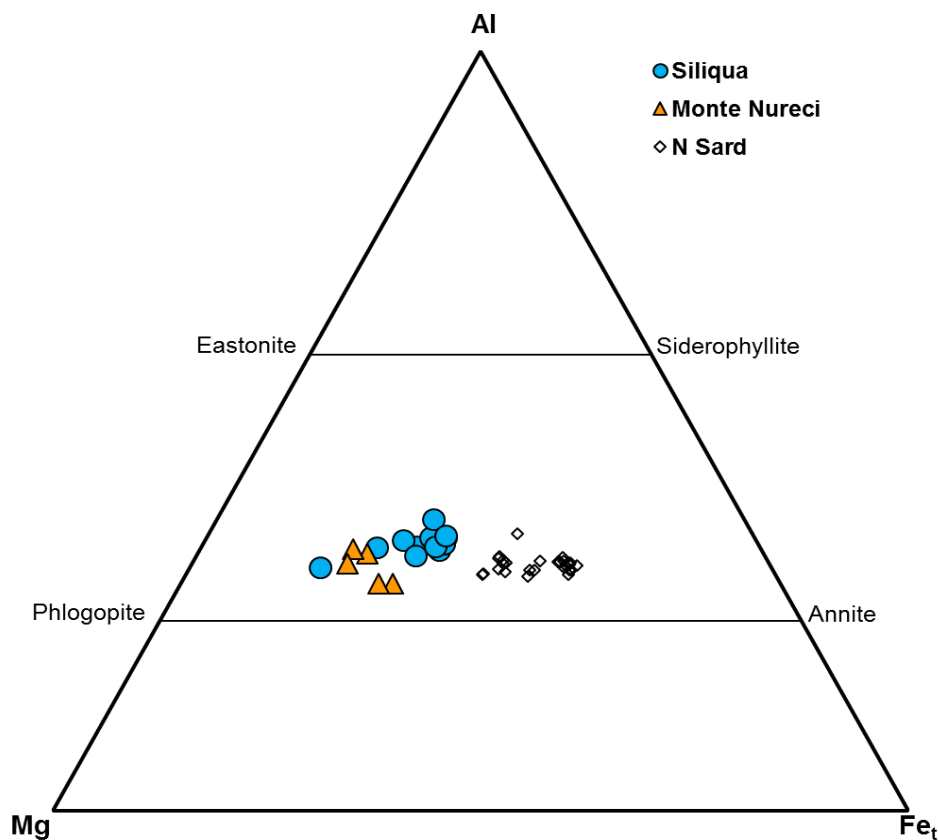


Figure 27 - Classification diagram for mica in Siliqua, Monte Nureci and Northern Sardinia (Marrazzo, 2008; Guarino et al., 2011) rocks.

4.6 Opaque oxides

Opaque oxides are magnetite, plus rare ilmenite (Fig. 28, Sup. Tab. 7a) and occur as phenocrysts or microcrysts in the groundmass and in other phenocrysts in the rocks from Cixerri and Siliqua districts. Opaque oxides in Siliqua rocks have higher ulvöspinel (up to 0.45 mol) and lower ilmenite (0.72-0.83 mol) contents than those from Cixerri (0.01-0.23 mol and 0.86-0.93 mol, respectively). Ilmenite becomes rarer in the evolved rocks and is absent in Siliqua dacites.

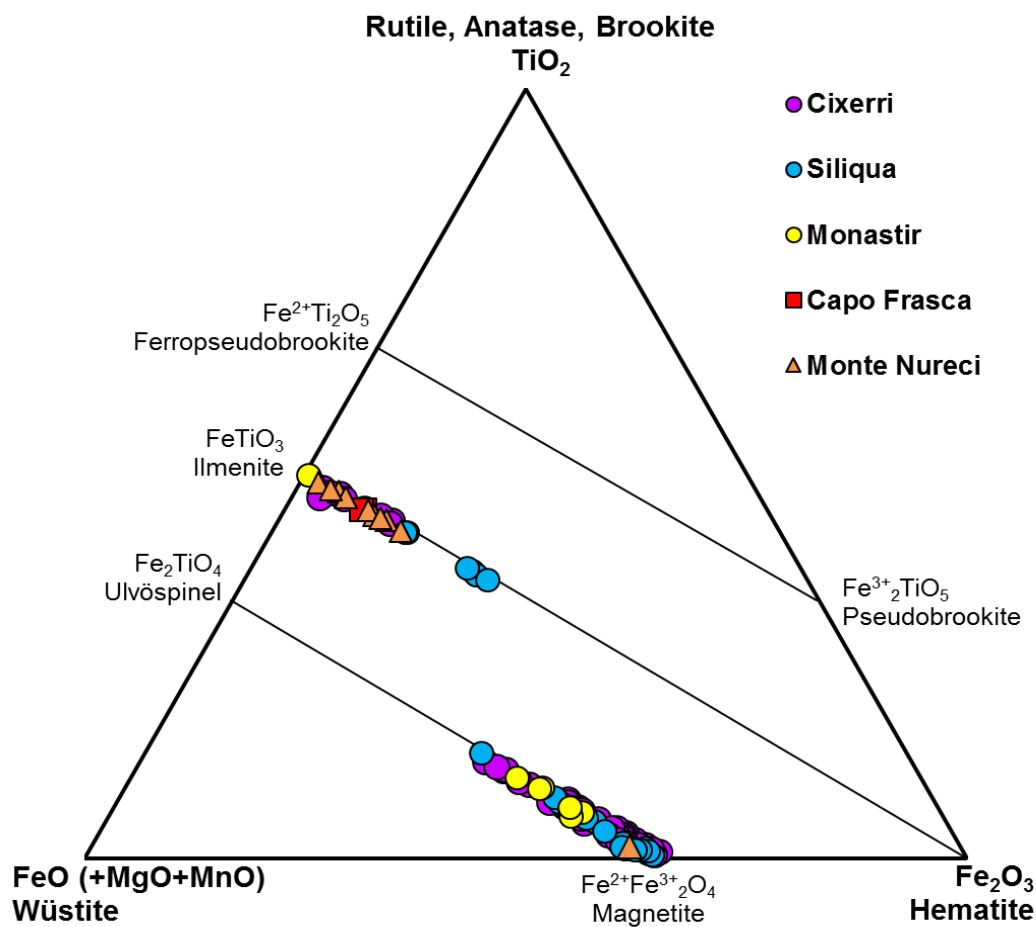


Figure 28 - Classification diagram for opaque oxides in Cixerri, Siliqua, Monastir, Capo Frasca and Monte Nureci rocks.

The andesite of Monastir contains magnetite and rare ilmenite as micro- and phenocrysts with a narrow range of composition (ulvöspinel=0.12-0.20 mol, ilmenite=0.97 mol). Ilmenite is absent in the Monastir basaltic andesite,

that contains magnetite with lower ulvöspinel content (0.10-0.13 mol), Cr-magnetite (Cr=23-30 mol%), Al-magnetite (Al=23-40 mol%) and Cr-spinel (Cr=70 mol%) (Fig. 29, Sup. Tab. 7b).

There is rare ilmenite in Capo Frasca basaltic andesite with ilmenite=0.90 mol.

Opaque oxides in Monte Nureci gabbronorite are ilmenite (=0.86-0.94 mol) and rare magnetite (ulvöspinel=0.03 mol); instead there are Cr-magnetite (Cr=15-39 mol%), Cr-spinel (Cr=48-52 mol%) (Fig. 29, Sup. Tab. 7b), and rare ilmenite (=0.96 mol) in olivine gabbronorites.

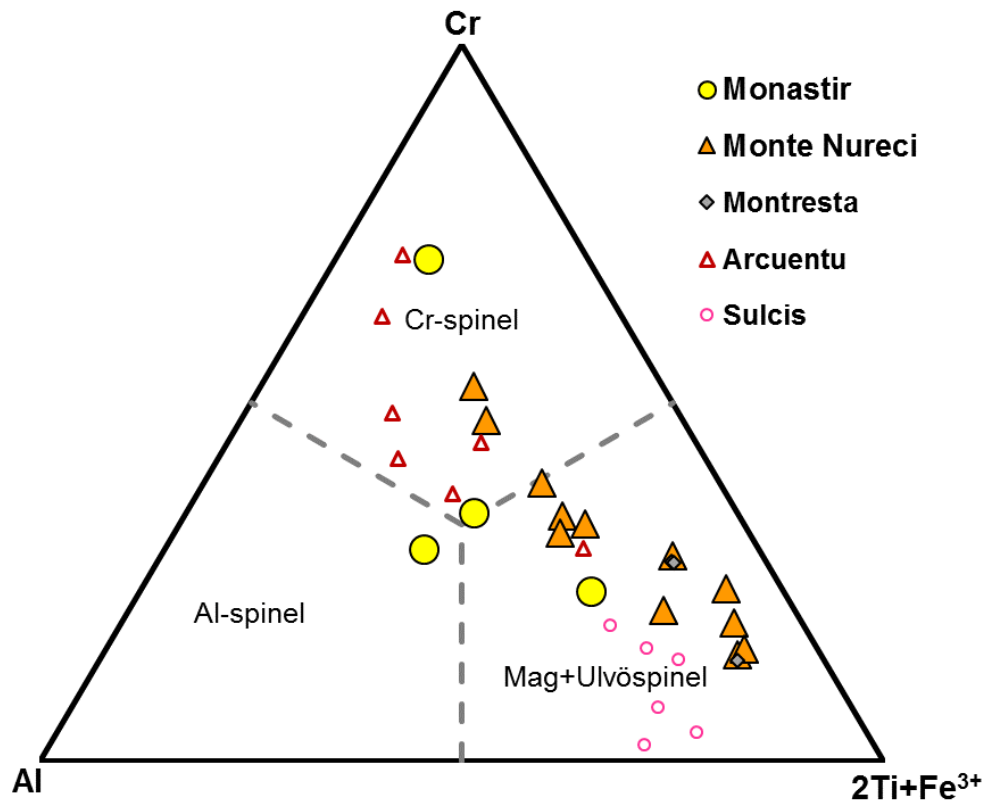


Figure 29 - Classification diagram (Barnes and Roeder, 2001) for spinel and magnetite in the rocks of Monastir, Monte Nureci, Montresta (Morra et al., 1997), Arcuentu (Brotzu et al., 1997b) and Sulcis (Brotzu et al., 1997a).

Opaque oxides occur in calcalkaline rocks of other districts as magnetite, minor ilmenite and rare Cr-spinel (Fig. 29-30). Rocks from basalts to andesites of Sindia and Arcuentu districts contain magnetite, there are magnetite, Cr-spinel and Cr-magnetite in the Arcuentu basalts. Sarroch effusive and intrusive samples contain both magnetite and ilmenite. The rocks from Sulcis,

Montresta and northern districts have magnetite and rare ilmenite, with Al-magnetite and Cr-magnetite in the basalts from Sulcis and Montresta districts, respectively.

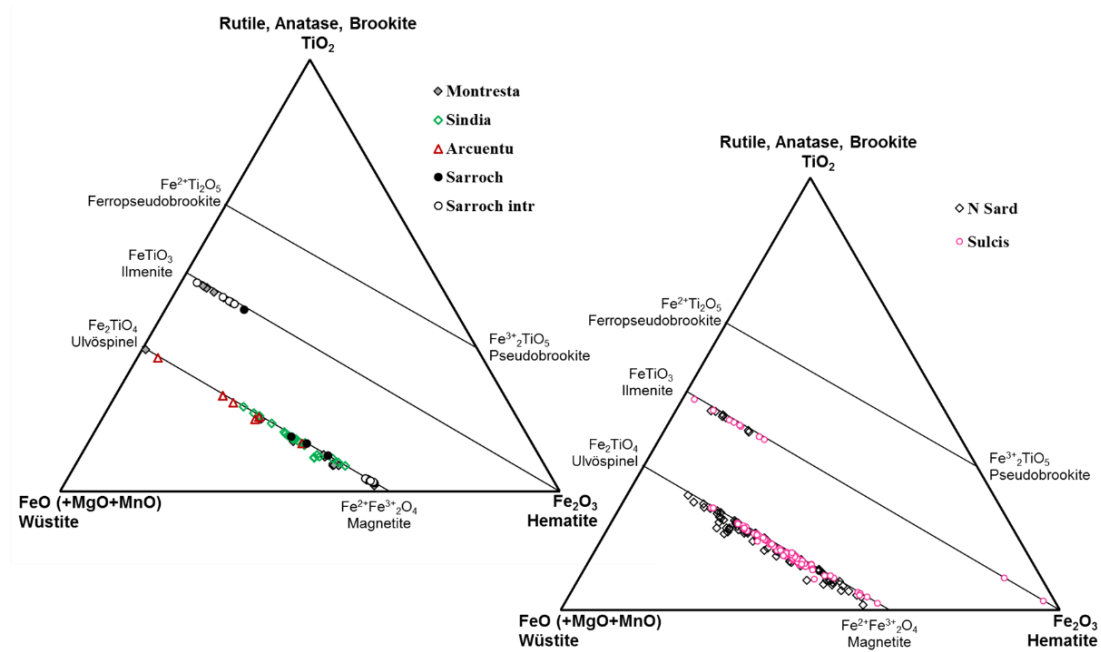


Figure 30 - Classification diagrams for opaque oxides in the rocks of the other Sardinian districts: N Sard (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Montresta (Morra et al., 1997), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011), Sarroch and Sarroch intrusive (Conte, 1997).

4.7 Accessory phases

Zircon occurs in Monte Truxionis lava dome (Siliqua district) with variable ZrO_2 content (60-66 wt.%) and high HfO_2 content (up to 2.2 wt.%) in the dacite (Sup. Tab. 8a). There is apatite in almost all the samples with low SrO (<1.4 wt.%) content (Sup. Tab. 8b). Titanite occurs in some rocks of Cixerri, Siliqua and Punta Su Silixianu, often as alteration phase on the rim of amphibole and plagioclase phenocrysts. It has variable TiO_2 (22-32 wt.%) content and sometimes high La_2O_3 (up to 1.6 wt.%) and Ce_2O_3 (up to 1.8 wt.%) contents (Sup. Tab. 8c).

4.8 Mineral chemistry of the Monastir xenolith

The Monastir xenolith (CMO1) contain plagioclase (Sup. Tab. 3) with andesinic composition ($An_{35-41} Ab_{50-57} Or_{2-10}$), normally zoned crystals show slight compositional variation from core to rim. Mica belongs to the phlogopite-annite series (Sup. Tab. 6); it has $Mg\#=0.59-0.67$ and sometimes high F content (up to 3% in the red mica). There are also monazite crystals with high REE (Rare Earth Elements) content ($La_2O_3=16-17$ wt.%, $Ce_2O_3=31-33$ wt.%, $Nd_2O_3=11-13$ wt.% and $ThO_2=6-8$ wt.%) (Sup. Tab. 8b).

5. Bulk Rock chemical composition

The analyses of the rocks of this study, and of literature rocks that were re-analysed, are provided in the Supplementary Materials (Sup. Tab. 1).

5.1 Major element composition

Cixerri lava domes have variable composition from basaltic andesite to andesite with $\text{SiO}_2=54.8\text{-}60.5$ wt.%, $\text{Fe}_2\text{O}_{3\text{tot}}=6.8\text{-}8.9$ wt.%, $\text{MgO}=3.5\text{-}6.4$ wt.%, $\text{CaO}=6.7\text{-}8.7$ wt.% and $\text{Mg\#}=0.48\text{-}0.60$, except for one andesite (SAR12) with higher SiO_2 (62.9 wt.%), lower MgO (2.1 wt.%), CaO (6.2 wt.%) and $\text{Mg\#}$ (0.38). Other oxides concentrations are roughly constant ($\text{TiO}_2\approx 0.6$ wt.%, $\text{Al}_2\text{O}_3\approx 17$ wt.%, $\text{MnO}\approx 0.15$ wt.% $\text{Na}_2\text{O}\approx 2.5$ wt.% $\text{K}_2\text{O}\approx 1$ wt.%, $\text{P}_2\text{O}_5\approx 0.1$ wt.%). The Loss On Ignition (LOI) is 0.6-4 wt.%, generally with higher values in more evolved rocks.

Siliqua lava domes are generally more evolved than Cixerri ones, they are andesites and dacites with homogeneous composition ($\text{SiO}_2\approx 63$ wt.%, $\text{TiO}_2\approx 0.5$ wt.%, $\text{Al}_2\text{O}_3\approx 17$ wt.%, $\text{MnO}\approx 0.1$ wt.%, $\text{MgO}\approx 3$ wt.%, $\text{CaO}\approx 5.5$ wt.% $\text{Na}_2\text{O}\approx 3$ wt.%, $\text{K}_2\text{O}\approx 2$ wt.%, $\text{P}_2\text{O}_5\approx 0.25$ wt.%), $\text{Fe}_2\text{O}_{3\text{tot}}$ (4-6 wt.%) and $\text{Mg\#}$ (0.44-0.59) are more variable. Just one basaltic andesite (SIL2) outcrops in Acquafredda dome, it shows lower SiO_2 (56.8 wt.%), Na_2O (2.3 wt.%) and K_2O (1.4 wt.%) concentrations and higher MgO (4.5 wt.%), $\text{Fe}_2\text{O}_{3\text{tot}}$ (8.3 wt.%) and CaO (7.7 wt.%) concentrations. The LOI varies between 2.1 and 3.9 wt.% with a higher value (6.5 wt.%) in the dacite of Monte Truxionis (MTR1).

In Monastir district the dyke (CMO3) is a basaltic andesite with $\text{SiO}_2=53.6$ wt.%, $\text{TiO}_2=0.7$ wt.%, $\text{Al}_2\text{O}_3=17.9$ wt.%, $\text{Fe}_2\text{O}_{3\text{tot}}=8.9$ wt.%, $\text{MnO}=0.1$ wt.%, $\text{MgO}=6.8$ wt.%, $\text{CaO}=8.5$ wt.%, $\text{Na}_2\text{O}=2.3$ wt.% $\text{K}_2\text{O}=1.0$ wt.%, $\text{P}_2\text{O}_5=0.1$ wt.%, $\text{Mg\#}=0.60$ and $\text{LOI}=1.1$ wt.%. The andesitic lava (CMO2) differs for SiO_2 (57.7 wt.%), Al_2O_3 (18.7 wt.%), $\text{Fe}_2\text{O}_{3\text{tot}}$ (7.5 wt.%), MgO (4.3 wt.%), CaO (7.7 wt.%) concentrations, it has lower $\text{Mg\#}$ (0.53) and higher LOI value (3.3 wt.%).

Punta Su Silixianu andesite has major elements concentrations like those from other districts and high LOI (4.1 wt.%) for its high alteration degree.

Monte Nureci olivine gabbro-norites have variable SiO_2 (47.7-53.5 wt.%), TiO_2 (0.2-0.5 wt.%), Al_2O_3 (16.1-20.0 wt.%), $\text{Fe}_2\text{O}_{3\text{tot}}$ (6.7-7.9 wt.%), MgO (5.0-13.1 wt.%), CaO (10.6-13.8 wt.%), Na_2O (1-2.5 wt.%), K_2O (0.1-1.0 wt.%) concentrations and $\text{Mg\#}$ (0.60-0.77). The gabbro-norite shows higher SiO_2 (56.7 wt.%), TiO_2 (0.7 wt.%), $\text{Fe}_2\text{O}_{3\text{tot}}$ (8.3 wt.%) and K_2O (1.4 wt.%) concentrations, lower Al_2O_3 (15.7 wt.%), CaO (8.5 wt.%) concentrations and $\text{Mg\#}$ value (0.58). The LOI values (0.6-1.1 wt.%) are low in the three samples.

Major element concentration of the rocks of this study are plotted, with the literature data, against the silica concentration (Fig. 31). All the rocks, except for Monte Nureci samples that are often outlier because of their cumulitic genesis, generate trends in the Harker diagrams: MgO , $\text{Fe}_2\text{O}_{3\text{tot}}$, CaO and MnO are negatively correlated with silica, instead Na_2O , K_2O are positively correlated with silica, but with greater dispersion of the points when $\text{SiO}_2 > 65$ wt.%. TiO_2 and Al_2O_3 show variable trends: they generally decrease when silica increases, except for the least evolved samples from Montresta, Arcuentu, Capo Frasca and Marmilla districts where TiO_2 and Al_2O_3 increase with silica. Their concentrations increase in Montresta rocks when $\text{SiO}_2 = 47-51$ wt.%, in Arcuentu and Capo Frasca rocks when $\text{SiO}_2 = 51-59$ wt.%, in Marmilla basaltic andesites when $\text{SiO}_2 = 51.8-53.5$ wt.%. P_2O_5 concentration is generally variable between 0 and 0.5 wt.% with high dispersion of the points, but it decreases in North Sardinia dacite and rhyolites with silica increase.

Basaltic andesites, andesites and dacites from Cixerri, Siliqua, Monastir and Punta Su Silixianu have higher MgO , $\text{Mg\#}$ and lower TiO_2 concentrations than rocks with the same silica concentration from other districts, particularly Sulcis and Sindia. Andesites from Siliqua have lower MnO (0.12-0.15 wt.%), higher Na_2O (3-3.5 wt.%), K_2O (1.9-2.6 wt.%), P_2O_5 (0.23-0.29 wt.%) and $\text{Mg\#}$ (0.55) than those from Cixerri (0.16 wt.%, 2.8 wt.%, 1.5 wt.%, 0.16 wt.% and 0.4, respectively).

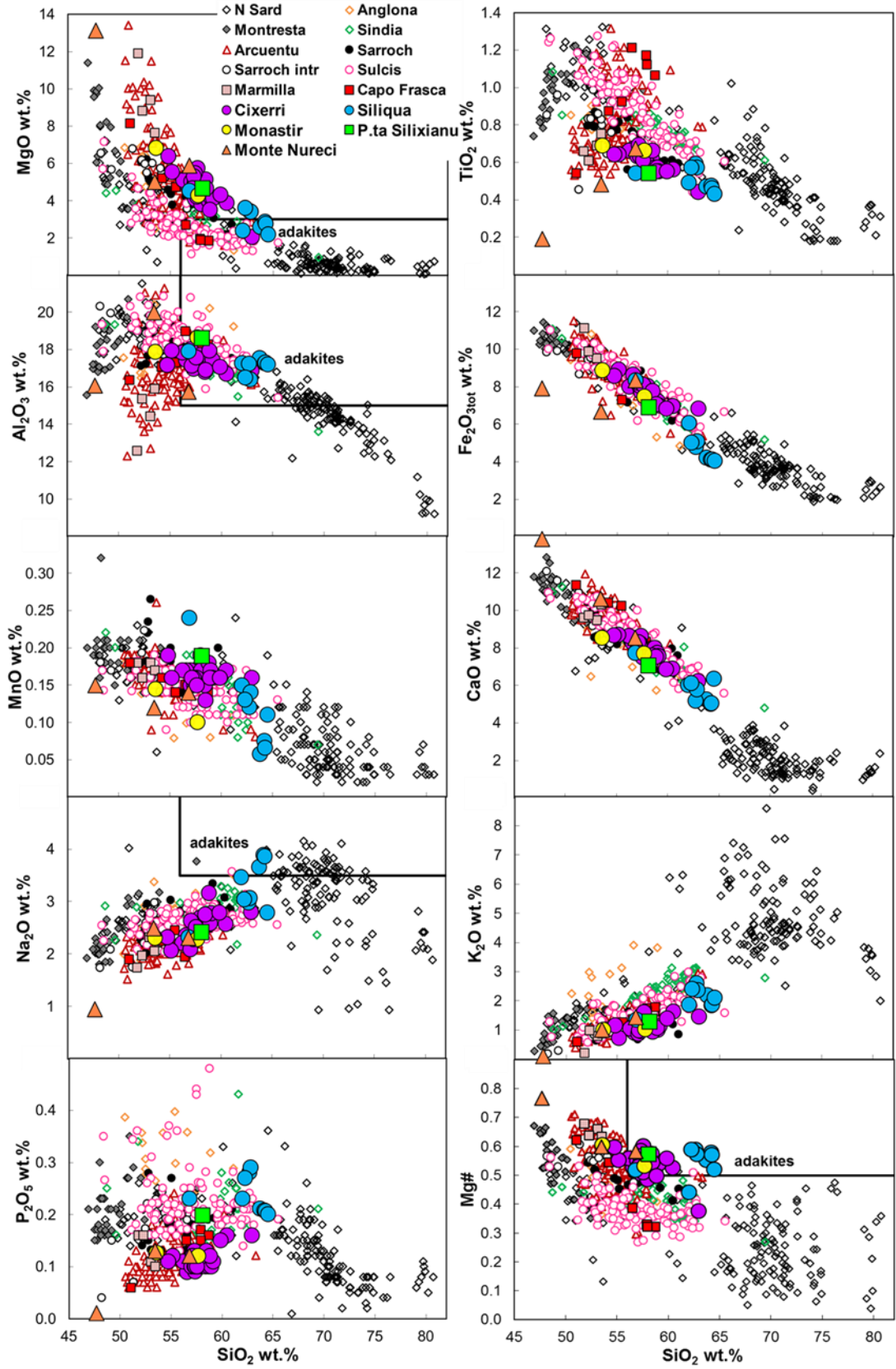


Figure 31 - Major element (wt. %) and Mg# [Mg# = Mg/(Mg+Fe)] vs silica variation diagrams for the rocks of this study and literature data. References as in figure 9. The adakites field is taken from Defant and Drummond (1990) and Martin et al. (2005).

Some basalts and basaltic andesites ($\text{SiO}_2=47\text{-}53$ wt.%) from Motresta, Arcuentu, Marmilla and Capo Frasca have high MgO concentration (up to 13.4 wt.%). Those from Montresta and Arcuentu have $\text{MgO}>7$ wt.%, $\text{Al}_2\text{O}_3<16$ wt.%, $\text{Cr}>700$ ppm and $\text{Ni}>200$ ppm, so they can be classified as High Magnesia Basalts (HMB, Morra et al., 1997; Franciosi et al., 2003), other basalts from Montresta, Arcuentu, Sulcis, Sindia, and north Sardinia districts have $\text{Al}_2\text{O}_3>16$ wt.% and $\text{MgO}<7$ wt.%, so they are classified as High Alumina Basalts, according to Kersting and Arculus (1994).

5.2 Trace element and volatiles composition

The Cixerri lava domes have low Cr (<140 ppm) and Ni (<15 ppm) contents, they show a large variability in terms of Sc (17-31 ppm), V (112-219 ppm), Cu (10-31 ppm), Zn (71-153 ppm), Sr (233-352 ppm), Zr (71-150 ppm), Ba (198-524 ppm), Ce (16-30 ppm) and Pb (3-21 ppm) concentrations and roughly constant Ga (~ 18 ppm), Rb (~ 40 ppm), Y (~ 23 ppm), Nb (~ 6 ppm), La (~ 12 ppm), Nd (~ 12 ppm), Eu (~ 0.9 ppm), Yb (~ 2 ppm), Hf (~ 3 ppm), Th (~ 4 ppm) and U (~ 1 ppm), except for SAR12 sample that has lower Sc (8 ppm) and V (56 ppm), higher La (19 ppm), Ce (39 ppm), Nd (17 ppm) concentrations. Volatiles contents are variable (Cl=50-305 ppm, F=386-930 ppm, S=6-324 ppm).

The Siliqua lava domes show low Cr (<90 ppm) and Ni (<20 ppm) concentrations, with wide range of compositional variation in V (70-141 ppm), Sr (521-1185 ppm), Zr (115-216 ppm), Nb (8-20 ppm), Ba (726-1323 ppm), La (29-51 ppm), Ce (44-94 ppm), Nd (23-38 ppm), Yb (1-2 ppm), Hf (2-5), Pb (14-48 ppm) and volatile concentrations (Cl=52-141, F=787-1057 and S=2-36). The basaltic andesite (SIL2) is the only sample with high S concentration (1027 ppm). Other trace elements concentrations are approximately constant (Sc ~ 14 ppm, Cu ~ 14 ppm, Zn ~ 75 ppm, Ga ~ 20 ppm, Rb ~ 49 ppm, Y ~ 17 ppm, Eu ~ 1.3 ppm, Th ~ 12 ppm, U ~ 3 ppm).

The Monastir andesite and basaltic andesite have similar composition for some trace elements (Sc $\approx$ 28 ppm, Cu $\approx$ 22 ppm, Zn $\approx$ 93 ppm, Ga $\approx$ 19 ppm, Rb $\approx$ 23 ppm, Y $\approx$ 20 ppm, Nb $\approx$ 4 ppm, La $\approx$ 13 ppm, Hf $\approx$ 2 ppm, Pb $\approx$ 5 ppm, Th $\approx$ 4 ppm, U $\approx$ 1 ppm) and differs in V (177 and 244 ppm), Cr (10 and 150 ppm), Ni (8 and 27 ppm), Sr (300 and 665 ppm), Zr (98 and 60 ppm), Ba (292 and 193 ppm), Ce (34 and 26 ppm, respectively) concentrations. The basaltic andesite has Nd=14 ppm, Eu=1 ppm and Yb=1.5 ppm. The andesite and the basaltic andesite have similar Cl ($\sim$ 46 ppm) and different F (409 and 224 ppm, respectively) contents.

The andesite of Punta Su Silixianu has trace elements concentrations similar to the basaltic andesite of Siliqua, with higher S concentration (1446 ppm) due to the presence of pyrite.

The trace element concentrations show wide range of variation in Monte Nureci intrusive rocks (Sc=29-44 ppm, V=140-230 ppm, Cr=140-840 ppm, Ni=30-150 ppm, Cu=7-58 ppm, Zn=65-86 ppm, Ga=13-19 ppm, Zr=17-97 ppm, La=3-17 ppm, Ce=6-34 ppm, Eu=0.4-1.1, Yb=0.7-2 ppm), with the highest Cr, Ni, Sc and the lowest REE (Rare Earth Elements) contents in the olivine gabbro-norite MNU3. Volatile contents have limited variation (F=334-563 ppm, Cl=200-353 ppm, S=19 ppm).

Cr and Ni concentrations are generally low (<200 and <50 ppm), except for Montresta, Arcuentu, Capo Frasca and Marmilla basalts and basaltic andesites where they reach 1000 and 250 ppm, respectively. Arcuentu, Sulcis and Capo Frasca basaltic andesites have also higher Sc (up to 50 ppm) and V (up to 300 ppm) concentrations than those from Cixerri.

The Siliqua rocks have higher Sr, Nb, Ba, La, Ce, Nd, Eu, Th and U concentrations than rocks with the same silica content from Cixerri district. Rb, Sr, Y and Nd concentrations in Cixerri rocks are also lower than those from Sulcis and Sindia districts. Sr concentration is particularly low in Arcuentu, Capo Frasca and Marmilla rocks ($\sim$ 100-300 ppm).

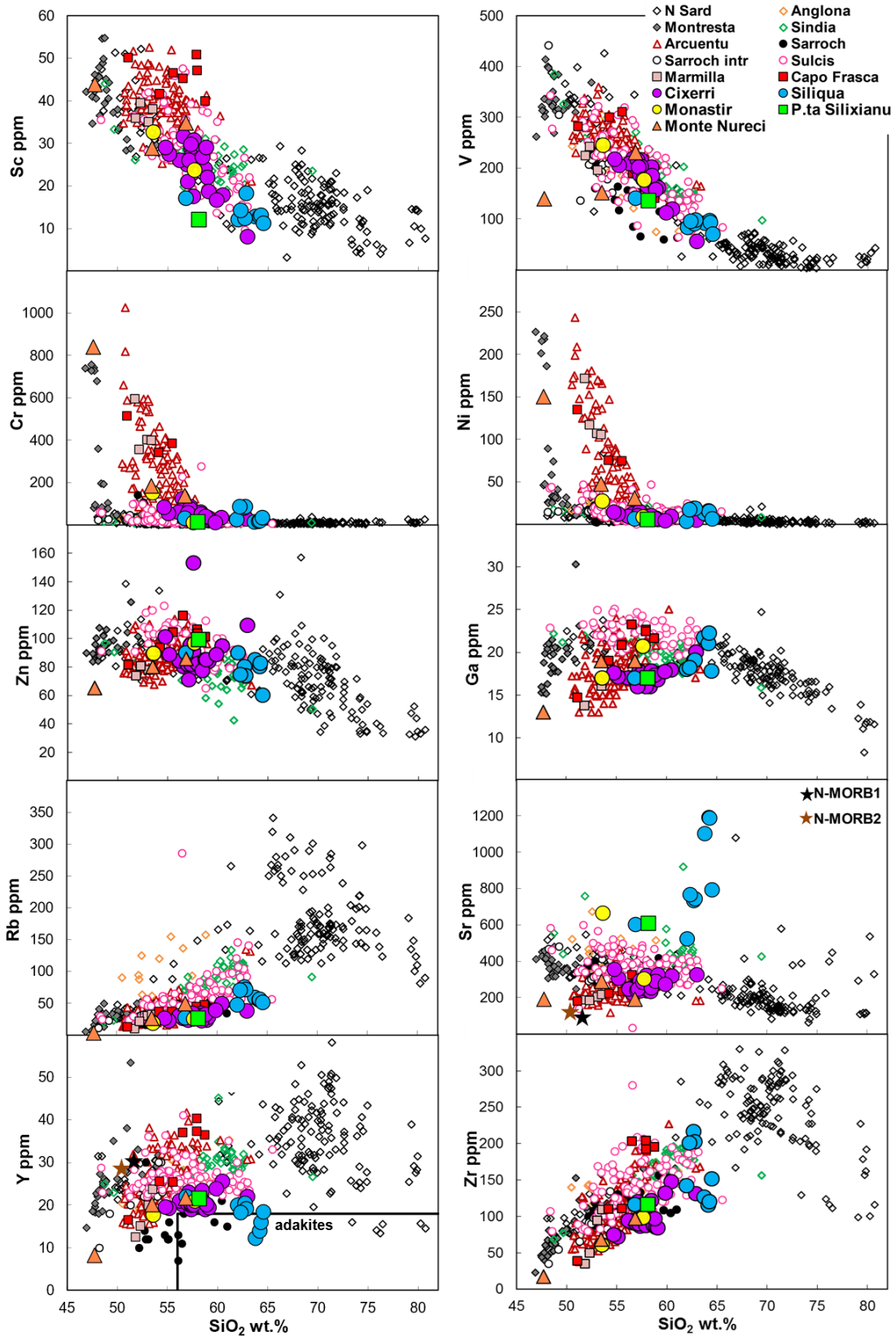


Figure 32 - Trace element and volatile (ppm) vs silica variation diagrams for the rocks of this study, literature data and N-MORB1,2 (Arevalo and McDonough, 2008). References as in figure 9 . The adakites field is taken from Defant and Drummond (1990).

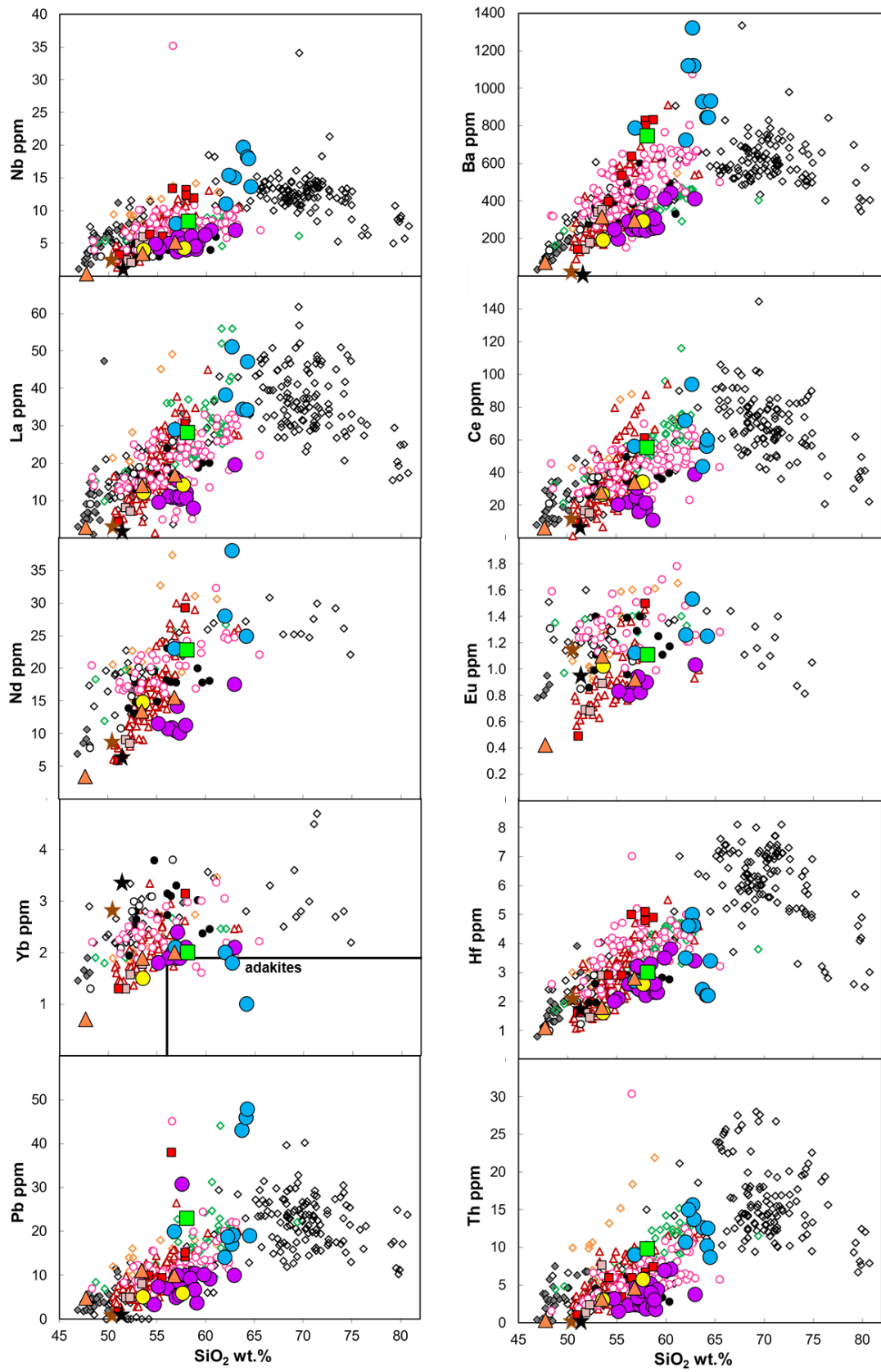


Figure 32 - Continued.

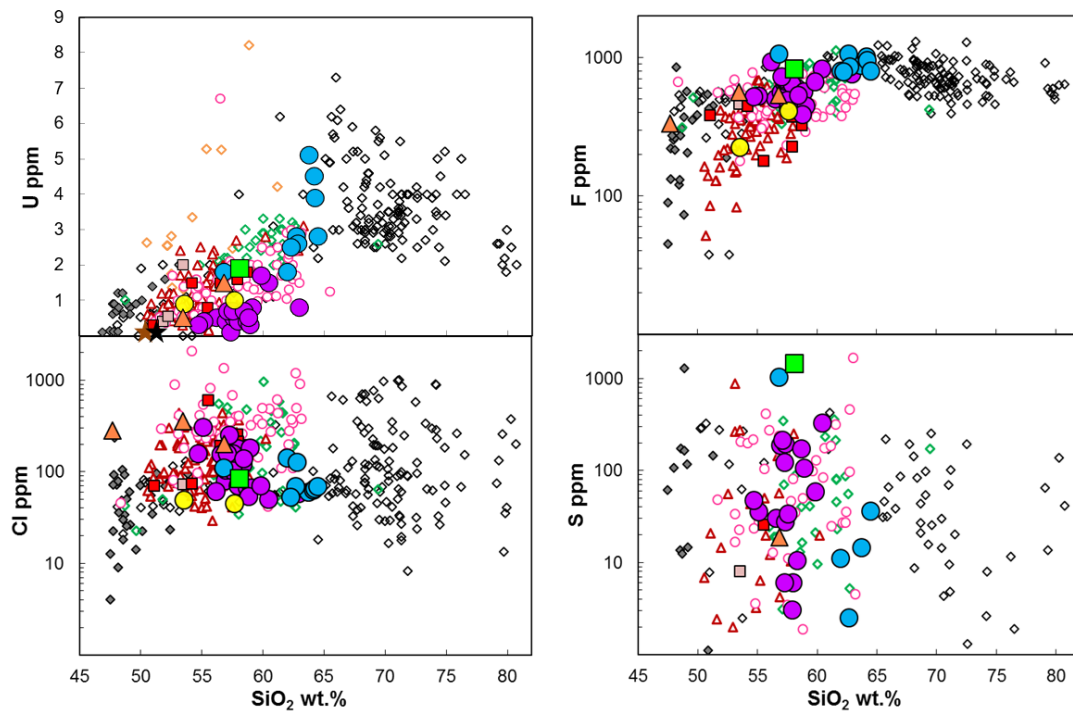
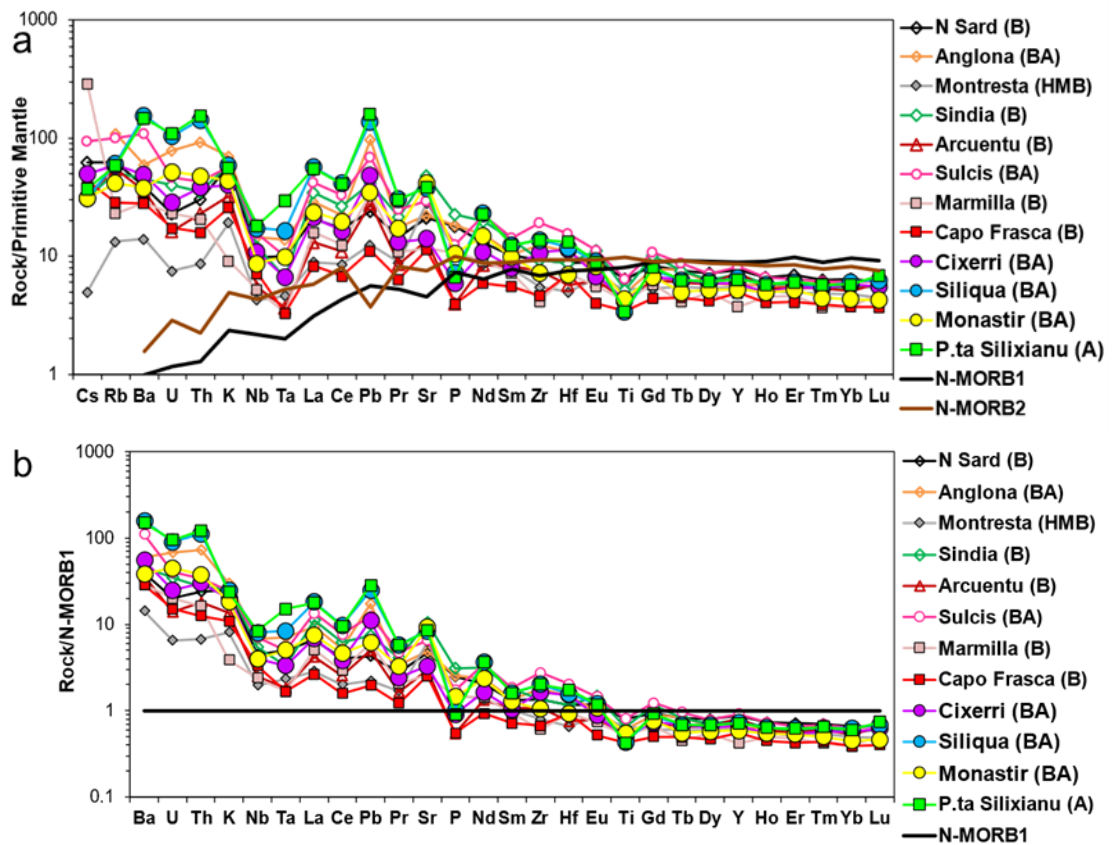


Figure 32 - Continued.

The trace element concentrations in the rocks of this study are plotted, with the literature data, against the silica concentration (Fig. 32). Some trends can be observed: Sc, V, Cr, Ni, Zn and Sr are negatively correlated with silica, instead Rb, Y, Zr, Nb, Ba, La, Ce, Nd, Eu, Yb, Hf, Pb, Th and U show positive correlation with SiO_2 , except for Siliqua samples that are scattered, the trends of Rb, Nb, Ba, La, Ce, Nd and Eu change when $\text{SiO}_2 > 67$ wt.% in the rocks of northern Sardinia districts. The concentration of Y and La remains approximately constant only in Cixerri rocks when silica increases. Ga shows variable trends with silica: it remains roughly constant in the Cixerri rocks and varies between 18 and 22 ppm in Siliqua andesites and dacites; Ga increases with silica in Monastir, Montresta, Capo Frasca and Arcuentu rocks, decreases with silica increase in Sulcis, Sindia and north Sardinia samples.

The least evolved samples of the various districts have peaks at Pb, K, La, Rb, Ba and Sr and troughs in high field strength elements (Nb, Ta, Ti, Zr) in the multi-element diagram normalized to the primitive mantle (Fig. 33a; Lyubetskaya and Korenaga, 2007). The anomalies are less pronounced and the

element concentrations, especially of the most incompatible elements, are lower in less evolved samples, with the exception of Sindia basalt that is enriched as more evolved rocks from other districts. The High Magnesium Basalt (HMB) from Montresta is enriched just 5-10 times the primitive mantle. Two representative compositions of Atlantic Normal-Mid Oceanic Ridge Basalt (N-MORB; Arevalo and McDonough, 2008) are depleted in the most incompatible elements and have K peak; N-MORB1 is more depleted than N-MORB2 that has Pb trough. In the multi-element diagrams normalized to two Atlantic N-MORBs all the samples have patterns similar to those normalized to the primitive mantle and are depleted in REE (Rare Earth Elements), Zr, Hf, Ti respect to the two Atlantic N-MORBs (Fig. 33b-c).



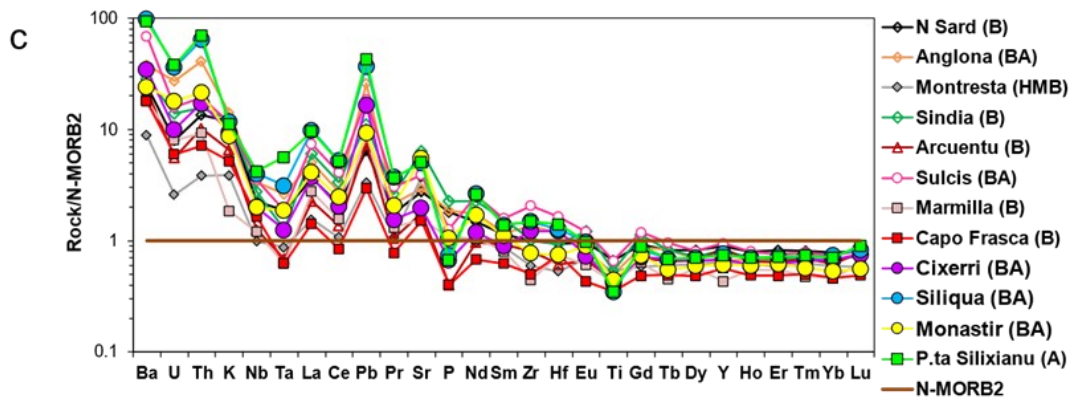


Figure 33 - a) Primitive mantle normalized trace elements diagram and b-c) N-MORBs normalized trace elements diagrams for the rocks of this study and literature. References as in fig. 9. B=basalt, BA=basaltic andesite, HMB=High Magnesium basalt, A=andesite.

In the rare earth elements diagram normalized to the chondrite (Fig. 34; Anders and Grevesse, 1989) the LREE (Light REE) are slightly more enriched than the HREE (Heavy REE), with flat HREE patterns: the La_N/Yb_N is 4-6 in Cixerri rocks, 10-24 in Siliqua, 5.5 in Monastir and 10 in Punta Su Silixianu, these values are generally higher in more evolved rocks (Fig. 42c). Relatively low values of La_N/Yb_N are found in some more primitive rocks of other districts like the basalts from Montresta (1.9-2.7), Arcuentu (2.6-2.9) and Capo Frasca (2.2). Sulcis basaltic andesite shows high La_N/Yb_N (7). Basaltic andesites to dacites from Cixerri, Siliqua, Monastir, Punta Su Silixianu have no or slight negative Eu anomaly (0.9-1) indicating no alkali feldspar fractionation. A slightly more pronounced negative Eu anomaly is observed in the Arcuentu basalts (0.8-0.9). The N-MORBs (Arevalo and McDonough, 2008) are depleted in LREE respect to HREE ($La_N/Yb_N=0.3-0.7$).

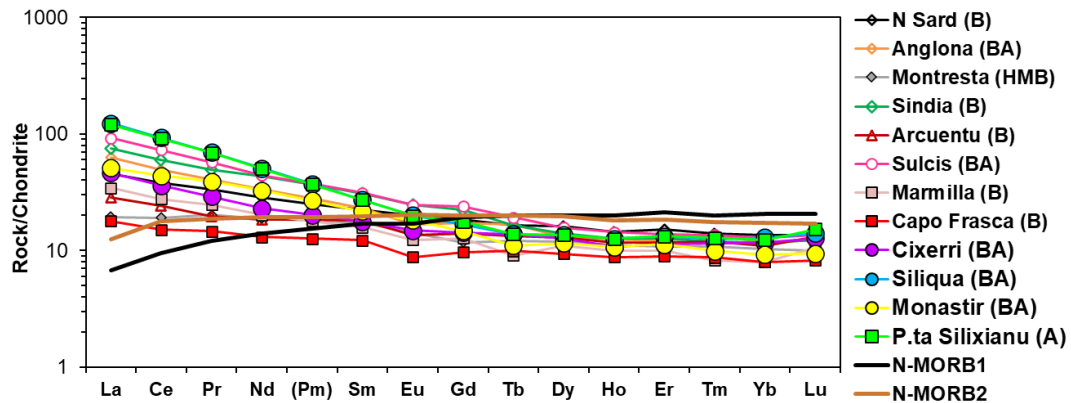


Figure 34 - Chondrite normalized rare earth element (REE) diagram for the rocks of this study and literature. References as in fig. 9. Abbreviations as in previous figure.

6. Conditions of magma crystallization

Geothermobarometers and hygrometers were applied to discover in which conditions of pressure, temperature, H₂O content and oxygen fugacity the magmas evolved, and the different mineral phases crystallized. The results, expressed as mean values for each sample, and the error associated to each thermobarometer and hygrometer are provided in Sup. Tab. 9.

Different thermobarometers were applied on pyroxenes, they are mainly based on: 1) the composition of clinopyroxene (Nimis, 1995; Putirka, 2008); 2) clinopyroxene-liquid and orthopyroxene-clinopyroxene pairs (Putirka, 2008). The clinopyroxene-liquid thermobarometer gave results for a few samples where clinopyroxene was in equilibrium with the host rock: it crystallized (considering the mean value in each sample) at ~1015-1055°C and ~3.9 kbar in Cixerri rocks, at ~1130°C and ~3.9 kbar in Capo Frasca basaltic andesite, at ~1060°C and ~1.6 kbar in Monte Nureci olivine gabbro. Clinopyroxene in Monastir rocks was in equilibrium with the melt: clinopyroxene cores crystallized at ~1115°C in the basaltic andesite, clinopyroxene crystallized at ~1065°C in the groundmass of the andesite, the crystallization pressure was not calculated because of the low Al concentration and the absence of ^{VI}Al indicating low crystallization pressure. The low Al concentration and the lack of ^{VI}Al were observed also in the clinopyroxene of Monte Truxionis lava dome (Siliqua). Higher temperatures and pressures of crystallization were obtained considering only the clinopyroxene composition when it was not in equilibrium with the rock: ~1145°C and ~1.6-6.2 kbar in Cixerri rocks, ~1130°C in Siliqua andesites, ~1165°C and ~5.2 kbar in the Monastir basaltic andesite, ~1145°C and ~2.5 kbar in the Monastir andesite, ~1210°C and ~4.4 kbar in Capo Frasca basalts, ~1170°C and ~2.5-4.3 kbar in Capo Frasca basaltic andesites, ~1075-1145°C and ~1.7-5.5 kbar in Monte Nureci gabbros. These pressure results were compared to those obtained with the barometer of Nimis (1995) based on clinopyroxene composition. The crystallization pressure could be calculated just in few samples and is

generally underestimated (Putirka, 2008), clinopyroxene crystallized at ~2.3-4.9 kbar in Cixerri rocks, ~0.6 kbar in Monastir basaltic andesite and ~1.3 kbar in Capo Frasca rocks. The results obtained for clinopyroxene in equilibrium with the host rock are the most reliable.

Orthopyroxene and clinopyroxene occur in Monastir, Capo Frasca and Monte Nureci rocks, the thermobarometer of Putirka (2008) provided the temperature and pressure of crystallization for the pairs in equilibrium (when $K_d(\text{Fe-Mg})=1.09\pm0.14$), obtaining ~1027°C and ~3.4 kbar in Monastir basaltic andesite, ~1152°C and ~5.5 kbar in Capo Frasca basalt, ~1094°C and ~3.2 kbar in Capo Frasca basaltic andesite, ~1020°C and ~2.5 kbar in Monte Nureci olivine gabbro-norites. These results are generally concordant with those calculated considering the clinopyroxene-liquid pairs in equilibrium, except for Monastir basaltic andesite where clinopyroxene crystallized at low pressure, but it was not possible to calculate the pressure.

Pigeonite is present in Monastir basaltic andesite, in one basaltic andesite (MAL29) of Capo Frasca and in the gabbro-norite of Monte Nureci. The minimum temperature of crystallization was calculated with the thermometer of Ishii (1975) obtaining 1097°C, 1051°C and 1086°C respectively.

The plagioclase-liquid thermobarometer of Putirka (2008) provided information about the temperature, pressure and H₂O concentration of the melt for plagioclase in equilibrium with the rock, considering the albite-anorthite exchange. The spreadsheet calculates the maximum temperature of crystallization of plagioclase on the base of the crystallization pressure calculated for clinopyroxene, but it has some limits: the temperatures seem to be overestimated and the plagioclase barometer does not work well (Putirka, 2008); therefore, the calculated pressures were not considered. The maximum temperature of plagioclase crystallization (considering the mean value in each sample) are: ~1220°C and ~1160-1220°C for plagioclase in basaltic andesites and andesites from Cixerri, respectively, ~1140°C in andesites and dacites from Siliqua, ~1200°C in Punta Su Silixianu andesite, ~1220°C in Monastir

samples, ~1230°C in Capo Frasca rocks, ~1270°C in olivine gabbronorites and ~1175°C in the gabbronorite from Monte Nureci, respectively. The H₂O concentration varies in the ranges 2.7-4.1 wt.% in Cixerri rocks, with lower values in the least evolved samples, 3.7-5.6 wt.% in Siliqua andesites and dacites, 3.6 wt.% in Punta Su Silixianu andesite, ~3 wt.% in Monastir rocks, 2.3-4.2 wt.% in Capo Frasca samples and 2.2-4.2 wt.% in Monte Nureci intrusive rocks.

Another thermometer, based on the anorthite content in the plagioclase (Thy et al., 2013), was applied obtaining lower crystallization temperatures for plagioclase. The temperatures generally decrease from the core to the rim of the phenocrysts and to the plagioclase in the groundmass. The calculated temperatures are: ~1130-1195°C in Cixerri rocks, ~1065-1100°C in Siliqua rocks, ~1180°C in Monastir samples, ~1160°C in Punta Su Silixianu andesite, ~1155-1220°C in Capo Frasca rocks, ~1225°C and ~1125°C in Monte Nureci olivine gabbronorites and gabbronorite, respectively. These results were used with the H₂O content calculated with the hygrometer of Putirka (2008): the lava domes of Siliqua contain plagioclase crystallized at the lowest temperatures and from magmas with the highest H₂O contents, which are also the most evolved.

Amphibole is an abundant phase in Cixerri and Siliqua rocks, it occurs also in Monastir andesite and Monte Nureci gabbronorites, where it appears interstitial and as secondary phase. The thermobarometer of Ridolfi et al. (2010), for calcalkaline amphiboles, was not applied for Monte Nureci gabbros, but gave information about the other districts. The error associated to the Ridolfi barometer and hygrometer is variable, it is higher at higher pressure and H₂O content. Amphibole crystallized at ~852-977°C and 2.1-5.7 kbar from a magma with ~6.4-8.0 wt.% H₂O concentration and ~10⁻¹¹-10⁻⁹ bar fO₂ at Cixerri, at ~893-1002°C and ~2.6-7.0 kbar from a melt with ~6.4-8.4 wt.% H₂O concentration and ~10⁻¹¹-10⁻⁹ bar fO₂ at Siliqua, at ~1030°C and ~7.7 kbar from magma with ~8.4 wt.% H₂O concentration and ~10⁻⁹ bar fO₂ at

Monastir andesite. Generally, the H₂O concentration was higher when amphibole crystallized at higher temperature and pressure (Fig. 35b-d). Furthermore, at higher temperature amphibole crystallized at higher pressure and oxygen fugacity conditions (Fig. 35a-c).

Amphibole is rare in the rocks of the other districts; it occurs in northern Sardinia with higher crystallization temperature, pressure and H₂O content in the basalts and basaltic andesites (~1050°C, ~9 kbar, ~8 wt.%) than in the rhyolites (~900°C, ~2 kbar, ~5 wt.%). In Sarroch basaltic andesites and in Sulcis andesites the crystallization of this phase took place at ~980°C, ~5.5 kbar, ~7.5 wt.% H₂O and ~920°C, ~3.3 kbar, ~5 wt.% H₂O content, respectively. The temperature, pressure and oxygen fugacity are similar to those calculated in the rocks of this study (Fig. 35a-c). The calculated concentration of H₂O (4-8 wt.%; Fig. 35b) is lower than in Cixerri, Siliqua and Monastir melts, explaining the low amount of amphibole in these rocks.

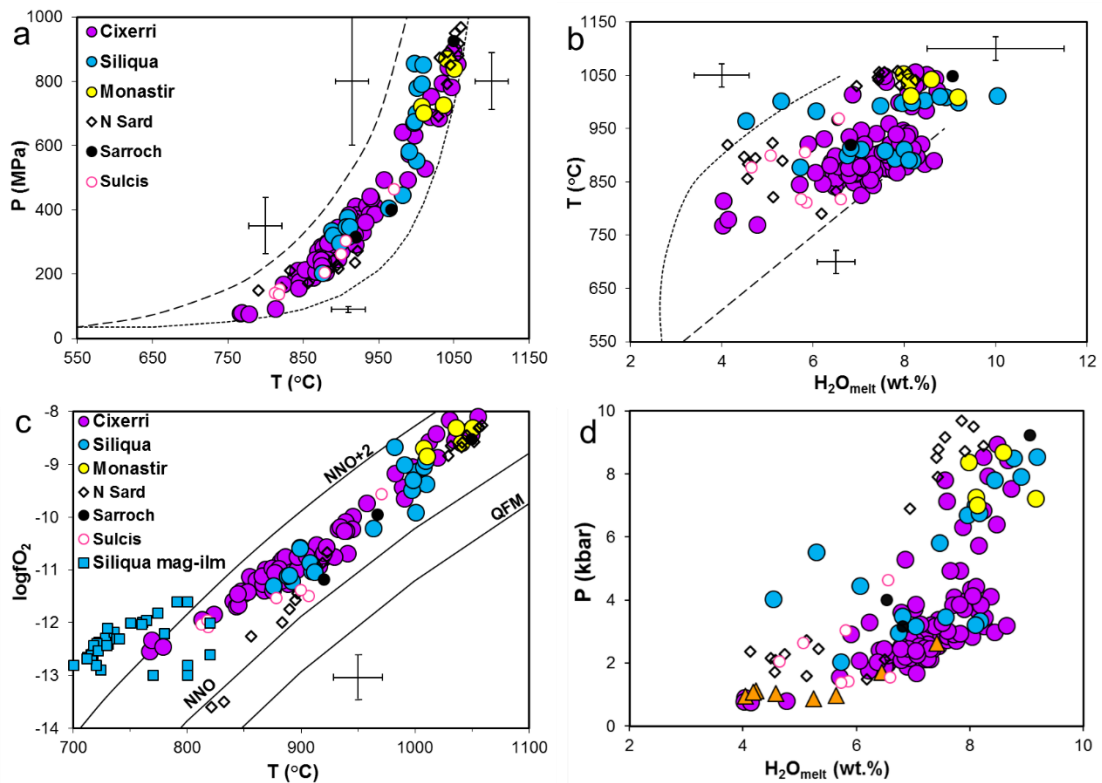


Figure 35 - a) T (°C) vs. P (MPa), b) H₂O melt (wt.%) vs T (°C), c) T (°C) vs. logfO₂, diagrams with stability curves (dashed lines) and error bars (Ridolfi et al., 2010), d) H₂O melt (wt.%) vs P (kbar) diagram for calcalkaline amphiboles and magnetite-ilmenite equilibrium pairs in the rocks from Cixerri, Siliqua, Monastir districts, compared to those from N Sard (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Sulcis (Brotzu et al., 1997a; Conte et al., 2010) and Sarroch (Conte, 1997) districts.

The thermobarometer of Putirka (2016) was applied on amphibole in equilibrium with the host rock, obtaining crystallization temperatures and pressures comparable to those calculated with that of Ridolfi et al. (2010). These results were not considered because only few samples contain amphibole in equilibrium with the liquid, and the thermobarometer of Ridolfi et al. (2010) provides more reliable information considering the higher error associated to the thermobarometer of Putirka ($\pm 30^{\circ}\text{C}$ and ± 2 kbar).

Olivine is not in equilibrium with the host rock, so it was not possible to calculate its crystallization temperature.

Magnetite occurs in almost all the studied samples, instead ilmenite is generally rarer. The equilibration temperature and oxygen fugacity of opaque oxides were calculated using the ILMAT spreadsheet (Lepage, 2003). Magnetite-ilmenite pairs are in equilibrium in Siliqua andesites, where the calculated temperatures of crystallization are low ($\sim 700\text{-}800^{\circ}\text{C}$) indicating a re-equilibration process after the crystallization. The oxygen fugacity is 10^{-13} - 10^{-12} bar in Siliqua magmas, these values are comparable to those calculated for amphibole ($\sim 10^{-11}$ - 10^{-9} bar, fig. 35c).

7. Age determinations

7.1 Previous work

A few ages are available for the Cenozoic subduction-related igneous rocks cropping out in Sardinia; many of them were performed with K-Ar technique (Coulon et al., 1974; Montigny et al., 1981; Beccaluva et al., 1985 and references therein; Lecca et al., 1997) and limited the orogenic magmatic activity between about 32 and 14 Ma. The K-Ar technique has disadvantages because the results are very sensitive to the excess of ^{40}Ar and to the alteration processes that rocks suffered after their genesis (McDougall and Harrison, 1999).

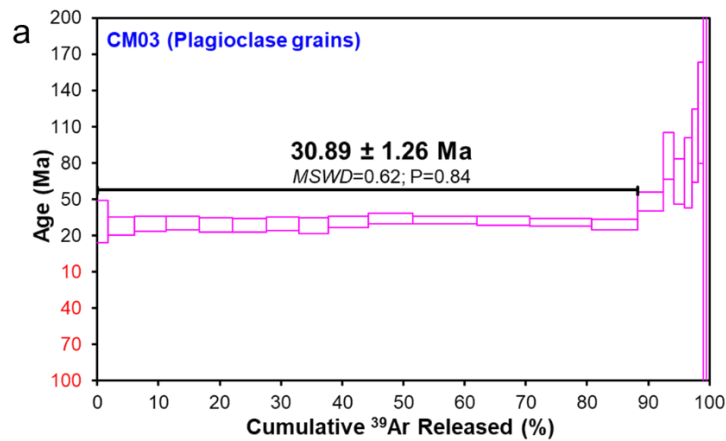
A few samples were dated with $^{40}\text{Ar}/^{39}\text{Ar}$ method obtaining ~20-18 Ma for Anglona district (Oudet et al., 2010), ~21-15 Ma for Bosa-Alghero (Deino et al., 2001; Gattacceca et al., 2007), ~18.6 Ma for Montresta, ~21-17 Ma for Arcuentu, ~19.6 Ma for Marmillla, ~38.3 Ma for Calabona and ~12.2 Ma for Cuguttada districts (Lustrino et al., 2009). Generally, these values are within the range defined by K-Ar ages for each district, except for the new ages obtained for Cuguttada and Calabona rocks which enlarged the range of the subduction-related magmatic activity from 32-14 Ma to 38-12 Ma.

New age determinations on the rocks of this study are necessary because Siliqua, Silixianu, Cixerri and Monastir lavas were dated with K-Ar method giving 29-27 Ma (Savelli, 1995; Lecca et al., 1997; Funedda et al., 2009), 29-26 Ma (Funedda et al., 2009), 21.5-13.5 Ma and 23-25 Ma (Savelli et al., 1979), respectively. This wide range of activity can be better constrained with the more precise method of $^{40}\text{Ar}/^{39}\text{Ar}$ dating on separated crystals. Moreover, the Monastir lava was dated also with $^{40}\text{Ar}/^{39}\text{Ar}$ method obtaining 27.3 ± 1.9 - 28 ± 1.3 Ma (Barca et al., 2005); this result differs from the previous obtained with K-Ar method underlining the already discussed limits of this technique.

7.2 This study

The results of $^{40}\text{Ar}/^{39}\text{Ar}$ dating are provided in Sup. Tab. 10.

Plagioclase and amphibole grains of an andesitic sample (SAR21) from Cixerri graben were analysed obtaining the same plateau ages within the error, that is always lower for the amphibole. Plagioclase separates yield an age of 21.52 ± 0.73 Ma with MSWD (Mean Standard Weighted deviation) = 1.62 and probability (P) = 0.10 (Fig. 36a), amphibole separates yield 21.31 ± 0.05 Ma with MSWD=1.01 and P=0.44 (Fig. 37a). The normal isochrons gave ages of 20.81 ± 2.39 Ma (MSWD=1.78, initial $^{40}\text{Ar}/^{36}\text{Ar}=302.2 \pm 11.8$; Fig. 36b) for plagioclase and 21.34 ± 0.07 Ma (MSWD=1.04, initial $^{40}\text{Ar}/^{36}\text{Ar}=297.9 \pm 1.3$; Fig. 37b) for amphibole. The ages provided by the inverse isochron are 20.85 ± 2.31 Ma (MSWD=1.72; initial $^{40}\text{Ar}/^{36}\text{Ar}=302.2 \pm 11.5$; Fig. 36c) and 21.34 ± 0.07 Ma (MSWD=1.05; initial $^{40}\text{Ar}/^{36}\text{Ar}=297.9 \pm 1.3$; Fig. 37c) for plagioclase and amphibole, respectively; so also the normal and inverse isochron ages are within the error. These results are coherent with the previous ages (21.5-13.5 Ma) obtained with K-Ar method (Savelli et al., 1979).



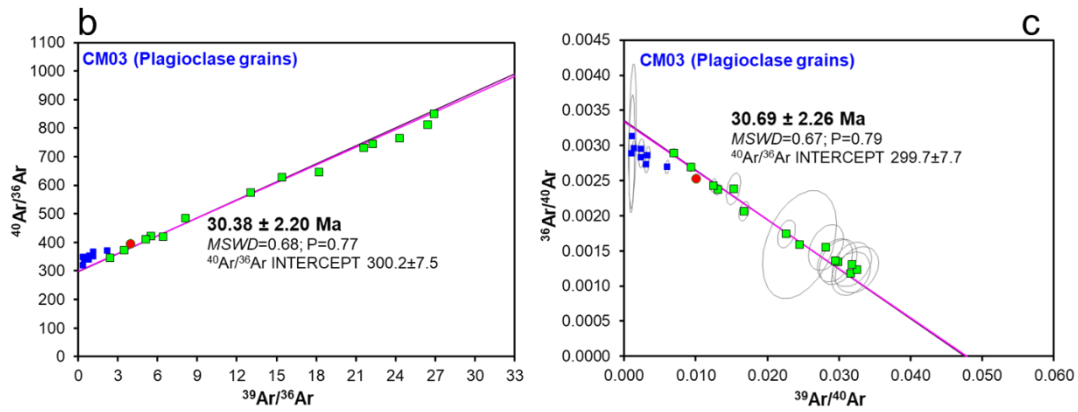


Figure 36 - a) Age plateau (including >70% ^{39}Ar released) with MSWD and P, black horizontal line indicating the steps considered in the age calculation. b) Normal isochron and c) inverse isochron with MSWD, P and $^{40}\text{Ar}/^{36}\text{Ar}$ intercept for plagioclase grains of SAR21 sample from Cixerri district.

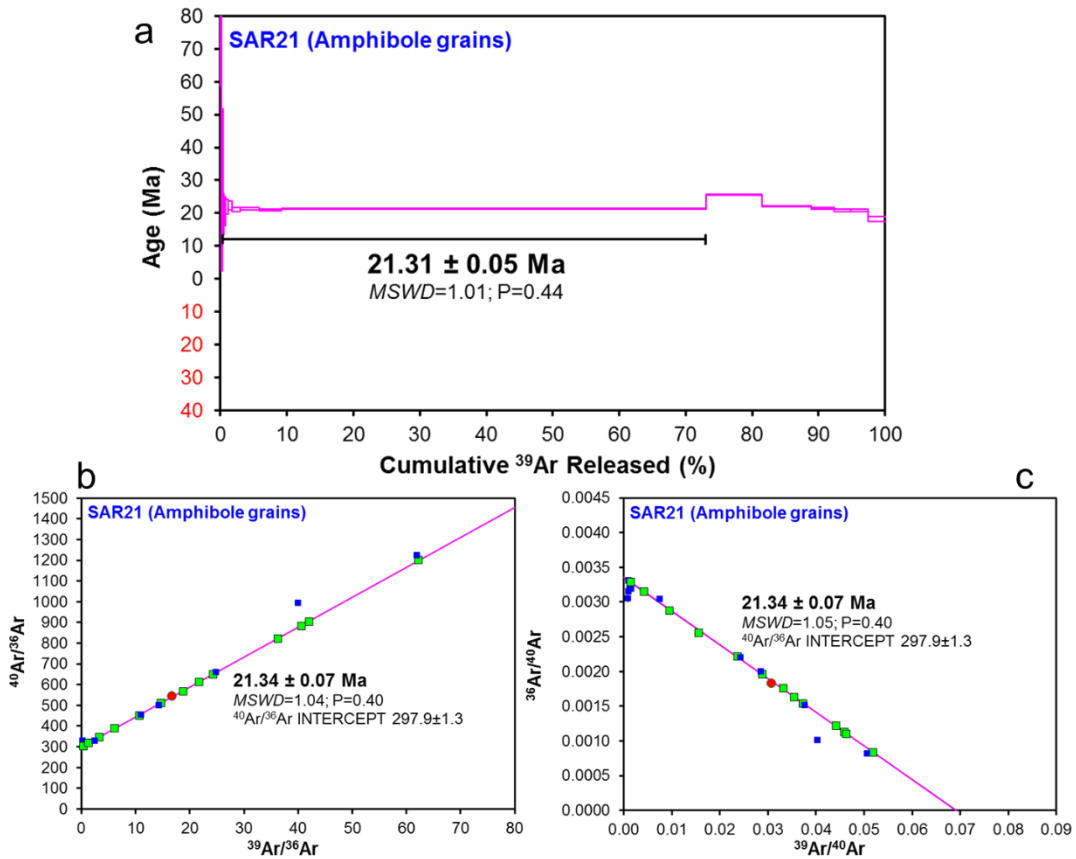


Figure 37 - a) Age plateau (including >70% ^{39}Ar released) with MSWD and P, black horizontal line indicating the steps considered in the age calculation. b) Normal isochron and c) inverse isochron with MSWD, P and $^{40}\text{Ar}/^{36}\text{Ar}$ intercept for amphibole grains of SAR21 sample from Cixerri district.

Plagioclase grains separated from Monastir basaltic andesite (CM03) yielded a plateau age with higher uncertainty: 30.89 ± 1.26 Ma (MSWD=0.62; P=0.84; Fig. 38a). The high uncertainty is due to the low amount of clean plagioclase grains (6.6 mg) that were analysed. The ages obtained by the

normal and the inverse isochron are coherent with the plateau age so the result is convincing: 30.38 ± 2.20 Ma (MSWD=0.68; initial $^{40}\text{Ar}/^{36}\text{Ar}=300.2 \pm 7.5$; Fig. 38b) and 30.69 ± 2.26 Ma (MSWD=0.67; initial $^{40}\text{Ar}/^{36}\text{Ar}=299.7 \pm 7.7$; Fig. 38c), respectively. This result is not concordant with the previous age determinations of Savelli et al. (1979) that will be not further considered and it is approximately within the error of 28 ± 1.3 Ma obtained by Barca et al. (2005).

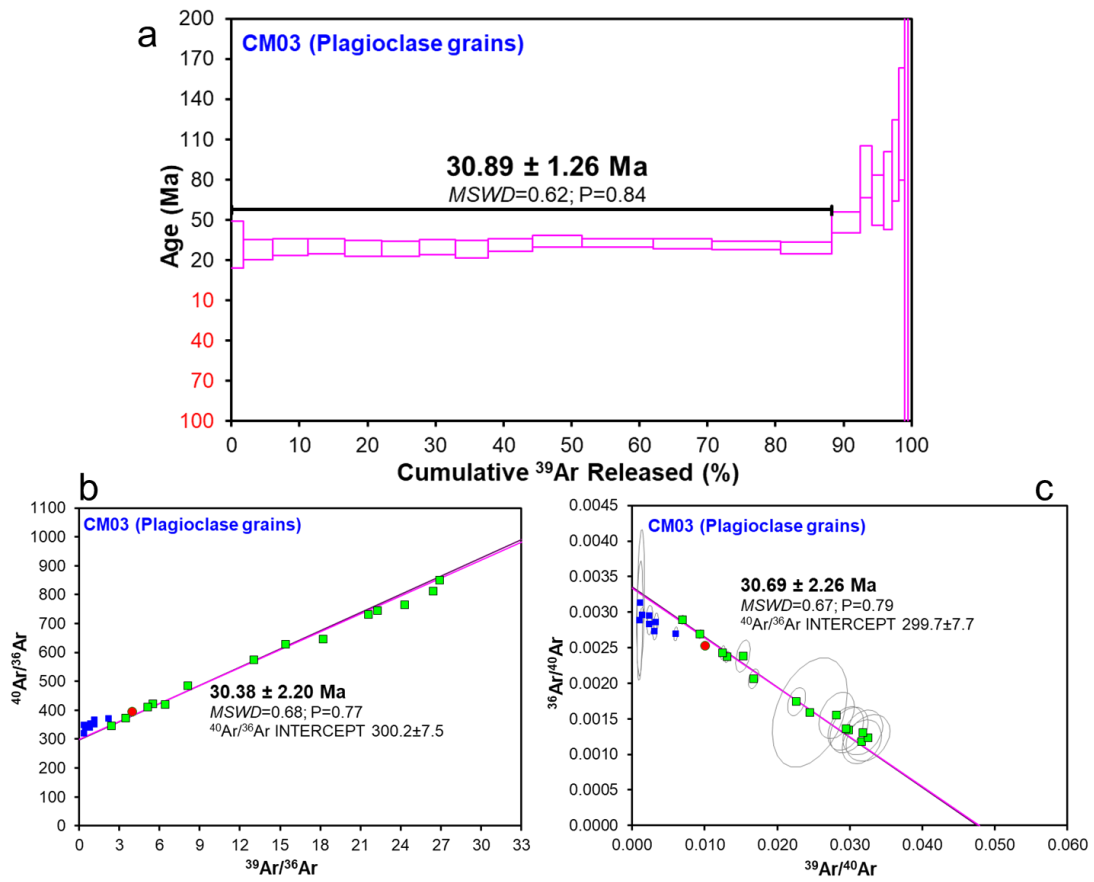


Figure 38 - a) Age plateau (including >70% ^{39}Ar released) with MSWD and P, black horizontal line indicating the steps considered in the age calculation. b) Normal isochron and c) inverse isochron with MSWD, P and $^{40}\text{Ar}/^{36}\text{Ar}$ intercept for plagioclase grains of CMO3 sample from Monastir district.

8. Isotopic composition

The Cixerri basaltic andesite and andesite show a narrow range of $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70707-0.70796) and $^{143}\text{Nd}/^{144}\text{Nd}$ (0.512345-0.512457). The measured values were recalculated at 21 Ma: $^{87}\text{Sr}/^{86}\text{Sr}_i=0.70701$ -0.70786 and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.512328$ -0.512436. Siliqua rocks, from basaltic andesite to dacite, have $^{87}\text{Sr}/^{86}\text{Sr}=0.70604$ -0.70694 and $^{143}\text{Nd}/^{144}\text{Nd}=0.512396$ -0.512501, and the measured values were recalculated at 28 Ma ($^{87}\text{Sr}/^{86}\text{Sr}_i=0.70599$ -0.70682 and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.512379$ -0.512482). The Monastir basaltic andesite is the sample of this study with the lowest $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70443) and the highest $^{143}\text{Nd}/^{144}\text{Nd}$ (0.512577), the measured values were recalculated at 31 Ma ($^{87}\text{Sr}/^{86}\text{Sr}_i=0.704340$ and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.512550$). The isotopic composition of Monte Nureci gabbros vary in a narrow range ($^{87}\text{Sr}/^{86}\text{Sr}=0.70889$ -0.70978 and $^{143}\text{Nd}/^{144}\text{Nd}=0.512283$ -0.512305), which overlaps the isotopic range of the overlying Arcuentu volcanic rocks (Sup. Tab. 11).

The literature data were used for comparison and were integrated with new $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ measurements on representative samples, with different silica content, from Arcuentu, Sindia and Sulcis districts (Sup. Tab. 11). The measured values were recalculated at 18, 21 and 18 Ma, respectively. The $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ measured in these samples fall in the range already known in literature, except for Sindia samples where $^{143}\text{Nd}/^{144}\text{Nd}$ had never been measured before.

Considering new and literature data, the Arcuentu samples show the widest variation range for $^{87}\text{Sr}/^{86}\text{Sr}_i$ (0.70538-0.71127) and $^{143}\text{Nd}/^{144}\text{Nd}_i$ (0.512172-0.51268). The recalculated values are $^{87}\text{Sr}/^{86}\text{Sr}_i=0.704801$ -0.70692 and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.51251$ -0.512594 for Sindia samples, $^{87}\text{Sr}/^{86}\text{Sr}_{17-21}=0.70440$ -0.70858 and $^{143}\text{Nd}/^{144}\text{Nd}_{17-21}=0.51234$ -0.512411 for Sulcis rocks, $^{87}\text{Sr}/^{86}\text{Sr}_{16-21}=0.70611$ -0.70878 and $^{143}\text{Nd}/^{144}\text{Nd}_{16-21}=0.51228$ -0.512511 for North Sardinia rocks, $^{87}\text{Sr}/^{86}\text{Sr}_{18}=0.70398$ -0.70592 and $^{143}\text{Nd}/^{144}\text{Nd}_{18}=0.51269$ -0.51271 for Montresta rocks, $^{87}\text{Sr}/^{86}\text{Sr}_{19,6}=0.70552$ and $^{143}\text{Nd}/^{144}\text{Nd}_{19,6}=0.512683$ for Capo Frasca basalt, $^{87}\text{Sr}/^{86}\text{Sr}_{19,6}=0.70670$ -

0.70884 and $^{143}\text{Nd}/^{144}\text{Nd}_{19.6}=0.512289\text{--}0.512484$ for Marmilla rocks, $^{87}\text{Sr}/^{86}\text{Sr}_{21}=0.70603\text{--}0.70725$ and $^{87}\text{Sr}/^{86}\text{Sr}_{21}=0.70570\text{--}0.70795$ for Sarroch intrusive and effusive samples.

A positive correlation between $^{87}\text{Sr}/^{86}\text{Sr}_i$ and SiO_2 can be observed in the rocks of the various districts (Fig. 39a). There is the positive trend, although with more scattered points, also when Zr concentration is used as differentiation index (Fig. 39b), except for the highly evolved dacites and rhyolites of North Sardinia where Zr concentrations decrease with silica increase. The Arcuentu rocks show the largest isotopic variation at $\text{SiO}_2 \approx 51\text{--}58$ wt.%, with the exception of an outlier: a dacitic lava from Monte Arcuentu (Downes et al., 2001) has higher silica concentration (63 wt.%) than other samples with the same $^{87}\text{Sr}/^{86}\text{Sr}_i$. The Arcuentu andesites show the highest $^{87}\text{Sr}/^{86}\text{Sr}_i$ and the lowest $^{143}\text{Nd}/^{144}\text{Nd}_i$, also compared to the rocks with $\text{SiO}_2 > 65$ wt.% from North Sardinia (Fig. 39-40).

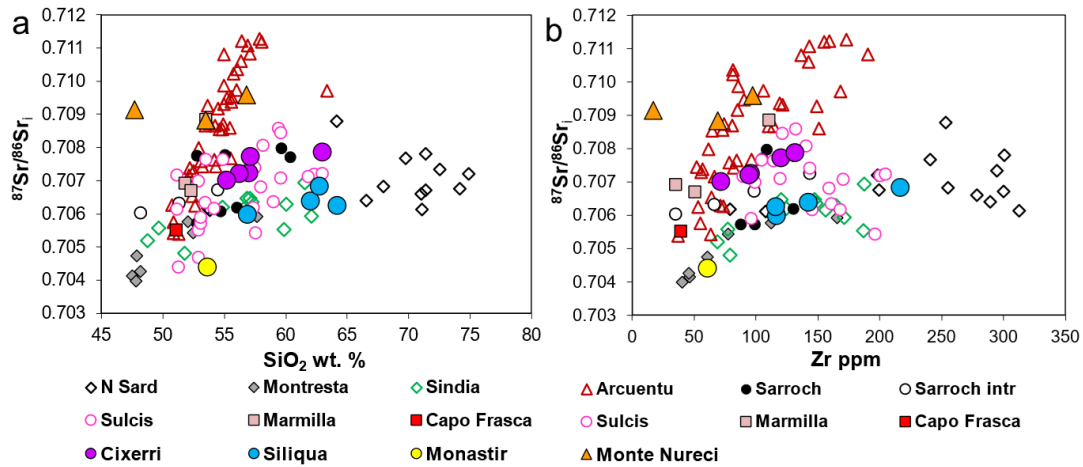


Figure 39 - a) SiO_2 (wt.%) vs $^{87}\text{Sr}/^{86}\text{Sr}_i$ diagram and b) Zr (ppm) vs $^{87}\text{Sr}/^{86}\text{Sr}_i$ for studied rocks (Cixerri, Siliqua, Monastir, Monte Nureci, Arcuentu, Sindia and Sulcis) integrated with literature data: North Sardinia (Lustrino et al., 2013), Montresta (Morra et al., 1997; Franciosi et al., 2003), Sindia (Lonis et al., 1997), Arcuentu (Downes et al., 2001; Franciosi et al., 2003; Lustrino et al., 2009, 2013), Sarroch and Sarroch intrusive (Conte, 1997), Sulcis (Morra et al., 1994; Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011; Lustrino et al., 2013; Gisbert et al., 2019), Marmilla and Capo Frasca (Lustrino et al., 2009, 2013).

The least evolved rocks in Sardinia crop out in Montresta district, they are High Magnesium Basalts (HMB) with $\text{SiO}_2 \approx 48$ wt.%, the lowest $^{87}\text{Sr}/^{86}\text{Sr}_i$ and the highest $^{143}\text{Nd}/^{144}\text{Nd}_i$, similar to the Bulk Earth. The Monastir basaltic andesite has similar $^{87}\text{Sr}/^{86}\text{Sr}_i$ and lower $^{143}\text{Nd}/^{144}\text{Nd}_i$. In the $^{87}\text{Sr}/^{86}\text{Sr}_i$ vs

$^{143}\text{Nd}/^{144}\text{Nd}_i$ diagram (Fig. 40) the rocks of different districts show an overall negative trend. The rocks, except for Montresta and Capo Frasca samples, have $^{87}\text{Sr}/^{86}\text{Sr}$ higher than the Bulk Earth and $^{143}\text{Nd}/^{144}\text{Nd}$ lower than the Bulk Earth.

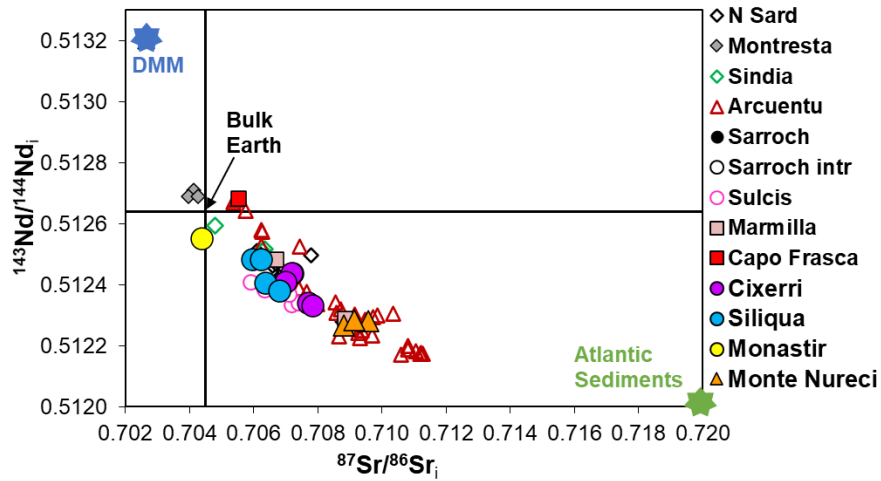


Figure 40 - $^{87}\text{Sr}/^{86}\text{Sr}_i$ vs $^{143}\text{Nd}/^{144}\text{Nd}_i$ diagram for the studied rocks (Cixerri, Siliqua, Monastir, Monte Nureci, Arcuentu, Sindia and Sulcis) integrated with literature data. DMM (Depleted MORB Mantle) and Atlantic sediments (Downes et al., 2001 and references therein), other references as in fig. 39.

9. Discussion

The rocks of the various Sardinian districts vary in composition from basalts to rhyolites (Fig. 9) and show calcalkaline and high-K calcalkaline affinity (Fig. 11). They belong to the subduction-related magmatic activity developed during the Eo-Miocene period in Sardinia (Lustrino et al., 2009), as highlighted by the Pb peak and the Ti-Nb-Ta troughs in the multi-element diagram normalized to the primitive mantle and to N-MORB (Fig. 33). The rocks of this study (Cixerri, Siliqua, Monastir, Punta Su Silixianu and Monte Nureci districts) vary in composition from basaltic andesites to dacites, except for the intrusive gabbro-norites of Monte Nureci.

Generally, the effusive rocks have porphyritic texture with plagioclase, amphibole and minor clinopyroxene phenocrysts included in a micro- to cryptocrystalline groundmass composed by the same mineral phases plus alkali feldspar and quartz. Opaque oxides are found always in the phenocrysts and in the groundmass because they start to crystallize early, this feature is typical of magmas with calcalkaline affinity. The sequence of crystallization is opaque oxides → plagioclase ± clinopyroxene → amphibole ± mica → alkali feldspar/ quartz. Plagioclase phenocrysts show normal, reverse or oscillatory zoning (Fig. 20) and sometimes sieve texture (Fig. 12, SAR12). The plagioclase composition depends on the variations of temperature, pressure, melt composition and H₂O concentration: the decrease of anorthite content from the core to the rim (normal zoning) of the phenocrysts is controlled by the evolution of the magma during the crystallization, the reverse zoning can be related to the increase of H₂O concentration or to the pressure decrease (Bennett et al., 2019). These changes may be caused by magma recharge/mixing or decompression. These phenomena could also explain the altered rims of amphibole phenocrysts, its growth at the expense of clinopyroxene and the presence of phenocrysts not in equilibrium with the host rock (Fig. 18b-22b-26). The occurrence of plagioclase with patchy zoning is observed also in Sarroch and Sindia rocks, where its presence seems to be

due to the magma mixing (Conte, 1997) and to the T and P_{H_2O} variation in the zoned magma reservoir (Lonis et al., 1997), respectively.

The rocks of the various Sardinian districts have major- and trace-elements compositional trends in the Harker diagrams (Fig. 31-32) due to the evolution driven by the fractional crystallization of common phases observed in thin sections like olivine, plagioclase, clinopyroxene and magnetite. Their fractional crystallization causes the decrease of MgO, Ni, Al_2O_3 , CaO, Sr, Fe_2O_{3tot} , TiO_2 , V, Zn, concentration. The decrease of Cr concentration is related to Cr-spinel and Cr-magnetite fractionation. The increase of trace elements like Zr, Y, La during magma evolution is due to their high incompatibility with the crystallizing phases, Zr and Y concentrations start to decrease when zircon fractionates in north Sardinia rhyolites. The different behavior of Y and La between the Sardinian districts can be related to the amphibole fractionation: their concentrations remain constant in Cixerri rocks where they are removed from the melt during amphibole fractionation, but Y and La are incompatible with the fractionating phases in other districts, where amphibole is rare. The Dy/Yb decrease in Cixerri rocks (Fig. 41) also suggests the amphibole fractionation because Dy is generally more compatible with amphibole than Yb (Davidson et al., 2007a,b, 2008).

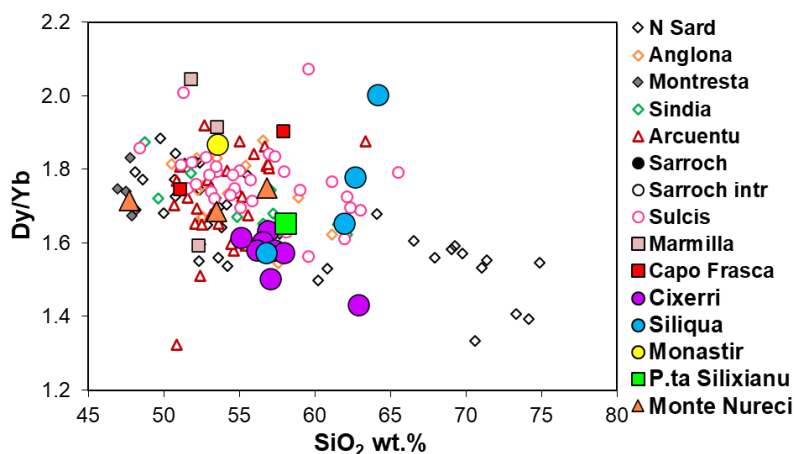


Figure 41 - SiO_2 vs Dy/Yb diagram for the rocks of this study (Cixerri, Siliqua, Monastir, Punta Su Silixianu, Monte Nureci) and literature data. References as in fig. 9.

The lower HREE (Heavy Rare Earth Element) content in the most primitive rocks of the Sardinian districts compared to various compositions of

Atlantic N-MORB (Normal-Mid Oceanic Ridge Basalts), points to a depleted N-MORB-like source metasomatized by the fluids of a subducting slab that gave the typical subduction-related patterns to the rocks in the primitive mantle-normalized multi-element diagram (Fig. 33). The fluids were rich in mobile elements like Rb, Ba, Pb, Sr and poor in immobile HFSE (High Field Strength Element) like Zr, Nb, Ta, Ti. This is confirmed also by the Nb/Yb vs. Th/Yb diagram, where the rocks of the various Sardinian districts fall in the Arc array field (Fig. 42a). Furthermore, the flat HREE patterns, in the chondrite-normalized REE diagram (Fig. 34), suggest a source in the spinel stability field in the mantle. Further investigation about magma sources were hampered due to the lack of primitive samples representative of the magma source, as indicated by the low Cr and Ni concentrations in the studied rocks. Few samples with primitive features crop out in Montresta and Arcuentu districts and have been already studied (e.g. Morra et al., 1997; Downes et al., 2001; Franciosi et al., 2003; Lustrino et al., 2013); their magma sources were identified in the mantle as a N-MORB-like source variably enriched by slab fluids and low amount of sediment fluids (<0.1%).

The rocks with the same evolution degree of the various districts were compared, observing different trace element concentrations. The Cixerri basaltic andesites have lower Sc and V contents than those from Capo Frasca, Sulcis and Arcuentu. The concentrations of Rb, Sr, Y and Nd in the Cixerri rocks are lower than those from Siliqua, Sulcis and Sindia districts. Sr concentration is particularly low in Arcuentu, Capo Frasca and Marmilla rocks (<350 ppm). The Siliqua rocks have higher Nb, Ba, La, Ce, Nd, Eu, Pb, Th and U concentrations than rocks with the same silica content from Cixerri district. The observed differences in trace element contents indicate diverse primitive magmas compositions, that could be related to different sources and/or various enrichment of the depleted source by the slab fluids and/or different partial melting degrees of the mantle source. The fluids flux from the slab to the mantle wedge is highly variable in the same volcanic arc affecting

the degree of partial melting, the volatile concentration and the magma composition (Zellmer et al., 2015; Francalanci and Zellmer, 2019). A higher fluid flux can explain the enrichment of Siliqua magmas in mobile elements like Sr, Ba and Pb and the highest H₂O content (up to 10 wt.%) in Cixerri, Siliqua and Monastir magmas that induced significant amphibole crystallization.

Low Th/Yb, Sr/Y, (La/Yb)_N and (La/Sm)_N in the basalts point to a limited input of the subducted sediments in the mantle (Auwera et al., 2021). Sr/Y show negative correlation with silica content (Fig. 42b), (La/Yb)_N and (La/Sm)_N are positively correlated with silica (Fig. 42c-d); these correlations indicate that the trace elements ratios are controlled by magma evolution for fractional crystallization; the higher ratios in the Siliqua rocks suggest that the input of subducted sediments in Siliqua magmas was more relevant. This is also confirmed by the higher Pb content in the Siliqua rocks.

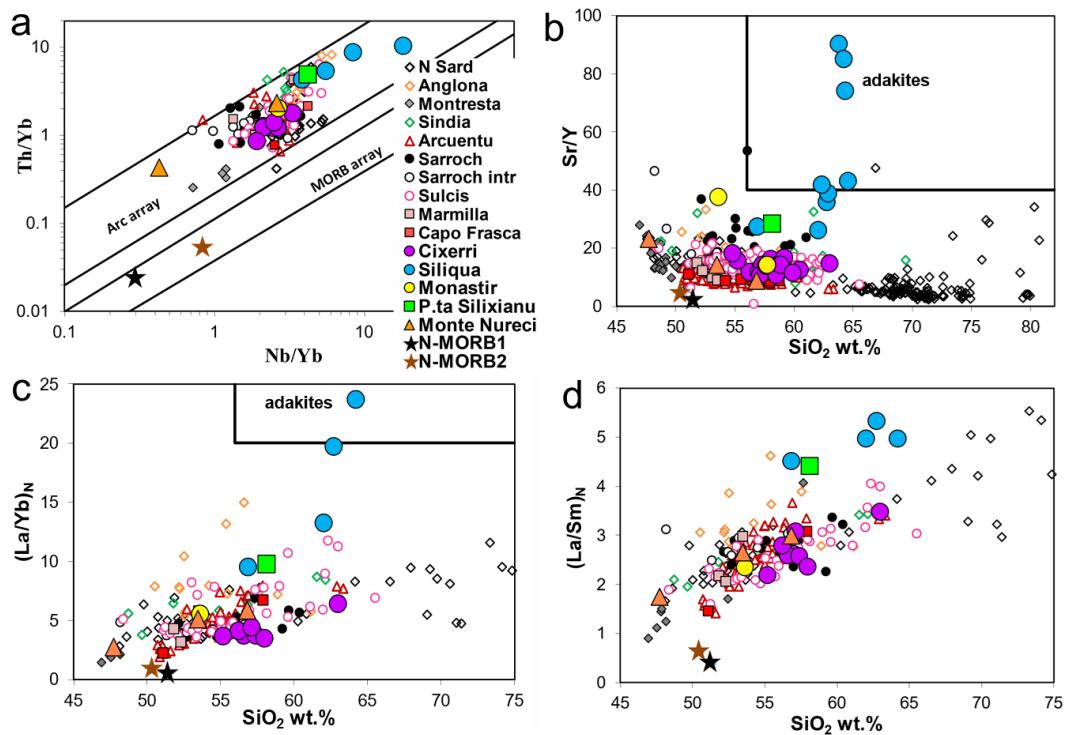


Figure 42 - a) Nb/Yb vs Th/Yb with MORB and Arc array from Pearce et al. (1995) b) SiO₂ vs Sr/Y, c) SiO₂ vs (La/Yb)_N, d) SiO₂ vs (La/Sm)_N diagrams for the studied rocks (Cixerri, Siliqua, Monastir, Punta Su Silixianu, Monte Nureci), the literature data and N-MORB1,2 (Arevalo and McDonough, 2008). _N=normalized to the chondrite (Anders and Grevesse, 1989). References as in Fig. 9. The adakites field is taken from Defant and Drummond (1990) and Moyen (2009).

The range of $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$, in the rocks of the same district and of different districts, cannot be related to variable degrees of partial melting of the source or to the evolution degree of the magma. The $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ change in the same district when the magma evolution takes place in an open system and the magma suffers crustal assimilation. The positive correlation of $^{87}\text{Sr}/^{86}\text{Sr}$ with various indexes of chemical differentiation (Fig. 39a-b) point to AFC (Assimilation + Fractional Crystallization) processes. The Arcuentu rocks have a marked increase in the Sr-isotopes with changing degree of magmatic evolution, suggesting a higher degree of crustal contamination.

The $^{87}\text{Sr}/^{86}\text{Sr}_i$ vs $^{143}\text{Nd}/^{144}\text{Nd}_i$ diagram (Fig. 40) of the rocks of various districts highlights the following features: a) the Cixerri rocks have higher $^{87}\text{Sr}/^{86}\text{Sr}_i$ and lower $^{143}\text{Nd}/^{144}\text{Nd}_i$ than Siliqua samples, it can be due to the isotopically different magma sources or to different degrees of crustal assimilation; their roughly parallel trends suggest that, although with slightly different degrees of assimilation, the primitive magmas were isotopically different; b) the basaltic andesite of Monastir have the same $^{87}\text{Sr}/^{86}\text{Sr}_i$ and lower $^{143}\text{Nd}/^{144}\text{Nd}_i$ than the Montresta High Magnesium Basalts (HMBs) pointing to different magma sources and mantle heterogeneity under Sardinia.

The Montresta HMBs have lower $^{143}\text{Nd}/^{144}\text{Nd}_i$ and higher $^{87}\text{Sr}/^{86}\text{Sr}_i$ than the DMM (Depleted MORB Mantle) suggesting a less depleted source. Franciosi et al. (2003) calculated that the DMM mantle wedge was enriched by 0.5% of MORB (Mid Oceanic Ridge Basalt) fluids and less than 0.1% of sediment fluids. The isotopic composition of the magma sources cannot be fruitfully modelled in other districts for the lack of primitive samples. The rocks plot between the DMM-like source and the Atlantic sediments in the $^{87}\text{Sr}/^{86}\text{Sr}_i$ vs $^{143}\text{Nd}/^{144}\text{Nd}_i$ diagram; this trend can be related to the assimilation during the magma evolution of material isotopically similar to the Atlantic sediments.

9.1 Cixerri district

The domes cropping out in the westernmost part of the Cixerri half-graben vary in composition from basaltic andesite to andesite (Serra Areni and Punta Perdu Antiogu), except for Monte Limpiu samples that are andesites. The domes are porphyritic with zoned plagioclase, amphibole and minor clinopyroxene phenocrysts. Plagioclase varies in composition from anorthite to andesine plus rare albite, alkali feldspar occurs in the groundmass (Fig. 19). Clinopyroxene is diopside and augite (Fig. 22a). Amphibole is calcic and is classified as tschermakite, magnesio-hornblende, magnesio-hastingsite, rare ferro-hornblende, ferro-actinolite and pargasite (Leake et al., 1997) (Fig. 25). Cixerri rocks contain magnetite and minor ilmenite (Fig. 28).

The presence of clinopyroxene cores in amphibole phenocrysts (Fig. 12, SAR17) indicate that the last crystallized at the expense of clinopyroxene when the H₂O concentration increased; it is found also in other calcalkaline rocks worldwide (e.g. Methana, Aegean Arc; Schoenhofen et al., 2020).

The mass balance calculation from the least evolved to the most evolved sample shows that the transition from the basaltic andesite to the andesite took place with 46% of fractional crystallization of plagioclase, amphibole, orthopyroxene and magnetite (Fig. 43). The removed assemblage was composed by the 42.8% of plagioclase and 34.5% of amphibole, indicating that they were the main mineral phases controlling the magmatic evolution for fractional crystallization in Cixerri district.

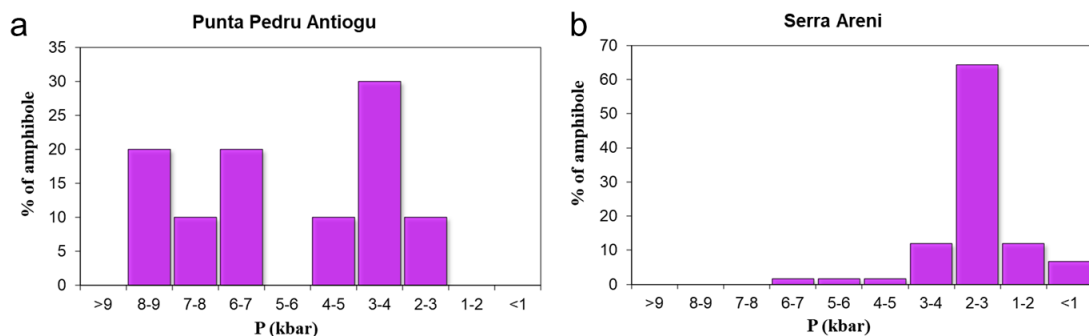
Sample	Initial Liquid		Final Liquid		Mineral phases			
	BA	A	SAR18	SAR12	pl	amph	opx	mag
SiO ₂	55.66	63.39	45.86	44.19	51.91	0.16		
TiO ₂	0.65	0.44			1.41	0.18	5.49	
Al ₂ O ₃	18.13	17.01	34.90	12.49	0.93	4.52		
FeO _{tot}	8.09	6.19	0.53	13.85	22.21	88.13		
MnO	0.16	0.16		0.05	0.52	0.82		
MgO	5.61	2.09		13.60	22.84	0.88		
CaO	8.78	6.28	16.97	12.00	1.12			
Na ₂ O	2.09	2.82	1.75	2.13	0.29			
K ₂ O	0.73	1.46		0.29				
P ₂ O ₅	0.12	0.16						
	100.00	100.00	100.00	100.00	100.00	100.00		

	Diff. Calc.	Deviation ²	pl	amph	opx	mag
SiO ₂	7.76	0.00	-19.58	-15.82	-10.20	-0.19
TiO ₂	-0.05	0.02				
Al ₂ O ₃	-1.12	0.00				
FeO _{tot}	-1.89	0.00				
MnO	0.01	0.00	% fractional crystallization			
MgO	-3.53	0.00		-45.79		
CaO	-2.46	0.00				
Na ₂ O	0.58	0.02				
K ₂ O	0.62	0.01				
P ₂ O ₅	0.07	0.00	Composition of removed assemblage			
			pl	amph	opx	mag
ΣR ²	0.06		42.77	34.54	22.28	0.41

Figure 43 - Mass balance calculation from a basaltic andesite to an andesite of Cixerri district. Abbreviations from Whitney and Evans (2010).

Different thermobarometers were applied obtaining higher temperature and pressure of crystallization and lower H₂O concentration for plagioclase (~1160°C, ~3.5 H₂O wt.%) and clinopyroxene (~1030°C, ~4.5 kbar) than for amphibole (~900°C, ~3.5 kbar, ~7.2 H₂O wt.%). These results are on average concordant with the observed sequence of crystallization, but not in each sample: in SAR17 and SAR11 the pressure of crystallization of amphibole is higher than clinopyroxene (Sup. Tab. 9). These results are due to the inaccurate estimation for the crystallization pressure of clinopyroxene because the barometers of Putirka (2008) and Nimis (1995) consider mineral and host rock composition and not the structure of the crystals. Tommasini et al. (2021) pointed out that the crystal structure and the cell volume of clinopyroxene depend upon the pressure, and not the temperature, of crystallization; they should be considered to obtain the correct pressure result.

Taking into account the crystallization pressure of amphibole, some lava domes show bimodal distribution: amphibole crystallized at 6-9 kbar (22-33 km in depth) and 2-4 kbar (7-15 km) in Punta Pedru Antiogu (Fig. 44a), 2-3 kbar (7-11 km) in Serra Areni (Fig. 44b), 7-8 kbar (26-30 km) and 2-5 kbar (7-18 km) in Monte Limpiu (Fig. 44c). The crystallization took place in polybaric feeding systems composed by more magmatic chambers at different depths in the continental crust. Serra Areni is characterized by the shallowest reservoir at 7-11 km.



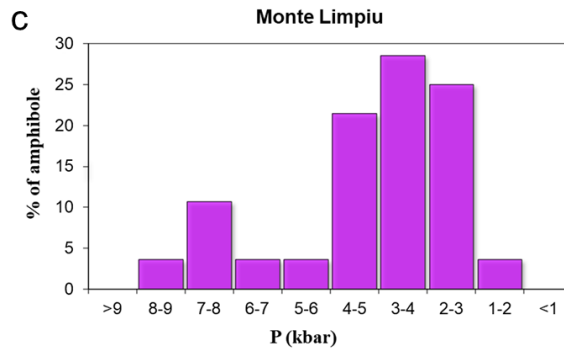


Figure 44 - Statistic distribution of amphibole crystallization pressure (kbar) in rocks of a) Punta Pedru Antiogu, b) Serra Areni and c) Monte Limpiu lava domes.

The age results (for separated plagioclase and amphibole grains) of 21 Ma of one andesite from Serra Areni lava dome (Fig. 36-37) confirm that these products are part of the subduction-related magmatic cycle that developed in Sardinia during the Eo-Miocene period, with a peak of activity at 21 Ma (Lustrino et al., 2009; Carminati et al., 2012).

The Cixerri basaltic andesites and andesites show a narrow range of $^{87}\text{Sr}/^{86}\text{Sr}_{21}$ (0.70701-0.70786) and $^{143}\text{Nd}/^{144}\text{Nd}_{21}$ (0.512328-0.512436). The $^{87}\text{Sr}/^{86}\text{Sr}_i$ is positively correlated with SiO_2 concentration (Fig. 39a) and negatively with $^{143}\text{Nd}/^{144}\text{Nd}_i$ (Fig. 40). The increase of $^{87}\text{Sr}/^{86}\text{Sr}_i$ during magma evolution (Fig. 39) is caused by AFC processes (Assimilation + Fractional Crystallization). The AFC was modelled applying the equations of DePaolo (1981) to quantify the degree of crustal assimilation. The model calculates how the Nd concentration and $^{143}\text{Nd}/^{144}\text{Nd}$ change during magma evolution with different degrees of crustal assimilation, expressed as r (r = assimilation rate/ crystallization rate). The AFC was modelled supposing two different contaminants: the Lower crust has $\text{Nd}=33.4$ ppm, $^{143}\text{Nd}/^{144}\text{Nd}=0.51198$ and represents the Hercynian Lower crust of Calabria (Caggianelli et al., 1991); the metabasalt of 490 Ma has $\text{Nd}=40.6$ ppm, $^{143}\text{Nd}/^{144}\text{Nd}=0.51188$ and represents the Sardinian bedrock (Gaggero et al., 2011).

It is necessary to know the total partition coefficient (D) of Nd to model its concentration in the melt during the AFC. The D_{Nd} was calculated with two different methods to find the most reliable result. The first method consists in

a mass balance with major elements from the least evolved to the most evolved rock that was performed to calculate the fractional crystallization, the fraction of residual magma ($f = 1 - \text{fraction of fractional crystallization}$) and the percentage of mineral phases that crystallize. Knowing the partition coefficient (K_d) of each element for the crystallizing phases and their abundances, the D is calculated as the weighted sum of every K_d . The Rayleigh law of fractional crystallization ($C_m/C^0 = f^{D-1}$) was applied: knowing f , D , and the element concentration in the least evolved magma (C^0), the concentration of the element in the evolved magma (C_m) can be calculated. The calculated C_m of the trace elements are compared to the trace elements composition of the most evolved rock to verify if the calculated D are correct. When the model fits with the real composition for Nd, its D can be used. Then the second method was applied: considering the element that increases more, from the least to the most evolved rock, as completely incompatible ($D=0$), the Rayleigh law of fractional crystallization is applied to find f ($f = C^0/C_m$) and after to find D_{Nd} .

In the Cixerri district, the calculated residual liquid fraction (hereafter f) from a basaltic andesite to an andesite are 0.54 with major elements mass balance and 0.55 considering Zr as the most incompatible trace element. The $D_{Nd}=0.29$ with the first method and $=0.31$ with the second one. These results are concordant, so $D_{Nd}=0.30$ was used for the AFC modeling. Supposing the Lower crust as contaminant the calculated r varies between 0.2 and 0.3 and $f=0.6$ (Fig. 45a), instead r is 0.1-0.2 and f is 0.6 when the metabasalt is the contaminant (Fig. 45b). In both hypothesis the f is concordant with those above calculated.

When the supposed contaminant is isotopically more different from the evolving magma, a lower degree of assimilation is necessary to change the isotopic composition of the magma. A lower r seems to be more reliable, because the $^{87}\text{Sr}/^{86}\text{Sr}_i$ variation during evolution is not wide. The Sardinian metabasalt of 490 Ma, or a rock with similar composition, could be the contaminant of Cixerri magmas.

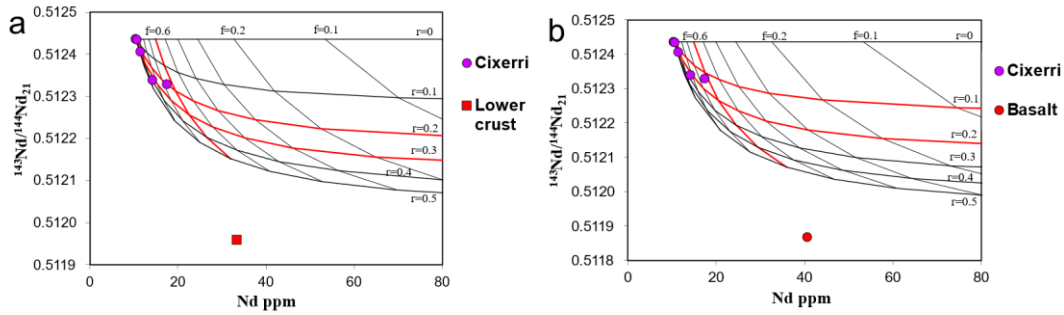


Figure 45 - Nd (ppm) vs. $^{143}\text{Nd}/^{144}\text{Nd}$; AFC models for Cixerri rocks considering a) Lower Crust (Caggianelli et al. 1991) and b) Metabasalt of 490 Ma (Gaggero et al. 2011) as contaminants.

9.2 Siliqua district

Two lava domes of Siliqua district, in the easternmost part of the Cixerri half-graben, have been studied: the Acquafredda dome varies in composition from basaltic andesite to dacite, the Monte Truxionis dome varies from andesite to dacite. They show the same petrographic features of the Cixerri lava domes with more abundant quartz phenocrysts (Fig. 13), clinopyroxene phenocrysts are present only in Monte Truxionis andesites. Mica is found in Monte Truxionis rocks, in Monte Nureci intrusive samples and in north Sardinia rhyolites and dacites (Fig. 27). Plagioclase varies in composition from bytownite to albite, with alkali feldspar in the groundmass and rarely as phenocrysts (Fig. 19). Clinopyroxene is diopside to augite with higher Mg# (up to 0.94) than in Cixerri rocks (Fig. 22). Amphibole is tschermakite, minor magnesio-hastingsite, rare magnesio-hornblende and pargasite (Fig. 25). Opaque oxides in Siliqua rocks are magnetite and rare ilmenite (Fig. 28).

The applied thermobarometers calculated higher crystallization temperature and pressure and lower H_2O concentration for plagioclase ($\sim 1080^\circ\text{C}$, ~ 4.5 wt.%), than for amphibole ($\sim 900^\circ\text{C}$, ~ 3.2 kbar, ~ 7.5 wt.%). Clinopyroxene thermobarometers provided no results because this phase is not in equilibrium with the host rock; its crystallization pressure is low, as highlighted by the low Al concentration and the absence of $^{\text{VI}}\text{Al}$. Amphibole in Acquafredda dacites crystallized at high temperature ($\sim 1030^\circ\text{C}$), pressure (~ 8

kbar; Fig. 46a) and H₂O concentration (~8.6 wt.%); whereas amphibole from Monte Truxionis rocks crystallized in shallow magmatic chamber at ~11-14 km of depth (~3 kbar; Fig. 46b).

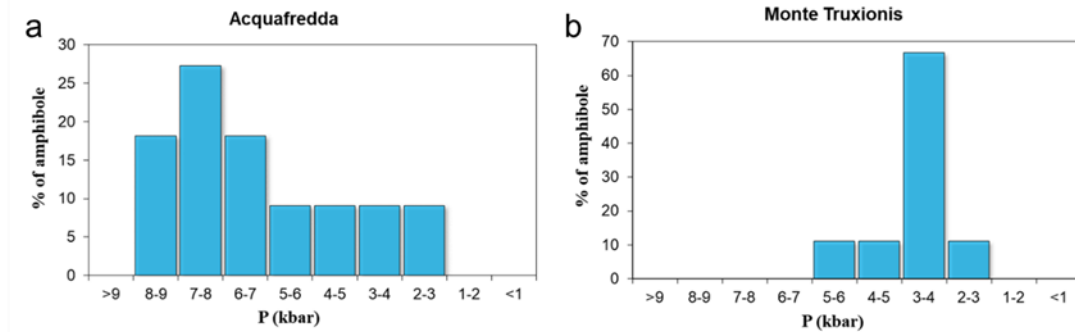


Figure 46 - Statistic distribution of amphibole crystallization pressure (kbar) in the rocks of a) Acquafredda, b) Monte Truxionis lava domes.

The Acquafredda dacites (ACQ1-ACQ2-ACQ3) show peculiar chemical composition compared to the other rocks of Siliqua and other Sardinian districts with the same degree of magmatic evolution, they plot outside of the trends depicted by the other samples in the Harker diagrams. Indeed, they have higher Na₂O (>3.5 wt.%), Sr (>1000 ppm), Nb (>15 ppm), Ba (>800 ppm), Pb (>40 ppm), U (>3 ppm) concentrations and Mg# (0.55-0.58) values. Also some trace elements ratios are higher: Sr/Y>70, (La/Yb)_N>20, (La/Sm)_N>5. Sr/Y variable between 40 and 100 and (La/Yb)_N>20 suggest an adakitic signature for the dacites; Sr/Y is generally lower than 80 in normal arc rocks (Moyen, 2009). Defant and Drummond (1990) defined the adakites as silicic rocks (mainly dacites) with SiO₂>56 wt.%, Al₂O₃>15 wt.%, MgO<3 wt.%, Y<18 ppm and Yb<1.9 ppm. Following Martin et al. (2005) classification, adakites are sodic with Na₂O>3.5 wt.% and K₂O/Na₂O≈0.4, Mg#≈0.5, Cr≈36 ppm and Ni≈24 ppm. The dacites of the Acquafredda lava dome have slightly higher K₂O/Na₂O (0.5-0.6) and Mg#, lower Cr (13-19 ppm) and Ni (9-13 ppm) concentrations than the values defined by Martin et al. (2005) for the adakites, but respect all the criteria of Defant and Drummond (1990) and Moyen (2009) classification (Fig. 31-32-42b-c). The Acquafredda dacites can be distinguished from the Acquafredda andesite and basaltic andesite and

Monte Truxionis andesites and dacite for their *adakitic* signature. Acquafredda dacites have relatively low concentrations in HREE ($\text{La}_N/\text{Yb}_N > 20$ and $\text{HREE} < 10$ times chondrite): in the chondrite-normalized REE diagram ACQ2 sample show the same pattern of an andesite of Monte Truxionis (MTR2), but two times less enriched in REE; its LREE concentration is the same of the Acquafredda basaltic andesite (SIL2) with lower HREE contents (Fig. 47). During fractional crystallization the melt is enriched in incompatible elements, with LREE (Light REE) typically more enriched than HREE (La_N/Yb_N increases with silica increase, Fig. 42c); therefore the Acquafredda dacites cannot be related to the Acquafredda basaltic andesite through fractional crystallization processes.

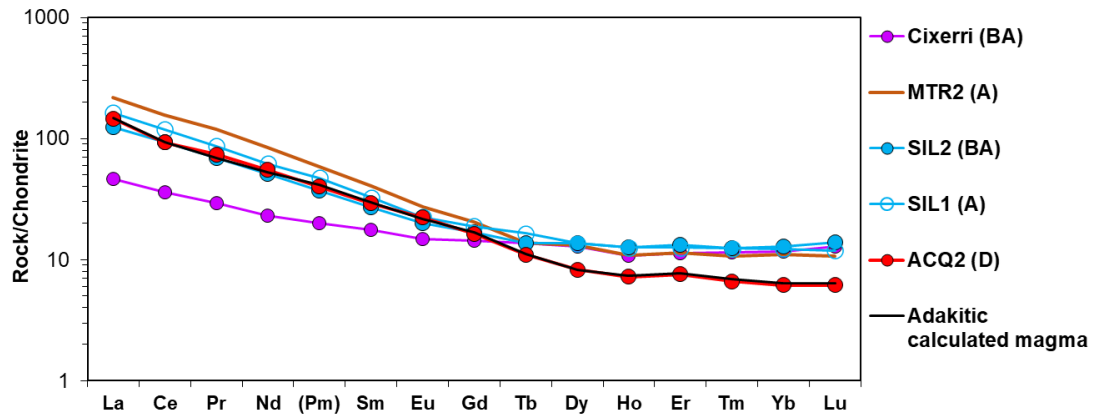


Figure 47 - Chondrite normalized (Anders and Grevesse, 1989) rare earth elements (REE) diagram for a basaltic andesite of Cixerri, an andesite of Monte Truxionis (MTR2), the basaltic andesite of Acquafredda (SIL2), the andesite of Acquafredda (SIL1), an adakitic dacite of Acquafredda (ACQ2) and the modelled magma source of adakites.

The worldwide occurrence of adakitic dacites associated with non-adakitic andesites in the same volcano has been explained through the evolution from the second to the first rock type by fractional crystallization or AFC processes (Richards and Kerrich, 2007). In this case the adakitic dacites have more potassic signature ($0.5 < \text{K}_2\text{O}/\text{Na}_2\text{O} < 1$), lower Mg# and Sr/Y. Non-adakitic andesites can evolve to adakitic dacites by amphibole fractionation which removes Y and HREE from the melt (Davidson et al., 2007a,b, 2008); amphibole fractionation produces also the decrease of Dy/Yb with silica increase, as observed in Cixerri rocks (Fig. 41). The Acquafredda dacites have

$K_2O/Na_2O > 0.4$, and relatively high Mg# and Sr/Y. The absence of negative correlation between silica and Dy/Yb in Acquafredda rocks rule out the hypothesis that *adakitic* dacites derive from andesites by amphibole removal.

Adakite formation in arc magmas is thought to be related to slab melting of hot and young subducted lithosphere (Defant and Drummond, 1990; Moyen, 2009). Sr-rich slab melts under the Aleutian volcanic arc interacted with the peridotitic mantle generating a magma with high Mg#, Cr, Ni and Sr concentrations (Kay, 1978; Myers and Frost, 1994; Yogodzinski et al., 1998). The HREE and Y depletion in the magma is related to the presence of amphibole or garnet as residual phases of the slab melting that hold back these elements. The slab melting under Sardinia can be excluded because the Cenozoic igneous activity is related to the NW-ward directed subduction of the ancient Tethys Ocean (Rollet et al., 2002; Carminati and Doglioni, 2004, and references therein). Furthermore, the slab melt would have caused an enrichment in the mantle wedge in incompatible elements such as Zr, not observed in Acquafredda *adakites*; actually, the Zr concentration is higher in Monte Truxionis andesites and dacite (Sup. Tab. 1).

Other authors rejected the theory of slab melting because the *adakites* are found also in subduction zones where the slab is older than 25 My (Macpherson et al., 2006). They explained the emplacement of *adakites* in the Philippines volcanic arc with two possible processes which took place at high pressure, where garnet (and amphibole) is stable: the fractional crystallization of a garnet-bearing assemblage from a basaltic arc magma or the garnet-bearing basaltic arc rock re-melting. The presence of garnet, or amphibole, in the assemblage or as residue of partial melting is necessary to produce the depletion of HREE and Y typical of *adakitic* magmas. The hypothesis that Acquafredda *adakites* are the products of fractional crystallization has been ruled out because the Dy/Yb variation is barely compatible with dominant amphibole fractionation. The *adakitic* signature is absent in the Cixerri rocks.

The Siliqua rocks have $^{87}\text{Sr}/^{86}\text{Sr}_i=0.70599-0.70682$ and $^{143}\text{Nd}/^{144}\text{Nd}_i=0.512379-0.512482$. They show positive correlation between SiO_2 and $^{87}\text{Sr}/^{86}\text{Sr}_i$, except for the ACQ2 sample, an *adakitic* dacite: it has the highest silica concentration, but the $^{87}\text{Sr}/^{86}\text{Sr}_i$ (0.70625) value is intermediate between those of the Acquafredda basaltic andesite (0.70599) and andesite (0.70638) (Sup. Tab. 11). The similar isotopic composition between the Acquafredda *adakite* and less evolved samples rule out the possibility that the *adakites* derive from the basaltic andesite by fractional crystallization and crustal assimilation. On the other hand, the isotopic similarities point to a common source; then, the *adakites* could be the product of re-melting, at high pressures, of an amphibole-bearing arc rock with isotopic composition like the basaltic andesite of Siliqua. The high crystallization pressure (6-9 kbar) calculated for amphibole in the *adakites* corroborates this hypothesis.

The genesis of Acquafredda *adakites* was modelled in two-steps process: 1) the andesite (SIL1) is the product of 28.8% of fractional crystallization from the basaltic andesite (SIL2) of plagioclase (46.1%), orthopyroxene (25.4%), amphibole (23.5%) and magnetite (5%), the transition was calculated with the major elements mass balance (Fig. 48); 2) a low degree of re-melting ($f=20\%$) of the removed assemblage was modelled applying the modal batch melting equation ($C_l=C_o/D+f^{1-D}$), starting from the REE composition of SIL2 (C_o), the REE composition of the magma (C_l) was obtained with total partition coefficients ($D_{La}=0.8$, $D_{Ce}=0.95$, $D_{Pr}=0.9$, $D_{Nd}=0.9$, $D_{Sm}=0.9$, $D_{Eu}=1.1$, $D_{Gd}=1$, $D_{Tb}=1.3$, $D_{Dy}=1.8$, $D_{Ho}=1.9$, $D_{Er}=1.9$, $D_{Tm}=2$, $D_{Yb}=2.3$, $D_{Lu}=2.5$) values similar to the K_d (partition coefficient) of the REE for the amphibole because it is the main phase retaining the REEs during the melting process. The match between the modelled magma and the *adakite* (ACQ2) REE patterns (Fig. 47) confirms that Acquafredda *adakites* could derive from re-melting of an amphibole-bearing intrusive arc rock, which retained HREE, represented by the removed assemblage by the basaltic andesite-andesite transition.

Sample	Initial Liquid		Final Liquid		Mineral phases			
	BA	SIL2	A	SIL1	pl	opx	amph	mag
SiO ₂	57.31	62.39	45.54	51.43	43.58	1.11		
TiO ₂	0.55	0.49	0.39	1.67	6.30			
Al ₂ O ₃	18.06	17.38	34.50	4.16	11.58	1.76		
FeO _{tot}	7.56	5.49	0.35	15.05	16.89	88.69		
MnO	0.24	0.15	0.09	0.43	1.27			
MgO	4.56	2.42		27.47	12.19	0.54		
CaO	7.80	6.08	18.53	1.35	11.44	0.32		
Na ₂ O	2.34	3.49	1.07	0.05	1.62			
K ₂ O	1.35	1.89			0.59			
P ₂ O ₅	0.23	0.23						
	100.00	100.00	100.00	100.00	100.00	100.00		

	Diff. Calc.	Deviation ²	pl	opx	amph	mag
SiO ₂	5.20	0.02	-13.30	-7.34	-6.77	-1.44
TiO ₂	-0.09	0.00				
Al ₂ O ₃	-0.69	0.00				
FeO _{tot}	-1.99	0.01				
MnO	-0.01	0.01				
MgO	-2.15	0.00	% fractional crystallization			
CaO	-1.59	0.02				
Na ₂ O	0.75	0.16				
K ₂ O	0.50	0.00				
P ₂ O ₅	0.07	0.00	Composition of removed assemblage			
			pl	opx	amph	mag
	ΣR ²	0.21	46.10	25.46	23.46	4.98

Figure 48 - Mass balance calculation from the basaltic andesite to the andesite of Acquafredda lava dome (Siliqua district). Abbreviations from Whitney and Evans (2010).

The positive correlation of $^{87}\text{Sr}/^{86}\text{Sr}_i$ with silica content (Fig. 39a) indicates that the magmas evolved in open system through AFC processes. The AFC was modelled with the DePaolo (1981) equation supposing two possible contaminants (Lower crust and metabasalt) as for Cixerri rocks. The Monastir basaltic andesite was considered as the primitive magma of Siliqua rocks for its geographical proximity. The evolution from the Monastir basaltic andesite to the Siliqua andesite was modelled with mass balance calculation obtaining 0.35 as fraction of residual melt (f). The f calculated considering the most incompatible element (Nb) with $D=0$ is 0.26. The D_{Nd} , were calculated, as above explained for the Cixerri rocks, obtaining $D_{\text{Nd}}=0.34$ with the first method and $D_{\text{Nd}}=0.29$ with the second method. Then a $D_{\text{Nd}}=0.31$ was applied obtaining $r=0.1-0.2$ and $f<0.4$ with both the contaminants (Lower crust and Basalt, Fig. 49). The residual liquid fraction matches that calculated with the major oxide mass balance calculations. The low assimilation degree is due to the relatively high concentration of Sr and Nd of the Siliqua magmas, making them less susceptible to crustal contamination.

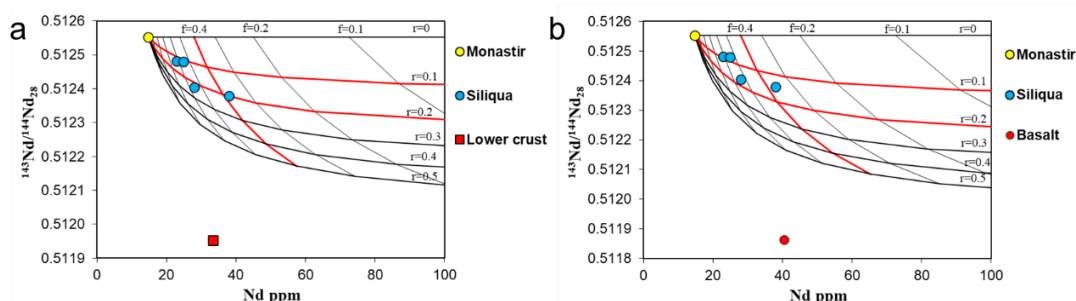


Figure 49 - Nd (ppm) vs. $^{143}\text{Nd}/^{144}\text{Nd}_i$: AFC models for Monastir and Siliqua rocks considering a) Lower Crust (Caggianelli et al. 1991) and b) Metabasalt of 490 Ma (Gaggero et al. 2011) as contaminants.

9.3 Monastir district

Three rocks from Monte Olandri quarry were analyzed: the andesitic lava, cut by the dyke classified as basaltic andesite, which includes a xenolith with monzodioritic composition which represents one of the bedrocks of this vent. The $^{40}\text{Ar}/^{39}\text{Ar}$ dating method applied on separated plagioclase grains of the basaltic andesite, provided an age of 30.89 ± 1.26 Ma (Fig. 38); the Monastir igneous products belong to the subduction-related magmatic activity that interested Sardinia between 38 and 12 Ma (Lustrino et al., 2009) and represent the first, less intense, period of activity.

The basaltic andesite and andesite show the same petrography of Cixerri and Siliqua rocks, but differ for the presence of orthopyroxene phenocrysts (Fig. 14). The basaltic andesite has also pigeonite in the groundmass, olivine relicts completely replaced by orthopyroxene; amphibole is absent. The observed sequence of crystallization is spinel/ olivine $\rightarrow$ orthopyroxene $\rightarrow$ plagioclase $\rightarrow$ clinopyroxene $\rightarrow$ pigeonite in the basaltic andesite, plagioclase/ opaque oxides $\rightarrow$ orthopyroxene/ amphibole $\rightarrow$ clinopyroxene/ quartz in the andesite. The plagioclase has compositional variation from bytownite to labradorite in the basaltic andesite, and from bytownite to oligoclase in the andesite. Augite occurs in the groundmass of the andesite; augite and diopside are the phenocrysts of the basaltic andesite. The occurrence of enstatite is common to the rocks of Capo Frasca and other Sardinian districts (Fig. 22a-24). Amphibole phenocrysts in Monastir andesite are unzoned and are magnesio-hastingsite and rare tschermakite (Fig. 25). The andesite contains magnetite and rare ilmenite as micro- and phenocrysts, as the andesites of Cixerri and Siliqua districts. There are Cr-magnetite, Al-magnetite and Cr-spinel in the basaltic andesite (Fig. 29), opaque oxides with these compositions are absent in the basaltic andesites of other districts and rare in less evolved rocks: there are Cr-spinel and Cr-magnetite in the Arcuentu

basalts, Al-magnetite in the Sulcis basalts and Cr-magnetite in the Montresta basalts.

The chemical composition of basaltic andesite and andesite is similar to the rocks of other districts with the same evolution degree, except for the higher Sr concentration in the basaltic andesite (>600 ppm).

The calculated crystallization pressure, temperature and H₂O concentration of the various mineral phases in the andesite (Sup. Tab. 9) broadly agree with the crystallization sequence observed in thin section: plagioclase crystallized at ~1185°C, followed by amphibole at ~1030°C and ~7.7 kbar, clinopyroxene at 1065°C and low pressure; clinopyroxene is never in equilibrium with orthopyroxene which crystallized only in the groundmass, when the magma was at lower pressure. In the basaltic andesite plagioclase crystallized at 1175°C, clinopyroxene at 1115°C and low pressure, followed by pigeonite in the groundmass at 1097°C. The magma H₂O concentration calculated with plagioclase, is lower in the basaltic andesite (2.8 wt.%) than in the andesite (3.4 wt.%), explaining the absence of amphibole in the basaltic andesite.

The $^{87}\text{Sr}/^{86}\text{Sr}_i$ (0.70440) of the Monastir basaltic andesite is lower than rocks with the same evolution degree from other districts, except for a few basaltic andesites from Sulcis, and is almost the same of the Montresta High Magnesium Basalts (HMBs), which are the most primitive rocks cropping out in the island. The $^{143}\text{Nd}/^{144}\text{Nd}_i$ (0.512550) is lower than Montresta HMBs and similar to some basaltic andesites from Arcuentu with higher $^{87}\text{Sr}/^{86}\text{Sr}_i$ (Fig. 40). The same $^{87}\text{Sr}/^{86}\text{Sr}_i$ of the primitive HMBs of Montresta that had not suffered crustal contamination, makes suppose that the assimilation was absent or negligible in Monastir basaltic andesite. Since the isotopic ratios of only one rock of Monastir are available, further consideration about crustal assimilation cannot be done. On the other hand, the different $^{143}\text{Nd}/^{144}\text{Nd}_i$ respect to the Montresta HMBs point to a isotopic heterogeneity of the mantle wedge under Sardinia.

9.4 Punta Su Silixianu district

The Punta Su Silixianu lava has andesitic composition. It crops out near Siliqua, but has been distinguished for its high alteration. It contains alteration phases like chlorite, epidote, pyrite and titanite. The zoned plagioclase phenocrysts show composition variable from bytownite to andesine, falling in the range of the plagioclase from Siliqua and other districts (Fig. 19). Considering the major and trace elements composition, it is similar to the andesites from Siliqua (Fig. 31-32), but with higher S concentration due to the abundance of pyrite.

9.5 Monte Nureci (Arcuentu) district

The Monte Nureci intrusive rocks are medium (MNU1) to coarse (MNU2-3) grained with holocrystalline inequigranular structure. They are classified, on the basis of their paragenesis and their chemical composition with the R1-R2 diagram (Fig. 10), as gabbronorite and olivine gabbronorites, respectively. The olivine gabbronorites are made up of euhedral to subhedral plagioclase, clinopyroxene, orthopyroxene, olivine and accessory amphibole, mica, apatite and opaque oxides. Pyroxene and olivine crystals generally occur as not zoned cumulus phases, Cr-spinel is sometimes included in olivine (Fig. 16). The gabbronorite contains also rare alkali feldspar, quartz and pigeonite, clinopyroxene and plagioclase with normal zoning, olivine is absent. The general sequence of crystallization is opaque oxides/ plagioclase → olivine → orthopyroxene/ clinopyroxene → amphibole/ mica ± alkali feldspar ± quartz.

The forsterite content in olivine varies between 74 and 78 mol.%, falling in the range of olivine (Fo=71-85 mol.%) in the Arcuentu basalts and basaltic andesites (Fig. 18a). The plagioclase is more calcic in the olivine gabbronorites (An₉₅₋₈₃) than in the gabbronorite where it varies from bytownite to andesine (Fig. 19), showing a wider compositional range than plagioclase (anorthite-labradorite; Fig. 21) in the Arcuentu rocks (from basalts

to andesites). Diopside and augite have higher Mg# in the olivine gabbronorites (0.79-0.91) than in the gabbronorite (0.63-0.89). The enstatite also shows higher Mg# values in the olivine gabbronorites (0.76-0.80) than in the gabbronorite (0.56-0.60). Arcuentu rocks contain enstatite, pigeonite and augite without diopside (Fig. 24). Mica belongs to the phlogopite-annite series and has higher Mg# in the olivine gabbronorites (0.70-0.74) than in the gabbronorite (0.65-0.67).

The olivine gabbronorites, especially the MNU3 sample, are constituted by the minerals with the highest Mg# and anorthite content suggesting that these phases fractionated by a magma with higher Mg#, that is a less evolved magma. The chemical analysis of mineral phases of MNU3 sample were used to model, with a mass balance calculation, the evolution for fractional crystallization from a basaltic andesite to an andesite of Arcuentu (Fig. 50). The low sum of squares of the residuals ($R^2=0.05$) point to a genetically link between the Monte Nureci intrusive rocks and the overlying lavas of the Arcuentu district. The Monte Nureci intrusive rocks thus derive by mineral accumulus from Arcuentu magmas. The transition from a basaltic andesite to an andesite is the result of 25.4% of fractional crystallization, with a fractionated assemblage made up of 40.1% plagioclase, 27.4% clinopyroxene, 22.4% orthopyroxene and 10.1% olivine; the relative abundance of the mineral phases in the assemblage broadly matches the modal abundances of the MNU3 sample.

Sample	Initial Liquid		Final Liquid		Mineral phases			
	BA AR181	A RL48			pl	cpx	opx	ol
SiO ₂	55.24	57.52	45.34	52.13	54.36	38.27		
TiO ₂	0.68	1.08		0.07	0.02			
Al ₂ O ₃	17.74	18.88	34.22	1.14	1.55			
FeO _{tot}	7.33	7.51	0.39	5.35	12.76	22.51		
MnO	0.15	0.15		0.46	0.46	0.43		
MgO	5.16	1.84		16.61	28.69	38.75		
CaO	9.98	8.52	17.96	23.98	1.95	0.04		
Na ₂ O	2.26	2.49	1.92	0.27	0.21			
K ₂ O	1.36	1.85	0.17					
P ₂ O ₅	0.09	0.16						
	100.00	100.00	100.00	100.00	100.00	100.00		

	Diff. Calc.	Deviation ²	pl	cpx	opx	ol
SiO ₂	2.29	0.00	-10.19	-6.96	-5.68	-2.56
TiO ₂	0.27	0.02				
Al ₂ O ₃	1.14	0.00				
FeO _{tot}	0.19	0.00				
MnO	-0.03	0.00	% fractional crystallization			
MgO	-3.31	0.00		-25.40		
CaO	-1.45	0.00				
Na ₂ O	0.41	0.03				
K ₂ O	0.45	0.00				
P ₂ O ₅	0.04	0.00	Composition of removed assemblage			
			pl	cpx	opx	ol
ΣR ²		0.05	40.13	27.41	22.37	10.09

Figure 50 - Mass balance calculation from a basaltic andesite to an andesite of Arcuentu (Brotzu et al., 1997b) removing the mineral phases of MNU3 sample. Abbreviations from Whitney and Evans (2010).

The only reliable results of thermobarometers for Monte Nureci minerals were calculated for orthopyroxene-clinopyroxene pairs in equilibrium (Putirka, 2008) obtaining $\sim 1020^{\circ}\text{C}$ and $\sim 1.3\text{-}3.5$ kbar of crystallization in the olivine gabbro-norites; these results are comparable to those obtained for pyroxenes pairs in equilibrium in the Arcuentu rocks: they crystallized at $\sim 1110^{\circ}\text{C}$ and ~ 3.8 kbar in the basalts, $\sim 1090^{\circ}\text{C}$ and ~ 2.6 kbar in the basaltic andesites confirming that the pyroxenes nucleated in a basaltic andesite melt.

The isotopic composition of Monte Nureci intrusive rocks varies in a narrow range ($^{87}\text{Sr}/^{86}\text{Sr}_{18}=0.70882\text{-}0.70959$ and $^{143}\text{Nd}/^{144}\text{Nd}_{18}=0.512265\text{-}0.512284$), which falls in the isotopic range of the Arcuentu effusive rocks. The Arcuentu lavas and dykes have wide variation range for $^{87}\text{Sr}/^{86}\text{Sr}_i$ ($0.70538\text{-}0.71127$) and $^{143}\text{Nd}/^{144}\text{Nd}_i$ ($0.512172\text{-}0.51268$), considering new and literature data. The isotopic composition of Monte Nureci rocks is like the Arcuentu basaltic andesites (Fig. 39-40), confirming that they are made up by mineral phases that were removed by magma with basaltic andesite composition.

The high variability of $^{87}\text{Sr}/^{86}\text{Sr}_i$ in the Arcuentu samples were explained by Downes et al. (2001) with a variable enrichment (2-10%) of the mantle source by subducted siliceous sediments which caused the silica increase. This enrichment should induce also different trace element concentrations (as higher Pb) and higher Th/Yb, Sr/Y, $(\text{La}/\text{Yb})_N$ and $(\text{La}/\text{Sm})_N$, as observed in Siliqua rocks. Moreover, the source enrichment does not explain the trends of major and trace elements observed in the Harker diagrams. Therefore, this theory has been excluded.

The strong increase of $^{87}\text{Sr}/^{86}\text{Sr}_i$ with a narrow range of silica increase in the Arcuentu samples was interpreted as the result of fractional crystallization of olivine, clinopyroxene and negligible amount of plagioclase in the lower crust, where the magma interacted with the crust (Kempton et al., 2018). The fractionation of olivine and clinopyroxene induced a slight silica increase

during the magma evolution; the heat of magmatic activity had “softened” the lower crust that was assimilated by the evolving magma.

The evolution of the Arcuentu magmas for AFC processes was modelled applying the equations of DePaolo (1981) to calculate the degree of assimilation (r), as explained for Cixerri rocks. The transition from a basalt to a dacite was calculated obtaining $f=0.20$ and $D_{Nd}=0.28$ with the first method, $f=0.16$ and $D_{Nd}=0.25$ with the second method described for Cixerri rocks. The f and D_{Nd} calculated with the two methods are concordant, thus the mean value of 0.27 for D_{Nd} was applied in the equations. Supposing the interaction with the Lower crust a high degree of assimilation ($r=0.4-0.6$) is necessary to reach the lowest $^{143}Nd/^{144}Nd_i$ values with the 50% of fractional crystallization (Fig. 51a); the assimilation of the metabasalt of 490Ma gave more reliable results ($r=0.2-0.4$ and $f<0.4$, Fig. 51b), also considering the f values above calculated.

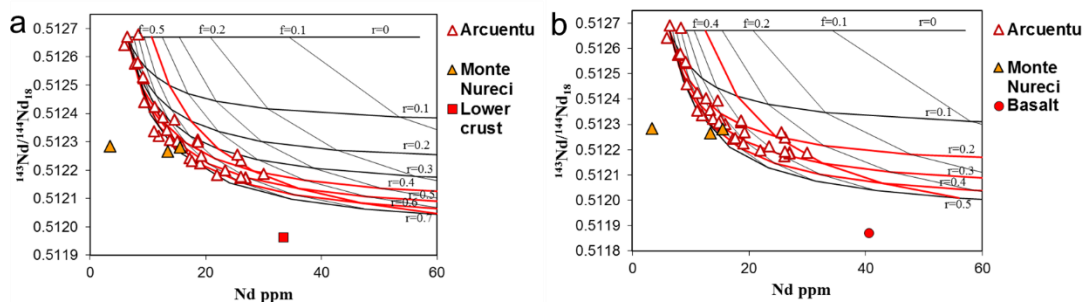


Figure 51 - Nd (ppm) vs. $^{143}Nd/^{144}Nd_i$: AFC models for Arcuentu rocks (from this study and Downes et al., 2001; Franciosi et al., 2003; Lustrino et al., 2013) considering a) Lower Crust (Caggianelli et al. 1991) and b) Metabasalt of 490 Ma (Gaggero et al. 2011) as contaminants.

Concluding remarks

The petrographic, geochemical and isotopic characterization of the studied igneous rocks, and their comparison with the literature data, allow to conclude that:

- the Cixerri, Siliqua, Monastir and Punta Su Silixianu rocks vary in composition from basaltic andesite to dacite; the Monte Nureci intrusive rocks are olivine gabbonorites and gabbronorite. They have calcalkaline affinity and the typical subduction-related patterns related to the N-NW directed Appennine-Maghrebide subduction system;

- the volcanic rocks of this area span a significant range of ages, also including the earliest stages of activity, as confirmed by the new $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations of a Cixerri andesite (~21 Ma) and of the Monastir basaltic andesite (~31 Ma);

- the Sardinian mafic magmas evolved for fractional crystallization of olivine, plagioclase, pyroxenes and magnetite in polybaric, open plumbing systems, as pointed out by the major- and trace elements trends of the rocks;

- amphibole was the main mafic phase removed by Cixerri magmas in the basaltic andesite-andesite transition;

- the abundance of amphibole in Cixerri and Siliqua rocks, differently from the rocks of the other Sardinian districts, is due to the high H_2O content (likely as high as 10 wt.%) in the magmas;

- the isotopic and mineral chemical composition of the Monte Nureci olivine gabbonorites indicate that they represent the complementary cumulate of the Arcuentu magmas in the basaltic andesite-andesite transition;

- oscillatory and reverse zoning of plagioclase and amphibole, sieve texture in plagioclase phenocrysts and amphibole growth at the expense of clinopyroxene are due to the magma recharge/mixing and/or to variations of pressure, temperature and H_2O content in the magma;

- the Acquafredda (Siliqua district) dacites have a remarkable *adakitic* signature, testified by the HREE and Y depletion. It could be the result of the remelting, at high pressure, of an amphibole-bearing intrusive arc rock formed by the removed assemblage during the transition from the Acquafredda basaltic andesite to andesite, compatible with Sr-Nd-isotopes and geochemical modelling;

- the isotopic variability of the studied samples is related to mantle wedge heterogeneity and to magma evolution mainly driven by fractional crystallization in open systems; crustal assimilation was lower in the Cixerri and Siliqua andesites ($r=0,1-0,2$) than in the Arcuentu rocks ($r=0,2-0,4$), suggesting independence of the feeder systems and parental magmas from depth;

- the lack of primitive samples in many districts hampers a detailed study of the magma sources; however, the lower concentration of HREE in the more primitive rocks than typical N-MORBs is likely due to the depleted signature of the mantle wedge prior to the enrichment by slab and sediment-derived fluids;

- the higher trace elements concentrations (e.g. Sr, Ba, Pb) and ratios (e.g. La/Sm) observed in the Siliqua rocks might be due to a higher sediment-derived fluid flux in the mantle source;

- the Cenozoic calcalkaline volcanism in Sardinia could not lead to the formation of significant economic ore deposits due to the low concentration of trace elements such as Cu and Zn in the igneous rocks.

Analytical techniques

Sample preparation and analysis took place in different laboratories of the “Dipartimento di Scienze della Terra, dell’Ambiente e delle Risorse” (DiSTAR, University of Naples Federico II, Italy), ActLabs (Canada) and University of Curtin in Perth (Australia).

Thin section preparation and study, chemical analysis of mineral phases

Sample preparation started in the DiSTAR laboratories with the cut of 43 rocks from different Sardinian districts, using a diamond blade circular saw to obtain small blocks. One block of each sample was used for thin section preparation, necessary to perform petrographic studies. The block was submitted to polishing cycles with progressively smaller knit disks (80, 180, 300 and 600 Mesh) to obtain a smooth surface. The polished face was glued to a glass plate with resin, then the block was reduced with a trimmer up to 30-60 μm of thickness. The last step was the thin section polishing with an alumina solution on the lapping machine.

Petrographic analysis on the thin sections were performed with the polarizing microscope, where mineral assemblages, textures and structures were recognized, and the sequences of crystallization reconstructed.

Chemical composition of mineral phases in representative thin sections from Cixerri, Siliqua, Monastir, Punta Su Silixianu, Capo Frasca and Monte Nureci (Arcuentu) districts were obtained with Oxford Instruments Microanalysis Unit (SEM-EDS) at DiSTAR laboratories. The Scanning Electron Microscope (SEM) can magnify the sample up to 100000x. The instrument consists of an accelerated electron beam that hits the sample surface causing the emission of back-scattered electrons, secondary electrons and characteristic X-rays (Middendorf et al., 2005). The process occurs when the sample is metallic, so no-metallic samples (thin sections) need to be

metalized with graphite or gold. The diffusion of electrons creates high resolution imaging (BSE image) of the sample surface. The emission of back-scattered electrons depends on the atomic number of the analysed sample: when the atomic number is higher, the image is brighter.

When the SEM is coupled with an X-ray detector based on Energy Dispersion System (EDS) also punctual chemical analysis of the minerals can be performed (Callebaut et al., 2001). The JEOL JSM-5310 microscope is equipped with an INCA X-act detector that operates at 15 kV primary beam voltage, 50-100 mA filament current, on variable spot size, with 50 s net acquisition time. An INCA X-stream pulse processor and an INCA Energy software are necessary for measures. The standards necessary for calibration are the following: diopside (Ca), San Carlos olivine (Mg), anorthoclase (Al, Si), albite (Na), rutile (Ti), fayalite (Fe), Cr₂O₃ (Cr), rhodonite (Mn), orthoclase (K), apatite (P), fluorite (F), barite (Ba), strontianite (Sr), zircon (Zr, Hf), synthetic Smithsonian orthophosphates (REE, Y, Sc), pure vanadium, niobium and tantalum (V, Nb, Ta), Corning glass (Th and U), sphalerite (S, Zn), sodium chloride (Cl), and pollucite (Cs). The results have 2% of precision.

Powder and disk pellets preparation

Other blocks of 40 samples were reduced in smaller fragments thanks to a chipmunk jaw crusher. The fragments were washed in deionized water, dried at ~100° C for one night. ~25g of fragments were selected avoiding hammer marks, saw cuts and alteration, to be pulverized in a low-blank agate mortar, in the “Preparazione Campioni” laboratory of DiSTAR, where four grams of the obtained powder were glued with MOWIOL (Polyvinyl alcohol) and dried at 100°C. The pellets were prepared putting the glued powder in an aluminium container over a layer of boric acid, then the container was pressed at 20 Ton/cm² for 20 seconds.

Bulk rock chemical analysis

The pressed pellets of this study and of literature rocks (North Sardinia, Montresta, Sindia, Arcuentu, Sulcis, Capo Frasca and Marmilla) were (re)analysed with XRF (X-Ray Fluorescence) in the “XRF” laboratory of the DiSTAR to acquire the chemical composition of each sample in order to obtain a homogeneous database. The X-ray fluorescence spectroscopy consists in the irradiation of the sample with X-rays and Gamma-rays at high-energy to excite it. The excitation of atoms of the sample produce a jump of energy of the electrons that cause a gap in the electronic structure. Franzini et al. (1975) explicated this phenomenon defining it “photoelectric effect”. The excited high energy electron comes back to the initial state to replace the gap, releasing a photon with energy given by the difference of energy of the two positions occupied by the electron after the excitation. So, the irradiation of the sample causes the emission of fluorescence radiation with a spectrum that is specific for each chemical element because it depends on the specific electronic structure of the element atoms (Leoni and Saitta, 1976). The qualitative analysis is accomplished recognizing the characteristic emission lines (spectrum) of each chemical element present in the sample. The quantitative analysis is obtained for comparison between the intensity of the X-ray lines in the analysed sample and those of a standard that contains known quantity of the element under analysis.

Major elements, few trace elements and volatiles can be analysed with XRF. The concentrations of major elements are expressed as oxides in weight percentages (SiO_2 , TiO_2 , Al_2O_3 , $\text{Fe}_2\text{O}_{3\text{tot}}$, MnO , MgO , CaO , Na_2O , K_2O , P_2O_5). The analysed trace elements are Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb, Ba, La, Ce, Hf, Pb, Th, U, the volatiles are F, Cl, S and their concentrations are expressed as ppm (parts per million). Analytical uncertainties are in the order of 1-2% for major elements and 5-10% for trace elements and volatiles.

The powder of representative samples was subjected to fast fusion to be completely digested in a 5% nitric acid solution containing an internal standard that was analysed with the Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) method in the Activation Laboratories in Ontario, Canada (see <https://actlabs.com/geochemistry/lithogeochemistry-and-whole-rock-analysis/> for a complete description of the analytical technique) to determine the trace elements composition of the bulk rocks. The results are expressed in ppm (parts per million) and have precision <5%. The detection limit differs for every element and varies from 0.04 ppm for Lu to 30 ppm for Zn.

The Loss On Ignition (L.O.I.) indicates the fluid concentration of the rock and its alteration degree. It was measured, in the “Forni e Muffole” laboratory of the DiSTAR, on the 40 samples of this study heating one gram of powder at 1000°C for 4 h and weighting it after the heating. It is expressed in weight percentage calculating the difference of weight before and after the heating of the sample.

Dating

Two representative samples (SAR21 from Cixerri and CMO3 from Monastir) were selected for dating. They are the least altered samples and with the cleanest phenocrysts. About 0.6 kg of each sample was reduced to the smallest achievable fragments with the chipmunk jaw crusher in the “Taglio e macinazione” laboratory of DiSTAR. The fragments were washed in deionized water, dried at ~100° C for one night and sieved into 125-250 µm and 250-500 µm fractions. The sieved fractions were cleaned with deionized water in the ultrasound bath and dried at ~100° C for one night. Plagioclase crystals of both samples were selected from the smallest fraction, instead the amphibole crystals of SAR21 were selected from the 250-500 µm fraction. A magnet was used to discard fragments with opaque oxides. The remaining fragments (~20g of every fraction) were observed under binocular microscope

in the “Microscopia ottica” laboratory of the DiSTAR, where clean transparent crystals, without inclusions or altered rims, were carefully hand-picked obtaining 38 mg of SAR21 plagioclase (Fig. 52), 25 mg of SAR21 amphibole (Fig. 53) and 22 mg of CMO3 plagioclase (Fig. 54).

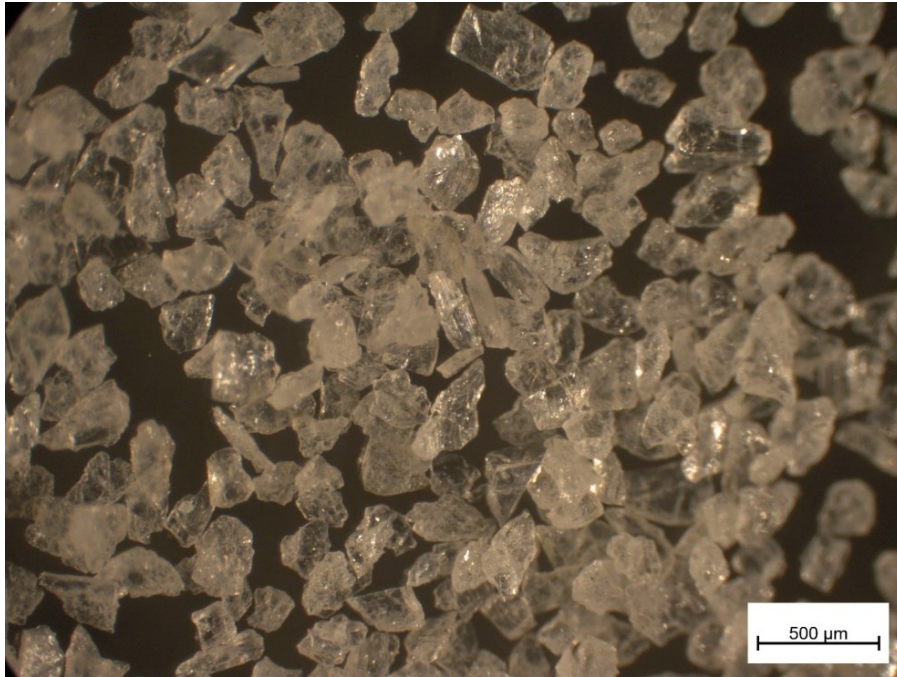


Figure 52 - Separated grains of clean plagioclase from SAR21 sample.

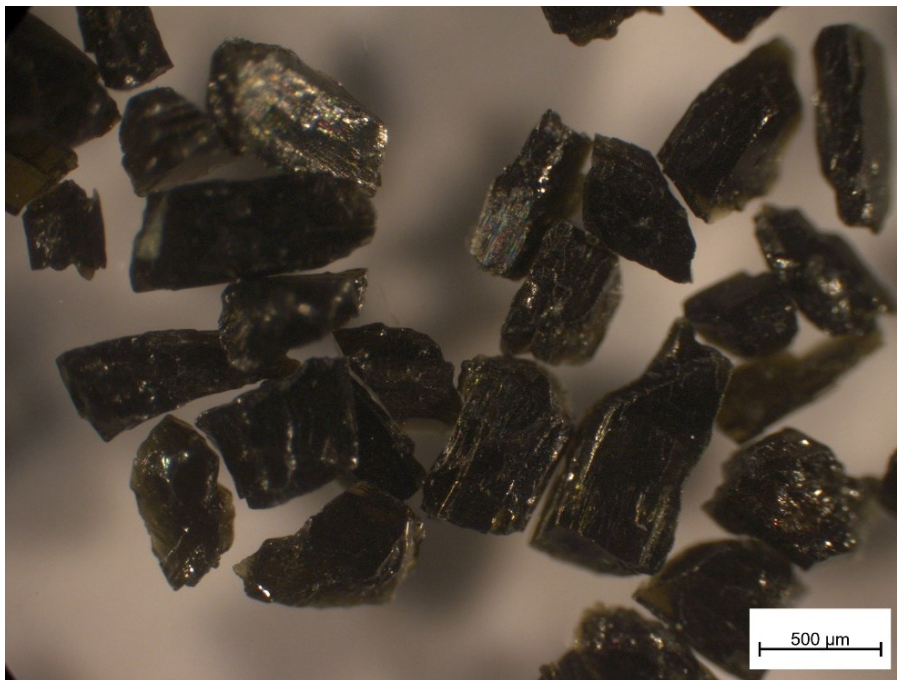


Figure 53 - Separated grains of clean amphibole from SAR21 sample.

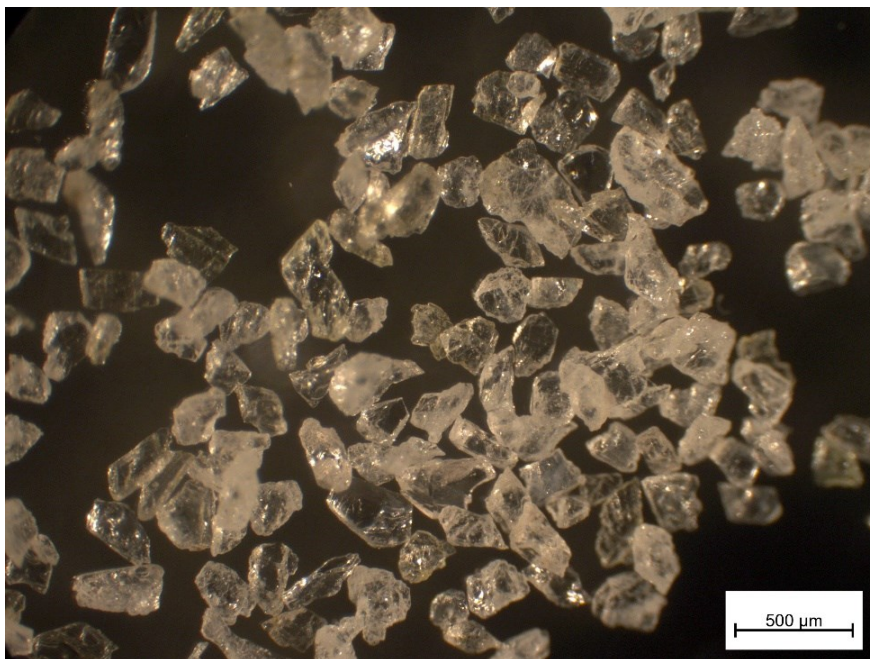


Figure 54 - Separated grains of clean plagioclase from CMO3 sample.

The selected crystals were sent to the Western Australian Argon Isotope Facility at Curtin University (Perth, Australia), where they were leached in HF for one minute and then cleaned in distilled water. The grains of each sample were irradiated for 25 h in the nuclear reactor of the Hamilton McMaster University in Canada, after loading them on aluminium discs with FCs used as neutron fluence monitor. The Fish Canyon sanidine standard has an age of 28.294 (± 0.037) Ma (Renne et al., 2010) and a good in-between grain reproducibility (Renne et al., 1998). The discs had been before shielded with Cd to reduce nuclear interference reactions. The mean J values were $0.00082040 \pm 0.00000025$. Correction factors for the interfering isotopes were applied: $(^{39}\text{Ar}/^{37}\text{Ar})_{\text{Ca}} = 6.95 \times 10^{-4}$ (± 0.000009), $(^{36}\text{Ar}/^{37}\text{Ar})_{\text{Ca}} = 2.65 \times 10^{-4}$ (± 0.000002) and $(^{40}\text{Ar}/^{39}\text{Ar})_{\text{K}} = 7.02 \times 10^{-4}$ (± 0.000087).

The $^{40}\text{Ar}/^{39}\text{Ar}$ measurements were performed at Curtin University, where every sample was loaded in 0-blank Cu-foil packages and was step-heated in a Pond Engineering® double vacuum resistance furnace. The gas purification took place in a stainless-steel extraction line with a GP50, two AP10 SAES getters and a liquid nitrogen condensation trap. The isotopes measurements occurred in a static mode employing a MAP 215-50 mass spectrometer

(resolution of ~ 450 ; sensitivity of 4×10^{-14} mol/V) with a Balzers SEV 217 electron multiplier and 9-10 cycles of peak-hopping. The Argus program, written by M.O. McWilliams, was applied for data acquisition in a LabView environment and the ArArCALC software (Koppers, 2002) for data processing. The measured Ar isotopic data were corrected for radioactive decay, mass discrimination and blank. The results are in Sup. Tab. 11. Blanks were monitored every 3-4 steps, ^{40}Ar blanks are in the range 4×10^{-15} - 3×10^{-14} mol for SAR21 amphibole, 9×10^{-16} - 2×10^{-15} mol for SAR21 plagioclase and 4×10^{-16} - 6×10^{-15} mol for CMO3 plagioclase. The decay constants determined by Renne et al. (2010) were applied to calculate the plateau and isochron ages that have uncertainties originated by errors on the age of the standard and on the decay constant. The plateau must comprise minimum 70% of ^{39}Ar , be distributed over at least 3 consecutive steps and the probability of fit (P) must be higher than 0.05. The plateau age was calculated considering the means of every step and the uncertainty is expressed as 2σ .

$^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ measurements

The $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ were measured in 26 representative samples (5 from Cixerri, 4 from Siliqua, 1 from Monastir, 3 from Monte Nureci, 3 from Sindia, 3 from Sulcis and 7 from Arcuentu; Sup. Tab. 11) with the Triton Plus instrument in the “Spettrometria di Massa” laboratory of the DiSTAR. It is based on the TIMS (Thermal Ionization Mass Spectrometry) technique: the separated element of each sample is deposited on a Re filament that is heated by an electrical potential gradient to obtain the sample evaporation and ionization. The ions pass through a magnetic field where they are separated in beams on the basis of their masses (each isotope of the element is recognizable for its mass). Every ion beam reaches a Faraday cup (collector) where a potential drop occurs proportionally to its abundance. So, the abundance of each isotope of the element is measured in a cup. The TRITON PLUS has one fixed and eight mobile Faraday cups to acquire

simultaneously several ion beams in static mode. All the measured isotopes are expressed as ratios referred to a stable isotope of the same element. The standard error ($2\sigma_{\text{mean}}$) of 150 measurements, was lower than ± 0.000008 for Sr and ± 0.000006 for Nd. In-run isotopic fractionation was corrected normalizing the measured $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ to $^{88}\text{Sr}/^{86}\text{Sr}=8.37521$ and $^{146}\text{Nd}/^{144}\text{Nd}=0.7219$, respectively. The international standards (NIST–SRM 987 for Sr and JNdi–1 for Nd) were measured for monitoring the external reproducibility; the measured $^{87}\text{Sr}/^{86}\text{Sr}$ of NIST–SRM 987 and $^{143}\text{Nd}/^{144}\text{Nd}$ of JNdi–1 were normalized to $^{87}\text{Sr}/^{86}\text{Sr}=0.710248\pm 0.000012$ and to $^{143}\text{Nd}/^{144}\text{Nd}=0.512107\pm 0.000012$, respectively (Zhang and Hu, 2020).

The previous separation of the target elements was performed in the “Camera Bianca” laboratory of the DiSTAR. 500 mg of powder of each sample were dissolved in HF-HNO₃-HCl acid mixtures in three steps; the dissolution lasted 4 days and the dissolved sample was diluted in 2.5N HCl. All the procedures took place within a Plexiglas laminar flow hood furnished with two HEPA filters. Quartz columns filled with AG[®] 50W-X8 (for Sr and Rare Earth Elements) or Ln Spec[®] (for Nd) resins were used for Sr and Nd separation, based on the cation-exchange chromatographic techniques. Firstly, the diluted sample was loaded in the Sr-columns to collect Sr and REE, they evaporated at 180° C and the REEs (Rare Earth Elements) were loaded in the Nd-columns to collect Nd. After Nd evaporation, the separated elements of each sample were ready to be loaded on the Re filament.

References

- Abers G. (2000) - "*Hydrated subducted crust at 100-250 km depth*" Earth and Planetary Science Letters, 176, 323-330.
- Agus M. and Pecorini G. (1977) - "*Livelli a Carofite nel carbone della "prima vena" della Miniera di Seruci e nel Cixerri.*" Resoconti dell'Associazione Mineraria Sarda, 84, 43-65.
- Alvarez W. (1974) - "*Fragmentation of the Alpine orogenic belt by microplate dispersal.*" Nature, 248, 309-314.
- Anders E. and Grevesse N. (1989) - "*Abundances of the elements: meteoritic and solar.*" Geochimica et Cosmochimica Acta, 53, 197-214.
- Arevalo Jr. R. and McDonough W. F. (2008) - "*Tungsten geochemistry and implications for understanding the Earth's interior.*" Earth and Planetary Science Letters, 272 (3-4), 656-665.
- Assorgia A., Fadda A., Gimeno Torrente D., Morra V., Ottelli L. and Secchi F.A.G. (1990) - "*Le successioni ignimbriche terziarie del Sulcis (Sardegna Sud-Occidentale).*" Memorie della Società Geologica Italiana, 45, 951-963.
- Assorgia A., Barca S., Cocozza T., Decandia A., Fadda A., Gandin A. and Ottelli L. (1992a) - "*Characters of the Caenozoic sedimentary and volcanic succession of western Sulcis (SW Sardinia).*" Contribution to the geology of Italy with special regard to the Palaeozoic basement: International Geological Correlation Program, 276, 17-20.
- Assorgia A., Cincotti F., Fadda A., Gimeno Torrente D., Morra V., Ottelli L. and Secchi F. A. (1992b) - "*Caratteri vulcanologici e petrografici delle successioni "ignimbriche" terziarie del Sulcis (Sardegna sudoccidentale).*" Guida alle escursioni sui depositi piroclastici cenozoici sardi. Riunione scientifica, 32-60.
- Barca S., Annino E. and Costamagna L.G. (2001) - "*Evoluzione stratigrafica e tettonica delle coperture tardo-paleozoiche e meso-cenozoiche del Sulcis*

- (*Sardegna sud-occidentale*).
Rendiconti seminario Facoltà Scienze,
Università di Cagliari, 71, 1.
- Barca S. and Costamagna L.G. (2000) - "*Il bacino paleogenico del Sulcis-Iglesiente (Sardegna SW): Nuovi dati stratigrafico-strutturali per un modello geodinamico nell'ambito dell'orogenesi pirenaica*." Bollettino della Società Geologica Italiana, 119, 497-515.
- Barca S. and Costamagna L. G. (2010) - "*New stratigraphic and sedimentological investigations on the middle Eocene-Early Miocene continental successions in southwestern Sardinia (Italy): Paleogeographic and geodynamic implications*." Comptes Rendus Geoscience, 342, 116-125.
- Barca S., Ulzega A., Melis E. and Orru P. E. (2005) - "*Carta geologica d'Italia F° 557 Cagliari in scala 1: 50.000*." APAT.
- Barnes S. J. and Roeder P. L. (2001) - "*The range of spinel compositions in terrestrial mafic and ultramafic rocks*." Journal of petrology, 42 (12), 2279-2302.
- Beccaluva L., Civetta L., Macciotta G. and Ricci C.A. (1985) - "*Geochronology in Sardinia: results and problems*." Rendiconti Società Italiana di Mineralogia e Petrologia, 40, 57-72.
- Beccaluva L., Brotzu P., Macciotta G., Morbidelli L., Serri G. and Traversa G. (1989) - "*Cainozoic tectono-magmatic evolution and inferred mantle sources in the Sardo-Tyrrhenian area*." In The Lithosphere in Italy, Accademia Nazionale dei Lincei, Roma, 229-248.
- Beccaluva L., Bianchini G., Natali C. and Siena F. (2011) - "*Geodynamic control on orogenic and anorogenic magmatic phases in Sardinia and Southern Spain: Interferences for the Cenozoic evolution of the western Mediterranean*." Lithos, 123, 218-224.
- Beccaluva L., Bianchini G., Mameli P. and Natali C. (2013) - "*Miocene shoshonite volcanism in Sardinia: Implications for magma sources and*

- geodynamic evolution of the central-western Mediterranean."* Lithos, 180-181, 128-137.
- Bennett E. N., Lissenberg C. J. and Cashman K. V. (2019) - "*The significance of plagioclase textures in mid-ocean ridge basalt (Gakkel Ridge, Arctic Ocean).*" Contributions to Mineralogy and Petrology, 174 (6), 1-22.
- Brotzu P., Callegari E., Morra V. and Ruffini R. (1997a) - "*The orogenic basal-andesite suites from the Tertiary volcanic complex of Narcao, S-W Sardinia (Italy): petrology, geochemistry and Sr-isotope characteristics.*" Periodico di Mineralogia, 66, 101-150.
- Brotzu P., Lonis R., Melluso L., Morbidelli L., Traversa G. and Franciosi L. (1997b) - "*Petrology and evolution of calcalkaline magmas from the Arcuentu volcanic complex (SW Sardinia, Italy).*" Periodico di Mineralogia, 66, 151-184.
- Caggianelli A., Del Moro A., Paglionico A., Piccarreta G., Pinarelli L. and Rottura A. (1991) - "*Lower crustal granite genesis connected with chemical fractionation in the continental crust of Calabria (Southern Italy).*" European Journal of Mineralogy, 3 (1), 159-180.
- Callebaut K., Elsen J., Van Balen K. and Viaene W. (2001) - "*Nineteenth century hydraulic restoration mortars in the Saint Michael's Church (Leuven, Belgium): Natural hydraulic lime or cement?*" Cement and Concrete Research, 31 (3), 397-403.
- Carmignani L., Carosi R., Di Pisa A., Gattiglio M., Musumeci G., Oggiano G. and Pertusati P. C. (1994) - "*The Hercynian chain in Sardinia.*" Geodinamica Acta, 7, 31-47.
- Carminati E. and Doglioni C. (2004) - "*Mediterranean geodynamics.*" In Encyclopedia of Geology, Elsevier, 2, 135-146.
- Carminati E., Lustrino M., Cuffaro M. e Doglioni C. (2010) - "*Tectonics, magmatism and geodynamics of Italy: what we know and what we imagine.*" Journal of the virtual Explorer, 36 (8), 10-3809.

- Carminati E., Lustrino M. and Doglioni C. (2012) - "*Geodynamic evolution of the central and western Mediterranean: tectonic vs. igneous constraints.*" *Tectonophysics*, 579, 173-192.
- Casula G., Cherchi A., Montadert L., Murru M. and Sarria E. (2001) - "*The Cenozoic graben system of Sardinia (Italy): geodynamic evolution from seismic and field data.*" *Marine and Petroleum Geology*, 18, 863-888.
- Cebriá J. M., López-Ruiz J., Doblas M., Oyarzun R., Hertogen J. e Benito R. (2000) - "*Geochemistry of the Quaternary alkali basalts of Garrotxa (NE Volcanic Province, Spain): a case of double enrichment of the mantle lithosphere.*" *Journal of Volcanology and Geothermal Research*, 102 (3-4), 217-235.
- Cherchi A. and Montadert L. (1982) - "*Il sistema di rifting oligo-miocenico del Mediterraneo occidentale e sue conseguenze paleogeografiche sul Terziario sardo.*" *Memorie della Società Geologica Italiana*, 24, 387-400.
- Cherchi A., Mancin N., Montadert L., Murru M., Putzu M.T., Schiavotto F. and Verrubbi V. (2008) - "*The stratigraphic response to the Oligo-Miocene extension in the western Mediterranean from observations on the Sardinia graben system (Italy).*" *Bullettin de la Société Géologique de France*, 179, 267-287.
- Conte A. M. (1997) - "*Petrology and geochemistry of Tertiary calc-alkaline magmatic rocks from the Sarroch domain (Sardinia, Italy).*" *Periodico di Mineralogia*, 66, 63-100.
- Conte A. M., Palladino D. M., Perinelli C., and Argenti E. (2010) - "*Petrogenesis of the high-alumina basalt-andesite suite from Sant'Antioco Island, SW Sardinia, Italy.*" *Periodico di Mineralogia*, 79 (1), 27-55.
- Conticelli S., D'Antonio M., Pinarelli L. and Civetta L. (2002) - "*Source contamination and mantle heterogeneity in the genesis of Italian potassic and ultrapotassic volcanic rocks: Sr-Nd-Pb isotope data from Roman*

- province and southern Tuscany.*" *Mineralogy and Petrology*, 74, 189-222.
- Costamagna L.G. e Schäfer A. (2017) - "*Evolution of a Pyrenean molassic basin in the Western Mediterranean area: The Eocene-Oligocene Cixerri Formation in Southern Sardinia (Italy).*" *Geological Journal*, 1-14.
- Coulon C., Demant A. and Bellon H. (1974) - "*Premières datations par la methode K-Ar de quelques laves cénozoïques et quaternaires de Sardaigne nord-occidentale.*" *Tectonophysics*, 22, 59-82.
- Coulon C., Megartsi M., Fourcade S., Maury R. C., Bellon H., Louni-Hacini A., Cotten J., Coutelle A. and Hermitte D. (2002) - "*Post-collisional transition from calc-alkaline to alkaline volcanism during the Neogene in Oranie (Algeria): magmatic expression of slab break off.*" *Lithos*, 62, 87-110.
- Davidson J., MacPherson C. and Turner S. (2007a) - "*Amphibole control in the differentiation of arc magmas.*" *Geochimica et Cosmochimica Acta* 71 (15), A204-A204.
- Davidson J., Turner S., Handley H., Macpherson C. and Dosseto A. (2007b) - "*Amphibole "sponge" in arc crust?*" *Geology* 35 (9), 787-790.
- Davidson J., Turner S. and Macpherson C. (2008) - "*Water storage and amphibole control in arc magma differentiation.*" *Geochimica et Cosmochimica Acta*, 72 (12), A201-A201.
- De La Roche D. H., Leterrier J. T., Grandclaude P. and Marchal M. (1980) - "*A classification of volcanic and plutonic rocks using R1R2-diagram and major-element analyses-its relationships with current nomenclature.*" *Chemical geology*, 29 (1-4), 183-210.
- DePaolo D. J. (1981) - "*Trace element and isotopic effects of combined wallrock assimilation and fractional crystallization.*" *Earth and planetary science letters*, 53 (2), 189-202.

- Defant M. J. and Drummond M. S. (1990) - "*Derivation of some modern arc magmas by melting of young subducted lithosphere*" *Nature*, 367, 662-665.
- Deino A. J., Gattacceca J., Rizzo R. and Montanini A. (2001) - " *$^{40}\text{Ar}/^{39}\text{Ar}$ dating and paleomagnetism of the Miocene volcanic successions of Monte Furru (western Sardinia): Implications for the rotation history of the Corsica-Sardinia microplate.*" *Geophysical Research Letters*, 28, 3373-3376.
- Dewey J.F., Helman M.L., Turco E., Hutton D.H.W. e Knott S.D. (1989) - "*Kinematics of the western mediterranean.*" *Geological Society, London, Special Publications*, 45 (1), 265-283.
- Dieni I., Massari F. and Médus J. (2008) - "*Age, depositional environment and stratigraphic value of the Cuccuru 'e Flores Conglomerate: insight into the Paleogene to Early Miocene geodynamic evolution of Sardinia.*" *Société Geologique de France*, 179, 51-72.
- Doglioni C. (1991) - "*A proposal of kinematic modelling for W-dipping subductions - possible applications to the Tyrrhenian-Apennines system.*" *Terra Nova*, 3, 423-434.
- Doglioni C., Fernandez M., Gueguen E. and Sabat F. (1998) - "*On the interference between the early Apennines-Maghrebides backarc extension and the Alps-Betics fore in the Neogene Geodynamics of the Western Mediterranean.*" *Bollettino della Società Geologica Italiana*, 118, 75-89.
- Doglioni C., Gueguen E., Harabaglia P. and Mongelli F. (1999) - "*On the origin of W-directed subduction zones and applications to the western Mediterranean.*" *Geological Society of London Special Publication*, 156, 541-561.
- Dostal J., Coulon C. and Dupuy C. (1982) - "*Cainozoic andesitic rocks of Sardinia (Italy).*" *Andesites*, 353-370.

- Downes H., Thirlwall M. F. and Trayhorn S. C. (2001) - "*Miocene subduction-related magmatism in southern Sardinia: Sr-Nd-and oxygen isotopic evidence for mantle source enrichment.*" *Journal of Volcanology and Geothermal Research*, 106 (1-2), 1-22.
- Faccenna C., Speranza F., D'Ajello Caracciolo F., Mattei M. and Oggiano G. (2002) - "*Extensional tectonics on Sardinia (Italy): insights into the arc-backarc transitional regime.*" *Tectonophysics*, 356, 213-232.
- Fanucci F., and Morelli D. (1995) - "*Modello cinematico di evoluzione del Mediterraneo occidentale.*" *Studi Geologici Camerti*, Vol. Spec., 383-390.
- Fedele L. (2002) - "*Il vulcanismo Cenozoico della Sardegna centrale e meridionale. Caratteristiche petrologiche e geochemiche*" Master degree Thesis.
- Féraud J., Fornari M., Geffroy J. and Lenck P. P. (1977) - "*Minéralisations arsénifères et ophiolites: le filon à réalgar et stibine de Matra et sa place dans le district à Sb-As-Hg de la Corse alpine.*" *Bulletin du BRGM II* 2, 91-112.
- Ferrandini J., Gattacceca J., Ferrandini M., Deino A. and Janin M. C. (2003) - "*Chronostratigraphie et paléomagnétisme des dépôts oligo-miocènes de Corse: implications géodynamiques pour l'ouverture du bassin liguro-provençal.*" *Bulletin de la Société géologique de France* 174 (4), 357-371.
- Francalanci L. and Zellmer G. F. (2019) - "*Magma genesis at the South Aegean volcanic arc.*" *Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology*, 15 (3), 165-170.
- Franciosi L., Lustrino M., Melluso L., Morra V. and D'Antonio M. (2003) - "*Geochemical characteristics and mantle sources of the Oligo-Miocene primitive basalts from Sardinia*" *Ofioliti*, 28, 105-114.
- Franzini M., Leoni L. and Saitta M. (1975) - "*Revisione di una metodologia analitica per fluorescenza-X, basata sulla correzione completa degli*

- effetti di matrice."* Rendiconti della Società Italiana di Mineralogia e Petrologia, 31 (2), 365-378.
- Funedda A. L., Carmignani L., Patta E. D., Uras V., Conti P., Pasci S. and Leone F. (2009) - "*Carta geologica d'Italia F° 556 "Assemini" in scala 1: 50.000*".
- Gaggero L., Oggiano G., Funedda A. and Buzzi L. (2012) - "*Rifting and arc-related early Paleozoic volcanism along the north Gondwana margin: geochemical and geological evidence from Sardinia (Italy)*." The Journal of Geology, 120 (3), 273-292.
- Garzanti E. and Malusà M. G. (2008) - "*The Oligocene Alps: Domal unroofing and drainage development during early orogenic growth*." Earth and Planetary Science Letters, 268, 487-500.
- Garzanti E., Lustrino M., Malusà M. G. and Doglioni C. (2008) - "*Eocene change in subduction polarity and onset of calcalkaline magmatism in the Alps-Apennines system*." Rendiconti della Società Geologica Italiana, 3, 407-408.
- Gattacceca J., Deino A., Rizzo R., Jones D. S., Henry B., Beaudoin B. and Vadeboin F. (2007) - "*Miocene rotation of Sardinia: new paleomagnetic and geochronological constraints and geodynamic implications*." Earth and Planetary Science Letters, 258, 359-377.
- Gisbert G., Cai Y. and Gimeno D. (2019) - "*Geodynamic history and mantle evolution recorded in Cenozoic lavas of Sardinia*." Journal of the Geological Society, 176, 689-703.
- Guarino V., Fedele L., Franciosi L., Lonis R., Lustrino M., Marrazzo M., Melluso L., Morra V., Rocco I. and Ronga F. (2011) - "*Mineral compositions and magmatic evolution of the calcalkaline rocks of northwestern Sardinia, Italy*." Periodico di Mineralogia, 80, 3, 517-545.
- Gueguen E., Doglioni C. and Fernandez M. (1998) - "*On the post-25 Ma geodynamic evolution of the western Mediterranean*." Tectonophysics, 298, 259-269.

- Irvine T. N. and Baragar W. R. A. (1971) - "*A guide to the chemical classification of the common volcanic rocks.*" Canadian journal of earth sciences, 8 (5), 523-548.
- Ishii T. (1975) - "*The relations between temperature and composition of pigeonite in some lavas and their application to geothermometry.*" Mineralogical Journal, 8 (1), 48-57.
- Jarvis A., Reuter H.I., Nelson A. and Guevara E. (2008) - "*Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database*" (<http://srtm.csi.cgiar.org>).
- Jolivet L. and Faccenna C. (2000) - "*Mediterranean extension and the Africa-Eurasia collision.*" Tectonics, 19, 1095-1106.
- Jolivet L., Frizon de Lamotte D., Mascle A. and Sèranne M. (1999) - "*The Mediterranean basin: Tertiary extension within the Alpine Orogen- an Introduction.*" Geological Society, London, Special Publications, 156, 1-14.
- Kay R.W. (1978) - "*Aleutian magnesian andesites: melts from subducted Pacific Ocean crust.*" Journal of Volcanology and Geothermal Research, 4, 117-132.
- Kempton P. D., Downes H. and Lustrino M. (2018) - "*Pb and Hf isotope evidence for mantle enrichment processes and melt interactions in the lower crust and lithospheric mantle in Miocene orogenic volcanic rocks from Monte Arcuentu (Sardinia, Italy)*" Geosphere, 14, 3, 926-950.
- Kersting A. B. and Arculus R. J. (1994) - "*Klyuchevskoy Volcano, Kamchatka, Russia: The role of high-flux recharged, tapped and fractionated magma chamber(s) in the genesis of High-Al₂O₃ from High-MgO basalt.*" Journal of Petrology, 35, 1-41.
- Koppers A. A. (2002) - "*ArArCALC-software for ⁴⁰Ar/³⁹Ar age calculations.*" Computers and Geosciences 28, 5, 605-619.

- Lapage L. D. (2003) - "*ILMAT: an Excel worksheet for ilmenite-magnetite geothermometry and geobarometry.*" Computers and Geosciences, 29, 673-678.
- Le Bas M. J., Le Maitre R. W., Streckeisen A. and Zanettin B. (1986) - "*A chemical classification of volcanic rocks based on the total alkali-silica diagram.*" Journal of Petrology, 27, 745-750.
- Leake B. E., Woolley A. R., Arps C. E. S., Gilbert M. C., Grice J. D., Hawthorne F. C., Kato A., Kisch A. J., Krivovichev V. G., Linthout K., Laird J., Mandarino J. A., Maresch W. V., Nickel E. H., Schumacher J. C., Smith D. C., Stephenson N. C. N., Whittaker E. J. W. and Youzhi G. (1997) - "*Nomenclature of amphiboles: report of the subcommittee on amphiboles of the International Mineralogical Association, commission on new minerals and minerals names.*" Canadian Mineralogist, 35, 219-246.
- Lecca L., Carboni S., Scarteddu R., Sechi F., Tilocca G. and Pisano S. (1987) - "*Schema stratigrafico della piattaforma continentale occidentale e meridionale della Sardegna.*" Memorie della Società Geologica Italiana, 36, 31-41.
- Lecca L., Lonis R., Luxoro S., Melis F., Secchi F. and Brotzu P. (1997) - "*Oligo-Miocene volcanic sequences and rifting stages in Sardinia: a review.*" Periodico di Mineralogia, 66, 7-61.
- Leoni L. and Saitta M. (1976) - "*X-ray fluorescence analysis of 29 trace elements in rock and mineral standards.*" Rendiconti della Società Italiana di Mineralogia e Petrologia, 32 (2), 497-510.
- Lonis R., Morra V., Lustrino M., Melluso L. and Secchi F. (1997) - "*Plagioclase textures, mineralogy and petrology of Tertiary orogenic volcanic rocks from Sardinia (central Sardinia).*" Periodico di Mineralogia, 66, 185-210.
- Lustrino M., Melluso L. and Morra V. (2000) - "*The role of lower continental crust and lithospheric mantle in the genesis of Plio-Pleistocene volcanic*

- rocks from Sardinia (Italy).*" Earth and Planetary Science Letters, 180, 259-270.
- Lustrino M., Morra V., Melluso L., Brotzu P., d'Amelio F., Fedele L., Franciosi L., Lonis R. and Petterutti Liebercknecht A. M. (2004) - "*The Cenozoic igneous activity of Sardinia.*" Periodico di Mineralogia, 73, 105-134.
- Lustrino M. and Wilson M. (2007) - "*The circum-Mediterranean anorogenic Cenozoic igneous province.*" Earth-Science Reviews, 81, 1-65.
- Lustrino M., Melluso M. and Morra V. (2007a) - "*The geochemical peculiarity of "Plio-Quaternary" volcanic rocks of Sardinia in the circum-Mediterranean area.*" In Cenozoic Volcanism in the Mediterranean Area, edito da Beccaluva L., Bianchini G. e Wilson M. Geological Society of America, Special Paper, 418, 277-301.
- Lustrino M., Morra V., Fedele L. and Serracino M. (2007b) - "*The transition between "orogenic" and "anorogenic" magmatism in the western Mediterranean area. The Middle Miocene volcanic rocks of Isola del Toro (SW Sardinia, Italy).*" Terra Nova, 19, 148-159.
- Lustrino M., Morra V., Fedele L. and Franciosi L. (2009) - "*Beginning of the Apennine subduction system in the central-western Mediterranean: constraints from Cenozoic "orogenic" magmatic activity of Sardinia (Italy).*" Tectonics, 28, 1-23.
- Lustrino M., Duggen S. and Rosenberg C. L. (2011) - "*The central-western Mediterranean: anomalous igneous activity in an anomalous collisional tectonic setting.*" Earth-Science Reviews, 104, 1-40.
- Lustrino M., Fedele L., Melluso L., Morra V., Ronga F., Geldmacher J., Duggen S., Agostini S., Cucciniello C., Franciosi L. and Meisel T. (2013) - "*Origin and evolution of Cenozoic magmatism of Sardinia (Italy). A combined isotopic (Sr-Nd-Pb-O-Hf-Os) and petrological view.*" Lithos, 180-181, 138-158.

- Lustrino M., Fedele L., Agostini S., Di Vincenzo G. and Morra V. (2017) - "*Eocene-Miocene igneous activity in Provence (SE France): $^{40}\text{Ar}/^{39}\text{Ar}$ data, geochemical-petrological constraints and geodynamic implications.*" *Lithos*, 288, 72-90.
- Lyubetskaya, T. and Korenaga J. (2007) - "*Chemical composition of Earth's primitive mantle and its variance: 1. Method and results.*" *Journal of Geophysical Research: Solid Earth*, 112 (B3).
- Macpherson C. G., Dreher S. T. and Thirlwall M. F. (2006) - "*Adakites without slab melting: high pressure differentiation of island arc magma, Mindanao, the Philippines.*" *Earth and Planetary Science Letters*, 243 (3-4), 581-593.
- Marrazzo M. (2006) - "*Caratterizzazione petrologica e geochemica dei prodotti del ciclo vulcanico Oligo-Miocenico della Sardegna Nord Occidentale*" Ph.D. Thesis.
- Martin H., Smithies R. H., Rapp R. P., Moyen J. F. and Champion D. C. (2005) - "*An overview of adakite, tonalite–trondhjemite–granodiorite (TTG) and sanukitoid: relationships and some implications for crustal evolution.*" *Lithos*, 79 (1-2), 1-24.
- Mattioli M., Guerrera F., Tramontana M., Raffaelli G. and D'Atri M. (2000) - "*High-Mg Tertiary basalts in southern Sardinia (Italy)*" *Earth Planetary and Science Letters*, 179, 1-7.
- Maxia C. (1959) - "*Malacofauna oligotipica di età oligocenica nella valle del Cixerri (Iglesiente, Sardegna Sud-occidentale).*" *Istituto di Geologia e Paleontologia dell'Università di Roma*, 7, 1-19.
- McDougall I. and Harrison T. M. (1999) - "*Geochronology and Thermochronology by the $^{40}\text{Ar}/^{39}\text{Ar}$ Method.*" Oxford University Press on Demand.
- Middendorf B., Hughes J. J., Callebaut K., Baronio G. and Papayianni I. (2005) - "*Investigative methods for the characterisation of historic*

- mortars-part 1: mineralogical characterization.*" Materials and Structures, 38 (8), 761-769.
- Molli G. (2008) - "*Northern Apennine-Corsica orogenic system: an updated review.*" Geological Society, London, Special Publications, 298, 413-442.
- Monaghan A. (2001) - "*Coeval extension, sedimentation and volcanism along the Cainozoic rift system of Sardinia.*" Mémoires du Muséum national d'histoire naturelle, 186, 707-734.
- Montigny R., Edel J. B. and Thuizat R. (1981) - "*Oligo-Miocene rotation of Sardinia: K-Ar ages and paleomagnetic data of Tertiary Volcanism.*" Earth and Planetary Science Letters, 54, 261-271.
- Morimoto N., Fabries J., Ferguson A. K., Ginzburg I. V., Ross M., Seifert F.A., Zussman J., Aoki K. and Gottardi D. (1988) - "*Nomenclature of pyroxenes.*" American Mineralogist, 62, 53-62.
- Morra V., Secchi F.A. and Assorgia A. (1994) - "*Petrogenetic significance of peralkaline rocks from Cenozoic calcalkaline volcanism from SW Sardinia, Italy.*" Chemical Geology, 118, 109-142.
- Morra V., Secchi F. A. G., Melluso L. and Franciosi L. (1997) - "*High-Mg subduction-related Tertiary basalts in Sardinia, Italy*" Lithos, 40, 69-91.
- Moyen J. F. (2009) - "*High Sr/Y and La/Yb ratios: the meaning of the "adakitic signature".*" Lithos, 112 (3-4), 556-574.
- Myers J. D. and Frost C. D. (1994) - "*A petrologic re-investigation of the Adak volcanic center, central Aleutian arc, Alaska.*" Journal of Volcanology and Geothermal Research, 60, 109-146.
- Nimis P. (1995) - "*A clinopyroxene geobarometer for basaltic systems based on crystal-structure modeling.*" Contributions to Mineralogy and Petrology, 121 (2), 115-125.
- Orsini J. B., Coulon C. and Coccozza T. (1980) - "*Dérive cénozoïque de la Corse et de la Sardaigne et ses marqueurs géologiques.*" Geologie en Mijnbouw, 59, 385-396.

- Oudet J., Münch Ph., Verati C., Ferrandini M., Melinte-Dobrinescu M., Gattacceca J., Corn   J. J., Oggiano G., Quill  v  r   F., Borgomano J. and Ferrandini J. (2010) - "*Integrated chronostratigraphy of an intra-arc basin: $^{40}\text{Ar}/^{39}\text{Ar}$ datings, micropalaeontology and magnetostratigraphy of the early Miocene Castelsardo basin (northern Sardinia, Italy).*" *Palaeogeography, Palaeoclimatology, Palaeoecology*, 295, 293-306.
- Papike J. J., Cameron K. L. and Baldwin K. (1974) - "*Amphiboles and pyroxenes: characterization of other than quadrilateral components and estimates of ferric iron from microprobe data.*" *Geological Society of America Abstracts with Programs*, 6, 1053-1054.
- Pearce J. A., Baker P. E., Harvey P. K. and Luff I. W. (1995) - "*Geochemical evidence for subduction fluxes, mantle melting and fractional crystallization beneath the South Sandwich island arc.*" *Journal of Petrology*, 36 (4), 1073-1109.
- Pecorini G. and Cherchi A. P. (1969) - "*Ricerche geologiche e biostratigrafiche sul Campidano meridionale (Sardegna).*" *Memorie della Societ   Geologica Italiana*, 8, 421-451.
- Pittau Demelia P. (1979) - "*Palinologia e datazione della sezione di Tanca Aru nella valle del Cixerri (Sardegna Sud-occidentale).*" *Bollettino della Societ   Paleontologica Italiana*, 18, 303-314.
- Putirka K. (2008) - "*Thermometers and Barometers for Volcanic Systems.*" *Reviews in Mineralogy and Geochemistry*, 69 (1), 61-120.
- Putirka K. (2016) - "*Amphibole thermometers and barometers for igneous systems and some implications for eruption mechanisms of felsic magmas at arc volcanoes.*" *American Mineralogist*, 101 (4), 841-858.
- R  hault J. P., Boillot G. and Mauffret A. (1984) - "*The Western Mediterranean basin geological evolution.*" *Marine Geology*, 55, 447-477.
- R  hault J. P., Honthaas C., Guennoc P., Bellon H., Ruffet G., Cotten J., Sosson M. and Maury R. C. (2012) - "*Offshore Oligo-Miocene volcanic*

- fields within the Corsica-Liguria Basin: Magmatic diversity and slab evolution in the Western Mediterranean Sea.*" Journal of Geodynamics, 58, 73-95.
- Renne P. R., Swisher C. C., Deino A. L., Karner D. B., Owens T. and DePaolo D. J. (1998) - *"Intercalibration of standards, absolute ages and uncertainties in $^{40}\text{Ar}/^{39}\text{Ar}$ dating."* Chemical Geology, 145 (1-2), 117-152.
- Renne P. R., Mundil R., Balco G., Min K. and Ludwig K.R. (2010) - *"Joint determination of ^{40}K decay constants and $^{40}\text{Ar}^*/^{40}\text{K}$ for the Fish Canyon sanidine standard, and improved accuracy for $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology."* Geochimica et Cosmochimica Acta, 74 (18), 5349-5367.
- Richards J. R. and Kerrich R. (2007) - *"Special paper: Adakite-like rocks: their diverse origins and questionable role in metallogenesis."* Economic Geology, 102 (4), 537-576.
- Ridolfi F., Renzulli A. e Puerini M. (2010) - *"Stability and chimica equilibrium of amphibole in calc-alkaline magmas: an overview, new thermobarometric formulations and application to subduction-related Volcanoes."* Contributions to Mineralogy and Petrology, 160, 45-66.
- Rollet N., Déverchère J., Beslier M. O., Guennoc P., Réhault J. P., Sosson M. and Truffert C. (2002) - *"Back arc extension, tectonic inheritance, and volcanism in the Ligurian Sea, western Mediterranean."* Tectonics, 21 (3), 1015.
- Ronga F. (2011) - *"Petrogenesi delle vulcaniti del Sulcis (Sardegna Sud-occidentale)"* Ph.D. Thesis.
- Rosenbaum G., Lister G. S. and Duboz C. (2002) - *"Relative motions of Africa, Iberia and Europe during Alpine Orogeny."* Tectonophysics, 359, 117-129.
- Sartori R., Torelli L., Zitellini N., Carrara G., Magaldi M. and Mussoni P. (2004) - *"Crustal features along a W-E Tyrrhenian transect from*

- Sardinia to Campaniamargins (central Mediterranean)."* Tectonophysics, 383, 171-192.
- Savelli, C. (1975) - "*Datazioni preliminari col metodo K-Ar di vulcaniti della Sardegna sud-occidentale.*" Rendiconti della Società Italiana di Mineralogia e Petrologia, 31, 191-198.
- Savelli C. (2015) - "*Fast episodes of West Mediterranean-Tyrrhenian oceanic opening and revisited relations with tectonic setting.*" Scientific Reports, 5.
- Savelli C., Beccaluva L., Deriu M., Macciotta G. and Maccioni L. (1979) - "*K/Ar geochronology and evolution of the Tertiary "calc-alkalic" volcanism of Sardinia (Italy).*" Journal of Volcanology and Geothermal Research, 5 (3-4), 257-269.
- Schettino A. and Turco E. (2006) - "*Plate kinematics of the Western Mediterranean region during the Oligocene and Early Miocene.*" Geophysical Journal International, 166, 1398-1423.
- Schmidt M. and Poli S. (1998) - "*Experimentally based water budgets for dehydrating slabs and consequences for arc magma generation.*" Earth and Planetary Science Letters, 163 (1-4), 361-379.
- Schoenhofen M. V., Haase K. M., Beier C., Woelki D. and Regelous M. (2020) - "*Chemical evolution of calc-alkaline magmas during the ascent through continental crust: constraints from Methana, Aegean arc.*" Journal of Petrology, 61 (3), egaa036.
- Speranza F., Villa I.M, Cagnotti L., Florindo F., Casentino D., Cipollati P. and Mattei M. (2002) - "*Age of the Corsica-Sardinia rotation and Liguro-Provençal Basin spreading: New paleomagnetic and Ar/Ar evidence.*" Tectonophysics, 347, 231-251.
- Tarquini S., Isola I., Favalli M. and Battistini A. (2007) - "*TINITALY, a digital elevation model of Italy with a 10 meters cell size (Version 1.0) [Data set].*" Istituto Nazionale di Geofisica e Vulcanologia (INGV). <https://doi.org/10.13127/TINITALY/1.0>

- Tecchiato V., Gaeta, M., Mollo S., Scarlato P., Bachmann O. and Perinelli C. (2018) - "*Petrological constraints on the high-Mg basalts from Capo Marargiu (Sardinia, Italy): Evidence of cryptic amphibole fractionation in polybaric environments.*" *Journal of Volcanology and Geothermal Research*, 349, 31-46.
- Thomas B. and Gennesseaux M. (1986) - "*A two stage rifting in the basins of the Corsica–Sardinia straits.*" *Marine Geology*, 72, 225-239.
- Thy P., Leshner C.E. e Tegner C. (2013) - "*Further work on experimental plagioclase equilibria and the Skaergaard liquidus temperature.*" *American Mineralogist*, 98, 1360-1367.
- Tommasini S., Bindi L., Savia L., Mangler M. F., Orlando A. and Petrone C. M. (2022) - "*Critical assessment of pressure estimates in volcanic plumbing systems: The case study of Popocatepetl volcano, Mexico.*" *Lithos*, 408, 106540.
- Trua T., Serri G., Marani M., Renzulli A. and Gamberi F. (2002) - "*Volcanological and petrological evolution of Marsili seamount (southern Tyrrhenian Sea).*" *Journal of Volcanology and Geothermal Research*, 114, 441-464.
- Turner S. P., Platt J. P., George R. M. M., Kelley S. P., Pearson D. G. and Nowell G. M. (1999) - "*Magmatism associates with orogenic collapse of the Betic-Alboran domain SE Spain.*" *Journal of Petrology*, 40, 1011-1036.
- Vander Auwera J., Montalbano S., Namur O., Bechon T., Schiano P., Devidal J. L. and Bolle O. (2021) - "*The petrology of a hazardous volcano: Calbuco (Central Southern Volcanic Zone, Chile).*" *Contributions to Mineralogy and Petrology*, 176 (6), 1-34.
- Vigliotti L. and Langenheim V. E. (1995) - "*When did Sardinia stop rotating? New paleomagnetic results.*" *Terra Nova*, 7, 424-435.
- Whitney D. L. and Evans B. W. (2010) - "*Abbreviations for names of rock-forming minerals.*" *American mineralogist*, 95 (1), 185-187.

- Yogodzinski G. M. and Kelemen P. B. (1998) - "*Slab melting in the Aleutians: implications of an ion probe study of clinopyroxene in primitive adakite and basalt.*" Earth and Planetary Science Letters, 158 (1-2), 53-65.
- Zellmer G. F., Edmonds M. and Straub S. M. (2015) - "*Volatiles in subduction zone magmatism.*" Geological Society, London, Special Publications, 410 (1), 1-17.
- Zhang, W. and Hu Z. (2020) - "*Estimation of isotopic reference values for pure materials and geological reference materials.*" Atomic Spectroscopy, 41 (3), 93-102.
- <https://actlabs.com/geochemistry/lithogeochemistry-and-whole-rock-analysis/>

Supplementary Materials

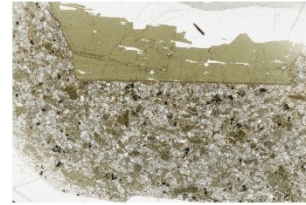
Thin sections of Cixerri and Punta Su Silixianu samples



CSA 1



CSA 2



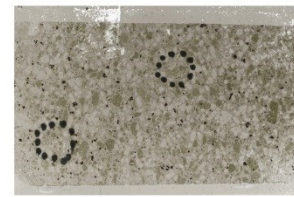
CSA 3



SAR 1



SAR 2



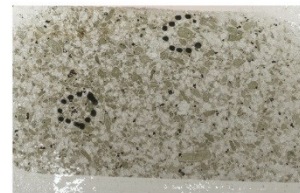
SAR 3



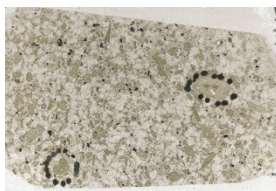
SAR 4A



SAR 4B



SAR 5



SAR 6



SAR 7



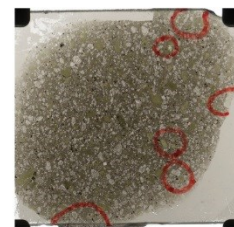
SAR 8



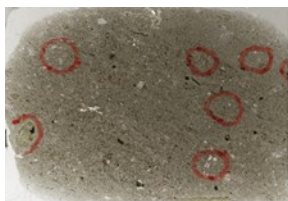
SAR 9



SAR 10



SAR 11



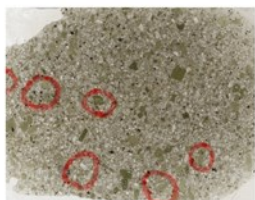
SAR 12



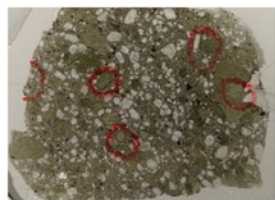
SAR 13



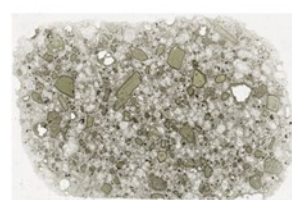
SAR 16



SAR 17



SAR 18



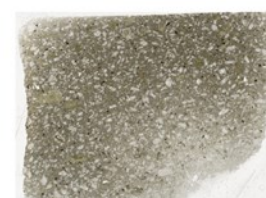
SAR 19



SAR 20



SAR 21



SAR 22



SAR 23



SAR 24

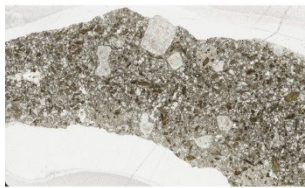


SAR 25

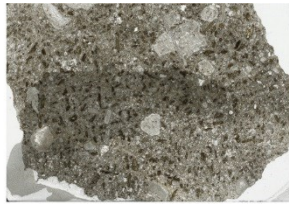


PSS 1

Thin sections of Siliqua, Monastir and Monte Nureci samples



ACQ 1



ACQ 2



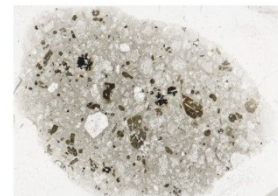
ACQ 3



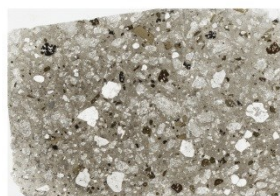
SIL 1



SIL 2



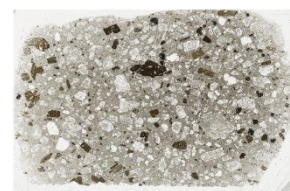
MTR 1



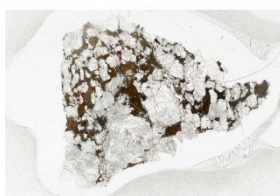
MTR 2



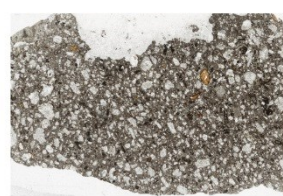
MTR 3



MTR 4



CMO 1



CMO 2



CMO 3



MNU 1



MNU 2



MNU 3

Chemical composition of rocks

District	Cixerri						Cixerri				
Sample	SAR18	SAR19	SAR20	SAR1	SAR3	SAR6	SAR2	SAR7	SAR5	CSA1	SAR8
Locality	Punta Pedru Antioqu						Serra Areni				
Lithology	BA	BA	A	BA	BA	BA	A	A	A	A	A
SiO ₂	55.16	54.76	57.28	56.96	56.58	56.21	57.01	57.33	57.36	57.36	57.61
TiO ₂	0.64	0.64	0.63	0.64	0.67	0.66	0.63	0.64	0.65	0.63	0.61
Al ₂ O ₃	17.97	17.17	16.99	17.54	17.44	17.85	18.02	17.46	17.78	17.22	17.24
Fe ₂ O ₃ _{tot}	8.91	8.57	8.05	8.02	8.63	8.01	8.17	7.82	7.90	7.71	7.63
MnO	0.16	0.19	0.16	0.17	0.17	0.17	0.15	0.16	0.16	0.15	0.16
MgO	5.55	6.41	5.31	4.93	4.86	5.10	5.04	4.96	4.09	5.46	5.77
CaO	8.70	8.68	8.16	8.20	8.28	8.63	7.91	8.24	8.65	7.68	7.52
Na ₂ O	2.07	2.32	2.34	2.36	2.36	2.21	2.09	2.29	2.25	2.61	2.32
K ₂ O	0.72	1.15	0.96	1.08	0.92	1.05	0.88	1.00	1.06	1.08	1.05
P ₂ O ₅	0.12	0.11	0.13	0.10	0.09	0.11	0.10	0.10	0.09	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	2.79	3.47	3.30	3.44	3.28	3.27	2.97	3.29	3.32	3.69	3.37
LOI	0.59	2.05	1.74	2.42	2.30	3.88	2.52	2.55	3.54	3.14	3.18
Mg#	0.55	0.60	0.57	0.55	0.53	0.56	0.55	0.56	0.51	0.58	0.60
Be	1			< 1	< 1	< 1			< 1		
Sc	27.4	28.9	29.7	25	31.5	26	21	29	29	27	30.7
V	205.1	217.3	185.9	200	219	209	215.8	195	216	202.6	201
Cr	53.3	81.5	76.8	85	124	60	27.5	34	86	43.6	28.4
Co	16.2	17.6	14.4	14	18	14	10.5	11	16	11.4	12.3
Ni	12.1	14.4	14.6	9	12	9	7.8	8	10	7.4	7.9
Cu	31.1	38.3	31.6	22	25	13	22.6	20	29	18.9	19.5
Zn	88.5	101.1	95.3	84	80	84	81.7	88	78	81.7	90.8
Ga	17.1	17.6	17.8	17	17	17	16.6	17	17	16.8	17.6
Ge	2			2	2	2			2		
As	< 5			< 5	< 5	< 5			< 5		
Rb	22.8	26.4	32	30	27	30	24.5	28	28	28.4	30.3
Sr	303.7	352.6	290.3	236	223	246	239.3	235	234	264.8	250.1
Y	19.3	19.5	20.5	20	20	21	20.4	20	19	20.2	20.4
Zr	71.5	74.4	89	95	91	94	89.7	93	89	86.5	100.6
Nb	4.3	4.9	4.4	4	5	5	3.7	5	4	4.5	4.8
Mo	< 2			4	< 2	< 2			4		
Ag	< 0.5			< 0.5	< 0.5	< 0.5			< 0.5		
In	< 0.2			< 0.2	< 0.2	< 0.2			< 0.2		
Sn	< 1			< 1	< 1	< 1			< 1		
Sb	0.7			< 0.5	< 0.5	1.2			0.9		
Cs	1.1			0.7	0.8	0.8			0.9		
Ba	197.6	250.2	248.7	276	249.8	292	261.1	269	245	280	284
La	9.5			10.9	10.8	11.2	11	11	10.3		
Ce	20.3			21.8	22.1	21.9	25.1	16	21.1		
Pr	2.61			2.59	2.68	2.63			2.47		
Nd	11.5			10.4	10.9	10.7			10.1		
Sm	2.7			2.6	2.6	2.5			2.5		
Eu	0.83			0.83	0.84	0.8			0.82		
Gd	2.5			2.8	2.9	2.7			2.8		
Tb	0.5			0.5	0.5	0.5			0.5		
Dy	2.9			3.1	3.2	3			3		
Ho	0.6			0.6	0.6	0.6			0.6		
Er	1.8			1.8	1.9	2			1.9		
Tm	0.26			0.28	0.29	0.29			0.29		
Yb	1.8			1.9	2	1.9			1.9		
Lu	0.27			0.31	0.3	0.31			0.3		
Hf	2.1	2	2.4	2.6	2.6	2.6	2.5	2.6	2.5	2.4	2.8
Ta	0.2			0.2	0.2	0.2			0.2		
W	< 1			< 1	< 1	< 1			< 1		
Tl	0.1			0.1	0.1	0.1			< 0.1		
Pb	7.3	3.2	8.4	9	7	7	4.9	5.9	6	5.5	7.1
Bi	< 0.4			< 0.4	< 0.4	< 0.4			< 0.4		
Th	1.5	3.2	4.3	2.4	2.4	2.3	4.7	3	2.3	4.8	3
U	0.4	0.3		0.5	0.5	0.5	0.4	0.1	0.5	0.7	0.5
F	523.8	516.8	700.9	510	501	930	556.5	639	563	671.7	429.8
Cl	305.2	157.1	249.4	79	152	60	103.9	125	121	112.7	156.9
S	35.5	46.5	122.3	185	30	<LLD	0.3	6	192	27.2	<LLD
Dy/Yb	1.6			1.6	1.6	1.6			1.6		
Nb/Yb	2.4			2.1	2.5	2.6			2.1		
Th/Yb	0.8			1.3	1.2	1.2			1.2		
Sr/Y	15.7	18.1	14.2	11.8	11.2	11.7	11.7	11.8	12.3	13.1	12.3
(La/Yb) _N	3.7			4.0	3.7	4.1			3.8		
(La/Sm) _N	2.2			2.6	2.6	2.8			2.6		

Supplementary table 1 - Major (wt.%), LOI (wt.%) and trace element (ppm) concentrations of the studied samples and of the re-analysed rocks of literature. Literature samples in bold type are unpublished. The major oxides are recalculated to 100 wt.% LOI-free. Mg# = Mg/(Mg+Fe). _N = normalized to the chondrite (Anders and Grevesse, 1989). BA=basaltic andesite, A=andesite, D=dacite, MD=monzodiorite, (OI) GN=(olivine) gabbro, B=basalt, HAB=high alumina basalt, HMB=high magnesium basalt, TR-D=trachy-dacite, R=rhyolite, <LLD= lower than detection limit.

District	Cixerri						Cixerri					
Sample	SAR4	SAR9	SAR17	SAR21	SAR22	SAR23	SAR11	SAR13	SAR16	SAR10	SAR12	
Locality	Serra Areni						Monte Limpiu					
Lithology	A	A	A	A	A	A	A	A	A	A	A	A
SiO ₂	57.99	58.39	57.97	57.11	57.57	58.46	58.73	58.96	59.11	60.47	62.95	
TiO ₂	0.63	0.62	0.59	0.69	0.61	0.66	0.57	0.57	0.55	0.56	0.44	
Al ₂ O ₃	17.69	16.82	17.73	17.16	17.58	16.91	17.47	17.47	17.45	16.71	16.89	
Fe ₂ O ₃ tot	7.76	7.58	8.05	8.19	8.11	7.76	7.34	7.24	7.01	6.95	6.83	
MnO	0.17	0.15	0.19	0.16	0.15	0.13	0.18	0.17	0.16	0.17	0.16	
MgO	4.20	5.15	3.81	4.66	4.24	4.66	4.00	4.17	4.13	3.89	2.07	
CaO	7.81	7.23	7.57	8.30	7.51	7.60	8.01	7.72	7.57	6.89	6.24	
Na ₂ O	2.53	2.75	2.69	2.63	2.51	2.75	2.56	2.58	2.78	2.58	2.80	
K ₂ O	1.11	1.21	1.29	0.98	1.61	0.94	1.04	1.01	1.13	1.62	1.45	
P ₂ O ₅	0.10	0.10	0.11	0.12	0.10	0.13	0.10	0.10	0.11	0.16	0.16	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Na ₂ O+K ₂ O	3.64	3.96	3.98	3.61	4.12	3.69	3.60	3.60	3.91	4.21	4.26	
LOI	2.36	1.45	2.47	2.10	3.03	0.90	4.03	2.24	2.18	3.22	3.77	
Mg#	0.52	0.57	0.48	0.53	0.51	0.54	0.52	0.53	0.54	0.53	0.38	
Be			< 1	1							1	
Sc	26	28.3	26	26	17.5	26.7	24	22	18.7	17.8	8	
V	190	201.5	165	202	178.2	185.4	167	163.1	160.8	119.7	56	
Cr	36	58.6	37	58	14.8	51.5	21	26	32.7	34.3	28	
Co	12	13.2	12	13	11.2	14.3	13	12.1	10.8	13.5	7	
Ni	6	8	9	10	7	9.9	8	7.2	5.3	8.9	5	
Cu	24	28.2	30	27	22.5	23.3	25	21.1	25.5	12.6	9	
Zn	85	83.5	82	71	153	77.4	85	83.7	83.9	94.8	109	
Ga	17	16	16	16	17.6	17.8	17	17.5	16.8	17.9	20	
Ge			2	1							2	
As			< 5	< 5							< 5	
Rb	30	34.6	31	24	34.2	22.4	26	24.1	28.3	49.3	38	
Sr	237	233.2	322	245	281	252.4	272	297.8	324.8	318.2	325	
Y	20	21.5	20	23	20.2	23.4	19	20.2	19.4	25.6	22	
Zr	93	89	87	120	99.2	121.5	87	84.5	83.5	147.7	131	
Nb	5	4.4	4	6	5	6.1	5	4.1	5	7	7	
Mo			< 2	< 2							< 2	
Ag			< 0.5	< 0.5							0.6	
In			< 0.2	< 0.2							< 0.2	
Sn			1	< 1							1	
Sb			1.2	2.4							1	
Cs			0.5	0.5							0.6	
Ba	290	315.2	243	317	445.2	319.15	256	264.6	257.3	442.9	412	
La	12		10.6	15.3			8				19.5	
Ce	18		21.4	30.5			11				38.9	
Pr			2.66	3.59							4.4	
Nd			11.3	14.2							17.5	
Sm			2.8	3.1							3.5	
Eu			0.9	0.94							1.03	
Gd			3	3.3							3.4	
Tb			0.5	0.6							0.5	
Dy			3.3	3.6							3	
Ho			0.7	0.8							0.6	
Er			2.1	2.3							1.9	
Tm			0.32	0.34							0.3	
Yb			2.1	2.4							2.1	
Lu			0.32	0.38							0.35	
Hf	2.6	2.5	2.2	3.2	2.7	3.3	2.4	2.3	2.3	3.8	3.4	
Ta			0.2	0.3							0.2	
W			3	2							< 1	
Tl			0.1	0.1							0.2	
Pb	8.3	7.5	10	10	30.8	9.3	7.1	10.3	3.7	9.1	10	
Bi			< 0.4	< 0.4							< 0.4	
Th	3.3	5.2	1.8	3.3	4.2	4	2.1	1.7	4.4	7.1	3.7	
U			0.4	0.7	0.7	0.7	0.4	0.3	0.8	1.5	0.8	
F	509	597.4	635	719	491	529.6	440	561.7	446.7	825.9	760	
Cl	178	118.9	70	155	102.2	136.6	66	180.5	65.5	49.2	57	
S	6	10.4	3	212	33.1	<LLD	170	104.7	<LLD	323.7	<LLD	
Dy/Yb			1.6	1.5							1.4	
Nb/Yb			1.9	2.5							3.3	
Th/Yb			0.9	1.4							1.8	
Sr/Y	11.9	10.8	16.1	10.7	13.9	10.8	14.3	14.7	16.7	12.4	14.8	
(La/Yb) _N			3.5	4.4							6.4	
(La/Sm) _N			2.4	3.1							3.5	

Supplementary table 1 - Continued.

District	Cixerri		Cixerri		Siliqua		Siliqua		
Sample	SAR24		SAR25		SIL2	SIL1	MTR2	MTR3	MTR4
Locality	Monte Gioiosa	Guardia	Punta Fradis	Saruís	Acquafredda		Monte Truxionis		MTR1
Lithology	A		A		BA	A	A	A	D
SiO ₂	58.85		59.85		56.83	62.01	62.70	62.82	62.29
TiO ₂	0.55		0.55		0.54	0.49	0.59	0.57	0.43
Al ₂ O ₃	17.96		17.08		17.91	17.27	17.25	16.42	16.52
Fe ₂ O _{3tot}	7.06		6.82		8.33	6.06	4.80	5.09	5.01
MnO	0.16		0.16		0.24	0.15	0.12	0.14	0.13
MgO	3.51		4.33		4.52	2.40	3.46	3.43	3.63
CaO	7.55		6.87		7.74	6.04	5.19	5.80	6.12
Na ₂ O	3.16		2.79		2.32	3.47	2.99	3.08	3.05
K ₂ O	1.08		1.40		1.34	1.87	2.61	2.36	2.42
P ₂ O ₅	0.12		0.15		0.23	0.23	0.28	0.29	0.27
Total	100.00		100.00		100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.24		4.19		3.67	5.34	5.60	5.43	5.46
LOI	3.10		3.24		3.42	2.74	3.84	2.14	2.55
Mg#	0.50		0.56		0.52	0.44	0.59	0.57	0.59
Be					1	2	3		
Sc	28.9		16.6		17	12	12.3	18.2	14.2
V	157.3		112		141	83	90.6	98.1	94.7
Cr	39.1		11.3		32	24	80.9	84.6	87
Co	11.7		9.3		13	7	9	7.7	10
Ni	6.3		4.4		6	3.6	18.7	18.5	16.8
Cu	18.3		10.8		20	8	10	12.1	11.2
Zn	84.8		88.8		90	90	80	73.6	74.4
Ga	17.3		17.7		17	18	19	19.1	18.2
Ge					1	2	2		
As					< 5	< 5	< 5		
Rb	32		38.6		28	48	75.9	72	71.2
Sr	288.8		272		600	521	730.9	742.1	764
Y	20.2		23.8		22	20	20.4	19.1	18.3
Zr	96.5		131.6		116	142	216.3	202.3	200.8
Nb	4.5		6.3		8	11	15.1	15	15.4
Mo					< 2	2	< 2		
Ag					0.5	0.7	0.8		
In					< 0.2	< 0.2	< 0.2		
Sn					< 1	1	1		
Sb					0.6	0.5	< 0.5		
Cs					0.5	0.7	1.7		
Ba	306		412.9		790	726	1322.6	1120.55	1119.6
La					28.9	38.2	51.1		
Ce					56	71.6	93.8		
Pr					6.19	7.72	10.6		
Nd					23	28	38		
Sm					4	4.8	6		
Eu					1.12	1.26	1.53		
Gd					3.3	3.7	4		
Tb					0.5	0.6	0.5		
Dy					3.3	3.3	3.2		
Ho					0.7	0.7	0.6		
Er					2.1	2	1.8		
Tm					0.3	0.3	0.26		
Yb					2.1	2	1.8		
Lu					0.34	0.29	0.26		
Hf	2.6		3.5		2.7	3.5	5	4.6	4.6
Ta					0.5	0.7	1		
W					2	2	< 1		
Tl					0.3	0.2	0.2		
Pb	6.7		10.1		20	14	17	19.1	18.7
Bi					< 0.4	< 0.4	< 0.4		
Th	3		6.9		9	10.7	15.6	13.7	15
U	0.5		1.7		1.8	1.8	2.8	2.6	2.5
F	385.7		666.3		1054	794	1057.3	853.3	787.3
Cl	53.5		69.6		109	141	67.8	125.9	52.1
S	<LLD		57.9		1027	11	2.5	<LLD	<LLD
Dy/Yb					1.6	1.7	1.8		
Nb/Yb					3.8	5.5	8.4		
Th/Yb					4.3	5.4	8.7		
Sr/Y	14.3		11.4		27.3	26.1	35.8	38.9	41.7
(La/Yb) _N					9.5	13.2	19.7		
(La/Sm) _N					4.5	5.0	5.3		

Supplementary table 1 - Continued.

District	Siliqua			Monastir			Punta Su Silixianu	Monte Nureci (Arcuentu)		
Sample	ACQ1	ACQ2	ACQ3	CMO2	CMO3	CMO1	PSS1	MNU2	MNU3	MNU1
Locality		Acquafredda		Monte Olandri	Quarry					
Lithology	D	D	D	A	BA	MD	A	OI GN	OI GN	GN
SiO ₂	63.75	64.18	64.27	57.68	53.58	60.87	58.11	53.46	47.71	56.81
TiO ₂	0.47	0.47	0.46	0.66	0.69	1.68	0.54	0.48	0.19	0.67
Al ₂ O ₃	17.55	17.28	17.32	18.66	17.89	18.96	18.64	20.00	16.08	15.75
Fe ₂ O ₃ tot	4.23	4.12	4.11	7.48	8.88	3.27	6.89	6.66	7.89	8.33
MnO	0.06	0.08	0.07	0.10	0.15	0.04	0.19	0.12	0.15	0.14
MgO	2.62	2.87	2.76	4.29	6.83	2.85	4.66	5.02	13.11	5.88
CaO	5.27	5.03	5.05	7.69	8.55	3.71	7.07	10.63	13.80	8.54
Na ₂ O	3.67	3.90	3.87	2.29	2.31	2.88	2.43	2.49	0.95	2.32
K ₂ O	2.19	1.85	1.88	1.02	1.00	5.66	1.28	1.00	0.11	1.43
P ₂ O ₅	0.21	0.21	0.21	0.12	0.13	0.08	0.20	0.13	0.01	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	5.85	5.75	5.75	3.31	3.31	8.53	3.70	3.49	1.06	3.75
LOI	2.72	2.29	2.63	3.30	1.05	1.68	4.05	0.69	1.07	0.57
Mg#	0.55	0.58	0.57	0.53	0.60	0.63	0.57	0.60	0.77	0.58
R1						1586		2261	2610	2400
R2						911		1779	2443	1515
Be		6			< 1		1	1	< 1	1
Sc	12.7	12.8	13	23.7	32.5	1.8	12.1	28.8	43.7	34.7
V	91.5	96	93	176.7	244.6	199.1	135.9	151.4	139.1	229.9
Cr	12.8	16.1	18.8	9.6	153	33.5	13.7	184.2	840.7	138.6
Co	12.5	10	9.2	12	26	7.4	10	24	50	29
Ni	12.6	15.4	14.8	8.2	26.8	13	5.3	47.3	150.6	30.8
Cu	10.8	10	8.8	19.9	24.1	11.9	14.3	20	7.2	58
Zn	85.2	80	82.5	96.8	89.5	73.6	99.2	80	65.3	86
Ga	21.7	21	22.2	20.7	17	25.5	17	19	13	19
Ge		1			2		1	1	2	2
As		< 5			< 5		< 5	< 5	< 5	< 5
Rb	59.4	55.4	55.9	25.7	19.1	140	26.9	26.9	3.7	50
Sr	1100.3	1189.3	1185.5	299.7	665	359.3	607.2	287.5	189.9	187.9
Y	12.2	14	16	21	17.7	9.4	21.5	20.2	8.2	21.7
Zr	126.4	115.6	120.3	97.7	60.5	202.2	116	68.6	16.9	97.2
Nb	19.7	18.2	17.9	4.3	4	7.7	8.4	3.4	0.3	5.2
Mo		< 2			< 2		< 2	6	< 2	< 2
Ag		0.5			< 0.5		< 0.5	< 0.5	< 0.5	0.6
In		< 0.2			< 0.2		< 0.2	< 0.2	< 0.2	< 0.2
Sn		2			1		1	1	< 1	1
Sb		1.3			0.5		0.8	< 0.5	< 0.5	0.6
Cs		5.8			0.5		0.6	0.8	0.6	2
Ba	928.6	847.1	844.8	292.3	193.3	4458.7	747.2	316.8	75.1	298.6
La	34.3	34.2	47.1	14.1	12	219.2	28.2	14	2.8	16.8
Ce	43.7	56	59.9	34.1	26.5	406.5	55.1	28	6	33.9
Pr		6.56			3.48		6.13	3.38	0.74	3.78
Nd		24.9			14.8		22.8	13.4	3.4	15.5
Sm		4.3			3.2		4	3.3	1	3.5
Eu		1.25			1.02		1.11	1.1	0.42	0.92
Gd		3.2			2.9		3.5	3.1	1.1	3.8
Tb		0.4			0.4		0.5	0.5	0.2	0.6
Dy		2			2.8		3.3	3.2	1.2	3.5
Ho		0.4			0.6		0.7	0.7	0.3	0.7
Er		1.2			1.8		2.1	2	0.7	2
Tm		0.16			0.24		0.31	0.28	0.1	0.29
Yb		1			1.5		2	1.9	0.7	2
Lu		0.15			0.23		0.37	0.3	0.1	0.33
Hf	2.4	2.2	2.2	2.6	1.6	5.3	3	1.8	1.1	2.8
Ta		1.3			0.3		0.9	0.2	< 0.1	0.3
W		< 1			< 1		2	2	< 1	< 1
Tl		0.1			< 0.1		0.2	< 0.1	< 0.1	0.1
Pb	43	46	47.8	5.8	5	29.8	23	11	4.8	10
Bi		< 0.4			< 0.4		< 0.4	< 0.4	< 0.4	< 0.4
Th	12.6	10.2	12.5	5.7	3	153	9.8	3.1	0.3	4.6
U	5.1	4.5	3.9	1	0.9	1	1.9	0.5	< 0.1	1.5
F	868.9	1010.5	952.9	408.9	223.6	1477.5	818.1	562.8	334	538.8
Cl	59.5	62.9	65	44.3	48.3	21.2	82.9	352.6	279.6	198.9
S	14.4	<LLD	<LLD	<LLD	<LLD	<LLD	1446.3	<LLD	<LLD	18.8
Dy/Yb		2.0			1.9		1.7	1.7	1.7	1.8
Nb/Yb		18.2			2.7		4.2	1.8	0.4	2.6
Th/Yb		10.2			2.0		4.9	1.6	0.4	2.3
Sr/Y	90.2	85.0	74.1	14.3	37.6	38.2	28.2	14.2	23.2	8.7
(La/Yb) _N		23.7			5.5		9.8	5.1	2.8	5.8
(La/Sm) _N		5.0			2.3		4.4	2.7	1.8	3.0

Supplementary table 1 - Continued.

District	North Sardinia							North Sardinia				
Sample	MARA18	MARA19	MARA20	MARA21	MARA1	MARA2	MARA36	MA24	MA25B	MARA3	MARA15	MARA16
Locality	Montresta							Bosa-Alghero				
Reference	Marrazzo (2008), Guarino et al. (2011)							Marrazzo (2008), Guarino et al. (2011)				
Lithology	TR-D	TR-D	R	B	R	BA	A	R	TR-A	R	R	R
SiO ₂	63.30	68.35	74.15	48.58	70.25	53.15	60.96	72.59	61.05	71.77	74.47	72.53
TiO ₂	0.52	0.44	0.25	1.11	0.33	0.96	0.74	0.51	0.88	0.43	0.23	0.36
Al ₂ O ₃	16.50	16.41	14.58	18.85	14.77	20.49	16.28	14.10	16.68	14.30	12.91	14.17
Fe ₂ O _{3tot}	4.97	3.71	2.05	10.76	2.67	7.89	6.63	3.26	6.62	3.80	2.10	3.64
MnO	0.12	0.14	0.02	0.19	0.04	0.18	0.14	0.10	0.14	0.02	0.04	0.04
MgO	2.21	0.94	0.33	5.10	0.29	2.74	3.53	0.99	1.90	0.41	0.34	1.31
CaO	4.83	1.50	0.38	11.60	2.47	9.95	7.18	1.56	4.11	1.08	1.93	1.85
Na ₂ O	2.88	2.68	2.16	2.40	3.25	2.91	2.09	2.23	2.53	3.47	1.49	0.96
K ₂ O	4.51	5.73	6.06	1.21	5.86	1.54	2.29	4.57	5.84	4.70	6.43	5.07
P ₂ O ₅	0.16	0.09	0.03	0.19	0.07	0.20	0.16	0.09	0.26	0.02	0.06	0.06
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	7.39	8.41	8.21	3.62	9.11	4.45	4.37	6.80	8.36	8.17	7.92	6.04
LOI	2.5	3.7	2.7	2.6	1.7	0.9	4.4	5.5	5.8	3.3	6.9	8.3
Mg#	0.47	0.33	0.24	0.48	0.18	0.41	0.51	0.38	0.36	0.18	0.24	0.42
Be				2								
Sc	26.1	12.1	12.2	37.6	15.4	34.4	23.6	18.4	23.8	22.9	11.8	14.9
V	66.5	23.2	20.6	324.5	32.8	221.3	158.6	9.9	92.8	10.8	15.2	57.3
Cr	15.3	10.2	10.2	29.8	10.1	4.2	9.7	8.6	8.7	4.6	4.8	6.9
Co	11.2	6.7	1.7	29.1	3.7	16.8	10.7	1.6	16.7	2.3	2.5	4.9
Ni	5.3	2.8	3.3	26.8	6.4	2.9	4.4	4.4	6.3	<LLD	2.9	3.1
Cu	23.6	22.2	14.3	73.3	13	35.3	10.4	4.9	33.9	11	17.2	42.9
Zn	60.8	74.7	35.1	95.6	34.2	77.5	71.2	62.2	81.1	80.2	39.5	52
Ga	21.3	16.5	14.2	20.5	14.1	22.1	19.1	15	20	18.8	16.6	17.6
Ge				1								
As												
Rb	163.9	164.8	218.8	33.1	170.9	40.5	46.8	148.2	174	152.8	298.4	239.2
Sr	246.7	118.1	60.3	372	186.6	448.1	293.8	377.1	438.6	113.5	167.8	209.4
Y	34.4	35.6	25.3	25.5	38.9	27.1	31.5	37.2	33.9	33	37.3	32.7
Zr	257.2	275.9	227.1	75	285.6	110.8	164.7	208.8	157.5	328.5	227.3	204.7
Nb	10.7	12.9	11.3	6.1	12.8	8.6	14.5	12.2	7.8	18.3	11.9	9.7
Mo												
Ag												
In												
Sn												
Sb												
Cs				1								
Ba	664.6	791.7	701.7	139.2	754	350.5	905.8	633.3	418.5	769.5	648.6	682.6
La	42.9	38.7	20.6	11.4	35.8	24.1	31.5	30	25.7	46.3	48.8	40.6
Ce	79.7	69.9	57.1	25	65.6	50.8	58.7	44.3	41.1	36	86.7	75.6
Pr				3.33								
Nd				14.2								
Sm				3.7								
Eu				1.22								
Gd				3.9								
Tb				0.7								
Dy				3.9								
Ho				0.8								
Er				2.4								
Tm				0.35								
Yb				2.2								
Lu				0.33								
Hf	6.4	6.8	5.8	1.9	7	2.8	4.2	5.1	3.9	8.1	5.7	5.2
Ta				0.3								
W												
Tl												
Pb	28.4	16.8	23	0.9	18	9.1	12.2	16.8	13.8	21.4	25.9	24.7
Bi												
Th	18.6	14.3	19.7	2.2	16.1	6.7	11.6	10.2	9.7	16.9	21.1	20.1
U	4	3	4	0.5	3.5	2	<LLD	2.5	2.5	4	4.5	4.2
F	971.6	734.2	658.2	437.4	732.6	540.7	1002	459.4	650.3	558	883.1	1288.5
Cl	63.3	122.2	879.9	21	91.7	37	56.5	96.2	328.1	91.3	26.6	31.7
S	<LLD	<LLD	2.6	<LLD	<LLD	<LLD	171.3	<LLD	428.2	<LLD	<LLD	<LLD
Dy/Yb				1.8								
Nb/Yb				2.8								
Th/Yb				1.0								
Sr/Y	7.2	3.3	2.4	14.6	4.8	16.5	9.3	10.1	12.9	3.4	4.5	6.4
(La/Yb) _N				3.6								
(La/Sm) _N				1.9								

Supplementary table 1 - Continued.

District	North Sardinia										
Sample	MARA12	MARA13	MARA14	MARA22	vitrofiro	vitrofiro2	MARA23	MARA23bis	MARA23bis+	MARA24	MARA25
Locality	Bosa-Alghero										
Reference	Marrazzo (2008), Guarino et al. (2011)										
Lithology	R	D	R	D	D	R	TR-D	BA	BA	B	B
SiO ₂	69.74	64.12	71.14	68.34	71.39	69.46	66.97	52.36	52.32	51.81	50.71
TiO ₂	0.43	0.48	0.39	0.66	0.50	0.78	0.68	1.00	1.01	0.95	1.02
Al ₂ O ₃	14.63	15.75	14.44	14.74	14.18	13.93	15.24	19.34	19.31	19.18	19.40
Fe ₂ O ₃ tot	3.84	4.89	3.66	5.14	3.78	3.67	4.98	9.75	9.79	9.91	9.96
MnO	0.11	0.07	0.03	0.12	0.12	0.06	0.09	0.21	0.21	0.23	0.20
MgO	0.60	2.93	0.45	0.67	0.94	0.79	1.63	3.20	3.27	3.42	3.58
CaO	2.75	5.00	1.80	2.39	3.86	2.35	2.44	10.12	10.00	10.76	10.87
Na ₂ O	3.14	2.82	1.93	4.06	2.63	3.39	3.86	2.78	2.87	2.65	2.65
K ₂ O	4.63	3.73	6.05	3.69	2.52	5.41	3.94	1.09	1.06	0.93	1.34
P ₂ O ₅	0.13	0.20	0.09	0.18	0.08	0.16	0.17	0.15	0.16	0.15	0.27
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	7.77	6.55	7.99	7.75	5.15	8.80	7.80	3.88	3.93	3.59	3.99
LOI	1.3	2.5	2.5	1.8	7.4		2.8	0.9	0.9	0.2	0.6
Mg#	0.24	0.54	0.20	0.21	0.33	0.30	0.39	0.39	0.40	0.41	0.42
Be	3	2			2			2			2
Sc	10.5	26.5	19	28.3	16.6	9.3	21.4	36.3	37.4	44.7	50.9
V	57	60.7	50	65.1	19.7	46.2	33.1	295.2	307.4	330.9	324.8
Cr	11.2	23.1	11.8	<LLD	<LLD	37.8	9.3	6.3	10.2	35.6	19.8
Co	9.6	8.6	3.4	3.3	6	7.9	5.5	23.3	22.4	26.8	26.2
Ni	1.8	4.1	3.8	8.6	3.2	20.9	5.4	9.3	5.5	12.3	11.5
Cu	29.5	22.6	9.3	17.3	12.4	9.5	15.5	58.5	61.8	56.4	141.5
Zn	58	63.5	47.6	109.1	94.9	89.3	95.8	96.2	98	89.8	86
Ga	17.8	21.9	18.3	18.6	20.2	24.7	17.5	20.2	21.2	20.7	21.8
Ge	1	1			2			1			1
As					6						
Rb	181	141.5	191	127.7	284.9	194.6	135.7	28.9	28	23.5	28.6
Sr	202	298.1	154.7	203.4	577.1	274.4	180.6	308	307	299.9	333.1
Y	31.1	31.9	31.7	52.9	58.1	28.7	38.5	24.2	24.7	23.2	26
Zr	240.6	253.1	235.1	259.2	300.4	287.6	213.5	85.8	86.6	79.6	78.1
Nb	10.8	10.4	10.5	13.2	13.7	34.1	11.6	6.6	5	5.3	4.5
Mo											
Ag											
In											
Sn	2	2			2						
Sb											
Cs	5	3.2			17.1			0.6			1
Ba	722.6	656.6	694.2	672.2	730.7	759.6	519.2	221.8	198.1	202.9	198.4
La	34.4	33.5	41.4	41.4	32.2	61.8	32.8	11.3	13.9	17.2	10.6
Ce	67.8	64.8	74.4	70.9	61.7	144.6	63.1	24	12.9	17.1	22.9
Pr	7.14	7.34			7.66			3.03			2.97
Nd	25.3	27.2			29.9			13			12.8
Sm	5.1	5.6			6.8			3.3			3.3
Eu	1.02	1.44			1.4			1.11			1.11
Gd	4.6	5.3			7.2			3.7			3.6
Tb	0.7	0.8			1.2			0.6			0.6
Dy	4.4	4.7			7.3			4			3.9
Ho	0.9	0.9			1.5			0.8			0.8
Er	2.6	2.7			4.6			2.4			2.4
Tm	0.42	0.42			0.72			0.35			0.34
Yb	2.8	2.8			4.7			2.2			2.2
Lu	0.44	0.41			0.71			0.35			0.33
Hf	6	6.3	5.9	6.4	7.2	7.1	5.4	2.2	2.2	2	2
Ta	0.9	0.8			1			0.3			0.3
W		1			1						
Tl	1	0.5			3.4			0.2			0.2
Pb	24	23	28.3	21	28	31	14.9	4.9	3.6	4.1	3.5
Bi	2	0.7			1.8						
Th	14.2	11.2	16.8	12.5	10	26.7	12.5	2.3	3.5	6.8	1.9
U	3.2	2.5	3.5	2.6	2.7	5.5	3.6	0.5	0.9	2	0.4
F	871.7	1027.9	721.5	893.3	933.9	862	820.1	479	508.8	328.4	264.5
Cl	68.1	102.1	33.6	84.1	855.4	634.4	110.9	76.7	79.5	47.7	77.6
S	<LLD	<LLD	<LLD	83	<LLD	0.2	86.7	<LLD	<LLD	279	327.2
Dy/Yb	1.6	1.7			1.6			1.8			1.8
Nb/Yb	3.9	3.7			2.9			3.0			2.0
Th/Yb	5.1	4.0			2.1			1.0			0.9
Sr/Y	6.5	9.3	4.9	3.8	9.9	9.6	4.7	12.7	12.4	12.9	12.8
(La/Yb) _N	8.5	8.3			4.8			3.6			3.3
(La/Sm) _N	4.2	3.7			3.0			2.1			2.0

Supplementary table 1 - Continued.

District	North Sardinia										
Sample	MARA25(2)	MARA25(3)	MARA26	MARA27	MARA27bis	MARA28	MARA29	MARA30	MARA31	MARA31bis	MARA32
Locality	Bosa-Alghero										
Reference	Marrazzo (2008), Guarino et al. (2011)										
Lithology	B	B	R	R	R	R	TR-D	TR-D	R	R	R
SiO ₂	50.37	50.23	70.28	79.72	69.98	70.10	68.09	65.74	70.99	70.20	70.28
TiO ₂	1.02	1.02	0.54	0.37	0.46	0.48	0.51	0.61	0.44	0.46	0.42
Al ₂ O ₃	19.80	20.00	15.23	9.69	14.85	15.51	15.50	16.21	14.98	15.06	15.38
Fe ₂ O ₃ tot	10.20	10.19	3.48	2.98	3.58	3.44	3.86	4.44	3.20	3.55	3.47
MnO	0.20	0.20	0.05	0.07	0.12	0.06	0.07	0.12	0.04	0.11	0.08
MgO	3.66	3.59	0.32	0.06	0.64	0.67	1.49	1.63	0.75	0.22	0.64
CaO	10.83	10.91	1.19	1.55	1.66	1.50	1.88	3.06	1.30	1.11	1.26
Na ₂ O	2.63	2.59	3.94	2.42	3.56	3.82	4.16	3.90	3.84	3.78	3.59
K ₂ O	1.09	1.10	4.89	3.04	5.04	4.34	4.32	4.09	4.38	5.43	4.80
P ₂ O ₅	0.19	0.18	0.09	0.11	0.11	0.08	0.11	0.19	0.08	0.07	0.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.72	3.69	8.83	5.46	8.60	8.16	8.48	7.99	8.22	9.21	8.39
LOI			1.6	0.7	1.3	2.5	2.3	2.8	2.8	1.2	2.1
Mg#	0.42	0.41	0.15	0.04	0.26	0.28	0.43	0.42	0.32	0.11	0.27
Be											
Sc	34.2	40.6	17.8	14.4	13.8	14.2	22.7	16.3	15.7	15.8	11.6
V	335.2	343.7	22	15.7	31.4	8.6	33.2	52	24.5	15.3	22.2
Cr	27.8	30.7	9.2	6.7	7.7	8.1	11.5	5.7	4.3	10.5	4.4
Co	33.1	28.3	1.7	3.7	3.7	1.5	4.6	3.3	1.8	4.8	2.1
Ni	8.4	7.7	1.7	2.1	1.8	2.5	1.5	3.1	2.8	2.8	0.5
Cu	136.5	137.3	3.4	14	5.4	7.5	6.1	20.8	5.1	6	4.1
Zn	92.1	90.6	66	30.9	73.8	58.4	96.4	80	80.4	86.1	83.9
Ga	20.4	21.2	16.8	8.3	17	18.4	18.7	18.8	16.2	16.2	17.8
Ge											
As											
Rb	27.4	26.3	159.5	100.7	173	159.1	155	159	155.9	189.5	172.1
Sr	311.7	307.8	121.4	108	137.5	147.8	162.4	212	134.8	123.9	136.3
Y	23.9	23.6	40	27.6	39.8	36.1	44.8	42.9	47.4	32.5	42.1
Zr	76.1	76.6	264	156.6	246.4	282	265	240	263.4	272.5	285.1
Nb	5	5.4	13.6	8.3	11.9	14.8	13.7	12.9	11.9	13.4	13
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	184.4	199.8	558	414.7	575.6	592.9	544.6	579.8	543.8	654.5	622.2
La	11.8	10.4	37.2	19.3	31.4	33.9	31.4	29.1	30.1	23.1	39
Ce	12.5	23.6	65.8	35.6	60.7	57.3	65.2	60.9	64.6	41.8	49.4
Pr											
Nd											
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Lu											
Hf	2	2	6.6	4.1	6.2	7	6.6	6	6.5	6.8	7.1
Ta											
W											
Tl											
Pb	4	3.4	20.5	24.8	22.2	25.8	17.4	16.4	22.5	40.2	23.8
Bi											
Th	1.3	0.5	14.4	8.1	12.3	13	14.4	10.3	12.1	13	16.8
U	<LLD	<LLD	3.1	2.2	2.6	3	3.6	3	3.5	2.8	3.5
F	495.9	566.5	521.7	596.3	657.3	630	950.9	721.5	751.6	890	597.6
Cl	75.9	81.7	16.5	13.5	28.8	46.8	306.5	180	90.1	106.9	78.9
S	292.4	284.5	<LLD	<LLD	<LLD	<LLD	143.4	217.7	<LLD	<LLD	<LLD
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	13.0	13.0	3.0	3.9	3.5	4.1	3.6	4.9	2.8	3.8	3.2
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	North Sardinia											
Sample	MARA33	MARA37	MARA34	MARA35	MARA38	MA20	MA21	MA22	MA23	MA25A	MA25C	MA26
Locality	Bosa-Alghero											
Reference	Marrazzo (2008), Guarino et al. (2011)											
Lithology	BA	BA	BA	R	R	D	D	B	B	R	R	R
SiO ₂	53.80	53.72	53.66	70.59	74.85	69.36	67.73	48.44	48.09	71.15	71.06	70.32
TiO ₂	1.01	1.18	0.93	0.45	0.29	0.58	0.84	1.27	1.31	0.43	0.44	0.52
Al ₂ O ₃	17.17	18.83	19.82	14.60	13.56	14.98	14.83	19.53	19.05	14.11	14.05	14.27
Fe ₂ O ₃ _{tot}	9.90	9.00	8.91	3.80	2.64	3.81	4.89	10.36	10.71	3.74	3.77	4.35
MnO	0.19	0.18	0.19	0.08	0.03	0.04	0.10	0.18	0.18	0.11	0.12	0.10
MgO	4.49	3.56	2.27	1.27	0.27	0.73	1.14	5.28	6.02	0.80	0.55	0.73
CaO	8.96	9.08	9.87	1.59	1.98	2.83	3.35	11.08	11.02	2.05	2.07	1.96
Na ₂ O	2.65	2.51	2.95	3.10	2.38	3.36	3.66	2.38	2.14	3.66	3.48	3.57
K ₂ O	1.58	1.69	1.17	4.42	3.92	4.17	3.25	1.24	1.23	3.86	4.37	4.05
P ₂ O ₅	0.24	0.25	0.24	0.10	0.08	0.15	0.21	0.23	0.23	0.08	0.08	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.23	4.20	4.12	7.52	6.30	7.53	6.91	3.63	3.38	7.52	7.86	7.62
LOI	1.5	1.1	0.4	3.7	1.8	2.1	2.9	0.2	1.6	3.2	4.9	2.8
Mg#	0.47	0.44	0.34	0.40	0.17	0.28	0.32	0.50	0.53	0.30	0.22	0.25
Be	2		2		2				2		2	
Sc	35.9	30.7	27.5	19.7	9.2	8.6	25	47.3	45.8	10.7	12.6	21.4
V	270.7	258.9	275.8	21.5	19	52.3	43.9	387.2	398.7	12.4	15.8	26.1
Cr	25.9	4.3	17.1	4.4	3.1	4.8	1.9	42	36.6	8.1	12	5.2
Co	25.3	19.1	20.4	1.8	2	4.6	1.5	28.1	26.9	1.7	4.6	2
Ni	11.1	83.7	6.4	2.3	5.7	7.8	8	11	10	1.6	2.1	3.2
Cu	77.9	36.3	60.8	10.6	10.2	23.5	11.5	25.6	23.5	15.2	14.7	21
Zn	86.9	89.7	85.8	77.7	34.9	64.9	87.6	86.8	92.1	76.3	77.8	79.7
Ga	21	22.7	21.2	19.4	15.1	17.4	19.3	19.6	20.8	17.8	17.3	17.2
Ge	2		1		1				2		2	
As					14						8	
Rb	39	50.6	27.7	150.1	138.4	158.8	122.4	31.2	32.1	168.3	200.4	137
Sr	302.7	428.8	318.2	144	194.4	192.5	413.5	536.6	516.6	142.1	140.4	167.3
Y	30.5	30.5	25.3	43.8	25.5	43.3	48.4	31.5	31.5	47.8	48.9	50.6
Zr	107.7	108.8	78.7	299.9	197.9	250.8	192.1	97.1	97.4	310.4	312.4	277.7
Nb	7.5	8	5.6	15.4	8.6	12.1	11.1	6.5	7.5	13.9	13.4	13.9
Mo												
Ag												
In												
Sn	1		1								3	
Sb												
Cs	2.3		1.4		4.3				0.5		9.4	
Ba	246.5	307.2	218.2	788.2	497	533.3	485.1	147.8	170.6	565.7	577.4	723.8
La	14.6	13.7	11.4	37.2	29.2	41.1	29.6	13.2	11.7	37.7	31	44.9
Ce	30.7	33.4	24	81.3	56.5	60.5	50.7	34	28.5	72.8	61.6	78.1
Pr	3.85		3.04		6.28				3.83		7.06	
Nd	16.1		12.8		22.1				17.4		27.6	
Sm	4.1		3.4		4.3				4.4		6	
Eu	1.26		1.13		1.05				1.51		1.24	
Gd	4.3		3.8		3.9				5.1		6.1	
Tb	0.7		0.7		0.6				0.9		1.1	
Dy	4.6		3.9		3.4				5.2		6.9	
Ho	0.9		0.8		0.7				1		1.4	
Er	2.8		2.3		2.1				3.1		4.3	
Tm	0.42		0.35		0.34				0.46		0.68	
Yb	2.8		2.3		2.2				2.9		4.5	
Lu	0.43		0.34		0.34				0.44		0.68	
Hf	2.8	2.7	2	7.4	5	6.2	4.6	2.4	2.4	7.7	7.7	6.9
Ta	0.4		0.3		0.6				0.4		1.1	
W					2						2	
Tl	0.2		0.1		0.6						1.2	
Pb	8	9.5	6	19.5	21.5	17.5	15.3	4.6	4.1	26.3	23.7	26.3
Bi	0.4		<0.4		<0.4							
Th	2.8	5.1	2.2	15.7	9.5	14.6	9.8	6.2	1.2	14.5	10.5	14.3
U	0.7	1.1	0.5	4	2.1	3.7	2.6	<LLD	0.3	3.8	2.9	2.9
F	490.5	448	436.1	765.7	731.6	696	780.9	533.8	406.6	568.7	656.1	688.6
Cl	301.6	59.2	115.2	41.6	70.8	44.9	26.2	48.4	41.1	1013	980.4	130.8
S	268.6	2.5	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	101.2	9.5	<LLD
Dy/Yb	1.6		1.7		1.5				1.8		1.5	
Nb/Yb	2.7		2.4		3.9				2.6		3.0	
Th/Yb	1.0		1.0		4.3				0.4		2.3	
Sr/Y	9.9	14.1	12.6	3.3	7.6	4.4	8.5	17.0	16.4	3.0	2.9	3.3
(La/Yb) _N	3.6		3.4		9.2				2.8		4.8	
(La/Sm) _N	2.2		2.1		4.2				1.7		3.2	

Supplementary table 1 - Continued.

District	North Sardinia										
Sample	MA27A	MA27B	MA28	MA29A	MA29B	MA29C	MA30	MA31	MA32	MA33	MA35
Locality	Bosa-Alghero										
Reference	Marrazzo (2008), Guarino et al. (2011)										
Lithology	R	R	D	D	D	D	R	R	R	R	R
SiO ₂	72.60	70.56	69.39	68.66	69.05	68.66	72.61	70.39	71.86	71.54	72.51
TiO ₂	0.41	0.51	0.56	0.73	0.68	0.71	0.36	0.49	0.48	0.44	0.33
Al ₂ O ₃	13.93	14.28	14.68	15.55	15.28	15.58	14.24	15.05	13.58	14.33	14.17
Fe ₂ O _{3tot}	3.66	4.17	4.37	3.86	3.91	3.74	2.81	3.59	3.79	3.24	2.94
MnO	0.07	0.06	0.07	0.04	0.07	0.04	0.03	0.04	0.04	0.04	0.05
MgO	0.19	0.63	0.80	0.69	0.60	0.64	0.57	0.51	0.27	0.37	1.02
CaO	1.26	1.85	2.48	2.96	3.06	3.15	1.42	2.72	1.83	1.98	2.18
Na ₂ O	3.60	3.79	3.70	3.58	3.32	3.54	3.40	3.75	3.57	3.67	2.59
K ₂ O	4.19	4.04	3.82	3.72	3.87	3.75	4.51	3.37	4.48	4.28	4.15
P ₂ O ₅	0.09	0.11	0.14	0.21	0.15	0.19	0.06	0.10	0.10	0.10	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	7.79	7.83	7.52	7.30	7.19	7.29	7.91	7.12	8.05	7.95	6.74
LOI	1.9	2.2	2.2	2.5	3.6	1.7	2.4	2.0	1.9	1.5	5.8
Mg#	0.09	0.23	0.27	0.26	0.23	0.25	0.29	0.22	0.12	0.18	0.41
Be					2						
Sc	18.4	16	21.6	20.9	16.4	18.2	11.5	17.6	15.9	13.4	14.4
V	19.2	23.7	42.6	72.8	41	70.3	21.6	45.1	13.9	47.1	29.3
Cr	7.8	4.6	8.2	4.5	10.6	7.3	10.7	7.4	5.5	7.4	12.5
Co	0.3	3.6	1.2	4.9	2.8	2.4	3.5	3	1.6	4.7	8.1
Ni	1.6	5.3	1.7	2.5	6.8	2.4	2.4	3.7	0.3	4.3	1
Cu	12.7	12.6	10.8	13.2	9.9	12.6	9.1	8.6	13.4	11.3	11.9
Zn	69.7	100.3	99.4	79.3	74.7	71.8	65.9	62.9	79.8	66.5	57
Ga	16.9	17.2	19.6	19.1	18.1	19.2	15.9	18.6	16.6	16.8	17.1
Ge					1						
As					9						
Rb	137.2	143.7	128.4	150.7	152.3	146.9	166.6	113.1	173.4	165.5	170.9
Sr	124.4	159.7	186.4	200	193.7	207.8	116.5	194	146.2	147.9	154.2
Y	36.3	48.6	42.2	44.3	32.4	39	34.6	41.4	41.7	44.3	44.1
Zr	260.9	279.2	252.7	248.1	216.8	239.5	276.2	223.9	286.9	283.3	294.2
Nb	21.3	14	12.6	14.3	12.3	14.5	12.9	12	13.9	13.5	13.2
Mo											
Ag											
In											
Sn					2						
Sb											
Cs					8.7						
Ba	742.3	751.6	687.2	504.9	621.5	519.4	566	735.6	503.9	594.9	981.8
La	33.1	44.1	34.4	29.9	28.3	30	34.4	24.5	33.4	34.7	35.8
Ce	61	84.5	74.6	67.3	56.7	67.6	82.2	69.2	64.5	66.2	71.2
Pr					6.49						
Nd					25.2						
Sm					5.4						
Eu					1.32						
Gd					5.3						
Tb					0.9						
Dy					5.7						
Ho					1.2						
Er					3.5						
Tm					0.54						
Yb					3.6						
Lu					0.56						
Hf	6.5	6.9	6.3	6.2	5.5	6	6.9	5.6	7.1	7	7.3
Ta					1.1						
W					1						
Tl					0.8						
Pb	17.4	21.3	14.2	23	24.5	21.3	18.1	20.6	19.4	22.4	23.9
Bi											
Th	17	14.6	15.7	15.3	9.4	15.6	15.6	12	14.8	15.5	14.5
U	3.9	3.1	3.3	3.2	2.5	3.3	4	2.8	4	3.2	3.3
F	581.3	652.8	528.1	885.5	871.7	879	644.6	819.6	729.6	665.1	947.4
Cl	23.9	350.5	194.1	299.4	775.6	116.6	126.9	29.6	89.6	249.4	581.2
S	<LLD	<LLD	<LLD	26.7	97.6	21	1.3	29.9	<LLD	20.2	194.3
Dy/Yb					1.6						
Nb/Yb					3.4						
Th/Yb					2.6						
Sr/Y	3.4	3.3	4.4	4.5	6.0	5.3	3.4	4.7	3.5	3.3	3.5
(La/Yb) _N					5.5						
(La/Sm) _N					3.3						

Supplementary table 1 - Continued.

District	North Sardinia											
Sample	MARA4	MARA5	MARA5+	MARA6	MA36	MA37	MARA7	MARA7+	MARA8	MARA9	MARA10	MA10
Locality	Logudoro											
Reference	Marrazzo (2008), Guarino et al. (2011)											
Lithology	R	R	R	D	R	R	D	D	D	R	D	R
SiO ₂	74.23	73.30	73.83	68.29	74.84	74.14	67.95	68.46	68.11	69.95	68.37	69.58
TiO ₂	0.18	0.20	0.18	0.52	0.19	0.19	0.49	0.42	0.48	0.43	0.46	0.44
Al ₂ O ₃	15.03	13.96	13.81	15.19	13.16	13.49	15.43	15.72	15.27	14.82	15.09	15.13
Fe ₂ O _{3tot}	1.88	2.20	2.13	3.53	2.03	2.16	3.58	3.35	3.61	3.32	3.57	3.09
MnO	0.04	0.02	0.02	0.03	0.06	0.07	0.08	0.07	0.08	0.04	0.09	0.04
MgO	0.14	0.29	0.26	0.76	0.19	0.44	1.16	0.93	1.59	0.89	1.12	0.89
CaO	0.58	1.31	1.19	3.89	1.11	1.48	3.72	3.62	3.59	2.75	3.63	3.08
Na ₂ O	2.25	3.04	3.03	2.97	3.24	3.10	3.01	3.25	2.81	2.95	2.93	2.89
K ₂ O	5.63	5.63	5.48	4.63	5.12	4.87	4.42	4.05	4.29	4.72	4.61	4.74
P ₂ O ₅	0.02	0.05	0.06	0.18	0.05	0.06	0.15	0.12	0.16	0.13	0.13	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	7.89	8.67	8.51	7.60	8.36	7.96	7.43	7.30	7.10	7.67	7.53	7.63
LOI	1.5	1.1		0.9	0.6	3.4	2.6		3.8	1.2	3.2	2.7
Mg#	0.13	0.21	0.19	0.30	0.16	0.29	0.39	0.36	0.47	0.35	0.38	0.36
Be		3				2	2					
Sc	4.2	7.3	4.5	22	6.6	5.2	12.8	14.4	9	14.6	11	10.3
V	6.9	3.7	2.7	65.4	3.2	3.8	58	46.3	51.7	41.6	49.3	58.2
Cr	6.6	4	5.3	9.4	6.7	6.7	9.6	9.7	5	9.7	5.3	8
Co	1.3	2.9	4	8	4	0.4	5.6	6.9	5.3	5.4	7	5.8
Ni	0.8	2	2	5.5	2.2	4.8	0.7	1.5	4.2	4.7	3.8	3.1
Cu	10.4	6.7	4.7	13.6	6.3	9.1	15.2	11.2	14.3	16.4	6.9	15.9
Zn	33.1	43.9	43.1	50	34.4	57.7	64.8	62.1	67.7	47	63.3	65.5
Ga	15.2	16.4	15.1	19.1	16.6	16.6	19.3	17.1	19.5	16.9	19.1	17
Ge		1				2	1					
As		8				7	5					
Rb	219.9	204.2	198.5	177	198.5	201.8	158.9	146.7	171.1	176.9	175.8	183.9
Sr	79.4	143.2	134.4	272.7	122.6	154.8	286.8	274.5	296.5	214.7	283	225.5
Y	24	25.7	24.6	29.4	27.7	29	29.7	28	31.7	27.6	31.6	31.8
Zr	196.5	202.7	207.1	259.9	189.6	199.4	255.1	235.1	258.1	250.4	243.5	241.6
Nb	11.9	11.9	11.5	12.9	10.8	11.3	11.9	11.5	11.9	11.9	11.1	10.2
Mo												
Ag												
In												
Sn		2				2	2					
Sb												
Cs		5				6.6	5					
Ba	483.1	570	527.7	681.2	532.2	508.1	682.8	632.7	688.2	631.7	748	621.2
La	41.7	45.1	50.9	37.5	47.2	38.5	34.2	47.8	46.1	37.2	36	52.1
Ce	84.2	82.2	82.6	79.9	90	73.8	64	76	90.8	71.7	79.6	77.2
Pr		8.75				7.51	7.44					
Nd		29.2				26.1	25.2					
Sm		5.1				4.5	4.9					
Eu		0.87				0.81	1.11					
Gd		4.3				3.8	4.3					
Tb		0.7				0.6	0.7					
Dy		3.8				3.9	3.9					
Ho		0.8				0.8	0.8					
Er		2.3				2.5	2.4					
Tm		0.4				0.4	0.38					
Yb		2.7				2.8	2.5					
Lu		0.41				0.45	0.4					
Hf	5	5.2	5.2	6.4	4.9	5.1	6.3	5.8	6.4	6.2	6.1	6
Ta		1				1	1					
W		1				2	2					
Tl		0.8				0.8	0.4					
Pb	28.9	27.3	27.7	39.6	25.4	30.5	27.3	24.2	27.2	26.7	29.1	24.9
Bi		0.4					2.1					
Th	20.4	16.1	19.5	17.1	22.6	14.3	14.4	17.8	18	18	19.9	17.7
U	5	2.7	3.9	4.2	5.2	3.5	3.4	4.4	3.9	5.1	5	4.2
F	639.6	786.3	690.1	1310.5	799.6	891.7	1164.9	778.5	970.3	1069.5	925.4	722.1
Cl	230.9	334.8	299.1	76.3	182.6	905.6	628.9	583	702.2	175.5	706.7	60.1
S	8	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	8.7	<LLD	<LLD	25.5
Dy/Yb		1.4				1.4	1.6					
Nb/Yb		4.4				4.0	4.8					
Th/Yb		6.0				5.1	5.8					
Sr/Y	3.3	5.6	5.5	9.3	4.4	5.3	9.7	9.8	9.4	7.8	9.0	7.1
(La/Yb) _N		11.6				9.5	9.5					
(La/Sm) _N		5.5				5.4	4.4					

Supplementary table 1 - Continued.

District	North Sardinia											
Sample	MA11	MARA11	MA12	MA13A	MA13B	MA9	MA14A	MA15	MA16A	MA16B	MA18	MA19
Locality	Logudoro											
Reference	Marrazzo (2008), Guarino et al. (2011)											
Lithology	A	D	BA	D	R	R	R	TR-D	D	D	D	BA
SiO ₂	60.86	66.87	55.56	68.37	70.61	69.25	70.42	65.13	66.19	68.32	69.04	52.39
TiO ₂	0.78	0.24	0.82	0.44	0.38	0.44	0.45	0.65	1.02	0.88	0.63	0.85
Al ₂ O ₃	17.29	12.19	17.53	15.46	14.73	15.54	15.33	15.41	15.30	14.88	15.03	19.25
Fe ₂ O _{3tot}	6.97	2.85	8.19	3.44	2.69	3.33	3.47	5.24	6.60	5.04	4.92	9.95
MnO	0.09	0.05	0.16	0.09	0.05	0.03	0.05	0.15	0.05	0.03	0.05	0.20
MgO	0.85	1.06	3.63	1.13	0.68	0.69	0.49	0.62	0.42	0.49	0.38	3.72
CaO	6.45	1.79	8.43	3.59	3.22	2.41	0.48	3.54	3.12	2.88	2.87	9.89
Na ₂ O	2.88	2.15	2.75	3.17	3.09	2.89	1.69	3.49	3.57	3.62	3.40	2.52
K ₂ O	3.63	3.39	2.73	4.18	4.43	5.29	7.54	5.61	3.40	3.59	3.49	1.07
P ₂ O ₅	0.20	0.01	0.20	0.12	0.12	0.13	0.08	0.16	0.33	0.26	0.19	0.15
Total	100.00	90.60	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	6.51	5.54	5.47	7.35	7.52	8.18	9.23	9.10	6.97	7.21	6.89	3.59
LOI	1.7	10.3	1.3	2.5	0.7	2.6	3.1	1.8	1.6	2.5	2.6	1.8
Mg#	0.20	0.42	0.47	0.39	0.33	0.29	0.22	0.19	0.11	0.16	0.13	0.43
Be			2		2	2						1
Sc	26.4	3.1	29.6	15	11.6	13.6	13.3	20.5	29.3	24.9	19.1	33.6
V	205.4	29.5	239.2	39.6	42.5	45.5	26.1	48	35	27.2	53.5	262.9
Cr	24.9	5.7	27.2	14.1	19.8	6.5	10.6	17.3	<LLD	30.2	4.2	10.6
Co	12.5	6.4	26.6	6	2	5.8	7.4	5.7	3.1	4.3	7.1	24.8
Ni	7.5	3.1	13.3	3.5	2.1	1.8	4.1	3.8	3.6	16.9	3.8	9.8
Cu	56.1	10.6	109.9	11.2	11.7	10.1	6.7	28.8	27.6	19.1	20.2	53.3
Zn	70.8	68.6	75.5	62.1	38.5	49.4	85.6	89.4	131.1	157.2	66.2	92.3
Ga	19.2	16.7	17.5	17.6	16.2	16.7	15.8	20.7	19.8	19	17.8	20.8
Ge			1		1	1						2
As					5	16						
Rb	133.8	113.1	87.8	170.3	160.2	192.4	255.1	250.2	123.4	127.6	120.1	32
Sr	434.1	1078	458.2	273.4	248.2	214.7	81.2	239.6	243.8	215.6	194.3	348.9
Y	30.1	22.7	24.6	30.6	28.3	27.8	37.6	35.6	42.4	38.1	40.7	21.7
Zr	208.3	167.3	154.5	245.4	223.5	236.2	292.7	283.5	207.9	211	202.8	72.9
Nb	10.7	10	9.2	12	9.6	11	12.2	15.2	11.8	11.7	11.6	4.8
Mo												
Ag												
In												
Sn			1		2	2						
Sb												
Cs			2.1		3.7	4.5						1.5
Ba	407.1	719.1	300.3	655	703.7	655.4	831.5	590.3	571	602.6	561.4	190.3
La	36.5	39.5	25.1	42.3	35	36.3	46.3	43.3	32.3	36.1	30.3	9.5
Ce	72.1	65.2	52.9	80.4	65.7	70.1	79	91.1	74.9	74.5	74.3	20.2
Pr			6.05		6.91	2						2.46
Nd			24.2		24.7							10.7
Sm			4.9		4.4	4.5						2.6
Eu			1.38		1.1	1.16						0.99
Gd			4.4		4	4.2						3
Tb			0.7		0.7	0.7						0.5
Dy			4.1		4	4.3						3.3
Ho			0.8		0.8	0.8						0.7
Er			2.3		2.6	2.5						2
Tm			0.36		0.41	0.4						0.3
Yb			2.3		3	2.7						2
Lu			0.35		0.47	0.42						0.3
Hf	5.1	3.7	3.8	6.1	5.6	5.9	7.3	7	5.2	5.3	5.1	1.9
Ta			0.6		0.9	0.9						0.2
W					1	1						
Tl			0.3		0.6	0.9						
Pb	19.3	18.7	10	23.7	23.8	29.8	26.8	27.2	26.4	26.2	12.7	7.9
Bi						2.5						
Th	14.2	16.5	7.1	16.9	11.5	12.2	19.8	24	12.1	14.1	13.1	1.5
U	3.1	3.8	1.7	4.3	2.5	2.5	4.3	5	3	3	3	0.5
F	1026.7	635.1	668.6	937.7	980.3	928.4	600	1228.1	696.8	854.4	652	279.7
Cl	98.2	62.7	61.9	707.8	282.8	192.7	<LLD	71.4	67.6	266.6	195.5	40.8
S	<LLD	<LLD	120.4	<LLD	4.3	<LLD	14.3	<LLD	<LLD	<LLD	54.1	<LLD
Dy/Yb			1.8		1.3	1.6						1.7
Nb/Yb			4.0		3.2	4.1						2.4
Th/Yb			3.1		3.8	4.5						0.8
Sr/Y	14.4	47.5	18.6	8.9	8.8	7.7	2.2	6.7	5.8	5.7	4.8	16.1
(La/Yb) _N			7.6		8.1	9.3						3.3
(La/Sm) _N			3.2		5.0	5.0						2.3

Supplementary table 1 - Continued.

District	North Sardinia											
Sample	MA38	MA70	MA71	MA72A	MA72B	MA72C	MA72D	MA73	MA42	MA44	MA45A	MA45B
Locality	Logudoro											
Reference	Marrazzo (2008), Guarino et al. (2011)											
Lithology	B	D	R	BA	BA	B	B	R	R	TR-D	R	R
SiO ₂	51.86	69.29	75.85	53.68	52.64	50.05	51.00	69.16	73.41	67.61	69.87	71.35
TiO ₂	1.00	0.44	0.18	1.05	1.09	0.95	1.00	0.51	0.27	0.61	0.57	0.62
Al ₂ O ₃	18.81	15.46	13.12	20.40	20.55	20.21	18.79	15.40	13.52	14.98	14.02	12.74
Fe ₂ O _{3tot}	10.22	3.62	2.10	9.39	10.36	10.23	11.39	2.78	2.68	5.08	4.52	4.90
MnO	0.18	0.02	0.04	0.06	0.14	0.13	0.17	0.05	0.06	0.12	0.09	0.08
MgO	3.84	0.44	0.88	0.72	1.36	2.72	4.82	0.26	1.12	0.39	0.46	0.86
CaO	9.24	2.98	2.07	9.94	9.20	11.47	6.76	1.34	1.81	2.88	2.21	2.23
Na ₂ O	3.11	2.99	1.66	2.33	2.84	2.65	4.03	3.72	1.04	3.88	3.63	3.16
K ₂ O	1.48	4.61	4.06	2.27	1.71	1.38	1.90	6.66	6.03	4.26	4.44	3.89
P ₂ O ₅	0.26	0.15	0.04	0.15	0.09	0.21	0.14	0.12	0.05	0.19	0.18	0.17
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.59	7.60	5.72	4.61	4.56	4.03	5.93	10.38	7.08	8.14	8.08	7.05
LOI	1.9	1.6	6.2	1.3	1.4	1.9		1.1	4.0	0.6	2.1	3.4
Mg#	0.43	0.19	0.45	0.13	0.21	0.34	0.46	0.16	0.45	0.13	0.17	0.26
Be	2											
Sc	26.8	17.8	6.2	30.8	35.1	33	38	15.3	6.1	20	15.7	20.9
V	284.9	49.5	20.8	425.6	114.8	330.2	398.1	9.7	43.2	24.7	30.3	24.7
Cr	13.9	15.2	16.5	4.9	8.8	30.4	9.8	4.5	17.2	8.8	12.8	6.3
Co	30.5	2.8	1.4	15.8	18	25.3	38.1	1.5	5.1	4.5	4.1	3.7
Ni	21.9	2.9	1.4	6.1	8.9	10.4	10.7	1.8	2.9	2.4	1.4	<LLD
Cu	69	19.9	8.7	24.6	63.1	27.3	46.2	14.5	16.4	11.7	10.4	24
Zn	94.3	50.9	40.2	86.9	78.2	92.2	109.9	82.6	48.4	80.6	79.8	79.4
Ga	21.3	20	15.4	23.8	22.1	22.5	18.8	20.1	15	19.2	16.3	18.2
Ge	2											
As												
Rb	39	173.1	161.2	88.1	43.2	47.5	42.6	290	179.1	127	134.4	122.9
Sr	545.5	220.2	222.8	396.6	435.6	455.3	476.7	151.4	386.2	215.7	181.2	186.2
Y	23.6	37.2	14.1	17.7	23	24.1	27.8	31.9	16	44.2	41.7	46.1
Zr	93.6	241.2	124	85.7	77.6	78.6	80.1	326	129.4	234.4	227.2	216.2
Nb	6.5	9.6	6.2	5.6	5.9	6.5	4.7	16.1	5.3	12.1	12.2	12
Mo												
Ag												
In												
Sn												
Sb												
Cs	0.7											
Ba	256.1	637.6	656.4	240.9	180.6	185.3	234.9	578.3	496.1	694.4	636.1	589.1
La	22	36.3	31.3	5.2	16.1	15	7.5	50.7	26.8	37.5	31.5	35.2
Ce	45.7	75.2	49.8	14	23.5	28.4	23.4	102.3	46.1	77.9	60.9	64.7
Pr	5.44											
Nd	22.7											
Sm	4.9											
Eu	1.6											
Gd	4.6											
Tb	0.7											
Dy	4											
Ho	0.8											
Er	2.3											
Tm	0.34											
Yb	2.2											
Lu	0.33											
Hf	2.2	6	3.2	2.2	2	2	2	8	3.3	5.8	5.7	5.4
Ta	0.4											
W												
Tl	0.1											
Pb	6.9	20.6	20.4	5	4.9	3	9.7	24.8	17.5	16.8	22.5	15.6
Bi												
Th	3.8	15.3	18.7	5.8	5.7	6.6	2.8	28	17.7	13.3	14	10.1
U	0.9	3.1	4	<LLD	<LLD	1.9	<LLD	5.8	4	3.2	2.9	2.2
F	500.2	829.5	700.6	284.3	37.6	536.5	37.8	856.8	707.5	664.8	529.5	801
Cl	43.8	116.2	261	130.7	115.3	41	42	135	64.8	56.9	967.7	17.8
S	<LLD	15.8	<LLD	63	116.6	<LLD	7.8	<LLD	<LLD	<LLD	<LLD	<LLD
Dy/Yb	1.8											
Nb/Yb	3.0											
Th/Yb	1.7											
Sr/Y	23.1	5.9	15.8	22.4	18.9	18.9	17.1	4.7	24.1	4.9	4.3	4.0
(La/Yb) _N	6.9											
(La/Sm) _N	2.8											

Supplementary table 1 - Continued.

District	North Sardinia										
Sample	MA46	MA48A	MA48B	MA49A	MA49B	MA50	MA51	MA52A	MA52B	MA52C	MA54
Locality	Logudoro										
Reference	Marrazzo (2008), Guarino et al. (2011)										
Lithology	R	TR-D	R	R	R	R	TR-D	TR-D	TR-D	R	R
SiO ₂	76.20	67.28	76.47	80.26	80.71	71.33	64.50	68.03	68.35	73.88	74.37
TiO ₂	0.18	0.54	0.18	0.21	0.31	0.28	0.82	0.68	0.62	0.40	0.41
Al ₂ O ₃	12.42	14.88	12.10	9.90	9.20	14.39	15.37	14.65	14.38	12.45	12.59
Fe ₂ O _{3tot}	1.99	4.11	1.97	2.36	2.65	2.77	6.39	5.20	5.41	3.61	3.26
MnO	0.04	0.11	0.03	0.03	0.03	0.03	0.19	0.12	0.09	0.04	0.08
MgO	0.91	0.20	0.79	0.61	0.75	0.20	0.63	0.55	0.52	0.33	0.11
CaO	1.94	2.10	2.41	1.64	2.37	1.16	3.67	2.52	2.10	1.44	1.66
Na ₂ O	1.45	3.42	0.93	2.10	1.89	2.21	3.99	3.67	3.48	3.42	3.41
K ₂ O	4.82	7.25	5.03	2.85	2.00	7.56	4.08	4.39	4.89	4.35	4.04
P ₂ O ₅	0.04	0.12	0.08	0.05	0.08	0.07	0.36	0.19	0.15	0.08	0.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	6.27	10.67	5.96	4.94	3.90	9.77	8.07	8.06	8.37	7.77	7.44
LOI		1.0			3.4	0.8	0.9	1.5	1.9	1.2	0.6
Mg#	0.48	0.09	0.44	0.34	0.36	0.13	0.16	0.17	0.16	0.15	0.06
Be											
Sc	4	14.3	5.1	9.9	7.6	13	26.4	24.4	15.9	17.2	11.2
V	12.6	7	23.4	33	42.8	32.3	26.2	71.4	38.3	15.1	12.7
Cr	9.7	1.8	11	11.8	26.5	13.6	16	10.2	10.1	7.2	7.5
Co	3.8	3.9	6.2	7.5	5.3	5.6	4.8	6.4	3.5	3.5	2.5
Ni	1.9	3.2	0.8	2.3	1	0.3	3.5	3.2	3.2	2.2	0.2
Cu	6.5	19.1	6.2	9.4	5	16.2	23.7	17.2	7.8	8.2	4.3
Zn	38.1	80.4	33.6	33.1	35.7	44.6	92.8	80.8	71.7	71.7	49.9
Ga	16	20.4	13.4	11.9	11.6	15	18.8	17	18.2	16.4	14.8
Ge											
As											
Rb	139.4	310.5	123.9	81.6	90.3	263.9	115.7	135.7	118	143.5	144.9
Sr	397.2	149.2	446.8	535.3	328.9	121.6	246.7	178.6	174.7	129.6	139.7
Y	13.4	34.8	15.6	15.7	14.5	23.1	43.7	40.2	33.7	36.2	40.7
Zr	115.8	329.7	111.2	100.3	116	213.8	202.4	208.5	235.2	252.5	241.2
Nb	7.4	15.8	6.3	5.7	7.6	8.4	11.5	10.7	13.2	13.2	13.4
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	402.3	578.3	843	579.6	405.5	602.7	584.3	490.1	536.1	666.7	505.4
La	27.4	44.8	30.2	25	17.4	30.3	33	26.9	32.7	32.5	27.2
Ce	20.7	91.8	37.9	41	22.3	66.2	61.4	53.3	52.2	58.1	56.4
Pr											
Nd											
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Lu											
Hf	3	8.1	2.8	2.5	3	5.4	5.1	5.2	5.9	6.3	6
Ta											
W											
Tl											
Pb	16	29.8	21.2	17	23.8	20.4	12.8	13.2	23.2	17.1	15.2
Bi											
Th	19.4	27.5	15.6	12	7.9	19.3	9.3	10.8	12.3	11.2	11.7
U	5	5.9	4	2.5	2	4	2.2	3	2.7	3	2.5
F	786.4	809.9	661.6	635.8	641.3	683.6	779.4	628.3	587.4	478	525.4
Cl	68.4	131.1	154.4	372.4	201.9	60.1	18.2	40.8	76.6	62	32.6
S	11.5	<LLD	1.9	136.4	41.2	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	29.6	4.3	28.6	34.1	22.7	5.3	5.6	4.4	5.2	3.6	3.4
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	North Sardinia										
Sample	MA55	MA56	MA57	MA58	MA75	MA76	MA78	MA79	MA80	MA91	MA91A
Locality	Logudoro										
Reference	Marrazzo (2008), Guarino et al. (2011)										
Lithology	TR-D	R	D	R	R	R	TR-D	TR-D	TR-D	TR-D	TR-A
SiO ₂	68.98	71.83	67.38	71.34	69.55	79.10	67.72	68.56	65.98	65.70	58.06
TiO ₂	0.54	0.37	0.65	0.40	0.36	0.25	0.50	0.51	0.64	0.58	0.73
Al ₂ O ₃	14.49	14.05	15.26	14.78	15.15	11.17	16.04	15.05	15.69	16.11	17.88
Fe ₂ O _{3tot}	4.65	3.64	4.75	3.63	3.17	2.06	4.01	4.29	5.20	4.93	6.68
MnO	0.07	0.03	0.07	0.08	0.07	0.03	0.07	0.05	0.12	0.10	0.12
MgO	0.65	0.23	1.16	0.38	0.78	0.47	0.11	0.33	0.57	0.50	2.50
CaO	2.17	1.25	3.34	1.28	1.35	0.97	1.06	1.63	2.27	2.37	7.12
Na ₂ O	4.08	4.11	3.30	3.40	0.94	2.07	3.38	3.09	3.49	3.56	2.99
K ₂ O	4.22	4.42	3.94	4.64	8.59	3.83	7.01	6.29	5.88	5.98	3.69
P ₂ O ₅	0.15	0.07	0.15	0.07	0.04	0.06	0.11	0.19	0.17	0.16	0.23
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	8.30	8.53	7.24	8.04	9.53	5.90	10.38	9.38	9.37	9.54	6.67
LOI	1.7	1.2	2.8	1.6	4.0	2.4	0.8	1.2	1.6	1.1	1.2
Mg#	0.22	0.11	0.33	0.17	0.33	0.31	0.05	0.13	0.18	0.17	0.43
Be											
Sc	23.4	18.4	15.2	16.8	11.6	6.6	9.7	10.9	14	17.8	21.1
V	44.4	26.1	66.5	7.8	42.5	26.3	12.4	26.1	45.9	49	152.3
Cr	4.1	9.5	6.2	12.5	11.6	26.5	9.1	6.6	4.5	10.1	14
Co	3.7	2.6	8.8	1.2	6	0.3	3.3	1.8	10	7.8	22.6
Ni	5.8	5.3	1.6	0.4	4.4	2.5	2.1	2.3	2.5	4.5	17.9
Cu	19.6	11.8	23.5	10.8	19.4	10.1	12.9	11.9	41.7	21.5	86.5
Zn	93.3	87.5	82.4	68	59.4	32.6	59	53.1	91.2	84.7	71
Ga	18.3	17.8	18.2	18.1	15	12.3	18.3	16.9	21.8	19.2	21.5
Ge											
As											
Rb	134.2	145.9	150.9	171.8	253.8	184.2	291	228	262.3	258.4	149
Sr	182.8	125.4	206.4	118	247.3	292.4	174.5	181.2	227.6	227.1	405.7
Y	46.1	49.9	40.7	50.8	19.6	25.4	30.5	30.5	33.7	40.7	26.6
Zr	257.1	288.6	238.8	286.4	228.4	98.9	303.9	248	301.6	286.4	172.5
Nb	12.7	14.5	13.5	13.5	10.8	5	13.3	11.6	14.5	13.5	8.5
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	668.7	722.7	534	595.2	435.5	700.2	616.6	506.9	831.3	577.8	377.5
La	35	47.3	26.9	47.8	29	15.5	40.5	37.2	48.9	46.6	31.2
Ce	84.6	75.5	55.1	85.6	43.2	30.3	99.4	75.2	80	92.4	56.4
Pr											
Nd											
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Lu											
Hf	6.3	7.1	5.9	7.1	5.7	2.6	7.5	6.2	7.4	7.1	4.3
Ta											
W											
Tl											
Pb	15.9	15.5	18.3	16.2	19.8	17	22	23	31.4	23.5	16.5
Bi											
Th	13.2	15.1	13.8	12.3	18	9.3	26.2	18.1	25.3	22.8	15
U	2.9	3.5	3.1	3.6	3.4	2.6	5.2	4.6	7.3	5.7	4
F	697.1	533.1	765	691.1	723.5	915.4	531.7	680.4	973.9	846.1	755.4
Cl	227.2	8.3	33	19.6	112.7	75	38.6	55.9	94.3	58.1	47.1
S	<LLD	<LLD	<LLD	<LLD	254.9	64.9	<LLD	<LLD	66.5	<LLD	<LLD
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	4.0	2.5	5.1	2.3	12.6	11.5	5.7	5.9	6.8	5.6	15.3
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	North Sardinia									
Sample	MA3	MA1	MA2	MA4	MA5	MA6A	MA7	MA8	MA81	MA82
Locality	Anglona									
Reference	Marrazzo (2008), Guarino et al. (2011)									
Lithology	TR-D	BA	R	TR-D	TR-D	R	TR-D	R	R	BA
SiO ₂	66.54	56.67	79.83	61.38	68.65	74.18	67.38	79.92	79.56	55.66
TiO ₂	0.62	0.97	0.37	0.57	0.52	0.41	0.54	0.32	0.36	0.84
Al ₂ O ₃	15.79	18.12	9.28	14.13	14.88	13.01	15.51	9.99	9.24	17.80
Fe ₂ O ₃ tot	4.88	6.68	2.90	4.60	4.12	2.53	4.41	2.17	2.87	8.74
MnO	0.09	0.14	0.04	0.24	0.05	0.04	0.07	0.03	0.04	0.15
MgO	1.18	2.21	0.39	0.39	0.34	0.17	0.27	0.12	0.58	2.48
CaO	2.64	10.16	1.38	9.06	1.87	1.48	1.64	1.38	1.28	8.85
Na ₂ O	3.55	2.67	2.11	3.20	3.55	3.58	3.69	2.42	2.21	2.68
K ₂ O	4.56	2.17	3.59	6.31	5.87	4.53	6.34	3.56	3.78	2.61
P ₂ O ₅	0.15	0.20	0.10	0.12	0.14	0.08	0.14	0.09	0.08	0.19
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	8.11	4.84	5.70	9.50	9.42	8.11	10.03	5.98	5.99	5.28
LOI	5.5	4.0	2.0	5.8	0.9	0.6	1.8	0.9	1.8	1.2
Mg#	0.32	0.40	0.21	0.14	0.14	0.12	0.11	0.10	0.29	0.36
Be	3									
Sc	10.6	38.7	14.3	9.9	14.2	10.3	17	14	10.4	36
V	20	344.3	15.3	25.8	31.8	7.3	21.1	21.5	24.6	271.5
Cr	7.4	11.1	7.5	7.5	5.4	8.9	5.2	11	11.1	13.3
Co	1.3	21.4	4.4	5.9	3.8	3.7	4.9	2.1	1.5	23.8
Ni	4.5	8.8	3.6	4.4	4	2	2.1	0.5	2.2	8.8
Cu	29.5	37.2	5.2	18.6	17.6	12	17.8	6.2	6.3	78.9
Zn	94.3	105.8	44	79.1	84.8	59	66.7	34.6	52.4	79
Ga	20	20.9	11.6	19	18.9	15.6	18.4	11.9	11.1	20.7
Ge	1									
As	10									
Rb	239.6	45.2	124	265.5	250	165.2	258.3	109.7	149	112.4
Sr	247.1	421.6	114.4	207.7	196	128.4	186.9	113.1	114.1	374.7
Y	37.5	22.9	28.3	46.7	30.4	38.5	40.1	31.4	29.2	25.8
Zr	289	112.6	162.2	285.4	275.1	260.1	288.6	191.8	178.9	125.4
Nb	14.8	6.9	8.8	12.7	12.7	12.7	14.9	9.2	8.6	4.9
Mo										
Ag										
In										
Sn	3									
Sb										
Cs	13.4									
Ba	594.2	339.9	346.1	623.4	549.4	542.5	562.4	401	368.5	416
La	39.5	3.6	16.1	43.2	46.7	28.3	44.9	24.8	20.3	21.7
Ce	77	34.6	40.8	90	81.9	61	101.7	49.4	37.2	33.2
Pr	8.37									
Nd	30.8									
Sm	6									
Eu	1.44									
Gd	5.5									
Tb	0.9									
Dy	5.3									
Ho	1.1									
Er	3.2									
Tm	0.5									
Yb	3.3									
Lu	0.49									
Hf	7.1	2.8	4.2	7	6.8	6.5	7.1	4.9	4.6	3.2
Ta	1.2									
W	2									
Tl	0.9									
Pb	26.7	8.9	10.2	29.4	29.7	17.7	24.1	11.2	11.6	9.6
Bi										
Th	16.6	6.9	7.6	21.1	22.7	12.9	25.5	12.4	6.7	7.9
U	4.2	1.6	1.8	6.2	4.6	3.4	5.2	3	2	2
F	1025.3	637.7	536.7	1022.1	636.3	527.9	767.5	498.8	559.5	854.4
Cl	605.7	73.6	35.1	58.9	65.1	284.6	42.4	40.6	255.9	71.3
S	38.6	<LLD	<LLD	<LLD	44	<LLD	<LLD	<LLD	<LLD	<LLD
Dy/Yb	1.6									
Nb/Yb	4.5									
Th/Yb	5.0									
Sr/Y	6.6	18.4	4.0	4.4	6.4	3.3	4.7	3.6	3.9	14.5
(La/Yb) _N	8.3									
(La/Sm) _N	4.1									

Supplementary table 1 - Continued.

District	North Sardinia								
Sample	MA83A	MA83B	MA84A	MA84B	MA85	MA87	MA88	MA89	MA90
Locality	Anglona								
Reference	Marrazzo (2008), Guarino et al. (2011)								
Lithology	R	R	TR-D	TR-D	TR-D	TR-D	TR-D	TR-D	TR-D
SiO ₂	69.54	71.23	65.86	65.59	66.35	65.50	66.80	65.39	66.10
TiO ₂	0.46	0.43	0.64	0.61	0.53	0.58	0.53	0.59	0.57
Al ₂ O ₃	15.21	14.27	15.83	15.83	15.51	15.49	15.94	16.80	16.12
Fe ₂ O ₃ _{tot}	3.28	3.21	4.80	5.37	4.42	4.66	4.43	4.81	4.64
MnO	0.03	0.05	0.05	0.12	0.15	0.09	0.06	0.06	0.08
MgO	0.16	0.14	0.62	1.49	0.42	1.25	1.03	0.68	0.50
CaO	1.12	1.02	2.41	3.20	2.00	2.18	1.33	1.80	2.08
Na ₂ O	3.59	3.41	3.48	3.31	2.99	3.22	2.82	3.26	3.60
K ₂ O	6.52	6.18	6.14	4.32	7.41	6.90	6.93	6.44	6.15
P ₂ O ₅	0.09	0.07	0.17	0.16	0.22	0.13	0.12	0.16	0.16
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	10.11	9.59	9.62	7.63	10.40	10.12	9.75	9.70	9.75
LOI	1.0	1.0	0.9	5.1	0.8	1.3	3.0	2.2	1.1
Mg#	0.09	0.08	0.20	0.35	0.16	0.35	0.32	0.22	0.18
Be									
Sc	15.2	11.2	14.8	21.6	14	20.2	14.5	18.1	17.1
V	10.4	13.4	53.1	51.8	43.2	42.7	35.6	49.4	37.6
Cr	1.5	2.3	9	9.5	6	4.5	4.2	8.6	8.6
Co	0.9	0.3	4.9	7.5	3.6	6.1	6.8	8.4	4.3
Ni	3.9	4.4	2.5	2.9	4.9	8.5	8.6	5.1	4.4
Cu	9.6	10.2	24	26.7	20.2	29.6	35.5	24.3	23
Zn	55.8	59.6	99.8	97.9	87.6	76.8	76.6	84.2	79.2
Ga	18.5	17.8	21	20.8	18.3	19.9	18.4	20.8	19.9
Ge									
As									
Rb	301.6	278.4	280.6	341.3	250.2	319.8	281.5	268.2	267.6
Sr	152.4	140.6	231	269.6	201.7	181.9	156.9	207	207.4
Y	28	22.7	35.3	52.1	31.9	29.6	33.7	33.1	36
Zr	289.8	284	292.5	308.5	268.4	281.5	292.7	291.6	297.7
Nb	13.9	13.8	14.4	13.5	14	12.3	13.4	13.1	13.1
Mo									
Ag									
In									
Sn									
Sb									
Cs									
Ba	559.4	587	565.4	662.7	566.3	538.4	520.1	562	574.7
La	56.9	46.7	40.3	47.8	39.4	44	50.8	36.4	47.7
Ce	101.2	78.5	91.7	105.7	84	84	91.5	78.7	102.3
Pr									
Nd									
Sm									
Eu									
Gd									
Tb									
Dy									
Ho									
Er									
Tm									
Yb									
Lu									
Hf	7.2	7.1	7.2	7.6	6.6	6.9	7.2	7.2	7.4
Ta									
W									
Tl									
Pb	32.8	29.3	27.1	29.4	24.6	26.2	23.9	23.4	23.5
Bi									
Th	27.6	26.7	25	23.3	22.5	23.9	22.7	23.9	25.7
U	5.6	5.5	5.6	6.2	6.4	4.9	5	4.9	6.1
F	392.2	465.4	1212.6	979.5	957.4	916.6	1024	1034.5	960.5
Cl	30.2	32.2	83.3	663.8	79.8	85.2	58	54	60.4
S	<LLD	<LLD	31.4	46.2	<LLD	31.1	<LLD	<LLD	<LLD
Dy/Yb									
Nb/Yb									
Th/Yb									
Sr/Y	5.4	6.2	6.5	5.2	6.3	6.1	4.7	6.3	5.8
(La/Yb) _N									
(La/Sm) _N									

Supplementary table 1 - Continued.

District	North Sardinia							North Sardinia			
Sample	MA60	MA61	MA62A	MA62B	MA63	MA64	MA65	MA66	MA67	MA68	MA69
Locality	Mulargia-Macomer							Ottana			
Reference	Marrazzo (2008), Guarino et al. (2011)							Marrazzo (2008), Guarino et al. (2011)			
Lithology	TR-D	R	R	R	R	R	TR-D	R	R	R	D
SiO ₂	60.10	70.63	71.35	71.24	71.32	71.10	68.36	74.91	71.02	79.31	67.71
TiO ₂	0.87	0.50	0.39	0.40	0.46	0.40	0.59	0.36	0.49	0.28	0.73
Al ₂ O ₃	16.98	14.35	14.37	14.54	14.63	14.82	15.68	12.27	14.09	10.26	14.80
Fe ₂ O _{3tot}	7.11	4.01	3.65	3.88	3.58	3.61	4.30	3.20	4.13	2.50	5.45
MnO	0.19	0.07	0.06	0.06	0.08	0.09	0.13	0.03	0.04	0.06	0.04
MgO	1.06	0.21	0.43	0.35	0.49	0.83	0.75	0.16	0.35	0.10	0.66
CaO	3.85	1.27	1.45	1.35	1.57	1.37	2.07	1.34	2.00	1.16	2.88
Na ₂ O	3.29	3.55	3.65	3.43	3.47	3.08	3.79	3.34	3.58	2.82	3.64
K ₂ O	6.21	5.33	4.56	4.67	4.33	4.62	4.19	4.31	4.17	3.44	3.88
P ₂ O ₅	0.33	0.08	0.09	0.08	0.07	0.08	0.14	0.08	0.13	0.07	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	9.50	8.88	8.21	8.10	7.80	7.70	7.98	7.64	7.75	6.25	7.53
LOI	1.6	1.0	1.4	1.9	1.8	2.8	2.1	1.2	2.2	1.4	2.9
Mg#	0.23	0.09	0.19	0.15	0.21	0.31	0.26	0.09	0.14	0.07	0.19
Be											
Sc	25.4	20.4	15.7	21	19.2	20.4	18.4	18.9	15.4	14.5	23.7
V	136.1	27.4	20.5	16.5	21.4	11.7	42.4	23.2	33.9	9.9	69.2
Cr	5.1	9.1	8.2	13.4	8.8	8.2	11.4	10.7	5.6	11.3	3.4
Co	12.5	1.3	2.9	1.7	3	4.6	4.6	2.2	1.7	1.1	4.9
Ni	4.5	1.9	0.5	1.3	2.1	2	1.2	0.5	<LLD	0.5	3.1
Cu	30.1	10.9	9.8	7.6	5.6	7.4	11.3	7.1	11.7	6.6	15.2
Zn	86.5	81.2	71.9	71.7	67.6	72.7	59.3	53.8	68.5	47.7	103.4
Ga	18.6	18.3	16.9	18.2	17.3	17.6	16.5	15.4	19	13.9	20.1
Ge											
As											
Rb	165.5	160.4	174.6	175.9	154.1	170.2	141.9	165.2	157.8	135.2	126.7
Sr	214.1	126.3	126.5	121	144.2	121.7	172	108.1	153.9	106.3	243.9
Y	44.4	34.9	47.4	50.2	35.8	38.6	40	43.4	37.5	38.9	42.4
Zr	160.6	256.8	299.6	294.8	262	283.1	231.5	274.8	278.3	227.6	241.6
Nb	8.4	12.4	14.5	14.4	13.5	14.6	13.1	12.9	13.3	10.7	13.1
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	424.9	534.2	616.3	631.8	555.7	608.5	531.2	605.1	621.7	497.1	1333.9
La	29.5	28.6	48.7	29.2	38.3	32.6	30.8	33.1	29.2	29.5	30.5
Ce	49.4	48.9	78.7	50.6	49.6	59.5	52.7	63.9	59.9	61.7	84.1
Pr											
Nd											
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Lu											
Hf	4.1	6.4	7.4	7.3	6.5	7	5.8	6.9	6.9	5.7	6
Ta											
W											
Tl											
Pb	10.6	14.5	25.6	16	19.5	23.3	11.8	13	19.8	17.6	17.2
Bi											
Th	6.3	13.3	14.1	15.5	12.7	12.4	11.2	13.3	13.3	10.6	14.5
U	1.5	3.3	4	3.4	3.1	3.6	2.9	3.4	3.4	2.6	3
F	655.1	602	629.1	395.4	650.9	732.5	522.5	461.1	506.4	599.3	542.9
Cl	65.3	183.5	99.7	92.7	27.1	65.3	107.1	46.1	50.5	133.3	355.7
S	<LLD	<LLD	<LLD	<LLD	<LLD	4.8	<LLD	<LLD	69.2	13.5	193.1
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	4.8	3.6	2.7	2.4	4.0	3.2	4.3	2.5	4.1	2.7	5.8
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	Montresta									
Sample	KGB LF	KB24	KB23	KB22	KB21	KB13	KB14	KB37	KB2	KB32
Reference	Morra et al. (1997), Franciosi et al. (2003)									
Lithology	HMB	HMB	HMB	HMB	B	B	HAB	HAB	HAB	HAB
SiO ₂	47.76	47.50	47.79	47.51	48.02	48.14	48.49	47.75	47.87	48.89
TiO ₂	0.82	0.83	0.78	0.81	0.92	0.83	0.88	0.89	0.97	1.04
Al ₂ O ₃	16.97	16.99	17.21	17.22	16.82	17.09	17.93	19.22	18.22	18.51
Fe ₂ O _{3tot}	10.53	10.24	10.38	10.45	10.03	10.27	10.55	10.83	11.43	10.72
MnO	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.21	0.21
MgO	9.74	9.91	9.87	9.58	10.05	7.99	6.62	6.06	6.38	5.71
CaO	11.38	11.63	11.09	11.55	11.03	12.82	12.52	11.88	11.64	10.96
Na ₂ O	2.02	2.09	2.09	2.09	1.99	1.99	2.06	2.29	2.21	2.42
K ₂ O	0.43	0.44	0.42	0.44	0.65	0.50	0.58	0.66	0.88	1.33
P ₂ O ₅	0.15	0.17	0.17	0.15	0.30	0.17	0.16	0.21	0.18	0.21
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	2.46	2.54	2.52	2.54	2.65	2.49	2.64	2.96	3.10	3.75
Mg#	0.65	0.66	0.65	0.64	0.67	0.61	0.55	0.53	0.53	0.51
Be										
Sc	46.1	40.8	44.6	34.6	43.1	47.8	54.5	42.2	40.5	42.5
V	310.2	320.4	300.9	313.4	336.8	330.4	348.1	335.3	413.2	311.4
Cr	740.9	757.7	726.6	727	680.1	360.2	194.9	80.8	93.7	71.6
Co	49.1	44.3	48	48.8	43.7	41.6	38.3	39.4	39.4	34.5
Ni	218	201.6	221.7	215.9	186.1	88.8	57.9	46.2	47.2	34.5
Cu	102.8	86	117	103.8	79.6	87.7	94.1	110.1	135.2	90.2
Zn	87.1	83.6	88.8	89.4	84.3	88	93.6	96	100.3	95.6
Ga	15.3	15.3	15.5	16	15.2	16.3	17.6	18.8	19.9	17.8
Ge		1.35	1.38			1.35				
As										
Rb	8.1	6.1	8.4	7.5	16.1	11.8	16	15.7	22.4	34.5
Sr	414.8	448.3	428.7	427.9	429.1	382.2	407.2	455.8	412	333.7
Y	19.5	18.6	18.3	18.5	22	18	18.6	20.4	22.7	25.7
Zr	42.4	46.4	40.1	44.2	58	45.8	51.3	50.4	60.5	73.6
Nb	3.6	1.97	1.85	2.5	3.6	1.81	3.5	2.8	3.4	5.8
Mo		0.09	0.23			0.2				
Ag										
In		0.04	0.03			0.03				
Sn		0.74	0.55			0.47				
Sb										
Cs		0.08	0.15			0.2				
Ba	59.6	71.1	77.3	79	90.7	73.1	86.3	102.4	101.6	128.8
La	9	4.55	6	6	6.6	4.88	1	5	6.86	9
Ce	16	11.5	13	11	8.2	11.5	12	29	16.5	34
Pr		1.8	1.84			1.69			2.24	
Nd		8.52	9.18			8.27			10.6	
Sm		2.53	2.59			2.45			2.86	
Eu		0.8	0.84			0.88			0.95	
Gd		2.31	2.49			2.3			2.73	
Tb		0.44	0.46			0.4			0.5	
Dy		2.89	2.84			2.72			3.18	
Ho		0.62	0.64			0.62			0.66	
Er		1.71	1.57			1.57			1.85	
Tm		0.26	0.27			0.25			0.27	
Yb		1.66	1.55			1.61			1.9	
Lu		0.24	0.28			0.22			0.28	
Hf	1.10	1.13	1.14	1.10	1.40	1.01	1.30	1.20	1.50	1.80
Ta		0.14	0.13			0.13				
W		0.02	0.05			0.03				
Tl										
Pb	<LLD	1.8	1.95	3.9	5.8	1.88	<LLD	3.8	3.7	5
Bi										
Th	2	0.54	0.63	3.80	2.80	0.59	0	4	3	3
U	0.60	0.13	0.12	<LLD	0.70	0.12	<LLD	0.90	0.90	0.90
F	<LLD	89.80	131.90	45.10	253.00	262.00	119.90	221.60	273.40	370.80
Cl	22.40	12.60	92.10	4.00	72.20	78.90	104.60	72.70	233.80	50.50
S	<LLD	61.10	<LLD	<LLD	106.00	<LLD	<LLD	<LLD	<LLD	1289.70
Dy/Yb		1.7	1.8			1.7			1.7	
Nb/Yb		1.2	1.2			1.1			1.8	
Th/Yb		0.3	0.4			0.4			1.7	
Sr/Y	21.3	24.1	23.4	23.1	19.5	21.2	21.9	22.3	18.1	13.0
(La/Yb) _N		1.9	2.7			2.1			2.5	
(La/Sm) _N		1.1	1.4			1.2			1.5	

Supplementary table 1 - Continued.

District	Montresta									
Sample	KB1	KB12	KB16	KB18	KB30	KB35	KB36	KB6	KB10	KB17
Reference	Morra et al. (1997), Franciosi et al. (2003)									
Lithology	B	B	HAB	B	B	B	HAB	HAB	HAB	HAB
SiO ₂	48.14	49.15	50.13	48.55	48.71	48.71	48.24	49.59	49.11	48.59
TiO ₂	1.04	0.95	1.07	1.00	1.01	0.98	1.08	1.07	0.93	1.07
Al ₂ O ₃	17.78	17.08	18.54	17.76	17.91	16.90	18.42	18.17	19.01	19.08
Fe ₂ O _{3tot}	11.27	10.99	9.74	10.70	10.61	10.20	11.11	10.36	10.35	10.95
MnO	0.16	0.18	0.21	0.17	0.20	0.18	0.32	0.15	0.20	0.21
MgO	8.04	7.94	6.12	7.23	7.18	8.21	6.49	6.65	5.25	4.91
CaO	10.90	10.87	10.05	11.28	10.79	11.81	10.47	10.17	11.66	11.64
Na ₂ O	1.80	1.85	2.50	2.09	1.85	2.23	2.18	2.33	2.24	2.57
K ₂ O	0.71	0.81	1.42	1.04	1.56	0.60	1.45	1.29	1.02	0.80
P ₂ O ₅	0.16	0.17	0.22	0.17	0.18	0.18	0.23	0.21	0.21	0.17
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	2.51	2.66	3.93	3.13	3.42	2.84	3.63	3.63	3.27	3.38
Mg#	0.59	0.59	0.55	0.57	0.57	0.61	0.54	0.56	0.50	0.47
Be										
Sc	45.4	44.2	33.4	48.8	39.3	54.7	36.4	37.1	40.4	49.8
V	396.8	383.1	322.1	321.7	268.4	379.9	341.8	313.8	315.4	350.5
Cr	30.4	101.8	49.3	84.1	38.4	191.6	34.4	38.9	76.2	28.1
Co	35.2	40.9	28.3	37.1	30.8	35.6	33	32.3	32.4	36.1
Ni	25.4	41	22.8	33.2	32	73.7	24.9	23.8	30.8	24.9
Cu	39	113.2	55	80.9	90.3	114.8	78.7	62.5	80.6	81.8
Zn	107.7	97.5	92.3	102.5	94.7	89.7	92.7	98.5	90.4	101.8
Ga	20.4	17.7	19.9	18.4	19.8	18.2	21	19.2	20.5	21.5
Ge										
As										
Rb	13.2	22.7	38.2	26.6	50	13.4	41.3	33.6	25.8	21.2
Sr	304.3	381.3	343.3	328.3	370.6	480	358.2	338.1	352.6	314
Y	23.5	22.8	25.9	24.5	26.2	22.4	27.3	35	23.1	24.8
Zr	67.2	56.2	83.3	62.1	76.2	52.3	80.8	79.6	69.5	67.4
Nb	4.2	4.4	5.9	4	5.2	2.9	5.8	5.9	5.1	4.5
Mo										
Ag										
In										
Sn										
Sb										
Cs										
Ba	120.4	136.4	199.9	136.7	155.2	124	151.5	153	175.4	128.2
La	14.8	4.8	11.1		18.4	6.6	11.8	47.2	12	7
Ce	18.6	11.3	16.7		8.6	11.7	26.1	18.8	35	21
Pr										
Nd										
Sm										
Eu										
Gd										
Tb										
Dy										
Ho										
Er										
Tm										
Yb										
Lu										
Hf	1.70	1.40	2.00	1.60	1.90	1.30	2.00	2.00	1.70	1.70
Ta										
W										
Tl										
Pb	2.9	3.7	5.6	3	4.5	<LLD	4.5	3.8	5.1	2.9
Bi										
Th	6	3	5	5	8	2	3	3	3	3
U	1.20	0.80	1.00	1.20	<LLD	<LLD	0.80	0.90	0.60	0.60
F	215.50	204.20	475.00	130.40	308.90	506.60	850.30	352.50	568.60	273.80
Cl	9.10	26.60	22.60	18.10	33.70	93.40	36.00	14.00	60.80	30.10
S	<LLD	14.70	<LLD	13.60	12.50	<LLD	<LLD	<LLD	117.90	174.90
Dy/Yb										
Nb/Yb										
Th/Yb										
Sr/Y	12.9	16.7	13.3	13.4	14.1	21.4	13.1	9.7	15.3	12.7
(La/Yb) _N										
(La/Sm) _N										

Supplementary table 1 - Continued.

District	Montresta									
Sample	KB7	KB25	KB18	KB26	KB29	KB15	KB9	KB31	KB19	KB28
Reference	Morra et al. (1997), Franciosi et al. (2003)									
Lithology	HAB	HAB	HAB	HAB	HAB	BA	BA	BA	BA	A
SiO ₂	49.97	50.84	48.86	51.31	50.95	53.84	54.02	52.43	52.02	57.64
TiO ₂	1.03	1.07	1.04	1.19	1.22	1.02	0.99	1.17	1.18	0.98
Al ₂ O ₃	18.42	19.73	19.35	19.04	20.70	18.55	18.40	18.98	18.96	17.66
Fe ₂ O _{3tot}	10.27	9.83	10.76	9.83	9.75	9.00	8.76	10.19	10.06	7.96
MnO	0.18	0.17	0.21	0.16	0.21	0.18	0.20	0.14	0.21	0.18
MgO	5.47	3.54	4.86	3.89	2.56	3.32	3.36	2.77	3.10	2.43
CaO	10.79	10.51	11.31	9.66	9.48	9.18	9.15	10.99	9.34	7.78
Na ₂ O	2.49	2.93	2.66	2.96	3.08	3.01	3.18	2.02	3.16	3.77
K ₂ O	1.17	1.11	0.79	1.67	1.71	1.69	1.70	1.11	1.71	1.36
P ₂ O ₅	0.20	0.27	0.16	0.29	0.35	0.22	0.24	0.19	0.27	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.67	4.04	3.46	4.63	4.79	4.70	4.88	3.14	4.87	5.13
Mg#	0.51	0.42	0.47	0.44	0.34	0.42	0.43	0.35	0.38	0.38
Be										
Sc	37.8	28.3	45	28.7	30.8	29.5	34.2	41.9	37.5	23
V	324.7	309.8	334.9	258.1	256.3	262.2	260.5	368.3	284.9	190.8
Cr	44.1	19.6	31.8	6.9	15.2	17.2	19.2	49.1	2.7	11.6
Co	29.6	27.1	32.9	22.7	17.1	25.2	28.8	42.2	27.9	17.3
Ni	31.4	19.3	31.6	12.4	10.5	16.7	17.6	31.7	13.2	8.2
Cu	47.8	167	100	67.8	56.3	54.4	51.3	79.3	63.4	49.3
Zn	93.9	96	106.3	125.9	104.4	84.4	85.8	83.2	101.6	86.7
Ga	20.5	19.2	20.6	23.1	30.3	20.1	20.4	21.1	21.6	20.8
Ge										
As										
Rb	30.7	28.7	20.8	30.2	33.8	42.5	39.3	38.7	49.4	69
Sr	355.4	379.6	315.1	417.5	245.1	415.4	371.3	390.2	378.3	353.2
Y	26.2	27.9	25.6	53.4	38	29.2	31.7	27.1	33	33.8
Zr	82.5	93.9	62.9	122.5	153	93.1	118.4	77.4	112	165.2
Nb	5.9	7	4.9	7.5	11.2	5.5	8	5.3	8	11.1
Mo										
Ag										
In										
Sn										
Sb										
Cs										
Ba	188	189.8	120.5	270.2	174.2	201.3	273.6	165.1	216.7	342.1
La	11	14			16.2	14.6	23.6	10.9	16.5	33.3
Ce	27	33			48.6	34.8	41.4	12.5	38.2	57.4
Pr								3.53		5.36
Nd								16.5		21.8
Sm								3.98		5.11
Eu								1.23		1.4
Gd								3.94		4.5
Tb								0.69		0.76
Dy								4.23		4.82
Ho								0.96		1.09
Er								2.66		2.89
Tm								0.4		0.43
Yb								2.65		2.97
Lu								0.37		0.47
Hf	2.10	2.40	1.60	3.00	3.90	2.30	3.00	1.90	2.80	4.10
Ta										
W										
Tl										
Pb	1.9	5.6	4.6	8	10.8	6.5	3.3	5.6	8.4	10.6
Bi										
Th	5	2	4	3	6	4	6	5	7	6
U	<LLD	0.50	0.90	0.60	1.40	0.80	1.50	1.20	1.60	1.20
F	383.70	543.30	72.80	449.50	426.90	344.30	461.90	189.50	553.90	616.70
Cl	71.50	54.90	25.60	95.30	34.70	94.70	61.70	23.50	69.90	354.40
S	<LLD	1.10	164.60	145.80	<LLD	<LLD	<LLD	0.90	<LLD	<LLD
Dy/Yb								1.6		1.6
Nb/Yb								2.0		3.7
Th/Yb								2.0		2.0
Sr/Y	13.6	13.6	12.3	7.8	6.5	14.2	11.7	14.4	11.5	10.4
(La/Yb) _N								2.9		7.8
(La/Sm) _N								1.7		4.1

Supplementary table 1 - Continued.

District	Sindia										
Sample	SD1	SS1	SD2	SIN18	SIN51	SIN22	SIN28	SIN38	SIN49	SIN55	SIN46
Reference	Lonis et al. (1997)										
Lithology	HAB	HAB	HAB	BA	A	BA	BA	BA	A	BA	A
SiO ₂	48.72	49.64	51.77	54.86	57.17	56.58	56.01	56.43	58.02	56.38	58.97
TiO ₂	1.08	0.85	0.82	0.91	0.76	0.83	0.86	0.82	0.75	0.81	0.83
Al ₂ O ₃	19.33	19.33	19.33	17.86	17.51	17.59	17.72	17.30	17.30	18.27	16.79
Fe ₂ O _{3tot}	11.06	10.57	9.53	9.15	8.05	8.64	8.90	8.57	7.73	8.15	7.68
MnO	0.22	0.20	0.17	0.19	0.16	0.19	0.17	0.17	0.13	0.17	0.15
MgO	4.43	4.55	3.81	3.40	3.13	2.96	2.98	3.46	3.31	2.65	3.14
CaO	10.96	11.28	9.94	8.98	8.11	8.08	8.33	8.29	7.61	8.63	7.22
Na ₂ O	2.93	2.27	2.90	2.68	2.78	2.78	2.99	2.78	2.83	2.77	2.81
K ₂ O	1.02	1.13	1.38	1.81	2.18	2.13	1.86	2.04	2.16	2.01	2.25
P ₂ O ₅	0.25	0.16	0.34	0.16	0.16	0.22	0.17	0.14	0.17	0.16	0.17
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.95	3.41	4.28	4.49	4.95	4.91	4.85	4.82	4.99	4.78	5.06
LOI	1.63	2.17	1.84	1.78	1.58	1.40	1.24	1.68	1.79	1.40	2.00
Mg#	0.44	0.46	0.44	0.42	0.43	0.40	0.40	0.44	0.46	0.39	0.45
Be			1								
Sc	44	33.2	26	28.4	30.1	19.7	37.7	36.9	31	28.1	23.4
V	384.5	326	259.1	270	214	199.5	256.2	257.4	206.6	213.6	209.2
Cr	13.9	15.2	6	9.3	19.5	15.9	21.5	14	16.9	0.4	4.5
Co	32.6	33.5	30	28.2	22	25.2	25.7	24.2	21	22.8	18.3
Ni	17.7	16	13	18.3	13	11.7	9	11.3	11.7	7.9	7.2
Cu	135.6	120	169.4	49.8	70	56.8	67.6	71.9	43.8	53.8	38.7
Zn	96.8	90.4	83.1	86.5	89.2	81.9	85	79.8	82	70.8	71.3
Ga	22.2	21.2	22	20.9	19.8	19.9	20.1	21.2	18.9	19.2	18.3
Ge			2								
As			< 5								
Rb	19.9	23.4	23.5	55.4	75	69.4	57.3	65.2	68	74.4	69.6
Sr	554.3	437	756.6	393.6	349.7	443.4	393.9	335.8	341	391.5	353.7
Y	24.9	23	23.7	28	25.6	31.9	25.6	23.7	24	28	29.4
Zr	68.6	77.2	78.8	124.2	143.1	156.2	126.7	129.5	141.6	143.7	153.6
Nb	5	5.3	5.5	6.9	6.1	8.1	6.3	7	7	6.8	8.1
Mo			< 2								
Ag			< 0.5								
In			< 0.2								
Sn			1								
Sb			1.3								
Cs			0.5								
Ba	165.1	240	230	297.2	394.1	318.9	326.2	299.2	338.2	293.2	338
La	15.2	9.8	17.7	19.6	23	25.3	36	36	20	21	22
Ce	32.7	21.2	36	41.3	42	52.8	56	54	52	52	58
Pr			4.4								
Nd	18.3	11.9	19.8	19.9		26					
Sm	4.51	3.12	4.5	4.74		5.55					
Eu	1.35	0.97	1.38	1.2		1.4					
Gd	3.72	2.81	4.4	3.89		4.65					
Tb			0.6								
Dy	3.56	3.08	3.4	3.89		4.41					
Ho			0.7								
Er	1.82	1.68	2	2.19		2.48					
Tm			0.29								
Yb	1.9	1.79	1.9	2.33		2.67					
Lu	0.29	0.26	0.3	0.34		0.42					
Hf	1.7	1.9	2	3.1	3.6	3.8	3.1	3.3	3.5	3.6	3.8
Ta			0.2								
W			< 1								
Tl			< 0.1								
Pb	8.4	6.9	6	12.5	22.8	19.1	12.4	11.2	13.2	12.8	15.1
Bi			< 0.4								
Th	4.4	4.8	2.2	7.8	8.9	8.3	6.7	9.4	10.3	9.2	7.2
U	1	<LLD	0.7	2	2	2	1.7	2.1	2.5	<LLD	1.9
F	311.7	515.6	567.5	576.5	452.8	560.4	634.4	565.2	640.4	369.4	848.1
Cl	42.9	22.9	50	75.2	101	104	91.7	70.5	34.5	554.1	68.7
S	<LLD	<LLD	0.9	35.9	344.7	18.8	24.5	27.7	<LLD	19.1	<LLD
Dy/Yb	1.9	1.7	1.8	1.7		1.7					
Nb/Yb	2.6	3.0	2.9	3.0		3.0					
Th/Yb	2.3	2.7	1.2	3.3		3.1					
Sr/Y	22.3	19.0	31.9	14.1	13.7	13.9	15.4	14.2	14.2	14.0	12.0
(La/Yb) _N	5.5	3.8	6.5	5.8		6.6					
(La/Sm) _N	2.1	2.0	2.5	2.6		2.9					

Supplementary table 1 - Continued.

District	Sindia										
Sample	SIN39	SIN50	SIN15	SIN26	SIN33	SIN53	SIN23	SIN6	SIN60	SIN48	SIN7
Reference	Lonis et al. (1997)										
Lithology	A	A	A	A	BA	A	A	A	A	A	A
SiO ₂	57.08	57.23	58.18	58.67	56.84	57.21	58.76	59.40	61.42	58.56	60.90
TiO ₂	0.83	0.79	0.86	0.81	0.85	0.84	0.77	0.75	0.75	0.84	0.70
Al ₂ O ₃	17.75	17.74	17.13	17.50	17.42	17.49	16.89	16.97	17.06	17.22	16.37
Fe ₂ O ₃ tot	8.22	8.02	7.90	7.39	8.82	8.05	7.35	7.21	6.28	7.54	7.07
MnO	0.17	0.17	0.18	0.18	0.17	0.19	0.13	0.14	0.15	0.15	0.11
MgO	2.60	2.73	2.96	2.22	3.29	3.48	3.23	3.17	1.76	2.69	2.01
CaO	8.57	8.26	7.47	7.76	7.83	7.69	7.61	6.81	6.77	7.51	7.23
Na ₂ O	2.77	2.80	2.69	2.93	2.83	2.80	2.63	2.82	3.03	2.85	2.82
K ₂ O	1.85	2.09	2.46	2.36	1.81	2.08	2.49	2.55	2.53	2.46	2.62
P ₂ O ₅	0.16	0.17	0.19	0.19	0.14	0.18	0.15	0.19	0.25	0.19	0.17
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.62	4.88	5.14	5.28	4.64	4.88	5.11	5.36	5.55	5.30	5.43
LOI	2.10	1.73	1.58	1.53	1.74	1.79	2.16	1.80	2.64	1.54	1.82
Mg#	0.38	0.40	0.43	0.37	0.42	0.46	0.47	0.47	0.36	0.41	0.36
Be	1										
Sc	30.2	27.2	24.9	24.3	28.2	27.3	31.1	23.4	21.6	25.6	19
V	248	222.5	236.9	215.7	270.2	214.3	221	184.9	152.4	195.2	160.4
Cr	79.1	21.9	44.3	2.1	18	9.7	4.3	6.1	5.9	8.3	4.8
Co	24.4	21.3	23.6	16.9	27	25.2	17.5	21.9	16.7	20.7	14
Ni	24.6	10.9	20.9	10.2	11.8	13.3	8.7	14.8	7.1	8.8	7.5
Cu	74.7	50.6	71.1	70.6	63.8	63.9	34.5	46	40	47.1	18.9
Zn	89.2	84.5	79	85.6	96.3	77.8	58.3	66.6	86.4	75.2	63.9
Ga	21.4	19.8	19.8	20.6	18.6	20.1	18.2	20.1	19.9	19.9	18.4
Ge	2										
As	< 5										
Rb	91.7	78.9	63.8	88.3	56.3	65.5	79.5	81.3	133.3	81.9	82.1
Sr	376.3	366.9	376.9	376.9	330.8	357.4	365.3	374.6	416.7	366.4	375.9
Y	27.4	27.3	30.6	30	23.6	26.3	28.7	29.3	32.6	31.5	30.6
Zr	147.3	148.1	153.8	162.8	119.9	132.4	154.5	161.7	186.8	173.9	163.4
Nb	7.1	7.2	8.6	8.1	4.8	7.6	7.4	8.3	8.2	8	8.2
Mo	< 2										
Ag	0.7										
In	< 0.2										
Sn	1										
Sb	< 0.5										
Cs	2.3										
Ba	357.3	360.7	359.4	396.7	279.5	328.6	335.5	349.1	439.9	365	346.3
La	22.2	24.9	37	25	19.6	16	22	23	30	21	37
Ce	44.9	49.9	49	62	38.9	48	63	56	68	50	57
Pr	5.62										
Nd	22.1	23.7			18.9						
Sm	4.9	5.2			4.36						
Eu	1.28	1.41			1.19						
Gd	4	5			3.62						
Tb	0.7										
Dy	3.82	4.2			3.54						
Ho	0.8										
Er	2.2	2.4			2.1						
Tm	0.36										
Yb	2.19	2.5			2.15						
Lu	0.37	0.39			0.36						
Hf	3.7	3.4	3.8	4	3	3.3	3.8	4	4.6	4.3	4
Ta	0.4										
W	< 1										
Tl	0.7										
Pb	15	13	15	18.9	5.4	17.6	11	15.2	20.1	16.3	9.6
Bi	< 0.4										
Th	9.6	5.9	7.4	9.7	9.1	8.6	8.7	12.3	9.1	12.2	7.9
U	2.2	1.7	2	2.2	2.2	2	2	2.7	2.1	3	2
F	331.1	563.7	641.3	526	437.9	642	838.3	907.1	618.7	735.5	705.1
Cl	500.1	405.8	75.6	479.3	68.3	88.8	51.9	75.6	445	103.6	51.3
S	3.1	5.8	89.4	40.2	<LLD	70.8	16.4	41.3	<LLD	13	<LLD
Dy/Yb	1.7	1.7			1.6						
Nb/Yb	3.2	2.9			2.2						
Th/Yb	4.4	2.4			4.2						
Sr/Y	13.7	13.4	12.3	12.6	14.0	13.6	12.7	12.8	12.8	11.6	12.3
(La/Yb) _N	7.0	6.9			6.3						
(La/Sm) _N	2.8	3.0			2.8						

Supplementary table 1 - Continued.

District	Sindia										
Sample	SIN47	SIN52BIS	SIN34	SIN14	SIN32	SIN30	SIN44	SIN42	SIN45	SIN59BIS	SIN43
Reference	Lonis et al. (1997)										
Lithology	A	A	A	A	A	A	A	A	A	A	A
SiO ₂	58.90	61.59	61.64	61.44	62.69	59.85	60.68	62.37	61.35	60.29	62.10
TiO ₂	0.81	0.76	0.67	0.67	0.67	0.72	0.74	0.62	0.75	0.74	0.64
Al ₂ O ₃	16.58	15.50	16.77	16.47	16.26	17.29	17.08	16.30	17.25	17.57	16.61
Fe ₂ O _{3tot}	8.12	6.71	5.88	6.19	5.72	6.42	6.42	5.87	6.14	6.57	5.95
MnO	0.14	0.08	0.10	0.12	0.13	0.14	0.15	0.12	0.15	0.11	0.11
MgO	3.71	2.43	2.49	2.91	1.87	2.26	1.72	2.40	1.61	1.85	2.35
CaO	6.67	8.05	6.35	6.22	6.33	7.37	6.92	6.06	6.74	6.73	6.13
Na ₂ O	2.60	2.19	3.05	2.89	3.01	2.97	3.26	3.06	3.20	2.75	3.14
K ₂ O	2.29	2.26	2.84	2.89	3.13	2.76	2.77	2.98	2.56	3.13	2.79
P ₂ O ₅	0.16	0.43	0.22	0.21	0.18	0.23	0.26	0.22	0.25	0.24	0.18
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.89	4.44	5.88	5.78	6.13	5.72	6.03	6.03	5.76	5.88	5.92
LOI	1.38	2.27	2.32	2.01	1.89	1.51	1.55	1.92	2.49	1.35	1.51
Mg#	0.48	0.42	0.46	0.48	0.39	0.41	0.35	0.45	0.34	0.36	0.44
Be											
Sc	23.3	22.7	27.3	23.5	20.3	30.8	23.8	19.7	23.7	20.8	19.9
V	200	202.8	137.5	144.2	147.8	163.7	140.9	140.5	140.6	148.4	143.8
Cr	8.7	9.6	8.3	11.5	9.7	6	35.2	4.3	17	7.2	10
Co	21.4	14.2	12.4	15.9	12.8	20.3	9.8	16.6	14.8	12.7	17.9
Ni	11.4	13.1	7	8.4	10.6	10.6	14.8	12.3	11.8	9.5	12
Cu	53.4	66.4	38.4	40.3	32.2	57.3	40.1	42.9	38.4	42	41.8
Zn	76.4	42.3	72.4	82.4	71.6	76.7	85.6	65	82.4	66.4	72.1
Ga	21	17.5	18.9	19.4	18.8	19.1	19.6	18.7	21.1	19.3	19
Ge											
As											
Rb	82.8	75.7	93.2	97.1	108.9	92.3	107.1	103.7	122.3	116.2	96.3
Sr	375.6	918.5	377.7	452.8	413.9	500.9	418.6	490.4	420	440.1	398.8
Y	30.9	28.2	30.5	28.4	29.8	30.7	32.9	28.5	32.3	29.8	28.5
Zr	174.5	146.6	174.3	180.3	177.8	186.3	196	178.7	193.2	188.1	170.7
Nb	8.1	4.6	7.9	8.4	7.8	7.1	8.8	6.8	7.6	7.8	7.1
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	370.7	293.6	450.4	425.4	461.8	427.4	460.2	428.2	468	452.2	412.8
La	20	52	25	28	56	34.3	32	42	27	32	29.9
Ce	51	116	76	60	57	69.5	67	93	69	69	59.7
Pr											
Nd											26.7
Sm											5.44
Eu											1.33
Gd											4.49
Tb											
Dy											3.99
Ho											
Er											2.31
Tm											
Yb											2.46
Lu											0.42
Hf	4.3	3.3	4.3	4.4	4.3	4.5	4.8	4.3	4.7	4.6	4.1
Ta											
W											
Tl											
Pb	16.4	16.2	18.2	22.9	16.2	16.4	24.6	18	21.3	17.7	15.1
Bi											
Th	11.2	10.7	9.3	13.3	13.7	9.3	12	13	15.2	11.6	12.8
U	2.5	2.3	2.1	3	2.9	2.4	2.9	2.8	3.3	2.6	2.9
F	817.7	1132.7	695	770.4	768.5	709.3	598.1	709	463.1	882.8	779.4
Cl	109.1	113.7	62.2	47.6	40.9	219.2	462.2	44.8	586.8	189.3	60.4
S	<LLD	79.9	23	361.2	5.2	21.1	<LLD	<LLD	<LLD	<LLD	<LLD
Dy/Yb											1.6
Nb/Yb											2.9
Th/Yb											5.2
Sr/Y	12.2	32.6	12.4	15.9	13.9	16.3	12.7	17.2	13.0	14.8	14.0
(La/Yb) _N											8.4
(La/Sm) _N											3.4

Supplementary table 1 - Continued.

District	Sindia										
Sample	SIN36	SIN54	SIN37	SIN29	SIN57	SIN24	SIN52-41	SIN57BIS	SIN59-B1	SIN52-43	SIN41
Reference	Lonis et al. (1997)										
Lithology	A	A	A	A	A	A	A	A	A	A	D
SiO ₂	60.66	60.03	59.95	61.58	61.53	60.05	61.61	62.55	62.57	62.39	69.43
TiO ₂	0.73	0.77	0.72	0.70	0.68	0.70	0.70	0.69	0.71	0.69	0.61
Al ₂ O ₃	17.12	17.08	17.32	16.87	16.89	17.29	16.61	16.44	16.50	16.30	13.60
Fe ₂ O _{3tot}	6.36	6.95	6.18	6.20	6.00	6.75	6.17	5.34	5.60	5.69	5.18
MnO	0.16	0.16	0.11	0.14	0.13	0.12	0.15	0.10	0.11	0.09	0.07
MgO	1.99	1.95	2.33	1.78	2.07	2.30	1.80	2.03	1.47	1.94	0.96
CaO	7.02	7.09	7.13	6.80	6.64	7.24	6.82	6.59	6.69	6.62	4.79
Na ₂ O	3.09	3.30	3.07	3.04	3.09	2.71	3.05	2.96	3.00	2.99	2.36
K ₂ O	2.67	2.48	2.92	2.67	2.78	2.70	2.88	3.08	3.12	3.09	2.79
P ₂ O ₅	0.21	0.18	0.28	0.22	0.21	0.15	0.21	0.22	0.22	0.21	0.21
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	5.76	5.78	5.99	5.70	5.87	5.40	5.93	6.04	6.12	6.08	5.15
LOI	1.89	1.65	1.34	2.22	1.72	1.55	1.38	1.51	1.53		
Mg#	0.38	0.36	0.43	0.36	0.41	0.40	0.37	0.43	0.34	0.40	0.27
Be											
Sc	29.2	24.8	21.3	24.4	22.2	27	21.8	25	28.5	24.4	23.4
V	145.8	159.8	148.6	145.3	145.4	202	142.7	140.2	153.3	150.9	97.2
Cr	6.2	6.4	14.3	16.4	6.5	0	14.1	20.8	16.7	20.8	10.4
Co	15.4	19.2	15.3	16.4	17.4	19.9	16.5	17.7	15.5	15.5	11.3
Ni	7.7	9.3	11.5	12.5	9.7	7.6	12.3	15.6	14	11.8	7.9
Cu	64.3	48.5	54.1	50.8	66.1	36.5	54.5	55.2	50.5	51.9	19.1
Zn	85.5	77.2	75	78.7	74.2	54.2	79.3	67.8	73.4	69.8	50.6
Ga	20.1	18.5	19.6	20.6	19.2	18.1	20.3	18.9	20.8	18.1	15.9
Ge											
As											
Rb	107.3	110.1	100.8	113.7	103.8	88.1	108.5	113.3	110.7	111.4	91.6
Sr	420.2	385	576.2	463	431.5	355.9	468	444	459.4	449.7	423.4
Y	33.4	34.8	31.2	31.1	28.4	45.2	29.6	31.9	30.3	29.8	26.7
Zr	182.1	187.5	191.7	194.2	187.1	164.3	188.5	194.6	187.3	187.2	156.2
Nb	8.1	9	8.2	8.5	9.8	6.7	8.1	8.7	8.7	7.9	6.1
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	490.8	370.9	401.8	442.4	456.2	394	470.6	459.5	461.8	461	403.9
La	31	29	36	56	30.8	33	28	31	43		
Ce	73	63	96	75	62.3	64	71	75	75		
Pr											
Nd					28.1						
Sm					5.63						
Eu					1.4						
Gd					4.46						
Tb											
Dy					4.06						
Ho											
Er					2.31						
Tm											
Yb					2.46						
Lu					0.41						
Hf	4.5	4.6	4.6	4.7	4.6	4.1	4.6	4.7	4.5	4.6	3.8
Ta											
W											
Tl											
Pb	31.2	18.2	24.2	20.2	44.1	11.6	19.1	21	20.1	21.8	22
Bi											
Th	12.4	14.2	11.2	12	12.4	12.8	11.9	12.9	14.4	14.3	11.5
U	2.7	3.3	2.9	3	3	2.9	2.6	2.8	3.1	3.2	2.6
F	676.6	845.6	781.7	483.7	687.2	735.4	403.8	867.1	789.9	900.5	420.4
Cl	344.2	967.5	96.6	443.6	269.7	61.4	434.7	196.9	207.4	184.7	64.7
S	233.6	64.5	61.6	45.8	213.7	9.6	81.7	<LLD	55.6	87.1	171.8
Dy/Yb					1.7						
Nb/Yb					4.0						
Th/Yb					5.0						
Sr/Y	12.6	11.1	18.5	14.9	15.2	7.9	15.8	13.9	15.2	15.1	15.9
(La/Yb) _N					8.7						
(La/Sm) _N					3.4						

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	A63	A1	RL116	F39	AR115	AR280	A89	AR31	AR51	AR139	AR139 (2)
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	HMB	B	HAB	HAB	B	B	BA	BA	BA	B	B
SiO ₂	50.87	51.06	50.83	51.59	50.57	50.71	52.93	53.14	53.63	51.74	51.85
TiO ₂	0.72	0.67	0.68	0.66	0.56	0.77	0.81	1.14	1.12	1.09	0.76
Al ₂ O ₃	15.20	15.17	16.62	17.34	15.25	16.06	17.93	19.23	16.01	17.98	17.27
Fe ₂ O _{3tot}	10.15	10.60	11.49	9.57	9.60	10.13	9.35	10.23	9.88	10.59	9.86
MnO	0.18	0.19	0.19	0.17	0.19	0.18	0.18	0.18	0.26	0.19	0.17
MgO	10.03	8.90	6.47	6.70	11.50	9.18	5.59	3.17	5.69	4.79	6.13
CaO	10.09	10.64	10.59	10.90	9.78	10.26	10.22	9.62	10.36	10.32	10.46
Na ₂ O	1.84	2.22	2.33	2.35	1.72	2.07	2.10	2.39	1.82	2.43	2.33
K ₂ O	0.84	0.46	0.74	0.65	0.75	0.56	0.81	0.78	1.05	0.76	1.07
P ₂ O ₅	0.08	0.08	0.06	0.07	0.08	0.07	0.08	0.11	0.17	0.10	0.09
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	2.69	2.69	3.08	3.01	2.47	2.64	2.92	3.17	2.88	3.19	3.41
LOI	0.91	1.28	1.18	1.26	1.61	1.09	1.10	1.35	1.40		
Mg#	0.66	0.62	0.53	0.58	0.70	0.64	0.54	0.38	0.53	0.47	0.55
Be			0.36			0.13			<1		
Sc	40.1	43.4	37.4	41.4	34.7	41.8	45.1	48.2	41	48.5	35.8
V	259.6	294.5	299	307.3	263.9	255	296.4	318	246	337.8	307.9
Cr	1025.4	587.6	271.3	300	289.1	661	323.3	70.6	290	172.3	271.8
Co	45.8	47.6	42.5	35	42.3	36.4	50.6	41.3	24	32.9	40.4
Ni	243.5	209.1	175	124.6	164.2	172	63.6	22.4	20	43.2	125.4
Cu	71.20	127.10	97.40	142.30	88.60	84.90	50.10	14.10	30	28.70	122.10
Zn	89.10	87.50	91.20	80.30	75.40	77.00	89.80	110.30	80	109.30	89.20
Ga	15.80	17.20	15.50	17.40	17.20	15.10	16.60	22.80	15	21.50	18.40
Ge			1.26			1.11			1		
As									< 5		
Rb	23.6	43.4	24.9	18.2	13.5	14.3	22.8	22.3	33.4	28.3	32.2
Sr	211.7	198.7	214.4	216.4	207.2	212.9	205.1	288.1	299.9	307.2	223.2
Y	22.8	20.2	24.5	18.1	15.9	21.5	22.6	38.2	36	30.8	22.6
Zr	90.7	70.7	63.3	61.7	54.3	73.4	91.5	133.3	148.7	125.4	82.8
Nb	4.5	2.7	2.5	3.2	3.4	4.7	5.2	7.4	7.7	6.9	3.8
Mo			0.59			0.51			< 2		
Ag									< 0.5		
In			0.03			0.05			< 0.2		
Sn			0.49			0.37			1		
Sb									< 0.5		
Cs			0.54			0.36			< 0.5		
Ba	286.7	185.2	182.3	207.4	159.5	203.3	290.6	415.8	382	427.8	239.5
La	13.2	6.03	6.66	5.08	16.5	7.15	12.13	15.77	17.4		
Ce	22.1	17.39	14.69	14.17	1.3	20.47	30.04	34.89	32.1		
Pr			1.76			1.92			4.18		
Nd		7.77	8.36	6.77	6.00	8.22	12.65	16.36	17.20		
Sm		2.50	2.66	2.24		2.63	3.40	4.40	3.80		
Eu		0.65	0.76	0.65		0.79	0.92	1.39	1.07		
Gd		2.42	2.73	2.21		2.61	3.43	4.74	3.60		
Tb			0.48			0.43			0.60		
Dy		2.64	3.13	2.50		2.91	3.40	4.96	3.80		
Ho			0.65			0.60			0.80		
Er		1.49	1.87	1.50		1.74	1.96	2.90	2.50		
Tm			0.29			0.24			0.37		
Yb		1.46	1.77	1.45		1.71	1.92	2.83	2.30		
Lu		0.30	0.32	0.26		0.26	0.33	0.51	0.34		
Hf	2.40	1.80	1.30	1.60	1.40	1.42	2.40	3.40	2.30	3.20	2.10
Ta			0.11			0.17			0.30		
W			0.17			0.16			< 1		
Tl									0.20		
Pb	6.1	7.5	4.03	8.1	5.1	4	2.8	7.8	8	8.5	9.7
Bi									< 0.4		
Th	4	2	1.43	4	2	1.11	4	4	3	5	3
U	0.90	0.50	0.28	<LLD	0.60	0.22		0.80	0.50	1.20	0.80
F	140.50	84.70	<LLD	127.90	163.00	51.80	278.50	147.70	350.70	197.70	160.30
Cl	120.80	84.80	53.60	84.30	62.30	109.30	92.80	433.60	107.90	196.50	94.80
S	<LLD	20.70	<LLD	2.40	6.80	<LLD	2.00	265.00	<LLD	<LLD	<LLD
Dy/Yb		1.8	1.8	1.7		1.7	1.8	1.8	1.7		
Nb/Yb		1.8	1.4	2.2		2.7	2.7	2.6	3.3		
Th/Yb		1.4	0.8	2.8		0.6	2.1	1.3	1.5		
Sr/Y	9.3	9.8	8.8	12.0	13.0	9.9	9.1	7.5	8.3	10.0	9.9
(La/Yb) _N		2.9	2.6	2.4		2.9	4.4	3.9	5.2		
(La/Sm) _N		1.5	1.6	1.4		1.7	2.2	2.2	2.9		

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	AR139 (3)	A46	A48	RL16	RL30	L34A	RL92	A68	AR59	AR186b	AR41
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	B	BA	BA	BA	HAB	BA	BA	BA	BA	BA	BA
SiO ₂	51.55	53.26	52.52	52.24	51.93	53.62	52.34	53.52	53.01	52.99	53.15
TiO ₂	1.10	0.86	0.66	0.70	0.67	0.58	0.66	0.75	0.92	1.18	1.14
Al ₂ O ₃	18.01	15.99	15.12	16.27	19.47	20.93	16.28	15.03	17.26	18.20	18.07
Fe ₂ O _{3tot}	10.61	9.44	9.53	10.00	8.68	7.20	9.71	9.37	9.68	10.60	10.49
MnO	0.19	0.17	0.17	0.16	0.15	0.12	0.18	0.20	0.17	0.19	0.19
MgO	4.80	7.20	8.99	6.96	3.85	3.11	7.03	7.28	5.63	3.97	3.44
CaO	10.46	9.76	9.80	10.54	11.94	11.06	10.88	10.75	10.31	9.51	9.97
Na ₂ O	2.43	2.11	2.01	2.21	2.28	2.54	2.08	2.02	2.08	2.42	2.52
K ₂ O	0.75	1.11	1.09	0.83	0.95	0.78	0.77	0.99	0.83	0.84	0.89
P ₂ O ₅	0.10	0.10	0.09	0.07	0.07	0.06	0.07	0.09	0.10	0.10	0.13
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.18	3.23	3.11	3.05	3.24	3.33	2.86	3.01	2.91	3.27	3.41
LOI			1.07	1.37	1.15	1.49	1.33	1.82	1.27	0.74	1.71
Mg#	0.47	0.60	0.65	0.58	0.47	0.46	0.59	0.61	0.54	0.43	0.39
Be											
Sc	51.5	48.3	39.4	42.4	34.8	38.9	48.3	40.4	48.7	46.6	52.4
V	327.3	255.2	257.6	289.2	278.9	245.8	282.9	287	308.9	344.6	358.5
Cr	170.5	532	559.2	491	234.8	123.1	465.2	401.7	310.5	75.5	109.7
Co	28.1	40	47	40.6	34	31.7	37.8	42.4	49.4	35.5	25.4
Ni	42.1	102.2	181.1	153	88.9	47.6	119.7	166	53.1	11.9	18.9
Cu	28.70	54.80	95.40	115.10	103.90	106.80	83.50	105.20	47.40	15.20	16.50
Zn	106.40	91.00	83.00	91.50	84.20	67.50	84.30	89.80	96.70	107.10	120.10
Ga	22.10	17.30	15.80	17.40	19.70	19.30	15.20	17.10	20.00	19.30	20.00
Ge											
As											
Rb	29.5	25.9	41.5	37.4	31.6	26.1	27.7	37.4	28.4	20.3	23.7
Sr	309.3	214.7	193.3	206.1	263.5	273.3	208.4	210.4	236.4	269.6	294.1
Y	31.9	27.7	18.9	22.6	23.4	15.9	20.3	23.2	27.3	30.1	33.2
Zr	127.6	128.9	78.6	76.6	75	59.1	78.2	93.8	124.9	108.4	114.9
Nb	7.2	7	4.6	3.6	3.2	3.4	4.2	4.5	6.8	6	6.3
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	406.1	456.3	233.4	214.8	254.6	169	264	313.5	443.2	355	394.2
La		18.2	13	9.9	10.5	10.4	7.3	4.4	18.1	14.5	15
Ce		49.8	19.7	20.4	9.1	6.6	17.9	23	38.8	29.3	40.5
Pr											
Nd			13	8	9	9	10	12	18		15
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Hf	3.30	3.30	2.00	2.00	1.90	1.50	2.00	2.30	3.20	2.80	3.00
Ta											
W											
Tl											
Pb	6.9	6.1	4.4	6.1	7.8	7.3	6.9	8.5	8.9	6.3	2.7
Bi											
Th	3	8	4	4	2	4	5	5	3	3	2
U	<LLD	1.70	0.80	0.90	0.50	<LLD	1.20	<LLD	0.70	<LLD	0.40
F	128.80	152.30	219.30	212.90	416.40	415.20	374.60	375.00	384.50	165.60	331.80
Cl	194.60	85.30	79.80	69.40	98.70	63.20	297.40	306.20	203.50	193.30	182.20
S	<LLD	<LLD	55.20	<LLD	14.50	<LLD	<LLD	274.90	<LLD	<LLD	875.50
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	9.7	7.8	10.2	9.1	11.3	17.2	10.3	9.1	8.7	9.0	8.9
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	AR289	L36	RL48b	AR195	L5	F69	L7	AR75	L31	L29	F71
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA
SiO ₂	53.53	54.15	52.69	54.43	53.05	54.43	54.28	55.30	54.28	54.16	54.91
TiO ₂	1.14	0.72	0.59	1.31	0.64	0.77	0.70	0.96	0.75	0.79	0.74
Al ₂ O ₃	19.89	18.56	16.02	19.33	16.00	21.28	16.26	18.30	16.83	15.87	16.74
Fe ₂ O _{3tot}	9.02	8.48	9.39	8.65	9.00	6.46	8.99	7.84	9.02	9.61	8.67
MnO	0.16	0.14	0.19	0.16	0.17	0.11	0.16	0.14	0.15	0.16	0.17
MgO	2.93	4.28	6.85	3.03	7.98	2.42	6.90	4.64	5.67	5.91	6.04
CaO	9.84	9.82	11.19	9.42	10.03	10.63	9.15	8.66	9.70	10.16	9.37
Na ₂ O	2.50	2.58	2.01	2.69	2.07	2.53	2.18	2.50	2.26	2.04	2.03
K ₂ O	0.90	1.16	1.01	0.89	0.99	1.28	1.29	1.50	1.23	1.20	1.22
P ₂ O ₅	0.10	0.11	0.06	0.10	0.07	0.08	0.09	0.16	0.10	0.08	0.11
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.41	3.75	3.03	3.58	3.07	3.82	3.48	4.00	3.50	3.25	3.26
LOI	0.98	1.03	1.01	2.02	1.16	1.50	1.18	1.59	1.02	1.32	1.50
Mg#	0.39	0.50	0.59	0.41	0.64	0.43	0.60	0.54	0.55	0.55	0.58
Be											
Sc	34.8	33.9	44.4	37.1	44.5	25.2	41.2	35.9	37	47.9	44.2
V	286.5	285.1	275.4	297	251	195.9	248.5	220.6	276.2	305.6	220.1
Cr	32	171.5	595.2	25.4	557.5	80.9	465	59.9	274.3	378.2	412.1
Co	39.5	40.3	45.7	28.6	48	39.3	52.4	17.9	47.8	45	44.7
Ni	8.3	89	134.5	8	134.2	25.6	147.2	26	95	97.2	89.4
Cu	17.80	118.20	80.00	15.50	80.90	75.70	70.10	23.20	102.60	107.00	54.00
Zn	96.80	83.90	87.00	99.10	78.00	69.80	85.80	87.60	85.30	99.30	87.40
Ga	21.20	19.20	15.70	21.50	14.90	23.10	15.30	22.40	17.50	17.50	18.00
Ge											
As											
Rb	19.1	48.4	29.6	25.6	40.4	42.8	55.4	28.8	54.6	50.3	37.1
Sr	283.3	247.4	188.2	283.6	173	273.5	190.5	335.8	198	206.3	218.5
Y	33.2	21.1	22.2	32	18.9	23.3	21	33.7	23	24.9	22.9
Zr	111.4	86.2	73.4	118.4	77.9	117.8	95.2	152.7	93.2	100.4	111.3
Nb	5.7	4.7	3.2	5.6	4.4	6.9	5.2	8.1	4.3	5.4	5.6
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	333.1	287.6	259.3	380.4	255.5	390.3	321.6	566.6	335.1	290.6	412.4
La	9.2	16.3	15.15	13.8	14.4	23.4	16.7	22	11.3	14.7	20.8
Ce	24	23.9	32	40.7	11.7	35.1	27.5	51.2	28.6	22.1	45.8
Pr											
Nd	15	11	14.14	15	12	20	14		14	18	17
Sm			3.67								
Eu			0.87								
Gd			3.58								
Tb											
Dy			3.38								
Ho											
Er			1.89								
Tm											
Yb			1.76								
Lu			0.31								
Hf	2.80	2.20	1.90	3.00	2.00	3.00	2.50	3.80	2.40	2.60	2.90
Ta											
W											
Tl											
Pb	5.4	8.6	5	8.6	6.4	10.2	9.3	8.3	8.7	10.9	9.6
Bi											
Th	<LLD	6	5	2	3	6	3	5	5	6	5
U	1.50	1.50	1.20	0.40	0.60	<LLD	0.80	<LLD	1.20	<LLD	1.10
F	213.60	395.60	365.40	266.80	230.60	331.30	420.10	570.40	287.60	217.00	196.60
Cl	226.70	65.50	96.70	134.30	75.50	88.50	61.50	169.50	62.50	54.70	154.30
S	<LLD	<LLD	<LLD	<LLD	<LLD	43.50	<LLD	<LLD	<LLD	<LLD	3.20
Dy/Yb			1.9								
Nb/Yb			1.8								
Th/Yb			3.0								
Sr/Y	8.5	11.7	8.5	8.9	9.2	11.7	9.1	10.0	8.6	8.3	9.5
(La/Yb) _N			6.0								
(La/Sm) _N			2.6								

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	AR286	RL13	L34	AR287	RL27	F41	AR44	L30	AR114	AR306	AR291
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA
SiO ₂	54.04	53.91	53.25	54.98	54.63	54.85	54.98	54.43	54.88	54.96	55.68
TiO ₂	1.11	0.75	0.73	0.85	0.74	0.75	1.21	0.79	1.04	1.16	1.21
Al ₂ O ₃	18.54	16.55	15.76	17.52	16.04	17.15	18.57	16.34	17.34	19.07	15.72
Fe ₂ O _{3tot}	9.37	9.19	9.52	8.90	8.91	8.57	8.90	9.73	9.56	8.20	9.87
MnO	0.18	0.17	0.17	0.16	0.16	0.16	0.18	0.15	0.17	0.15	0.17
MgO	3.66	5.44	7.10	4.58	6.21	5.33	3.00	5.18	3.59	3.04	5.44
CaO	9.44	10.36	9.88	9.50	9.78	9.60	9.54	9.64	9.51	9.32	9.06
Na ₂ O	2.64	2.21	2.12	2.15	2.11	2.31	2.50	2.24	2.43	2.54	1.78
K ₂ O	0.90	1.32	1.36	1.26	1.31	1.16	0.91	1.38	1.36	1.33	0.92
P ₂ O ₅	0.12	0.09	0.10	0.09	0.10	0.11	0.21	0.11	0.12	0.23	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.55	3.53	3.49	3.42	3.43	3.47	3.42	3.63	3.79	3.87	2.71
LOI	0.87	1.37	0.00	1.69	1.18	1.17	1.32				
Mg#	0.44	0.54	0.60	0.50	0.58	0.55	0.40	0.51	0.43	0.42	0.52
Be											
Sc	41.2	44.6	38.6	47.3	40.9	39	40.1	41.2	46.5	31.9	43.4
V	294.9	260.6	267.8	262.3	262.6	218	261.2	297.5	267.3	248	303
Cr	52.5	396	582.2	199.3	383.5	352.2	38.3	263.3	137.4	21.1	45.2
Co	44.7	31.8	40.4	61.2	34.1	38.8	31.5	37.8	23.5	36.6	18.9
Ni	15.4	88.5	168.6	53.3	83.2	86.2	14.8	77.2	19.6	7.6	17
Cu	13.10	69.20	84.60	41.20	69.60	53.10	19.50	108.00	18.70	15.40	13.80
Zn	95.70	91.90	90.90	88.50	89.90	88.30	99.80	101.80	107.00	88.90	114.00
Ga	20.80	19.10	16.80	18.70	15.80	17.90	24.00	18.90	22.60	21.20	23.80
Ge											
As											
Rb	19.1	54.5	54.7	42.2	45	40.3	15.8	53.2	44	30.1	17.5
Sr	270.8	206.1	201.4	229.6	189.8	234.4	406.5	204.5	285.4	423	361.9
Y	33.7	24.6	22	26.7	23.7	26.2	36.6	26.3	31.6	34.3	36.4
Zr	116.3	110.7	101.2	121.5	102.6	123.2	137.6	102.4	162.2	134.3	146.7
Nb	5.9	4.8	5.1	6.4	4.6	6.5	8.4	5.3	10.2	7.5	9.5
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	366	404.2	334.5	410.5	331.8	442.1	437.5	341.3	562.8	573.7	259.3
La	13	16.9	18.8	24	15.1	18.6	17.85	22.4	26.6	28.7	28.6
Ce	31.1	31.8	28.8	42.4	28.1	46.1	39.66	30.4	79.3	60.2	54.7
Pr											
Nd	17	16	14	19	15	19	18.42				
Sm							4.64				
Eu							1.45				
Gd							4.61				
Tb											
Dy							4.83				
Ho											
Er							2.86				
Tm											
Yb							2.78				
Lu							0.46				
Hf	3.00	2.90	2.60	3.10	2.70	3.20	3.40	2.60	4.10	3.30	3.70
Ta											
W											
Tl											
Pb	4.9	12.7	6.4	10.4	9.2	8.8	14.4	7.5	12.4	7.5	7.8
Bi											
Th	2	6	9	4	9	5	4	4	9	2	6
U	0.60	1.70	2.40	1.00	2.00	1.20	1.00	0.90	2.50	0.50	<LLD
F	282.90	413.00	83.30	378.00	516.30	341.10	290.60	317.50	363.60	681.30	481.70
Cl	60.80	125.60	90.00	237.60	143.70	198.50	40.60	42.00	237.50	84.70	99.50
S	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	45.20	<LLD	<LLD	<LLD	19.60
Dy/Yb							1.7				
Nb/Yb							3.0				
Th/Yb							1.6				
Sr/Y	8.0	8.4	9.2	8.6	8.0	8.9	11.1	7.8	9.0	12.3	9.9
(La/Yb) _N							4.5				
(La/Sm) _N							2.4				

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	AR58	AR46	RL17	A77	RL91	AR181	L33	A69	L38	AR114	AR256
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	BA	BA	BA	BA	A	BA	BA	BA	BA	BA	BA
SiO ₂	55.55	55.23	55.99	56.39	57.47	54.80	54.82	55.07	55.13	55.87	55.31
TiO ₂	1.05	1.09	0.69	1.08	1.01	0.67	0.65	0.76	0.65	0.98	1.16
Al ₂ O ₃	17.26	19.50	17.37	18.44	18.31	17.60	16.90	17.02	17.33	17.74	18.80
Fe ₂ O _{3tot}	8.86	7.72	8.52	8.13	7.98	8.08	8.47	8.67	8.81	8.92	7.90
MnO	0.13	0.14	0.15	0.15	0.15	0.15	0.16	0.15	0.17	0.16	0.11
MgO	5.08	3.16	3.74	3.31	2.60	5.12	5.72	5.26	4.56	3.58	3.53
CaO	8.62	9.16	9.67	8.63	8.43	9.90	9.62	9.56	10.13	8.96	9.16
Na ₂ O	2.25	2.63	2.21	2.19	2.47	2.24	2.22	2.04	2.10	2.39	2.55
K ₂ O	1.02	1.21	1.54	1.54	1.45	1.35	1.35	1.35	1.04	1.28	1.24
P ₂ O ₅	0.17	0.15	0.11	0.14	0.13	0.09	0.09	0.10	0.08	0.12	0.24
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.27	3.85	3.76	3.73	3.93	3.60	3.58	3.39	3.14	3.67	3.79
LOI						0.79	0.00	0.70	1.01	1.47	0.85
Mg#	0.53	0.45	0.47	0.45	0.39	0.56	0.57	0.55	0.51	0.44	0.47
Be											
Sc	41.1	39.4	39.4	35	39.6	38.9	45.1	39.9	46	37.4	37.1
V	292.9	275	260.2	230.3	192.2	246.9	240.2	229.7	276.3	252.6	249.6
Cr	61.8	39.1	132.5	25.4	72.7	299.2	406.3	319.3	280.9	112.4	14.4
Co	27.5	29	42.1	29	33.5	53.8	48.2	41.5	46.6	47.8	28.1
Ni	8.5	11.3	28.2	11.1	19.5	73.3	81.3	67.8	72.9	14.8	9.5
Cu	13.90	15.90	48.00	15.60	19.10	72.10	62.40	55.10	57.50	14.00	21.00
Zn	95.90	79.70	88.10	104.70	96.80	79.80	85.10	86.10	83.30	99.90	88.30
Ga	21.20	20.00	18.10	20.90	20.90	17.10	16.60	18.00	17.30	21.30	21.90
Ge											
As											
Rb	20.1	21.6	66.1	44.7	48.6	48.3	47.5	40.9	41.4	39.8	28.9
Sr	297.1	476.7	212.1	279.7	282.8	200.1	179.4	226.7	198.2	271.9	445.6
Y	32.1	33.2	24.2	33.8	34.8	19.6	20	24.9	20	30.2	34.4
Zr	123.9	114.8	99.3	164.3	173	86.9	94.3	118.6	81.8	152.8	136.4
Nb	7.7	6.8	5.6	8.2	10.2	3.5	5.6	7.2	5.4	9.5	8.3
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	479.8	416.3	358.8	614.8	692.3	293.2	343.7	440.9	266.2	563.5	590.7
La	24	15.6	21.8	27.4	35	1.4	20.2	18.8	9.7	26.4	11.6
Ce	36.1	49.1	38.5	69.1	80.3	17.8	34.5	32.9	16.4	65.8	62.5
Pr											
Nd						13	16	17	14	24	24
Sm											
Eu											
Gd											
Tb											
Dy											
Ho											
Er											
Tm											
Yb											
Lu											
Hf	3.10	2.80	2.60	4.10	4.30	2	2	3	2	4	3
Ta											
W											
Tl											
Pb	11.1	5	12.6	15	12.4	7.9	7.4	11.4	8.5	10.7	6.7
Bi											
Th	3	5	9	9	7	6	4	5	6	9	3
U	0.70	<LLD	2.40	1.90	1.60	1.30	1.00	1.20	1.40	2.30	0.90
F	496.70	229.70	447.70	496.90	187.00	345.50	349.50	536.20	687.20	263.20	609.10
Cl	226.50	83.20	212.40	324.10	41.10	101.40	64.40	226.30	154.20	252.30	50.50
S	49.90	6.40	<LLD	<LLD	<LLD	<LLD	<LLD	33.70	<LLD	<LLD	<LLD
Dy/Yb											
Nb/Yb											
Th/Yb											
Sr/Y	9.3	14.4	8.8	8.3	8.1	10.2	9.0	9.1	9.9	9.0	13.0
(La/Yb) _N											
(La/Sm) _N											

Supplementary table 1 - Continued.

District	Arcuentu										
Sample	AR219	AR45	AR255	RL11	RL17	RL90	AR182	RL6 BIS	RL16b	L1	AR171
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)										
Lithology	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA
SiO ₂	55.96	55.42	55.86	56.05	55.39	55.81	55.92	56.39	56.18	55.98	56.83
TiO ₂	0.92	1.04	1.10	0.67	0.72	0.71	0.91	0.71	0.79	0.72	0.97
Al ₂ O ₃	17.62	19.29	19.29	16.22	17.21	16.46	16.94	16.43	17.32	16.51	19.01
Fe ₂ O _{3tot}	8.19	7.49	7.53	8.31	8.84	8.68	8.55	8.24	8.31	8.49	7.93
MnO	0.17	0.13	0.13	0.16	0.16	0.15	0.16	0.14	0.15	0.15	0.14
MgO	4.14	2.94	2.67	5.57	3.82	4.55	4.05	5.16	3.75	4.89	2.35
CaO	9.47	9.36	9.01	9.37	9.95	9.78	9.50	9.14	9.28	9.43	8.47
Na ₂ O	2.22	2.75	2.74	2.26	2.22	2.20	2.28	2.39	2.27	2.13	2.37
K ₂ O	1.19	1.39	1.46	1.29	1.58	1.52	1.56	1.30	1.84	1.58	1.78
P ₂ O ₅	0.12	0.19	0.22	0.09	0.10	0.13	0.12	0.10	0.10	0.11	0.14
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.41	4.14	4.20	3.56	3.80	3.73	3.85	3.69	4.11	3.72	4.16
LOI	1.44	0.96	0.88	1.19	1.29	1.33	0.88		1.28	0.00	1.21
Mg#	0.50	0.44	0.41	0.57	0.46	0.51	0.48	0.55	0.47	0.53	0.37
Be		<1								1	
Sc	41.7	26	34.6	41.8	51.9	39.3	40.5	37.6	42.5	35.0	37.5
V	269.5	227	267.9	248.4	266.8	257.4	270	237.7	247.4	223.0	213.7
Cr	144.3	30	36.3	324.1	171.1	208.5	185.4	262.9	181.6	310.0	23.8
Co	39.3	23	35.2	28.1	23.4	25.6	51.9	26.1	20.6	40	45.6
Ni	23.3	17	11.2	56.1	41.7	48.4	35.9	55.5	40.5	70.0	9.6
Cu	31.30	20	21.80	57.30	51.80	77.40	70.00	52.70	37.40	70	14.70
Zn	97.40	80	79.90	85.10	94.70	87.70	93.50	87.20	91.80	90	97.50
Ga	18.90	19	21.20	16.50	20.30	19.80	19.60	17.90	20.40	17	21.30
Ge		1								2	
As		< 5								< 5	
Rb	39.6	32	31.4	56.4	67.5	52	55.9	62.2	71.3	59.9	55.5
Sr	252.1	356.4	324.4	175.4	220.6	233.1	208.9	207.6	227.5	192.9	271.1
Y	28.4	34.2	32.1	25.8	27.1	24.7	26.7	22.9	25.5	22.7	33
Zr	141.3	150.4	141.6	103.1	104.1	100.4	127.3	112.3	128.1	105.8	166.2
Nb	8.1	8.5	8.1	5.3	6	6	6.8	6.6	6	5.9	10.7
Mo		< 2								2.0	
Ag		< 0.5								< 0.5	
In		< 0.2								< 0.2	
Sn		1								1.0	
Sb		< 0.5								< 0.5	
Cs		< 0.5								2.4	
Ba	525.7	519	567.4	339.8	358.3	369	457.1	432.8	447	329.0	616.8
La	27	17.8	23.5	20.6	28.7	30.2	21.9	21.2	22.8	15.3	33.5
Ce	52.9	36.3	44	34.2	26.3	32	43.5	39.6	46.2	31.0	64.5
Pr		4.4								3.9	
Nd	24	18.60	18	16	15	19	20		19	15.5	25
Sm		4.40								3.6	
Eu		1.35								0.9	
Gd		4.20								3.5	
Tb		0.70								0.6	
Dy		4.30								3.5	
Ho		0.90								0.7	
Er		2.70								2.1	
Tm		0.41								0.3	
Yb		2.70								1.9	
Lu		0.42								0.3	
Hf	4	3	4	3	3	3	3	3	3	2.5	4.20
Ta		1								0.9	
W		75								117.0	
Tl		< 0.1								0.2	
Pb	9.9	7	6.9	11.6	10.7	12.4	10.7	12.6	11.5	13.0	13.7
Bi		< 0.4								< 0.4	
Th	9	2	3	6	6	8	6	7	6	4.7	7
U	2.00	0.40	0.60	1.40	1.50	1.80	1.40	1.50	<LLD	1.5	1.60
F	458.00	493.70	615.80	408.10	559.50	473.20	393.00	305.90	382.10	307.2	359.00
Cl	120.00	42.10	29.00	115.80	212.40	129.70	100.90	137.70	219.40	129.2	96.50
S	<LLD	<LLD	<LLD	12.20	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Dy/Yb		1.6								1.8	
Nb/Yb		3.1								3.1	
Th/Yb		0.9								2.5	
Sr/Y	8.9	10.4	10.1	6.8	8.1	9.4	7.8	9.1	8.9	8.5	8.2
(La/Yb) _N		4.6								5.6	
(La/Sm) _N		2.5								2.7	

Supplementary table 1 - Continued.

District	Arcuentu									
Sample	RL84	AR165	RL20	AR159	RL88	RL48	RL48 (2)	L33A	RL125	AR164
Reference	Brotzu et al. (1997b), Franciosi et al. (2003)									
Lithology	BA	A	A	BA	A	A	BA	BA	A	A
SiO ₂	56.79	58.01	57.82	56.99	57.99	57.04	56.88	56.71	60.22	58.90
TiO ₂	0.98	0.91	0.82	0.83	0.98	1.07	1.08	0.76	1.09	0.93
Al ₂ O ₃	17.79	18.10	17.00	18.37	18.94	18.72	18.80	15.97	18.49	18.19
Fe ₂ O _{3tot}	8.18	8.18	8.47	7.49	7.18	8.27	8.34	8.35	5.52	7.78
MnO	0.16	0.15	0.15	0.16	0.14	0.15	0.15	0.16	0.09	0.14
MgO	2.63	2.66	3.31	2.70	1.94	1.82	1.76	5.21	1.59	2.23
CaO	9.15	8.12	8.40	9.33	8.36	8.45	8.50	9.26	8.22	7.37
Na ₂ O	2.31	2.08	2.11	2.30	2.34	2.47	2.48	1.98	2.37	2.35
K ₂ O	1.89	1.67	1.79	1.73	1.99	1.83	1.85	1.47	2.21	1.96
P ₂ O ₅	0.11	0.12	0.13	0.11	0.15	0.16	0.15	0.12	0.20	0.14
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.20	3.75	3.91	4.03	4.32	4.30	4.32	3.46	4.57	4.32
LOI	1.53	1.85	1.45	1.12	1.58	1.10		0.00		0.82
Mg#	0.39	0.39	0.44	0.42	0.35	0.30	0.30	0.55	0.36	0.36
Be										
Sc	40.2	33.2	39.2	31.8	32	39.8	40.1	37.9	36.4	41.3
V	239.9	213.9	227.8	244.8	176.4	210.3	220	255.7	134.9	205.9
Cr	77	56.5	120.9	142.8	22.7	45.8	49.4	200.7	44.8	23.1
Co	22.5	44.4	17.9	22.4	29.5	13.8	13.5	36.4	11.2	22.3
Ni	16.7	12.6	15.5	36.3	6.2	14.4	15.1	44	14.4	7.8
Cu	25.70	17.50	17.00	44.60	14.30	13.50	12.80	39.60	12.1	14.00
Zn	103.70	96.20	100.00	89.30	91.40	110.30	106.40	94.20	87.3	96.20
Ga	22.30	21.50	18.70	21.20	21.40	23.10	22.90	19.90	25	20.80
Ge										
As										
Rb	57.5	49.4	52.8	39.5	55.3	56.6	55.3	58.8	55.1	57
Sr	258.8	244.7	237.6	292.2	318.9	325.6	328.8	228.7	346.3	256.2
Y	32.3	33.6	30.3	28.3	34.5	39.7	41.7	23.3	35.3	33.9
Zr	172.3	155.1	150	119.1	189.6	189.9	190	105.9	226.5	171.1
Nb	8.3	7.7	7.8	6.1	11.4	11.8	10.6	6	13.1	9.2
Mo										
Ag										
In										
Sn										
Sb										
Cs										
Ba	567.3	578.6	558.3	480.1	766	773.2	807.1	348	913.3	628.7
La	24.8	32.6	24.5	15.6	33.1	37.8	30.1	15.17	44.9	34.7
Ce	51.92	54.7	54	36.36	87.4	77.9	75.9	37.87	93.9	66.2
Pr										
Nd	22.25	26		14.51	31	30		15.01		29
Sm	5.05			3.89				3.72		
Eu	1.20			1.07				0.91		
Gd	4.73			4.25				3.52		
Tb										
Dy	4.40			3.57				3.24		
Ho										
Er	2.51			2.05				1.77		
Tm										
Yb	2.43			1.98				1.74		
Lu	0.42			0.36				0.31		
Hf	4.30	3.90	3.80	3.10	4.70	4.70	4.70	2.70	5.50	4.30
Ta										
W										
Tl										
Pb	14.3	11.5	11.3	10.8	13.6	26.4	15.8	15.7	19.6	15.4
Bi										
Th	10	7	10	2	10	6	9	8	12	10
U	<LLD	1.80	2.70	0.50	<LLD	1.60	2.00	2.00	2.80	2.00
F	489.20	319.80	280.80	206.90	437.10	542.00	530.80	372.70	662.30	324.50
Cl	325.80	368.60	271.50	307.50	213.40	232.50	246.40	434.70	229.60	85.50
S	56.80	249.00	10.40	<LLD	<LLD	<LLD	4.20	144.30	19.80	<LLD
Dy/Yb	1.8			1.8				1.9		
Nb/Yb	3.4			3.1				3.4		
Th/Yb	4.2			1.0				4.4		
Sr/Y	8.0	7.3	7.8	10.3	9.2	8.2	7.9	9.8	9.8	7.6
(La/Yb) _N	7.1			5.5				6.0		
(La/Sm) _N	3.1			2.5				2.6		

Supplementary table 1 - Continued.

District	Sulcis										
Sample	V2	V1	V5	V3	V4	GK60	GK54	GK2	GK1	GK63	GK66
Reference					Ronga (2011), Lustrino et al. (2013)						
Lithology	BA	BA	BA	BA	BA	BA	BA	A	A	A	A
SiO ₂	52.77	53.07	55.06	55.69	56.76	54.49	55.81	57.78	58.48	58.77	62.10
TiO ₂	1.17	1.04	1.07	1.06	1.02	0.82	0.86	0.81	0.69	0.66	0.63
Al ₂ O ₃	18.39	19.84	18.93	18.48	17.62	19.90	18.80	19.03	15.89	19.21	17.69
Fe ₂ O _{3tot}	10.32	9.47	9.12	8.95	9.14	8.52	8.06	7.33	7.78	6.50	6.17
MnO	0.16	0.15	0.16	0.15	0.12	0.14	0.15	0.15	0.14	0.11	0.11
MgO	3.22	2.35	2.22	2.21	2.47	2.81	3.20	2.32	4.13	1.91	1.67
CaO	10.65	10.76	9.60	9.70	9.02	9.94	8.98	8.17	8.70	8.82	6.44
Na ₂ O	2.17	2.34	2.42	2.32	2.57	2.04	2.57	2.67	2.43	2.55	2.86
K ₂ O	0.94	0.78	1.25	1.26	1.06	1.17	1.45	1.54	1.64	1.34	2.10
P ₂ O ₅	0.21	0.20	0.17	0.18	0.21	0.16	0.13	0.20	0.11	0.12	0.22
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.11	3.12	3.67	3.58	3.63	3.22	4.02	4.21	4.07	3.90	4.96
LOI	3.86	2.10	2.74	3.25	3.53	2.75	1.59	2.79	1.83	1.28	1.67
Mg#	0.38	0.33	0.32	0.33	0.35	0.39	0.44	0.39	0.51	0.37	0.35
Be											
Sc	41.4	41.9	37.5	45.8	46.6	41.4	30.4	29.6	37.6	39.5	20.4
V	308.3	321.1	304.9	318.9	284.8	272.9	236.2	187.2	214.3	208.1	126.6
Cr	47.3	43.3	17.4	15.2	10.3	29.9	65.4	7.5	275.3	14.1	
Co	21.6	17.4	16.9	18.5	17.4	27.5	21.9	15.8	24.3	13.4	13.5
Ni	14.1	16.9	3.4	5.2	6.1	12.4	22.2	4.1	46.6	4.8	3.3
Cu	36.6	44.4	34.4	21.7	25.3	53.5	53.2	24.5	63.2	25.4	13.3
Zn	118.3	103.3	111.6	103.3	104	95.1	89.2	94.6	81.8	65.1	92.1
Ga	23.1	22	20.5	20.5	22.4	21.2	20.7	21	16.4	19.6	20.9
Ge											
As											
Rb	29.2	26.2	40.4	38.1	32.1	36.6	65.3	58	64.4	39.1	74.3
Sr	479.5	481.7	357.7	354.7	386.8	426.9	352.1	353	360.6	292.5	353.7
Y	32.3	22.3	26.5	22.6	22.5	23.6	24	25.6	20.9	20.3	24.6
Zr	124.6	96	119.4	109.7	118.6	91.5	108.1	178.4	130.9	95.1	174.3
Nb	7.7	5.4	7	6.4	6.6	4.1	5.4	8.1	6	4.4	6.7
Mo											
Ag											
In											
Sn											
Sb											
Cs			0.6	0.5			2.2				2.1
Ba	322.5	275.5	418.9	381.2	296.8	297	335.6	649.7	428.1	462.3	605.3
La	15	13.6	14.9	14.2		11	14.8	12.8	8.7	15	28.5
Ce	29.7	28.9	31	30.5	32	26.8	30.3	69.8	43.2	31.7	52.7
Pr	4.43	3.96	4.18	4.1			3.88				6.78
Nd	19.3	16.7	17.7	17.2			16.2				25.4
Sm	4.5	4	4.1	4.1			3.7				5
Eu	1.22	1.13	1.15	1.16			1.01				1.21
Gd	4.9	4.2	4.2	4.2			3.9				4.2
Tb	0.8	0.7	0.7	0.7			0.6				0.7
Dy	4.4	4	3.9	3.9			3.6				3.8
Ho	0.9	0.8	0.8	0.8			0.7				0.7
Er	2.6	2.3	2.3	2.2			2.1				2.2
Tm	0.39	0.35	0.35	0.34			0.32				0.34
Yb	2.4	2.3	2.3	2.2			2.1				2.2
Lu	0.39	0.37	0.37	0.36			0.33				0.36
Hf	3.2	3.3	4.1	4.1	3	2.3	2.8	4.4	3.3	2.5	4.3
Ta	0.6	0.7	0.8	0.8			0.3				0.5
W											
Tl							0.1				0.1
Pb	8.7	7.1	7.4	11.1	11.4	5.8	9.9	10.1	12.2	3.3	12.2
Bi											
Th	3.2	3.3	4.1	4.1	6.1	5.7	3.6	7.2	8.8	2.8	5.7
U	0.6	0.7	0.8	0.8		1.3	1	1.6	2	0.6	1.3
F	582.4	536.3	384.5	392.7	552.9	411.9	415.9	546.5	576.8	597.9	596.7
Cl	907.6	263.4	548.5	830.7	1368.2	280.5	281.1	401.9	203.9	63.5	59.2
S	3710.2	16.8	27.7	419.3	241.1			46.5		1.9	
Dy/Yb	1.8	1.7	1.7	1.8			1.7				1.7
Nb/Yb	3.2	2.3	3.0	2.9			2.6				3.0
Th/Yb	1.3	1.4	1.8	1.9			1.7				2.6
Sr/Y	14.8	21.6	13.5	15.7	17.2	18.1	14.7	13.8	17.3	14.4	14.4
(La/Yb) _N	4.3	4.1	4.5	4.5			4.9				9.0
(La/Sm) _N	2.1	2.1	2.3	2.2			2.5				3.6

Supplementary table 1 - Continued.

District	Sulcis										
Sample	GK59	GK3	GK65	GK92	GK95	GK83	GK93	GK94	GK82	GK90	GK81
Reference	Ronga (2011), Lustrino et al. (2013)										
Lithology	A	A	A	BA	BA	BA	BA	A	A	A	A
SiO ₂	62.39	62.70	62.41	54.66	55.56	55.95	56.81	57.01	58.14	58.58	60.38
TiO ₂	0.44	0.61	0.61	0.97	0.93	0.98	1.04	0.66	0.75	0.75	0.73
Al ₂ O ₃	17.47	17.06	17.64	19.34	19.17	19.19	18.58	20.82	18.50	19.12	17.75
Fe ₂ O _{3tot}	5.24	5.46	6.12	8.87	8.95	8.21	8.05	6.18	7.58	6.83	7.54
MnO	0.17	0.11	0.12	0.15	0.17	0.16	0.16	0.10	0.16	0.12	0.11
MgO	2.77	1.97	1.59	2.78	2.59	2.50	1.88	1.15	2.46	1.91	1.58
CaO	6.35	6.59	6.94	9.57	8.69	8.82	8.65	10.03	7.60	8.70	7.08
Na ₂ O	3.15	2.81	2.67	2.49	2.58	2.79	2.98	2.82	2.80	2.28	2.80
K ₂ O	1.83	2.48	1.68	0.98	1.20	1.19	1.59	1.00	1.80	1.57	1.84
P ₂ O ₅	0.19	0.21	0.21	0.19	0.16	0.20	0.25	0.23	0.21	0.13	0.19
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.98	5.29	4.35	3.48	3.79	3.98	4.57	3.82	4.60	3.86	4.64
LOI	2.83	3.64	2.59	2.96	2.76	1.91	2.02	2.25	2.61	1.87	1.55
Mg#	0.51	0.42	0.34	0.38	0.36	0.38	0.32	0.27	0.39	0.36	0.29
Be											
Sc	13.7	9.6	15.5	39.3	32.8	29.2	22.9	25.3	32.2	21.8	22.9
V	75.5	123.6	115.6	232.4	219	225	152.7	87.2	199	172.2	136.4
Cr	29.5	9.8	8.2	14.7	11.2	12.6	11.1	12.5	7.5	27.4	6.5
Co	8.6	12.8	14.3	19.1	21.5	11.3	12.9	10.4	17.6	18.8	13.6
Ni	3.6	3.7	2.2	8.5	6.9	3.4	7.6	0	7	10.6	2.4
Cu	12.3	9.8	17.3	23.1	20.8	21.6	17.9	9.3	21.2	21.8	11.8
Zn	80	84.7	88.8	101	106.3	106.9	115.6	90.9	92.9	76.6	100.4
Ga	20.1	21.2	21.3	22.8	20.1	20.5	23.7	24.7	20.6	22.2	20.7
Ge											
As											
Rb	57.6	100.2	83	31.6	35.5	40.5	45.7	26.1	55.5	65.8	58.2
Sr	290.6	363.9	370.3	369.1	327.6	322.4	355.6	392.6	295.2	279.6	271.1
Y	21.7	24.1	23.8	27.3	27.5	31.2	31.7	25.8	26.9	22	24
Zr	150.5	192.9	171	116.9	112	156.4	148.5	209.1	125.5	108.5	130.6
Nb	8.9	9	8.1	6.4	6.3	9.6	9.4	10.1	7.4	5.1	6.7
Mo											
Ag											
In											
Sn											
Sb											
Cs				2.4		0.7					
Ba	805.5	1076.2	633.2	320.8	318.5	152	457.3	498.7	618.7	397.3	435.1
La	18.2	30.5	26.4	13.9	4.9	18.3	5.1	7.1	15.5	5	13.5
Ce		44.4	23.3	31	28.1	37.6	32.2	14.3	29.3	23.5	44.5
Pr				4.16		5.07					
Nd				17.9		21.5					
Sm				4.3		4.8					
Eu				1.19		1.27					
Gd				4.5		4.8					
Tb				0.7		0.8					
Dy				4.2		4.6					
Ho				0.8		0.9					
Er				2.4		2.8					
Tm				0.36		0.43					
Yb				2.4		2.9					
Lu				0.38		0.47					
Hf	3.8	4.8	4.2	3	2.9	4	3.8	5.2	3.2	2.9	3.4
Ta				0.4		0.5					
W											
Tl											
Pb	11.3	22.1	12.9	5.7	7	10.2	10.7	10	11.3	8.4	12.2
Bi											
Th	6.3	10.6	9.4	3.1	5.5	3.9	6.6	4.1	4.5	6.9	5.1
U	1.6	1.7	2	0.6		0.8		1	1.5	1.6	1.1
F	847.1	551.4	439.3	415.3	329.3	559.2	652.9	624	650.2	519.1	709.5
Cl	111.5	499.1	343.4	247.6	322.4	355.1	289.1	210	127.7	163.1	42.5
S		97.2	35.9	23.6		275.4			35	10.7	
Dy/Yb				1.8		1.6					
Nb/Yb				2.7		3.3					
Th/Yb				1.3		1.3					
Sr/Y	13.4	15.1	15.6	13.5	11.9	10.3	11.2	15.2	11.0	12.7	11.3
(La/Yb) _N				4.0		4.4					
(La/Sm) _N				2.0		2.4					

Supplementary table 1 - Continued.

District	Sulcis										
Sample	V 1211	V 1293	V1215	V1280	V1348	V1200	V1199	V1342	V1228	V1338	V1198
Reference	Brotzu et al. (1997a)										
Lithology	B	BA	B	BA	BA	BA	BA	BA	BA	BA	BA
SiO ₂	48.36	53.01	51.66	52.63	53.09	53.53	53.42	54.77	54.16	54.59	54.55
TiO ₂	1.24	0.92	1.14	1.02	1.27	0.96	1.02	1.22	0.97	1.21	0.92
Al ₂ O ₃	19.37	18.48	19.41	18.08	19.31	18.35	17.95	18.78	18.63	18.29	19.18
Fe ₂ O _{3tot}	9.99	8.76	9.78	9.68	9.41	9.53	10.05	9.19	9.60	9.65	8.48
MnO	0.17	0.15	0.17	0.14	0.16	0.18	0.15	0.15	0.15	0.09	0.17
MgO	5.72	4.42	3.08	3.41	2.60	3.24	3.25	2.10	2.67	2.64	2.61
CaO	10.95	9.38	10.66	10.36	9.62	10.16	10.18	9.00	9.11	8.63	9.37
Na ₂ O	2.56	2.69	2.66	2.54	2.78	2.52	2.48	2.87	2.82	2.70	2.72
K ₂ O	1.28	1.91	1.08	1.88	1.44	1.32	1.32	1.55	1.63	1.85	1.79
P ₂ O ₅	0.35	0.27	0.36	0.26	0.31	0.20	0.19	0.37	0.25	0.35	0.21
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	3.84	4.60	3.74	4.42	4.22	3.84	3.80	4.42	4.45	4.54	4.51
LOI	1.90	2.52	1.71	2.66	3.18	1.83	1.91	3.20	1.72	1.75	2.31
Mg#	0.53	0.50	0.38	0.41	0.35	0.40	0.39	0.31	0.36	0.35	0.38
Be							1.00				
Sc	35.4	28.1	36.4	35.6	33.6	38.5	27	26.2	32.9	39.6	26.5
V	343.1	229.5	332.3	298.2	246.6	263	224	205.2	227.1	270.5	197.8
Cr	60.5	76.7	96.1	98.4	22.6	69.7	24	37.6	41.6	49	15.8
Co	31.4	31.2	27	26.2	21.5	34	23	15.7	22	17.1	19
Ni	42.1	39.4	46.3	34.2	16.4	23.5	21	20.6	20.7	23.9	14.5
Cu	75.10	63.70	84.80	57.50	34.50	52.90	50	57.70	43.20	43.00	28.40
Zn	91.50	96.80	90.90	108.20	107.60	103.60	120	109.50	103.20	123.20	106.00
Ga	22.90	22.00	23.30	23.50	25.00	21.90	22	25.10	23.30	24.70	23.30
Ge							2				
As							< 5				
Rb	29.2	56.6	29.4	48.7	45.6	33.9	45.7	59.9	48.1	50.2	61.6
Sr	579.7	480.8	596.1	499.7	565.8	445.1	467.8	458.9	478.4	518.8	438.5
Y	28.7	22.6	28.3	25.6	36	26.9	27.5	36.4	27.6	32.9	26.8
Zr	107	135	115.5	141.3	169.1	134	160.7	189.9	167.5	161.5	171.7
Nb	5.4	7	6.7	7.4	10.1	6.4	7.1	9.9	8.2	9.1	8.9
Mo							< 2				
Ag							0.7				
In							< 0.2				
Sn							1				
Sb							< 0.5				
Cs							1.5				
Ba	322	442.7	334.9	469.5	453.1	550.1	551	457.9	541	602.3	564.1
La	16.2	22.2	16	25	15	17	21.6	28	25	26	23.7
Ce	45.3	48	41	54	42	42	44.1	54	44	44	53.3
Pr							5.11				
Nd	20.50	21.30					22.0				22.10
Sm	5.35	5.00					4.6				5.09
Eu	1.59	1.36					1.37				1.57
Gd	5.44	4.03					4.70				4.20
Tb							0.7				
Dy	4.11	3.34					3.8				3.75
Ho							0.8				
Er	2.39	1.92					2.2				2.16
Tm							0.3				
Yb	2.21	1.87					2.1				2.10
Lu	0.46	0.34					0.3				0.39
Hf	2.60	3.20	2.70	3.40	4.00	3.30	3.5	4.60	4.10	3.90	4.20
Ta							0.3				
W							< 1				
Tl							0.1				
Pb	6.9	12.3	8.3	11.9	8.7	8.4	10.0	8.3	12.2	11	15.5
Bi							< 0.4				
Th	1.60	4.00	<LLD	6.60	2.60	6.20	2.7	6.10	5.80	4.50	6.50
U	<LLD	1.00	<LLD	1.70	<LLD	1.40	0.8	1.40	1.50	1.10	1.60
F	668.70	592.20	565.40	577.90	700.90	180.30	371.7	560.90	612.30	783.50	374.20
Cl	46.50	74.50	299.00	82.10	415.00	182.10	350.3	414.30	2089.80	98.40	275.10
S	<LLD	<LLD	49.00	<LLD	33.80	206.10	22.9	3.60	201.30	218.90	<LLD
Dy/Yb	1.9	1.8					1.8				1.8
Nb/Yb	2.4	3.7					3.4				4.2
Th/Yb	0.7	2.1					1.3				3.1
Sr/Y	20.2	21.3	21.1	19.5	15.7	16.5	17.0	12.6	17.3	15.8	16.4
(La/Yb) _N	5.1	8.2					7.1				7.8
(La/Sm) _N	1.9	2.8					2.9				2.9

Supplementary table 1 - Continued.

District	Sulcis										
Sample	V1318	V1355	V1154	V1346	V1296	V1055	V1235	V1281	V1101	V1580	V1226
Reference	Brotzu et al. (1997a)										
Lithology	BA	BA	BA	A	A	A	A	BA	BA	BA	A
SiO ₂	54.68	55.34	55.57	57.50	57.52	58.76	60.49	56.25	56.54	56.84	57.32
TiO ₂	0.81	0.90	1.07	0.89	0.86	0.90	0.71	0.87	0.73	0.95	0.93
Al ₂ O ₃	18.70	19.69	17.78	18.36	18.38	17.92	18.09	19.21	16.70	18.22	18.13
Fe ₂ O _{3tot}	8.48	7.79	8.92	8.12	8.05	7.80	6.60	7.59	9.00	7.97	7.72
MnO	0.14	0.14	0.15	0.16	0.11	0.11	0.13	0.12	0.15	0.13	0.14
MgO	2.83	2.55	3.27	2.00	1.55	1.62	1.57	2.15	3.87	2.49	2.61
CaO	9.54	9.18	8.60	7.79	7.91	7.28	7.37	9.36	9.24	8.49	8.65
Na ₂ O	2.77	2.66	2.78	2.95	3.11	3.05	2.69	2.63	2.30	2.71	2.56
K ₂ O	1.82	1.53	1.49	1.80	2.08	2.08	2.17	1.57	1.38	1.91	1.71
P ₂ O ₅	0.22	0.22	0.36	0.44	0.43	0.48	0.19	0.25	0.09	0.29	0.22
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.59	4.19	4.27	4.74	5.18	5.12	4.85	4.20	3.69	4.62	4.27
LOI	1.70	1.64	1.93	2.65	1.91	2.33	2.11	2.50		1.69	2.63
Mg#	0.40	0.39	0.42	0.33	0.28	0.29	0.32	0.36	0.46	0.38	0.40
Be											
Sc	30.9	26.1	31.8	19.4	22.2	19.3	24.1	30	47.4	35.4	39.1
V	211	230.8	227.7	141	143.8	148.5	149.5	193.5	293.4	223.7	220.9
Cr	68.8	66.8	39.9	17.5	22.8	15.3	27.6	53.5	227.1	37	30.9
Co	22.6	17.3	22.1	14.3	14.9	13.5	13.7	18.7	27.7	16.5	18
Ni	22.1	21.5	21.4	12.8	9.8	12.3	12.8	17.4	40.8	18.1	16.9
Cu	38.90	54.90	60.10	65.90	67.60	56.30	24.00	61.60	110.20	30.60	29.40
Zn	106.70	98.80	111.00	108.30	101.90	112.90	90.50	87.60	84.30	94.70	87.40
Ga	21.70	22.10	23.70	24.20	24.30	23.70	22.60	24.00	18.10	22.30	22.60
Ge											
As											
Rb	56.5	47.3	50.6	57.6	69.5	66.2	71	45.9	286.1	59.2	76.6
Sr	482.3	420.3	493.9	484.3	469.3	464.4	325.6	457	32.8	449.2	441.2
Y	26	26	32.4	29.8	31.5	26.8	22.3	25.1	41.1	23.5	25.4
Zr	150.7	157.5	196.4	192.4	195.6	201.2	195	163	280.6	137.1	145.2
Nb	5.8	6.8	10.3	9.6	8.5	10.8	8.5	8.2	35.2	7	7.6
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	522.8	500.8	651.6	564.6	525	680.5	672.3	555.3	204.4	477.8	501.8
La	20	16	27	26	31	23	22	22		16	21.4
Ce	40	40	54	56	56	54	49	43		32	46.8
Pr											
Nd											20.50
Sm											4.85
Eu											1.16
Gd											4.24
Tb											
Dy											3.58
Ho											
Er											2.01
Tm											
Yb											1.95
Lu											0.32
Hf	3.70	3.90	4.70	4.60	4.70	4.90	4.80	4.00	7.00	3.40	3.60
Ta											
W											
Tl											
Pb	15.4	7.9	10.7	14.4	12	20	13.4	8.6	45.1	11.1	12.7
Bi											
Th	6.00	4.90	2.40	7.10	6.10	5.80	7.00	6.80	30.40	3.50	9.10
U	1.40	1.20	0.60	1.80	1.50	1.40	1.50	1.60	6.70	0.80	2.10
F	565.80	312.00	503.70	572.70	649.10	765.30	376.00	455.80	1015.90	492.40	526.10
Cl	77.10	237.50	274.90	696.60	247.50	174.20	490.50	199.30	234.20	69.20	358.20
S	<LLD	<LLD	105.50	3.50	11.10	50.20	85.30	12.80	<LLD	161.90	158.00
Dy/Yb											1.8
Nb/Yb											3.9
Th/Yb											4.7
Sr/Y	18.6	16.2	15.2	16.3	14.9	17.3	14.6	18.2	0.8	19.1	17.4
(La/Yb) _N											7.6
(La/Sm) _N											2.8

Supplementary table 1 - Continued.

District	Sulcis										
Sample	V1061	V1283	V1334	V1066	V1291	V1476	V1103	V1399	V1276	V1473	V1247
Reference	Brotzu et al. (1997a)										
Lithology	A	A	A	A	A	A	A	A	A	A	A
SiO ₂	57.93	57.97	57.43	59.56	58.98	59.58	59.70	59.93	62.06	58.29	59.23
TiO ₂	0.82	0.83	0.76	0.74	0.74	0.79	0.75	0.73	0.69	0.81	0.76
Al ₂ O ₃	17.84	18.68	18.08	18.56	17.36	17.37	17.84	17.41	16.69	18.06	17.57
Fe ₂ O _{3tot}	7.45	7.41	7.19	6.92	7.67	7.06	7.14	6.69	6.26	7.29	7.10
MnO	0.11	0.15	0.13	0.11	0.14	0.14	0.16	0.14	0.11	0.14	0.14
MgO	2.37	1.97	2.08	2.02	2.21	2.30	2.14	2.12	2.05	2.24	2.12
CaO	8.02	8.24	7.81	7.68	8.19	7.85	7.30	7.79	6.73	8.02	7.84
Na ₂ O	2.83	2.88	2.63	2.52	2.48	2.56	2.57	2.64	2.61	2.72	2.91
K ₂ O	2.37	1.68	1.64	1.63	2.10	2.16	2.23	2.38	2.66	2.23	2.10
P ₂ O ₅	0.26	0.19	0.18	0.26	0.13	0.20	0.18	0.18	0.14	0.20	0.23
Total	100.00	100.00	97.93	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	5.19	4.56	4.27	4.15	4.58	4.71	4.79	5.01	5.26	4.95	5.01
LOI	1.88	1.95	2.11	3.22	2.05	2.48	2.21	1.93	2.29	1.81	1.81
Mg#	0.39	0.34	0.36	0.37	0.36	0.39	0.37	0.39	0.39	0.38	0.37
Be											
Sc	23.6	29.6	19.2	18.8	37.2	26.8	30.8	35	22	17.7	20.2
V	188.7	180.2	186.2	143.2	224.7	163.8	205.5	193.4	172.9	164.1	162.5
Cr	75	29.2	31.3	24.1	48.3	42.3	27.8	38.6	50.3	19.4	36.8
Co	18.4	13.9	17.1	14.7	20.5	18.1	21	17.1	14	16.7	16.6
Ni	29.9	14.8	14.5	12.9	20.9	16.9	13.1	14.9	24	11.4	14.8
Cu	26.00	30.50	29.20	23.60	57.10	25.30	63.20	60.40	56.10	22.00	24.40
Zn	88.10	95.70	86.90	77.60	83.00	88.30	79.90	83.90	77.70	91.80	86.30
Ga	22.60	23.30	21.10	23.80	21.70	20.90	20.90	22.20	22.70	22.10	22.00
Ge											
As											
Rb	75.2	72.3	62.8	69	95.5	80.7	77.3	100.1	145.7	82.9	82.9
Sr	402	378	346	391	299.8	387.9	335	382.4	267.3	387.8	382.1
Y	24.9	26.8	24.4	24.6	23.1	25	23.4	27.8	23.1	26.3	24.9
Zr	158.7	197.1	174.4	170.1	143.9	163.2	151.5	170.4	201.5	162.6	167.7
Nb	6.8	8.3	6.6	8.5	5.6	8	6.6	6.9	5.8	7.2	8.4
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	565.6	594.1	469.1	595.2	402.5	646.2	547.4	515	617.7	535.6	640.9
La	22.3	20	24	24.8	19.7	28	22	23	26	26	25
Ce	44.6	57	48	50.5	41.1	56	47	55	47	59	48
Pr											
Nd	20.40			23.70	16.90						
Sm	4.77			4.93	4.02						
Eu	1.35			1.39	0.99						
Gd	3.38			4.09	3.53						
Tb											
Dy	3.57			3.34	3.02						
Ho											
Er	2.05			1.78	1.75						
Tm											
Yb	1.99			1.61	1.73						
Lu	0.39			0.32	0.28						
Hf	3.90	4.80	4.30	4.20	3.60	4.00	3.80	4.20	5.00	4.00	4.10
Ta											
W											
Tl											
Pb	15.5	13.2	11.6	13.1	14.1	10.8	24.4	13.5	18.2	14.3	15.7
Bi											
Th	8.50	5.80	7.90	8.30	7.80	8.00	5.20	10.80	9.60	8.20	5.90
U	2.00	1.40	2.00	1.80	2.00	2.00	1.30	2.50	2.20	2.00	1.30
F	759.90	439.10	235.00	463.30	291.80	405.20	743.10	397.40	382.00	422.40	484.90
Cl	73.00	408.80	203.90	144.60	325.40	372.20	72.90	339.70	201.00	260.80	185.10
S	<LLD	81.50	<LLD	52.90	<LLD	99.80	<LLD	<LLD	<LLD	<LLD	0.80
Dy/Yb	1.8			2.1	1.7						
Nb/Yb	3.4			5.3	3.2						
Th/Yb	4.3			5.2	4.5						
Sr/Y	16.1	14.1	14.2	15.9	13.0	15.5	14.3	13.8	11.6	14.7	15.3
(La/Yb) _N	7.8			10.7	7.9						
(La/Sm) _N	2.9			3.1	3.1						

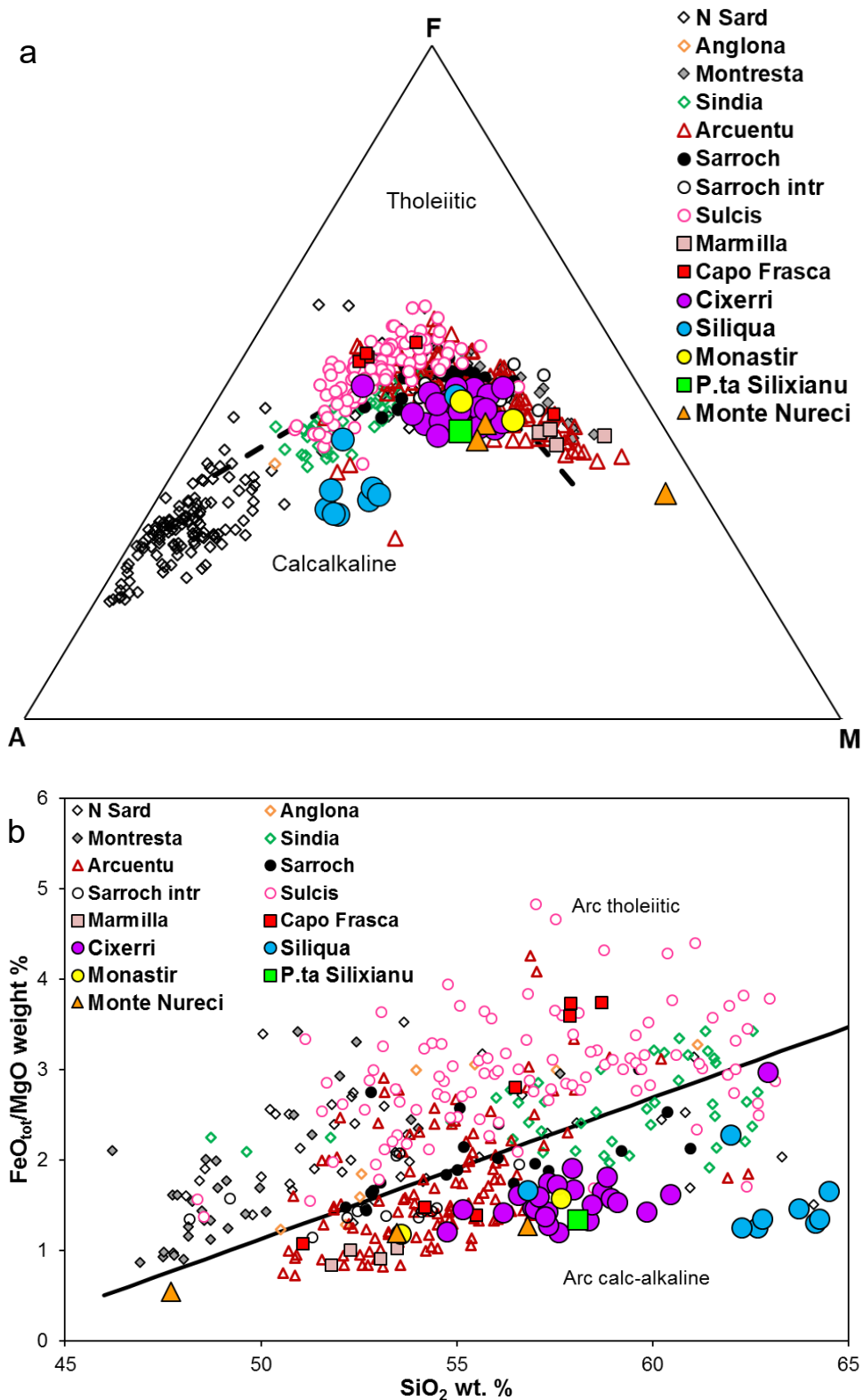
Supplementary table 1 - Continued.

District	Sulcis										
Sample	V1206	V1252	V1421	V1514	V1070	V1089	V1471	V1413	V1068	V1119	V1583
Reference	Brotzu et al. (1997a)										
Lithology	A	A	A	A	A	A	A	A	A	A	D
SiO ₂	59.89	60.59	61.12	61.17	61.51	61.91	62.67	62.11	62.98	62.31	63.13
TiO ₂	0.68	0.80	0.66	0.73	0.64	0.66	0.71	0.70	0.54	0.56	0.65
Al ₂ O ₃	17.98	17.39	17.43	17.22	18.04	17.17	16.48	16.95	17.01	17.21	16.41
Fe ₂ O _{3tot}	6.96	7.27	6.12	6.30	6.61	6.08	5.84	5.86	5.50	5.84	5.86
MnO	0.15	0.10	0.14	0.13	0.11	0.13	0.12	0.12	0.12	0.14	0.11
MgO	1.77	2.07	2.36	1.85	1.66	1.86	2.00	1.75	1.31	1.37	1.83
CaO	7.62	6.17	7.11	7.20	6.55	6.37	6.58	6.86	7.04	6.87	6.44
Na ₂ O	2.80	2.58	2.75	2.68	2.62	2.67	2.74	2.75	2.69	2.86	2.59
K ₂ O	1.93	2.83	2.13	2.50	2.03	2.99	2.61	2.70	2.57	2.62	2.80
P ₂ O ₅	0.22	0.21	0.19	0.22	0.22	0.18	0.24	0.21	0.23	0.22	0.18
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	4.72	5.41	4.87	5.18	4.64	5.66	5.35	5.44	5.27	5.48	5.38
LOI	1.93		1.65	1.75		1.86	2.62	2.03	2.88	1.80	1.75
Mg#	0.34	0.36	0.43	0.37	0.33	0.38	0.40	0.37	0.32	0.32	0.38
Be											
Sc	13.6	23.7	18.2	14.8	21.2	19.2	26.5	19.6	15.1	12.5	21.9
V	116.4	124.4	128.5	136.2	121.9	148.8	140.7	151.1	91.7	86.8	140.5
Cr	16.2	39.9	27.9	25.4	27.9	27.6	32.9	33	43.1	18.5	27.1
Co	11.1	17.5	14.2	12.9	11.9	14.5	15	14.4	11	7	11.3
Ni	11.3	15.6	16.9	15.4	10.5	14.2	15.6	13.3	12.8	7.9	11.5
Cu	19.20	17.80	22.30	25.30	16.60	31.70	18.60	23.00	17.50	17.40	19.30
Zn	100.40	94.70	79.90	79.30	92.20	79.30	74.10	76.60	78.80	88.50	82.90
Ga	22.90	21.00	19.80	19.60	21.90	19.80	20.40	21.30	22.70	23.70	22.00
Ge											
As											
Rb	71	94	69.7	96.4	98	121	104.3	107.7	91.5	91.3	140.6
Sr	415.7	409.1	353	388	410.1	343.1	395.1	420.8	402.1	396.2	366.1
Y	24.6	24.5	23.6	26.7	25.5	23.2	25.5	27.5	25.3	24.4	23.4
Zr	179.8	162.6	157.4	179	177.7	173.2	185.7	186.3	204.3	200.3	188.8
Nb	8.3	7.7	7.6	8	8	8.2	9	9.3	10.2	9.4	7.8
Mo											
Ag											
In											
Sn											
Sb											
Cs											
Ba	765.5	653.8	592.3	667.9	653.3	691.5	638	673.4	665	638	669.6
La	33		26	32		26	33	28	32	31.9	30
Ce	58		43	54		53	67	49	62.3	62.5	57
Pr											
Nd									24.70	24.50	
Sm									5.01	4.92	
Eu									1.26	1.21	
Gd									4.00	3.66	
Tb											
Dy									3.33	3.19	
Ho											
Er									1.93	1.84	
Tm											
Yb									1.97	1.88	
Lu									0.43	0.43	
Hf	4.40	4.00	3.90	4.40	4.30	4.30	4.60	4.60	5.00	4.90	4.70
Ta											
W											
Tl											
Pb	16.7	11.9	17.8	14.1	18.4	20.1	16.6	18.9	16.7	17.4	22
Bi											
Th	7.10	9.80	8.10	10.10	6.40	12.50	10.50	9.50	5.90	11.90	13.10
U	1.80	2.40	2.00	2.50	1.70	2.90	2.40	2.30	1.50	3.00	2.90
F	375.10	614.00	421.00	772.80	780.90	788.30	760.80	554.90	500.50	524.50	552.90
Cl	499.40	278.20	622.00	444.30	111.20	161.40	1213.70	281.50	924.30	377.60	384.10
S	129.40	177.40	186.70	25.00	321.60	<LLD	466.20	27.30	1699.30	27.40	4.60
Dy/Yb									1.7	1.7	
Nb/Yb									5.2	5.0	
Th/Yb									3.0	6.3	
Sr/Y	16.9	16.7	15.0	14.5	16.1	14.8	15.5	15.3	15.9	16.2	15.6
(La/Yb) _N									11.3	11.8	
(La/Sm) _N									4.0	4.1	

Supplementary table 1 - Continued.

District	Marmilla		Capo Frasca					
Sample	MAL28	MAL35	MAL29	MAL38	MAL41	MAL37	MAL39	MAL40
Reference	Felede (2002), Lustrino et al. (2013)							
Lithology	BA	B	BA	BA	BA	A	A	A
SiO ₂	53.48	51.05	56.49	54.17	55.50	57.89	58.69	57.91
TiO ₂	0.75	0.54	1.21	0.87	0.92	1.17	1.06	1.12
Al ₂ O ₃	15.91	16.37	18.99	17.07	17.33	18.25	18.29	18.64
Fe ₂ O ₃ _{tot}	8.69	9.79	8.47	8.60	7.29	7.89	7.71	7.90
MnO	0.17	0.18	0.15	0.16	0.14	0.15	0.14	0.15
MgO	7.65	8.16	2.72	5.21	4.72	1.97	1.85	1.90
CaO	10.32	11.35	8.49	10.41	10.25	8.35	7.80	8.12
Na ₂ O	2.05	1.90	1.94	2.26	2.46	2.41	2.51	2.46
K ₂ O	0.87	0.59	1.38	1.12	1.27	1.74	1.78	1.64
P ₂ O ₅	0.10	0.06	0.15	0.12	0.11	0.17	0.16	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Na ₂ O+K ₂ O	2.93	2.50	3.33	3.38	3.73	4.15	4.29	4.10
LOI	1.94	1.38	2.94	1.44	1.66	0.97	1.29	1.08
Mg#	0.64	0.62	0.39	0.55	0.56	0.33	0.32	0.32
Be								
Sc	38	50	45.2	41.6	46.5	50.7	39.9	47.1
V	249.1	282.3	189.2	299.9	311.1	176.3	140.4	165.8
Cr	398	514.3	28.5	340.4	383.7	27.9	35.4	24.5
Co	33.3	42.4	16	29.4	30.3	10.3	11.6	12.5
Ni	105.7	135.3	7.5	75.2	74.4	4.8	9.6	5.5
Cu	68.9	119.3	10.8	95.7	103.6	10.5	14.3	9
Zn	90.9	81.7	116.6	94	104.9	106.6	101.4	104
Ga	16.1	14.8	23.3	19.1	20.9	22.7	21.7	22.5
Ge								
As								
Rb	32.5	13.1	31.5	37.1	36.7	41.9	48.2	45.1
Sr	214.9	181	323.1	223.2	232.6	324.9	318.1	322.1
Y	23.7	16.5	37	25.6	25.5	40.3	36.5	37.3
Zr	110	39	203.9	110.2	111.4	204.2	196.3	192.6
Nb	6	3.3	13.4	6.4	6.1	13.2	11.9	12.4
Mo								
Ag								
In								
Sn								
Sb								
Cs	1	0.7						
Ba	355	142.9	637.3	398.5	537.9	831.8	833.3	801.7
La	14.8	4.2				30.5		
Ce	28.7	9.1				61		
Pr	3.6	1.3				7.5		
Nd	13.9	5.9				29.3		
Sm	3.1	1.8				6.2		
Eu	0.89	0.49				1.5		
Gd	3.1	1.9				5.7		
Tb	0.55	0.36				0.96		
Dy	3.41	2.27				6		
Ho	0.71	0.49				1.24		
Er	1.93	1.42				3.29		
Tm	0.3	0.21				0.51		
Yb	1.78	1.3				3.15		
Lu	0.27	0.2				0.45		
Hf	2.9	1.6	5	2.9	2.9	5.1	4.9	4.8
Ta		0.1						
W								
Tl								
Pb	8.1	1.6	38	10	9.4	14.2	11.1	15.1
Bi								
Th	7.6	1	6	6	3.4	6.7	7.4	6.1
U	2.0	0.3	1.5	1.5	0.8	1.6	1.8	1.6
F	466.9	384.7	526.9	451.1	181.3	227.7	327.4	374.9
Cl	73.3	71.1	192.3	74.5	606.1	257.5	196.8	216.2
S	8.1	<LLD	<LLD	<LLD	25.8	<LLD	<LLD	<LLD
Dy/Yb	1.9	1.7				1.9		
Nb/Yb	3.4	2.5				4.2		
Th/Yb	4.3	0.8				2.1		
Sr/Y	9.1	11.0	8.7	8.7	9.1	8.1	8.7	8.6
(La/Yb) _N	5.8	2.2				6.7		
(La/Sm) _N	3.0	1.5				3.1		

Supplementary table 1 - Continued.



Supplementary figure 1 - a) AFM diagram, dot line from Irvine and Baragar (1971) b) SiO_2 vs. $\text{FeO}_{\text{tot}}/\text{MgO}$ diagram (Miyashiro, 1974) for the studied rocks compared with literature data: North Sardinia (Marrazzo, 2008; Guarino et al., 2011; Tecchiato et al., 2018), Anglona (Beccaluva et al., 2013), Montresta (Morra et al., 1997; Franciosi et al., 2003), Sindia (Lonis et al., 1997), Arcuentu (Brotzu et al., 1997b; Franciosi et al., 2003), Sarroch and Sarroch intrusive (Conte, 1997), Sulcis (Brotzu et al., 1997a; Conte et al., 2010; Ronga, 2011; Lustrino et al., 2013), Marmilla and Capo Frasca (Fedele, 2002; Lustrino et al., 2013).

Chemical composition of olivine

District	Capo Frasca				Monte Nureci (Arcuentu)					
Sample	MAL35	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2
Lithology	Basalt				Olivine Gabbroonorite					
Description	ol	ol	ol in cpx	ol core	ol rim	ol	ol in opx	ol	ol core	ol rim
SiO ₂	39.50	38.18	37.85	38.20	38.32	38.19	37.96	37.86	38.11	38.02
FeO	16.24	23.17	23.76	21.63	23.23	22.97	23.61	23.82	23.42	22.76
MnO	0.26	0.10	0.41	0.54	0.49	0.23	0.44	0.44	0.00	0.70
MgO	43.37	38.49	37.66	38.95	37.61	38.57	37.95	37.03	38.42	38.16
CaO	0.21	0.06	0.06	0.07	0.05	0.00	0.07	0.01	0.01	0.06
NiO		0.00	0.12	0.58	0.02	0.00	0.00	0.00	0.00	0.28
ZnO		0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.07	0.00
Cr ₂ O ₃		0.00	0.12	0.00	0.27	0.03	0.00	0.59	0.00	0.00
Total	99.56	100.01	99.98	99.97	99.99	99.98	100.03	100.01	100.03	99.98
Si	1.002	0.996	0.994	0.995	1.002	0.996	0.995	0.995	0.995	0.995
Fe	0.345	0.506	0.522	0.471	0.508	0.501	0.517	0.524	0.512	0.498
Mn	0.006	0.002	0.009	0.012	0.011	0.005	0.010	0.010	0.000	0.016
Mg	1.640	1.497	1.474	1.513	1.466	1.500	1.482	1.452	1.496	1.489
Ca	0.006	0.002	0.002	0.002	0.001	0.000	0.002	0.000	0.000	0.002
Ni		0.000	0.003	0.012	0.000	0.000	0.000	0.000	0.000	0.006
Zn		0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.001	0.000
Cr		0.000	0.003	0.000	0.006	0.001	0.000	0.012	0.000	0.000
Tot	2.998	3.004	3.005	3.005	2.995	3.003	3.005	2.998	3.005	3.005
Fo%	82.64	74.76	73.86	76.25	74.27	74.96	74.13	73.48	74.52	74.93

Supplementary table 2 - Elements concentration (in wt. %) of olivine in studied rocks. Structural formula calculation based on 4 oxygens and 3 cations, values in apfu. Fo%=100*Mg/(Mg+Fe). Abbreviation from Whitney and Evans (2010).

District	Monte Nureci (Arcuentu)									
Sample	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3
Lithology					Olivine Gabbroonorite					
Description	ol in opx	ol	ol	ol	ol core	ol rim	ol	ol	ol core	ol rim
SiO ₂	38.63	38.14	38.20	38.33	38.25	38.59	38.27	38.28	38.17	37.94
FeO	20.23	22.71	21.95	22.12	22.02	22.08	21.68	22.07	22.46	23.71
MnO	0.56	0.53	0.49	0.69	0.43	0.40	0.20	0.17	0.43	0.33
MgO	40.35	38.48	38.61	38.84	39.12	38.43	39.20	39.16	38.65	37.89
CaO	0.00	0.10	0.07	0.00	0.05	0.24	0.00	0.00	0.04	0.04
NiO	0.01	0.00	0.41	0.00	0.12	0.28	0.59	0.33	0.23	0.10
ZnO	0.13	0.04	0.00	0.00	0.00	0.00	0.07	0.00	0.07	0.00
Cr ₂ O ₃	0.13	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.03	100.01	100.05	99.98	99.99	100.02	100.01	100.01	100.04	100.01
Si	0.997	0.996	0.995	0.998	0.995	1.004	0.995	0.996	0.995	0.995
Fe	0.436	0.496	0.478	0.482	0.479	0.480	0.472	0.480	0.490	0.520
Mn	0.012	0.012	0.011	0.015	0.010	0.009	0.004	0.004	0.010	0.007
Mg	1.552	1.498	1.500	1.507	1.517	1.491	1.520	1.518	1.503	1.481
Ca	0.000	0.003	0.002	0.000	0.001	0.007	0.000	0.000	0.001	0.001
Ni	0.000	0.000	0.009	0.000	0.002	0.006	0.012	0.007	0.005	0.002
Zn	0.003	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Cr	0.003	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	3.002	3.004	3.001	3.002	3.005	2.996	3.005	3.004	3.005	3.005
Fo%	78.05	75.13	75.82	75.79	76.00	75.63	76.32	75.98	75.42	74.02

Supplementary table 2 - Continued.

Chemical composition of feldspar

District	Cixerri										
Sample	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18
Lithology	Basaltic Andesite										
Description	pl. profile zoning 1 from rim to core										
SiO ₂	50.05	49.06	47.10	44.47	45.91	46.65	48.44	48.80	46.24	48.48	46.66
Al ₂ O ₃	31.53	31.97	33.12	34.96	33.89	33.70	32.77	33.03	34.03	32.59	33.87
FeO _t	0.27	0.40	0.58	0.46	0.67	0.50	0.45	0.51	0.19	0.40	0.58
CaO	14.01	15.32	16.67	18.58	17.94	16.91	16.07	14.56	17.31	15.09	16.51
Na ₂ O	4.07	3.17	2.28	1.35	1.61	2.23	2.62	3.27	2.11	3.09	2.37
K ₂ O	0.00	0.10	0.01	0.08	0.03	0.02	0.01	0.00	0.01	0.09	0.13
BaO	0.00	0.00	0.00	0.23	0.00	0.06	0.03	0.00	0.00	0.35	0.08
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.93	100.02	99.76	100.12	100.05	100.06	100.41	100.16	99.91	100.09	100.19
Si	9.072	8.938	8.648	8.177	8.440	8.539	8.825	8.865	8.471	8.844	8.519
Al	6.736	6.866	7.169	7.577	7.343	7.270	7.037	7.072	7.349	7.008	7.289
Fe	0.041	0.061	0.089	0.070	0.104	0.077	0.069	0.077	0.030	0.061	0.088
Ca	2.720	2.990	3.280	3.660	3.534	3.316	3.137	2.834	3.398	2.949	3.230
Na	1.429	1.121	0.811	0.480	0.574	0.790	0.927	1.152	0.749	1.092	0.839
K	0.000	0.023	0.003	0.020	0.007	0.004	0.002	0.000	0.003	0.021	0.030
Ba	0.000	0.000	0.000	0.017	0.000	0.004	0.002	0.000	0.000	0.025	0.005
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	65.55	72.33	80.11	87.99	85.89	80.68	77.16	71.10	81.88	72.60	78.81
Ab mol %	34.45	27.11	19.81	11.53	13.95	19.22	22.79	28.90	18.04	26.89	20.47
Or mol%	0.00	0.56	0.07	0.48	0.16	0.10	0.06	0.00	0.08	0.51	0.72

Supplementary table 3 - Elements concentration (in wt. %) of feldspar in studied rocks. Structural formula calculation based on 32 oxygens and 20 cations, values in apfu. An mol%=100*Ca/(Ca+Na+K), Ab mol%=100*Na/(Ca+Na+K), Or mol%=100*K/(Ca+Na+K). Abbreviation from Whitney and Evans (2010), gm=groundmass.

District	Cixerri								Cixerri	
Sample	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18
Lithology	Basaltic Andesite								Basaltic Andesite	
Description	pl. profile zoning 2 from rim to core								pl core	pl rim
SiO ₂	49.66	49.25	48.45	49.25	48.08	46.23	46.76	45.73	48.05	46.35
Al ₂ O ₃	30.61	31.66	32.88	32.31	32.65	34.61	33.89	34.80	32.91	33.73
FeO _t	0.77	0.47	0.28	0.58	0.38	0.13	0.37	0.53	0.05	0.24
CaO	13.68	14.33	15.42	14.82	15.39	16.98	17.48	16.92	15.71	17.57
Na ₂ O	4.39	3.58	3.15	3.28	3.35	1.85	1.69	1.75	3.14	2.09
K ₂ O	0.28	0.13	0.00	0.02	0.13	0.01	0.06	0.00	0.00	0.01
BaO	0.66	0.19	0.07	0.13	0.27	0.00	0.09	0.40	0.00	0.34
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.05	99.60	100.25	100.38	100.24	99.81	100.33	100.12	99.87	100.33
Si	9.015	8.995	8.800	8.944	8.731	8.488	8.570	8.401	8.751	8.480
Al	6.550	6.816	7.041	6.917	6.989	7.491	7.321	7.536	7.066	7.272
Fe	0.117	0.072	0.042	0.087	0.057	0.020	0.056	0.081	0.008	0.037
Ca	2.661	2.804	3.002	2.884	2.995	3.341	3.433	3.331	3.066	3.443
Na	1.546	1.269	1.110	1.154	1.180	0.657	0.599	0.622	1.110	0.740
K	0.064	0.030	0.000	0.005	0.029	0.003	0.014	0.000	0.000	0.003
Ba	0.047	0.014	0.005	0.009	0.019	0.000	0.006	0.028	0.000	0.024
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	62.30	68.35	73.01	71.34	71.25	83.50	84.84	84.25	73.42	82.24
Ab mol %	36.20	30.93	26.99	28.55	28.06	16.42	14.81	15.73	26.58	17.68
Or mol%	1.50	0.72	0.00	0.11	0.69	0.07	0.35	0.01	0.00	0.08

Supplementary table 3 - Continued.

District	Cixerri						Cixerri			
Sample	SAR18	SAR18	SAR18	SAR18	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
Lithology	Basaltic Andesite						Basaltic Andesite			
Description	pl core	pl rim	pl	pl gm	pl core	pl core	pl rim	pl core	pl rim	pl core
SiO ₂	44.78	46.94	44.81	46.55	47.46	45.43	46.47	48.35	47.40	45.96
Al ₂ O ₃	35.39	33.50	35.48	34.34	33.18	33.70	34.14	32.35	33.23	33.89
FeO _t	0.16	0.63	0.23	0.06	0.37	0.31	0.35	0.47	0.27	0.60
CaO	18.56	16.58	18.34	16.46	16.85	18.76	17.49	15.88	16.55	17.97
Na ₂ O	1.16	2.61	1.41	2.50	2.10	1.41	1.64	2.78	2.16	1.45
K ₂ O	0.09	0.00	0.10	0.15	0.10	0.00	0.00	0.00	0.12	0.13
BaO	0.00	0.00	0.00	0.00	0.00	0.16	0.17	0.24	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.07	0.00	0.27
Total	100.13	100.26	100.36	100.07	100.06	100.04	100.26	100.13	99.74	100.28
Si	8.226	8.551	8.197	8.482	8.698	8.376	8.527	8.839	8.707	8.447
Al	7.662	7.193	7.651	7.376	7.168	7.325	7.384	6.970	7.196	7.343
Fe	0.024	0.097	0.035	0.010	0.057	0.048	0.054	0.072	0.042	0.093
Ca	3.653	3.236	3.594	3.213	3.308	3.707	3.438	3.111	3.257	3.540
Na	0.413	0.923	0.499	0.884	0.746	0.504	0.584	0.984	0.769	0.518
K	0.021	0.000	0.024	0.036	0.023	0.000	0.000	0.000	0.029	0.031
Ba	0.000	0.000	0.000	0.000	0.000	0.012	0.013	0.017	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.029	0.000	0.007	0.000	0.029
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	89.37	77.80	87.30	77.75	81.12	88.04	85.49	75.97	80.32	86.57
Ab mol %	10.12	22.20	12.12	21.38	18.30	11.96	14.51	24.03	18.97	12.66
Or mol%	0.51	0.00	0.59	0.87	0.57	0.00	0.00	0.00	0.71	0.77

Supplementary table 3 - Continued.

District	Cixerri									
Sample	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
Lithology	Basaltic Andesite									
Description	pl rim	pl	pl	pl	pl	pl	Afs	Afs	pl	pl
SiO ₂	47.77	47.72	45.37	47.11	52.74	53.53	64.33	65.07	47.63	46.79
Al ₂ O ₃	33.45	33.06	34.67	33.46	29.14	28.98	18.63	18.55	33.31	33.48
FeO _t	0.54	0.21	0.50	0.03	0.78	0.08	0.56	0.52	0.37	0.00
CaO	15.96	16.52	18.25	17.18	11.94	12.08	0.17	0.24	16.93	17.61
Na ₂ O	2.17	2.03	1.38	1.92	4.71	4.85	2.67	1.59	2.09	1.90
K ₂ O	0.03	0.13	0.10	0.19	0.06	0.18	12.41	13.93	0.02	0.00
BaO	0.24	0.06	0.00	0.00	0.00	0.13	1.07	0.61	0.03	0.00
SrO	0.00	0.00	0.00	0.00	0.15	0.00	0.25	0.00	0.00	0.13
Total	100.18	99.74	100.27	99.89	99.53	99.83	100.09	100.50	100.37	99.91
Si	8.756	8.781	8.325	8.647	9.604	9.699	11.858	11.972	8.705	8.595
Al	7.228	7.171	7.497	7.241	6.255	6.190	4.047	4.023	7.175	7.248
Fe	0.083	0.033	0.077	0.005	0.118	0.012	0.087	0.080	0.056	0.000
Ca	3.135	3.257	3.588	3.379	2.329	2.344	0.033	0.046	3.315	3.466
Na	0.773	0.723	0.490	0.684	1.664	1.705	0.953	0.566	0.742	0.678
K	0.008	0.030	0.023	0.045	0.014	0.041	2.917	3.269	0.005	0.000
Ba	0.017	0.005	0.000	0.000	0.000	0.009	0.077	0.044	0.002	0.000
Sr	0.000	0.000	0.000	0.000	0.016	0.000	0.027	0.000	0.000	0.013
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	80.06	81.21	87.51	82.26	58.13	57.32	0.85	1.20	81.61	83.64
Ab mol %	19.74	18.03	11.94	16.66	41.53	41.69	24.41	14.58	18.27	16.36
Or mol%	0.21	0.76	0.55	1.09	0.34	0.99	74.74	84.22	0.11	0.00

Supplementary table 3 - Continued.

District	Cixerri									
Sample	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
Lithology	Basaltic Andesite									
Description	pl	pl core	pl rim	pl	pl	pl core	pl rim	pl	Afs	pl
SiO ₂	46.70	46.11	47.42	46.43	45.36	46.53	50.89	46.06	66.54	46.59
Al ₂ O ₃	33.82	34.08	33.24	33.60	34.36	33.80	31.20	34.14	18.04	33.64
FeO _t	0.29	0.40	0.19	0.65	0.35	0.60	0.65	0.71	0.12	0.63
CaO	17.44	17.63	16.81	17.47	18.46	17.54	13.87	17.76	0.05	17.16
Na ₂ O	1.69	1.78	2.22	1.82	1.07	1.63	3.59	1.51	2.13	1.87
K ₂ O	0.11	0.13	0.13	0.08	0.00	0.00	0.06	0.13	12.73	0.00
BaO	0.00	0.00	0.00	0.00	0.11	0.12	0.00	0.00	0.51	0.00
SrO	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00
Total	100.05	100.12	100.00	100.05	99.82	100.23	100.26	100.31	100.13	99.90
Si	8.576	8.451	8.683	8.525	8.391	8.548	9.243	8.449	12.262	8.566
Al	7.320	7.362	7.173	7.271	7.492	7.319	6.679	7.382	3.917	7.290
Fe	0.045	0.061	0.028	0.100	0.054	0.093	0.098	0.109	0.019	0.097
Ca	3.432	3.463	3.297	3.437	3.659	3.452	2.700	3.491	0.010	3.380
Na	0.603	0.632	0.787	0.648	0.384	0.581	1.264	0.538	0.761	0.667
K	0.025	0.030	0.032	0.019	0.000	0.000	0.015	0.030	2.993	0.000
Ba	0.000	0.000	0.000	0.000	0.008	0.009	0.000	0.000	0.037	0.000
Sr	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	84.54	83.95	80.11	83.75	90.51	85.60	67.86	86.01	0.28	83.53
Ab mol %	14.84	15.33	19.12	15.79	9.49	14.40	31.77	13.26	20.22	16.47
Or mol%	0.61	0.72	0.77	0.46	0.00	0.00	0.37	0.73	79.50	0.00

Supplementary table 3 - Continued.

District	Cixerri					Cixerri				
Sample	SAR1	SAR1	SAR1	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3
Lithology	Basaltic Andesite									
Description	pl	pl core	pl rim	pl	pl	pl core	pl rim	pl	pl	pl
SiO ₂	54.46	52.96	47.58	47.95	46.95	46.87	51.58	46.42	44.03	52.18
Al ₂ O ₃	28.12	29.49	33.18	33.03	33.36	33.68	29.80	33.75	35.60	30.45
FeO _t	0.58	0.64	0.96	0.36	0.52	0.18	0.47	0.39	0.32	0.54
CaO	10.85	12.30	16.10	16.36	17.48	17.11	12.81	17.40	19.29	12.76
Na ₂ O	5.32	4.60	1.97	2.26	1.77	1.84	4.09	1.87	0.58	3.89
K ₂ O	0.60	0.27	0.00	0.09	0.00	0.08	0.16	0.04	0.03	0.16
BaO	0.11	0.00	0.00	0.07	0.00	0.29	0.10	0.00	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.07	0.00	0.12
Total	100.04	100.27	99.79	100.12	100.08	100.04	99.45	99.95	99.85	100.09
Si	9.827	9.567	8.765	8.779	8.626	8.614	9.441	8.526	8.146	9.486
Al	5.980	6.279	7.206	7.128	7.223	7.295	6.429	7.307	7.764	6.525
Fe	0.088	0.097	0.148	0.055	0.080	0.028	0.071	0.060	0.049	0.082
Ca	2.099	2.381	3.179	3.209	3.441	3.369	2.513	3.424	3.825	2.485
Na	1.862	1.613	0.702	0.802	0.629	0.654	1.453	0.665	0.207	1.372
K	0.137	0.063	0.000	0.022	0.000	0.020	0.037	0.010	0.008	0.038
Ba	0.008	0.000	0.000	0.005	0.000	0.021	0.007	0.000	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.008	0.000	0.013
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	51.20	58.70	81.91	79.58	84.54	83.34	62.77	83.53	94.68	63.82
Ab mol %	45.44	39.76	18.09	19.88	15.46	16.18	36.30	16.22	5.12	35.22
Or mol%	3.35	1.54	0.00	0.55	0.00	0.49	0.93	0.25	0.20	0.97

Supplementary table 3 - Continued.

District	Cixerri					Cixerri				
Sample	SAR3	SAR3	SAR3	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6
Lithology	Basaltic Andesite					Basaltic Andesite				
Description	pl	pl	pl	pl	pl	pl gm	pl gm	Afs gm	Afs gm	pl gm
SiO ₂	58.77	46.26	54.86	47.47	46.18	51.24	55.05	64.31	64.45	53.40
Al ₂ O ₃	25.08	33.96	28.06	33.17	33.93	29.77	28.15	18.58	18.42	28.93
FeO _t	0.72	0.21	0.77	0.26	0.55	0.94	0.55	0.57	0.47	0.43
CaO	9.17	17.13	10.80	16.92	17.49	13.50	10.97	0.09	0.47	11.83
Na ₂ O	5.60	1.27	4.93	1.85	1.72	3.82	5.31	1.56	2.51	4.56
K ₂ O	0.40	0.20	0.44	0.03	0.15	0.21	0.26	14.58	12.32	0.35
BaO	0.12	0.00	0.00	0.17	0.19	0.24	0.00	0.00	1.21	0.00
SrO	0.18	0.48	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.36
Total	100.03	99.51	99.86	100.11	100.22	99.72	100.30	99.69	99.86	99.87
Si	10.661	8.581	9.950	8.731	8.475	9.372	9.912	11.863	11.922	9.706
Al	5.362	7.426	5.999	7.191	7.339	6.417	5.974	4.041	4.015	6.198
Fe	0.109	0.032	0.117	0.040	0.084	0.144	0.083	0.087	0.072	0.065
Ca	1.782	3.404	2.098	3.335	3.439	2.646	2.117	0.019	0.094	2.304
Na	1.968	0.458	1.734	0.658	0.613	1.354	1.854	0.557	0.902	1.608
K	0.092	0.046	0.101	0.007	0.036	0.050	0.060	3.433	2.908	0.082
Ba	0.009	0.000	0.000	0.012	0.014	0.018	0.000	0.000	0.088	0.000
Sr	0.019	0.052	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.038
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	46.38	87.11	53.35	83.36	84.11	65.35	52.52	0.47	2.40	57.70
Ab mol %	51.23	11.71	44.09	16.46	15.00	33.43	46.00	13.89	23.10	40.25
Or mol%	2.40	1.18	2.56	0.18	0.88	1.22	1.48	85.65	74.50	2.05

Supplementary table 3 - Continued.

District	Cixerri										
Sample	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5
Lithology	Andesite										
Description	pl	pl	pl	Ab gm	pl gm	pl gm	Aks gm	pl gm	pl	pl	pl
SiO ₂	47.47	54.20	49.62	66.72	54.04	53.64	63.82	48.12	55.44	46.00	48.85
Al ₂ O ₃	33.49	27.79	31.49	20.32	28.18	28.15	18.75	32.15	27.58	34.00	32.65
FeO _t	0.30	0.81	0.84	0.41	0.57	0.34	0.86	0.51	0.78	0.59	0.24
CaO	16.77	11.51	14.44	1.17	11.10	11.44	0.38	15.82	10.19	18.01	16.00
Na ₂ O	2.09	4.93	3.00	10.76	5.31	5.20	2.20	2.55	5.51	1.53	2.25
K ₂ O	0.12	0.17	0.27	0.11	0.24	0.35	13.54	0.02	0.37	0.00	0.09
BaO	0.00	0.25	0.00	0.20	0.29	0.05	0.34	0.46	0.00	0.00	0.00
SrO	0.00	0.33	0.32	0.30	0.35	0.99	0.17	0.39	0.09	0.00	0.00
Total	100.23	99.99	100.00	99.99	100.08	100.16	100.04	100.02	99.96	100.13	100.07
Si	8.681	9.853	9.081	11.755	9.777	9.710	11.732	8.849	10.014	8.453	8.951
Al	7.220	5.955	6.793	4.219	6.010	6.006	4.063	6.969	5.871	7.365	7.051
Fe	0.045	0.123	0.129	0.061	0.086	0.052	0.132	0.079	0.118	0.091	0.036
Ca	3.286	2.241	2.833	0.222	2.153	2.219	0.074	3.116	1.971	3.546	3.141
Na	0.741	1.736	1.066	3.674	1.862	1.825	0.783	0.909	1.931	0.544	0.800
K	0.027	0.039	0.064	0.024	0.055	0.081	3.174	0.004	0.086	0.000	0.021
Ba	0.000	0.018	0.000	0.014	0.020	0.004	0.025	0.033	0.000	0.000	0.000
Sr	0.000	0.035	0.034	0.031	0.037	0.104	0.018	0.041	0.009	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	81.05	55.81	71.49	5.66	52.90	53.80	1.84	77.35	49.43	86.70	79.28
Ab mol %	18.29	43.22	26.90	93.73	45.75	44.23	19.41	22.56	48.42	13.30	20.19
Or mol%	0.67	0.98	1.61	0.62	1.35	1.96	78.74	0.09	2.15	0.00	0.52

Supplementary table 3 - Continued.

District	Cixerri											
Sample	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17
Lithology	Andesite											
Description	pl core	pl rim	pl	pl	pl	pl gm	Afs gm	pl	pl in amp	pl core	pl mantle	
SiO ₂	55.88	49.82	45.38	48.88	48.47	48.45	63.98	43.99	48.92	48.22	47.19	
Al ₂ O ₃	27.65	31.67	35.08	32.36	32.76	32.94	18.76	35.85	32.41	32.69	33.90	
FeO _t	0.00	0.05	0.09	0.41	0.05	0.08	0.28	0.26	0.47	0.39	0.44	
CaO	9.41	13.69	16.75	14.36	15.74	15.51	0.00	19.29	14.95	15.95	16.40	
Na ₂ O	6.38	4.01	1.93	3.35	2.95	2.54	0.64	0.50	3.12	2.98	2.49	
K ₂ O	0.60	0.09	0.17	0.16	0.08	0.22	16.21	0.11	0.15	0.02	0.05	
BaO	0.07	0.45	0.36	0.45	0.00	0.06	0.00	0.08	0.00	0.00	0.00	
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	99.99	99.79	99.74	99.96	100.05	99.80	99.88	100.08	100.01	100.25	100.49	
Si	10.004	9.062	8.338	8.919	8.828	8.874	11.821	8.125	8.913	8.770	8.580	
Al	5.834	6.792	7.598	6.958	7.033	7.113	4.085	7.805	6.961	7.007	7.266	
Fe	0.000	0.008	0.013	0.062	0.008	0.012	0.044	0.041	0.071	0.059	0.068	
Ca	1.804	2.669	3.297	2.808	3.072	3.044	0.000	3.817	2.918	3.108	3.196	
Na	2.216	1.415	0.687	1.186	1.040	0.901	0.230	0.180	1.102	1.050	0.879	
K	0.136	0.021	0.040	0.037	0.019	0.051	3.821	0.026	0.035	0.005	0.011	
Ba	0.005	0.032	0.026	0.032	0.000	0.004	0.000	0.005	0.000	0.000	0.000	
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	
An mol%	43.41	65.00	81.93	69.67	74.36	76.17	0.00	94.86	71.96	74.65	78.22	
Ab mol %	53.31	34.48	17.08	29.42	25.19	22.54	5.67	4.48	27.17	25.23	21.50	
Or mol%	3.28	0.52	1.00	0.91	0.45	1.29	94.33	0.65	0.87	0.12	0.28	

Supplementary table 3 - Continued.

District	Cixerri											
Sample	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17
Lithology	Andesite											
Description	pl rim	pl, profile zoning 1 from rim to core										
SiO ₂	53.21	52.23	51.62	49.44	48.43	51.30	48.36	47.11	46.70	48.10	47.36	
Al ₂ O ₃	29.26	29.50	30.00	31.77	32.40	30.39	32.73	32.80	33.79	32.63	33.23	
FeO _t	0.65	0.35	0.03	0.00	0.44	0.00	0.31	0.73	0.22	0.24	0.26	
CaO	11.54	12.55	13.19	15.20	15.74	13.54	14.85	16.38	16.93	16.25	15.92	
Na ₂ O	5.14	4.98	4.43	3.37	2.91	4.58	3.28	2.69	2.18	2.86	2.83	
K ₂ O	0.17	0.00	0.22	0.02	0.08	0.10	0.14	0.10	0.09	0.00	0.19	
BaO	0.26	0.30	0.23	0.09	0.00	0.05	0.12	0.00	0.14	0.00	0.00	
SrO	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	
Total	100.27	99.91	99.72	99.89	99.99	99.95	99.80	99.81	100.05	100.31	99.79	
Si	9.595	9.451	9.377	9.008	8.838	9.272	8.817	8.622	8.549	8.757	8.648	
Al	6.219	6.292	6.423	6.824	6.970	6.475	7.034	7.075	7.292	7.002	7.152	
Fe	0.097	0.052	0.004	0.000	0.068	0.000	0.048	0.112	0.033	0.036	0.040	
Ca	2.230	2.434	2.568	2.967	3.078	2.622	2.901	3.212	3.322	3.170	3.115	
Na	1.799	1.748	1.561	1.190	1.029	1.606	1.161	0.956	0.774	1.011	1.001	
K	0.039	0.000	0.050	0.005	0.017	0.022	0.032	0.023	0.020	0.000	0.045	
Ba	0.019	0.021	0.017	0.006	0.000	0.003	0.008	0.000	0.010	0.000	0.000	
Sr	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.000	
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	
An mol%	54.82	58.20	61.45	71.29	74.63	61.69	70.87	76.64	80.70	75.82	74.87	
Ab mol %	44.23	41.80	37.36	28.60	24.95	37.79	28.36	22.81	18.80	24.18	24.05	
Or mol%	0.95	0.00	1.20	0.11	0.42	0.52	0.78	0.55	0.50	0.00	1.08	

Supplementary table 3 - Continued.

District	Cixerri						Cixerri			
Sample	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17
Lithology	Andesite						Andesite			
Description	pl, profile zoning 1 from rim to core						pl, profile zoning 2 from rim to core			
SiO ₂	49.45	46.41	47.27	44.26	45.08	53.82	52.41	47.57	48.91	46.65
Al ₂ O ₃	31.98	33.37	33.35	35.40	34.76	28.61	29.85	32.85	32.37	33.67
FeO _t	0.02	0.56	0.33	0.67	0.39	0.43	0.09	0.60	0.22	0.00
CaO	15.08	16.71	16.59	18.68	18.48	10.91	12.22	16.19	14.72	16.30
Na ₂ O	3.35	2.64	2.42	0.89	1.22	5.65	5.14	2.55	3.42	2.73
K ₂ O	0.00	0.09	0.11	0.00	0.12	0.06	0.01	0.15	0.22	0.00
BaO	0.08	0.03	0.00	0.12	0.09	0.28	0.20	0.00	0.00	0.24
SrO	0.08	0.29	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.23
Total	100.04	100.11	100.07	100.02	100.13	99.76	99.92	99.98	99.86	99.82
Si	8.999	8.474	8.637	8.171	8.293	9.722	9.458	8.703	8.899	8.534
Al	6.861	7.181	7.182	7.704	7.536	6.090	6.350	7.085	6.942	7.260
Fe	0.003	0.086	0.050	0.103	0.059	0.065	0.014	0.092	0.034	0.000
Ca	2.940	3.269	3.248	3.696	3.642	2.111	2.362	3.175	2.870	3.195
Na	1.183	0.936	0.857	0.318	0.435	1.977	1.799	0.904	1.206	0.968
K	0.000	0.021	0.025	0.000	0.027	0.015	0.002	0.034	0.050	0.000
Ba	0.006	0.002	0.000	0.009	0.006	0.020	0.014	0.000	0.000	0.017
Sr	0.008	0.031	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.025
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	71.31	77.35	78.64	92.07	88.73	51.45	56.74	77.18	69.56	76.74
Ab mol %	28.69	22.15	20.76	7.93	10.60	48.19	43.21	21.99	29.22	23.26
Or mol%	0.00	0.51	0.60	0.00	0.67	0.36	0.05	0.83	1.22	0.00

Supplementary table 3 - Continued.

District	Cixerri						Cixerri			
Sample	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17
Lithology	Andesite						Andesite			
Description	pl, profile zoning 2 from rim to core						pl, profile zoning 2 from rim to core			
SiO ₂	48.28	48.50	46.79	50.04	48.43	47.51	46.97	47.77	50.15	48.62
Al ₂ O ₃	32.57	32.52	33.36	31.59	32.46	32.71	33.18	33.16	31.15	29.89
FeO _t	0.00	0.42	0.54	0.24	0.24	0.52	0.68	0.15	0.82	0.71
CaO	15.83	14.94	16.48	14.05	15.98	16.34	16.20	15.90	13.47	14.94
Na ₂ O	2.87	3.18	2.62	3.81	2.81	2.55	2.72	2.57	4.16	3.28
K ₂ O	0.06	0.16	0.05	0.00	0.05	0.00	0.12	0.23	0.10	0.27
BaO	0.21	0.17	0.07	0.06	0.00	0.15	0.00	0.15	0.02	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.83	99.89	99.91	99.79	99.97	99.79	99.88	99.93	99.87	99.83
Si	8.829	8.849	8.556	9.104	8.843	8.716	8.583	8.737	9.103	8.869
Al	7.020	6.994	7.189	6.773	6.986	7.073	7.148	7.149	6.665	6.878
Fe	0.000	0.063	0.083	0.037	0.037	0.080	0.105	0.022	0.124	0.109
Ca	3.102	2.921	3.229	2.738	3.127	3.211	3.173	3.116	2.620	2.920
Na	1.019	1.123	0.927	1.344	0.996	0.909	0.963	0.913	1.465	1.159
K	0.014	0.037	0.011	0.000	0.011	0.000	0.029	0.053	0.022	0.063
Ba	0.015	0.012	0.005	0.005	0.000	0.011	0.000	0.011	0.001	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	75.01	71.56	77.48	67.08	75.64	77.94	76.18	76.35	63.78	70.50
Ab mol %	24.65	27.53	22.25	32.92	24.09	22.06	23.12	22.36	35.67	27.98
Or mol%	0.34	0.91	0.27	0.00	0.27	0.00	0.70	1.29	0.55	1.52

Supplementary table 3 - Continued.

District	Cixerri							Cixerri		
Sample	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21
Lithology	Andesite							Andesite		
Description	pl core	pl rim	pl	pl	pl gm	pl core	pl, profile zoning 1	from rim to core		
SiO ₂	47.39	49.44	45.07	46.27	45.32	44.09	52.66	51.22	48.73	49.36
Al ₂ O ₃	33.52	32.19	34.92	33.71	34.69	35.51	29.37	30.27	32.56	31.82
FeO _t	0.44	0.14	0.72	0.39	0.57	0.64	0.74	0.71	0.44	1.00
CaO	15.95	15.12	17.73	17.68	17.80	18.67	12.55	13.17	14.91	14.40
Na ₂ O	2.64	3.32	1.49	2.12	1.84	0.98	4.76	4.68	3.19	3.52
K ₂ O	0.14	0.08	0.10	0.07	0.13	0.00	0.00	0.03	0.10	0.20
BaO	0.00	0.10	0.24	0.00	0.00	0.28	0.00	0.00	0.18	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.08	100.39	100.27	100.24	100.36	100.17	100.07	100.08	100.12	100.31
Si	8.642	8.965	8.275	8.453	8.278	8.127	9.525	9.253	8.872	8.956
Al	7.206	6.880	7.556	7.258	7.469	7.716	6.262	6.445	6.988	6.805
Fe	0.067	0.022	0.111	0.060	0.088	0.099	0.112	0.108	0.067	0.152
Ca	3.117	2.939	3.488	3.461	3.483	3.688	2.432	2.550	2.910	2.800
Na	0.935	1.168	0.531	0.752	0.653	0.350	1.668	1.638	1.127	1.240
K	0.033	0.019	0.023	0.016	0.030	0.000	0.000	0.007	0.023	0.047
Ba	0.000	0.007	0.017	0.000	0.000	0.020	0.000	0.000	0.013	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	76.31	71.22	86.29	81.83	83.62	91.33	59.31	60.79	71.66	68.52
Ab mol %	22.88	28.30	13.13	17.78	15.67	8.66	40.69	39.04	27.77	30.33
Or mol%	0.81	0.47	0.57	0.38	0.71	0.00	0.00	0.17	0.57	1.15

Supplementary table 3 - Continued.

District	Cixerri							Cixerri		
Sample	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR11	SAR11
Lithology	Andesite							Andesite		
Description	pl, profile zoning 1 from rim to core							pl	pl	
SiO ₂	47.58	46.27	46.45	47.12	47.30	47.17	48.10	45.12	46.14	45.88
Al ₂ O ₃	33.17	34.37	33.71	33.07	32.91	33.27	33.12	34.80	33.68	34.79
FeO _t	0.31	0.26	0.73	0.23	0.89	0.60	0.69	0.40	0.41	0.36
CaO	16.78	17.20	16.91	16.71	15.63	16.65	15.52	18.07	17.29	17.33
Na ₂ O	2.27	1.91	2.20	2.61	2.85	2.27	2.90	1.38	1.80	1.61
K ₂ O	0.04	0.12	0.10	0.14	0.13	0.12	0.03	0.26	0.23	0.06
BaO	0.08	0.00	0.00	0.16	0.35	0.00	0.00	0.00	0.14	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
Total	100.23	100.14	100.09	100.03	100.05	100.09	100.36	100.03	99.74	100.03
Si	8.699	8.468	8.500	8.606	8.647	8.633	8.746	8.290	8.500	8.422
Al	7.148	7.413	7.272	7.121	7.092	7.176	7.097	7.538	7.313	7.527
Fe	0.047	0.040	0.112	0.035	0.135	0.092	0.105	0.061	0.063	0.056
Ca	3.287	3.372	3.315	3.271	3.061	3.266	3.023	3.557	3.412	3.408
Na	0.804	0.679	0.779	0.923	1.011	0.806	1.024	0.492	0.641	0.574
K	0.009	0.028	0.022	0.033	0.030	0.028	0.006	0.062	0.054	0.014
Ba	0.005	0.000	0.000	0.011	0.025	0.000	0.000	0.000	0.010	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	80.16	82.68	80.54	77.39	74.63	79.66	74.59	86.53	83.06	85.30
Ab mol %	19.61	16.64	18.92	21.84	24.64	19.67	25.26	11.96	15.61	14.35
Or mol%	0.23	0.69	0.54	0.78	0.73	0.67	0.16	1.51	1.32	0.34

Supplementary table 3 - Continued.

District	Cixerri						Cixerri			
Sample	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11
Lithology	Andesite						Andesite			
Description	pl gm	pl core	pl rim	pl	pl rim amp		pl, profile	zoning 1	from rim to core	
SiO ₂	49.89	47.57	52.10	47.77	44.86	51.95	52.34	53.00	49.78	47.99
Al ₂ O ₃	31.64	33.58	30.47	33.09	35.20	30.06	30.16	29.11	31.56	33.42
FeO _t	0.32	0.18	0.31	0.05	0.16	0.44	0.46	0.03	0.36	0.20
CaO	14.53	15.96	11.88	15.69	18.33	12.44	12.41	12.05	14.52	15.03
Na ₂ O	3.19	2.52	4.43	2.90	1.30	4.65	4.73	5.32	3.40	3.05
K ₂ O	0.10	0.20	0.27	0.00	0.00	0.12	0.24	0.08	0.13	0.11
BaO	0.00	0.03	0.15	0.32	0.00	0.00	0.00	0.28	0.23	0.26
SrO	0.28	0.10	0.43	0.25	0.11	0.54	0.00	0.43	0.10	0.00
Total	99.95	100.14	100.04	100.06	99.96	100.20	100.33	100.31	100.08	100.06
Si	9.112	8.679	9.451	8.723	8.252	9.396	9.427	9.547	9.073	8.741
Al	6.811	7.221	6.516	7.123	7.634	6.408	6.403	6.181	6.780	7.174
Fe	0.049	0.027	0.047	0.007	0.025	0.066	0.069	0.004	0.054	0.030
Ca	2.844	3.120	2.309	3.070	3.612	2.411	2.394	2.327	2.835	2.933
Na	1.130	0.893	1.558	1.027	0.465	1.632	1.651	1.858	1.200	1.078
K	0.023	0.047	0.062	0.000	0.000	0.029	0.056	0.019	0.030	0.025
Ba	0.000	0.002	0.011	0.023	0.000	0.000	0.000	0.020	0.017	0.019
Sr	0.030	0.011	0.045	0.026	0.012	0.057	0.000	0.044	0.011	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	71.14	76.84	58.76	74.93	88.59	59.20	58.37	55.36	69.73	72.67
Ab mol %	28.27	22.00	39.66	25.07	11.41	40.09	40.25	44.20	29.52	26.72
Or mol%	0.59	1.16	1.58	0.00	0.00	0.71	1.37	0.44	0.75	0.61

Supplementary table 3 - Continued.

District	Cixerri										
Sample	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11
Lithology	Andesite										
Description	pl. profile zoning 1 from rim to core										
SiO ₂	50.15	47.55	50.53	49.08	52.81	51.09	51.53	48.84	47.26	49.91	47.77
Al ₂ O ₃	31.45	32.69	31.08	31.08	28.93	30.45	30.24	32.45	33.43	31.88	32.80
FeO _t	0.32	0.72	0.39	0.72	0.45	0.46	0.18	0.26	0.26	0.22	0.17
CaO	14.03	16.22	13.63	14.79	11.66	12.93	12.94	14.62	16.16	13.82	16.40
Na ₂ O	3.71	2.46	4.11	3.41	5.64	4.52	4.38	3.43	2.96	3.75	2.63
K ₂ O	0.03	0.02	0.17	0.02	0.13	0.11	0.04	0.04	0.02	0.11	0.28
BaO	0.20	0.29	0.30	0.00	0.28	0.26	0.13	0.17	0.00	0.01	0.19
SrO	0.00	0.22	0.19	1.20	0.33	0.32	0.60	0.27	0.07	0.31	0.12
Total	99.89	100.17	100.40	100.31	100.24	100.13	100.03	100.08	100.16	100.02	100.35
Si	9.133	8.718	9.146	8.963	9.499	9.255	9.358	8.888	8.593	9.069	8.705
Al	6.752	7.063	6.630	6.691	6.133	6.502	6.474	6.962	7.165	6.827	7.046
Fe	0.049	0.110	0.060	0.111	0.068	0.069	0.027	0.040	0.040	0.034	0.026
Ca	2.737	3.185	2.643	2.894	2.248	2.509	2.517	2.850	3.148	2.691	3.202
Na	1.308	0.874	1.441	1.209	1.968	1.587	1.541	1.210	1.042	1.319	0.929
K	0.006	0.005	0.040	0.006	0.030	0.026	0.008	0.009	0.005	0.026	0.065
Ba	0.015	0.021	0.022	0.000	0.020	0.018	0.009	0.012	0.000	0.001	0.013
Sr	0.000	0.024	0.019	0.127	0.035	0.033	0.063	0.029	0.007	0.033	0.013
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	67.56	78.37	64.10	70.44	52.95	60.86	61.90	70.04	75.05	66.67	76.30
Ab mol %	32.29	21.50	34.93	29.42	46.34	38.50	37.90	29.74	24.84	32.69	22.14
Or mol%	0.16	0.13	0.97	0.14	0.71	0.64	0.20	0.21	0.11	0.64	1.56

Supplementary table 3 - Continued.

District	Cixerri									
Sample	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11
Lithology	Andesite									
Description	pl. profile zoning 2 from rim to core									
SiO ₂	53.15	47.51	46.51	48.08	47.86	48.48	50.87	46.69	50.60	48.16
Al ₂ O ₃	29.20	32.91	33.71	32.78	33.21	32.35	31.40	33.82	31.40	32.11
FeO _t	0.41	0.58	0.09	0.17	0.08	0.46	0.19	0.26	0.33	0.66
CaO	11.66	15.81	17.50	15.28	15.89	15.50	13.27	16.73	14.27	15.10
Na ₂ O	5.03	2.84	2.03	2.45	2.90	2.96	4.36	2.32	3.66	3.43
K ₂ O	0.25	0.23	0.00	0.09	0.00	0.13	0.10	0.00	0.14	0.23
BaO	0.00	0.00	0.06	0.70	0.00	0.00	0.00	0.00	0.17	0.00
SrO	0.15	0.01	0.00	0.37	0.00	0.25	0.00	0.21	0.00	0.12
Total	99.84	99.89	99.90	99.93	99.95	100.14	100.20	100.03	100.56	99.81
Si	9.615	8.676	8.532	8.856	8.724	8.842	9.179	8.542	9.159	8.775
Al	6.227	7.083	7.289	7.117	7.134	6.954	6.678	7.292	6.698	6.897
Fe	0.062	0.089	0.013	0.026	0.012	0.070	0.028	0.039	0.051	0.100
Ca	2.260	3.094	3.440	3.016	3.103	3.028	2.566	3.279	2.767	2.949
Na	1.765	1.004	0.721	0.874	1.026	1.048	1.526	0.824	1.283	1.211
K	0.057	0.053	0.000	0.020	0.000	0.031	0.024	0.001	0.031	0.055
Ba	0.000	0.000	0.005	0.051	0.000	0.000	0.000	0.000	0.012	0.000
Sr	0.015	0.001	0.000	0.040	0.000	0.027	0.000	0.022	0.000	0.012
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	55.36	74.53	82.67	77.13	75.15	73.72	62.34	79.91	67.80	69.96
Ab mol %	43.25	24.19	17.33	22.35	24.85	25.53	37.08	20.07	31.44	28.74
Or mol%	1.39	1.28	0.00	0.52	0.00	0.75	0.58	0.02	0.77	1.30

Supplementary table 3 - Continued.

District	Cixerri											
Sample	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12
Lithology	Andesite											
Description	pl. profile zoning 1 from rim to core											
SiO ₂	55.39	53.71	54.33	55.83	52.95	49.85	48.90	52.04	52.64	52.44	51.56	50.89
Al ₂ O ₃	27.97	28.29	28.00	27.65	29.89	31.22	32.25	30.14	30.05	30.53	30.24	30.35
FeO _t	0.00	0.52	0.49	0.29	0.56	0.53	0.17	0.65	0.27	0.28	0.39	0.54
CaO	10.41	11.19	11.01	9.92	11.38	14.38	15.61	12.77	11.82	12.49	13.27	13.01
Na ₂ O	6.04	5.52	5.23	5.97	5.36	4.12	3.10	4.13	4.88	4.50	4.45	4.39
K ₂ O	0.09	0.17	0.19	0.11	0.12	0.02	0.18	0.26	0.25	0.13	0.17	0.03
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00	0.00	0.55
SrO	0.00	0.59	0.39	0.11	0.00	0.00	0.26	0.00	0.12	0.00	0.17	0.33
Total	99.90	99.98	99.63	99.88	100.25	100.12	100.49	100.08	100.03	100.38	100.26	100.10
Si	9.949	9.701	9.867	10.053	9.507	9.022	8.876	9.448	9.501	9.454	9.315	9.251
Al	5.922	6.022	5.992	5.868	6.325	6.660	6.900	6.449	6.392	6.488	6.439	6.502
Fe	0.000	0.078	0.074	0.044	0.083	0.080	0.025	0.098	0.041	0.043	0.059	0.082
Ca	2.003	2.165	2.142	1.915	2.190	2.789	3.037	2.484	2.287	2.413	2.569	2.535
Na	2.105	1.932	1.840	2.083	1.867	1.445	1.092	1.455	1.709	1.572	1.560	1.549
K	0.021	0.039	0.043	0.026	0.028	0.004	0.041	0.059	0.058	0.031	0.039	0.007
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.000	0.000	0.000	0.039
Sr	0.000	0.061	0.041	0.012	0.000	0.000	0.028	0.000	0.012	0.000	0.018	0.035
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	48.51	52.34	53.21	47.59	53.62	65.81	72.83	62.12	56.42	60.09	61.63	61.97
Ab mol %	50.98	46.71	45.72	51.77	45.71	34.09	26.19	36.39	42.16	39.14	37.42	37.86
Or mol%	0.51	0.95	1.07	0.64	0.68	0.10	0.99	1.49	1.43	0.76	0.94	0.17

Supplementary table 3 - Continued.

District	Cixerri							Cixerri				
Sample	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12	SAR12
Lithology	Andesite							Andesite				
Description	pl, profile	zoning	1 from rim to core	pl	pl in amp	pl core	pl rim	pl gm	pl core	pl rim	pl core	pl rim
SiO ₂	50.20	44.34	51.72	50.66	52.60	46.62	46.94	51.96	53.35	51.45	50.63	53.41
Al ₂ O ₃	31.43	35.31	30.24	30.06	28.98	33.49	33.18	29.95	29.59	30.18	31.39	28.67
FeO _t	0.29	0.50	0.35	0.47	0.87	0.29	0.42	0.54	0.25	0.77	0.00	0.59
CaO	14.15	18.42	12.33	13.87	12.41	16.93	16.34	12.71	11.44	13.34	13.90	10.80
Na ₂ O	3.51	1.49	4.72	4.12	5.02	2.38	2.61	4.53	5.09	3.96	4.02	5.91
K ₂ O	0.08	0.04	0.34	0.14	0.09	0.00	0.16	0.25	0.24	0.18	0.12	0.37
BaO	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.01	0.10	0.31	0.23	0.09
SrO	0.03	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Total	99.69	100.11	100.02	99.62	99.97	99.71	99.65	99.95	100.08	100.20	100.29	99.84
Si	9.163	8.130	9.349	9.243	9.509	8.547	8.598	9.410	9.620	9.354	9.159	9.603
Al	6.762	7.632	6.443	6.464	6.176	7.237	7.164	6.393	6.289	6.468	6.692	6.075
Fe	0.044	0.077	0.053	0.071	0.132	0.044	0.064	0.081	0.038	0.118	0.000	0.088
Ca	2.767	3.620	2.388	2.712	2.404	3.325	3.208	2.467	2.210	2.599	2.694	2.081
Na	1.243	0.529	1.656	1.456	1.759	0.846	0.929	1.589	1.778	1.397	1.409	2.061
K	0.018	0.010	0.077	0.033	0.021	0.000	0.037	0.059	0.055	0.042	0.028	0.086
Ba	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.001	0.007	0.022	0.016	0.006
Sr	0.003	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	68.69	87.04	57.95	64.55	57.45	79.71	76.85	59.95	54.65	64.36	65.20	49.21
Ab mol %	30.87	12.73	40.18	34.66	42.04	20.29	22.25	38.62	43.98	34.60	34.11	48.76
Or mol%	0.44	0.24	1.88	0.79	0.50	0.00	0.89	1.43	1.37	1.04	0.69	2.03

Supplementary table 3 - Continued.

District	Siliqua						Siliqua			
Sample	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1
Lithology	Andesite						Andesite			
Description	Ab core	pl rim	pl	pl	pl in amp	pl	pl, profile	zoning	1 from rim to core	
SiO ₂	64.50	53.84	54.16	53.93	53.56	53.62	53.33	53.74	53.93	50.10
Al ₂ O ₃	21.95	28.93	28.57	28.56	28.60	28.86	29.05	28.98	28.66	31.35
FeO _t	0.26	0.15	0.35	0.36	0.45	0.00	0.28	0.17	0.30	0.35
CaO	2.08	11.36	10.91	10.90	11.34	11.88	11.53	11.09	11.69	13.51
Na ₂ O	11.09	5.30	5.32	5.65	5.72	4.99	5.21	5.24	5.58	4.25
K ₂ O	0.04	0.25	0.42	0.14	0.20	0.19	0.22	0.03	0.19	0.25
BaO	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.35	0.11	0.17
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.17	0.00	0.09
Total	99.92	99.83	99.73	99.54	99.87	99.71	99.82	99.76	100.46	100.08
Si	11.278	9.715	9.787	9.742	9.639	9.717	9.638	9.739	9.665	9.068
Al	4.523	6.154	6.086	6.081	6.066	6.164	6.190	6.191	6.054	6.688
Fe	0.038	0.022	0.053	0.054	0.067	0.000	0.042	0.026	0.045	0.052
Ca	0.390	2.196	2.112	2.110	2.187	2.308	2.232	2.154	2.246	2.620
Na	3.761	1.855	1.866	1.980	1.994	1.755	1.827	1.841	1.941	1.491
K	0.010	0.058	0.096	0.033	0.047	0.044	0.050	0.007	0.043	0.059
Ba	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.025	0.007	0.012
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.017	0.000	0.009
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	9.36	53.44	51.84	51.16	51.73	56.20	54.33	53.82	53.10	62.84
Ab mol %	90.40	45.14	45.80	48.03	47.17	42.73	44.46	46.00	45.88	35.75
Or mol%	0.24	1.42	2.36	0.81	1.11	1.07	1.21	0.18	1.02	1.41

Supplementary table 3 - Continued.

District	Siliqua										
Sample	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1
Lithology	Andesite										
Description	pl, profile zoning 1 from rim to core										
SiO ₂	65.58	53.79	49.56	53.94	54.75	54.34	53.99	53.77	50.75	53.57	51.21
Al ₂ O ₃	20.63	28.88	32.30	28.70	28.29	28.08	28.55	28.79	30.68	28.80	30.31
FeO _t	0.00	0.00	0.49	0.56	0.32	0.37	0.39	0.12	0.27	0.38	0.05
CaO	1.38	11.77	14.11	11.30	10.42	10.73	10.98	10.86	13.64	11.54	13.86
Na ₂ O	12.35	5.19	3.26	5.01	5.51	5.96	5.37	5.95	4.32	5.03	3.93
K ₂ O	0.00	0.28	0.07	0.37	0.31	0.34	0.23	0.24	0.16	0.30	0.06
BaO	0.18	0.01	0.00	0.23	0.00	0.25	0.01	0.00	0.00	0.00	0.15
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.32	0.00	0.32	0.00
Total	100.12	99.92	99.79	100.10	99.60	100.08	99.70	100.06	99.81	99.93	99.59
Si	11.366	9.704	9.046	9.752	9.899	9.760	9.767	9.646	9.200	9.694	9.346
Al	4.216	6.141	6.949	6.115	6.030	5.946	6.088	6.089	6.556	6.144	6.520
Fe	0.000	0.000	0.075	0.084	0.049	0.056	0.059	0.019	0.041	0.057	0.008
Ca	0.256	2.275	2.759	2.189	2.020	2.065	2.128	2.087	2.650	2.237	2.711
Na	4.150	1.816	1.155	1.757	1.932	2.077	1.883	2.069	1.517	1.766	1.389
K	0.000	0.064	0.016	0.086	0.071	0.079	0.054	0.056	0.036	0.069	0.015
Ba	0.012	0.001	0.000	0.016	0.000	0.017	0.001	0.000	0.000	0.000	0.011
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.034	0.000	0.033	0.000
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	5.81	54.75	70.20	54.29	50.21	48.93	52.34	49.55	63.05	54.95	65.88
Ab mol %	94.19	43.70	29.39	43.57	48.03	49.20	46.33	49.12	36.10	43.37	33.77
Or mol%	0.00	1.55	0.41	2.14	1.76	1.87	1.33	1.33	0.85	1.68	0.36

Supplementary table 3 - Continued.

District	Siliqua						Siliqua				
Sample	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1
Lithology	Andesite						Andesite				
Description	Afs gm	pl core	pl rim	pl core	pl rim	pl rim	pl, profile zoning 2 from rim to core				
SiO ₂	62.19	54.09	53.31	52.46	54.90	54.66	53.28	54.32	52.96	53.67	53.25
Al ₂ O ₃	20.71	28.62	28.66	29.09	27.68	28.11	29.20	28.57	29.27	29.09	28.49
FeO _t	0.00	0.38	0.22	0.31	0.00	0.00	0.47	0.30	0.46	0.34	0.41
CaO	1.27	11.24	11.38	12.19	10.79	10.52	11.70	10.66	12.40	11.68	11.30
Na ₂ O	3.71	5.54	5.28	5.02	5.89	5.70	5.12	5.48	5.05	5.07	5.63
K ₂ O	9.52	0.09	0.27	0.09	0.15	0.26	0.25	0.32	0.11	0.11	0.17
BaO	2.58	0.14	0.57	0.16	0.18	0.53	0.23	0.13	0.10	0.06	0.66
SrO	0.00	0.00	0.22	0.57	0.00	0.00	0.00	0.13	0.00	0.00	0.14
Total	99.99	100.11	99.91	99.89	99.59	99.78	100.26	99.92	100.35	100.01	100.04
Si	11.482	9.736	9.657	9.512	9.911	9.880	9.602	9.803	9.533	9.692	9.616
Al	4.508	6.072	6.120	6.216	5.891	5.988	6.203	6.077	6.210	6.192	6.063
Fe	0.000	0.058	0.033	0.046	0.000	0.000	0.071	0.046	0.069	0.052	0.063
Ca	0.250	2.169	2.208	2.368	2.087	2.038	2.260	2.062	2.391	2.260	2.187
Na	1.330	1.935	1.856	1.766	2.063	1.996	1.790	1.917	1.764	1.775	1.972
K	2.243	0.021	0.062	0.020	0.034	0.059	0.056	0.073	0.026	0.026	0.039
Ba	0.187	0.010	0.041	0.011	0.013	0.038	0.017	0.010	0.007	0.004	0.046
Sr	0.000	0.000	0.023	0.060	0.000	0.000	0.000	0.013	0.000	0.000	0.014
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	6.55	52.58	53.52	57.00	49.87	49.79	55.03	50.88	57.20	55.66	52.09
Ab mol %	34.78	46.91	44.97	42.51	49.30	48.76	43.60	47.31	42.19	43.70	46.97
Or mol%	58.67	0.51	1.51	0.49	0.82	1.45	1.38	1.81	0.61	0.63	0.94

Supplementary table 3 - Continued.

District	Siliqua										
Sample	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1
Lithology	Andesite										
Description	pl, profile zoning 2 from rim to core										
SiO ₂	53.86	52.32	52.71	53.47	53.58	52.90	48.06	52.32	50.35	45.97	45.68
Al ₂ O ₃	28.62	29.62	29.63	29.30	28.60	29.59	32.29	29.85	31.16	34.18	34.29
FeO _t	0.00	0.06	0.22	0.36	0.00	0.09	0.84	0.08	0.32	0.00	0.14
CaO	11.07	12.78	11.75	11.12	11.78	11.66	15.36	12.06	14.39	17.26	17.56
Na ₂ O	5.80	4.37	5.28	5.46	5.87	4.86	2.97	4.72	3.40	2.14	1.71
K ₂ O	0.40	0.14	0.29	0.29	0.06	0.37	0.02	0.11	0.14	0.03	0.06
BaO	0.14	0.23	0.00	0.00	0.01	0.24	0.20	0.00	0.14	0.15	0.13
SrO	0.00	0.23	0.00	0.00	0.00	0.23	0.00	0.67	0.00	0.25	0.27
Total	99.88	99.76	99.88	99.99	99.90	99.93	99.74	99.82	99.91	99.97	99.83
Si	9.683	9.525	9.496	9.619	9.621	9.578	8.807	9.496	9.188	8.424	8.410
Al	6.064	6.356	6.292	6.214	6.053	6.315	6.975	6.387	6.702	7.383	7.442
Fe	0.000	0.010	0.034	0.054	0.000	0.013	0.128	0.012	0.050	0.000	0.021
Ca	2.132	2.492	2.268	2.143	2.266	2.262	3.016	2.345	2.814	3.389	3.465
Na	2.021	1.543	1.844	1.905	2.045	1.705	1.055	1.663	1.204	0.760	0.609
K	0.091	0.033	0.066	0.066	0.015	0.087	0.005	0.026	0.033	0.007	0.014
Ba	0.010	0.017	0.000	0.000	0.001	0.017	0.014	0.000	0.010	0.011	0.009
Sr	0.000	0.024	0.000	0.000	0.000	0.024	0.000	0.070	0.000	0.026	0.028
Tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	50.24	61.26	54.28	52.08	52.39	55.80	73.99	58.14	69.45	81.54	84.75
Ab mol %	47.63	37.93	44.14	46.31	47.27	42.06	25.88	41.21	29.73	18.28	14.90
Or mol%	2.14	0.81	1.58	1.61	0.34	2.14	0.13	0.65	0.82	0.17	0.35

Supplementary table 3 - Continued.

District	Siliqua										
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2
Lithology	Andesite										
Description	pl	pl	pl	pl	pl core	pl rim	pl rim	Ab in mica	Ab in mica	pl gm	pl gm
SiO ₂	54.10	53.60	53.52	53.36	52.43	53.51	56.68	65.96	54.86	64.64	57.60
Al ₂ O ₃	29.02	28.98	29.07	29.28	30.58	28.85	27.30	20.82	28.13	21.83	25.81
FeO _t	0.20	0.62	0.24	0.19	0.03	0.12	0.11	0.36	0.40	0.65	0.26
CaO	11.05	11.31	11.30	11.46	12.38	10.93	9.07	0.71	9.62	5.23	8.13
Na ₂ O	4.91	5.00	5.21	4.96	4.52	6.38	6.62	11.93	6.61	7.03	7.49
K ₂ O	0.22	0.30	0.34	0.35	0.23	0.26	0.23	0.00	0.28	0.61	0.64
BaO	0.03	0.00	0.02	0.20	0.00	0.00	0.00	0.40	0.00	0.04	0.20
SrO	0.16	0.24	0.41	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.70	100.04	100.12	100.14	100.16	100.05	100.01	100.18	99.90	100.03	100.11
Si	9.817	9.693	9.653	9.645	9.462	9.552	10.139	11.486	9.811	11.654	10.254
Al	6.207	6.177	6.181	6.238	6.505	6.071	5.757	4.273	5.930	4.638	5.415
Fe	0.031	0.094	0.035	0.029	0.004	0.018	0.016	0.053	0.060	0.099	0.039
Ca	2.148	2.191	2.185	2.219	2.394	2.090	1.739	0.132	1.843	1.010	1.550
Na	1.727	1.751	1.822	1.740	1.582	2.209	2.297	4.029	2.293	2.456	2.584
K	0.051	0.068	0.079	0.080	0.053	0.060	0.052	0.000	0.063	0.140	0.144
Ba	0.002	0.000	0.001	0.014	0.000	0.000	0.000	0.028	0.000	0.003	0.014
Sr	0.017	0.025	0.043	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	54.71	54.62	53.47	54.94	59.42	47.95	42.54	3.18	43.90	28.01	36.23
Ab mol %	43.98	43.67	44.60	43.07	39.26	50.68	56.18	96.82	54.60	68.10	60.40
Or mol%	1.31	1.71	1.93	1.99	1.32	1.37	1.28	0.00	1.50	3.89	3.37

Supplementary table 3 - Continued.

District	Siliqua								Siliqua		
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2
Lithology	Andesite								Andesite		
Description	pl, profile zoning 1 from core to rim								Ab in mica	pl in mica	pl in qz
SiO ₂	53.87	52.92	50.50	53.43	53.62	54.96	65.81	53.31	52.01	53.05	64.24
Al ₂ O ₃	29.12	29.27	30.93	29.86	29.06	28.46	20.90	29.14	29.78	29.82	18.83
FeO _t	0.13	0.65	0.58	0.08	0.20	0.05	0.21	0.40	0.26	0.18	0.02
CaO	10.70	10.82	13.57	10.68	10.71	10.24	1.13	11.15	12.19	11.03	0.41
Na ₂ O	6.05	5.88	4.25	5.21	5.98	5.88	11.90	5.84	5.32	5.42	2.42
K ₂ O	0.15	0.33	0.13	0.24	0.27	0.09	0.10	0.17	0.25	0.44	12.42
BaO	0.06	0.00	0.00	0.48	0.04	0.00	0.00	0.00	0.22	0.00	1.29
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Total	100.09	99.88	99.95	99.97	99.87	99.69	100.04	100.01	100.03	99.96	99.63
Si	9.643	9.501	9.149	9.652	9.621	9.899	11.443	9.564	9.363	9.537	11.905
Al	6.143	6.195	6.605	6.358	6.147	6.042	4.283	6.162	6.318	6.318	4.112
Fe	0.020	0.098	0.087	0.012	0.030	0.008	0.031	0.060	0.039	0.027	0.003
Ca	2.053	2.082	2.634	2.066	2.058	1.977	0.210	2.143	2.352	2.124	0.081
Na	2.101	2.049	1.495	1.823	2.080	2.054	4.011	2.032	1.856	1.890	0.868
K	0.035	0.076	0.030	0.055	0.061	0.020	0.022	0.038	0.057	0.102	2.937
Ba	0.004	0.000	0.000	0.034	0.003	0.000	0.000	0.000	0.016	0.000	0.094
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	49.01	49.50	63.33	52.38	49.01	48.80	4.96	50.87	55.14	51.61	2.08
Ab mol %	50.16	48.70	35.94	46.22	49.54	50.70	94.52	48.23	43.52	45.91	22.34
Or mol%	0.84	1.80	0.73	1.40	1.45	0.50	0.52	0.91	1.35	2.48	75.59

Supplementary table 3 - Continued.

District	Siliqua					Siliqua					Siliqua	
Sample	MTR2	MTR2	MTR2	MTR3	MTR3	MTR3	MTR3	MTR3	MTR3	MTR4	MTR4	MTR4
Lithology	Andesite					Andesite					Andesite	
Description	Afs in qz	Ab in mica	pl	pl	pl	Afs	pl	pl	pl	pl	pl	pl
SiO ₂	62.99	66.67	55.18	54.68	57.28	64.88	56.01	55.07	55.26	58.49	56.94	53.21
Al ₂ O ₃	18.95	20.34	27.84	28.12	26.60	18.88	27.10	28.25	27.82	25.38	27.00	29.87
FeO _t	0.73	0.00	0.75	0.54	0.21	0.13	0.20	0.23	0.56	0.31	0.43	0.14
CaO	0.36	0.75	9.12	10.55	8.52	0.25	9.38	10.33	9.77	7.27	8.80	11.98
Na ₂ O	2.51	12.07	6.20	5.36	6.34	2.47	5.78	5.44	5.59	7.25	6.04	4.64
K ₂ O	13.00	0.10	0.47	0.32	0.57	12.14	0.47	0.40	0.43	0.61	0.59	0.10
BaO	1.52	0.00	0.27	0.05	0.00	0.93	0.12	0.17	0.08	0.28	0.03	0.00
SrO	0.00	0.00	0.00	0.45	0.50	0.35	0.61	0.21	0.64	0.25	0.03	0.20
Total	100.05	99.92	99.83	100.08	100.02	100.03	99.67	100.10	100.14	99.85	99.87	100.14
Si	11.626	11.598	9.930	9.880	10.297	11.975	10.149	9.933	9.978	10.486	10.255	9.621
Al	4.123	4.171	5.906	5.990	5.637	4.108	5.788	6.005	5.921	5.364	5.730	6.366
Fe	0.112	0.000	0.114	0.082	0.031	0.019	0.030	0.035	0.084	0.047	0.065	0.021
Ca	0.071	0.140	1.759	2.043	1.642	0.049	1.821	1.996	1.890	1.396	1.698	2.321
Na	0.898	4.070	2.164	1.880	2.209	0.885	2.031	1.903	1.957	2.520	2.110	1.627
K	3.061	0.021	0.108	0.075	0.132	2.858	0.109	0.092	0.099	0.141	0.136	0.023
Ba	0.110	0.000	0.019	0.003	0.000	0.068	0.009	0.012	0.006	0.020	0.002	0.000
Sr	0.000	0.000	0.000	0.047	0.052	0.037	0.064	0.022	0.067	0.026	0.003	0.021
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	1.76	3.31	43.63	51.11	41.23	1.30	45.98	50.01	47.90	34.42	43.05	58.45
Ab mol %	22.29	96.19	53.68	47.02	55.46	23.34	51.27	47.68	49.60	62.11	53.48	40.97
Or mol%	75.96	0.51	2.69	1.87	3.31	75.35	2.74	2.31	2.50	3.47	3.46	0.58

Supplementary table 3 - Continued.

District	Siliqua									Siliqua	
Sample	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	ACQ1	ACQ1	ACQ1
Lithology											
Description	pl	pl	pl	pl	Afs	pl	pl	Ab in amp	pl core	Dacite	pl
SiO ₂	48.51	51.23	56.64	58.62	65.71	54.38	54.58	66.58	53.07	56.56	52.58
Al ₂ O ₃	32.44	30.51	27.15	25.77	18.69	28.62	28.51	20.63	29.58	26.39	29.80
FeO _t	0.17	0.32	0.31	0.08	0.02	0.32	0.12	0.28	0.06	0.82	0.38
CaO	15.34	13.06	8.84	7.55	0.18	10.75	10.88	1.25	11.51	8.27	11.76
Na ₂ O	2.98	4.24	6.19	7.04	2.34	5.39	5.44	9.07	5.47	7.17	5.56
K ₂ O	0.21	0.20	0.50	0.59	13.00	0.32	0.19	2.13	0.05	0.44	0.11
BaO	0.00	0.12	0.00	0.11	0.08	0.23	0.00	0.09	0.08	0.38	0.00
SrO	0.27	0.43	0.40	0.29	0.09	0.04	0.29	0.00	0.00	0.00	0.00
Total	99.92	100.09	100.03	100.04	100.10	100.05	100.01	100.03	99.83	100.02	100.20
Si	8.858	9.297	10.182	10.490	12.041	9.809	9.843	11.804	9.560	10.116	9.426
Al	6.983	6.526	5.754	5.435	4.038	6.086	6.060	4.311	6.281	5.563	6.298
Fe	0.027	0.048	0.046	0.012	0.003	0.048	0.018	0.041	0.009	0.122	0.056
Ca	3.001	2.540	1.703	1.448	0.035	2.078	2.103	0.237	2.221	1.586	2.260
Na	1.055	1.490	2.157	2.444	0.831	1.885	1.903	3.119	1.911	2.486	1.934
K	0.048	0.045	0.115	0.134	3.038	0.073	0.043	0.481	0.012	0.100	0.026
Ba	0.000	0.009	0.000	0.008	0.006	0.016	0.000	0.006	0.005	0.027	0.000
Sr	0.028	0.045	0.042	0.030	0.009	0.004	0.030	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	73.12	62.32	42.84	35.97	0.89	51.48	51.94	6.19	53.60	38.02	53.55
Ab mol %	25.72	36.57	54.25	60.71	21.28	46.70	46.99	81.28	46.11	59.59	45.83
Or mol%	1.17	1.11	2.90	3.32	77.83	1.82	1.07	12.53	0.30	2.39	0.62

Supplementary table 3 - Continued.

District	Siliqua											
Sample	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1
Lithology												
Description	pl	pl gm	Afs gm	pl	pl core	pl rim	pl	pl gm	pl gm	pl gm	pl	pl
SiO ₂	54.13	57.44	65.09	52.78	55.92	53.11	53.72	61.35	57.61	57.91	52.20	54.51
Al ₂ O ₃	28.46	26.54	19.17	30.75	27.77	29.31	29.10	23.45	25.76	25.58	30.04	28.90
FeO _t	0.46	0.17	0.27	0.00	0.28	0.18	0.24	0.09	0.56	0.68	0.46	0.00
CaO	10.47	8.06	0.12	11.54	9.35	11.84	10.82	4.62	7.86	6.78	12.44	10.56
Na ₂ O	5.90	6.96	4.46	5.02	6.28	5.28	5.62	8.93	7.03	7.61	4.89	5.77
K ₂ O	0.33	0.75	10.16	0.03	0.27	0.14	0.21	1.29	0.96	1.09	0.00	0.25
BaO	0.00	0.01	0.56	0.00	0.04	0.00	0.08	0.28	0.14	0.07	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.16	0.15	0.12	0.00	0.01	0.00	0.00	0.00
Total	99.74	99.92	99.83	100.11	100.05	100.03	99.91	100.01	99.94	99.71	100.03	99.99
Si	9.742	10.263	11.848	9.496	10.028	9.568	9.671	10.849	10.306	10.335	9.422	9.786
Al	6.036	5.588	4.113	6.521	5.870	6.224	6.176	4.888	5.432	5.381	6.391	6.116
Fe	0.069	0.026	0.042	0.000	0.042	0.028	0.036	0.014	0.084	0.101	0.069	0.000
Ca	2.018	1.542	0.023	2.225	1.797	2.286	2.087	0.875	1.507	1.296	2.407	2.032
Na	2.058	2.411	1.576	1.751	2.183	1.845	1.963	3.063	2.440	2.634	1.711	2.009
K	0.076	0.170	2.360	0.006	0.061	0.033	0.048	0.291	0.219	0.248	0.000	0.056
Ba	0.000	0.000	0.040	0.000	0.002	0.000	0.005	0.019	0.010	0.005	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.016	0.016	0.013	0.000	0.002	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	48.61	37.39	0.57	55.87	44.48	54.90	50.91	20.70	36.17	31.02	58.44	49.59
Ab mol %	49.56	58.47	39.80	43.97	54.02	44.31	47.90	72.43	58.57	63.04	41.56	49.03
Or mol%	1.83	4.13	59.62	0.16	1.51	0.79	1.18	6.88	5.27	5.93	0.00	1.38

Supplementary table 3 - Continued.

District Sample Lithology Description	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	Siliqua ACQ1 Dacite	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1
	pl. profile zoning 1 from core to rim										
SiO ₂	54.05	51.85	55.39	53.93	52.31	53.15	53.12	51.63	53.61	56.33	55.16
Al ₂ O ₃	29.13	30.43	28.06	28.80	30.14	29.50	29.78	30.66	29.21	27.76	28.04
FeO _t	0.08	0.21	0.00	0.15	0.30	0.00	0.59	0.19	0.47	0.00	0.48
CaO	10.98	12.24	9.07	11.10	11.93	11.23	10.53	12.40	10.15	9.40	9.09
Na ₂ O	5.47	4.93	6.84	5.56	5.07	5.53	5.54	4.79	6.01	6.05	6.42
K ₂ O	0.25	0.25	0.22	0.20	0.14	0.16	0.24	0.14	0.12	0.33	0.46
BaO	0.10	0.16	0.30	0.01	0.02	0.00	0.00	0.00	0.34	0.05	0.00
SrO	0.00	0.25	0.59	0.09	0.00	0.30	0.03	0.00	0.00	0.00	0.00
Total	100.06	100.31	100.48	99.83	99.92	99.87	99.82	99.81	99.91	99.92	99.64
Si	9.723	9.336	9.873	9.718	9.434	9.571	9.567	9.329	9.637	10.122	9.904
Al	6.177	6.457	5.897	6.118	6.408	6.262	6.321	6.530	6.190	5.879	5.934
Fe	0.011	0.032	0.000	0.023	0.045	0.000	0.088	0.029	0.070	0.000	0.072
Ca	2.117	2.361	1.733	2.143	2.305	2.167	2.031	2.402	1.955	1.810	1.749
Na	1.908	1.720	2.364	1.943	1.774	1.931	1.933	1.677	2.096	2.109	2.237
K	0.057	0.057	0.051	0.045	0.033	0.037	0.055	0.033	0.028	0.077	0.105
Ba	0.007	0.011	0.021	0.000	0.002	0.000	0.000	0.000	0.024	0.004	0.000
Sr	0.000	0.026	0.061	0.009	0.000	0.032	0.003	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	51.86	57.05	41.78	51.87	56.06	52.40	50.53	58.42	47.93	45.31	42.76
Ab mol %	46.74	41.58	56.99	47.03	43.14	46.70	48.10	40.79	51.38	52.77	54.68
Or mol%	1.40	1.37	1.23	1.10	0.80	0.90	1.38	0.79	0.69	1.92	2.56

Supplementary table 3 - Continued.

District Sample Lithology Description	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	Siliqua ACQ1 Dacite	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1
	pl. profile zoning 2 from core to rim										
SiO ₂	54.67	55.27	53.91	53.73	52.87	53.41	55.31	52.19	54.85	52.58	53.85
Al ₂ O ₃	28.60	28.20	28.93	28.73	29.90	29.23	28.35	29.96	28.24	29.33	28.24
FeO _t	0.28	0.47	0.16	0.00	0.19	0.05	0.14	0.22	0.31	0.38	0.10
CaO	10.04	10.10	10.91	11.56	11.87	10.58	9.67	12.54	10.00	11.25	11.30
Na ₂ O	6.05	5.83	5.83	5.21	4.73	5.78	6.27	4.56	6.11	5.94	5.64
K ₂ O	0.13	0.14	0.17	0.27	0.17	0.25	0.08	0.13	0.24	0.15	0.37
BaO	0.29	0.00	0.12	0.00	0.11	0.00	0.00	0.00	0.08	0.00	0.37
SrO	0.00	0.00	0.00	0.40	0.00	0.40	0.12	0.00	0.00	0.06	0.00
Total	100.07	100.01	100.03	99.89	99.84	99.70	99.95	99.59	99.82	99.70	99.86
Si	9.816	9.940	9.678	9.711	9.577	9.624	9.918	9.479	9.857	9.451	9.714
Al	6.053	5.978	6.122	6.121	6.384	6.208	5.992	6.413	5.982	6.215	6.004
Fe	0.042	0.070	0.024	0.000	0.028	0.008	0.021	0.033	0.047	0.058	0.016
Ca	1.931	1.946	2.099	2.238	2.304	2.043	1.857	2.440	1.925	2.167	2.184
Na	2.107	2.033	2.030	1.826	1.660	2.018	2.180	1.604	2.129	2.069	1.971
K	0.030	0.033	0.038	0.061	0.040	0.057	0.019	0.031	0.054	0.034	0.085
Ba	0.021	0.000	0.009	0.000	0.008	0.000	0.000	0.000	0.005	0.000	0.026
Sr	0.000	0.000	0.000	0.042	0.000	0.042	0.013	0.000	0.000	0.006	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	47.46	48.50	50.36	54.25	57.54	49.61	45.79	59.88	46.86	50.75	51.50
Ab mol %	51.81	50.69	48.72	44.26	41.46	49.01	53.74	39.37	51.82	48.44	46.49
Or mol%	0.73	0.81	0.91	1.49	1.00	1.39	0.47	0.75	1.32	0.81	2.00

Supplementary table 3 - Continued.

District	Monastir										
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite										
Description	pl	pl	pl core	pl rim	pl core	pl rim	pl	pl gm	pl core	pl in pl	pl rim
SiO ₂	45.66	45.34	47.07	45.53	46.53	45.33	45.49	47.73	46.78	60.07	46.66
Al ₂ O ₃	34.38	33.94	33.70	34.11	33.24	34.37	34.41	32.33	34.00	24.36	33.82
FeO _t	0.45	0.49	0.14	0.91	0.43	0.31	0.17	0.94	0.34	0.80	0.26
CaO	17.80	17.11	16.71	17.27	16.84	17.82	18.10	14.66	17.08	6.54	16.79
Na ₂ O	1.65	2.41	2.31	2.21	2.21	1.83	1.73	3.58	1.79	6.86	2.18
K ₂ O	0.08	0.28	0.00	0.16	0.25	0.01	0.00	0.08	0.30	0.90	0.00
BaO	0.00	0.48	0.00	0.00	0.00	0.15	0.47	0.00	0.08	0.38	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00
Total	100.02	100.06	99.94	100.18	99.50	99.83	100.37	99.46	100.35	99.91	99.71
Si	8.384	8.296	8.613	8.317	8.560	8.331	8.338	8.722	8.560	10.818	8.565
Al	7.440	7.319	7.269	7.346	7.208	7.446	7.433	6.964	7.332	5.172	7.317
Fe	0.069	0.075	0.022	0.139	0.067	0.048	0.027	0.144	0.051	0.121	0.040
Ca	3.502	3.354	3.276	3.381	3.318	3.509	3.555	2.870	3.348	1.262	3.302
Na	0.586	0.855	0.820	0.781	0.789	0.654	0.614	1.267	0.634	2.394	0.776
K	0.020	0.066	0.000	0.036	0.058	0.002	0.000	0.019	0.069	0.207	0.000
Ba	0.000	0.035	0.000	0.000	0.000	0.010	0.033	0.000	0.005	0.027	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	85.26	78.46	79.98	80.53	79.68	84.24	85.28	69.05	82.63	32.66	80.98
Ab mol %	14.26	19.99	20.02	18.61	18.94	15.70	14.72	30.49	15.65	61.98	19.02
Or mol%	0.47	1.55	0.00	0.86	1.38	0.06	0.00	0.46	1.71	5.36	0.00

Supplementary table 3 - Continued.

District	Monastir										
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite										
Description	pl. profile zoning 1 from core to rim										
SiO ₂	44.07	44.31	44.73	44.18	44.27	46.14	45.94	44.15	47.88	45.77	
Al ₂ O ₃	35.45	35.20	35.48	35.21	35.09	34.03	34.10	35.53	32.61	34.43	
FeO _t	0.37	0.75	0.46	0.64	0.49	0.85	0.45	0.53	0.28	0.41	
CaO	18.82	18.63	18.31	18.67	18.73	16.29	16.49	18.21	15.57	17.31	
Na ₂ O	1.21	1.16	1.18	1.01	1.08	2.12	2.60	1.25	2.82	1.92	
K ₂ O	0.11	0.00	0.01	0.00	0.00	0.08	0.07	0.07	0.12	0.09	
BaO	0.00	0.00	0.00	0.00	0.06	0.00	0.20	0.03	0.40	0.00	
SrO	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.03	0.00	
Total	100.03	100.05	100.17	99.97	99.72	99.50	99.85	99.75	99.73	99.93	
Si	8.100	8.158	8.218	8.157	8.181	8.494	8.400	8.139	8.782	8.392	
Al	7.680	7.639	7.684	7.661	7.644	7.385	7.349	7.719	7.050	7.441	
Fe	0.057	0.116	0.071	0.098	0.076	0.131	0.069	0.081	0.043	0.063	
Ca	3.706	3.674	3.604	3.693	3.709	3.214	3.230	3.597	3.060	3.400	
Na	0.430	0.414	0.420	0.363	0.386	0.758	0.922	0.446	1.004	0.684	
K	0.027	0.000	0.003	0.000	0.000	0.018	0.016	0.016	0.029	0.021	
Ba	0.000	0.000	0.000	0.000	0.004	0.000	0.014	0.002	0.029	0.000	
Sr	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.003	0.000	
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	
An mol%	89.02	89.88	89.49	91.06	90.56	80.55	77.49	88.62	74.77	82.84	
Ab mol %	10.34	10.12	10.43	8.94	9.44	19.00	22.12	10.99	24.52	16.66	
Or mol%	0.64	0.00	0.08	0.00	0.00	0.45	0.39	0.39	0.71	0.50	

Supplementary table 3 - Continued.

District	Monastir							Monastir			
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite							Andesite			
Description	pl, profile zoning 1 from core to rim							pl gm			
SiO ₂	44.67	47.26	59.20	46.03	45.56	59.67	51.50	46.43	46.77	44.93	45.23
Al ₂ O ₃	35.12	33.29	24.41	34.07	34.25	24.79	29.11	34.16	33.78	35.47	34.91
FeO _t	0.10	0.27	0.87	0.72	0.34	0.27	1.05	0.48	0.25	0.12	0.45
CaO	17.99	16.10	7.06	17.43	17.48	6.52	12.90	16.74	16.86	18.05	17.84
Na ₂ O	1.27	2.61	7.29	1.70	1.84	8.32	4.88	2.15	2.20	1.38	1.30
K ₂ O	0.08	0.03	0.92	0.00	0.24	0.53	0.16	0.13	0.01	0.00	0.10
BaO	0.37	0.25	0.08	0.00	0.07	0.00	0.44	0.00	0.21	0.00	0.16
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.60	99.80	99.83	99.95	99.78	100.09	100.03	100.10	100.08	99.96	100.00
Si	8.261	8.659	10.609	8.464	8.372	10.571	9.335	8.491	8.564	8.255	8.330
Al	7.656	7.188	5.156	7.385	7.417	5.176	6.220	7.364	7.290	7.681	7.578
Fe	0.016	0.041	0.131	0.111	0.052	0.040	0.159	0.073	0.038	0.019	0.070
Ca	3.565	3.160	1.355	3.435	3.442	1.237	2.505	3.281	3.308	3.554	3.521
Na	0.457	0.927	2.533	0.605	0.656	2.858	1.715	0.761	0.782	0.492	0.465
K	0.018	0.006	0.210	0.000	0.056	0.119	0.036	0.030	0.003	0.000	0.024
Ba	0.027	0.018	0.006	0.000	0.005	0.000	0.031	0.000	0.015	0.000	0.012
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	88.24	77.20	33.08	85.03	82.85	29.35	58.85	80.57	80.81	87.85	87.80
Ab mol%	11.31	22.65	61.81	14.97	15.79	67.83	40.29	18.69	19.11	12.15	11.60
Or mol%	0.45	0.16	5.11	0.00	1.36	2.83	0.86	0.74	0.07	0.00	0.60

Supplementary table 3 - Continued.

District	Monastir							Monastir			
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite							Andesite			
Description	pl, profile zoning 2 parallel to the rim							pl in pl			
SiO ₂	58.84	58.93	61.80	50.52	49.83	48.83	46.64	51.11	48.07	51.59	45.94
Al ₂ O ₃	24.68	24.29	22.90	30.77	31.80	32.60	33.93	30.85	33.38	30.33	34.68
FeO _t	0.33	1.01	0.50	0.43	0.44	0.21	0.66	0.57	0.37	0.61	0.19
CaO	7.24	6.58	5.04	13.53	13.96	15.14	16.40	12.56	15.50	12.13	17.81
Na ₂ O	7.94	8.01	8.38	4.44	4.14	2.93	2.52	4.67	2.72	4.76	1.58
K ₂ O	0.72	1.14	1.16	0.04	0.23	0.03	0.03	0.10	0.00	0.12	0.10
BaO	0.09	0.17	0.15	0.33	0.00	0.18	0.00	0.02	0.07	0.26	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.84	100.13	99.94	100.05	100.40	99.92	100.17	99.88	100.11	99.81	100.31
Si	10.479	10.477	10.995	9.150	8.982	8.923	8.505	9.243	8.769	9.352	8.410
Al	5.180	5.089	4.803	6.568	6.757	7.022	7.293	6.577	7.178	6.481	7.484
Fe	0.050	0.151	0.074	0.065	0.066	0.032	0.101	0.087	0.057	0.093	0.030
Ca	1.381	1.253	0.961	2.625	2.695	2.964	3.205	2.434	3.031	2.355	3.494
Na	2.741	2.759	2.892	1.559	1.446	1.039	0.890	1.636	0.961	1.673	0.559
K	0.164	0.260	0.264	0.010	0.053	0.006	0.006	0.022	0.000	0.027	0.024
Ba	0.006	0.011	0.010	0.023	0.000	0.013	0.000	0.001	0.005	0.019	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	32.23	29.33	23.35	62.58	64.26	73.92	78.15	59.48	75.92	58.07	85.71
Ab mol%	63.95	64.59	70.24	37.18	34.47	25.92	21.70	39.98	24.08	41.26	13.71
Or mol%	3.82	6.08	6.42	0.24	1.28	0.16	0.15	0.54	0.00	0.67	0.58

Supplementary table 3 - Continued.

District	Monastir									
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite									
Description	pl. profile zoning 3 from core to rim									
SiO ₂	47.04	47.55	47.78	46.64	47.44	45.77	47.55	45.49	44.95	46.06
Al ₂ O ₃	33.45	32.93	33.19	34.40	33.64	34.23	33.08	34.24	34.03	34.55
FeO _t	0.20	0.29	0.29	0.24	0.36	0.37	0.06	0.54	0.38	0.01
CaO	16.20	16.36	15.95	17.05	16.14	17.12	15.97	17.72	18.48	17.32
Na ₂ O	2.55	2.61	2.66	1.82	2.26	1.94	3.00	1.77	1.83	1.79
K ₂ O	0.00	0.04	0.16	0.09	0.17	0.10	0.14	0.00	0.11	0.00
BaO	0.13	0.16	0.05	0.00	0.00	0.45	0.17	0.00	0.19	0.09
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.58	99.94	100.07	100.23	100.01	99.98	99.98	99.77	99.96	99.83
Si	8.632	8.701	8.718	8.535	8.683	8.410	8.664	8.368	8.252	8.461
Al	7.236	7.103	7.138	7.420	7.257	7.415	7.105	7.425	7.365	7.482
Fe	0.031	0.044	0.044	0.036	0.055	0.057	0.009	0.083	0.059	0.002
Ca	3.186	3.207	3.118	3.344	3.164	3.371	3.117	3.493	3.636	3.409
Na	0.907	0.924	0.940	0.644	0.800	0.693	1.060	0.631	0.650	0.639
K	0.000	0.009	0.038	0.020	0.040	0.022	0.033	0.000	0.025	0.000
Ba	0.010	0.012	0.003	0.000	0.000	0.032	0.012	0.000	0.013	0.006
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	77.85	77.46	76.11	83.43	79.01	82.50	74.03	84.70	84.34	84.21
Ab mol %	22.15	22.32	22.96	16.07	19.98	16.95	25.17	15.30	15.08	15.79
Or mol%	0.00	0.22	0.93	0.51	1.01	0.55	0.79	0.00	0.58	0.00

Supplementary table 3 - Continued.

District	Monastir								Monastir	
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite								Andesite	
Description	pl. profile zoning 3 from core to rim								pl core	pl rim
SiO ₂	46.00	46.41	46.14	47.25	46.81	49.44	46.38	45.56	44.83	45.46
Al ₂ O ₃	34.25	33.97	34.62	33.10	33.13	31.55	33.82	34.20	34.32	34.94
FeO _t	0.14	0.52	0.30	0.22	0.56	0.23	0.71	0.50	0.78	0.12
CaO	17.11	16.42	16.85	16.63	16.66	14.25	16.08	18.21	18.03	17.71
Na ₂ O	1.93	2.03	1.82	2.60	2.30	3.95	2.49	1.39	1.72	1.75
K ₂ O	0.07	0.01	0.00	0.12	0.15	0.19	0.05	0.09	0.08	0.00
BaO	0.12	0.10	0.00	0.00	0.00	0.05	0.29	0.08	0.30	0.14
SrO	0.00	0.30	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.62	99.75	99.86	99.93	99.61	99.67	99.82	100.03	100.06	100.12
Si	8.463	8.544	8.478	8.633	8.602	8.988	8.504	8.387	8.240	8.328
Al	7.427	7.371	7.497	7.128	7.177	6.761	7.309	7.421	7.435	7.546
Fe	0.022	0.080	0.046	0.034	0.086	0.034	0.109	0.077	0.120	0.018
Ca	3.373	3.239	3.317	3.256	3.280	2.775	3.159	3.592	3.550	3.477
Na	0.690	0.724	0.647	0.922	0.819	1.393	0.885	0.497	0.613	0.621
K	0.016	0.003	0.000	0.027	0.035	0.044	0.012	0.021	0.020	0.000
Ba	0.009	0.008	0.000	0.000	0.000	0.004	0.021	0.005	0.022	0.010
Sr	0.000	0.032	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	82.70	81.69	83.67	77.42	79.34	65.88	77.88	87.40	84.87	84.85
Ab mol %	16.91	18.25	16.33	21.93	19.81	33.08	21.83	12.09	14.67	15.15
Or mol%	0.39	0.07	0.00	0.65	0.85	1.04	0.29	0.51	0.47	0.00

Supplementary table 3 - Continued.

District	Monastir								Monastir	
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO3	CMO3
Lithology	Andesite								Basaltic Andesite	
Description	pl rim	pl in opx	pl core	pl rim	pl core	pl rim	pl gm	pl gm	pl in cpx	pl in cpx
SiO ₂	44.59	47.06	46.60	45.78	46.32	45.46	45.98	57.04	56.11	49.73
Al ₂ O ₃	34.62	33.53	33.75	34.93	33.67	34.61	34.05	26.25	26.32	31.27
FeO _t	0.62	0.00	0.52	0.42	0.65	0.31	0.54	0.49	1.11	1.37
CaO	18.78	17.02	16.64	16.77	17.16	17.71	16.92	10.20	9.00	13.80
Na ₂ O	1.47	2.32	2.30	1.92	1.91	1.51	2.25	5.40	6.37	3.54
K ₂ O	0.00	0.16	0.25	0.09	0.12	0.00	0.05	0.46	1.16	0.41
BaO	0.00	0.00	0.00	0.07	0.00	0.33	0.12	0.00	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.08	100.10	100.07	99.97	99.82	99.94	99.91	99.85	100.08	100.12
Si	8.189	8.594	8.517	8.390	8.516	8.375	8.423	10.334	10.061	9.050
Al	7.494	7.216	7.271	7.546	7.296	7.516	7.353	5.607	5.563	6.706
Fe	0.095	0.000	0.080	0.065	0.100	0.048	0.082	0.075	0.167	0.209
Ca	3.697	3.330	3.259	3.292	3.380	3.497	3.321	1.981	1.728	2.691
Na	0.525	0.821	0.815	0.682	0.681	0.539	0.799	1.898	2.216	1.249
K	0.000	0.038	0.058	0.020	0.027	0.000	0.013	0.106	0.265	0.095
Ba	0.000	0.000	0.000	0.005	0.000	0.024	0.008	0.000	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	87.57	79.48	78.87	82.42	82.68	86.64	80.36	49.71	41.06	66.69
Ab mol %	12.43	19.60	19.72	17.08	16.66	13.36	19.34	47.63	52.64	30.95
Or mol%	0.00	0.92	1.40	0.50	0.67	0.00	0.31	2.65	6.30	2.36

Supplementary table 3 - Continued.

District	Monastir								Monastir	
Sample	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3
Lithology	Basaltic Andesite									
Description	pl core	pl rim	pl gm	pl core	pl rim	pl core	pl rim	pl	pl rim	pl gm
SiO ₂	44.85	51.96	50.26	47.37	46.41	45.14	46.69	44.44	45.40	49.96
Al ₂ O ₃	34.94	29.97	30.09	33.51	33.67	34.62	33.27	35.25	34.30	30.92
FeO _t	0.77	1.17	1.57	0.38	0.87	0.86	1.16	0.69	0.55	0.94
CaO	18.26	11.97	13.14	16.76	17.12	17.84	16.00	17.82	17.71	13.96
Na ₂ O	1.19	4.51	4.32	1.98	1.84	1.64	2.49	1.24	1.90	3.87
K ₂ O	0.05	0.28	0.13	0.09	0.18	0.00	0.26	0.14	0.14	0.39
BaO	0.00	0.15	0.57	0.00	0.00	0.04	0.26	0.44	0.02	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.06	100.00	100.08	100.10	100.09	100.13	100.15	100.03	100.01	100.05
Si	8.260	9.425	9.147	8.683	8.519	8.284	8.543	8.198	8.322	9.071
Al	7.585	6.408	6.455	7.240	7.285	7.489	7.176	7.663	7.410	6.616
Fe	0.118	0.177	0.239	0.058	0.134	0.132	0.178	0.107	0.084	0.143
Ca	3.603	2.327	2.562	3.291	3.367	3.509	3.138	3.523	3.477	2.716
Na	0.423	1.587	1.526	0.705	0.653	0.583	0.885	0.444	0.673	1.364
K	0.012	0.066	0.030	0.022	0.043	0.000	0.061	0.033	0.032	0.091
Ba	0.000	0.010	0.041	0.000	0.000	0.003	0.019	0.032	0.001	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	89.23	58.47	62.21	81.90	82.87	85.76	76.84	88.07	83.13	65.12
Ab mol %	10.48	39.89	37.05	17.56	16.08	14.24	21.66	11.11	16.10	32.71
Or mol%	0.29	1.65	0.74	0.54	1.05	0.00	1.50	0.82	0.77	2.17

Supplementary table 3 - Continued.

District	Punta Su Silixianu					Punta Su Silixianu					
Sample	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1	PSS1
Lithology	Andesite					Andesite					
Description	pl core	pl rim	pl core	pl rim	pl	pl, profile zoning 1 from rim to core					
SiO ₂	48.90	49.16	46.61	49.16	46.57	52.56	47.64	55.05	47.73	52.34	45.59
Al ₂ O ₃	32.13	32.27	33.47	32.14	34.37	30.32	32.76	28.65	33.21	30.46	34.87
FeO _t	0.51	0.63	0.88	0.35	0.31	0.21	0.15	0.24	0.50	0.45	0.16
CaO	14.89	14.36	16.57	14.38	16.00	11.71	16.56	9.58	15.25	12.14	17.69
Na ₂ O	3.35	3.48	2.45	3.74	2.54	4.85	2.75	5.71	3.06	4.57	1.70
K ₂ O	0.09	0.17	0.02	0.00	0.24	0.15	0.08	0.56	0.29	0.24	0.00
BaO	0.19	0.00	0.00	0.38	0.07	0.32	0.09	0.00	0.00	0.00	0.00
SrO	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.06	100.07	100.03	100.15	100.10	100.13	100.03	99.79	100.04	100.20	100.02
Si	8.905	8.933	8.526	8.926	8.487	9.492	8.693	9.913	8.683	9.448	8.360
Al	6.895	6.911	7.215	6.878	7.382	6.454	7.047	6.080	7.120	6.482	7.537
Fe	0.078	0.095	0.135	0.053	0.047	0.032	0.023	0.036	0.076	0.068	0.025
Ca	2.906	2.797	3.247	2.798	3.124	2.266	3.239	1.848	2.973	2.349	3.475
Na	1.181	1.225	0.870	1.317	0.899	1.699	0.973	1.993	1.080	1.599	0.604
K	0.020	0.040	0.004	0.000	0.056	0.035	0.019	0.130	0.068	0.054	0.000
Ba	0.013	0.000	0.000	0.027	0.005	0.023	0.006	0.000	0.000	0.000	0.000
Sr	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	70.75	68.86	78.78	68.00	76.60	56.64	76.55	46.54	72.13	58.70	85.20
Ab mol %	28.76	30.16	21.11	32.00	22.04	42.48	23.00	50.20	26.21	39.95	14.80
Or mol%	0.49	0.99	0.10	0.00	1.37	0.87	0.45	3.26	1.66	1.36	0.00

Supplementary table 3 - Continued.

District	Capo Frasca				Capo Frasca			Capo Frasca		
Sample	MAL35	MAL35	MAL35	MAL29	MAL29	MAL29	MAL29	MAL38	MAL38	
Lithology	Basalt				Basaltic Andesite			Basaltic Andesite		
Description	pl	pl	pl	pl	pl	pl	pl	pl	pl	
SiO ₂	50.78	50.74	46.19	46.99	45.39	45.44	47.35	50.77	50.11	
Al ₂ O ₃	30.41	30.11	34.00	33.74	34.76	34.95	33.60	30.44	31.26	
FeO _t	0.95	1.14	0.61	0.34	0.26	0.25	0.51	0.71	0.59	
CaO	14.29	14.46	17.55	16.88	18.25	18.11	16.69	14.30	14.71	
Na ₂ O	3.31	3.13	1.57	1.94	1.12	1.17	1.79	3.15	2.92	
K ₂ O	0.18	0.19	0.08	0.08	0.04	0.05	0.09	0.32	0.31	
Total	99.92	99.76	99.99	99.97	99.83	99.96	100.03	99.69	99.89	
Si	9.286	9.312	8.497	8.623	8.378	8.370	8.700	9.309	9.172	
Al	6.554	6.513	7.372	7.298	7.562	7.587	7.277	6.579	6.745	
Fe	0.146	0.175	0.093	0.052	0.040	0.038	0.078	0.109	0.090	
Ca	2.799	2.843	3.460	3.319	3.609	3.574	3.286	2.809	2.885	
Na	1.173	1.113	0.559	0.690	0.402	0.419	0.638	1.119	1.036	
K	0.042	0.044	0.019	0.018	0.009	0.011	0.021	0.076	0.072	
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	
An mol%	69.74	71.08	85.69	82.41	89.77	89.26	83.29	70.16	72.25	
Ab mol %	29.23	27.81	13.85	17.14	10.01	10.48	16.17	27.95	25.94	
Or mol%	1.04	1.10	0.46	0.45	0.22	0.27	0.53	1.89	1.81	

Supplementary table 3 - Continued.

District	Capo Frasca					Capo Frasca			
Sample	MAL38	MAL38	MAL38	MAL41	MAL41	MAL41	MAL41	MAL41	MAL41
Lithology	Basaltic Andesite					Basaltic Andesite			
Description	pl	pl	pl	pl	pl	pl	pl	pl	pl
SiO ₂	53.77	50.41	50.13	50.24	50.81	50.22	50.68	47.85	48.67
Al ₂ O ₃	28.26	30.72	31.17	31.10	30.48	31.21	30.72	32.76	32.31
FeO _t	1.09	0.81	0.62	0.74	0.75	0.74	0.75	0.64	0.65
CaO	11.77	14.23	14.58	14.58	13.93	14.58	14.29	16.37	15.67
Na ₂ O	4.56	3.04	2.95	3.02	3.19	2.95	3.16	2.11	2.42
K ₂ O	0.52	0.29	0.30	0.25	0.32	0.31	0.29	0.20	0.19
Total	99.97	99.50	99.75	99.94	99.48	100.03	99.89	99.94	99.91
Si	9.767	9.266	9.188	9.191	9.333	9.183	9.272	8.789	8.929
Al	6.050	6.656	6.735	6.706	6.599	6.727	6.624	7.092	6.986
Fe	0.165	0.125	0.095	0.113	0.115	0.114	0.115	0.099	0.099
Ca	2.290	2.803	2.864	2.858	2.742	2.857	2.801	3.221	3.080
Na	1.607	1.082	1.048	1.073	1.136	1.046	1.121	0.752	0.861
K	0.120	0.067	0.070	0.059	0.075	0.073	0.067	0.048	0.045
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	57.00	70.92	71.92	71.63	69.37	71.85	70.21	80.11	77.28
Ab mol %	40.00	27.38	26.32	26.88	28.73	26.31	28.11	18.70	21.59
Or mol%	3.00	1.70	1.75	1.49	1.90	1.85	1.68	1.19	1.13

Supplementary table 3 - Continued.

District	Monte Nureci (Arcuentu)								
Sample	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2
Lithology	Olivine Gabbro								
Description	pl	pl	pl	pl in cpx	pl	pl	pl	pl in ol	pl
SiO ₂	45.19	45.26	45.24	45.29	45.53	45.19	43.39	45.57	45.97
Al ₂ O ₃	35.09	34.89	34.33	34.67	34.76	34.69	36.64	34.59	34.38
FeO _t	0.00	0.38	0.59	0.45	0.35	0.44	0.14	0.48	0.37
CaO	18.20	17.44	17.85	17.67	17.41	17.63	19.37	17.29	17.43
Na ₂ O	1.37	1.64	1.67	1.55	1.71	1.63	0.53	1.76	1.50
K ₂ O	0.13	0.13	0.00	0.13	0.11	0.00	0.08	0.18	0.07
BaO	0.00	0.31	0.10	0.09	0.00	0.19	0.00	0.04	0.15
SrO	0.04	0.00	0.19	0.00	0.05	0.00	0.00	0.00	0.00
Total	100.03	100.05	99.96	99.85	99.91	99.76	100.16	99.92	99.86
Si	8.299	8.317	8.324	8.334	8.361	8.325	7.992	8.365	8.471
Al	7.596	7.557	7.445	7.520	7.524	7.533	7.955	7.485	7.468
Fe	0.000	0.058	0.091	0.069	0.053	0.068	0.022	0.074	0.058
Ca	3.581	3.434	3.520	3.484	3.425	3.480	3.823	3.402	3.442
Na	0.489	0.583	0.594	0.554	0.608	0.581	0.189	0.628	0.535
K	0.031	0.030	0.000	0.031	0.025	0.000	0.018	0.043	0.016
Ba	0.000	0.022	0.007	0.007	0.000	0.014	0.000	0.003	0.011
Sr	0.004	0.000	0.020	0.000	0.005	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	87.32	84.86	85.56	85.63	84.41	85.70	94.85	83.54	86.20
Ab mol %	11.91	14.40	14.44	13.60	14.98	14.30	4.70	15.41	13.40
Or mol%	0.77	0.75	0.00	0.77	0.61	0.00	0.45	1.05	0.39

Supplementary table 3 - Continued.

District	Monte Nureci (Arcuentu)							Monte Nureci (Arcuentu)		
Sample	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU1	MNU1	MNU1
Lithology	Olivine Gabbronorite							Gabbronorite		
Description	pl	pl in cpx	pl	pl	pl	pl	pl	pl	Afs	Afs
SiO ₂	44.33	44.05	45.08	45.02	45.31	45.35	44.29	58.19	64.23	65.07
Al ₂ O ₃	35.11	35.41	34.98	35.07	34.62	34.23	35.01	25.81	18.79	18.91
FeO _t	0.68	0.50	0.52	0.45	0.33	0.39	0.38	0.17	0.42	0.44
CaO	18.41	18.46	18.00	18.31	18.18	17.96	18.67	7.26	0.49	0.23
Na ₂ O	1.45	1.55	1.47	1.43	1.57	1.92	1.25	7.90	1.33	1.26
K ₂ O	0.10	0.18	0.01	0.03	0.26	0.17	0.14	0.59	14.49	14.48
BaO	0.00	0.00	0.04	0.09	0.12	0.00	0.32	0.01	0.30	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.08	100.15	100.10	100.41	100.39	100.02	100.05	99.93	100.05	100.40
Si	8.137	8.067	8.278	8.245	8.292	8.305	8.157	10.336	11.846	11.950
Al	7.597	7.644	7.572	7.570	7.466	7.389	7.599	5.403	4.086	4.094
Fe	0.104	0.077	0.079	0.069	0.051	0.059	0.058	0.025	0.065	0.068
Ca	3.622	3.622	3.542	3.593	3.564	3.525	3.684	1.381	0.096	0.046
Na	0.516	0.549	0.523	0.509	0.557	0.682	0.446	2.721	0.475	0.450
K	0.025	0.042	0.003	0.008	0.061	0.039	0.033	0.133	3.410	3.392
Ba	0.000	0.000	0.003	0.006	0.009	0.000	0.023	0.001	0.022	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	87.01	85.98	87.06	87.42	85.22	83.01	88.49	32.61	2.42	1.19
Ab mol %	12.40	13.03	12.86	12.38	13.31	16.06	10.71	64.25	11.93	11.58
Or mol%	0.59	0.99	0.08	0.20	1.46	0.93	0.80	3.14	85.66	87.23

Supplementary table 3 - Continued.

District	Monte Nureci (Arcuentu)									
Sample	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Gabbronorite									
Description	pl	pl	pl	pl core	pl rim	pl core	pl rim	Afs	pl	pl
SiO ₂	49.97	50.99	52.14	49.42	57.28	54.27	52.32	64.57	47.96	50.93
Al ₂ O ₃	31.23	30.87	30.08	32.18	26.16	28.72	29.94	18.72	32.83	30.67
FeO _t	0.53	0.27	0.58	0.20	0.41	0.41	0.57	0.19	0.59	0.71
CaO	14.13	13.48	12.47	14.28	8.12	10.52	12.08	0.05	14.97	12.58
Na ₂ O	4.11	4.30	4.55	3.46	7.46	5.68	4.74	1.34	3.39	4.47
K ₂ O	0.10	0.12	0.27	0.07	0.52	0.31	0.08	14.80	0.33	0.36
BaO	0.00	0.00	0.00	0.42	0.11	0.15	0.35	0.27	0.04	0.11
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.07	100.02	100.10	100.02	100.07	100.06	100.08	99.93	100.11	99.82
Si	9.048	9.227	9.427	9.004	10.198	9.762	9.473	11.910	8.704	9.233
Al	6.666	6.584	6.411	6.911	5.490	6.088	6.391	4.070	7.022	6.554
Fe	0.080	0.041	0.088	0.030	0.061	0.061	0.086	0.029	0.089	0.108
Ca	2.741	2.613	2.416	2.787	1.549	2.027	2.344	0.010	2.911	2.444
Na	1.441	1.507	1.595	1.221	2.575	1.979	1.664	0.478	1.194	1.572
K	0.024	0.028	0.063	0.017	0.119	0.070	0.018	3.484	0.077	0.082
Ba	0.000	0.000	0.000	0.030	0.008	0.011	0.025	0.019	0.003	0.008
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	65.16	62.99	59.30	69.25	36.50	49.73	58.23	0.25	69.60	59.64
Ab mol %	34.27	36.34	39.15	30.33	60.69	48.54	41.32	12.04	28.55	38.36
Or mol%	0.57	0.68	1.56	0.42	2.81	1.73	0.44	87.72	1.85	2.01

Supplementary table 3 - Continued.

District	Monte Nureci (Arcuentu)									
Sample	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Gabbroonorite									
Description	Afs	pl	pl	Afs	pl in opx	pl core	pl rim	pl core	pl rim	Afs
SiO ₂	64.33	57.09	51.20	64.54	49.35	44.32	51.75	45.71	51.10	63.62
Al ₂ O ₃	18.94	26.39	30.90	18.69	31.27	35.22	30.15	34.12	30.37	19.42
FeO _t	0.00	0.73	0.43	0.23	0.67	0.81	0.44	0.64	0.81	0.37
CaO	0.35	7.90	12.95	0.04	15.38	18.29	12.62	17.32	12.66	0.39
Na ₂ O	1.93	7.55	4.26	1.33	3.34	1.23	4.50	1.88	4.16	1.55
K ₂ O	14.22	0.29	0.02	14.66	0.20	0.15	0.12	0.07	0.18	14.33
BaO	0.68	0.02	0.22	0.63	0.00	0.00	0.35	0.30	0.29	0.29
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.45	99.97	99.99	100.12	100.20	100.02	99.92	100.05	99.56	99.96
Si	11.783	10.168	9.290	11.915	8.974	8.155	9.393	8.397	9.330	11.713
Al	4.089	5.541	6.608	4.068	6.703	7.638	6.451	7.387	6.536	4.213
Fe	0.000	0.109	0.066	0.035	0.101	0.125	0.067	0.099	0.123	0.057
Ca	0.069	1.508	2.517	0.009	2.996	3.607	2.454	3.409	2.476	0.077
Na	0.687	2.606	1.498	0.476	1.178	0.440	1.582	0.670	1.474	0.554
K	3.323	0.066	0.006	3.452	0.046	0.035	0.028	0.017	0.041	3.365
Ba	0.049	0.002	0.016	0.046	0.000	0.000	0.025	0.021	0.020	0.021
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	1.70	36.07	62.60	0.23	70.99	88.37	60.39	83.22	62.04	1.93
Ab mol %	16.83	62.36	37.26	12.08	27.92	10.77	38.92	16.36	36.93	13.86
Or mol%	81.47	1.57	0.14	87.69	1.10	0.87	0.69	0.41	1.03	84.21

Supplementary table 3 - Continued.

District	Monastir									
Sample	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1
Lithology	Monzodiorite									
Description	pl core	pl rim	pl	pl	pl	pl core	pl rim	pl	pl	pl
SiO ₂	56.36	57.60	56.32	56.93	56.52	56.70	55.85	56.58	99.72	56.33
Al ₂ O ₃	27.06	26.52	27.68	27.01	27.30	27.21	27.46	27.06	0.07	27.07
FeO _t	0.00	0.43	0.00	0.14	0.21	0.02	0.28	0.34	0.00	0.00
CaO	8.68	7.31	8.21	8.72	8.40	8.63	8.69	8.87	0.00	8.93
Na ₂ O	6.25	6.49	6.61	6.57	6.19	6.47	6.09	6.71	0.03	6.03
K ₂ O	1.31	1.75	1.15	0.39	1.24	0.55	1.73	0.32	0.09	1.86
BaO	0.29	0.00	0.00	0.06	0.03	0.00	0.15	0.00	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.95	100.09	99.97	99.82	99.90	99.58	100.25	99.87	99.91	100.22
Si	10.114	10.298	10.055	10.213	10.140	10.190	9.987	10.132	19.950	10.070
Al	5.723	5.588	5.825	5.711	5.774	5.764	5.787	5.711	0.016	5.705
Fe	0.000	0.064	0.000	0.020	0.031	0.004	0.042	0.051	0.000	0.000
Ca	1.669	1.400	1.570	1.677	1.614	1.661	1.665	1.701	0.000	1.711
Na	2.173	2.251	2.287	2.286	2.155	2.256	2.113	2.332	0.011	2.090
K	0.301	0.399	0.262	0.088	0.283	0.126	0.395	0.072	0.023	0.424
Ba	0.020	0.000	0.000	0.004	0.002	0.000	0.010	0.000	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
tot	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
An mol%	40.29	34.57	38.11	41.39	39.84	41.08	39.91	41.44	0.00	40.50
Ab mol %	52.45	55.58	55.53	56.43	53.17	55.80	50.63	56.79	31.63	49.47
Or mol%	7.26	9.85	6.36	2.18	6.98	3.12	9.47	1.76	68.37	10.03

Supplementary table 3 - Continued.

Chemical composition of pyroxene

District	Cixerri		Cixerri		Cixerri		Cixerri		Cixerri	
Sample	SAR18	SAR18	SAR1	SAR1	SAR1	SAR3	SAR3	SAR3	SAR6	SAR6
Lithology	Basaltic Andesite		Basaltic Andesite		Basaltic Andesite		Basaltic Andesite		Basaltic Andesite	
Description	cpx	cpx	cpx core	cpx rim	cpx	cpx core	cpx rim	cpx	cpx	cpx
SiO ₂	46.82	47.91	50.50	49.64	50.50	51.35	49.58	51.12	53.31	50.85
TiO ₂	0.58	0.80	0.33	0.76	0.67	0.39	0.72	0.48	0.28	0.40
Al ₂ O ₃	7.66	7.70	4.52	5.26	4.69	3.97	5.07	3.61	1.24	1.05
FeO _t	8.71	8.28	6.17	6.48	5.61	5.71	5.69	6.55	8.36	12.07
MnO	0.09	0.00	0.09	0.06	0.22	0.24	0.00	0.23	0.39	0.91
MgO	12.31	12.37	15.22	14.57	14.55	14.93	15.31	14.57	15.10	14.01
CaO	23.19	23.54	22.58	22.54	23.50	23.57	22.84	22.60	21.95	19.73
Na ₂ O	0.34	0.25	0.22	0.33	0.25	0.20	0.35	0.22	0.32	0.26
Cr ₂ O ₃	0.32	0.00	0.29	0.11	0.28	0.00	0.31	0.15	0.00	0.00
V ₂ O ₃	0.00	0.00	0.19	0.00	0.00	0.15	0.09	0.32	0.06	0.29
ZrO ₂	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.14
Total	100.02	100.84	100.11	99.76	100.27	100.51	100.07	99.84	101.00	99.73
Si	1.738	1.764	1.853	1.830	1.853	1.879	1.816	1.891	1.956	1.917
^{IV} Al	0.233	0.217	0.133	0.155	0.136	0.111	0.163	0.103	0.037	0.047
Ti	0.016	0.022	0.009	0.021	0.018	0.011	0.020	0.013	0.008	0.011
^{VI} Al	0.102	0.117	0.063	0.074	0.067	0.060	0.056	0.054	0.017	0.000
Fe ³⁺	0.114	0.074	0.060	0.059	0.042	0.044	0.083	0.033	0.028	0.043
Fe ²⁺	0.157	0.181	0.129	0.141	0.130	0.131	0.091	0.169	0.229	0.338
Mn	0.003	0.000	0.003	0.002	0.007	0.007	0.000	0.007	0.012	0.029
Mg	0.681	0.679	0.833	0.801	0.796	0.814	0.836	0.803	0.826	0.788
Ca	0.923	0.928	0.888	0.891	0.924	0.924	0.896	0.896	0.863	0.797
Na	0.024	0.018	0.015	0.023	0.018	0.014	0.025	0.016	0.023	0.019
Cr	0.009	0.000	0.008	0.003	0.008	0.000	0.009	0.004	0.000	0.000
V	0.000	0.000	0.006	0.000	0.000	0.005	0.003	0.009	0.002	0.009
Zr	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.003
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	49.15	49.86	46.41	47.04	48.66	48.11	47.01	46.92	44.08	39.97
Mg	36.29	36.44	43.54	42.30	41.92	42.40	43.85	42.08	42.20	39.49
Fe	14.55	13.70	10.04	10.66	9.42	9.49	9.15	10.99	13.71	20.54
Mg#	0.72	0.73	0.81	0.80	0.82	0.82	0.83	0.80	0.76	0.67

Supplementary table 4 - Elements concentration (in wt. %) of pyroxene in studied rocks. Structural formula calculation based on 6 oxygens and 4 cations, values in apfu. Fe³⁺ is calculated as in Papike et al. (1974). $Ca = Ca * 100 / (Ca + Mg + Mn + Fe^{3+} + Fe^{2+})$, $Mg = Mg * 100 / (Ca + Mg + Mn + Fe^{3+} + Fe^{2+})$, $Fe = (Mn + Fe^{3+} + Fe^{2+}) * 100 / (Ca + Mg + Mn + Fe^{3+} + Fe^{2+})$. $Mg\# = Mg / (Mg + Fe^{3+} + Fe^{2+})$. Abbreviation from Whitney and Evans (2010), gm=groundmass.

District		Cixerri			Cixerri			Cixerri			Cixerri	
Sample	SAR5	SAR5	SAR5	SAR17	SAR21	SAR21	SAR21	SAR21	SAR21	SAR11	SAR11	SAR11
Lithology		Andesite		Andesite		Andesite				Andesite		
Description	cpx	cpx	cpx	cpx in amp	cpx gm	cpx gm	cpx core	cpx rim	cpx	cpx	cpx in amp	
SiO ₂	52.50	52.09	52.31	49.21	52.73	51.46	51.33	48.97	50.54	49.54	50.35	
TiO ₂	0.52	0.37	0.18	0.21	0.00	0.38	0.39	0.45	0.41	0.30	0.03	
Al ₂ O ₃	2.11	1.32	1.87	5.31	3.27	2.96	3.38	5.75	3.45	5.31	4.26	
FeO _t	11.09	12.47	12.11	5.61	11.83	5.96	5.09	5.39	5.72	5.76	5.21	
MnO	0.98	0.91	0.82	0.13	1.30	0.00	0.20	0.24	0.00	0.28	0.00	
MgO	13.50	13.70	12.92	14.39	9.77	16.91	17.01	14.80	15.86	14.91	15.82	
CaO	18.76	18.84	18.29	23.78	20.02	21.29	22.04	23.62	23.19	22.64	23.56	
Na ₂ O	0.15	0.33	0.45	0.39	0.58	0.30	0.19	0.23	0.06	0.43	0.23	
Cr ₂ O ₃	0.09	0.00	0.00	0.00	0.00	0.15	0.73	0.89	0.01	0.42	0.33	
V ₂ O ₃	0.17	0.00	0.18	0.22	0.25	0.27	0.00	0.27	0.21	0.39	0.04	
ZrO ₂	0.23	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.23	0.00	0.00	
Total	100.10	100.02	99.13	99.24	99.73	99.69	100.50	100.61	99.69	99.97	99.84	
Si	1.975	1.959	1.986	1.818	2.011	1.886	1.866	1.788	1.861	1.818	1.842	
^{IV} Al	0.035	0.037	0.020	0.158	0.012	0.100	0.117	0.190	0.120	0.162	0.135	
Ti	0.015	0.011	0.005	0.006	0.000	0.011	0.011	0.012	0.011	0.008	0.001	
^{VI} Al	0.058	0.022	0.063	0.073	0.135	0.028	0.028	0.058	0.030	0.068	0.049	
Fe ³⁺	0.000	0.018	0.000	0.101	0.000	0.067	0.061	0.097	0.072	0.095	0.091	
Fe ²⁺	0.349	0.374	0.385	0.072	0.377	0.115	0.094	0.067	0.104	0.082	0.068	
Mn	0.031	0.029	0.026	0.004	0.042	0.000	0.006	0.007	0.000	0.009	0.000	
Mg	0.757	0.768	0.731	0.792	0.555	0.924	0.922	0.806	0.871	0.815	0.863	
Ca	0.756	0.759	0.744	0.941	0.818	0.836	0.859	0.924	0.915	0.890	0.924	
Na	0.011	0.024	0.033	0.028	0.043	0.022	0.013	0.016	0.005	0.030	0.016	
Cr	0.003	0.000	0.000	0.000	0.000	0.004	0.021	0.026	0.000	0.012	0.010	
V	0.005	0.000	0.006	0.006	0.008	0.008	0.000	0.008	0.006	0.011	0.001	
Zr	0.004	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.004	0.000	0.000	
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	
Ca	39.94	38.97	39.45	49.26	45.63	43.04	44.23	48.59	46.65	47.08	47.46	
Mg	39.99	39.43	38.76	41.47	30.99	47.56	47.48	42.37	44.38	43.12	44.35	
Fe	20.08	21.60	21.79	9.27	23.38	9.40	8.29	9.05	8.97	9.81	8.19	
Mg#	0.68	0.66	0.66	0.82	0.60	0.83	0.86	0.83	0.83	0.82	0.84	

Supplementary table 4 - Continued.

District		Siliqua				Siliqua		Siliqua	
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR3	MTR4	
Lithology			Andesite				Andesite	Andesite	
Description	cpx	cpx	cpx	cpx	cpx	cpx gm	cpx	cpx	
SiO ₂	53.36	53.39	53.24	53.81	52.60	53.33	52.29	53.51	
TiO ₂	0.34	0.57	0.52	0.03	0.55	0.29	0.48	0.30	
Al ₂ O ₃	1.04	1.09	0.45	0.82	0.86	1.03	1.34	1.12	
FeO _t	5.36	2.78	3.07	2.76	1.99	4.32	6.68	4.23	
MnO	0.09	0.00	0.56	0.36	0.00	0.00	0.35	0.34	
MgO	17.60	18.51	19.36	18.72	18.40	19.06	16.78	18.55	
CaO	22.09	23.19	21.90	22.50	23.91	20.89	21.53	21.24	
Na ₂ O	0.26	0.19	0.05	0.17	0.25	0.34	0.26	0.26	
Cr ₂ O ₃	0.00	0.21	0.35	0.44	1.16	0.76	0.07	0.14	
V ₂ O ₃	0.32	0.06	0.00	0.13	0.04	0.00	0.12	0.14	
ZrO ₂		0.04	0.00	0.00	0.00	0.00			
Total	100.44	100.04	99.50	99.74	99.75	100.02	99.92	99.84	
Si	1.939	1.933	1.938	1.953	1.910	1.932	1.921	1.945	
^{IV} Al	0.045	0.046	0.019	0.035	0.037	0.044	0.058	0.048	
Ti	0.009	0.015	0.014	0.001	0.015	0.008	0.013	0.008	
^{VI} Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Fe ³⁺	0.044	0.023	0.000	0.033	0.000	0.030	0.048	0.046	
Fe ²⁺	0.119	0.061	0.093	0.051	0.060	0.101	0.157	0.083	
Mn	0.003	0.000	0.017	0.011	0.000	0.000	0.011	0.011	
Mg	0.953	0.999	1.050	1.013	0.996	1.029	0.919	1.005	
Ca	0.860	0.900	0.854	0.875	0.930	0.811	0.848	0.827	
Na	0.018	0.014	0.003	0.012	0.017	0.024	0.019	0.018	
Cr	0.000	0.006	0.010	0.013	0.033	0.022	0.002	0.004	
V	0.009	0.002	0.000	0.004	0.001	0.000	0.004	0.004	
Zr	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	
Ca	43.46	45.37	42.39	44.14	46.82	41.14	42.75	41.95	
Mg	48.17	50.38	52.11	51.09	50.14	52.22	46.35	50.99	
Fe	8.37	4.25	5.50	4.77	3.04	6.64	10.90	7.05	
Mg#	0.85	0.92	0.92	0.92	0.94	0.89	0.82	0.89	

Supplementary table 4 - Continued.

District	Monastir									
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2
Lithology	Andesite									
Description	opx	opx	opx	cpx gm	cpx gm	opx	opx	opx	opx	opx
SiO ₂	51.31	53.46	52.73	51.38	50.22	52.74	51.54	52.02	52.83	49.14
TiO ₂	0.06	0.24	0.46	0.62	0.56	0.02	0.06	0.39	0.38	0.07
Al ₂ O ₃	2.25	1.03	1.79	1.48	2.86	1.54	2.25	0.65	0.95	2.67
FeO _t	21.31	20.48	20.43	6.39	9.79	20.07	21.35	23.15	21.03	28.24
MnO	1.04	0.31	0.45	0.25	0.41	0.83	0.76	0.68	0.75	0.74
MgO	22.11	22.70	22.98	17.00	15.50	23.27	22.38	21.60	22.69	18.24
CaO	1.01	1.20	0.80	22.14	19.60	0.95	1.02	1.24	0.92	0.27
Na ₂ O	0.21	0.07	0.16	0.26	0.48	0.26	0.00	0.00	0.00	0.03
Cr ₂ O ₃	0.24	0.36	0.11	0.20	0.00	0.00	0.05	0.00	0.20	0.02
V ₂ O ₃	0.00	0.12	0.00	0.01	0.19	0.05	0.23	0.00	0.00	0.07
ZrO ₂	0.00	0.00	0.00	0.30	0.00	0.00	0.24	0.00	0.00	0.34
Total	99.54	99.97	99.91	100.03	99.60	99.74	99.89	99.73	99.75	99.84
Si	1.912	1.982	1.950	1.885	1.865	1.948	1.917	1.953	1.967	1.883
^{IV} Al	0.075	0.023	0.049	0.064	0.111	0.043	0.072	0.029	0.034	0.097
Ti	0.002	0.007	0.013	0.017	0.016	0.001	0.002	0.011	0.011	0.002
^{VI} Al	0.024	0.022	0.029	0.000	0.014	0.024	0.027	0.000	0.008	0.024
Fe ³⁺	0.054	0.000	0.003	0.043	0.101	0.037	0.041	0.007	0.000	0.069
Fe ²⁺	0.610	0.635	0.629	0.153	0.203	0.583	0.623	0.720	0.655	0.836
Mn	0.033	0.010	0.014	0.008	0.013	0.026	0.024	0.022	0.024	0.024
Mg	1.228	1.254	1.267	0.930	0.858	1.281	1.241	1.209	1.260	1.042
Ca	0.040	0.048	0.032	0.870	0.780	0.038	0.041	0.050	0.037	0.011
Na	0.015	0.005	0.011	0.019	0.035	0.018	0.000	0.000	0.000	0.002
Cr	0.007	0.010	0.003	0.006	0.000	0.000	0.002	0.000	0.006	0.001
V	0.000	0.004	0.000	0.000	0.006	0.002	0.007	0.000	0.000	0.002
Zr	0.000	0.000	0.000	0.005	0.000	0.000	0.004	0.000	0.000	0.006
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	2.06	2.45	1.62	43.44	39.89	1.91	2.07	2.48	1.87	0.57
Mg	62.49	64.43	65.15	46.39	43.90	65.21	63.00	60.23	63.78	52.57
Fe	35.45	33.12	33.23	10.17	16.21	32.88	34.94	37.29	34.35	46.87
Mg#	0.65	0.66	0.67	0.83	0.74	0.67	0.65	0.62	0.66	0.54

Supplementary table 4 - Continued.

District	Monastir					Monastir				
Sample	CMO2	CMO2	CMO2	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3
Lithology	Andesite					Basaltic Andesite				
Description	opx	opx	opx	cpx core	cpx mantle	cpx rim	cpx core	cpx mantle	cpx rim	cpx in cpx
SiO ₂	51.49	51.28	52.13	52.62	49.59	51.16	50.12	50.49	51.23	50.03
TiO ₂	0.18	0.24	0.05	0.00	0.47	0.81	0.38	0.92	0.13	0.69
Al ₂ O ₃	0.92	2.97	1.84	1.67	5.27	1.89	4.76	3.84	3.67	3.61
FeO _t	22.03	20.02	20.54	3.57	7.01	13.89	7.47	8.60	8.21	8.88
MnO	0.52	0.52	0.94	0.07	0.00	0.65	0.09	0.00	0.00	0.15
MgO	22.65	23.69	22.92	18.34	15.40	16.01	15.77	15.80	16.66	15.51
CaO	1.11	0.82	1.28	23.21	21.19	16.05	21.06	19.93	19.56	20.60
Na ₂ O	0.29	0.24	0.00	0.08	0.27	0.21	0.23	0.21	0.28	0.36
Cr ₂ O ₃	0.00	0.08	0.00	0.48	0.63	0.00	0.35	0.28	0.00	0.00
V ₂ O ₃	0.29	0.00	0.16	0.00	0.12	0.20	0.02	0.00	0.04	0.06
ZrO ₂	0.13	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.04
Total	99.60	99.85	99.86	100.09	99.96	100.87	100.26	100.07	99.78	99.92
Si	1.918	1.884	1.931	1.906	1.823	1.898	1.837	1.863	1.882	1.848
^{IV} Al	0.040	0.098	0.061	0.071	0.161	0.083	0.146	0.127	0.103	0.130
Ti	0.005	0.007	0.001	0.000	0.013	0.023	0.010	0.025	0.004	0.019
^{VI} Al	0.000	0.030	0.020	0.000	0.068	0.000	0.060	0.040	0.056	0.027
Fe ³⁺	0.051	0.070	0.038	0.063	0.068	0.053	0.072	0.042	0.060	0.090
Fe ²⁺	0.635	0.545	0.598	0.045	0.148	0.378	0.157	0.223	0.192	0.184
Mn	0.016	0.016	0.030	0.002	0.000	0.021	0.003	0.000	0.000	0.005
Mg	1.258	1.298	1.266	0.991	0.844	0.885	0.862	0.869	0.912	0.854
Ca	0.044	0.032	0.051	0.901	0.835	0.638	0.827	0.788	0.770	0.815
Na	0.021	0.017	0.000	0.006	0.019	0.015	0.017	0.015	0.020	0.026
Cr	0.000	0.002	0.000	0.014	0.018	0.000	0.010	0.008	0.000	0.000
V	0.009	0.000	0.005	0.000	0.004	0.006	0.001	0.000	0.001	0.002
Zr	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	2.21	1.64	2.56	45.01	44.06	32.30	43.06	40.99	39.80	41.84
Mg	62.74	66.17	63.85	49.48	44.56	44.83	44.87	45.21	47.16	43.84
Fe	35.05	32.19	33.59	5.52	11.38	22.87	12.07	13.81	13.04	14.32
Mg#	0.65	0.68	0.67	0.90	0.80	0.67	0.79	0.77	0.78	0.76

Supplementary table 4 - Continued.

District	Monastir									
Sample	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3
Lithology	Basaltic Andesite									
Description	cpx in cpx	pgt rim	opx	opx rim	opx	pgt gm	pgt gm	cpx core	cpx rim	opx in cpx
SiO ₂	50.01	50.71	51.16	52.83	52.26	51.54	51.55	52.34	51.11	53.07
TiO ₂	0.59	0.20	0.39	0.12	0.23	0.48	0.41	0.17	0.08	0.31
Al ₂ O ₃	3.84	0.92	4.14	0.94	1.90	1.57	1.15	1.62	2.12	0.69
FeO _t	8.10	22.81	14.97	20.73	14.46	19.97	21.23	4.32	12.69	22.35
MnO	0.26	1.00	0.09	0.35	0.65	0.99	0.82	0.25	0.03	0.13
MgO	15.72	19.82	27.33	22.00	28.16	19.26	19.43	17.65	16.15	21.34
CaO	20.08	3.63	1.35	2.40	1.64	5.51	4.78	22.47	17.11	1.69
Na ₂ O	0.20	0.29	0.05	0.04	0.11	0.30	0.37	0.23	0.23	0.14
Cr ₂ O ₃	0.00	0.00	0.17	0.00	0.35	0.10	0.00	0.76	0.38	0.00
V ₂ O ₃	0.00	0.25	0.10	0.00	0.26	0.09	0.10	0.35	0.03	0.01
ZrO ₂	0.49	0.00	0.00	0.40	0.02	0.00	0.00	0.00	0.00	0.00
Total	99.29	99.63	99.75	99.81	100.05	99.79	99.83	100.15	99.93	99.73
Si	1.860	1.912	1.836	1.970	1.870	1.933	1.935	1.905	1.902	1.987
^{IV} Al	0.122	0.041	0.142	0.025	0.080	0.058	0.051	0.070	0.081	0.015
Ti	0.016	0.006	0.011	0.003	0.006	0.013	0.012	0.005	0.002	0.009
^{VI} Al	0.047	0.000	0.033	0.016	0.000	0.012	0.000	0.000	0.012	0.016
Fe ³⁺	0.056	0.051	0.087	0.006	0.066	0.038	0.056	0.055	0.069	0.000
Fe ²⁺	0.196	0.669	0.362	0.641	0.367	0.589	0.611	0.077	0.326	0.700
Mn	0.008	0.032	0.003	0.011	0.020	0.031	0.026	0.008	0.001	0.004
Mg	0.872	1.114	1.463	1.223	1.502	1.077	1.087	0.958	0.896	1.191
Ca	0.800	0.147	0.052	0.096	0.063	0.221	0.192	0.876	0.682	0.068
Na	0.014	0.021	0.003	0.003	0.008	0.022	0.027	0.016	0.017	0.010
Cr	0.000	0.000	0.005	0.000	0.010	0.003	0.000	0.022	0.011	0.000
V	0.000	0.007	0.003	0.000	0.008	0.003	0.003	0.010	0.001	0.000
Zr	0.009	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	41.42	7.29	2.64	4.85	3.12	11.32	9.74	44.41	34.56	3.45
Mg	45.11	55.37	74.37	61.88	74.45	55.05	55.13	48.54	45.38	60.68
Fe	13.46	37.34	22.99	33.27	22.43	33.63	35.13	7.05	20.06	35.87
Mg#	0.78	0.61	0.76	0.65	0.78	0.63	0.62	0.88	0.69	0.63

Supplementary table 4 - Continued.

District	Monastir								
Sample	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3	CMO3
Lithology	Basaltic Andesite								
Description	opx in pl	cpx core	cpx rim	opx core	opx rim	pgt gm	cpx core	cpx mantle	cpx rim
SiO ₂	52.28	51.54	49.68	53.51	53.62	51.84	52.72	48.62	49.38
TiO ₂	0.63	0.11	0.67	0.51	0.06	0.33	0.06	0.64	0.65
Al ₂ O ₃	1.03	2.02	5.59	3.12	2.50	0.85	1.64	6.34	3.58
FeO _t	21.52	4.35	7.67	12.99	14.38	21.56	3.47	7.89	11.68
MnO	0.81	0.46	0.00	0.07	0.30	0.54	0.14	0.28	0.50
MgO	21.36	17.52	14.39	28.06	27.47	20.17	17.63	13.95	14.45
CaO	2.24	22.99	21.51	1.28	1.66	4.22	23.35	21.48	19.08
Na ₂ O	0.06	0.36	0.29	0.00	0.19	0.08	0.28	0.36	0.44
Cr ₂ O ₃	0.09	0.61	0.00	0.08	0.00	0.12	0.63	0.07	0.00
V ₂ O ₃	0.00	0.00	0.09	0.00	0.00	0.15	0.00	0.14	0.19
ZrO ₂	0.00	0.05	0.00	0.19	0.00	0.00	0.00	0.00	0.00
Total	100.03	99.99	99.88	99.80	100.17	99.88	99.92	99.77	99.94
Si	1.953	1.875	1.835	1.914	1.915	1.946	1.916	1.799	1.841
^{IV} Al	0.045	0.086	0.154	0.083	0.072	0.038	0.068	0.182	0.134
Ti	0.018	0.003	0.019	0.014	0.002	0.009	0.002	0.018	0.018
^{VI} Al	0.001	0.000	0.089	0.048	0.033	0.000	0.002	0.094	0.024
Fe ³⁺	0.010	0.088	0.048	0.005	0.049	0.021	0.064	0.076	0.106
Fe ²⁺	0.662	0.044	0.189	0.383	0.380	0.655	0.041	0.168	0.259
Mn	0.026	0.014	0.000	0.002	0.009	0.017	0.004	0.009	0.016
Mg	1.189	0.950	0.792	1.496	1.463	1.129	0.955	0.769	0.803
Ca	0.090	0.896	0.851	0.049	0.063	0.170	0.909	0.852	0.762
Na	0.005	0.025	0.021	0.000	0.013	0.006	0.020	0.026	0.032
Cr	0.003	0.018	0.000	0.002	0.000	0.004	0.018	0.002	0.000
V	0.000	0.000	0.003	0.000	0.000	0.005	0.000	0.004	0.006
Zr	0.000	0.001	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	4.54	44.98	45.27	2.53	3.22	8.52	46.06	45.45	39.19
Mg	60.17	47.68	42.13	77.29	74.45	56.66	48.38	41.05	41.28
Fe	35.29	7.34	12.60	20.18	22.33	34.82	5.56	13.50	19.53
Mg#	0.64	0.88	0.77	0.79	0.77	0.63	0.90	0.76	0.69

Supplementary table 4 - Continued.

District	Capo Frasca								
Sample	MAL35	MAL35	MAL35	MAL35	MAL35	MAL35	MAL35	MAL35	MAL35
Lithology	Basalt								
Description	cpx	cpx	cpx	cpx	cpx	cpx	opx	opx	opx
SiO ₂	52.11	52.74	52.66	53.40	53.12	52.45	55.09	55.23	54.26
TiO ₂	0.27	0.19	0.17	0.19	0.32	0.24	0.20	0.12	0.23
Al ₂ O ₃	2.28	2.48	2.64	1.60	1.83	2.76	1.57	1.51	2.84
FeO _t	7.70	6.92	7.24	7.59	8.12	6.85	10.92	11.07	10.29
MnO	0.37	0.13	0.12	0.07	0.37	0.26	0.21	0.27	0.27
MgO	17.03	18.23	18.13	19.01	18.54	18.28	29.18	29.10	28.89
CaO	19.17	18.24	18.38	17.31	17.26	18.22	2.43	2.37	2.19
Na ₂ O	0.19	0.20	0.23	0.19	0.15	0.21	0.06	0.06	0.03
Cr ₂ O ₃	0.51	0.77	0.36	0.50	0.24	0.60	0.14	0.18	0.30
Total	99.62	99.90	99.94	99.85	99.96	99.88	99.79	99.90	99.30
Si	1.922	1.928	1.923	1.951	1.945	1.916	1.955	1.959	1.932
^{IV} Al	0.071	0.069	0.071	0.046	0.052	0.078	0.043	0.039	0.068
Ti	0.007	0.005	0.005	0.005	0.009	0.007	0.005	0.003	0.006
^{VI} Al	0.028	0.038	0.043	0.023	0.027	0.041	0.023	0.024	0.051
Fe ³⁺	0.027	0.012	0.024	0.012	0.011	0.022	0.009	0.007	0.000
Fe ²⁺	0.211	0.199	0.197	0.220	0.237	0.187	0.315	0.321	0.307
Mn	0.011	0.004	0.004	0.002	0.011	0.008	0.006	0.008	0.008
Mg	0.936	0.993	0.987	1.036	1.012	0.995	1.544	1.539	1.534
Ca	0.758	0.714	0.719	0.678	0.677	0.713	0.092	0.090	0.084
Na	0.013	0.014	0.016	0.013	0.011	0.015	0.004	0.004	0.002
Cr	0.015	0.022	0.010	0.014	0.007	0.017	0.004	0.005	0.008
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	39.00	37.14	37.25	34.80	34.74	37.04	4.69	4.59	4.33
Mg	48.18	51.64	51.10	53.18	51.92	51.68	78.50	78.30	79.38
Fe	12.81	11.22	11.65	12.03	13.34	11.28	16.81	17.12	16.29
Mg#	0.80	0.82	0.82	0.82	0.80	0.83	0.83	0.82	0.83

Supplementary table 4 - Continued.

District	Capo Frasca					Capo Frasca				
Sample	MAL29	MAL29	MAL29	MAL38	MAL38	MAL38	MAL38	MAL38	MAL38	MAL38
Lithology	Basaltic Andesite					Basaltic Andesite				
Description	opx	pgt	opx	cpx	cpx	cpx	cpx	cpx	cpx	cpx
SiO ₂	50.95	50.76	51.57	52.46	51.39	51.21	50.77	52.38	52.73	52.46
TiO ₂	0.50	0.39	0.55	0.46	0.41	0.44	0.86	0.24	0.34	0.21
Al ₂ O ₃	1.50	0.62	2.29	2.08	2.41	3.37	3.22	2.37	1.82	2.31
FeO _t	25.73	27.17	20.82	8.60	10.05	10.93	12.72	9.18	8.79	6.19
MnO	0.62	0.83	0.46	0.23	0.43	0.26	0.34	0.30	0.30	0.24
MgO	19.06	16.73	22.04	17.39	16.55	16.30	17.30	17.04	17.30	16.98
CaO	1.56	2.90	1.50	18.08	17.51	17.04	14.58	17.54	17.69	20.21
Na ₂ O	0.03	0.05	0.03	0.18	0.24	0.32	0.17	0.24	0.20	0.24
Cr ₂ O ₃	0.12		0.15	0.36	0.31	0.18	0.12	0.32	0.37	0.83
Total	100.06	99.46	99.42	99.84	99.29	100.05	100.07	99.61	99.54	99.68
Si	1.934	1.964	1.926	1.933	1.913	1.893	1.881	1.936	1.950	1.928
^{IV} Al	0.060	0.028	0.072	0.064	0.078	0.097	0.109	0.061	0.049	0.068
Ti	0.014	0.011	0.016	0.013	0.011	0.012	0.024	0.007	0.010	0.006
^{VI} Al	0.007	0.000	0.029	0.027	0.028	0.050	0.031	0.043	0.030	0.033
Fe ³⁺	0.024	0.009	0.010	0.014	0.036	0.040	0.039	0.012	0.003	0.017
Fe ²⁺	0.793	0.870	0.640	0.251	0.277	0.298	0.355	0.272	0.268	0.174
Mn	0.020	0.027	0.015	0.007	0.013	0.008	0.011	0.009	0.009	0.008
Mg	1.078	0.965	1.226	0.955	0.919	0.898	0.955	0.939	0.954	0.930
Ca	0.063	0.120	0.060	0.714	0.699	0.675	0.579	0.695	0.701	0.796
Na	0.003	0.003	0.003	0.013	0.017	0.023	0.012	0.017	0.014	0.017
Cr	0.004	0.000	0.004	0.011	0.009	0.005	0.004	0.009	0.011	0.024
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	3.20	6.04	3.07	36.77	35.94	35.17	29.85	36.05	36.20	41.36
Mg	54.51	48.45	62.86	49.21	47.26	46.80	49.27	48.73	49.27	48.36
Fe	42.29	45.51	34.07	14.02	16.79	18.03	20.88	15.22	14.53	10.29
Mg#	0.57	0.52	0.65	0.78	0.75	0.73	0.71	0.77	0.78	0.83

Supplementary table 4 - Continued.

District	Capo Frasca						Capo Frasca			
Sample	MAL38	MAL38	MAL38	MAL38	MAL41	MAL41	MAL41	MAL41	MAL41	MAL41
Lithology		Basaltic	Andesite				Basaltic	Andesite		
Description	opx	opx	opx	opx	cpx	cpx	cpx	opx	opx	opx
SiO ₂	54.02	54.76	54.21	54.25	51.99	52.24	51.97	53.04	53.97	54.26
TiO ₂	0.25	0.25	0.14	0.20	0.37	0.39	0.41	0.23	0.09	0.20
Al ₂ O ₃	1.51	1.03	0.99	1.31	2.24	2.32	2.13	2.17	1.69	1.22
FeO _i	14.31	14.02	16.01	14.24	6.95	6.26	8.86	16.02	14.82	15.45
MnO	0.24	0.43	0.44	0.30	0.20	0.10	0.36	0.24	0.24	0.35
MgO	26.78	27.40	25.85	26.93	17.00	16.83	16.93	25.15	26.60	26.00
CaO	2.29	2.13	2.27	2.44	19.81	20.53	17.88	2.36	2.09	2.37
Na ₂ O	0.04	0.02	0.04	0.03	0.18	0.20	0.24	0.07	0.04	0.05
Cr ₂ O ₃	0.14	0.10	0.13	0.36	0.58	0.66	0.47	0.14	0.28	0.08
Total	99.57	100.14	100.07	100.05	99.32	99.53	99.22	99.43	99.82	99.98
Si	1.952	1.965	1.964	1.952	1.921	1.924	1.930	1.935	1.948	1.964
^{IV} Al	0.045	0.033	0.032	0.045	0.073	0.072	0.065	0.061	0.048	0.035
Ti	0.007	0.007	0.004	0.005	0.010	0.011	0.011	0.006	0.002	0.005
^{VI} Al	0.019	0.010	0.010	0.011	0.024	0.029	0.028	0.033	0.024	0.018
Fe ³⁺	0.012	0.008	0.014	0.015	0.024	0.016	0.018	0.017	0.015	0.008
Fe ²⁺	0.421	0.412	0.471	0.413	0.190	0.177	0.257	0.472	0.433	0.460
Mn	0.007	0.013	0.013	0.009	0.006	0.003	0.011	0.008	0.007	0.011
Mg	1.442	1.465	1.396	1.444	0.936	0.924	0.937	1.368	1.431	1.403
Ca	0.089	0.082	0.088	0.094	0.784	0.810	0.711	0.092	0.081	0.092
Na	0.003	0.001	0.003	0.002	0.013	0.015	0.017	0.005	0.003	0.004
Cr	0.004	0.003	0.004	0.010	0.017	0.019	0.014	0.004	0.008	0.002
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	4.51	4.13	4.44	4.77	40.40	41.97	36.77	4.72	4.12	4.65
Mg	73.18	73.98	70.42	73.09	48.22	47.87	48.43	69.91	72.76	71.10
Fe	22.31	21.90	25.14	22.14	11.39	10.16	14.80	25.37	23.12	24.24
Mg#	0.77	0.78	0.74	0.77	0.81	0.83	0.77	0.74	0.76	0.75

Supplementary table 4 - Continued.

District	MONTE NURECI (Arcuentu)									
Sample	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2	MNU2
Lithology										
Description	opx	cpx	cpx	cpx	cpx	cpx	cpx	opx	cpx	opx
SiO ₂	53.54	50.61	51.30	51.79	50.49	52.31	52.93	52.60	52.30	53.31
TiO ₂	0.60	0.77	0.67	0.38	0.09	0.40	0.07	0.48	0.34	0.22
Al ₂ O ₃	1.14	2.34	2.45	2.38	2.67	2.37	0.85	1.54	1.58	1.48
FeO _i	13.75	7.14	7.24	7.00	8.21	7.76	3.83	14.28	5.92	14.63
MnO	0.60	0.07	0.00	0.03	0.17	0.28	0.24	0.10	0.04	0.32
MgO	28.62	15.97	15.86	16.59	17.56	18.02	17.29	28.07	15.41	27.14
CaO	1.54	21.52	21.21	20.81	19.71	17.90	24.20	1.92	23.37	1.90
Na ₂ O	0.08	0.36	0.29	0.41	0.32	0.43	0.27	0.00	0.33	0.00
Cr ₂ O ₃	0.33	0.60	0.49	0.17	0.59	0.09	0.10	0.20	0.21	0.05
V ₂ O ₃	0.05	0.20	0.00	0.08	0.00	0.00	0.11	0.00	0.00	0.00
ZrO ₂	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.09	0.00	0.09
Total	100.26	99.57	99.52	99.65	99.81	99.55	99.89	99.27	99.49	99.14
Si	1.910	1.872	1.899	1.904	1.851	1.918	1.928	1.897	1.933	1.933
^{IV} Al	0.048	0.102	0.090	0.081	0.115	0.070	0.036	0.066	0.056	0.057
Ti	0.016	0.021	0.019	0.010	0.003	0.011	0.002	0.013	0.009	0.006
^{VI} Al	0.000	0.000	0.017	0.023	0.000	0.032	0.000	0.000	0.013	0.007
Fe ³⁺	0.011	0.067	0.043	0.061	0.116	0.045	0.049	0.034	0.042	0.037
Fe ²⁺	0.399	0.154	0.181	0.154	0.136	0.193	0.068	0.397	0.141	0.407
Mn	0.018	0.002	0.000	0.001	0.005	0.009	0.007	0.003	0.001	0.010
Mg	1.522	0.880	0.875	0.909	0.960	0.985	0.939	1.509	0.849	1.467
Ca	0.059	0.853	0.841	0.820	0.774	0.703	0.945	0.074	0.926	0.074
Na	0.005	0.026	0.021	0.029	0.023	0.031	0.019	0.000	0.024	0.000
Cr	0.009	0.018	0.014	0.005	0.017	0.003	0.003	0.006	0.006	0.001
V	0.002	0.006	0.000	0.002	0.000	0.000	0.003	0.000	0.000	0.000
Zr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.002
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	2.92	43.60	43.35	42.14	38.90	36.34	47.05	3.67	47.25	3.69
Mg	75.76	45.01	45.10	46.74	48.19	50.90	46.76	74.82	43.35	73.56
Fe	21.31	11.39	11.55	11.12	12.91	12.75	6.18	21.51	9.40	22.74
Mg#	0.79	0.80	0.80	0.81	0.79	0.81	0.89	0.78	0.82	0.77

Supplementary table 4 - Continued.

District	Monte Nureci (Arcuentu)							Monte Nureci (Arcuentu)					
Sample	MNU2	MNU2	MNU2	MNU2	MNU2	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3
Lithology	Olivine Gabbro							Olivine Gabbro					
Description	cpx	opx	cpx	cpx	cpx	opx	cpx in opx	cpx in opx	cpx	opx	cpx	opx on rim spl	
SiO ₂	52.46	54.60	50.97	54.01	51.68	54.42	52.08	52.50	52.12	53.94	52.91	54.86	
TiO ₂	0.27	0.32	0.51	0.04	0.28	0.02	0.41	0.00	0.00	0.15	0.08	0.00	
Al ₂ O ₃	2.39	1.24	2.19	0.58	2.23	1.55	2.49	1.03	2.38	1.54	1.16	1.18	
FeO _t	3.65	15.13	7.46	3.20	6.90	12.77	6.20	5.15	6.17	13.14	3.69	12.86	
MnO	0.00	0.34	0.41	0.00	0.00	0.46	0.10	0.53	0.00	0.58	0.47	0.70	
MgO	16.79	27.47	16.79	17.60	17.23	28.72	16.34	16.79	16.59	28.16	16.63	28.16	
CaO	23.79	1.51	20.20	23.93	20.43	1.95	21.99	23.34	22.32	1.63	24.78	1.45	
Na ₂ O	0.22	0.00	0.50	0.10	0.33	0.21	0.06	0.22	0.15	0.10	0.19	0.06	
Cr ₂ O ₃	0.52	0.00	0.51	0.00	0.50	0.09	0.89	0.09	0.48	0.32	0.10	0.52	
V ₂ O ₃	0.08	0.00	0.00	0.00	0.04	0.12	0.00	0.26	0.09	0.00	0.00	0.32	
ZrO ₂	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.59	0.00	0.00	
Total	100.17	100.61	99.53	99.46	99.61	100.32	100.54	100.13	100.29	100.14	100.02	100.11	
Si	1.908	1.953	1.878	1.974	1.898	1.929	1.906	1.921	1.904	1.930	1.931	1.961	
^{IV} Al	0.081	0.043	0.095	0.021	0.086	0.057	0.088	0.044	0.082	0.056	0.050	0.038	
Ti	0.007	0.009	0.014	0.001	0.008	0.000	0.011	0.000	0.000	0.004	0.002	0.000	
^{VI} Al	0.022	0.010	0.000	0.004	0.011	0.008	0.019	0.000	0.021	0.009	0.000	0.012	
Fe ³⁺	0.045	0.016	0.088	0.022	0.068	0.059	0.025	0.057	0.058	0.037	0.056	0.015	
Fe ²⁺	0.066	0.437	0.142	0.076	0.144	0.319	0.165	0.100	0.130	0.356	0.057	0.369	
Mn	0.000	0.010	0.013	0.000	0.000	0.014	0.003	0.016	0.000	0.018	0.015	0.021	
Mg	0.910	1.465	0.922	0.959	0.943	1.518	0.891	0.916	0.904	1.502	0.904	1.500	
Ca	0.927	0.058	0.798	0.937	0.804	0.074	0.862	0.915	0.874	0.062	0.969	0.056	
Na	0.015	0.000	0.036	0.007	0.023	0.014	0.004	0.015	0.011	0.007	0.014	0.004	
Cr	0.015	0.000	0.015	0.000	0.014	0.003	0.026	0.003	0.014	0.009	0.003	0.015	
V	0.002	0.000	0.000	0.000	0.001	0.003	0.000	0.008	0.003	0.000	0.000	0.009	
Zr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.010	0.000	0.000	
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	
Ca	47.59	2.91	40.64	47.01	41.04	3.74	44.30	45.65	44.44	3.16	48.44	2.83	
Mg	46.71	73.77	46.98	48.09	48.15	76.48	45.80	45.68	45.97	76.05	45.21	76.50	
Fe	5.70	23.32	12.38	4.91	10.82	19.78	9.90	8.68	9.59	20.79	6.35	20.67	
Mg#	0.89	0.76	0.80	0.91	0.82	0.80	0.82	0.85	0.83	0.79	0.89	0.80	

Supplementary table 4 - Continued.

District	Monte Nureci (Arcuentu)							Monte Nureci (Arcuentu)		
Sample	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU1	MNU1
Lithology	Olivine Gabbro							Olivine Gabbro		
Description	cpx	opx	cpx	cpx	cpx	cpx	opx	cpx	opx	opx
SiO ₂	51.90	54.31	52.51	51.91	50.86	51.91	53.86	53.06	51.57	51.45
TiO ₂	0.19	0.25	0.39	0.28	0.72	0.07	0.59	0.07	0.74	0.00
Al ₂ O ₃	2.39	1.24	2.25	2.39	2.27	1.14	1.46	0.82	1.05	1.06
FeO _t	5.15	13.12	7.33	7.30	6.58	5.33	13.86	4.43	23.56	24.38
MnO	0.56	0.27	0.63	0.00	0.35	0.45	0.78	0.05	0.61	0.88
MgO	16.52	28.56	17.17	16.15	16.72	16.54	27.96	16.63	20.12	20.38
CaO	22.31	1.80	18.97	21.00	20.88	23.87	1.62	24.47	1.84	1.09
Na ₂ O	0.45	0.09	0.19	0.19	0.45	0.27	0.15	0.16	0.09	0.27
Cr ₂ O ₃	0.17	0.12	0.28	0.33	0.31	0.50	0.17	0.16	0.00	0.00
V ₂ O ₃	0.31	0.07	0.03	0.19	0.03	0.02	0.00	0.18	0.11	0.27
ZrO ₂	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.02
Total	99.94	99.82	99.75	99.75	99.17	100.09	100.44	100.04	99.85	99.79
Si	1.897	1.940	1.933	1.915	1.878	1.900	1.922	1.939	1.948	1.939
^{IV} Al	0.084	0.051	0.064	0.077	0.099	0.049	0.061	0.035	0.047	0.046
Ti	0.005	0.007	0.011	0.008	0.020	0.002	0.016	0.002	0.021	0.000
^{VI} Al	0.019	0.001	0.034	0.027	0.000	0.000	0.000	0.000	0.000	0.001
Fe ³⁺	0.082	0.039	0.014	0.038	0.082	0.050	0.035	0.039	0.011	0.065
Fe ²⁺	0.075	0.353	0.212	0.188	0.122	0.113	0.379	0.097	0.733	0.703
Mn	0.017	0.008	0.020	0.000	0.011	0.014	0.023	0.002	0.020	0.028
Mg	0.900	1.521	0.942	0.888	0.921	0.902	1.487	0.906	1.133	1.145
Ca	0.874	0.069	0.748	0.830	0.826	0.936	0.062	0.958	0.074	0.044
Na	0.032	0.006	0.014	0.014	0.032	0.019	0.010	0.011	0.007	0.020
Cr	0.005	0.003	0.008	0.010	0.009	0.014	0.005	0.005	0.000	0.000
V	0.009	0.002	0.001	0.006	0.001	0.000	0.000	0.005	0.003	0.008
Zr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	44.84	3.46	38.65	42.72	42.13	46.45	3.11	47.87	3.78	2.23
Mg	46.19	76.42	48.67	45.70	46.94	44.76	74.88	45.27	57.47	57.66
Fe	8.97	20.12	12.68	11.59	10.93	8.79	22.01	6.86	38.75	40.11
Mg#	0.85	0.80	0.81	0.80	0.82	0.85	0.78	0.87	0.60	0.60

Supplementary table 4 - Continued.

District	Monte Nureci (Arcuentu)										
Sample	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Gabbroonorite										
Description	cpx	cpx core	cpx mantle	cpx rim	pgt in cpx	cpx	pgt	cpx	opx	cpx in opx	opx in cpx
SiO ₂	52.06	53.22	51.86	50.96	51.22	49.67	52.09	51.23	51.11	50.72	50.99
TiO ₂	0.14	0.22	0.30	0.85	0.32	0.50	0.34	0.59	0.28	0.54	0.37
Al ₂ O ₃	1.38	2.05	1.93	2.49	1.21	2.39	0.73	1.02	0.79	1.36	0.78
FeO _t	10.62	3.68	9.20	10.34	20.55	11.31	22.41	12.54	24.79	11.30	26.40
MnO	0.54	0.00	0.37	0.57	0.68	0.27	0.77	0.84	0.52	0.62	0.45
MgO	13.42	17.32	15.72	13.16	16.21	13.60	19.38	13.86	19.71	13.89	19.19
CaO	21.36	22.09	19.87	20.29	9.51	20.61	3.92	20.22	1.78	21.40	1.28
Na ₂ O	0.19	0.22	0.23	0.53	0.34	0.51	0.00	0.26	0.21	0.37	0.00
Cr ₂ O ₃	0.05	0.89	0.33	0.00	0.00	0.08	0.02	0.00	0.00	0.03	0.19
V ₂ O ₃	0.12	0.29	0.00	0.66	0.08	0.13	0.09	0.00	0.00	0.00	0.02
ZrO ₂	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.06
Total	99.92	99.98	99.81	99.84	100.11	99.07	99.75	100.55	99.25	100.24	99.73
Si	1.954	1.924	1.940	1.913	1.938	1.873	1.970	1.917	1.944	1.895	1.946
^{iv} Al	0.040	0.066	0.060	0.081	0.050	0.102	0.029	0.045	0.035	0.060	0.035
Ti	0.004	0.008	0.006	0.024	0.009	0.014	0.010	0.016	0.008	0.015	0.011
^{vi} Al	0.021	0.018	0.028	0.029	0.004	0.004	0.003	0.000	0.000	0.000	0.000
Fe ³⁺	0.024	0.038	0.009	0.043	0.052	0.104	0.006	0.031	0.035	0.055	0.008
Fe ²⁺	0.310	0.247	0.103	0.282	0.598	0.253	0.702	0.361	0.754	0.298	0.834
Mn	0.017	0.011	0.000	0.018	0.022	0.009	0.025	0.027	0.017	0.020	0.014
Mg	0.751	0.870	0.941	0.736	0.914	0.765	1.093	0.773	1.118	0.774	1.091
Ca	0.859	0.790	0.863	0.816	0.385	0.833	0.159	0.811	0.072	0.856	0.052
Na	0.014	0.017	0.016	0.038	0.025	0.037	0.000	0.019	0.015	0.026	0.000
Cr	0.002	0.010	0.026	0.000	0.000	0.002	0.001	0.000	0.000	0.001	0.006
V	0.004	0.000	0.009	0.020	0.002	0.004	0.003	0.000	0.000	0.000	0.001
Zr	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	43.82	40.38	45.02	43.06	19.55	42.43	8.01	40.48	3.63	42.76	2.62
Mg	38.30	44.45	49.12	38.87	46.37	38.96	55.05	38.60	56.01	38.63	54.55
Fe	17.88	15.17	5.85	18.08	34.09	18.62	36.94	20.92	40.36	18.62	42.83
Mg#	0.69	0.89	0.75	0.69	0.58	0.68	0.61	0.66	0.59	0.69	0.56

Supplementary table 4 - Continued.

District	Monte Nureci (Arcuentu)										
Sample	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Gabbroonorite										
Description	cpx in cpx	cpx	cpx core	cpx rim	pgt	cpx	cpx core	cpx rim	opx	cpx in opx	cpx core
SiO ₂	50.80	50.84	50.28	50.36	51.22	50.96	50.78	50.05	52.26	51.38	49.65
TiO ₂	0.59	0.60	0.06	0.86	0.02	0.52	0.81	0.75	0.22	0.42	0.61
Al ₂ O ₃	1.93	2.06	2.35	1.84	0.67	1.38	1.92	1.61	0.77	0.92	2.88
FeO _t	13.72	10.52	9.95	13.58	24.60	13.11	11.16	12.99	24.89	11.36	11.77
MnO	0.38	0.02	0.49	0.12	0.57	0.40	0.16	0.38	0.03	0.62	0.46
MgO	15.06	13.86	14.71	14.22	19.35	13.75	12.81	13.84	19.78	13.51	13.88
CaO	16.47	21.43	20.65	17.37	2.92	18.96	20.92	19.48	1.34	20.76	19.01
Na ₂ O	0.24	0.42	0.32	0.42	0.36	0.39	0.40	0.42	0.00	0.56	0.52
Cr ₂ O ₃	0.00	0.03	0.63	0.29	0.00	0.24	0.38	0.10	0.44	0.00	0.24
V ₂ O ₃	0.32	0.12	0.17	0.31	0.06	0.12	0.38	0.00	0.15	0.41	0.05
ZrO ₂	0.00	0.00	0.14	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.50	99.88	99.75	99.56	99.77	99.84	99.71	99.63	99.88	99.93	99.05
Si	1.915	1.899	1.876	1.903	1.936	1.920	1.916	1.887	1.980	1.928	1.873
^{iv} Al	0.075	0.084	0.100	0.082	0.030	0.061	0.077	0.071	0.024	0.041	0.107
Ti	0.017	0.017	0.002	0.024	0.001	0.015	0.023	0.021	0.006	0.012	0.017
^{vi} Al	0.010	0.007	0.003	0.000	0.000	0.000	0.009	0.000	0.011	0.000	0.021
Fe ³⁺	0.049	0.073	0.097	0.055	0.055	0.054	0.040	0.057	0.000	0.058	0.082
Fe ²⁺	0.384	0.256	0.213	0.374	0.723	0.360	0.312	0.353	0.789	0.299	0.289
Mn	0.012	0.001	0.015	0.004	0.018	0.013	0.005	0.012	0.001	0.020	0.015
Mg	0.846	0.772	0.818	0.801	1.090	0.772	0.721	0.778	1.117	0.756	0.781
Ca	0.665	0.858	0.826	0.703	0.118	0.766	0.846	0.787	0.055	0.835	0.769
Na	0.017	0.030	0.023	0.031	0.026	0.029	0.029	0.031	0.000	0.041	0.038
Cr	0.000	0.001	0.019	0.009	0.000	0.007	0.011	0.003	0.013	0.000	0.007
V	0.010	0.004	0.005	0.009	0.002	0.004	0.012	0.000	0.004	0.012	0.002
Zr	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	34.01	43.79	41.92	36.30	5.91	38.98	43.97	39.62	2.78	42.45	39.71
Mg	43.27	39.40	41.53	41.34	54.39	39.33	37.47	39.16	56.95	38.42	40.33
Fe	22.73	16.80	16.55	22.36	39.71	21.69	18.56	21.23	40.26	19.13	19.95
Mg#	0.66	0.70	0.72	0.65	0.58	0.65	0.67	0.66	0.59	0.68	0.68

Supplementary table 4 - Continued.

District	Monte Nureci (Arcuentu)										
Sample	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Gabbro										
Description	cpx rim	opx	cpx	cpx core	cpx rim	cpx	opx	cpx core	cpx rim	cpx	opx in cpx
SiO ₂	50.63	51.98	51.72	50.33	50.33	51.29	51.12	51.27	50.89	51.50	51.48
TiO ₂	0.14	0.55	0.00	0.59	0.71	0.16	0.39	0.66	0.29	0.10	0.29
Al ₂ O ₃	1.56	0.70	1.15	2.02	1.84	0.98	0.82	2.17	2.12	0.96	0.88
FeO _t	12.67	25.48	10.32	11.03	14.97	11.95	24.09	10.50	11.47	10.88	25.43
MnO	0.33	0.00	0.13	0.09	0.55	0.29	0.66	0.39	0.57	0.37	0.37
MgO	14.07	19.80	13.14	13.73	14.02	13.14	20.47	16.06	13.68	13.82	19.87
CaO	19.12	1.18	22.16	20.89	16.38	21.72	2.30	18.76	20.00	21.51	1.60
Na ₂ O	0.40	0.00	0.38	0.12	0.31	0.26	0.01	0.25	0.55	0.12	0.07
Cr ₂ O ₃	0.11	0.25	0.00	0.28	0.18	0.05	0.08	0.00	0.00	0.02	0.01
V ₂ O ₃	0.16	0.00	0.10	0.07	0.00	0.26	0.00	0.00	0.25	0.16	0.00
ZrO ₂	0.05	0.00	0.20	0.09	0.18	0.00	0.00	0.00	0.17	0.30	0.28
Total	99.25	99.93	99.29	99.23	99.48	100.10	99.95	100.07	99.98	99.72	100.26
Si	1.912	1.971	1.951	1.902	1.912	1.928	1.926	1.899	1.905	1.938	1.944
^{IV} Al	0.068	0.031	0.036	0.086	0.075	0.043	0.037	0.086	0.075	0.042	0.039
Ti	0.004	0.016	0.000	0.017	0.020	0.005	0.011	0.018	0.008	0.003	0.008
^{VI} Al	0.001	0.000	0.015	0.004	0.007	0.000	0.000	0.009	0.019	0.000	0.000
Fe ³⁺	0.085	0.000	0.049	0.048	0.045	0.051	0.013	0.059	0.080	0.045	0.027
Fe ²⁺	0.316	0.808	0.277	0.300	0.430	0.324	0.747	0.267	0.279	0.298	0.776
Mn	0.011	0.000	0.004	0.003	0.018	0.009	0.021	0.012	0.018	0.012	0.012
Mg	0.792	1.119	0.739	0.774	0.794	0.736	1.150	0.887	0.764	0.776	1.118
Ca	0.774	0.048	0.895	0.846	0.667	0.875	0.093	0.745	0.802	0.867	0.065
Na	0.029	0.000	0.028	0.009	0.023	0.019	0.000	0.018	0.040	0.009	0.005
Cr	0.003	0.007	0.000	0.008	0.005	0.002	0.002	0.000	0.000	0.001	0.000
V	0.005	0.000	0.003	0.002	0.000	0.008	0.000	0.000	0.007	0.005	0.000
Zr	0.001	0.000	0.004	0.002	0.003	0.000	0.000	0.000	0.003	0.006	0.005
Tot	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Ca	39.14	2.42	45.59	42.92	34.12	43.83	4.60	37.82	41.29	43.43	3.23
Mg	40.08	56.67	37.63	39.25	40.64	36.89	56.83	45.03	39.31	38.83	55.98
Fe	20.78	40.92	16.78	17.83	25.24	19.28	38.57	17.14	19.41	17.73	40.79
Mg#	0.66	0.58	0.69	0.69	0.63	0.66	0.60	0.73	0.68	0.69	0.58

Supplementary table 4 - Continued.

Chemical composition of amphibole

District	Cixerri										
Sample	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18	SAR18
Lithology	Basaltic Andesite										
Description	amp	amp	amp core	amp mantle	amp rim	amp core	amp rim	amp core	amp rim	amp	amp core
SiO ₂	43.04	43.19	40.02	40.46	43.75	41.02	43.34	41.38	43.08	41.26	40.14
TiO ₂	1.72	1.34	1.45	1.11	1.41	1.08	1.23	1.02	1.22	1.43	1.38
Al ₂ O ₃	12.24	12.14	15.54	14.71	10.11	14.45	9.74	14.81	12.74	15.50	17.42
FeO	15.30	14.76	10.02	11.02	14.23	8.92	13.05	10.06	15.32	11.21	12.59
MnO	0.04	0.91	0.14	0.26	0.15	0.06	0.44	0.00	0.60	0.07	0.08
MgO	12.48	12.59	14.24	13.64	13.22	15.21	13.58	15.66	12.92	13.65	11.99
CaO	10.82	10.99	11.90	11.88	10.75	11.70	10.66	12.61	11.26	12.29	12.85
Na ₂ O	1.88	1.91	2.74	2.33	1.65	2.43	1.41	2.19	1.77	2.53	2.15
K ₂ O	0.42	0.39	0.43	0.45	0.22	0.40	0.09	0.31	0.40	0.54	0.28
BaO	0.00	0.31	0.00	0.44	0.00	0.00	0.06	0.00	0.00	0.00	0.00
SrO											
F	0.11	0.00	0.00	0.00	0.00	0.39	0.04	0.00	0.00	0.00	0.00
Cl	0.01	0.02	0.02	0.11	0.00	0.03	0.03	0.10	0.24	0.00	0.05
Total	98.33	98.58	96.50	96.58	95.50	95.75	93.82	98.14	99.60	98.67	98.94
Si	6.202	6.211	5.835	5.950	6.429	5.988	6.455	5.888	6.114	5.934	5.787
^{IV} Al	1.798	1.789	2.165	2.050	1.571	2.012	1.545	2.112	1.886	2.066	2.213
^{VI} Al	0.281	0.269	0.506	0.499	0.180	0.475	0.165	0.372	0.246	0.562	0.746
Ti	0.187	0.145	0.159	0.123	0.156	0.118	0.138	0.109	0.130	0.155	0.150
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.199	1.206	0.764	0.761	1.182	0.879	1.269	1.018	1.397	0.602	0.543
Fe ²⁺	0.645	0.570	0.458	0.595	0.566	0.210	0.357	0.179	0.421	0.747	0.975
Mn	0.005	0.111	0.017	0.032	0.019	0.008	0.056	0.000	0.072	0.009	0.010
Mg	2.682	2.700	3.096	2.990	2.896	3.311	3.016	3.322	2.734	2.926	2.577
Ca	1.670	1.693	1.860	1.872	1.693	1.830	1.702	1.923	1.713	1.894	1.985
Na	0.526	0.533	0.776	0.665	0.470	0.688	0.407	0.603	0.486	0.706	0.602
K	0.078	0.071	0.081	0.084	0.041	0.074	0.018	0.056	0.072	0.099	0.052
Ba	0.000	0.017	0.000	0.026	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.274	15.314	15.717	15.647	15.203	15.592	15.131	15.582	15.270	15.698	15.640
F ⁻	0.051	0.000	0.000	0.000	0.000	0.180	0.018	0.000	0.000	0.000	0.000
Cl ⁻	0.001	0.006	0.004	0.029	0.000	0.009	0.007	0.025	0.057	0.000	0.012
OH ⁻	1.948	1.994	1.996	1.971	2.000	1.812	1.975	1.975	1.943	2.000	1.988
Mg/(Mg+Fe ²⁺)	0.81	0.83	0.87	0.83	0.84	0.94	0.89	0.95	0.87	0.80	0.73
Amphibole name	tschermakite	tschermakite	magnesian-hastingsite	magnesian-hastingsite	tschermakitic hornblende	magnesian-hastingsite	tschermakitic hornblende	magnesian-hastingsite	tschermakite	magnesian-hastingsite	pargasite
Mg#	0.59	0.60	0.72	0.69	0.62	0.75	0.65	0.74	0.60	0.68	0.63

Supplementary table 5 - Elements concentration (in wt. %) of calcic amphibole in studied rocks. Structural formula calculation based on 23 oxygens and 13 cations, values in apfu. Mg# = Mg/(Mg+Fe³⁺+ Fe²⁺). Abbreviation from Whitney and Evans (2010), gm=groundmass.

District Sample Lithology Description	Cixerri						Cixerri					
	SAR18	SAR18	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
	Basaltic Andesite		Basaltic Andesite									
	amp mantle	amp rim	amp core	amp rim	amp core	amp rim	amp	amp core	amp rim	amp	amp	amp
SiO ₂	40.89	43.69	44.77	43.41	44.69	44.02	45.65	44.21	46.98	44.43	44.87	
TiO ₂	1.77	1.40	1.03	1.73	1.78	1.50	1.40	1.48	1.57	1.40	1.44	
Al ₂ O ₃	15.81	12.35	10.28	10.69	11.05	11.64	9.81	10.56	9.26	10.55	11.30	
FeO	9.49	13.69	14.98	14.10	15.00	15.06	14.53	15.08	14.60	15.69	15.10	
MnO	0.12	0.05	0.75	0.53	0.23	0.54	0.42	0.45	0.64	0.32	0.22	
MgO	15.41	13.45	13.21	13.12	13.48	12.95	13.13	13.10	13.89	12.80	12.89	
CaO	12.42	11.86	10.97	11.24	11.03	10.65	10.35	10.74	11.08	10.87	10.87	
Na ₂ O	2.36	2.10	1.90	1.56	1.74	1.68	1.48	1.26	1.66	1.39	1.63	
K ₂ O	0.48	0.29	0.42	0.36	0.34	0.50	0.25	0.57	0.34	0.44	0.31	
BaO	0.03	0.07	0.35	0.12	0.00	0.37	0.00	0.05	0.44	0.00	0.00	
SrO			0.00	0.36	0.00	0.26	0.00	0.00	0.00	0.00	0.00	
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cl	0.08	0.00	0.00	0.20	0.00	0.06	0.00	0.00	0.01	0.09	0.11	
Total	99.21	99.16	98.66	97.42	99.35	99.23	97.01	97.48	100.48	97.98	98.73	
Si	5.787	6.253	6.430	6.333	6.322	6.274	6.569	6.366	6.600	6.390	6.390	
^{IV} Al	2.213	1.747	1.570	1.667	1.678	1.726	1.431	1.634	1.400	1.610	1.610	
^{VI} Al	0.424	0.336	0.170	0.172	0.164	0.228	0.232	0.158	0.134	0.178	0.286	
Ti	0.188	0.150	0.111	0.190	0.189	0.161	0.152	0.160	0.166	0.152	0.154	
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Fe ³⁺	0.909	0.828	1.154	1.022	1.255	1.284	1.245	1.382	1.036	1.312	1.194	
Fe ²⁺	0.215	0.811	0.645	0.699	0.520	0.511	0.504	0.434	0.679	0.575	0.603	
Mn	0.014	0.006	0.091	0.065	0.028	0.066	0.051	0.055	0.076	0.039	0.026	
Mg	3.250	2.869	2.828	2.854	2.844	2.751	2.816	2.812	2.909	2.745	2.736	
Ca	1.883	1.819	1.689	1.756	1.671	1.626	1.596	1.657	1.668	1.675	1.658	
Na	0.649	0.584	0.529	0.440	0.476	0.466	0.412	0.352	0.451	0.386	0.449	
K	0.086	0.052	0.077	0.067	0.062	0.090	0.046	0.104	0.061	0.081	0.056	
Ba	0.002	0.004	0.020	0.007	0.000	0.021	0.000	0.003	0.024	0.000	0.000	
Sr	0.000	0.000	0.000	0.031	0.000	0.022	0.000	0.000	0.000	0.000	0.000	
Tot	15.619	15.459	15.314	15.301	15.209	15.225	15.054	15.116	15.205	15.142	15.164	
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Cl ⁻	0.020	0.000	0.000	0.049	0.000	0.015	0.000	0.000	0.003	0.022	0.027	
OH ⁻	1.980	2.000	2.000	1.951	2.000	1.985	2.000	2.000	1.997	1.978	1.973	
Mg/(Mg+Fe ²⁺)	0.94	0.78	0.81	0.80	0.85	0.84	0.85	0.87	0.81	0.83	0.82	
Amphibole name	magnesio- hastingsite	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	
Mg#	0.74	0.64	0.61	0.62	0.62	0.61	0.62	0.61	0.63	0.59	0.60	

Supplementary table 5 - Continued.

District	Cixerri										
Sample	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
Lithology	Basaltic Andesite										
Description	amp	amp	amp	amp	amp	amp	amp	amp	amp	amp	amp
SiO ₂	42.97	44.20	45.03	44.88	43.97	45.31	45.11	44.02	44.74	45.76	46.42
TiO ₂	1.04	1.38	1.29	1.18	1.36	1.32	1.78	1.53	1.11	1.37	1.79
Al ₂ O ₃	11.60	10.34	10.28	10.41	10.33	9.80	10.55	10.53	11.55	9.91	10.32
FeO	15.75	14.37	14.15	15.73	15.14	14.40	15.81	15.94	15.46	14.65	14.01
MnO	0.41	0.47	0.45	0.20	0.49	0.20	0.63	0.46	0.12	0.03	0.68
MgO	11.91	13.73	13.44	13.34	12.71	13.77	12.92	13.41	13.64	13.52	14.12
CaO	10.66	10.96	11.36	11.31	10.90	11.04	10.46	11.37	11.28	11.07	11.69
Na ₂ O	1.68	1.65	1.45	1.46	1.45	1.38	1.67	1.76	1.75	1.21	1.91
K ₂ O	0.33	0.42	0.29	0.35	0.36	0.31	0.19	0.30	0.21	0.29	0.16
BaO	0.27	0.23	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SrO	0.00	0.00	0.58	0.56	0.00	0.00	0.00	0.19	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.07	0.00	0.07
Total	96.66	97.74	98.71	99.43	96.77	97.54	99.13	99.51	99.94	97.81	101.17
Si	6.299	6.362	6.478	6.393	6.408	6.502	6.381	6.268	6.284	6.544	6.470
^{IV} Al	1.701	1.638	1.522	1.607	1.592	1.498	1.619	1.732	1.716	1.456	1.530
^{VI} Al	0.303	0.117	0.221	0.142	0.182	0.159	0.140	0.036	0.196	0.214	0.165
Ti	0.114	0.149	0.140	0.126	0.149	0.143	0.189	0.164	0.117	0.147	0.187
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.252	1.282	0.921	1.200	1.227	1.218	1.437	1.326	1.376	1.166	0.954
Fe ²⁺	0.678	0.448	0.781	0.675	0.619	0.511	0.434	0.573	0.439	0.586	0.679
Mn	0.051	0.057	0.055	0.024	0.060	0.024	0.075	0.055	0.015	0.004	0.080
Mg	2.602	2.947	2.883	2.833	2.763	2.945	2.725	2.846	2.857	2.882	2.934
Ca	1.674	1.690	1.750	1.726	1.703	1.697	1.585	1.735	1.698	1.696	1.746
Na	0.479	0.459	0.404	0.404	0.411	0.384	0.459	0.486	0.475	0.335	0.516
K	0.061	0.077	0.054	0.063	0.068	0.057	0.035	0.054	0.038	0.053	0.028
Ba	0.015	0.013	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sr	0.000	0.000	0.048	0.046	0.000	0.000	0.000	0.016	0.000	0.000	0.000
Tot	15.229	15.239	15.279	15.240	15.181	15.138	15.078	15.291	15.211	15.084	15.290
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.013	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.017	0.000	0.017
OH ⁻	1.987	2.000	2.000	2.000	1.987	2.000	2.000	2.000	1.983	2.000	1.983
Mg/(Mg+Fe ²⁺)	0.79	0.87	0.79	0.81	0.82	0.85	0.86	0.83	0.87	0.83	0.81
Amphibole name	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende
Mg#	0.57	0.63	0.63	0.60	0.60	0.63	0.59	0.60	0.61	0.62	0.64

Supplementary table 5 - Continued.

District	Cixerri										
Sample	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3
Lithology	Basaltic Andesite										
Description	amp	amp	amp	amp	amp	amp	amp	amp core	amp rim	amp	amp
SiO ₂	43.91	44.44	44.53	46.60	47.20	45.06	44.30	45.33	45.88	44.67	44.85
TiO ₂	1.39	1.51	1.81	1.69	1.17	0.92	0.87	1.37	1.41	1.44	1.51
Al ₂ O ₃	11.36	9.99	10.61	9.65	9.85	11.29	11.11	9.66	9.44	11.57	11.13
FeO	14.44	15.11	14.48	15.26	14.96	14.53	14.68	14.14	14.33	15.98	15.53
MnO	0.64	0.82	0.59	0.36	0.29	0.68	0.50	0.32	0.56	0.84	0.52
MgO	12.37	13.18	13.29	14.05	14.14	12.77	13.13	13.83	13.85	13.03	12.57
CaO	10.76	10.86	10.60	11.72	11.15	11.12	10.69	10.84	10.83	10.77	11.03
Na ₂ O	1.66	1.56	1.45	1.52	1.59	1.65	1.48	1.51	1.30	1.68	1.95
K ₂ O	0.29	0.17	0.22	0.24	0.36	0.23	0.36	0.32	0.21	0.45	0.51
BaO	0.48	0.00	0.00	0.00	0.32	0.18	0.35	0.09	0.07	0.00	0.11
SrO	0.25	0.00	0.08	0.00	0.00	0.08	0.00	0.00	0.50	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.18	0.00	0.07	0.00	0.00	0.09	0.10	0.10	0.07	0.09
Total	97.55	97.82	97.67	101.17	101.03	98.52	97.55	97.50	98.48	100.49	99.79
Si	6.385	6.395	6.374	6.496	6.562	6.450	6.376	6.514	6.543	6.252	6.389
^{IV} Al	1.615	1.605	1.626	1.504	1.438	1.550	1.624	1.486	1.457	1.748	1.611
^{VI} Al	0.332	0.090	0.164	0.081	0.176	0.355	0.261	0.150	0.128	0.160	0.257
Ti	0.153	0.163	0.195	0.177	0.122	0.099	0.094	0.148	0.151	0.151	0.162
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.006	1.372	1.366	1.115	1.168	1.050	1.359	1.214	1.228	1.519	1.020
Fe ²⁺	0.750	0.447	0.368	0.664	0.571	0.689	0.408	0.486	0.480	0.352	0.829
Mn	0.079	0.100	0.072	0.043	0.034	0.083	0.061	0.039	0.067	0.099	0.062
Mg	2.681	2.828	2.836	2.920	2.929	2.724	2.817	2.963	2.945	2.718	2.670
Ca	1.677	1.675	1.626	1.750	1.661	1.706	1.648	1.668	1.654	1.614	1.684
Na	0.467	0.436	0.402	0.411	0.429	0.458	0.414	0.420	0.361	0.457	0.539
K	0.054	0.031	0.040	0.043	0.064	0.042	0.066	0.058	0.039	0.080	0.093
Ba	0.027	0.000	0.000	0.000	0.018	0.010	0.020	0.005	0.004	0.000	0.006
Sr	0.021	0.000	0.006	0.000	0.000	0.007	0.000	0.000	0.041	0.000	0.000
Tot	15.246	15.141	15.074	15.204	15.172	15.224	15.148	15.152	15.099	15.152	15.321
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.000	0.044	0.000	0.017	0.000	0.000	0.021	0.024	0.024	0.016	0.021
OH ⁻	2.000	1.956	2.000	1.983	2.000	2.000	1.979	1.976	1.976	1.984	1.979
Mg/(Mg+Fe ²⁺)	0.78	0.86	0.89	0.81	0.84	0.80	0.87	0.86	0.86	0.89	0.76
Amphibole name	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende
Mg#	0.60	0.61	0.62	0.62	0.63	0.61	0.61	0.64	0.63	0.59	0.59

Supplementary table 5 - Continued.

District	Cixerri											
Sample	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3
Lithology							Basaltic Andesite					
Description	amp	amp core	amp rim	amp	amp	amp	amp	amp	amp	amp	amp	amp
SiO ₂	46.72	48.83	45.48	45.23	44.08	44.01	44.33	43.44	45.20	44.42	43.18	45.60
TiO ₂	1.48	1.18	1.37	1.14	1.58	1.74	1.46	1.56	0.96	1.28	1.09	1.33
Al ₂ O ₃	9.60	9.21	10.00	10.90	12.70	12.19	9.92	10.89	9.26	10.94	11.24	9.84
FeO	14.80	13.72	14.66	14.33	14.32	15.22	14.41	13.87	13.67	14.65	15.55	13.97
MnO	0.31	0.35	0.68	0.18	0.36	0.52	0.38	0.55	0.50	0.08	0.40	0.74
MgO	13.86	14.52	14.05	13.18	12.66	12.51	13.19	12.87	14.05	12.65	11.88	13.49
CaO	10.41	11.31	11.00	10.82	10.99	11.13	10.43	10.85	10.99	10.61	10.94	10.39
Na ₂ O	1.54	1.30	1.56	1.75	1.93	1.58	1.66	1.75	1.48	1.58	1.44	1.51
K ₂ O	0.35	0.23	0.21	0.32	0.39	0.41	0.23	0.28	0.27	0.43	0.21	0.24
BaO	0.00	0.00	0.33	0.44	0.11	0.00	0.00	0.12	0.20	0.15	0.37	0.00
SrO	0.11	0.00	0.23	0.00	0.16	0.00	0.09	0.00	0.00	0.00	0.18	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.06	0.01	0.13	0.09	0.00	0.00	0.02	0.00	0.07	0.15	0.01	0.14
Total	99.24	100.66	99.70	98.36	99.27	99.30	96.11	96.19	96.66	96.94	96.49	97.24
Si	6.569	6.753	6.421	6.482	6.270	6.253	6.464	6.366	6.555	6.455	6.357	6.543
^{IV} Al	1.431	1.247	1.579	1.518	1.730	1.747	1.536	1.634	1.445	1.545	1.643	1.457
^{VI} Al	0.160	0.255	0.085	0.324	0.399	0.294	0.169	0.247	0.138	0.328	0.307	0.206
Ti	0.157	0.123	0.146	0.123	0.170	0.186	0.160	0.172	0.105	0.140	0.121	0.143
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.321	1.003	1.336	1.032	1.001	1.185	1.264	1.072	1.191	1.092	1.117	1.308
Fe ²⁺	0.420	0.583	0.394	0.685	0.702	0.623	0.493	0.628	0.468	0.689	0.798	0.368
Mn	0.037	0.041	0.081	0.021	0.043	0.062	0.047	0.068	0.061	0.010	0.049	0.090
Mg	2.906	2.994	2.958	2.815	2.685	2.650	2.867	2.813	3.037	2.741	2.607	2.885
Ca	1.568	1.676	1.664	1.661	1.675	1.694	1.629	1.703	1.708	1.651	1.726	1.597
Na	0.420	0.348	0.426	0.486	0.532	0.435	0.469	0.498	0.417	0.446	0.410	0.419
K	0.062	0.041	0.037	0.059	0.071	0.073	0.043	0.053	0.051	0.080	0.040	0.043
Ba	0.000	0.000	0.018	0.025	0.006	0.000	0.000	0.007	0.012	0.009	0.022	0.000
Sr	0.009	0.000	0.019	0.000	0.013	0.000	0.007	0.000	0.000	0.000	0.016	0.000
Tot	15.060	15.065	15.164	15.231	15.296	15.203	15.148	15.261	15.187	15.185	15.213	15.060
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.013	0.002	0.031	0.021	0.000	0.000	0.004	0.000	0.018	0.038	0.003	0.035
OH ⁻	1.987	1.998	1.969	1.979	2.000	2.000	1.996	2.000	1.982	1.962	1.997	1.965
Mg/(Mg+Fe ²⁺)	0.87	0.84	0.88	0.80	0.79	0.81	0.85	0.82	0.87	0.80	0.77	0.89
Amphibole name	magnesio-hornblende	magnesio-hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	magnesio-hornblende	tscherma-kitic hornblende	tscherma-kitic hornblende	magnesio-hornblende
Mg#	0.63	0.65	0.63	0.62	0.61	0.59	0.62	0.62	0.65	0.61	0.58	0.63

Supplementary table 5 - Continued.

District Sample Lithology Description	Cixerri									Cixerri		
	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6	SAR5	SAR5	SAR5	SAR5
	Basaltic Andesite						Andesite					
	amp core	amp rim	amp	amp	amp	amp core	amp rim	amp core	amp rim	amp	amp	amp
SiO ₂	45.70	45.90	49.86	43.34	43.50	43.31	43.22	45.25	48.50	48.83	49.51	
TiO ₂	1.36	1.95	1.20	1.30	1.24	1.56	1.61	1.17	1.85	0.92	0.91	
Al ₂ O ₃	11.46	10.12	5.63	9.83	10.54	14.15	14.66	10.89	6.41	5.63	5.81	
FeO	15.11	14.70	12.00	14.13	14.06	10.11	10.16	14.93	13.91	12.49	11.75	
MnO	0.34	0.26	0.53	0.13	0.37	0.39	0.00	0.64	0.19	0.31	0.42	
MgO	13.33	13.79	15.87	13.34	12.64	16.23	14.97	13.84	15.04	15.43	15.97	
CaO	11.24	10.90	11.82	10.38	10.23	12.68	11.98	10.89	11.33	11.02	11.18	
Na ₂ O	1.60	1.74	1.51	1.63	1.59	2.47	2.25	1.83	1.77	1.40	0.98	
K ₂ O	0.36	0.11	0.25	0.30	0.33	0.50	0.65	0.32	0.37	0.36	0.24	
BaO	0.15	0.00	0.00	0.00	0.14	0.00	0.00	0.15	0.00	0.00	0.19	
SrO	0.00	0.00	0.26	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.15	
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cl	0.00	0.05	0.13	0.00	0.03	0.06	0.02	0.15	0.15	0.13	0.15	
Total	100.64	99.52	99.06	95.01	94.67	101.46	99.52	100.05	99.52	96.52	97.25	
Si	6.387	6.460	7.081	6.423	6.443	5.980	6.073	6.350	6.879	7.064	7.071	
^{IV} Al	1.613	1.540	0.919	1.577	1.557	2.020	1.927	1.650	1.072	0.936	0.929	
^{VI} Al	0.275	0.139	0.024	0.141	0.283	0.284	0.501	0.152	0.000	0.024	0.048	
Ti	0.143	0.207	0.128	0.145	0.138	0.162	0.170	0.124	0.197	0.100	0.098	
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Fe ³⁺	1.172	1.208	0.537	1.219	1.219	0.909	0.751	1.404	0.779	0.836	0.904	
Fe ²⁺	0.594	0.522	0.888	0.532	0.523	0.258	0.443	0.349	0.871	0.674	0.499	
Mn	0.040	0.031	0.064	0.017	0.046	0.046	0.000	0.076	0.023	0.039	0.050	
Mg	2.776	2.894	3.359	2.946	2.790	3.341	3.135	2.896	3.179	3.327	3.401	
Ca	1.683	1.643	1.799	1.649	1.623	1.877	1.803	1.638	1.722	1.708	1.710	
Na	0.434	0.475	0.416	0.467	0.456	0.660	0.613	0.497	0.486	0.394	0.272	
K	0.064	0.020	0.045	0.058	0.062	0.088	0.116	0.057	0.067	0.067	0.043	
Ba	0.008	0.000	0.000	0.000	0.008	0.000	0.000	0.008	0.000	0.000	0.011	
Sr	0.000	0.000	0.022	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.012	
Tot	15.190	15.138	15.282	15.226	15.148	15.625	15.532	15.200	15.275	15.169	15.049	
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Cl ⁻	0.000	0.011	0.031	0.000	0.008	0.014	0.006	0.036	0.035	0.031	0.036	
OH ⁻	2.000	1.989	1.969	2.000	1.992	1.986	1.994	1.964	1.965	1.969	1.964	
Mg/(Mg+Fe ²⁺)	0.82	0.85	0.79	0.85	0.84	0.93	0.88	0.89	0.78	0.83	0.87	
Amphibole name	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hastingsite	magnesio- hastingsite	tscherma- kitic hornblende	magnesio- hornblende	magnesio- hornblende	magnesio- hornblende	
Mg#	0.61	0.63	0.70	0.63	0.62	0.74	0.72	0.62	0.66	0.69	0.71	

Supplementary table 5 - Continued.

District Sample Lithology Description	Cixerri								Cixerri		
	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR5	SAR17	SAR17	SAR17	SAR17
	Andesite								Andesite		
	amp	amp	amp	amp	amp core	amp rim	amp	amp	amp	amp	amp
SiO ₂	45.17	43.62	45.34	44.64	45.49	44.41	45.91	43.94	44.24	43.01	40.56
TiO ₂	1.29	1.34	1.20	1.37	1.32	1.53	1.52	1.29	1.58	1.22	1.47
Al ₂ O ₃	9.95	11.68	10.89	10.74	10.58	10.00	11.41	8.16	9.59	9.81	14.64
FeO	13.89	14.75	15.83	13.83	15.26	14.97	15.66	14.41	14.32	13.85	9.34
MnO	0.10	0.50	0.62	0.45	0.69	0.27	0.26	0.85	0.32	0.54	0.25
MgO	13.82	12.54	12.95	12.94	13.36	13.16	13.35	12.69	13.34	12.91	14.97
CaO	10.81	10.51	10.68	10.42	11.00	11.18	10.90	10.98	10.58	10.32	11.99
Na ₂ O	1.72	2.07	2.05	1.56	1.54	1.84	1.54	1.43	1.80	1.80	2.68
K ₂ O	0.27	0.44	0.26	0.32	0.35	0.29	0.17	0.59	0.38	0.22	0.47
BaO	0.18	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.04	0.17	0.11
SrO	0.00	0.00	0.55	0.54	0.00	0.00	0.00				
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
Cl	0.11	0.00	0.10	0.11	0.06	0.06	0.00	0.21	0.10	0.05	0.00
Total	97.32	97.45	100.47	96.92	99.75	97.72	100.71	94.55	96.47	94.18	96.73
Si	6.512	6.311	6.396	6.479	6.413	6.435	6.368	6.626	6.473	6.444	5.908
^{IV} Al	1.488	1.689	1.604	1.521	1.587	1.565	1.632	1.374	1.527	1.556	2.092
^{VI} Al	0.203	0.303	0.207	0.316	0.170	0.143	0.234	0.076	0.125	0.176	0.421
Ti	0.139	0.145	0.127	0.150	0.140	0.167	0.158	0.147	0.174	0.137	0.161
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.115	1.172	1.217	1.077	1.322	1.046	1.399	0.927	1.151	1.209	0.751
Fe ²⁺	0.560	0.613	0.650	0.602	0.477	0.767	0.418	0.890	0.601	0.526	0.387
Mn	0.012	0.061	0.075	0.055	0.083	0.034	0.031	0.108	0.039	0.068	0.030
Mg	2.971	2.706	2.723	2.800	2.808	2.843	2.760	2.852	2.909	2.883	3.250
Ca	1.670	1.630	1.614	1.620	1.661	1.736	1.619	1.773	1.659	1.656	1.871
Na	0.481	0.581	0.560	0.440	0.420	0.516	0.414	0.418	0.510	0.522	0.757
K	0.049	0.082	0.047	0.059	0.064	0.054	0.030	0.113	0.071	0.042	0.088
Ba	0.010	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.002	0.010	0.006
Sr	0.000	0.000	0.045	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.211	15.293	15.266	15.164	15.149	15.306	15.063	15.304	15.242	15.230	15.722
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.000	0.000
Cl ⁻	0.027	0.000	0.024	0.027	0.014	0.014	0.000	0.054	0.024	0.012	0.000
OH ⁻	1.973	2.000	1.976	1.973	1.986	1.986	2.000	1.946	1.892	1.988	2.000
Mg/(Mg+Fe ²⁺)	0.84	0.82	0.81	0.82	0.85	0.79	0.87	0.76	0.83	0.85	0.89
Amphibole name	magnesio-hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio-hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio-hastingsite
Mg#	0.64	0.60	0.59	0.63	0.61	0.61	0.60	0.61	0.62	0.62	0.74

Supplementary table 5 - Continued.

District	Cixerri										Cixerri
Sample	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR21
Lithology	Andesite										Andesite
Description	amp core	amp mantle	amp rim	amp	amp in amp	amp	amp	amp	amp	amp	amp
SiO ₂	41.20	41.43	42.37	42.64	48.68	43.08	45.02	44.35	40.62	42.78	42.63
TiO ₂	1.37	1.19	1.02	0.82	0.31	1.13	1.78	0.72	1.59	1.74	1.25
Al ₂ O ₃	15.65	14.35	12.40	12.33	3.20	11.16	10.60	10.36	11.65	13.66	14.63
FeO	10.41	8.73	13.86	14.20	19.44	13.13	15.75	15.41	13.86	13.60	11.82
MnO	0.13	0.00	0.31	0.13	0.66	0.09	0.42	0.57	0.26	0.23	0.00
MgO	14.58	15.01	13.24	13.11	9.04	13.22	13.08	13.04	12.21	14.09	14.27
CaO	12.34	12.20	11.45	11.66	11.59	11.43	11.18	10.35	11.59	12.67	11.37
Na ₂ O	2.72	2.71	2.13	2.01	0.33	1.80	1.76	1.87	2.08	2.14	2.00
K ₂ O	0.36	0.67	0.33	0.31	0.05	0.39	0.29	0.19	0.34	0.30	0.54
BaO	0.00	0.12	0.78	0.71	0.25	0.00	0.00	0.65	0.00	0.00	0.13
SrO											
F	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.16	0.01	0.12	0.00	0.11	0.12	0.03	0.02
Total	98.87	96.55	97.99	98.15	93.65	95.99	99.88	97.64	94.31	101.40	98.66
Si	5.870	6.058	6.165	6.206	7.626	6.375	6.370	6.412	6.172	5.995	6.025
^{IV} Al	2.130	1.942	1.835	1.794	0.374	1.625	1.630	1.588	1.828	2.005	1.975
^{VI} Al	0.499	0.530	0.291	0.321	0.217	0.322	0.137	0.177	0.258	0.251	0.463
Ti	0.147	0.131	0.112	0.090	0.037	0.126	0.189	0.079	0.181	0.184	0.133
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.751	0.421	0.999	0.951	0.051	0.835	1.188	1.415	0.756	0.947	1.144
Fe ²⁺	0.490	0.647	0.687	0.778	2.495	0.790	0.676	0.449	1.005	0.647	0.253
Mn	0.016	0.000	0.038	0.016	0.088	0.011	0.051	0.070	0.034	0.028	0.000
Mg	3.097	3.271	2.873	2.845	2.112	2.916	2.759	2.810	2.765	2.944	3.007
Ca	1.885	1.911	1.785	1.818	1.946	1.813	1.695	1.603	1.886	1.903	1.721
Na	0.752	0.769	0.600	0.567	0.100	0.516	0.484	0.524	0.613	0.580	0.549
K	0.065	0.125	0.061	0.058	0.009	0.073	0.053	0.034	0.065	0.054	0.097
Ba	0.000	0.007	0.044	0.041	0.015	0.000	0.000	0.037	0.000	0.000	0.007
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.701	15.812	15.490	15.484	15.070	15.402	15.232	15.198	15.564	15.537	15.374
F ⁻	0.000	0.000	0.000	0.000	0.000	0.159	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.000	0.000	0.000	0.039	0.004	0.030	0.000	0.027	0.030	0.007	0.004
OH ⁻	2.000	2.000	2.000	1.961	1.996	1.811	2.000	1.973	1.970	1.993	1.996
Mg/(Mg+Fe ²⁺)	0.86	0.83	0.81	0.79	0.46	0.79	0.80	0.86	0.73	0.82	0.92
Amphibole name	magnesio-hastingsite	pargasite	tschermakite	tschermakite	ferro-actinolite	tschermakitic hornblende	tschermakitic hornblende	tschermakitic hornblende	magnesio-hastingsite	magnesio-hastingsite	tschermakite
Mg#	0.71	0.75	0.63	0.62	0.45	0.64	0.60	0.60	0.61	0.65	0.68

Supplementary table 5 - Continued.

District Sample Lithology Description	Cixerri						Cixerri			Cixerri	
	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR21	SAR11	SAR11
	Andesite						Andesite			Andesite	
	amp	amp core	amp rim	amp			amp, profile	zoning from core to rim		amp	amp
SiO ₂	42.63	41.89	43.36	41.84	42.24	42.75	42.69	42.48	42.58	43.86	44.40
TiO ₂	1.88	2.07	1.52	1.96	1.55	1.44	1.55	1.58	2.10	1.29	1.58
Al ₂ O ₃	11.03	10.81	11.54	12.53	11.96	12.06	13.45	12.06	11.41	10.41	12.00
FeO	14.15	14.84	14.84	15.39	16.87	14.98	13.28	12.91	14.47	15.60	12.29
MnO	0.15	0.42	0.13	0.09	0.27	0.52	0.05	0.43	0.00	0.75	0.29
MgO	12.91	12.50	12.88	11.78	11.60	11.94	13.75	13.14	12.63	13.10	13.38
CaO	11.08	10.77	10.75	10.92	10.45	10.57	10.91	11.49	11.20	10.30	11.58
Na ₂ O	2.12	2.15	1.83	2.29	2.17	1.83	2.25	2.08	2.33	1.56	1.70
K ₂ O	0.45	0.54	0.32	0.28	0.58	0.41	0.44	0.57	0.56	0.37	0.37
BaO	0.20	0.00	0.00	0.00	0.52	0.03	0.00	0.23	0.00	0.03	0.06
SrO											
F	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.01	0.01	0.00	0.02	0.03	0.08	0.01	0.09	0.00	0.15
Total	96.74	96.63	97.41	97.08	98.23	96.95	98.61	97.05	97.48	97.41	98.20
Si	6.280	6.218	6.275	6.139	6.161	6.257	6.075	6.231	6.252	6.314	6.399
^{IV} Al	1.720	1.782	1.725	1.861	1.839	1.743	1.925	1.769	1.748	1.686	1.601
^{VI} Al	0.195	0.108	0.243	0.307	0.217	0.338	0.331	0.316	0.227	0.080	0.438
Ti	0.208	0.231	0.165	0.216	0.170	0.158	0.166	0.175	0.231	0.139	0.171
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.897	1.065	1.244	0.984	1.235	1.174	1.235	0.769	0.767	1.644	0.694
Fe ²⁺	0.845	0.778	0.551	0.904	0.822	0.659	0.346	0.814	1.010	0.234	0.787
Mn	0.019	0.052	0.016	0.012	0.034	0.064	0.006	0.053	0.000	0.091	0.036
Mg	2.836	2.766	2.780	2.577	2.522	2.606	2.917	2.873	2.765	2.812	2.874
Ca	1.749	1.712	1.667	1.717	1.633	1.658	1.664	1.806	1.762	1.589	1.788
Na	0.606	0.619	0.514	0.651	0.613	0.519	0.621	0.592	0.663	0.434	0.476
K	0.085	0.103	0.059	0.052	0.107	0.076	0.080	0.106	0.104	0.068	0.067
Ba	0.012	0.000	0.000	0.000	0.030	0.002	0.000	0.013	0.000	0.002	0.004
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.452	15.434	15.240	15.420	15.383	15.254	15.364	15.516	15.530	15.093	15.335
F ⁻	0.000	0.271	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.000	0.001	0.003	0.000	0.005	0.007	0.020	0.003	0.022	0.000	0.036
OH ⁻	2.000	1.728	1.997	2.000	1.995	1.993	1.980	1.997	1.978	2.000	1.964
Mg/(Mg+Fe ²⁺)	0.77	0.78	0.83	0.74	0.75	0.80	0.89	0.78	0.73	0.92	0.78
Amphibole name	tscherma- kitic hornblende	tschermakit e	tscherma- kitic hornblende	tscherma- kite	tscherma- kite	tscherma- kitic hornblende	tscherma- kite	magnesio- hastingsite	magnesio- hastingsite hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende
Mg#	0.62	0.60	0.61	0.58	0.55	0.59	0.65	0.64	0.61	0.60	0.66

Supplementary table 5 - Continued.

District	Cixerri									Cixerri	
Sample	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR12	SAR12
Lithology	Andesite									Andesite	
Description	amp	amp	amp core	amp rim	amp	amp rim cpx	amp	amp in pl	amp	amp	amp
SiO ₂	41.49	40.39	40.07	43.42	45.62	44.18	42.14	44.21	41.96	41.38	41.81
TiO ₂	1.56	1.62	1.43	1.32	1.48	1.48	1.98	1.71	1.56	1.67	1.02
Al ₂ O ₃	13.65	15.36	15.04	11.43	8.47	9.57	11.29	9.94	12.78	11.09	11.63
FeO	12.02	11.56	10.63	13.82	13.13	14.36	15.01	14.60	15.25	13.24	14.12
MnO	0.42	0.48	0.00	0.02	0.83	0.56	0.27	0.59	0.37	0.25	0.07
MgO	13.03	14.22	14.57	12.29	14.16	13.63	12.49	12.80	12.47	12.53	12.93
CaO	12.00	11.64	12.19	11.39	10.86	11.36	10.82	10.95	10.67	11.32	11.05
Na ₂ O	2.22	2.49	2.68	2.07	1.61	1.71	1.96	1.77	2.03	1.94	2.28
K ₂ O	0.53	0.40	0.55	0.18	0.31	0.21	0.29	0.19	0.28	0.43	0.46
BaO	0.01	0.00	0.12	0.31	0.00	0.00	0.00	0.00	0.00	0.32	0.46
SrO											
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.04	0.06	0.06	0.12	0.00	0.10	0.00	0.01	0.05	0.00	0.00
Total	96.96	98.22	97.61	96.47	96.75	97.24	96.30	96.85	97.43	94.18	95.99
Si	6.089	5.770	5.821	6.430	6.626	6.426	6.201	6.457	6.071	6.279	6.217
^{IV} Al	1.911	2.230	2.179	1.570	1.374	1.574	1.799	1.543	1.929	1.721	1.783
^{VI} Al	0.449	0.357	0.396	0.426	0.075	0.066	0.160	0.169	0.250	0.264	0.256
Ti	0.172	0.175	0.157	0.147	0.161	0.162	0.220	0.188	0.170	0.190	0.114
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.614	1.198	0.803	0.574	1.087	1.124	1.174	1.034	1.408	0.704	0.979
Fe ²⁺	0.861	0.183	0.488	1.137	0.508	0.623	0.673	0.749	0.437	0.976	0.776
Mn	0.052	0.058	0.000	0.002	0.102	0.069	0.033	0.074	0.045	0.032	0.009
Mg	2.851	3.029	3.157	2.714	3.067	2.956	2.740	2.786	2.690	2.834	2.865
Ca	1.886	1.781	1.898	1.807	1.690	1.770	1.706	1.714	1.654	1.840	1.760
Na	0.630	0.690	0.756	0.593	0.453	0.481	0.560	0.502	0.571	0.572	0.659
K	0.099	0.073	0.101	0.034	0.057	0.039	0.054	0.035	0.052	0.083	0.088
Ba	0.001	0.000	0.007	0.018	0.000	0.000	0.000	0.000	0.000	0.019	0.027
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.617	15.544	15.762	15.452	15.200	15.290	15.320	15.250	15.277	15.514	15.533
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.010	0.014	0.015	0.030	0.000	0.025	0.000	0.002	0.012	0.000	0.000
OH ⁻	1.990	1.986	1.985	1.970	2.000	1.975	2.000	1.998	1.988	2.000	2.000
Mg/(Mg+Fe ²⁺)	0.77	0.94	0.87	0.70	0.86	0.83	0.80	0.79	0.86	0.74	0.79
Amphibole name	magnesio-hastingsite	magnesio-hastingsite	magnesio-hastingsite	tschermakitic hornblende	magnesio-hornblende	tschermakitic hornblende	tschermakite	tschermakitic hornblende	tschermakite	tschermakitic hornblende	magnesio-hastingsite
Mg#	0.66	0.69	0.71	0.61	0.66	0.63	0.60	0.61	0.59	0.63	0.62

Supplementary table 5 - Continued.

District Sample Lithology Description	Siliqua							Siliqua			
	SIL1	SIL1	SIL1	SIL1	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2
	amp in pl	amp	amp	amp	amp	amp core	amp core	amp	amp gm	amp	amp core
SiO ₂	41.67	44.08	45.47	44.32	43.70	43.94	43.33	42.92	43.72	43.42	41.09
TiO ₂	1.59	1.90	1.13	1.43	0.50	0.60	0.69	0.81	2.35	0.96	1.37
Al ₂ O ₃	11.07	9.47	7.71	8.52	11.61	11.33	11.69	11.79	12.69	11.01	14.30
FeO	16.15	13.93	13.18	14.03	16.22	14.62	15.73	14.24	13.36	14.68	9.89
MnO	0.41	0.98	0.72	0.43	1.01	0.80	0.43	0.68	0.00	0.48	0.00
MgO	11.65	13.12	14.02	13.24	11.75	12.16	12.08	11.44	13.62	11.54	14.18
CaO	10.94	10.85	10.20	10.74	10.65	10.96	11.30	10.52	11.86	10.85	11.89
Na ₂ O	1.55	1.78	1.23	1.69	1.79	1.82	1.92	1.76	2.49	1.67	2.35
K ₂ O	0.57	0.52	0.33	0.35	0.45	0.44	0.57	0.40	1.42	0.51	0.68
BaO	0.00	0.00	0.30	0.39	0.39	0.07	0.00	0.30	0.20	0.00	0.21
SrO											
F	0.62	0.00	0.49	0.00	0.00	0.77	0.00	0.00	0.35	0.37	0.00
Cl	0.00	0.15	0.07	0.04	0.06	0.09	0.15	0.08	0.12	0.06	0.00
Total	96.31	96.78	95.07	95.19	98.15	97.80	98.08	95.05	102.35	95.74	95.96
Si	6.215	6.460	6.721	6.601	6.332	6.433	6.320	6.415	6.183	6.487	6.043
^{IV} Al	1.785	1.540	1.279	1.399	1.668	1.567	1.680	1.585	1.817	1.513	1.957
^{VI} Al	0.162	0.096	0.065	0.098	0.316	0.389	0.329	0.492	0.299	0.427	0.523
Ti	0.179	0.209	0.126	0.160	0.055	0.067	0.075	0.092	0.250	0.108	0.151
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	1.211	1.016	1.283	0.950	1.304	1.000	1.023	0.919	0.462	0.816	0.563
Fe ²⁺	0.804	0.692	0.346	0.798	0.662	0.791	0.895	0.861	1.118	1.019	0.654
Mn	0.052	0.122	0.090	0.054	0.125	0.099	0.053	0.086	0.000	0.061	0.000
Mg	2.591	2.865	3.090	2.940	2.539	2.655	2.625	2.550	2.871	2.570	3.110
Ca	1.749	1.704	1.615	1.714	1.653	1.719	1.765	1.684	1.797	1.737	1.874
Na	0.448	0.505	0.353	0.489	0.504	0.516	0.543	0.509	0.683	0.484	0.670
K	0.108	0.098	0.062	0.067	0.084	0.083	0.105	0.076	0.256	0.097	0.127
Ba	0.000	0.000	0.017	0.023	0.022	0.004	0.000	0.018	0.011	0.000	0.012
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.305	15.306	15.048	15.294	15.263	15.322	15.413	15.288	15.748	15.317	15.683
F ⁻	0.292	0.000	0.227	0.000	0.000	0.358	0.000	0.000	0.159	0.177	0.000
Cl ⁻	0.000	0.037	0.018	0.010	0.015	0.023	0.037	0.020	0.029	0.015	0.000
OH ⁻	1.708	1.963	1.754	1.990	1.985	1.619	1.963	1.980	1.812	1.808	2.000
Mg/(Mg+Fe ²⁺)	0.76	0.81	0.90	0.79	0.79	0.77	0.75	0.75	0.72	0.72	0.83
Amphibole name	tscherma- kite	tscherma- kitic hornblende	magnesio- hornblende	magnesio- hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hastingsite	tscherma- kitic hornblende	magnesio- hastingsite
Mg#	0.56	0.63	0.65	0.63	0.56	0.60	0.58	0.59	0.64	0.58	0.72

Supplementary table 5 - Continued.

District	Siliqua				Siliqua				Siliqua			
Sample	MTR2	MTR2	MTR2	MTR2	MTR1	MTR1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1
Lithology	Andesite				Dacite				Dacite			
Description	amp rim	amp	amp gm	amp	amp	amp	amp	amp core	amp mantle	amp rim	amp	amp
SiO ₂	44.29	42.67	40.53	41.82	43.86	43.27	41.89	41.66	41.62	40.89	40.29	
TiO ₂	0.45	0.85	2.89	1.05	0.94	1.00	1.49	1.06	1.58	1.48	1.22	
Al ₂ O ₃	11.20	12.15	13.55	11.37	11.56	12.21	15.61	15.78	15.59	14.69	16.48	
FeO	14.49	15.40	13.80	15.91	16.97	17.15	13.22	14.18	13.09	13.70	14.98	
MnO	0.64	0.69	0.57	0.53	0.93	1.08	0.33	0.40	0.04	0.00	0.33	
MgO	13.37	10.39	12.23	11.28	11.64	11.36	13.52	12.34	13.58	12.90	11.51	
CaO	11.16	10.87	11.72	10.80	10.97	10.95	11.01	11.10	11.43	11.53	10.69	
Na ₂ O	2.03	1.94	1.74	2.06	1.69	1.84	2.35	2.42	2.15	2.09	2.29	
K ₂ O	0.59	0.82	1.60	0.76	0.54	0.57	0.65	0.66	0.49	0.71	0.58	
BaO	0.97	0.00	0.00	0.00		0.10	0.00	0.13	0.00	0.00	0.00	
SrO					0.41	0.14						
F	0.00	1.02	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	
Cl	0.00	0.01	0.00	0.15	0.05	0.04	0.00	0.12	0.00	0.00	0.00	
Total	99.19	96.82	98.95	95.73	99.56	99.93	100.32	99.85	99.77	98.00	98.65	
Si	6.369	6.407	5.925	6.280	6.299	6.208	5.861	5.910	5.856	5.905	5.781	
^{IV} Al	1.631	1.593	2.075	1.720	1.701	1.792	2.139	2.090	2.144	2.095	2.219	
^{VI} Al	0.267	0.557	0.260	0.291	0.255	0.273	0.436	0.548	0.441	0.406	0.568	
Ti	0.048	0.096	0.317	0.119	0.102	0.108	0.157	0.113	0.167	0.161	0.132	
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Fe ³⁺	1.045	0.624	0.715	0.973	1.229	1.285	1.333	1.142	1.247	1.081	1.359	
Fe ²⁺	0.697	1.309	0.972	1.025	0.809	0.773	0.214	0.540	0.292	0.574	0.438	
Mn	0.078	0.088	0.070	0.068	0.113	0.131	0.039	0.048	0.004	0.000	0.041	
Mg	2.865	2.326	2.666	2.525	2.492	2.430	2.821	2.610	2.848	2.778	2.462	
Ca	1.720	1.749	1.836	1.737	1.688	1.683	1.651	1.687	1.723	1.784	1.643	
Na	0.565	0.565	0.494	0.599	0.471	0.512	0.637	0.666	0.587	0.585	0.636	
K	0.109	0.158	0.299	0.145	0.099	0.104	0.116	0.119	0.088	0.132	0.107	
Ba	0.055	0.000	0.000	0.000	0.000	0.006	0.000	0.007	0.000	0.000	0.000	
Sr	0.000	0.000	0.000	0.000	0.034	0.012	0.000	0.000	0.000	0.000	0.000	
Tot	15.448	15.471	15.629	15.482	15.292	15.317	15.404	15.480	15.398	15.501	15.385	
F ⁻	0.000	0.484	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000	
Cl ⁻	0.000	0.003	0.000	0.039	0.012	0.010	0.000	0.030	0.000	0.000	0.000	
OH ⁻	2.000	1.513	2.000	1.961	1.988	1.890	2.000	1.970	2.000	2.000	2.000	
Mg/(Mg+Fe ²⁺)	0.80	0.64	0.73	0.71	0.75	0.76	0.93	0.83	0.91	0.83	0.85	
Amphibole name	tscherma- kitic hornblende	tscherma- kitic hornblende	magnesio- hastingsite	tscherma- kitic hornblende	tscherma- kitic hornblende	tscherma- kite	tscherma- kite	tscherma- kite	tscherma- kite	magnesio- hastingsite	tscherma- kite	
Mg#	0.62	0.55	0.61	0.56	0.55	0.54	0.65	0.61	0.65	0.63	0.58	

Supplementary table 5 - Continued.

District	Siliqua											
Sample	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1	ACQ1
Lithology	Dacite											
Description	amp core	amp rim	amp	amp	amp	amp	amp	amp core	amp mantle	amp rim	amp	amp
SiO ₂	41.80	42.04	42.14	41.78	40.93	40.35	43.45	41.28	43.41	42.13	41.44	42.47
TiO ₂	1.60	1.56	1.32	1.34	1.21	1.00	0.52	1.43	1.18	1.25	1.46	1.27
Al ₂ O ₃	14.10	14.82	14.27	14.97	15.18	15.33	15.76	14.99	13.01	14.07	14.62	14.87
FeO	12.54	13.73	12.46	11.23	13.10	12.21	9.34	12.80	8.22	11.18	12.95	12.42
MnO	0.14	0.36	0.00	0.00	0.00	0.24	0.09	0.17	0.04	0.30	0.00	0.18
MgO	12.74	13.08	13.06	13.06	12.49	13.12	15.80	12.21	16.62	14.53	13.39	13.39
CaO	11.35	11.67	11.21	11.32	11.28	11.05	11.21	11.31	11.88	11.66	11.47	11.41
Na ₂ O	2.27	2.39	2.12	2.61	2.28	2.11	2.69	2.49	2.26	2.05	2.41	2.25
K ₂ O	0.44	0.71	0.49	0.59	0.57	0.72	0.37	0.55	0.75	0.73	0.52	0.89
BaO	0.00	0.00	0.19	0.27	0.00	0.15	0.21	0.05	0.42	0.00	0.04	0.00
SrO												
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.10	0.06	0.09	0.03	0.09	0.10	0.00	0.05	0.07	0.00	0.03	0.04
Total	97.24	100.60	98.00	97.22	97.12	96.38	99.54	97.34	97.98	98.05	98.63	99.31
Si	6.091	5.943	6.098	6.083	5.958	5.885	6.026	6.025	6.179	6.023	5.948	6.036
^{IV} Al	1.909	2.057	1.902	1.917	2.042	2.115	1.974	1.975	1.821	1.977	2.052	1.964
^{VI} Al	0.513	0.412	0.531	0.651	0.563	0.520	0.602	0.604	0.363	0.394	0.422	0.528
Ti	0.176	0.166	0.143	0.147	0.132	0.110	0.054	0.157	0.127	0.134	0.157	0.136
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.777	0.995	0.903	0.561	0.947	1.173	1.084	0.706	0.776	1.040	1.016	0.907
Fe ²⁺	0.751	0.628	0.605	0.806	0.648	0.316	0.000	0.856	0.203	0.297	0.539	0.570
Mn	0.017	0.043	0.000	0.000	0.000	0.030	0.011	0.021	0.005	0.037	0.000	0.022
Mg	2.766	2.757	2.818	2.835	2.710	2.852	3.267	2.656	3.527	3.098	2.866	2.838
Ca	1.772	1.768	1.738	1.766	1.759	1.727	1.666	1.769	1.812	1.787	1.764	1.738
Na	0.641	0.655	0.594	0.738	0.643	0.598	0.723	0.706	0.623	0.569	0.671	0.620
K	0.083	0.127	0.091	0.110	0.105	0.133	0.066	0.103	0.135	0.132	0.096	0.161
Ba	0.000	0.000	0.011	0.015	0.000	0.008	0.011	0.003	0.024	0.000	0.002	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.495	15.551	15.434	15.630	15.508	15.466	15.484	15.580	15.593	15.488	15.533	15.519
F ⁻	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl ⁻	0.024	0.014	0.023	0.008	0.021	0.025	0.000	0.013	0.016	0.000	0.008	0.010
OH ⁻	1.976	1.986	1.977	1.992	1.979	1.975	2.000	1.987	1.984	2.000	1.992	1.990
Mg/(Mg+Fe ²⁺)	0.79	0.81	0.82	0.78	0.81	0.90	1.00	0.76	0.95	0.91	0.84	0.83
Amphibole name	tscherma-kite	magnesio-hastingsite	tscherma-kite	pargasite	magnesio-hastingsite	tscherma-kite	tscherma-kite	magnesio-hastingsite	magnesio-hastingsite	tscherma-kite	magnesio-hastingsite	magnesio-hastingsite
Mg#	0.64	0.63	0.65	0.67	0.63	0.66	0.75	0.63	0.78	0.70	0.65	0.66

Supplementary table 5 - Continued.

District	Monastir							Monte Nureci (Arcuentu)	
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	MNU2	MNU2
Lithology				Andesite				Olivine	Gabbro-norite
Description	amp	amp	amp	amp	amp	amp	amp	amp	amp
SiO ₂	40.87	40.25	40.87	39.86	41.31	41.38	38.53	41.43	44.70
TiO ₂	1.95	1.50	1.13	1.33	1.47	1.47	1.91	0.53	0.00
Al ₂ O ₃	15.69	15.46	14.73	15.36	15.01	15.03	14.07	14.33	10.53
FeO	9.99	10.21	9.28	9.14	11.12	12.38	11.62	12.43	11.17
MnO	0.00	0.33	0.00	0.00	0.04	0.14	0.37	0.19	0.48
MgO	14.45	14.66	15.11	14.50	14.60	14.36	13.91	12.95	14.61
CaO	11.81	11.97	12.61	12.23	11.35	11.05	11.56	11.94	12.62
Na ₂ O	2.55	2.79	2.24	1.94	2.17	2.96	2.34	2.88	2.03
K ₂ O	0.44	0.46	0.50	0.29	0.12	0.20	0.33	0.07	0.20
BaO	0.00	0.33	0.14	0.08	1.00	0.00	0.00	0.00	0.74
SrO									
F	0.00	0.00	1.26	0.26	0.00	0.99	0.00	0.00	0.61
Cl	0.00	0.03	0.04	0.10	0.01	0.00	0.02	0.42	0.36
Total	97.74	98.01	98.07	95.55	98.22	99.95	94.68	97.18	98.06
Si	5.856	5.796	5.945	5.873	5.888	5.843	5.737	6.081	6.555
^{IV} Al	2.144	2.204	2.055	2.127	2.112	2.157	2.263	1.919	1.445
^{VI} Al	0.506	0.420	0.471	0.540	0.409	0.343	0.206	0.559	0.376
Ti	0.210	0.162	0.123	0.147	0.157	0.156	0.214	0.058	0.000
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.803	0.864	0.663	0.815	1.191	1.313	1.202	0.657	0.403
Fe ²⁺	0.394	0.366	0.465	0.312	0.135	0.148	0.245	0.869	0.967
Mn	0.000	0.040	0.000	0.000	0.005	0.017	0.047	0.024	0.059
Mg	3.087	3.147	3.277	3.186	3.103	3.022	3.086	2.833	3.195
Ca	1.813	1.847	1.966	1.931	1.732	1.671	1.844	1.877	1.983
Na	0.709	0.778	0.633	0.553	0.599	0.810	0.676	0.820	0.577
K	0.080	0.085	0.093	0.054	0.023	0.036	0.063	0.013	0.037
Ba	0.000	0.019	0.008	0.004	0.056	0.000	0.000	0.000	0.043
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.602	15.729	15.700	15.542	15.410	15.517	15.583	15.710	15.640
F ⁻	0.000	0.000	0.580	0.121	0.000	0.441	0.000	0.000	0.284
Cl ⁻	0.000	0.008	0.009	0.026	0.002	0.000	0.006	0.105	0.089
OH ⁻	2.000	1.992	1.411	1.853	1.998	1.559	1.994	1.895	1.626
Mg/(Mg+Fe ²⁺)	0.89	0.90	0.88	0.91	0.96	0.95	0.93	0.77	0.77
Amphibole name	magnesio-hastingsite	magnesio-hastingsite	magnesio-hastingsite	magnesio-hastingsite	tschermakite	magnesio-hastingsite	subsilicic magnesio-hastingsite	magnesio-hastingsite	edenitic hornblende
Mg#	0.72	0.72	0.74	0.74	0.70	0.67	0.68	0.65	0.70

Supplementary table 5 - Continued.

District Sample Lithology Description	Monte Nureci (Arcuentu)						Monte Nureci (Arcuentu)				
	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU3	MNU1	MNU1	MNU1
	Olivine Gabbronorite						Gabbronorite				
	amp	amp	amp in pl	amp in pl	amp in pl	zoned amp	amp	amp	amp	amp	amp
SiO ₂	46.79	46.25	47.70	47.79	45.02	50.03	50.26	46.95	48.03	47.36	47.44
TiO ₂	0.11	0.35	0.41	0.00	0.00	0.40	0.00	0.46	0.52	0.32	0.83
Al ₂ O ₃	9.44	11.27	9.15	9.31	13.17	6.78	6.28	7.13	6.54	7.02	6.83
FeO	9.63	9.86	12.15	10.91	11.01	14.16	9.62	14.47	14.74	14.24	16.54
MnO	0.17	0.26	0.26	0.16	0.30	0.51	0.15	0.07	0.29	0.01	0.08
MgO	15.42	15.16	15.54	15.75	14.77	14.76	17.19	14.25	14.22	14.38	13.09
CaO	12.48	12.48	12.01	12.36	12.11	11.97	12.00	10.79	11.85	11.27	11.78
Na ₂ O	1.92	1.84	1.81	1.85	2.46	1.36	1.19	1.18	1.23	1.23	1.23
K ₂ O	0.14	0.26	0.15	0.02	0.09	0.25	0.16	0.82	0.78	0.83	0.70
BaO	0.09	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.52	0.00
SrO											
F	0.23	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.69	0.00
Cl	0.20	0.27	0.27	0.29	0.12	0.42	0.42	0.36	0.34	0.29	0.22
Total	96.73	98.07	99.51	98.54	99.39	100.65	98.04	96.47	98.75	98.55	98.91
Si	6.820	6.618	6.716	6.790	6.359	7.024	7.143	6.851	6.946	6.900	6.889
^{IV} Al	1.180	1.382	1.284	1.210	1.641	0.976	0.857	1.149	1.054	1.100	1.111
^{VI} Al	0.442	0.517	0.234	0.348	0.552	0.145	0.196	0.076	0.060	0.105	0.058
Ti	0.012	0.038	0.043	0.000	0.000	0.043	0.000	0.050	0.057	0.035	0.091
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.233	0.406	0.819	0.584	0.733	0.731	0.562	1.110	0.721	0.848	0.730
Fe ²⁺	0.941	0.774	0.612	0.712	0.568	0.932	0.582	0.655	1.062	0.888	1.278
Mn	0.021	0.032	0.031	0.019	0.036	0.060	0.018	0.009	0.035	0.001	0.009
Mg	3.351	3.233	3.261	3.336	3.110	3.089	3.642	3.099	3.065	3.124	2.834
Ca	1.950	1.913	1.812	1.882	1.833	1.800	1.828	1.687	1.835	1.759	1.833
Na	0.544	0.509	0.495	0.509	0.673	0.371	0.328	0.335	0.346	0.347	0.346
K	0.026	0.048	0.026	0.004	0.015	0.044	0.029	0.153	0.144	0.154	0.129
Ba	0.005	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.029	0.000
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	15.524	15.470	15.333	15.395	15.522	15.215	15.228	15.175	15.325	15.290	15.308
F ⁻	0.107	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.319	0.000
Cl ⁻	0.049	0.065	0.065	0.070	0.028	0.099	0.102	0.088	0.082	0.070	0.054
OH ⁻	1.844	1.907	1.935	1.930	1.972	1.901	1.898	1.912	1.851	1.611	1.946
Mg/(Mg+Fe ²⁺)	0.78	0.81	0.84	0.82	0.85	0.77	0.86	0.83	0.74	0.78	0.69
Amphibole name	edenite	magnesio-hornblende	magnesio-hornblende	magnesio-hornblende	magnesio-hastingsitic hornblende	magnesio-hornblende	magnesio-hornblende	magnesio-hornblende	magnesio-hornblende	magnesio-hornblende	magnesio-hornblende
Mg#	0.74	0.73	0.70	0.72	0.71	0.65	0.76	0.64	0.63	0.64	0.59

Supplementary table 5 - Continued.

Chemical composition of mica

District	Siliqua									
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2
Lithology	Andesite									
Description	mica	mica	mica	mica in amp	mica	mica	mica rim	mica core	mica	mica
SiO ₂	35.70	35.64	36.09	36.25	36.64	35.96	33.58	36.71	35.87	35.60
TiO ₂	2.74	2.75	3.12	3.13	3.31	3.01	4.36	2.45	3.00	3.55
Al ₂ O ₃	16.08	15.51	16.42	16.20	15.69	15.66	16.67	14.85	15.59	16.14
FeO	17.28	17.61	16.54	14.60	16.21	17.37	15.14	9.67	17.09	17.02
MnO	0.33	0.23	0.30	0.23	0.63	0.24	0.37	0.24	0.11	0.43
MgO	12.74	13.50	13.63	14.79	15.07	12.91	12.50	19.28	13.41	12.67
CaO	0.14	0.30	0.00	0.00	0.24	0.15	0.32	0.04	0.10	0.15
Na ₂ O	0.46	0.33	0.52	0.77	0.42	0.71	0.41	0.35	0.41	0.89
K ₂ O	8.45	8.09	8.78	9.01	7.35	8.20	9.16	9.12	8.25	8.51
SrO			0.00		0.00		0.00		0.00	0.00
BaO	1.00	1.02	0.44	0.41	0.11	0.74	1.76	0.00	0.87	0.17
F	1.60	0.00	0.00	0.00	0.00	0.00	1.17	2.51	0.53	0.00
Cl	0.10	0.04	0.01	0.07	0.06	0.02	0.00	0.10	0.00	0.07
Total	96.64	95.02	95.84	95.47	95.73	94.97	95.44	95.33	95.23	95.20
Si	5.261	5.439	5.416	5.422	5.444	5.475	5.068	5.219	5.405	5.394
Ti	0.304	0.316	0.352	0.352	0.370	0.344	0.495	0.262	0.340	0.404
Al	2.793	2.790	2.904	2.857	2.747	2.810	2.965	2.489	2.770	2.883
Fe	2.130	2.248	2.075	1.827	2.014	2.212	1.911	1.150	2.155	2.157
Mn	0.041	0.029	0.038	0.030	0.080	0.031	0.047	0.029	0.014	0.055
Mg	2.799	3.073	3.049	3.298	3.340	2.930	2.811	4.089	3.012	2.862
Ca	0.023	0.050	0.000	0.000	0.038	0.025	0.051	0.006	0.016	0.024
Na	0.132	0.096	0.151	0.224	0.120	0.211	0.121	0.096	0.120	0.261
K	1.589	1.575	1.681	1.719	1.394	1.592	1.763	1.655	1.586	1.646
Sr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.058	0.061	0.026	0.024	0.007	0.044	0.104	0.000	0.052	0.010
Tot	15.131	15.676	15.693	15.752	15.553	15.672	15.337	14.996	15.470	15.697
F ⁻	0.744	0.000	0.000	0.000	0.000	0.000	0.560	1.129	0.252	0.000
Cl ⁻	0.024	0.009	0.002	0.017	0.016	0.005	0.000	0.025	0.000	0.017
OH ⁻	1.232	1.991	1.998	1.983	1.984	1.995	1.440	0.847	1.748	1.983
Mg	36.06	37.75	37.80	41.17	40.83	36.70	36.35	52.71	37.89	35.96
Al	35.98	34.27	36.00	35.66	33.58	35.20	38.33	32.09	34.84	36.23
Fe	27.96	27.97	26.20	23.17	25.59	28.10	25.31	15.21	27.28	27.81
Mg#	0.57	0.58	0.59	0.64	0.62	0.57	0.60	0.78	0.58	0.57

Supplementary table 6 - Elements concentration (in wt. %) of mica in studied rocks. Structural formula calculation based on 22 oxygens, values in apfu. $Mg = Mg * 100 / (Al + Fe + Mn + Mg)$, $Al = Al * 100 / (Al + Fe + Mn + Mg)$, $Fe = (Fe + Mn) * 100 / (Al + Fe + Mn + Mg)$. $Mg\# = Mg / (Mg + Fe)$. Abbreviation from Whitney and Evans (2010).

District	Siliqua	Siliqua	Monte Nureci (Arcuentu)		Monte Nureci (Arcuentu)	Monte Nureci (Arcuentu)	
Sample	MTR4	MTR1	MNU2	MNU2	MNU3	MNU1	MNU1
Lithology	Andesite	Dacite	olivine	gabbro	olivine	gabbro	gabbro
Description	mica	mica	mica in cpx	mica in cpx	mica in pl	mica	mica
SiO ₂	36.74	35.73	36.38	37.28	37.41	39.19	36.73
TiO ₂	3.12	2.95	6.67	6.44	7.39	2.40	0.50
Al ₂ O ₃	15.91	15.64	14.72	14.91	13.64	13.25	13.43
FeO	13.16	15.79	11.95	10.93	10.30	15.47	14.66
MnO	0.07	0.11	0.15	0.00	0.47	0.06	0.00
MgO	16.22	14.22	15.93	16.35	16.36	15.89	16.73
CaO	0.16	0.17	0.00	0.00	0.08	0.33	0.14
Na ₂ O	0.32	0.52	0.22	0.38	0.28	0.01	0.06
K ₂ O	9.09	8.66	9.73	9.42	9.46	8.69	9.71
SrO	0.24	0.14	0.00	0.00			
BaO	0.89	0.90	0.00	0.04	0.53	0.00	0.55
F	0.88	0.94	0.00	0.00	0.00	0.95	1.46
Cl	0.11	0.09	0.14	0.19	0.28	0.45	0.47
Total	96.91	95.84	95.89	95.95	96.21	96.70	94.44
Si	5.343	5.319	5.359	5.437	5.467	5.681	5.489
Ti	0.341	0.330	0.739	0.706	0.812	0.261	0.057
Al	2.727	2.744	2.557	2.563	2.349	2.263	2.366
Fe	1.600	1.965	1.472	1.333	1.259	1.876	1.832
Mn	0.009	0.013	0.019	0.000	0.058	0.007	0.000
Mg	3.517	3.156	3.499	3.555	3.565	3.434	3.729
Ca	0.025	0.027	0.000	0.000	0.012	0.051	0.022
Na	0.090	0.149	0.062	0.107	0.081	0.004	0.016
K	1.686	1.644	1.828	1.754	1.764	1.607	1.852
Sr	0.020	0.012	0.000	0.000	0.000	0.000	0.000
Ba	0.051	0.053	0.000	0.003	0.030	0.000	0.032
Tot	15.409	15.411	15.534	15.458	15.398	15.184	15.394
F ⁻	0.405	0.441	0.000	0.000	0.000	0.437	0.692
Cl ⁻	0.027	0.024	0.035	0.047	0.069	0.111	0.119
OH ⁻	1.568	1.535	1.965	1.953	1.931	1.452	1.189
Mg	44.78	40.06	46.36	47.71	49.30	45.30	47.04
Al	34.73	34.83	33.88	34.40	32.49	29.86	29.85
Fe	20.49	25.11	19.76	17.89	18.21	24.84	23.11
Mg#	0.69	0.62	0.70	0.73	0.74	0.65	0.67

Supplementary table 6 - Continued.

District	Monastir										
Sample	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1	CMO1
Lithology	Monzodiorite										
Description	mica	mica	mica	mica	mica	mica	mica	mica	mica	mica	mica
SiO ₂	34.80	35.68	35.87	35.51	35.94	34.32	37.60	36.55	35.82	36.54	36.84
TiO ₂	4.21	4.77	4.91	5.72	4.77	3.74	3.07	3.68	4.39	3.54	3.80
Al ₂ O ₃	16.40	16.04	16.30	15.47	16.09	15.23	16.72	17.18	16.63	16.39	16.43
FeO	14.20	15.68	14.22	15.52	13.88	18.06	14.51	14.27	14.90	15.92	14.80
MnO	0.00	0.31	0.00	0.00	0.00	0.00	0.16	0.00	0.25	0.24	0.00
MgO	15.95	14.31	13.27	13.01	13.71	14.36	13.27	13.94	13.28	14.43	14.93
CaO	0.00	0.07	0.33	0.00	0.08	0.20	0.11	0.13	0.10	0.21	0.11
Na ₂ O	0.61	0.40	0.45	0.38	0.63	0.44	0.50	0.67	0.43	0.29	0.32
K ₂ O	9.12	9.10	9.28	9.36	9.25	8.77	9.46	9.16	9.39	8.96	9.11
BaO	0.00	0.07	0.07	0.00	0.00	0.33	0.38	0.50	1.04	1.10	0.87
F	2.55	2.93	1.69	0.00	1.95	1.81	2.51	0.83	2.25	2.74	1.49
Cl	0.13	0.05	0.11	0.06	0.18	0.01	0.14	0.00	0.35	0.18	0.01
Total	97.97	99.39	96.51	95.02	96.46	97.26	98.43	96.92	98.83	100.54	98.71
Si	5.208	5.308	5.392	5.362	5.410	5.241	5.581	5.413	5.360	5.393	5.416
Ti	0.474	0.534	0.555	0.649	0.540	0.430	0.342	0.410	0.494	0.393	0.420
Al	2.893	2.813	2.888	2.754	2.856	2.741	2.926	2.999	2.932	2.852	2.846
Fe	1.777	1.950	1.788	1.960	1.747	2.307	1.801	1.767	1.865	1.964	1.820
Mn	0.000	0.038	0.000	0.000	0.000	0.000	0.021	0.000	0.032	0.029	0.000
Mg	3.559	3.174	2.975	2.930	3.077	3.269	2.936	3.079	2.963	3.175	3.272
Ca	0.000	0.011	0.053	0.000	0.013	0.033	0.017	0.021	0.015	0.033	0.018
Na	0.178	0.114	0.131	0.112	0.183	0.129	0.145	0.191	0.124	0.084	0.091
K	1.742	1.726	1.779	1.803	1.776	1.709	1.792	1.730	1.792	1.687	1.708
Ba	0.000	0.004	0.004	0.000	0.000	0.020	0.022	0.029	0.061	0.064	0.050
Tot	15.831	15.673	15.564	15.569	15.602	15.878	15.582	15.639	15.638	15.674	15.641
F ⁻	1.205	1.380	0.804	0.000	0.928	0.873	1.178	0.390	1.066	1.279	0.695
Cl ⁻	0.033	0.012	0.029	0.016	0.045	0.004	0.034	0.000	0.089	0.046	0.003
OH ⁻	0.762	0.608	1.167	1.984	1.027	1.123	0.787	1.610	0.845	0.675	1.302
Mg	43.25	39.80	38.88	38.33	40.07	39.31	38.22	39.24	38.03	39.59	41.22
Al	35.15	35.26	37.75	36.03	37.18	32.96	38.08	38.23	37.63	35.55	35.85
Fe	21.60	24.94	23.37	25.64	22.75	27.74	23.71	22.52	24.34	24.86	22.92
Mg#	0.67	0.62	0.62	0.60	0.64	0.59	0.62	0.64	0.61	0.62	0.64

Supplementary table 6 - Continued.

Chemical composition of opaque oxides

District Sample Lithology Description	Cixerri						Cixerri				
	SAR18	SAR18	SAR18	SAR18	SAR18	SAR1	SAR1	SAR1	SAR1	SAR1	SAR1
	Basaltic Andesite						Basaltic Andesite				
	mag	mag	mag	mag	mag	mag	mag	mag	mag	mag	mag
SiO ₂	0.50	0.19	0.14	0.19	0.39	0.00	0.45	0.18	0.21	0.35	0.26
TiO ₂	5.85	5.91	4.91	5.45	6.08	3.92	3.67	3.07	2.77	2.88	1.20
Al ₂ O ₃	1.33	3.34	4.04	3.18	0.83	2.21	2.18	1.07	1.72	2.66	0.27
FeO _t	80.97	78.03	78.82	78.67	82.34	86.48	86.37	89.17	88.05	87.82	91.47
MnO	1.31	1.62	0.73	1.74	1.47	0.32	0.41	0.19	0.51	0.85	0.29
MgO	0.00	0.28	0.79	0.59	0.22	1.73	0.75	0.48	0.42	0.72	0.26
CaO	0.05	0.00	0.00	0.12	0.21	0.00	0.05	0.00	0.00	0.00	0.00
Cr ₂ O ₃	0.31	0.35	0.11	0.00	0.30	0.00	0.17	0.25	0.05	0.00	0.11
ZnO	0.00	0.06	0.31	0.13	0.00	0.93	0.32	0.13	0.00	0.25	0.18
V ₂ O ₃	0.47	0.36	0.74	0.21	0.23	0.52	0.44	0.67	0.81	0.73	0.45
NiO											
Nb ₂ O ₅	0.04	0.13	0.00	0.00	0.00	0.00	0.09	0.06	0.16	0.09	0.32
Total	90.84	90.28	90.59	90.26	92.06	96.12	94.88	95.27	94.70	96.34	94.82
Fe ₂ O ₃	51.36	49.24	50.98	51.23	53.19	60.65	58.50	61.64	60.90	60.73	66.04
FeO	34.75	33.73	32.95	32.57	34.48	31.92	33.73	33.71	33.25	33.18	32.05
Tot	95.98	95.30	95.91	95.44	97.46	102.19	100.75	101.45	100.80	102.42	101.43
Ulvöspinel	0.12	0.12	0.10	0.11	0.12	0.07	0.07	0.06	0.05	0.05	0.02
Ilmenite											
Si	0.020	0.007	0.006	0.007	0.015	0.000	0.017	0.007	0.008	0.013	0.010
Ti	0.174	0.175	0.143	0.161	0.178	0.108	0.103	0.086	0.078	0.079	0.034
Al	0.062	0.155	0.185	0.147	0.038	0.095	0.096	0.047	0.076	0.115	0.012
Fe ³⁺	1.526	1.456	1.489	1.510	1.559	1.673	1.645	1.738	1.723	1.678	1.879
Fe ²⁺	1.147	1.109	1.069	1.067	1.123	0.978	1.054	1.056	1.045	1.019	1.013
Mn	0.044	0.054	0.024	0.058	0.048	0.010	0.013	0.006	0.016	0.026	0.009
Mg	0.000	0.017	0.046	0.034	0.013	0.095	0.042	0.027	0.024	0.040	0.015
Ca	0.002	0.000	0.000	0.005	0.009	0.000	0.002	0.000	0.000	0.000	0.000
Cr	0.010	0.011	0.004	0.000	0.009	0.000	0.005	0.007	0.001	0.000	0.003
Zn	0.000	0.002	0.009	0.004	0.000	0.025	0.009	0.004	0.000	0.007	0.005
V	0.015	0.011	0.023	0.006	0.007	0.015	0.013	0.020	0.025	0.021	0.014
Zr	0.000	0.002	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Ni											
Nb	0.001	0.002	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.002	0.005
Tot	3.000	3.000	3.001	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.999
Rutile	6.01	6.22	5.17	5.68	6.10	3.78	3.61	2.97	2.71	2.80	1.16
Hematite	52.78	51.82	53.73	53.37	53.36	58.41	57.58	59.65	59.69	59.04	63.68
Wüstite	41.21	41.96	41.10	40.96	40.54	37.81	38.81	37.38	37.59	38.17	35.16

Supplementary table 7a - Elements concentration (in wt. %) of magnetite and ilmenite in studied rocks. Structural formula calculation based on 3 and 2 cations, respectively, values in apfu. Rutile= $100 \cdot \text{Ti} / (\text{Ti} + \text{Fe}^{3+} + \text{Fe}^{2+} + \text{Mn} + \text{Mg})$, Hematite= $100 \cdot \text{Fe}^{3+} / (\text{Ti} + \text{Fe}^{3+} + \text{Fe}^{2+} + \text{Mn} + \text{Mg})$, Wüstite= $100 \cdot (\text{Fe}^{2+} + \text{Mn} + \text{Mg}) / (\text{Ti} + \text{Fe}^{3+} + \text{Fe}^{2+} + \text{Mn} + \text{Mg})$. Abbreviation from Whitney and Evans (2010), gm=groundmass.

District	Cixerri					Cixerri						
Sample	SAR1	SAR1	SAR1	SAR1	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3	SAR3
Lithology		Basaltic	Andesite					Basaltic	Andesite			
Description	mag	ilm	ilm	ilm	mag	mag	mag	mag	mag	ilm	ilm	
SiO ₂	0.37	0.91	0.74	2.50	0.23	0.40	1.51	0.38	0.00	1.26	0.39	
TiO ₂	3.99	47.63	48.44	47.62	1.66	2.23	4.38	7.46	3.11	47.71	47.03	
Al ₂ O ₃	1.50	0.65	0.21	0.80	0.61	0.86	1.08	0.88	1.32	0.62	0.42	
FeO _t	87.85	44.21	43.74	43.47	86.91	87.17	81.70	81.65	85.33	40.01	40.57	
MnO	0.82	4.46	4.17	4.77	0.56	0.22	1.07	0.66	0.47	5.95	6.18	
MgO	0.41	0.14	0.18	0.24	0.16	0.00	0.13	0.22	0.28	0.17	0.16	
CaO	0.05	0.32	0.00	0.13	0.00	0.26	0.32	0.29	0.27	0.33	0.37	
Cr ₂ O ₃	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.20	0.00	0.31	0.00	
ZnO	0.72	0.13	0.00	0.00	0.57	0.33	0.18	0.64	0.00	0.35	0.00	
V ₂ O ₃	0.57	0.40	0.26	0.63	0.59	0.52	0.67	0.16	0.32	0.00	0.73	
NiO												
Nb ₂ O ₅	0.08	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.31	
Total	96.36	99.02	98.02	100.17	91.29	91.99	91.05	92.56	91.25	96.72	96.14	
Fe ₂ O ₃	59.78	6.19	4.26	3.41	62.25	60.90	52.60	50.77	59.26	2.93	5.34	
FeO	34.05	38.64	39.91	40.40	30.90	32.37	34.37	35.97	32.01	37.38	35.76	
Tot	102.35	99.64	98.44	100.51	97.53	98.09	96.32	97.65	97.19	97.01	96.68	
Ulvöspinel	0.07				0.03	0.04	0.09	0.15	0.06			
Ilmenite		0.90	0.93	0.89						0.93	0.92	
Si	0.014	0.023	0.019	0.062	0.009	0.016	0.059	0.015	0.000	0.033	0.010	
Ti	0.111	0.904	0.932	0.888	0.049	0.065	0.129	0.218	0.092	0.926	0.921	
Al	0.065	0.019	0.006	0.023	0.028	0.039	0.050	0.040	0.061	0.019	0.013	
Fe ³⁺	1.666	0.118	0.082	0.064	1.837	1.783	1.552	1.483	1.744	0.057	0.105	
Fe ²⁺	1.055	0.815	0.853	0.838	1.014	1.053	1.127	1.168	1.047	0.807	0.779	
Mn	0.026	0.095	0.090	0.100	0.019	0.007	0.036	0.022	0.016	0.130	0.136	
Mg	0.023	0.005	0.007	0.009	0.009	0.000	0.008	0.013	0.017	0.007	0.006	
Ca	0.002	0.009	0.000	0.004	0.000	0.011	0.013	0.012	0.011	0.009	0.010	
Cr	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.006	0.000	0.006	0.000	
Zn	0.020	0.002	0.000	0.000	0.017	0.009	0.005	0.018	0.000	0.007	0.000	
V	0.017	0.008	0.005	0.013	0.018	0.016	0.021	0.005	0.010	0.000	0.015	
Zr	0.000				0.000	0.000	0.000	0.000	0.000			
Ni		0.000	0.000	0.000						0.000	0.000	
Nb	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	
Tot	3.000	2.000	2.000	2.000	3.000	3.000	3.000	3.000	3.000	2.000	2.000	
Rutile	3.86	46.66	47.44	46.78	1.68	2.24	4.53	7.50	3.14	48.09	47.32	
Hematite	57.85	6.07	4.17	3.35	62.75	61.29	54.43	51.08	59.84	2.95	5.37	
Wüstite	38.29	47.27	48.40	49.86	35.57	36.46	41.04	41.41	37.02	48.96	47.31	

Supplementary table 7a - Continued.

District	Cixerri						Cixerri			
Sample	SAR6	SAR6	SAR6	SAR6	SAR6	SAR6	SAR5	SAR5	SAR5	SAR5
Lithology			Basaltic	Andesite				Andesite		
Description	mag	mag	mag	mag	ilm	ilm	mag	mag	mag	mag
SiO ₂	0.81	0.46	1.52	0.46	0.25	0.60	0.00	0.02	0.37	0.17
TiO ₂	3.37	0.38	1.23	1.65	45.24	44.86	2.98	0.71	0.85	3.29
Al ₂ O ₃	1.02	0.50	1.36	0.66	0.00	0.27	1.69	0.43	0.62	1.15
FeO _t	84.82	88.12	85.72	86.08	44.05	42.59	87.26	88.61	87.61	86.84
MnO	0.30	0.00	0.18	0.21	7.63	7.61	0.20	0.17	0.00	0.42
MgO	0.00	0.00	0.12	0.39	0.26	0.11	0.27	0.18	0.12	1.37
CaO	0.20	0.06	0.41	0.19	0.48	0.65	0.00	0.06	0.21	0.10
Cr ₂ O ₃	0.00	0.42	0.35	0.15	0.00	0.00	0.00	0.16	0.25	0.00
ZnO	0.00	0.13	0.37	0.37	0.19	0.06	0.00	0.45	0.00	0.00
V ₂ O ₃	0.48	1.04	0.80	0.87	0.74	0.28	0.59	0.47	0.80	0.48
NiO										
Nb ₂ O ₅	0.00	0.29	0.17	0.21	0.00	0.27	0.46	0.00	0.00	0.09
Total	91.02	91.40	92.23	91.25	98.86	97.31	93.45	91.25	90.83	93.92
Fe ₂ O ₃	56.62	63.32	59.01	61.15	13.37	11.47	60.09	64.94	62.79	61.10
FeO	33.88	31.14	32.63	31.06	32.02	32.27	33.19	30.17	31.11	31.86
Tot	96.69	97.74	98.14	97.38	100.20	98.46	99.47	97.76	97.12	100.04
Ulvöspinel	0.07	0.01	0.02	0.03			0.06	0.01	0.02	0.06
Ilmenite					0.86	0.87				
Si	0.032	0.018	0.058	0.018	0.006	0.015	0.000	0.001	0.014	0.007
Ti	0.100	0.011	0.036	0.049	0.859	0.865	0.086	0.021	0.025	0.093
Al	0.047	0.023	0.062	0.031	0.000	0.008	0.076	0.020	0.029	0.051
Fe ³⁺	1.674	1.869	1.713	1.801	0.254	0.221	1.728	1.917	1.859	1.733
Fe ²⁺	1.113	1.021	1.052	1.017	0.676	0.692	1.061	0.990	1.024	1.005
Mn	0.010	0.000	0.006	0.007	0.163	0.165	0.006	0.006	0.000	0.013
Mg	0.000	0.000	0.007	0.023	0.010	0.004	0.016	0.011	0.007	0.077
Ca	0.008	0.002	0.017	0.008	0.013	0.018	0.000	0.003	0.009	0.004
Cr	0.000	0.013	0.011	0.005	0.000	0.000	0.000	0.005	0.008	0.000
Zn	0.000	0.004	0.011	0.011	0.004	0.001	0.000	0.013	0.000	0.000
V	0.015	0.033	0.025	0.027	0.015	0.006	0.018	0.015	0.025	0.015
Zr	0.000	0.000	0.000	0.000			0.000	0.000	0.000	0.000
Ni					0.000	0.000				
Nb	0.000	0.005	0.003	0.004	0.000	0.004	0.008	0.000	0.000	0.001
Tot	3.000	2.999	3.000	3.000	2.000	2.000	2.999	3.000	3.000	3.000
Rutile	3.44	0.39	1.26	1.68	43.79	44.42	2.96	0.71	0.86	3.20
Hematite	57.79	64.41	60.87	62.19	12.94	11.36	59.66	65.12	63.78	59.32
Wüstite	38.77	35.20	37.86	36.13	43.26	44.22	37.38	34.17	35.36	37.49

Supplementary table 7a - Continued.

District	Cixerri					Cixerri					Cixerri	
Sample	SAR5	SAR5	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR17	SAR21	SAR21
Lithology	Andesite					Andesite					Andesite	
Description	mag	ilm	mag	mag	mag	mag	mag	mag	mag	mag	ilm	mag in amp
SiO ₂	0.07	0.23	0.12	0.53	0.16	0.24	0.05	0.36	0.24	0.24	0.24	0.39
TiO ₂	4.90	47.30	6.50	6.41	6.63	6.23	7.07	6.72	7.12	45.04	45.04	2.78
Al ₂ O ₃	1.30	0.04	1.96	1.21	1.22	3.08	1.45	1.43	0.95	0.35	0.35	3.75
FeO _t	83.51	43.65	80.03	81.11	82.74	79.19	79.21	80.45	81.38	46.49	46.49	81.25
MnO	0.91	7.08	1.05	1.27	0.87	0.71	1.43	0.79	0.73	5.60	5.60	0.60
MgO	0.05	0.27	0.86	0.51	0.51	0.55	0.47	0.43	0.08	0.32	0.32	0.50
CaO	0.06	0.07	0.00	0.00	0.24	0.04	0.00	0.41	0.10	0.09	0.09	0.13
Cr ₂ O ₃	0.05	0.09	0.00	0.24	0.14	0.38	0.11	0.29	0.00	0.00	0.00	0.08
ZnO	0.27	0.00	0.00	0.00	0.00	0.00	0.04	0.43	0.00	0.00	0.00	0.06
V ₂ O ₃	0.97	0.00	0.45	0.46	0.32	0.16	0.35	0.60	0.45	0.41	0.41	0.62
NiO											0.31	
Nb ₂ O ₅	0.38	0.09	0.29	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	92.47	98.83	91.25	91.72	92.96	90.58	90.18	91.90	91.04	98.85	98.85	90.17
Fe ₂ O ₃	55.16	9.51	51.17	51.36	52.92	49.43	49.96	50.78	50.46	13.40	13.40	54.89
FeO	33.88	35.09	33.99	34.89	35.12	34.71	34.26	34.76	35.98	34.43	34.43	31.87
Tot	98.00	99.78	96.38	96.87	98.26	95.53	95.70	96.99	96.10	100.19	100.19	96.34
Ulvöspinel	0.10		0.13	0.13	0.13	0.12	0.14	0.13	0.14			0.05
Ilmenite		0.90								0.86		
Si	0.003	0.006	0.005	0.020	0.006	0.009	0.002	0.014	0.009	0.006	0.006	0.015
Ti	0.143	0.901	0.191	0.188	0.192	0.183	0.210	0.197	0.212	0.855	0.855	0.081
Al	0.059	0.001	0.090	0.055	0.056	0.142	0.068	0.065	0.044	0.010	0.010	0.172
Fe ³⁺	1.612	0.181	1.502	1.506	1.532	1.455	1.488	1.486	1.500	0.255	0.255	1.607
Fe ²⁺	1.100	0.743	1.108	1.137	1.130	1.136	1.134	1.130	1.188	0.727	0.727	1.037
Mn	0.030	0.152	0.035	0.042	0.028	0.023	0.048	0.026	0.024	0.120	0.120	0.020
Mg	0.003	0.010	0.050	0.029	0.029	0.032	0.027	0.025	0.004	0.012	0.012	0.029
Ca	0.002	0.002	0.000	0.000	0.010	0.001	0.000	0.017	0.004	0.003	0.003	0.005
Cr	0.001	0.002	0.000	0.007	0.004	0.012	0.004	0.009	0.000	0.000	0.000	0.003
Zn	0.008	0.000	0.000	0.000	0.000	0.000	0.001	0.012	0.000	0.000	0.000	0.002
V	0.030	0.000	0.014	0.014	0.010	0.005	0.011	0.019	0.014	0.008	0.008	0.019
Zr	0.000		0.000	0.000	0.000	0.000	0.010	0.000	0.000			0.013
Ni		0.000								0.006		
Nb	0.007	0.001	0.005	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tot	2.999	2.000	2.999	3.000	3.000	3.000	3.002	3.000	3.000	2.002	2.002	3.003
Rutile	4.96	45.34	6.60	6.47	6.59	6.48	7.24	6.86	7.23	43.45	43.45	2.93
Hematite	55.81	9.11	52.04	51.90	52.63	51.42	51.17	51.88	51.21	12.93	12.93	57.93
Wüstite	39.23	45.55	41.36	41.63	40.78	42.09	41.59	41.26	41.56	43.62	43.62	39.14

Supplementary table 7a - Continued.

District	Cixerri					Cixerri					Cixerri	
Sample	SAR21	SAR21	SAR21	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR11	SAR12	SAR12
Lithology		Andesite				Andesite					Andesite	
Description	mag	mag	mag	mag	mag	mag	mag	mag	mag	mag	mag	mag
SiO ₂	0.91	0.34	0.28	0.42	0.35	0.47	0.09	0.39	0.03	0.56	0.35	
TiO ₂	12.07	2.29	1.79	6.28	5.02	9.14	5.57	6.56	6.37	6.91	10.75	
Al ₂ O ₃	2.29	3.69	3.56	2.70	3.25	2.44	3.06	2.92	3.18	3.44	2.84	
FeO _t	73.62	83.42	81.82	79.43	79.14	77.44	79.01	80.29	79.63	76.74	74.88	
MnO	2.07	0.78	0.68	0.61	0.43	0.88	0.92	1.01	0.49	2.21	0.78	
MgO	0.22	0.88	0.22	1.14	0.87	0.14	1.28	1.21	1.20	0.57	0.14	
CaO	0.46	0.00	0.22	0.00	0.26	0.31	0.00	0.00	0.05	0.01	0.00	
Cr ₂ O ₃	0.05	0.00	0.51	0.18	0.10	0.00	0.00	0.13	0.18	0.00	0.10	
ZnO	0.20	0.00	0.61	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.43	
V ₂ O ₃	0.37	0.40	0.95	0.08	0.80	0.43	0.49	0.24	0.36	0.55	0.54	
NiO												
Nb ₂ O ₅	0.39	0.83	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.63	
Total	92.66	92.63	90.64	90.86	90.22	91.25	90.89	92.75	91.49	90.98	91.43	
Fe ₂ O ₃	37.93	57.84	56.77	50.21	51.04	44.07	51.62	50.75	50.61	47.10	39.89	
FeO	39.49	31.37	30.73	34.25	33.21	37.78	32.57	34.62	34.10	34.36	38.99	
Tot	96.46	98.64	96.33	95.89	95.64	95.67	96.51	97.90	96.81	95.70	95.62	
Ulvöspinel	0.23	0.04	0.03	0.12	0.10	0.18	0.11	0.13	0.12	0.13	0.21	
Ilmenite												
Si	0.035	0.013	0.011	0.016	0.014	0.018	0.003	0.015	0.001	0.022	0.014	
Ti	0.351	0.065	0.052	0.183	0.147	0.269	0.162	0.188	0.185	0.202	0.317	
Al	0.104	0.165	0.163	0.124	0.150	0.112	0.139	0.131	0.144	0.158	0.131	
Fe ³⁺	1.104	1.653	1.664	1.468	1.498	1.299	1.504	1.452	1.466	1.378	1.177	
Fe ²⁺	1.278	0.997	1.001	1.113	1.083	1.237	1.055	1.101	1.098	1.117	1.279	
Mn	0.068	0.025	0.022	0.020	0.014	0.029	0.030	0.033	0.016	0.073	0.026	
Mg	0.013	0.050	0.013	0.066	0.051	0.008	0.074	0.068	0.069	0.033	0.008	
Ca	0.019	0.000	0.009	0.000	0.011	0.013	0.000	0.000	0.002	0.001	0.000	
Cr	0.001	0.000	0.016	0.006	0.003	0.000	0.000	0.004	0.006	0.000	0.003	
Zn	0.006	0.000	0.017	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.013	
V	0.012	0.012	0.030	0.003	0.025	0.013	0.015	0.007	0.011	0.017	0.017	
Zr	0.000	0.004	0.000	0.000	0.006	0.000	0.008	0.001	0.005	0.000	0.004	
Ni												
Nb	0.007	0.014	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.011	
Tot	2.999	2.999	3.000	3.000	3.001	3.000	3.001	3.000	3.001	3.000	3.000	
Rutile	12.48	2.34	1.91	6.43	5.27	9.47	5.75	6.61	6.51	7.21	11.29	
Hematite	39.24	59.25	60.44	51.49	53.63	45.69	53.24	51.10	51.75	49.16	41.93	
Wüstite	48.28	38.41	37.65	42.07	41.10	44.84	41.01	42.29	41.74	43.63	46.77	

Supplementary table 7a - Continued.

District	Cixerri						Siliqua			
Sample	SAR12	SAR12	SAR12	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1	SIL1
Lithology	Andesite						Andesite			
Description	mag	mag	mag	mag	mag	mag	mag	mag	ilm	ilm
SiO ₂	0.18	0.64	0.43	0.65	0.75	0.69	1.02	0.20	0.14	0.09
TiO ₂	11.02	9.52	11.33	4.83	7.01	6.23	5.75	7.62	42.20	41.99
Al ₂ O ₃	2.62	2.65	2.66	1.24	1.30	1.45	1.61	2.09	0.17	0.37
FeO _t	75.77	77.14	75.04	83.12	80.02	80.31	81.02	78.74	47.78	47.75
MnO	1.44	0.51	1.28	0.57	0.53	1.06	1.16	0.94	1.72	2.03
MgO	0.00	0.00	0.00	0.16	0.00	0.38	0.50	0.10	1.16	0.81
CaO	0.11	0.17	0.12	0.44	0.32	0.28	0.29	0.27	0.18	0.00
Cr ₂ O ₃	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
V ₂ O ₃	0.41	0.00	0.25	0.54	0.49	0.76	0.12	0.86	0.78	0.62
NiO									0.68	0.00
Nb ₂ O ₅	0.00	0.00	0.04	0.00	0.30	0.00	0.00	0.08	0.00	0.40
Total	91.55	90.72	91.16	91.55	90.72	91.16	91.59	91.09	94.82	94.05
Fe ₂ O ₃	40.81	42.45	39.33	54.22	48.46	50.50	51.56	47.47	15.21	14.85
FeO	39.05	38.94	39.65	34.33	36.42	34.86	34.63	36.03	34.09	34.39
Tot	95.64	94.98	95.10	96.98	95.58	96.22	96.76	95.85	96.34	95.54
Ulvöspinel	0.22	0.19	0.22	0.09	0.14	0.12	0.11	0.15		
Ilmenite									0.83	0.83
Si	0.007	0.025	0.017	0.025	0.030	0.027	0.040	0.008	0.004	0.002
Ti	0.325	0.282	0.335	0.142	0.209	0.184	0.168	0.225	0.831	0.835
Al	0.121	0.123	0.123	0.057	0.061	0.067	0.074	0.097	0.005	0.011
Fe ³⁺	1.203	1.259	1.164	1.592	1.443	1.488	1.507	1.403	0.300	0.295
Fe ²⁺	1.279	1.283	1.304	1.120	1.205	1.142	1.125	1.184	0.746	0.760
Mn	0.048	0.017	0.043	0.019	0.018	0.035	0.038	0.031	0.038	0.045
Mg	0.000	0.000	0.000	0.010	0.000	0.022	0.029	0.006	0.045	0.032
Ca	0.005	0.007	0.005	0.018	0.013	0.012	0.012	0.012	0.005	0.000
Cr	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
V	0.013	0.000	0.008	0.017	0.016	0.024	0.004	0.027	0.016	0.013
Zr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Ni									0.014	0.000
Nb	0.000	0.000	0.001	0.000	0.005	0.000	0.000	0.001	0.000	0.005
Tot	3.000	3.000	3.000	3.000	2.999	3.000	3.000	3.000	2.005	2.000
Rutile	11.37	9.94	11.78	4.92	7.26	6.40	5.86	7.91	42.39	42.43
Hematite	42.14	44.30	40.90	55.23	50.19	51.84	52.56	49.25	15.29	15.02
Wüstite	46.49	45.76	47.32	39.85	42.55	41.77	41.57	42.85	42.32	42.55

Supplementary table 7a - Continued.

District	Siliqua									
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2
Lithology	Andesite									
Description	mag	ilm	mag	mag	mag	mag	mag	mag	mag	mag
SiO ₂	1.08	0.20	0.68	0.16	0.78	0.66	0.27	0.64	1.03	0.64
TiO ₂	1.29	37.53	0.56	1.37	0.75	0.55	0.99	1.16	1.85	2.01
Al ₂ O ₃	1.34	0.28	0.85	1.28	0.69	0.74	1.27	1.35	1.41	2.05
FeO _t	85.20	52.46	85.93	85.06	87.04	86.60	86.97	85.34	85.18	84.68
MnO	0.40	1.07	0.87	0.72	0.74	0.85	0.46	1.05	0.44	0.35
MgO	0.56	1.66	0.99	0.85	0.81	0.84	0.58	1.10	0.53	0.54
CaO	0.20	0.03	0.11	0.10	0.12	0.11	0.02	0.07	0.13	0.00
Cr ₂ O ₃	0.02	0.08	0.07	0.06	0.05	0.11	0.19	0.21	0.00	0.20
ZnO	0.25	0.15	0.62	0.17	0.00	0.33	0.08	0.00	0.07	0.21
V ₂ O ₃	0.60	0.20	0.75	0.74	0.50	0.35	0.29	0.58	0.52	0.96
NiO		0.03								
Nb ₂ O ₅	0.19	0.12	0.00	0.03	0.10	0.13	0.05	0.07	0.27	0.00
Total	91.14	93.81	91.44	90.55	91.58	91.28	91.17	91.58	91.42	91.63
Fe ₂ O ₃	59.96	25.20	63.45	61.83	63.29	63.79	62.98	61.87	59.10	58.55
FeO	31.24	29.79	28.84	29.42	30.09	29.20	30.30	29.67	32.00	31.99
Tot	97.15	96.35	97.80	96.74	97.92	97.67	97.48	97.78	97.34	97.50
Ulvöspinel	0.03		0.01	0.03	0.01	0.01	0.02	0.02	0.04	0.04
Ilmenite		0.74								
Si	0.042	0.005	0.026	0.006	0.030	0.026	0.011	0.025	0.040	0.025
Ti	0.038	0.739	0.016	0.040	0.022	0.016	0.029	0.034	0.054	0.058
Al	0.061	0.009	0.039	0.059	0.031	0.034	0.059	0.061	0.064	0.093
Fe ³⁺	1.757	0.496	1.850	1.822	1.846	1.867	1.847	1.796	1.728	1.704
Fe ²⁺	1.017	0.652	0.935	0.964	0.975	0.950	0.987	0.957	1.040	1.035
Mn	0.013	0.024	0.029	0.024	0.024	0.028	0.015	0.034	0.015	0.011
Mg	0.033	0.065	0.057	0.050	0.047	0.049	0.034	0.063	0.031	0.031
Ca	0.009	0.001	0.005	0.004	0.005	0.005	0.001	0.003	0.005	0.000
Cr	0.001	0.002	0.002	0.002	0.002	0.003	0.006	0.007	0.000	0.006
Zn	0.007	0.003	0.018	0.005	0.000	0.010	0.002	0.000	0.002	0.006
V	0.019	0.004	0.023	0.023	0.015	0.011	0.009	0.018	0.016	0.030
Zr	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni		0.001								
Nb	0.003	0.001	0.000	0.001	0.002	0.002	0.001	0.001	0.005	0.000
Tot	3.000	2.000	3.000	3.000	3.000	3.000	3.000	3.000	2.999	3.000
Rutile	1.33	37.40	0.56	1.39	0.75	0.55	0.99	1.17	1.88	2.06
Hematite	61.48	25.12	64.09	62.84	63.33	64.17	63.42	62.26	60.27	60.01
Wüstite	37.20	37.48	35.34	35.77	35.91	35.28	35.59	36.57	37.85	37.93

Supplementary table 7a - Continued.

District	Siliqua								Siliqua	Siliqua	
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR4	MTR4	MTR4	ACQ1
Lithology				Andesite					Andesite		Dacite
Description	mag	mag	mag	mag in mica	ilm	ilm	ilm	mag	mag	mag	mag
SiO ₂	0.22	0.90	0.94	0.31	0.19	0.09	0.30	0.17	0.25	0.26	0.44
TiO ₂	13.31	1.48	1.15	3.50	36.77	35.95	37.09	2.25	22.88	1.01	5.18
Al ₂ O ₃	1.15	3.42	1.50	3.34	0.35	0.02	0.06	1.37	0.29	1.46	2.34
FeO _t	74.13	82.92	83.46	80.51	53.21	51.48	50.84	83.10	67.59	85.23	79.56
MnO	0.57	1.65	0.70	1.20	1.23	1.67	0.92	0.71	0.30	0.76	0.68
MgO	0.25	0.70	1.19	1.55	1.13	2.13	1.83	0.98	0.93	1.39	1.89
CaO	0.08	0.00	0.20	0.00	0.00	0.00	0.22	0.04	0.00	0.03	0.16
Cr ₂ O ₃	0.03	0.00	0.07	0.00	0.11	0.02	0.11	0.11	0.00	0.10	0.00
ZnO	0.00	0.00	1.67	0.51	0.00	0.02	0.00	0.29	0.10	0.54	0.26
V ₂ O ₃	0.52	0.24	0.69	0.10	0.48	0.61	0.98	0.56	0.36	0.58	0.23
NiO					0.49	0.00	0.20				
Nb ₂ O ₅	0.00	0.17	0.00	0.13	0.07	0.20	0.11	0.02	0.31	0.22	0.41
Total	90.27	91.47	91.57	91.17	94.02	92.18	92.68	89.60	93.01	91.57	91.15
Fe ₂ O ₃	36.84	58.16	60.96	55.94	25.75	27.26	24.00	59.18	20.31	63.11	53.10
FeO	40.98	30.58	28.61	30.18	30.04	26.94	29.25	29.85	49.31	28.44	31.78
Tot	93.97	97.30	97.68	96.77	96.11	94.91	94.88	95.28	95.07	97.89	96.21
Ulvöspinel	0.27	0.03	0.02	0.07				0.04	0.45	0.02	0.10
Ilmenite					0.73	0.72	0.74				
Si	0.009	0.034	0.036	0.012	0.005	0.002	0.008	0.007	0.010	0.010	0.017
Ti	0.401	0.043	0.033	0.101	0.728	0.717	0.740	0.067	0.675	0.029	0.151
Al	0.054	0.155	0.068	0.151	0.011	0.001	0.002	0.064	0.013	0.066	0.107
Fe ³⁺	1.109	1.681	1.769	1.617	0.510	0.544	0.479	1.766	0.600	1.831	1.545
Fe ²⁺	1.371	0.982	0.923	0.970	0.661	0.598	0.648	0.990	1.618	0.917	1.028
Mn	0.019	0.054	0.023	0.039	0.027	0.037	0.021	0.024	0.010	0.025	0.022
Mg	0.015	0.040	0.068	0.089	0.044	0.084	0.072	0.058	0.054	0.080	0.109
Ca	0.004	0.000	0.008	0.000	0.000	0.000	0.006	0.002	0.000	0.001	0.006
Cr	0.001	0.000	0.002	0.000	0.002	0.000	0.002	0.003	0.000	0.003	0.000
Zn	0.000	0.000	0.048	0.015	0.000	0.000	0.000	0.000	0.000	0.015	0.000
V	0.017	0.007	0.021	0.003	0.010	0.013	0.021	0.018	0.011	0.018	0.007
Zr	0.000	0.000	0.000	0.000				0.001	0.002	0.000	0.000
Ni					0.000	0.000	0.000				
Nb	0.000	0.003	0.000	0.002	0.001	0.002	0.001	0.000	0.005	0.004	0.007
Tot	3.000	3.000	3.000	3.000	2.000	2.000	2.000	3.000	3.000	3.000	2.999
Rutile	13.74	1.53	1.19	3.59	36.94	36.21	37.74	2.31	22.84	1.01	5.28
Hematite	38.04	60.05	62.82	57.43	25.87	27.47	24.42	60.80	20.28	63.54	54.13
Wüstite	48.21	38.43	35.99	38.98	37.19	36.32	37.83	36.89	56.89	35.44	40.59

Supplementary table 7a - Continued.

District	Monastir						Monastir		Capo Frasca	
Sample	CMO2	CMO2	CMO2	CMO2	CMO2	CMO2	CMO3	CMO3	MAL29	MAL29
Lithology			Andesite				Basaltic Andesite		Basaltic	Andesite
Description	mag	ilm	mag	mag	mag	mag gm	mag in cpx	mag gm	ilm	ilm
SiO ₂	0.08	0.14	0.43	0.00	0.30	0.05	0.51	0.31	0.41	0.56
TiO ₂	9.21	48.69	9.20	5.92	10.27	6.18	5.16	6.47	48.55	47.80
Al ₂ O ₃	1.22	1.27	1.32	1.96	1.95	3.71	4.12	1.34	0.20	0.19
FeO _t	78.65	37.48	76.67	80.83	76.93	79.96	78.48	80.59	48.08	46.97
MnO	0.21	0.18	0.94	0.85	0.10	0.08	0.31	0.51	0.64	1.07
MgO	1.29	3.61	2.49	0.89	0.79	1.14	0.38	0.00	2.14	2.03
CaO	0.10	0.16	0.04	0.00	0.00	0.00	0.50	0.12	0.18	0.14
Cr ₂ O ₃	0.00	0.00	0.00	0.16	0.00	0.00	0.88	0.03	0.15	0.09
ZnO	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.30		
V ₂ O ₃	0.60	0.00	0.05	0.79	0.88	0.21	0.64	1.37		
NiO		0.00								
Nb ₂ O ₅	0.25	0.11	0.00	0.00	0.14	0.23	0.34	0.20		
Total	91.61	91.64	91.16	91.63	91.38	91.57	91.32	91.23	100.35	98.86
Fe ₂ O ₃	46.95	0.38	47.11	52.58	42.56	50.47	48.89	50.02	9.57	9.09
FeO	36.40	37.14	34.28	33.51	38.64	34.55	34.48	35.58	39.47	38.79
Tot	96.31	91.68	95.88	96.90	95.64	96.63	96.22	96.24	101.31	99.77
Ulvöspinel	0.18		0.18	0.12	0.20	0.12	0.10	0.13		
Ilmenite		0.97							0.90	0.90
Si	0.003	0.004	0.017	0.000	0.012	0.002	0.020	0.012	0.010	0.014
Ti	0.270	0.972	0.267	0.173	0.302	0.179	0.150	0.192	0.897	0.897
Al	0.056	0.040	0.060	0.090	0.090	0.168	0.188	0.062	0.006	0.006
Fe ³⁺	1.376	0.008	1.370	1.535	1.252	1.461	1.422	1.483	0.177	0.171
Fe ²⁺	1.186	0.824	1.108	1.087	1.263	1.111	1.115	1.172	0.811	0.809
Mn	0.007	0.004	0.031	0.028	0.003	0.003	0.010	0.017	0.013	0.023
Mg	0.075	0.143	0.144	0.051	0.046	0.066	0.022	0.000	0.078	0.075
Ca	0.004	0.005	0.002	0.000	0.000	0.000	0.021	0.005	0.005	0.004
Cr	0.000	0.000	0.000	0.005	0.000	0.000	0.027	0.001	0.003	0.002
Zn	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.009	0.000	0.000
V	0.019	0.000	0.002	0.025	0.028	0.007	0.020	0.043	0.000	0.000
Zr	0.000		0.000	0.000	0.000	0.000	0.000	0.000		
Ni		0.000							0.000	0.000
Nb	0.004	0.001	0.000	0.000	0.002	0.004	0.006	0.004	0.000	0.000
Tot	2.999	2.000	3.000	3.000	3.000	2.999	2.999	3.000	2.000	2.000
Rutile	9.26	49.83	9.16	6.02	10.54	6.35	5.52	6.70	45.39	45.42
Hematite	47.23	0.39	46.91	53.41	43.67	51.81	52.31	51.78	8.95	8.64
Wüstite	43.50	49.78	43.93	40.58	45.79	41.84	42.18	41.52	45.66	45.94

Supplementary table 7a - Continued.

District	Monte Nureci (Arcuentu)					Monte Nureci (Arcuentu)					
Sample	MNU2	MNU2	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1	MNU1
Lithology	Olivine Gabbronorite					Gabbronorite					
Description	ilm in cpx	ilm in cpx	ilm	ilm	ilm	ilm	ilm	mgt	ilm	ilm	ilm
SiO ₂	0.25	0.37	0.17	0.27	0.00	0.29	0.22	0.42	0.13	0.23	0.21
TiO ₂	50.04	48.52	43.62	45.01	48.87	45.14	42.44	1.47	47.32	47.49	44.90
Al ₂ O ₃	0.16	0.00	0.01	0.35	0.35	0.16	0.06	1.42	0.42	0.24	0.09
FeO _i	41.66	41.92	48.73	48.54	45.92	47.47	49.39	84.75	45.61	45.31	48.97
MnO	2.23	1.07	0.46	0.68	0.53	0.78	0.20	0.41	1.27	0.99	0.39
MgO	1.73	1.58	0.55	0.64	1.00	0.49	1.07	0.10	0.76	0.10	0.87
CaO	0.08	0.10	0.19	0.00	0.18	0.23	0.00	0.00	0.00	0.00	0.11
Cr ₂ O ₃	0.18	0.57	0.00	0.00	0.32	0.19	0.00	0.32	0.00	0.30	0.17
ZnO	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V ₂ O ₃	0.31	0.00	1.42	0.29	0.24	0.13	1.57	2.76	0.28	0.30	0.49
NiO	0.13	0.33	0.26	0.62	0.00	0.32	0.59		0.11	0.00	0.00
Nb ₂ O ₅	0.09	0.44	0.19	0.00	0.02	0.13	0.13	0.12	0.19	0.04	0.11
Total	97.02	94.90	95.60	96.40	97.43	95.34	95.68	91.79	96.09	94.99	96.31
Fe ₂ O ₃	2.14	2.07	12.19	10.64	5.01	9.43	14.51	58.70	6.15	3.89	11.56
FeO	39.73	40.06	37.76	38.96	41.42	38.99	36.33	31.94	40.08	41.81	38.57
Tot	97.24	95.11	96.83	97.47	97.93	96.29	97.13	97.67	96.70	95.38	97.47
Ulvöspinel								0.03			
Ilmenite	0.96	0.96	0.86	0.88	0.94	0.89	0.83		0.93	0.94	0.87
Si	0.006	0.010	0.004	0.007	0.000	0.008	0.006	0.016	0.003	0.006	0.006
Ti	0.964	0.959	0.858	0.877	0.941	0.891	0.830	0.043	0.925	0.945	0.873
Al	0.005	0.000	0.000	0.011	0.010	0.005	0.002	0.065	0.013	0.008	0.003
Fe ³⁺	0.041	0.041	0.240	0.207	0.096	0.186	0.284	1.718	0.120	0.077	0.225
Fe ²⁺	0.851	0.880	0.825	0.844	0.886	0.855	0.790	1.039	0.871	0.925	0.834
Mn	0.048	0.024	0.010	0.015	0.011	0.017	0.004	0.014	0.028	0.022	0.009
Mg	0.066	0.062	0.021	0.025	0.038	0.019	0.041	0.006	0.029	0.004	0.033
Ca	0.002	0.003	0.005	0.000	0.005	0.006	0.000	0.000	0.000	0.000	0.003
Cr	0.004	0.012	0.000	0.000	0.006	0.004	0.000	0.010	0.000	0.006	0.004
Zn	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V	0.006	0.000	0.030	0.006	0.005	0.003	0.033	0.086	0.006	0.006	0.010
Zr								0.000			
Ni	0.003	0.007	0.005	0.013	0.000	0.007	0.012		0.002	0.000	0.000
Nb	0.001	0.005	0.002	0.000	0.000	0.002	0.002	0.002	0.002	0.000	0.001
Tot	2.001	2.002	2.002	2.004	2.000	2.002	2.004	3.000	2.001	2.000	2.000
Rutile	48.92	48.78	43.89	44.56	47.68	45.25	42.57	1.53	46.87	47.89	44.24
Hematite	2.09	2.08	12.27	10.54	4.89	9.45	14.55	60.93	6.09	3.92	11.39
Wüstite	48.99	49.14	43.84	44.91	47.43	45.30	42.87	37.54	47.04	48.19	44.37

Supplementary table 7a - Continued.

District	Monastir				Monte Nureci (Arcuentu)			
Sample	CMO3	CMO3	CMO3	CMO3	MNU2	MNU2	MNU2	MNU2
Lithology	Basaltic Andesite				Olivine Gabbro			
Description	Cr-spl in ol	Cr-mag in ol	Cr-mag in opx	Cr-mag in ol	Cr-mag	Cr-mag	Cr-mag	Cr-mag
SiO ₂	0.29	0.35	0.26	0.74	0.06	0.24	0.10	0.00
TiO ₂	0.79	3.98	3.86	4.56	4.61	2.75	3.65	3.76
Al ₂ O ₃	9.02	19.78	15.20	10.41	6.89	4.16	3.44	9.64
FeO _t	26.88	39.29	40.34	56.86	64.13	71.58	68.84	51.23
MnO	0.50	0.67	0.57	0.35	0.28	0.45	0.78	0.52
MgO	7.55	8.03	8.06	3.95	1.33	0.95	0.97	3.61
CaO	0.21	0.18	0.00	0.20	0.05	0.00	0.00	0.00
Cr ₂ O ₃	49.76	21.85	25.08	16.01	13.80	9.45	12.34	23.52
ZnO	0.00	0.00	0.00	0.23	0.00	0.03		0.07
V ₂ O ₃	0.15	1.04	0.43	0.83	1.12	1.69	0.83	0.56
Nb ₂ O ₅	0.02	0.06	0.00	0.00	0.00	0.49	0.00	0.76
Total	95.17	95.24	93.79	94.15	92.27	91.80	90.95	93.68
Fe ₂ O ₃	6.69	16.12	18.48	29.22	34.45	44.48	41.43	24.70
FeO	20.86	24.79	23.71	30.57	33.13	31.56	31.56	29.01
Tot	95.84	97.51	96.03	97.07	95.77	96.33	95.83	96.24
Si	0.082	0.093	0.071	0.212	0.017	0.075	0.030	0.000
Ti	0.168	0.792	0.794	0.981	1.048	0.636	0.851	0.823
Al	2.990	6.163	4.902	3.510	2.456	1.509	1.257	3.308
Fe ³⁺	1.416	3.207	3.806	6.291	7.837	10.294	9.661	5.413
Fe ²⁺	4.904	5.479	5.425	7.313	8.375	8.118	8.180	7.066
Mn	0.120	0.150	0.133	0.085	0.073	0.117	0.206	0.129
Mg	3.162	3.166	3.286	1.686	0.597	0.437	0.450	1.569
Ca	0.062	0.052	0.000	0.062	0.017	0.001	0.000	0.000
Cr	11.059	4.566	5.426	3.621	3.299	2.298	3.023	5.417
Zn	0.000	0.000	0.000	0.048	0.000	0.008	0.000	0.016
V	0.034	0.220	0.093	0.191	0.272	0.416	0.206	0.131
Zr	0.000	0.141	0.086	0.000	0.012	0.018	0.183	0.020
Nb	0.002	0.007	0.000	0.000	0.000	0.067	0.000	0.100
Tot	24.000	24.034	24.021	24.000	24.003	23.996	24.046	23.993
Cr	69.99	29.42	34.51	23.54	21.03	14.95	19.32	34.32
Al	18.92	39.71	31.18	22.82	15.65	9.82	8.04	20.96
2Ti+Fe ³⁺	11.09	30.87	34.30	53.64	63.32	75.23	72.64	44.73

Supplementary table 7b - Elements concentration (in wt. %) of spinel from studied rocks. Structural formula calculation based on 32 oxygens and 24 cations, values in apfu. $Cr=100*Cr/(Cr+Al+2*Ti+Fe^{3+})$, $Al=100*Al/(Cr+Al+2*Ti+Fe^{3+})$, $2Ti+Fe^{3+}=100*(2*Ti+Fe^{3+})/(Cr+Al+2*Ti+Fe^{3+})$. Abbreviation from Whitney and Evans (2010), gm=groundmass.

District	Monte Nureci (Arcuentu)				Monte Nureci (Arcuentu)			
Sample	MNU2	MNU2	MNU2	MNU3	MNU3	MNU3	MNU3	MNU3
Lithology	Olivine Gabbro				Olivine Gabbro			
Description	Cr-mag	Cr-mag	Cr-mag in cpx	Cr-mag	Cr-mag	Cr-spl	Cr-spl	Cr-mag in ol
SiO ₂	0.27	0.41	0.36	0.39	0.37	0.38	0.08	0.47
TiO ₂	3.59	4.90	3.94	4.08	3.32	0.98	1.18	2.15
Al ₂ O ₃	9.59	8.30	3.62	4.58	2.77	10.81	11.29	9.86
FeO _t	48.46	53.39	68.53	62.68	66.57	42.91	44.74	54.75
MnO	0.44	0.13	1.00	1.03	0.39	0.25	0.98	0.03
MgO	3.73	2.51	0.88	0.45	0.70	4.52	4.30	2.15
CaO	0.00	0.04	0.32	0.04	0.07	0.00	0.07	0.00
Cr ₂ O ₃	26.36	21.86	9.66	18.19	15.06	37.61	34.47	20.93
ZnO	0.00	0.10	0.56	0.00	0.93	0.00	0.00	0.55
V ₂ O ₅	0.76	0.96	2.79	1.89	1.98	0.08	0.58	1.16
Nb ₂ O ₅	0.00	0.00	0.39	0.14	0.15	0.00	0.23	0.09
Total	93.21	92.60	92.05	93.47	92.31	97.54	97.92	92.12
Fe ₂ O ₃	21.38	23.47	41.20	32.28	38.73	17.12	19.76	27.19
FeO	29.22	32.27	31.46	33.64	31.72	27.50	26.96	30.28
Tot	95.84	94.95	96.66	96.71	96.29	99.25	100.09	94.84
Si	0.079	0.123	0.111	0.120	0.113	0.105	0.021	0.140
Ti	0.787	1.099	0.910	0.935	0.772	0.205	0.245	0.480
Al	3.287	2.914	1.311	1.642	1.011	3.537	3.672	3.460
Fe ³⁺	4.682	5.262	9.516	7.395	9.016	3.576	4.104	6.090
Fe ²⁺	7.112	8.042	8.078	8.563	8.208	6.383	6.223	7.537
Mn	0.109	0.033	0.261	0.266	0.103	0.058	0.230	0.007
Mg	1.617	1.113	0.403	0.206	0.325	1.870	1.770	0.952
Ca	0.000	0.012	0.104	0.012	0.024	0.000	0.022	0.000
Cr	6.064	5.150	2.345	4.377	3.683	8.250	7.521	4.924
Zn	0.000	0.022	0.126	0.000	0.211	0.000	0.000	0.120
V	0.178	0.230	0.686	0.461	0.492	0.017	0.129	0.276
Zr	0.114	0.000	0.119	0.000	0.024	0.000	0.041	0.000
Nb	0.000	0.000	0.053	0.019	0.021	0.000	0.029	0.012
Tot	24.028	24.000	24.023	23.998	24.003	24.000	24.006	23.998
Cr	38.85	33.17	15.64	28.64	24.14	52.31	47.64	31.90
Al	21.06	18.77	8.75	10.74	6.63	22.42	23.26	22.42
2Ti+Fe ³⁺	40.08	48.05	75.61	60.62	69.23	25.27	29.10	45.68

Supplementary table 7b - Continued.

Chemical composition of accessory phases

District	Siliqua									Siliqua
Sample	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR2	MTR3
Lithology	Andesite									Andesite
Description	zrn	zrn in pl	zrn	zrn	zrn	zrn	zrn	zrn in qz	zrn	zrn
SiO ₂	33.08	33.32	28.72	32.44	32.11	32.52	32.48	32.96	33.05	30.93
TiO ₂	0.05	0.08	0.08	0.00	0.17	0.00	0.13	0.00	0.05	0.05
FeO	0.13	0.03	0.25	0.10	0.23	0.57	0.64	0.16	0.10	0.12
CaO	0.02	0.09	0.08	0.01	0.20	0.13	0.00	0.00	0.13	0.09
Sc ₂ O ₃	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.05	0.00	0.00
ZrO ₂	66.07	65.65	56.11	64.37	63.94	65.26	64.36	62.01	65.83	60.02
HfO ₂	1.87	1.96	1.04	1.68	1.27	0.88	1.56	0.47	1.81	1.83
ThO ₂	0.11	0.00	0.00	0.26	0.27	0.00	0.00	0.00	0.00	0.22
UO ₂	0.00	0.07	0.07	0.29	0.00	0.20	0.00	0.15	0.00	0.33
Total	101.32	101.21	86.35	99.18	98.19	99.57	99.17	95.80	100.96	93.60

Supplementary table 8a - Elements concentration (in wt. %) of zircon in studied rocks. Abbreviation from Whitney and Evans (2010).

District	Siliqua							Siliqua		
Sample	MTR3	MTR3	MTR3	MTR3	MTR3	MTR4	MTR4	MTR4	MTR4	MTR4
Lithology	Andesite							Andesite		
Description	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn in pl
SiO ₂	32.61	32.70	32.77	33.28	32.82	31.63	32.13	32.39	32.40	32.48
TiO ₂	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.04
FeO	0.39	0.15	0.00	0.17	0.25	0.07	0.00	0.00	0.00	0.14
CaO	0.10	0.10	0.19	0.12	0.09	0.00	0.00	0.08	0.08	0.00
Sc ₂ O ₃	0.05	0.06	0.00	0.00	0.05	0.75	0.69	0.24	0.12	0.18
ZrO ₂	63.58	65.33	65.01	65.44	65.40	60.66	63.98	63.33	64.00	64.38
HfO ₂	1.24	0.21	0.81	2.18	0.90	0.29	0.41	1.37	1.75	1.63
ThO ₂	0.58	0.00	0.15	0.08	0.00	0.56	0.08	0.32	0.18	0.05
UO ₂	0.00	0.06	0.23	0.00	0.00	0.57	0.00	0.15	0.25	0.13
Total	98.71	98.62	99.15	101.27	99.51	94.53	97.29	97.91	98.83	99.04

Supplementary table 8a - Continued.

District	Siliqua						Siliqua				
Sample	MTR4	MTR4	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1	MTR1
Lithology	Andesite						Dacite				
Description	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn	zrn
SiO ₂	32.18	31.64	32.74	32.79	32.25	32.86	32.86	32.57	32.69	32.88	32.55
TiO ₂	0.10	0.09	0.06	0.00	0.00	0.05	0.12	0.07	0.19	0.00	0.08
FeO	0.00	0.00	0.00	0.08	0.19	0.00	0.08	0.12	0.94	0.86	0.67
CaO	0.07	0.00	0.00	0.00	0.22	0.05	0.05	0.12	0.04	0.05	0.04
Sc ₂ O ₃	0.39	0.24	0.00	0.00	0.00	0.11	0.02	0.03	0.00	0.01	0.00
ZrO ₂	63.63	63.62	65.41	65.64	64.28	63.93	64.94	64.39	64.12	64.28	64.34
HfO ₂	1.23	0.38	2.32	2.12	0.76	2.01	1.85	2.24	1.87	1.37	1.53
ThO ₂	0.00	0.09	0.18	0.00	0.08	0.00	0.00	0.31	0.00	0.55	0.36
UO ₂	0.00	0.00	0.00	0.00	0.07	0.18	0.00	0.19	0.00	0.30	0.00
Total	97.60	96.06	100.71	100.62	97.84	99.19	99.92	100.05	99.84	100.30	99.57

Supplementary table 8a - Continued.

District	Cixerri	Cixerri	Siliqua	Siliqua		Siliqua		Monte Nureci	Monastir	P.ta Su Silixianu	Monastir	
Sample	SAR17	SAR12	SIL1	MTR2	MTR2	ACQ1	ACQ1	MNU2	CMO2	PSS1	CMO1	CMO1
Lithology	Andesite	Andesite	Andesite	Andesite		Dacite		Ol Gabbronorite	Andesite	Andesite	Monzodiorite	
Description	ap in amp	ap in amp	ap	ap	ap in mica	ap in amp	ap	ap	ap gm	ap	mnz	mnz
SiO ₂	0.47	0.45	0.06	0.18	0.31	0.29	0.06	0.65	0.61	0.30	0.68	0.40
Al ₂ O ₃	0.16	0.00	0.21	0.21	0.17	0.00	0.00	0.00	0.04	0.28	0.02	0.44
FeO	0.44	0.51	0.35	0.30	0.29	0.28	0.42	0.00	0.46	1.09	0.00	0.00
MnO	0.12	0.00	0.10	0.34	0.34	0.00	0.25	0.14	0.18	0.48	0.47	0.13
MgO	0.58	0.34	0.26	0.21	0.06	0.30	0.16	0.00	0.00	0.34	0.31	0.00
CaO	52.17	53.88	54.40	55.13	54.62	57.71	55.88	55.90	52.27	55.40	1.06	1.08
Na ₂ O	0.29	0.24	0.09	0.19	0.19	0.00	0.31	0.07	0.64	0.28	0.00	0.71
P ₂ O ₅	40.97	41.50	41.93	41.12	43.20	42.64	41.83	42.02	36.24	43.49	29.39	29.30
SrO	0.54	0.85	0.73	0.63	1.06			1.40	0.94	0.79	0.69	0.24
As ₂ O ₅	0.00	0.01	0.00	0.15	0.21			0.00	0.05	0.00		
La ₂ O ₃	0.54	0.00	0.27	0.26	0.03			0.00	0.00	0.05	16.48	17.41
Ce ₂ O ₃	0.42	0.00	0.34	0.00	0.07			0.71	0.00	0.48	30.95	32.69
Nd ₂ O ₃	0.57	0.32	0.02	0.00	0.00			0.00	0.05	0.20	13.26	11.02
ThO ₂	0.06	0.10	0.00	0.21	0.00			0.00	0.00	0.00	7.90	6.44
UO ₂	0.09	0.00	0.00	0.31	0.25			0.12	0.17	0.00	1.15	0.10
SO ₃	0.36	0.30	0.27	0.03	0.60	0.60	0.52	0.00	2.83	0.00		
F	0.00	1.59	4.11	3.25	4.45	2.73	2.91	0.00	0.48	2.76		
Cl	1.09	0.48	1.26	0.42	0.40	0.30	0.62	2.81	0.00	1.61	0.01	0.02
Total	98.99	100.71	104.82	103.35	106.32	104.85	102.95	104.44	95.90	107.93	103.59	100.34

Supplementary table 8b - Elements concentration (in wt. %) of apatite and monazite in studied rocks. Abbreviation from Whitney and Evans (2010).

District	Cixerri	Cixerri	Siliqua	Punta Su Silixianu		
Sample	SAR17	SAR11	SIL1	SIL1	PSS1	
Lithology	Andesite	Andesite	Andesite	Andesite	Andesite	
Description	ttn gm	ttn in amp	ttn rim amp	ttn pdf	ttn rim pl	ttn
SiO ₂	30.49	29.83	32.58	33.31	32.18	32.99
TiO ₂	31.50	27.31	26.25	25.13	21.95	33.25
Al ₂ O ₃	3.72	6.99	6.53	7.98	9.93	4.49
FeO	1.44	1.45	1.92	2.06	2.93	1.64
MnO	0.02	0.00	0.35	0.00	0.18	0.04
MgO	0.13	0.02	0.26	0.00	0.08	0.29
CaO	28.18	28.30	26.89	26.86	26.54	29.32
Na ₂ O	0.00	0.11	0.13	0.58	0.06	0.05
K ₂ O	0.02	0.08	0.01	0.31	0.17	0.00
SrO	0.00	0.00	0.35	0.13	0.00	0.00
ZrO ₂	0.01	0.01	0.39	0.22	0.01	0.29
Nb ₂ O ₅	0.00	0.22	0.00	0.03	0.00	0.26
La ₂ O ₃	1.25	0.00	0.43	1.67	0.78	0.78
Ce ₂ O ₃	0.57	0.00	0.83	1.84	0.84	0.82
Nd ₂ O ₃	0.23	0.12	0.80	0.00	0.00	0.00
Sm ₂ O ₃	0.00	0.00	0.69	0.00	0.00	0.58
ThO ₂	0.08	0.00	0.00	0.00	0.12	0.02
UO ₂	0.00	0.00	0.13	0.00	0.00	0.00
F	0.00	0.00	0.68	1.72	0.65	1.92
Cl	0.04	0.06	0.00	0.00	0.08	0.00
Total	97.68	94.50	99.22	101.83	96.51	106.75

Supplementary table 8c - Elements concentration (in wt. %) of titanite in studied rocks. Abbreviation from Whitney and Evans (2010).

Thermobarometer and hygrometer results

	District Sample Lithology	Error established by the Authors	Cixerri								
			SAR18 BA	SAR1 BA	SAR3 BA	SAR6 BA	SAR5 A	SAR17 A	SAR21 A	SAR11 A	SAR12 A
Clinopyroxene-liquid (Putirka, 2008)	T (°C)	±33	no eq	1038	1046	no eq	no eq	1038	1056	1016	
	P (kbar)	±0.7		3.9	4.2			3.9	4.1	3.6	
Clinopyroxene (Putirka, 2008)	T (°C)	±87	1116	1156	1142.0	1152	1152	-	1176	1129	no cpx
	P (kbar)	±2	5.4	4.3	3.2	5.5	6.2		7	1.6	
Clinopyroxene (Nimis, 1995)	P (kbar)	±2	2.7	2.3	3.6	-	-	4.9	2.4	2.5	
Two Pyroxenes (Putirka, 2008)	T (°C)	±56	no opx	no opx	no opx	no opx	no opx	no opx	no opx	no opx	no opx
	P (kbar)	±3.2									
Pigeonite (Ishii, 1975)	T _{min} (°C)	±20	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt
	T _{max} (°C)	±43	1239	1207	1205	1217	1220	1205	1208	1206	1166
Plagioclase-liquid (Putirka, 2008)	H ₂ O melt (wt.%)	±1	2.7	3.3	3.5	3.9	3.7	3.5	3.1	3.5	4.1
	T (°C)	±19	1190	1194	1176	1131	1128	1168	1189	1162	1130
Amphibole (Ridolfi et al., 2010)	T (°C)	±22	977	879	873	909	852	943	934	912	937
	P (kbar)	±0.2-1	5.7	2.5	2.5	3.5	2.1	4.3	4.1	3.7	4.0
	H ₂ O melt (wt.%)	±0.4-1.5	8.0	7.1	7.3	6.7	6.4	7.5	7.4	6.8	7.5
	logfO ₂	±0.4	-9.5	-11.1	-11.2	-10.5	-11.4	-10.1	-10.4	-10.5	-10.3
Magnetite-ilmenite (Lepage, 2003)	T (°C)		no ilm	no eq	no eq	no eq	no eq	no ilm	no eq	no ilm	no ilm
	logfO ₂										

Supplementary table 9 - Temperature (T, °C), pressure (P, kbar), H₂O concentration (H₂O melt, wt.%) and oxygen fugacity (logfO₂) results. No eq= the pair is not in equilibrium. Abbreviation from Whitney and Evans (2010), min= minimum, max= maximum, BA= basaltic andesite, A= andesite, D= dacite, B= basalt, GN= gabbro-norite, Ol GN=olivine gabbro-norite.

	District Sample Lithology	Error established by the Authors	Siliqua						Monastir	
			SIL1 A	MTR2 A	MTR3 A	MTR4 A	MTR1 D	ACQ1 D	CMO2 A	CMO3 BA
Clinopyroxene-liquid (Putirka, 2008)	T (°C)	±33		no eq	no eq	no eq			1065	1113
	P (kbar)	±0.7							low	low
Clinopyroxene (Putirka, 2008)	T (°C)	±87	no cpx	1164	1147	1102	no cpx	no cpx	1144	1165
	P (kbar)	±2		low	low	low			2.5	5.2
Clinopyroxene (Nimis, 1995)	P (kbar)	±2		-	-	-			-	0.6
Two Pyroxenes (Putirka, 2008)	T (°C)	±56	no opx	no opx	no opx	no opx	no opx	no opx	no eq	1027
	P (kbar)	±3.2								
Pigeonite (Ishii, 1975)	T _{min} (°C)	±20	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt	no pgt	1097
	T _{max} (°C)	±43	1157	1125	1123	1136	1147	1162	1222	1223
Plagioclase-liquid (Putirka, 2008)	H ₂ O melt (wt.%)	±1	4.5	4.7	4.8	4.3	5.6	3.7	3.4	2.8
	T (°C)	±19	1102	1075	1075	1067	1071	1080	1184	1174
Amphibole (Ridolfi et al., 2010)	T (°C)	±22	893	923			901	1002	1030	no amp
	P (kbar)	±0.2-1	2.6	3.7	-	-	3.5	7.0	7.7	
	H ₂ O melt (wt.%)	±0.4-1.5	6.4	6.8			7.9	8.6	8.4	
	logfO ₂	±0.4	-11.1	-10.7			-11.1	-9.2	-8.6	
Magnetite-ilmenite (Lepage, 2003)	T (°C)		800	740	-	-	-	-	no ilm	no ilm
	logfO ₂		-12.7	-12.3						

Supplementary table 9 - Continued.

	District	Error	P.ta Su Silixianu	Capo Frasca				Monte Nureci		
	Sample	established by	PSSI	MAL35	MAL38	MAL41	MAL29	MNU1	MNU2	MNU3
	Lithology	the Authors	A	B	BA	BA	BA	GN	Ol GN	Ol GN
Clinopyroxene-liquid (Putirka, 2008)	T (°C)	±33		no eq	1127	no eq		no eq	1060	no eq
	P (kbar)	±0.7			3.9				1.6	
Clinopyroxene (Putirka, 2008)	T (°C)	±87	no cpx	1211	1170	1172		1115	1147	1074
	P (kbar)	±2		4.4	4.3	2.5	no cpx	2.4	1.7	5.5
Clinopyroxene (Nimis, 1995)	P (kbar)	±2		0.9	1.8	0.8		-	-	-
Two Pyroxenes (Putirka, 2008)	T (°C)	±56	no opx	1152	1094	no eq		no eq	1017	1029
	P (kbar)	±3.2		5.5	3.2				1.3	3.5
Pigeonite (Ishii, 1975)	T _{min} (°C)	±20	no pgt	no pgt	no pgt	no pgt	1051	1086	no pgt	no pgt
Plagioclase-liquid (Putirka, 2008)	T _{max} (°C)	±43	1203	1246	1237	1226	1240	1176	1277	1266
	H ₂ O melt (wt.%)	±1	3.6	2.3	2.3	4.2	4.2	3.2	4.2	2.2
Plagioclase (Thy et al., 2013)	T (°C)	±19	1157	1182	1155	1175	1222	1125	1224	1223
	T (°C)	±22								
Amphibole (Ridolfi et al., 2010)	P (kbar)	±0.2-1	no amp	no amp	no amp	no amp	no amp	-	-	-
	H ₂ O melt (wt.%)	±0.4-1.5								
	logfO ₂	±0.4								
Magnetite-ilmenite (Lepage, 2003)	T (°C)		-	-	-	-	-	no mag	no mag	no ilm
	logfO ₂									

Supplementary table 9 - Continued.

⁴⁰Ar/³⁹Ar results

Sample Material	SAR21 Plagioclase	Sample Material	SAR21 Amphibole
<i>Plateau</i>		<i>Plateau</i>	
Age (Ma) ± 2σ	21.52±0.73	Age (Ma) ± 2σ	21.31±0.05
MSWD	1.62	MSWD	1.01
P	0.1	P	0.44
Total ³⁹ Ar released (%)	74.17	Total ³⁹ Ar released (%)	72.69
<i>Normal isochron</i>		<i>Normal isochron</i>	
Age (Ma) ± 2σ	20.81±2.39	Age (Ma) ± 2σ	21.34±0.07
MSWD	1.78	MSWD	1.04
P	0.08	P	0.4
⁴⁰ Ar/ ³⁶ Ar intercept	302.2±11.8	⁴⁰ Ar/ ³⁶ Ar intercept	297.9±1.3
<i>Inverse isochron</i>		<i>Inverse isochron</i>	
Age (Ma) ± 2σ	20.85±2.31	Age (Ma) ± 2σ	21.34±0.07
MSWD	1.72	MSWD	1.05
P	0.09	P	0.4
⁴⁰ Ar/ ³⁶ Ar intercept	302.2±11.5	⁴⁰ Ar/ ³⁶ Ar intercept	297.9±1.3
Sample Material	CMO3 Plagioclase		
<i>Plateau</i>			
Age (Ma) ± 2σ	30.89±1.26		
MSWD	0.62		
P	0.84		
Total ³⁹ Ar released (%)	87.71		
<i>Normal isochron</i>			
Age (Ma) ± 2σ	30.38±2.20		
MSWD	0.68		
P	0.77		
⁴⁰ Ar/ ³⁶ Ar intercept	300.2±7.5		
<i>Inverse isochron</i>			
Age (Ma) ± 2σ	30.69±2.26		
MSWD	0.67		
P	0.79		
⁴⁰ Ar/ ³⁶ Ar intercept	299.7±7.7		

Supplementary table 10 - Summary table indicating plateau and isochron ages for SAR21 and CMO3, with MSWD, P, ⁴⁰Ar/³⁶Ar intercept and ³⁹Ar degassed considered for the plateau calculation.

$^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ results

District	Cixerri					Siliqua			
Sample	SAR18	SAR1	SAR6	SAR21	SAR12	SIL2	SIL1	MTR2	ACQ2
Lithology	BA	BA	BA	A	A	BA	A	A	D
Rb	22.8	30	30	24	38	28	48	75.9	55.4
Sr	303.7	236	246	245	325	600	521	730.9	1189.3
Sm	2.7	2.6	2.5	3.1	3.5	4	4.8	6	4.3
Nd	11.5	10.4	10.7	14.2	17.5	23	28	38	24.9
$^{87}\text{Sr}/^{86}\text{Sr}$	0.707074	0.707350	0.707305	0.707811	0.707963	0.706039	0.706487	0.706943	0.706304
2 σ	± 0.000007	± 0.000007	± 0.000007	± 0.000006	± 0.000007	± 0.000007	± 0.000006	± 0.000006	± 0.000006
$^{143}\text{Nd}/^{144}\text{Nd}$	0.512426	0.512457	0.512454	0.512357	0.512345	0.512501	0.512424	0.512396	0.512499
2 σ	± 0.000005	± 0.000005	± 0.000005	± 0.000004	± 0.000004	± 0.000004	± 0.000005	± 0.000005	± 0.000005
$^{87}\text{Rb}/^{86}\text{Sr}$	0.2172	0.3678	0.3528	0.2834	0.3383	0.1350	0.2665	0.3004	0.1348
$(^{87}\text{Sr}/^{86}\text{Sr})_i$	0.707009	0.707240	0.707200	0.707726	0.707862	0.705985	0.706381	0.706824	0.706250
$^{147}\text{Sm}/^{144}\text{Nd}$	0.1419	0.1511	0.1412	0.1320	0.1209	0.1051	0.1036	0.0955	0.1044
$(^{143}\text{Nd}/^{144}\text{Nd})_i$	0.512407	0.512436	0.512435	0.512339	0.512328	0.512482	0.512405	0.512379	0.512480
Age (Ma)	21	21	21	21	21	28	28	28	28

Supplementary table 11 - Rb, Sr, Sm and Nd (in ppm) concentrations, measured $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ with uncertainties expressed as 2 σ , $(^{87}\text{Sr}/^{86}\text{Sr})_i$ and $(^{143}\text{Nd}/^{144}\text{Nd})_i$ recalculated at the provided Age, in representative rocks of this study, Sindia, Sulcis and Arcuentu districts. BA=basaltic andesite, A=andesite, D=dacite, GN=gabbronorite, Ol GN=olivine gabbronorite, HAB=high alumina basalts, B=basalt. Red values are supposed because they were not measured in those samples.

District	Monte Nureci (Arcuentu)			Monastir		Sindia		Arcuentu	
Sample	MNU2	MNU3	MNU1	CMO3	SD2	SIN50	SIN24	A1	L1
Lithology	Ol GN	Ol GN	GN	BA	HAB	A	A	B	BA
Rb	26.9	3.7	50	19.1	23.5	78.9	88.1	43.4	59.9
Sr	287.5	189.9	187.9	665	756.6	366.9	355.9	198.7	192.9
Sm	3.3	1	3.5	3.2	4.5	5.2	6	2.5	3.6
Nd	13.4	3.4	15.5	14.8	19.8	23.7	29	7.77	15.5
$^{87}\text{Sr}/^{86}\text{Sr}$	0.708886	0.709145	0.709784	0.704434	0.704828	0.706539	0.706490	0.706441	0.709948
2 σ	± 0.000007	± 0.000007	± 0.000007	± 0.000007	± 0.000006	± 0.000006	± 0.000006	± 0.000006	± 0.000006
$^{143}\text{Nd}/^{144}\text{Nd}$	0.512283	0.512305	0.512297	0.512577	0.512613	0.512534	0.512527	0.512598	0.512311
2 σ	± 0.000005	± 0.000004	± 0.000005	± 0.000005	± 0.000005	± 0.000005	± 0.000004	± 0.000005	± 0.000005
$^{87}\text{Rb}/^{86}\text{Sr}$	0.2707	0.0564	0.7700	0.0831	0.0898	0.6221	0.7161	0.6319	0.8986
$(^{87}\text{Sr}/^{86}\text{Sr})_i$	0.708817	0.709131	0.709587	0.704397	0.704801	0.706353	0.706276	0.706279	0.709718
$^{147}\text{Sm}/^{144}\text{Nd}$	0.1489	0.1778	0.1365	0.1307	0.1374	0.1326	0.1251	0.1945	0.1404
$(^{143}\text{Nd}/^{144}\text{Nd})_i$	0.512265	0.512284	0.512281	0.512550	0.512594	0.512516	0.512510	0.512575	0.512294
Age (Ma)	18	18	18	31	21	21	21	18	18

Supplementary table 11 - Continued.

District	Arcuentu					Sulcis		
Sample	AR45	AR51	RL48	AR287	AR165	V1199	V1291	V1119
Lithology	BA	BA	BA	BA	A	BA	A	A
Rb	32	33.4	56.6	42.2	49.4	45.7	95.5	91.3
Sr	356.4	299.9	325.6	229.6	244.7	467.8	299.8	396.2
Sm	4.4	3.8	6	4	5	4.6	4.02	4.92
Nd	18.6	17.2	30	19	26	22	16.9	24.5
$^{87}\text{Sr}/^{86}\text{Sr}$	0.708657	0.709332	0.710955	0.709442	0.711332	0.706410	0.706599	0.707359
2 σ	± 0.000007	± 0.000006	± 0.000007	± 0.000006	± 0.000006	± 0.000007	± 0.000007	± 0.000006
$^{143}\text{Nd}/^{144}\text{Nd}$	0.512325	0.512259	0.512201	0.512239	0.512187	0.512399	0.512428	0.512350
2 σ	± 0.000006	± 0.000005	± 0.000005	± 0.000005	± 0.000004	± 0.000005	± 0.000005	± 0.000004
$^{87}\text{Rb}/^{86}\text{Sr}$	0.2598	0.3223	0.5031	0.5319	0.5843	0.2826	0.9215	0.6667
$(^{87}\text{Sr}/^{86}\text{Sr})_i$	0.708591	0.709250	0.710826	0.709306	0.711183	0.706338	0.706363	0.707189
$^{147}\text{Sm}/^{144}\text{Nd}$	0.1430	0.1336	0.1209	0.1273	0.1162	0.1264	0.1438	0.1214
$(^{143}\text{Nd}/^{144}\text{Nd})_i$	0.512308	0.512243	0.512187	0.512224	0.512173	0.512384	0.512411	0.512336
Age (Ma)	18	18	18	18	18	18	18	18

Supplementary table 11 - Continued.

Acknowledgements

I would like to thank Dr. Aida Maria Conte and Prof. Rosolino Cirrincione for their reviews to my PhD thesis. Their suggestions were appreciated and have contributed to the improvement of my thesis.

I would like to acknowledge Prof. Fred Jourdan for having guided me for the grain separation for the Ar-Ar dating. I would like to thank my co-tutors for their help during the laboratory and field activities. The deep knowledge of Sardinia of Dr. Luca Giacomo Costamagna was essential for the sampling. I thank Prof. Massimo D'Antonio for his interest in my work and for his contribution to my education and research.

A special acknowledgement is for Dr. Vincenza Guarino and Prof. Ciro Cucciniello. They have always been source of advice to carry out my research project and to solve any problem. I thank them to have always found time to help, listen and support me, also on non-working days.

The words to thank my Tutor, Prof. Leone Melluso, will never be enough. He guided me from the master's degree, with his precious advices and immeasurable knowledge, always pushing me to improve myself and to reason about every aspect of my thesis. The scientific discussions with him have always been inspiring for me to find new points of view. I thank him for having created an enjoyable work environment where I have always felt free to debate and ask explanation to solve my scientific doubts.

Lastly, not for importance, I would like to profoundly thank my family for their unconditional and constant love and support, for admiring me, more than I do.