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Aeromagnetic anomalies reveal hidden tectonic and volcanic structures in the Aeolian Islands, southern Tyrrhenian Sea, Italy

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The structures of the Southern Tyrrhenian Sea active volcanoes have been successfully investigated through the use of the magnetic data. Particularly, several high resolution aeromagnetic campaigns have been carried out on the Aeolian Archipelago and its western limit by the Airborne Geophysics Science Team of Istituto Nazionale di Geofisica e Vulcanologia of Roma. The results indicate that the volcanism is controlled by tectonic structures both at local and regional scale. The emplacement of magnetized bodies (e.g. volcanic conduits, dikes swarms, intrusions) is along or strictly correlated with this tectonic framework. The consolidation of highly magnetized material inside the volcanic conduits determines contrast with surrounding less magnetized material producing intense magnetic anomalies. Therefore, modeling of these sources is suggestive of the position and deep extent of eruptive vents, especially in the offshore area, where we do not know where future submarine activity may take place (De Ritis et al., 2005). We present here a case study were the magnetic tool resolved a geological interpretative problem that was not settled earlier. In fact, in the Calabria mainland, widespread, dacitic to rhyolitic pumices with calc-alkaline affinity of Pleistocene age (1-0.7 Ma) are exposed. The tephra falls are related to explosive activity and show thickness decreasing from the Capo Vaticano area southeastward. The lithics indicate a source located not far from Capo Vaticano. The interpretation of the magnetic anomaly field together with the other geological and geophysical data has allowed to discover the presence of a previously unknown volcanic structure (De Ritis et al., 2010), very close to the Calabria Western coast (Capo Vaticano). Aeromagnetic data collected between the Panarea island and the Calabria arc highlight a WNW-ESE elongated positive magnetic anomaly centered on the Capo Vaticano morphological ridge. Forward and inverse modeling show a magnetized body extending from the bathymetric surface to about 3 km of depth. The magnetic properties of such a body are consistent with those of the medium to highly evolved volcanic rocks of the Aeolian Arc, i.e. dacites and rhyolites. The combined interpretation of the magnetic and available geological data reveal that (1) the Capo Vaticano WNW-ESE elongated positive magnetic anomaly is due to the occurrence of a WNW-ESE elongated sill; (2) such a sill represents the remnant of the plumbing system of a Pleistocene volcano that erupted explosively producing the pumice tephra exposed in Calabria; and (3) the volcanism is consistent with the Aeolian products, in terms of age, magnetic signature, and geochemical affinity of the erupted products. The results indicate that such volcanism developed along seismically active faults transversal to the general trend of the Aeolian Arc and Calabria block, in an area where uplift is maximized (4 mm/yr). Such uplift could also be responsible for fragmentation of the upper crust and formation of transversal faults along which seismic activity and volcanism occur.