PLIO-QUATERNARY MAGMATISM IN ITALY: AN INTRODUCTION

by

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ABSTRACT

The circum-Tyrrhenian area is one of the most complex magmatic setting on Earth. Plio-Quaternary magmatism exhibits an extremely variable composition, which spans almost entirely the spectrum of magmatic rocks occurring world-wide. Magma types, range from ultrabasic to acid, from oversaturated to strongly undersaturated in silica, and include tholeiitic, calcalkaline, shoshonitic and Na- and K potassic alkaline and ultra-alkaline compositions (Fig. 1). This variable magmatic setting reveals compositionally complex sources, whose nature and geodynamic significance are still a matter for debate.

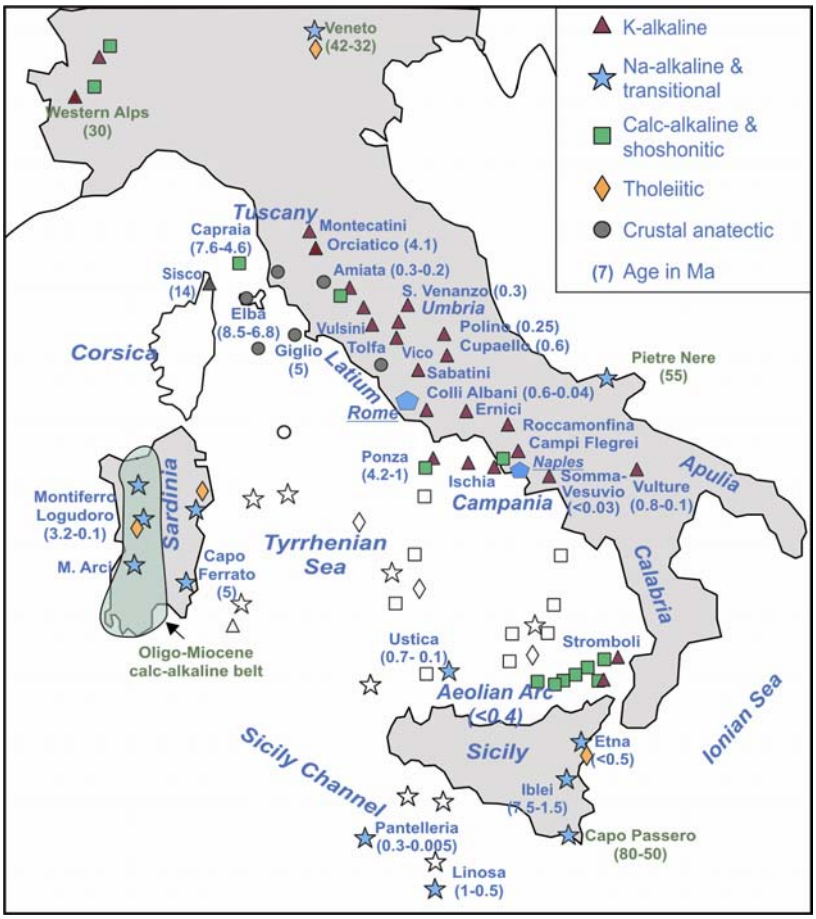

Figure 1. Distribution, petrochemical affinity and ages of the main Plio-Quaternary magmatic centres in Italy. Location of the Cretaceous to Miocene magmatic rocks of Capo Passero, Pietre Nere, Sardinia, Western Alps and Veneto is also reported. Open symbols refer to outcrops below the sea level. From Peccerillo (2003, 2005), modified.

Petrological and geochemical data provide a basis for distinguishing various magmatic provinces (or regions or districts), which show different major element and/or trace element and/or radiogenic isotope compositions. These are: Tuscany Province, Intra-Apennine or Umbria Province, Roman Province, Ernici-Roccamonfina Province, Neapolitan-Pontine (Campanian) Province, Vulture or Apulian Province, Aeolian Arc Province, Sicily Province, Sardinia Province and Southern Tyrrhenian Sea Province (Fig. 2). These provinces are divided between each other by important tectonic alignments such as the Ancona-Anzio and the Ortona-Roccamonfina lines.

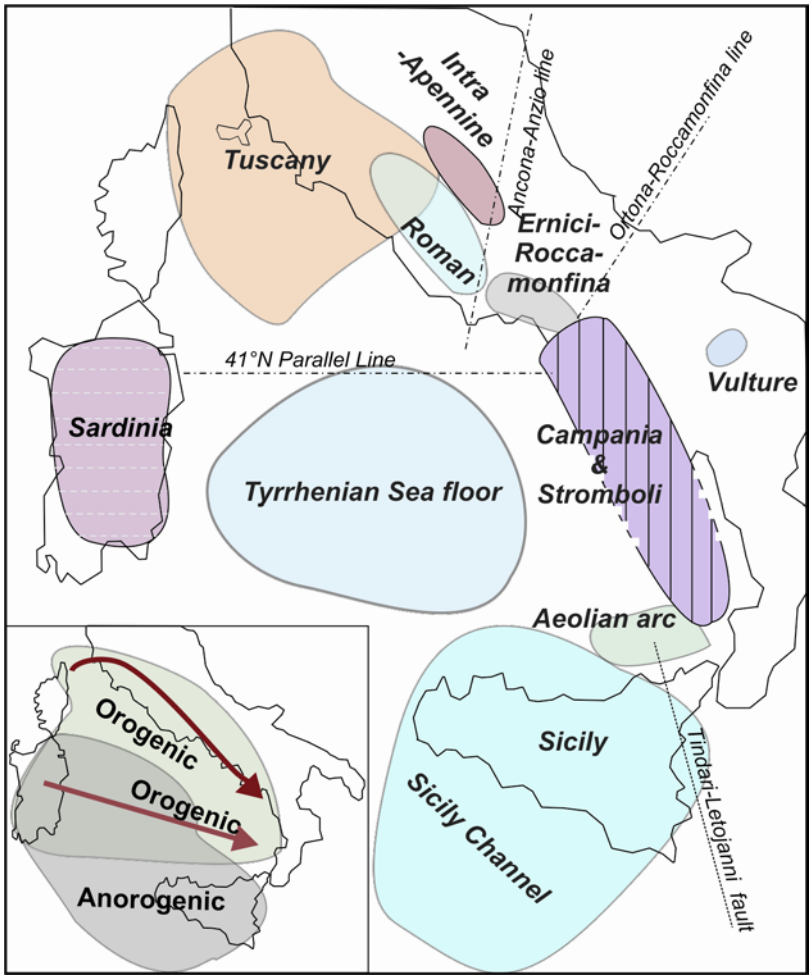

Figure 2. Magmatic provinces in Italy. Inset: distribution of volcanism with orogenic (i.e. high LILE/HFSE ratios) and anorogenic (i.e. low LILE/HFSE ratios) compositions. Arrows indicates migration of orogenic magmatism from Oligocene to present. From Peccerillo (2003, 2005), modified.

The Tuscany Province (14-0.2 Ma) consists of silicic magmas generated through crustal anatexis, plus mantle-derived calcalkaline to ultrapotassic mafic rocks, and various mixtures of mantle and crustal melts. The Roman, Umbria, Ernici-Roccamonfina and Neapolitan provinces (0.8 Ma to present) are formed by mantle-derived potassic to ultrapotassic rocks having variable trace element

and isotopic compositions. The Aeolian arc (0.4 Ma to present) mainly consists of calcalkaline to shoshonitic rocks; Stromboli shows strong compositional affinities with the Neapolitan volcanoes and, as indicated in Fig. 2, it could be considered as belonging to the Campanian Province rather than to the Aeolian arc. The Sicily Province contains young to active centers (notably Etna) with a tholeiitic to Na-alkaline affinity. Finally, volcanoes of variable composition occur in Sardinia and, as seamounts, on the Tyrrhenian Sea floor.

Magmas in the Aeolian arc and along the Italian peninsula have subduction-related or "orogenic" geochemical signatures, i.e. high ratios of LILE/HFSE and Pb/LREE with negative anomalies of Ta, Nb and Ti and positive spike of Pb in the incompatible element patterns of mafic rocks (Fig 3a). Overall, orogenic magmatism shows a decrease in age from the Oligo-Miocene volcanism of Sardinia to the Neapolitan area and the southern Tyrrhenian Sea (Fig. 2, inset). The Sicily and Sardinia Provinces display intraplate (anorogenic) signatures, i.e. low ratios of LILE/HFSE and Pb/Ce, and a positive spike or no negative anomalies of Ta, Nb and Ti (Fig. 3b). Anorogenic and orogenic volcanics coexist on the Tyrrhenian Sea floor.

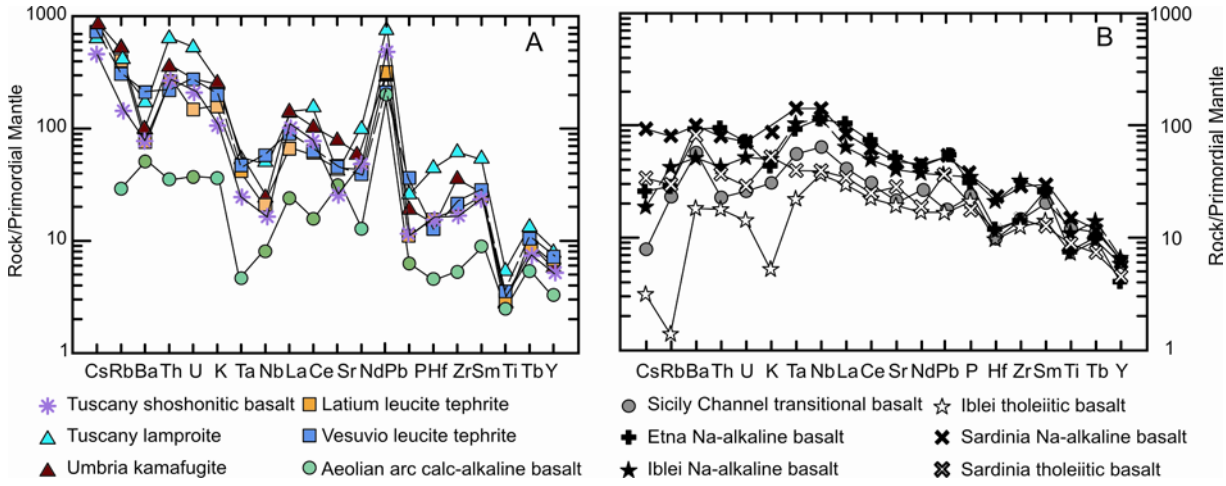

Figure 3. Patterns of incompatible elements normalised against mantle compositions for representative Italian Plio-Quaternary mafic rocks (MgO > 5 wt%). From Peccerillo (2005), modified.

The largest part of Plio-Quaternary magmas in the Tyrrhenian Sea area is of mantle origin. The geochemical and isotopic complexities reveal that the upper mantle beneath Italy consists of various domains, spanning both orogenic and anorogenic compositions. Isotopic data suggest that compositional heterogeneity originated from mixing among various mantle reservoirs, and between these and subduction-related crustal material. This mostly occurred during the Cenozoic-Quaternary geodynamic evolution of the western Mediterranean, but older metasomatic processes (e.g. during Hercynian orogeny) also contribute significantly to compositional heterogeneity of the upper mantle.

Bibliography

PECCERILLO A. (2003) *Plio-Quaternary magmatism in Italy.* Episodes, 26, 222-226.

PECCERILLO A. (2005) *Plio-Quaternary volcanism in Italy.* Petrology, Geochemistry, Geodynamics. Springer, Heidelberg, 365 pp.