

Petrogenetic Processes and Metallogenic Potential in the Veneto Volcanic Province (VVP), North-east Italy

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The Veneto Volcanic Province (VVP) is the largest magmatic unit of the Adria plate, located across Trentino and Veneto regions in northeastern Italy. Formed mainly during the Paleogene, it comprises five districts: Val d'Adige, Lessini Mountains, Berici Hills, Euganean Hills, and Marostica Hills; dominated by mafic to ultramafic rocks (nephelinites to tholeiites) and locally by felsic sub-volcanic bodies in the Euganean Hills. The VVP records intraplate magmatism associated with transtensional rifting during the collision of the European and Adria plates. Proposed mechanisms include decompression melting, slab breakoff, or mantle flow bypassing the Alpine slab, isolating the magmas from subduction fluids.

Based on available geochronological data, volcanism migrated southeastward between ca. 51 and 20 Ma, starting in the Lessini Mountains and Val d'Adige, shifting through the Berici and Euganean Hills, and ending in the Marostica Hills in early Miocene. Our study refines these ages with U-Pb zircon dating and investigates the petrogenesis and metallogenic potential of the VVP using bulk-rock geochemistry, including radiogenic isotopes analysis (Sr, Nd, Pb), and zircon plus apatite trace-element data and Hf isotopes.

Mafic rocks from Val d'Adige, Lessini, and Marostica range from foidites to alkali basalts with OIB-like signatures, while Euganean Hills rocks show compositions from tholeiitic basalts to rhyolites, indicating crustal assimilation and/or fractional crystallization. REE modelling of primitive mafic rocks suggests a metasomatized mantle source enriched in incompatible elements, with isotopic signatures resembling HIMU-FOZO reservoirs and minor EMI contributions.

Metallogenic evaluation indicates that Euganean intermediate-felsic bodies align with major element trends of Au-rich Cu-Au porphyry systems, whereas the mafic units only partially align, matching key trace-element ratios such as Sr/Y, but diverging for La/Yb and Dy/Yb. Ongoing AFC modelling aims to reproduce evolved VVP compositions and, together with zircon-apatite geochemistry, further evaluate the province's mineralization potential.