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Temporal evolution of the Western and Central volcanism of the Aeolian Island Arc (Italy, southern Tyrhhenian Sea)

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The Aeolian Archipelago is a volcanic arc in the Southern Tyrrhenian Sea located on the continental margin of the Calabro-Peloritan basement. The Aeolian volcanism occurs in a very complex geodynamic setting linked to the convergence of the European and African plates. For that reason, it is strongly related to regional tectonic lineaments, such as the NW-SE trending Tindari-Letojani (TL) fault. The archipelago consists of seven main islands and several seamounts, which extend around the Marsili Basin, forming a ring-like shape, typical for an island arc. While the seamounts began their activities around 1 Ma , the emerged part is active since about 400 ka. The magmatic products of the whole arc range from typical island arc calc-alkaline (CA) and shoshonitic series, to slightly silica undersaturated potassic alkaline series that are typical of post-collisional settings. Furthermore, the TL fault, along which the Lipari and Vulcano islands are developed, separates a calc-alkaline western sector (Alicudi, Filicudi and Salina islands) from the calc-alkaline to potassic eastern system (Panarea and Stromboli islands) (Peccerillo,1999). This makes of the Aeolian Islands a complex volcanism, with a still controversial origin.

In this context, the aim of this work is to constrain the sources and spatio-temporal evolution of this magmatism. We present here new K-Ar ages based on the accurate Cassignol-Gillot technique devoted to the dating of very young rocks (Gillot et Cornette, 1986). These geochronological data were used together with new geochemical data on the same samples. In this study, we attempt to understand the origin of those magmatic events and the relationship between the deep processes and the shallow structures. Our results allow us to define specific periods of very quick geomechemical changes. In the case of Filicudi island, the first rocks range in composition from CA basalts to andesites. This period ended with the edification of the Mte Guardia at 189±4 ka. Then the activity was followed by the construction of the Mte Terrione at 168±4 ka (Gillot 1987), which is matched by High K-Ca andesites emplaced in the Chiumento crater. Therefore, two different magmatic series took place in only 15 ka. The last eruption of Filicudi built the High K-CA dacite lava dome of Mte Montagnola. For Lipari island, the same event is observed around 120-100 ka. In fact, the emitted products evolved from CA andesitic basalts, that emplaced from 256±8 ka (Monte Chirica) to 119±7 ka (Monterosa), to High K-CA andesite after 100 ka. The rocks becam more and more differentiated to achieve High K-CA rhyolite composition during the last 40 ka. At the same time, the Monte Fossa delle Felci of Salina island shows a geochemical “excursion” around 100 ka, characterised by High K-CA dacite. The lower limit of Pollara explosive eruption, that emitted High K-CA rhyolite products, is constrain by a Monte dei Porri lava flow affected by Pollara crater and dated at 13±2 ka. Thus, all these magmatic changes correlate with morphological and volcanic variations.

Finally, our first results confirm that the Aeolian arc volcanism is generated in a complex source, with important roles of both arc-type and anorogenic-type compositions. Datings on key samples show that role of different mantle sources change within a very short time span, especially in the central portion of the arc, along the TL lithosheric fault system. This work also gives new geochronological constrains on the duration of magmatic evolution and eruptive phases.