



## **The transition between orogenic and anorogenic magmatism in the western Mediterranean area. The Middle Miocene volcanic rocks of Isola del Toro (SW Sardinia, Italy)**

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The Isola del Toro is a small island ( $\sim 1 \text{ km}^2$ ) about 5 nautical miles SW of Sardinia. The island is entirely made up of mildly alkaline sodic evolved rocks (benmoreites and trachytes) related to each other by fractionation processes.

In Sardinia there were two distinct magmatic episodes during the Cenozoic: the first, of Oligo-Miocene age ( $\sim 32\text{-}15 \text{ Ma}$ ), is considered to be related to subduction of a NW-dipping oceanic lithosphere; the second is upper Miocene-Quaternary ( $\sim 7\text{-}0.1 \text{ Ma}$ ), and shows *anorogenic* geochemical characteristics.

$^{40}\text{Ar}/^{39}\text{Ar}$  dating of an anorthoclase mineral separate from a trachyte gave an age of  $11.83 \pm 0.10 \text{ Ma}$ . This age estimate fall within an interval previously considered amagmatic in Sardinia.

Initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ranges from 0.70481 to 0.70544, without correlation with  $\text{SiO}_2$ , whereas  $^{143}\text{Nd}/^{144}\text{Nd}$  ranges from 0.512783 to 0.512750, showing a good correlation with  $\text{SiO}_2$ . The samples with the highest  $^{87}\text{Sr}/^{86}\text{Sr}$  are likely to reflect contamination by sea water. Major and trace element and Sr-Nd isotopic compositions of the Isola del Toro volcanic rocks share more similarities with the oldest products of the upper Miocene-Quaternary magmatic phase (Capo Ferrato, Guspini, Rio Girone) than with those of the Oligo-Miocene Sulcis magmatism. The results of this study shift the beginning of the upper Miocene-Quaternary volcanism of Sardinia back to the late Serravalian, thus reducing the time gap of magmatic activity between the two magmatic phases to less than 4 Myr.

The transition between *orogenic* (subduction-related) and *anorogenic* (intraplate-like) activity in Sardinia is markedly different from that recorded in the rest of the circum-Mediterranean area (e.g., SE Spain, Morocco, Algeria, S France, Carpatho-Pannonian Region, Serbia, Turkey). In the other circum-Mediterranean districts this transition is much more gradual, both in time and in terms of magma composition (i.e., with formation of hybrid magmas with geochemical compositions intermediate between classical subduction-related and intraplate-like magmas). On the other hand, the transition between *orogenic* and *anorogenic* magmatism in Sardinia is rather sharp and lacks hybrid compositions. The association of nearly coeval magmas in the same area with extremely different geochemical characteristics must be related to different mantle sources: lithospheric mantle for the *orogenic* lavas and asthenospheric mantle for the *anorogenic* rocks.

The Isola del Toro volcanic rocks represent the first *anorogenic* products produced during the opening of the western Mediterranean Sea.