

Magma Evolution at Filicudi Volcano, Aeolian Arc, Italy

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The Island of Filicudi is a multicenter volcanic complex in the Aeolian Arc, southern Tyrrhenian Sea. It consists of several monogenic and polygenic centres, parallel to the main regional structural lineaments, built up by explosive and effusive activity over a time span between about 1 Ma and 40 ka. Stratigraphic investigations and dating have defined four main cycles of activity interrupted by periods of quiescence. Volcanic rocks range in composition from calcalkaline basalts to dacites. New major, trace element and isotopic (Sr, Nd, Pb) data are reported and discussed with the aim of determining compositional variations and exploring petrogenetic implications. The analysed rocks display negative correlation between silica vs. MgO, CaO, TiO₂ and FeO_{total}; instead, K₂O, Na₂O and P₂O₅ increase from basalts to dacites. LILE and HFSE increase with silica, whereas ferromagnesian trace elements have an opposite tendency. The main stratigraphic sequences reconstructed on Filicudi display irregular variations of rock evolution over time, with recurrent reversals to more basic compositions. Both major and trace elements define linear correlation on inter-element diagrams, and curved trends typical of fractional crystallisation processes are rarely observed. ⁸⁷Sr/⁸⁶Sr is poorly variable, from 0.7040 to 0.7047, and show overall higher values in the mafic than in the sialic rocks. Such a tendency is also shown by the nearby volcano of Alicudi. Nd isotope ratios

range from 0.51267 to 0.51276 and are negatively correlated with ⁸⁷Sr/⁸⁶Sr. Pb isotope ratios cluster around ²⁰⁶Pb/²⁰⁴Pb = 19.0-19.7, ²⁰⁷Pb/²⁰⁴Pb = 15.64-15.69, ²⁰⁸Pb/²⁰⁴Pb = 39.1-39.5. Major, trace element and isotopic variations reveal complex, multistage polybaric evolutionary processes for the Filicudi island. However, linear trends observed on inter-element diagrams suggest that mixing processes have played a main role. The overall decrease of Sr isotope ratios from mafic to intermediate rocks suggests that interaction with crustal material affected more heavily mafic than sialic magmas; this could be related to higher temperature of basaltic melts, which were able to assimilate higher amounts of continental crust. When compared with other Aeolian arc volcanoes, Filicudi shows intermediate petrological and geochemical characteristics between the nearby islands of Salina and Alicudi. The three islands consist of calcalkaline rocks, but the degree of magma evolution increases while going from the Alicudi in the west to Salina in the central sector of the arc. These variations are likely related to the plumbing system of the three volcanoes. The regional tectonic stress regime deeply influenced the volcanic activity of the area. However, trace element and isotopic evidence also suggest that there are significant variations of primary magmas, which reveal a zoned source which suffered different types of metasomatism.