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Quaternary fault-controlled volcanic vents and crustal thinning: new insights from the magma-rich Tyrrhenian passive margin (Italy)

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The discover of monogenic Quaternary volcanic vents, that were recently mapped along major fault zones both inland and offshore the Tyrrhenian magma-rich passive margin, poses questions about: timing and role they had into Plio-Pleistocene crustal thinning with relevant consequences for the hazard assessment of an area inhabited by some 0.5 million people. The present-day margin is stretched over 100 km between the Volsci Range (VR) and the Pontian escarpment, being defined by moderate shallow seismicity (Mw$\leq$4.6), relative high geothermal gradient and ongoing hydrothermal activity. Although major central volcanoes (e.g., Colli Albani), occurring at major fault intersections are well studied, smaller volcanic fields were so far unconstrained. Both field survey in the VR and offshore high-resolution geophysical data, allow us to: 1) better define the anatomy of the poorly known VR volcanic field; 2) furnish new insights on the regional Quaternary dynamics; 3) propose modes and reason of magma emplacement. The VR is composed of about 40 punctual and linear monogenic and mostly phreatomagmatic vents occurring at the edges of the Apennine carbonate fold-and-thrust belt and within the VR backbone. Volcanites are characterized by zeolitized to incoherent tuffs and surge deposits locally covered by lavas and slope deposits. Most explosive units host carbonate-rich lithics with different degrees of rounding and decarbonation, which frequently belong to Albian-Cenomanian aquifers. By comparing cross-section with lithic analyses we demonstrate that fragmentation, transport, progressive disintegration and decarbonation occur at multiple depths, depending on the fold-and-thrust belt setting. Thus, along the same vent zone, juvenile lithic composition proves repeated fragmentation within pressured-aquifers, testifying for fissural activity with implications for local seismic and volcanic assessment. Pyroclastic deposits occur as well in the Pontina and Fondi coastal plains at shallow depth suggesting recent (<10 kyr) and possibly local eruptions. Offshore, 25 km north of Ventotene, a middle Pleistocene 200 m-high truncated volcano was found partially covered by middle to recent deposits. It is delimited by well defined WNW-striking fault-controlled escarpment dissected by NE-striking faults. As on the Ponza-Zannone high, volcanic complex occur on a horst intersecting the two main regional trends, possibly associated with younger SE-stretching. Quaternary stretching rotation occurs as a response to Tyrrhenian back-arc opening and contemporaneous inarching of the Apennine front. In this frame, frontal to lateral slab tearing and retreat is tracked by E-rejuvenated volcanic activity along the Palmarola-Vesuvius lineament. In conclusion, we argue about the role NE-dipping crustal detachment(s) may have played into crustal thinning, driving and occasionally hampering magma-emplacement.