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The Volsci Volcanic Field (central Italy): Anatomy of a tectonically controlled, carbonate-seated, volcanic activity

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The Quaternary Volsci Volcanic Field (VVF) represents one of the products of the west-directed subduction of the Adriatic slab that drove the development of the Apennine mountain belt in central Italy. Here, we present new results on the eruptive history and the diatreme processes of exemplar tectonically controlled carbonate-seated maar-diatreme volcanoes. The VVF is defined by phreatomagmatic surge deposits, rich in accidental carbonate lithics, and subordinate Strombolian scoria fall deposits and lava flows, locally sourced from some tens of monogenetic eruptive centers, mostly consisting of small volume (0.01-0.1 km³) tuff rings and scoria cones. In light of new ⁴⁰Ar/³⁹Ar geochronological data and compositional characterization of juvenile eruptive products, we refine the history of VVF activity and envisage the implications on the pre-eruptive magma system and the continental subduction processes involved. Leucite-bearing, high-K (HKS) magmas mostly fed the early phase of activity (□761–539 ka); primitive, plagioclase-bearing (KS) magmas appeared during the climactic phase (□424–349 ka), partially overlapping with HKS ones, and then prevailed during the late phase of activity (□300–231 ka). As the volcanic centers cluster along high-angle faults, we investigate the relationships between faulting and explosive magma-water interaction, as well as the distribution pattern of the eruptive centers. New field data allowed to retrieve the fold-and-thrust belt structure associated with the eruptive centers. Analysis of componentry, grain-size, degrees of whiteness and roundness of carbonate lithic inclusions, along with their micropaleontological features, has allowed to establish volcano tectonic correlations. In our interpretation, the clustering of eruptive centers is controlled by tectonic features. Specifically, a first order control is tentatively related to crustal laceration and deep magma injection along a ENE-trending Quaternary lateral tear in the slab and to Mesozoic rift-related normal faults. A second-order control is provided by orogenic structures (mainly thrust and extensional faults). In particular, magma-water explosive interaction occurred at multiple levels (< 2.3 km depth), depending on the structural setting of the Albian-Cenomanian aquifer-bearing carbonates, which are intersected by high-angle faults. The progressive comminution, rounding and whitening of entrained carbonate lithics allow us to trace multistage diatreme processes. Finally, our findings bear implications on volcanic hazard assessment in the densely populated (> 0.4 million people) areas of the Volsci Range and adjoining Pontina Plain and Middle Latin Valley.

