Per. Mineral. (2003), ***72*****, SPECIAL ISSUE:** *Miocene to Recent...*, **27-39** http://go.to/permin

PERIODICO di MINERALOGIA
established in 1930

An International Journal of
MINERALOGY, CRYSTALLOGRAPHY, GEOCHEMISTRY,
ORE DEPOSITS, PETROLOGY, VOLCANOLOGY
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CHAPTER 1

The Tuscan Magmatic Province

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1.1 GENERALS

The Tuscan magmatic province consists of a series of mafic to acid intrusive and extrusive centers scattered through southern Tuscany and the Tuscan archipelago. The acid centers of the Tolfa-Cerveteri-Manziana area, northwest of Rome, are also traditionally included into the Tuscany province.

Figure 1 gives an overview of locations, ages and main compositional characteristics of the Tuscan magmatism. Representative compositions are given in table 1. Magmatic rocks consists of stocks, dykes, necks, lava flows and domes, and of the large volcanic edifices of Monte Amiata, Monti Cimini and Capraia Island. Ages range from 8-7 Ma to 0.2 Ma (e.g., Ferrara and Tonarini, 1985; Fornaseri, 1985; Villa *et al.*, 1987; Serri *et al.*, 1993; Aldighieri *et al.*, 1998), and shows a tendency to decrease from west to east (Fig. 1). In particular four age zones can be recognised (from n. 1 to n. 4 in Fig. 1). An outcrop of lamproitic rocks at Sisco (Corsica) is about 14 Ma old, and is here also considered to belong to the Tuscan province.

The basement rocks in Tuscany consist of metamorphic terranes overlain by various allochthonous and autochthonous sequences (see Abbate *et al.*, 1970). The thickness of the continental crust is moderate, and reaches a minimum beneath the Tyrrhenian border of southern Tuscany, where the Moho occurs at a depth of about 25 km. This reveals a mantle doming beneath southern Tuscany. Heat flow is high, as testified by the occurrence of well known geothermal fields at Larderello.

An important geophysical feature of southern Tuscany is given by a zone of low seismic velocities within the upper mantle. This has been interpreted as due to the occurrence of a layer with a crustal-type density. There is debate on the physical nature of this layer, which has been suggested to represent either an upper crustal slice within the upper mantle (crustal doubling), or partially molten mantle material (e.g., metasomatic veins) (Morelli, 1982; Locardi, 1988; Peccerillo and Panza, 1999). Therefore, southern Tuscany magmatism appears to be associated with thin crust, high heat flow and mantle doming.

High velocities of S-waves (up to 4.6 km/s) in the north-central Apennine area, below a depth of about 70 km suggest the presence of deep-seated lithospheric roots (e.g., Panza and Mueller, 1979; Babuska *et al.*, 1985), which are almost vertical. These roots have been interpreted to represent a relict of an undergoing lithospheric slab (see Peccerillo and Panza, 1999 and references therein).

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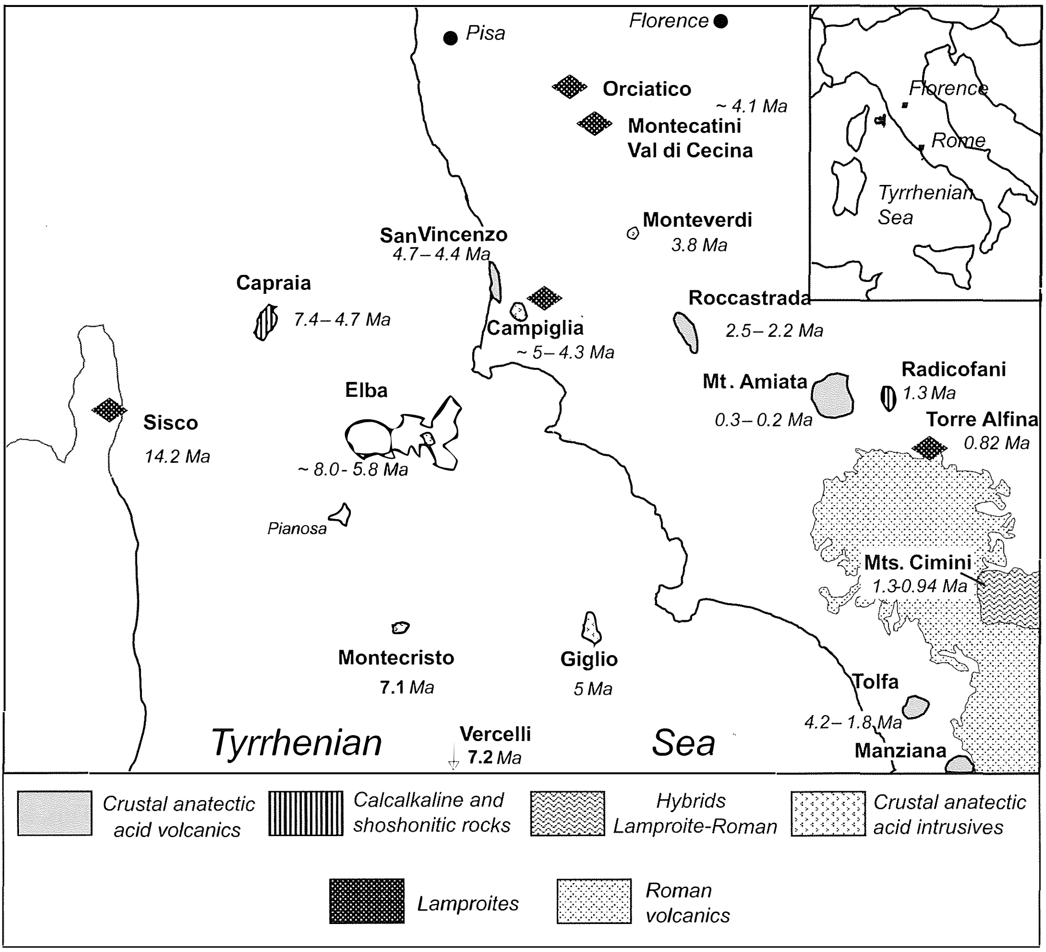

Fig. 1 – Location, age and compositional characteristics of intrusive and extrusive rocks of the Tuscan magmatic province. Note the younging of magmatism from west to east.

1.2 COMPOSITIONAL CHARACTERISTICS OF TUSCAN MAGMATISM

The Tuscan magmatic province is very complex. Peccerillo *et al.* (1987) first recognized the coexistence of several types of magmas. These include crustal anatectic acid peraluminous rhyolites and granites, and a wide range of mafic to intermediate magmas, including high-potassium calcalkaline (HKCA), shoshonitic (SHO), potassic alkaline (KS) and ultrapotassic lamproitic rocks. Mixing appears to have affected both mafic and acid rocks; the latter bear textural (mafic xenoliths, xenocrysts, etc.) and geochemical evidence of mingling and mixing with various types of mantle-derived calcalkaline to potassic melts (Poli, 1992).

Diagrams of K_2O and alkalies vs. SiO_2, K_2O/Na_2O vs. ΔQ, and MgO vs. some major and trace elements are reported in figures 2 and 3 to show the compositional variability and

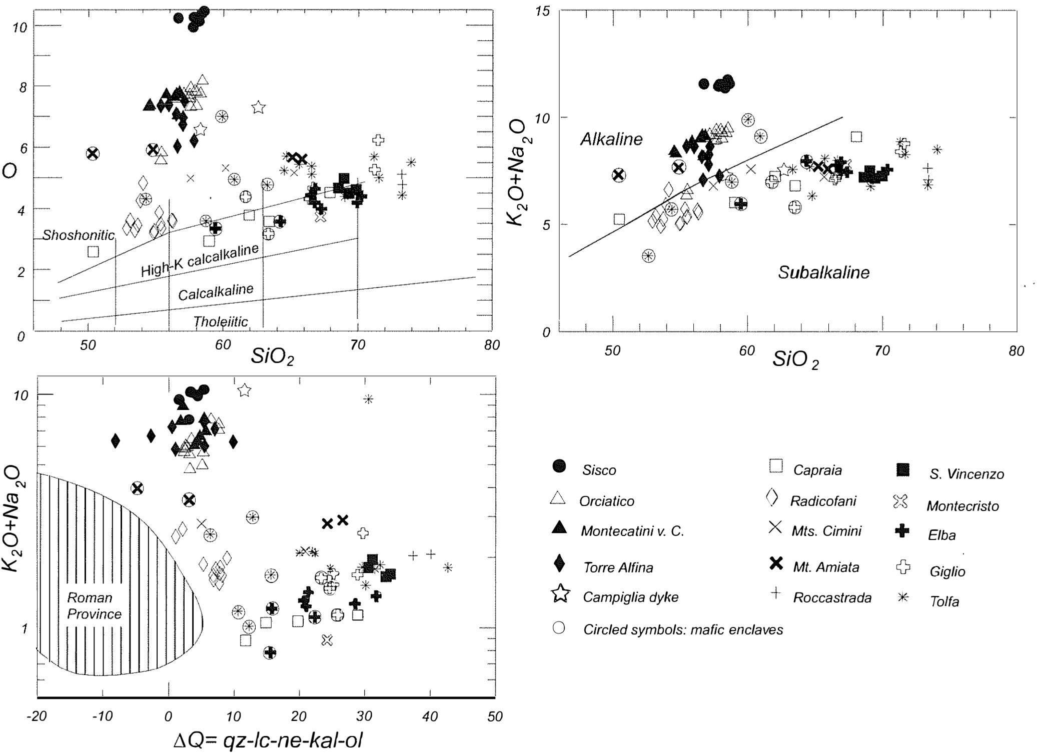

Fig. 2 – K_2O vs. SiO_2, alkalies vs. SiO_2, and K_2O/Na_2O vs. ΔQ diagrams for magmatic rocks of the Tuscan province. ΔQ is the algebraic sum of quartz minus undersaturated minerals and defines the degree of silica saturation. For source of data see Peccerillo *et al.* (2001). Ruled area: mafic rocks from the Roman province. Circled symbols indicate mafic enclaves from various localities.

degree of silica saturation of Tuscany rocks. These range from mafic to acid. Mafic rocks range from HKCA to shoshonitic potassic and ultrapotassic. They are nearly saturated in silica, in contrast with the rocks from the Roman province which are saturated to strongly undersaturated in silica. CaO, Al_2O_3, FeO_{tot}, MnO, V and Sr are lower, whereas TiO_2, Ta, Nb and other High Field Strength Elements are higher in the Tuscan mafic rocks than in the Roman province.

Mafic enclaves in acid rocks (shown with circled symbols in the figures) also show variable compositions.

1.2.1 Acid Magmatism

1.2.1.1 Petrological and geochemical characteristics

Acid rocks in the Tuscan province occur as lavas at San Vincenzo, Roccastrada, Monte Amiata and Monti Cimini, and as intrusive bodies at Elba, Montecristo, and Giglio islands, and at Gavorrano and Campiglia. Other granite bodies occur as seamounts in the northern Tyrrhenian sea (Vercelli; Barbieri *et al.*, 1986), and as hidden intrusions encountered by drilling (Franceschini *et al.*, 2000). Notably, pyroclastic rocks are scarce or absent, except at Mt. Cimini and Tolfa where ignimbrites are occurred.

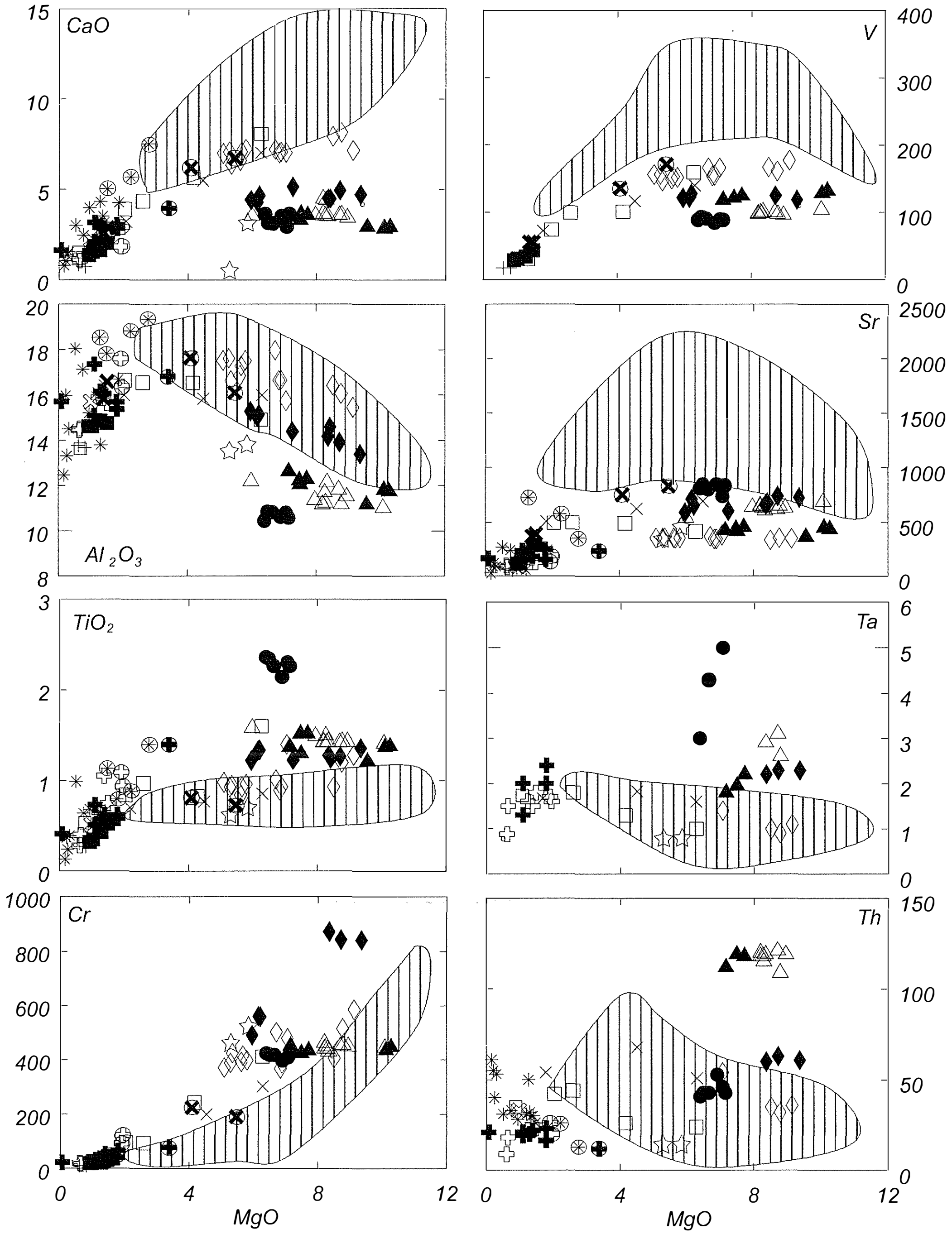

Fig. 3 – Variation diagrams of selected major and trace elements for Tuscan magmatic rocks. Symbols and source of data as in figure 2.

The acid rocks, except for Roccastrada rhyolites, are associated with variable amounts of mafic material. At Monti Cimini rhyodacitic pyroclastic rocks and domes are associated with olivine latite lavas. Monte Amiata and San Vincenzo lavas, and the intrusive bodies contain microgranular mafic enclaves and dykes, which represent blobs of mafic melts intruded into and mingled with the acid host magma (Poli, 1992; Poli *et al.*, 1989).

At Roccastrada acid rocks consist of rhyolitic lava flows and domes emitted from NW-SE trending facture (Mazzuoli, 1967). $^{87}Sr/^{86}Sr$ isotope ratios are high and not very variable (0.718-0.720 ca), and $^{143}Nd/^{144}Nd$ is low (= 0.51222). Geochemical and petrological data clearly suggest a genesis by partial melting of upper crustal material of probable metapelitic composition (Giraud *et al.*, 1986; Pinarelli *et al.*, 1989). The poorly variable compositional characteristics and the absence of mafic material suggest that Roccastrada magma represents a pure anatectic melt, which did not interact significantly with subcrustal magmas.

At San Vincenzo, acid lavas show lower silica contents and more variable isotopiccomposition than at Roccastrada. Sr isotopic ratios range from 0.7133 to 0.7255, Nd isotopic ratios range from 0.51214 to 0.51225. (e.g. Vollmer, 1976; Giraud *et al.*, 1986; Ferrara *et al.*, 1989; Feldstein *et al.*, 1994). Isotopic disequilibrium among phenocrysts and between phenocrysts and groundmass have been detected (Ferrara *et al.* 1989; Feldstein *et al.*, 1994). All these features suggest that San Vincenzo rhyolites result from mixing between crustal anatectic melt and subcrustal mafic-intermediate magma, most probably with calcalkaline composition (Ferrara *et al.*, 1989).

Monte Amiata is built up by quartz-latite to trachyte lava flows and domes. Sr isotope ratios cluster around 0.711 (Poli *et al.*, 1984). Mafic enclaves are abundant in the summit domes (Ferrari *et al.*, 1996; Rombai *et al.*, 1995).

The Monti Cimini acid rocks consist of rhyodacitic domes and ignimbrites, which resemble closely the acid rocks of Monte Amiata. Late mafic olivine latite lava flows are present in this volcano.

The intrusive rocks range in composition from granodiorite to alkali-granite, with a strong predominance of monzogranites. Granite porphyries crop out mainly at Elba. Variable amounts of mafic microgranular enclaves occur in the intrusive bodies. Rock compositions straddle the I and S fields of Chappel and White (1974); mineralogical and chemical characteristics indicate that the more basic rocks are broadly I-type, whereas the high-silica rocks are S-type (Poli *et al.*, 1989; Macera and Bruno, 1994; Innocenti *et al.*, 1997).

The Tolfa, Cerveteri and Manziana volcanism makes up a multi-center acid volcanic complex formed by lava flows and domes ranging from quartz-latites to high silica rhyolites. The age is 4.2 to 2.3 Ma (Fornaseri, 1985). Pinarelli (1987a, 1991) and Bertagnini *et al.* (1995) suggested that the Tolfa-Cerveteri-Manziana magmatism is generated by crustal melting and variable mixing with mafic potassic liquids. Mafic enclaves show incompatible element patterns similar to those of mafic rocks from Tuscany. These data provide support to the hypothesis that the Tolfa magmatism represents the southernmost end of the Tuscan province.

1.2.1.2 Petrogenesis

Petrological, geochemical and isotopic data reveal a genesis by crustal anatexis for acid rocks of the Tuscan province. Geochemical features, especially variable Sr isotope ratios, highlight interaction between crustal melts and various types of mantle-derived magmas (Poli, 1992; Poli *et al.*, 1989); most of the rocks with intermediate silica contents also derive from such a process. Geochemical modelling suggests that melting of a gneiss with a compositions as those occurring in the Tuscan metamorphic basement, can explain the genesis of the crustal magmas (e.g. Pinarelli *et al.*, 1989).

1.2.2 Mafic Magmatism

Mafic rocks are here defined as those with MgO > 4 wt%. They occur as small intrusive bodies, as lava flows, and as enclaves in acid rocks.

1.2.2.1 *Classification and geochemical characteristics*

The mafic rocks from Tuscany have variable degree of enrichment in alkalies, especially potassium, from HKCA and shoshonitic, potassic and ultrapotassic types (Peccerillo *et al.*, 1987; Conticelli and Peccerillo, 1992). These define continuos trends that straddle the boundary between potassic rocks with lamproitic affinity (Group I ultrapotassic rocks; Foley *et al.*, 1987), and Roman-type HKS and KS rocks (Group III) (Fig. 4). The rocks from Sisco show the most typical lamproitic composition, whereas Radicofani falls in the field of Roman-type rocks. The other rocks define intermediate compositions.

Lamproites. Rocks with lamproitic compositions occur at Montecatini val di Cecina, Orciatico, Torre Alfina and Sisco (Fig. 1). A few dikes at Campiglia also show lamproitic affinity, although deuteric transformation has strongly modified pristine composition.

The Sisco lamproite form a small sill cutting through alpine high-P metamorphic rocks. It shows microgranular to slightly porphyritic texture. Main phases include olivine, sanidine, phlogopite and K-richterite. Accessory minerals include sphene, chromite, ilmenite, priderite and rutile. The Montecatini val di

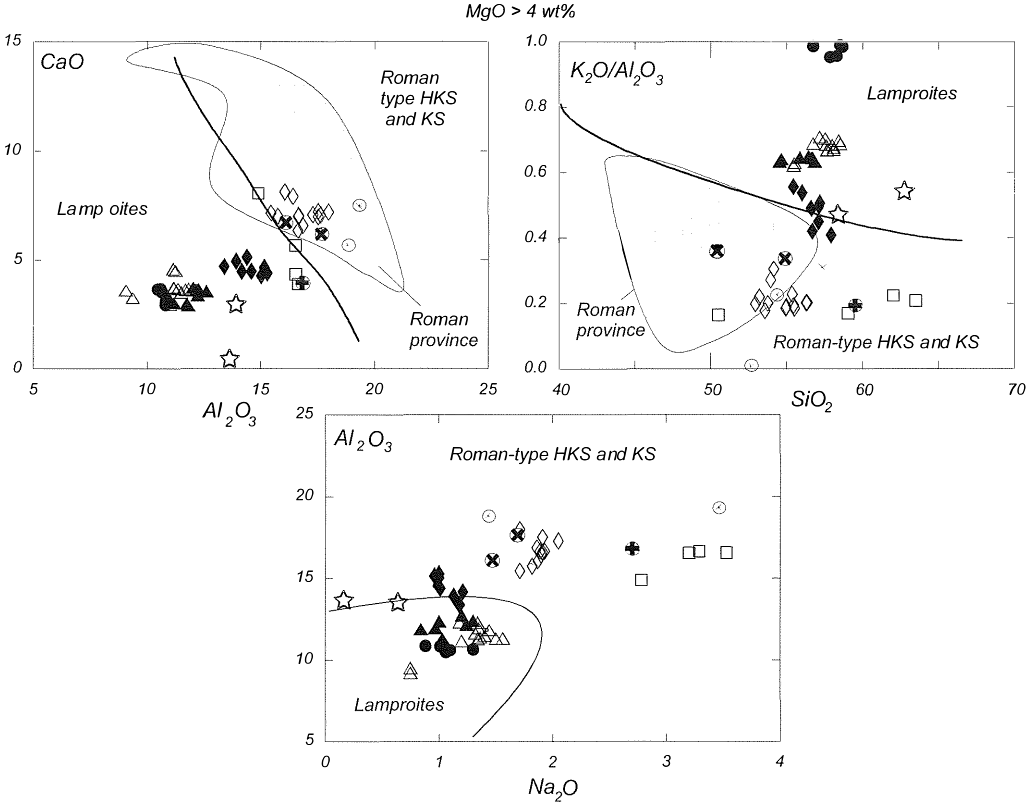

Fig. 4 – Classification diagrams for potassic mafic rocks (Foley *et al.*, 1987). The lines divide the fields of lamproites and Roman-type HKS and KS rocks. Rocks with MgO > 4 wt% have been reported. Symbols and source of data as in figure 2.

Cecina lamproite is represented by a subvolcanic body some hundreds of meters in diameter, cut by several thin veins of leucocratic material. The main rock facies is a minette with a medium-fine grained phaneritic texture with dominant phlogopite, sanidine and minor clinopyroxene. Strongly altered and resorbed olivine crystal and a few intergranular quartz are also present. Apatite, amphibole and Fe-Ti oxides are the main accessories. Felsic veins have a medium grained texture and consists of dominant sanidine with minor quartz and brown mica; apatite is the main accessory phase. At Orciatico, lamproites consist of a dyke of dark colored aphanitic rock. At the microscope the Orciatico lamproite reveals a poorly porphyritic texture, with phenocrysts of olivine, phlogopite and clinopyroxene; groundmass consists of the same phases plus sanidine, glass, K-richterite, and accessory rutile, ilmenite, chromite. Olivine is highly magnesian (up to 90% Fo) and sometimes shows kinking. Torre Alfina is formed by a few lava flows and necks. Rocks range from aphyric to poorly porphiritic. Euhedral to skeletal olivine (Fo = 84-90%) is the main phenocryst. Other phases include clinopyroxene, phlogopite, K-feldspar and glass. The Torre Alfina rocks contain abundant xenoliths of both crustal and mantle origin, which are best observed on the walls of the Torre Alfina castle, which dominates the homonymous village (Conticelli and Peccerillo, 1990).

Calcalkaline and shoshonitic rocks are exposed at Capraia and Radicofani. The Capraia rocks are mainly represented by lavas and scoriae, which range from high-K calcalkaline to shoshonitic. Two phases of activity, separated by a long (1.5 Ma) quiescence, have been recognized at 7.6 and 4.7 Ma. Rocks are generally porphyritic with dominant plagioclase phenocrysts, minor clinopyroxene, orthopyroxene, and biotite, and sporadic olivine and amphibole. At Radicofani shoshonitic rocks are basic to intermediate and form a large neck and some dismembered lava flows. The neck forms a well preserved towering monolith, above which the village of Radicofani has been built up; lava flows have been completely dismembered and are presently recorded by a few erratic blocks. Rock textures are scarcely porphyritic with phenocrysts of, olivine, clinopyroxene, and plagioclase.

Hybrids between Calc-alkaline- shoshonitic (or Roman-type KS) and Lamproitic magmas. Some rocks have intermediate compositions between lamproite and Calc-alkaline - shoshonitic (or Roman-type KS). The most important outcrop is found at Monti Cimini, as small olivine latite lava flows; however, also the enclaves in the Monte Amiata domes, and, to some extent, Radicofani belong to this group. Incompatible element patterns resemble those of lamproites (Fig. 5), but element concentrations (especially HFSE) are generally lower than in lamproites.

1.2.2.2 Petrogenesis

The high Mg#, Ni and Cr, of most of the mafic rocks in Tuscany as well as the occurrence of ultramafic xenoliths in some outcrops, testify to a mantle origin. The variable petrological and geochemical composition reveals a strongly heterogeneous mantle source.

Lamproites. Lamproitic magmas have low CaO, Na_2O, and Al_2O_3, and very high K_2O (Fig. 2-4). Since major element composition of primary melts depend on the type and proportions of mineral phases eneteri ng the melt, the particular composition of lamproites suggests a genesis by melting of a peridotite depleted in clinopyroxene (i.e. residual harzburgite) and enriched in a K-rich phase, such as phlogopite.

The silica oversaturation and the high silica contents point to a genesis in the uppermost mantle, as demonstrated experimentally (Wendlandt and Eggler, 1980; Foley, 1992; Melzer and Foley, 2000). Trace element abundance and ratios, and isotopic signatures (Fig. 5,6) reveal compositions that resemble upper crust rather than typical mantle values. This points to a genesis in an anomalous

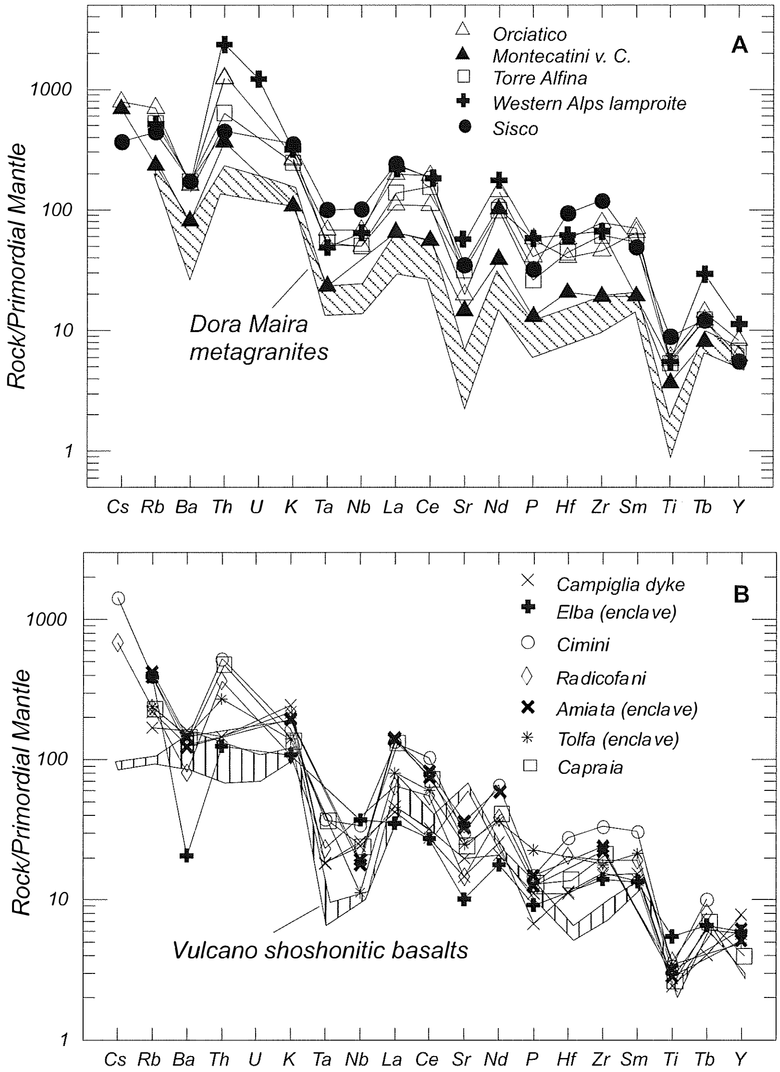

Fig. 5 – Incompatible element patterns for Tuscan mafic rocks, for a lamproite from Western Alps, and for shoshonitic basalts from Vulcano, Aeolian arc; normalization values from Wood (1979). Data for Dora Maira metagranites from Cadoppi (1990).

metasomatic harzburgite, which suffered metasomatic modification by addition of upper crustal material. Introduction of upper crust into the mantle was likely produced by subduction processes.

The Capraia and Radicofani rocks show the lowest concentrations in incompatible elements among Tuscan mafic rocks. At Capraia, Sr isotope ratios are the lowest in the Tuscan province ($^{87}Sr/^{86}Sr$ = 0.708-0.709 ca); higher values are found at Radicofani ($^{87}Sr/^{86}Sr$ = 0.713-0.716) (Poli *et al.*, 1984; Conticelli *et al.*, 2001a; Poli, unpublished data).

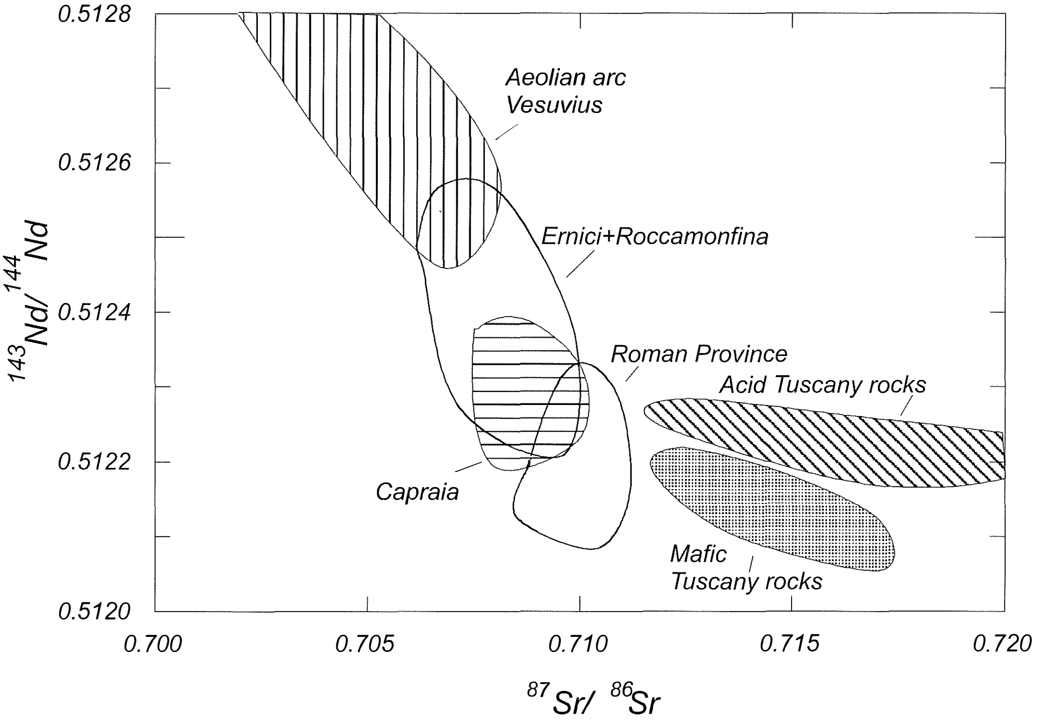

Fig. 6 – Sr-Nd isotopic composition of Tuscan rocks, compared with Roman Province, Ernici and Roccamonfina, and Aeolian Arc and Vesuvius.

Calcalkaline and shoshonitic rocks have lower enrichment in potassium and incompatible elements than lamproites, whereas CaO, Al_2O_3, and Na_2O are higher. However, the shape of incompatible element patterns is similar to lamproites and is different from those of typical shoshonitic rocks, e.g. from the Aeolian arc (Fig. 5B); for instance, Tuscan rocks have negative spikes of Ba, Sr ad P, and positive spikes of Th and Rb which are not encountered in the Aeolian shoshonites. Therefore, calcalkaline and shoshonitic magmas were likely generated in a source which had similar, although less intense, type of enrichment in incompatible elements as the lamproite source. The higher CaO, Al_2O_3, and Na_2O of calcalkaline and shoshonitic rocks suggests a lherzolitic source for these magmas.

Overall, Tuscan mafic rocks display trends of incompatible element ratios and isotopes that are different from those of the nearby Roman province (Fig. 7).

This has been interpreted as an evidence for two distinct metasomatic events, respectively in Tuscany and in the Roman region (Peccerillo, 1999; Peccerillo and Panza, 1999).

In conclusion, the overall petrogenetic history for the Tuscan province consists of the following main steps:

1. Subduction processes introduced upper crustal material into the mantle. Both fertile lherzolites (asthenosphere?) and residual harzburgite (lithosphere?) were contaminated at various extent by crustal rocks. This generated heterogeneous and anomalous mantle sources whose incompatible trace element patterns and geochemical signatures resemble those of the upper crust.

2. Variable degrees of partial melting of heterogeneous mantle generated various types

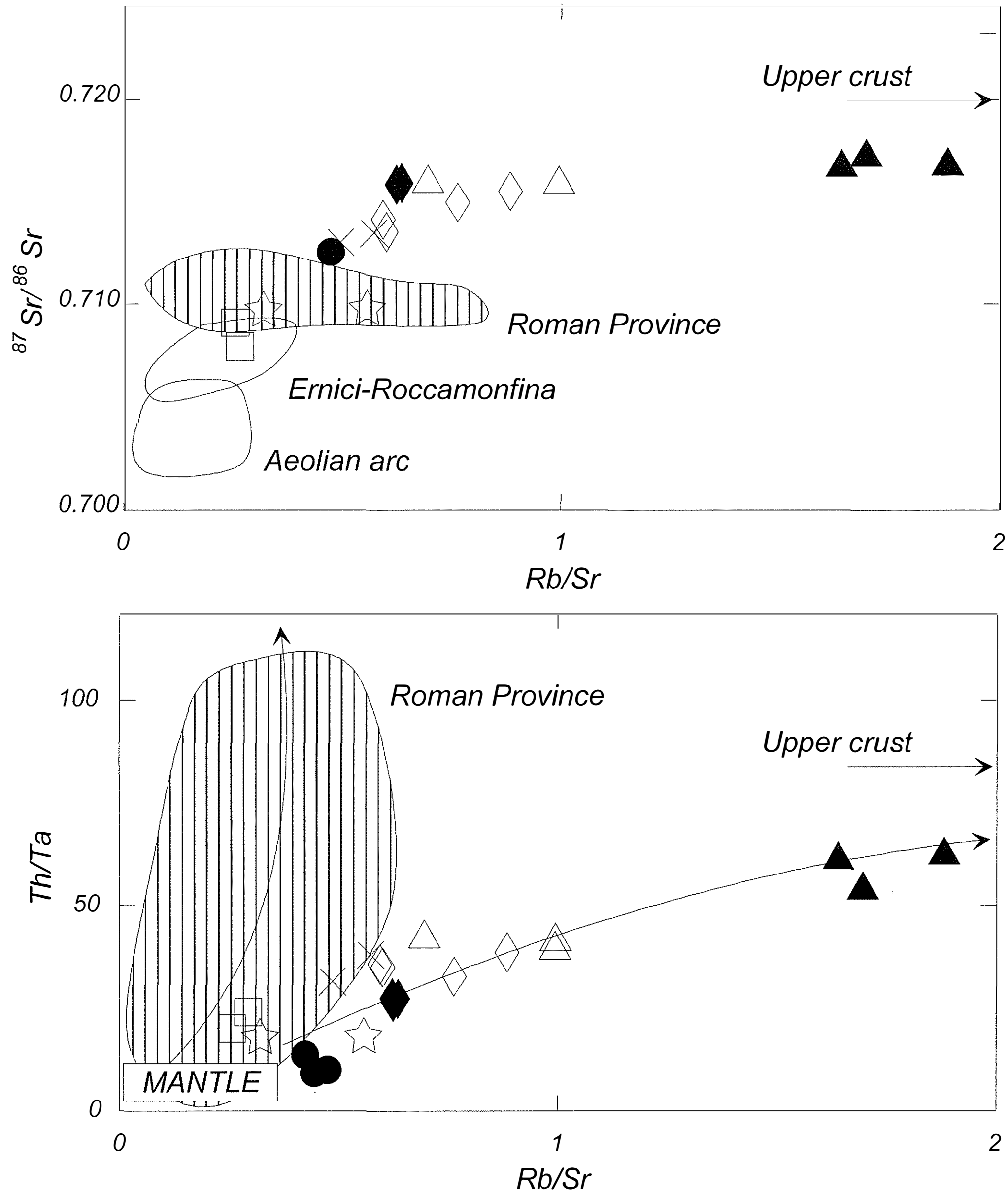

Fig. 7 – Variation diagrams of key trace element ratios and ^{87}Sr/^{86}Sr for the Tuscan mafic rocks (MgO > 4 wt%). Tuscan lamproites define mixing trends between upper mantle and upper crust compositions, and are distinct from the Roman province. Symbols and source of data as in figure 2.

of magmas, from calcalkaline to lamproitic, which are of obviuos mantle origin but have crustal-like geochemical and isotopic signatures.

3. Injection of mafic magmas into the continental crust induced an increase of isotherms, with onset of crustal anatexis and mafic-acid magma mingling.

1.3 TIMING, NATURE AND GEODYNAMIC IMPLICATIONS OF METASOMATIC EVENTS

A crucial problem for exploring geodynamic implications of petrological and geochemical data is that of understanding the age of metasomatic processes that affected the upper mantle beneath Tuscany. This problem is discussed in detail by Peccerillo (1999). In general terms, crustal material into the upper mantle could be provided by recent subduction processes (Alpine and Apennine subduction), or by older subduction events (e.g. Hercynian or older). In the latter case, crustal material could have been subducted to deep mantle where it was stored for long times before being emplaced into the lithosphere by a rising plume.

Definite evidence to discriminate between various possibilities are lacking. However, Tuscany mafic rocks have variable Rb/Sr and ^{87}Sr/^{86}Sr (Fig. 7). These define a positive trend which, if interpreted as an isochron, would suggest an age of less than 100 Ma. This would point to an Alpine age for metasomatism. Moreover, the close similarity between upper crust and the Tuscany mafic rocks requires that the crustal material introduced into the mantle did not suffer any significant geochemical modification during storage. This is difficult to envisage, if one assumes a very long history for metasomatizing upper crustal material, such as the one suggested by the plume hypothesis. Therefore, a recent contamination events seems more probable.

TABLE 1

Sample	Orciatico lamproite	Montecatini lamproite	Torre Alfina lamproite	Sisco lamproite	Campiglia lamproite	Capraia	Capraia	Radicofani	Cimini Ol-latite
SiO_2	57.68	56.86	55.47	58.5	62.7	63.5	50.5	52.95	57.43
TiO_2	1.43	1.37	1.36	2.27	0.62	0.84	1.6	0.93	0.85
Al_2O_3	12.14	12.61	13.39	10.84	13.5	16.64	14.9	16.43	15.99
Fe_2O_3	2.17	3.25	0.78	0.81	3.88	3.55	10.2	2.33	1.22
FeO	3.12	2.84	5.08	2.42	1.9	1.4	-	3.89	3.66
MnO	0.09	0.1	0.1	0.06	0.21	0.06	0.15	0.12	0.09
MgO	8.34	7.15	9.36	6.63	5.29	2.04	6.27	8.51	6.3
CaO	3.5	3.47	4.7	3.12	0.49	3.9	8.05	7.92	6.82
Na_2O	1.34	1.2	1.18	1.02	0.13	3.29	2.78	1.9	1.81
K_2O	8.05	7.91	7.46	10.73	7.39	3.5	2.46	3.26	5.01
P_2O_5	0.85	0.92	0.54	0.67	0.14	0.2	0.48	0.27	0.31
LOI	1.22	2.43	0.58	2.09	3.72	1.08	1.4	1.2	0.51
Sc	18.5	20.2	17	11.5	14	-	22.8	26	21
V	101	118	118	91	-	74	159	167	137
Cr	430	451	841	420	461	97	412	407	302
Co	31	32	36	23	18	12	42	33	-
Ni	288	150	349	264	135	14	79	97	108
Rb	601	792	453	380	189	177	121	201	336
Sr	604	421	726	803	339	492	412	335	688
Y	30	33	33	27	38	24	27	-	-
Zr	859	537	674	1309	171	252	243	211	366
Nb	42	36	31	63	16	17	24	-	21
Cs	15	6	-	7	-	-	4	13	27
Ba	1210	1200	1293	1310	964	713	556	610	1061
La	140	78	98	172	30	62	29.3	46	94
Ce	365	206	294	347	53	115	68.4	105	196
Nd	181	133	127	139	33	-	51.9	50	85
Sm	27.1	24	20.7	19	5.3	-	9.6	7.4	11.8
Eu	3.88	3.67	3.5	3.2	0.88	-	2.09	1.81	2.4
Gd	-	-	-	-	-	-	6.2	-	-
Tb	1.2	1.3	1.21	1.2	0.4	-	1	0.8	1
Yb	1.68	2.25	2.4	1.1	1.9	-	2.3	1.94	2.26
Lu	0.43	0.31	0.39	-	0.21	-	0.35	0.36	0.36
Hf	20	13	15.5	33	4	-	5.6	7.2	9.7
Ta	2.9	1.8	2.3	4.3	0.78	-	1	1	1.6
Th	119	112	61	43	14	42	24	35	50
U	-	-	-	-	-	-	-	-	-
$^{87}Sr/^{86}Sr$	0.71582	0.71673	0.71583	0.71256	0.70978	0.70903	0.70813	0.71352	0.7128
$^{143}Nd/^{144}Nd$	0.51209	0.512085	0.51212	0.51218	-	0.51234	0.51227	0.512171	-
$^{206}Pb/^{204}Pb$	18.729	18.757	18.66	-	-	-	-	18.686	-
$^{207}Pb/^{204}Pb$	15.715	15.675	15.65	-	-	-	-	15.674	-
$^{208}Pb/^{204}Pb$	39.192	39.116	38.85	-	-	-	-	38.98	-

Representative geochemical composition of rocks from the Tuscan Magmatic Province.

Cimini	Rocca strada rhyolite	San Vincenzo rhyolite	Tolfa enclave	Tolfa Latite	Tolfa rhyolite	Elba granite	Montecrist ogranite	Giglio granite	Amiata lava	Amiata enclave
65.37	73.4	69.97	60.91	66.66	71.66	66.92	67.31	71.59	65.94	50.4
0.72	0.27	0.32	0.99	0.64	0.39	0.58	0.51	0.28	0.55	0.73
15.83	13.67	14.61	18.04	17.11	14.5	16.16	15.71	14.45	15.82	16.1
1.41	1.82	1.19	5.32	1.08	2.18	0.84	3.5	0.35	2.35	5.76
2.76	-	0.92	0.19	1.2	0.25	2.4	-	1.4	1.01	0.81
0.07	0.02	0.03	0.04	0.03	0.03	0.07	0.06	0.04	0.05	0.1
1.82	0.81	0.93	0.51	0.75	0.31	1.3	0.98	0.62	1.39	5.46
3.3	0.72	1.34	3	2.46	1.51	2.95	2.2	1.13	2.58	6.72
2.48	2.31	2.69	4.18	2.86	3.28	3.27	4.14	2.48	1.95	1.47
5.16	4.76	4.57	4.93	5.11	4.99	4.62	3.65	6.28	5.63	5.83
0.25	0.11	0.11	0.18	0.11	0.03	0.2	0.26	0.15	0.16	0.31
0.84	2.1	3.32	1.54	1.93	0.81	0.69	0.95	1.23	2.57	6.32
11	-	-	-	-	-	9	7.6	4.7	-	-
73	17	29	-	-	-	-	-	-	55	171
33	11	19	-	-	-	37	24	21	27	191
-	-	-	-	-	-	5	5	3.9	-	-
14	8	9	-	-	-	-	-	-	11	68
287	521	341	259	272	385	288	330	332	413	361
486	55	115	266	240	91	248	88	100	368	831
-	23	9	50	106	35	26	27	77	26	25
276	100	118	250	202	214	147	137	77	228	264
-	10	10	13	11	10	15	17	5	15	11
-	-	-	-	-	-	-	-	-	-	-
991	105	283	620	635	231	448	161	354	523	1101
84	19	29	75	61	71	29	32	19.5	79	99
164	38	44	114	128	133	59	65	40	141	157
63	-	-	60	63	50	25	31	16	-	-
9.4	-	-	11.5	15	9.4	5.5	6.6	4.74	-	-
2.21	-	-	1.74	2.57	0.82	1.02	0.61	0.65	-	-
-	-	-	-	-	-	-	-	-	-	-
1.1	-	-	-	-	-	0.59	0.76	0.46	-	-
2.67	-	-	4.5	10.1	3.4	1.46	1.92	2	-	-
0.44	-	-	0.78	1.94	0.63	0.24	0.29	0.29	-	-
7.9	-	-	-	-	-	-	-	2.3	-	-
1.7	-	-	-	-	-	-	-	0.88	-	-
54	-	-	31	33	53	20	33	8.9	-	-
-	-	-	-	-	-	-	-	-	-	-
0.714	-	-	0.7196	0.71354	0.7131	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	18.732	18.752	18.723	-	-	-	-	-
-	-	-	15.672	15.684	15.663	-	-	-	-	-
-	-	-	38.895	38.914	38.859	-	-	-	-	-