Nd-Sr-Pb Isotopic Link Between Panarea And Sardinia Predating the Opening of the Tyrrhenian Sea

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BACKGROUND

Plio-Quaternary Tyrrhenian magmatism in the Italian peninsula and Aeolian volcanic rocks is characterized by systematic trends in Sr-Nd-Pb isotopic space, implying different mantle end-member source contributions [1] and reference therein. The isotopic trends also support the notion of mantle-crust interaction during magma genesis. In the general context of the investigation of upper mantle processes in orogenic areas, we present new isotopic data on lava and tephra from Panarea Island representing its entire eruptive history. These data together with those from GEOROC [2] database and Mt. Somma-Vesuvius geochemical archive [3] allow for a regional evaluation of the isotopic trends in the Tyrrhenian region.

Panarea Island

Panarea is the oldest (200±15ka) and smallest island (3.3 km²) of the Aeolian archipelago and is located in the southern margin of the Tyrrhenian Sea, west of the Italian peninsula. Panarea and surrounding islands are remnants of subaerial eruptions built upon a submarine volcanic calc-alkaline basement that covers about 460 km².

RESULTS

Panarea rocks vary from andesite to rhyolite, show a systematic depletion of CaO, Fe₂O₃, MnO, MgO, TiO₂ wt.% and enrichment in alkalis consistent with crystal fractionation.

Nd-Sr-Pb Isotopes

Volcanic rocks from the Aeolian Islands show an increase of Pb from West to East. Note that it is possible to use the ²⁰⁷Pb/²⁰⁴Pb as a regional discriminant from east to the central Aeolian archipelago to the west islands.

CONCLUSIONS

The complex geodynamic history of the Tyrrhenian area has likely played a fundamental role in the development of the large compositional variation and different mantle end-member signature observed.

In the larger regional context, Panarea Sr-Nd-Pb isotopic compositions fall midway between the compositions of the calc-alkaline western sector and Stromboli and Campanian volcanic rocks (located in the Aeolian eastern sector and Southern Italian Peninsula respectively). Notably, some rocks in Panarea display comparable Pb-Sr isotope compositions but much lower Nd-isotope ratios (²⁰⁶Pb/²⁰⁴Pb 0.512235-0.512415) than previously found in the Aeolian archipelago.

Systematic trends in Sr-Nd-Pb isotopic space, implicate different mantle end-member source contributions [1], and reference therein. The isotopic trends also support the notion of mantle-crust interaction during magma genesis. Notably, some rocks in Panarea display comparable Pb-Sr isotope compositions but much lower Nd-isotope ratios than previously found in the Aeolian archipelago. Nd and Sr isotopic compositions plot close to the fields of the northern and central Plio-Quaternary volcanic rocks (e.g.Mt. Arci) and Oligo-Miocene rocks from Sardinia and trend toward a mantle end-member (EM1). This newly observed isotopic similarity between Panarea and Sardinia could represent an ancient source link predating the opening of the Tyrrhenian Sea that can be explained by 1) delamination of the Sardinian lower crust during Hercynian continental collision, or 2) modification of the lithospheric mantle during Oligo-Miocene arc-volcanism, coeval back arc extension, and counter-clockwise rotation of the Corsica-Sardinia block.

References


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