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The "hidden" craton in the Adria plate: evidence from geochemistry and Re-Os of mantle xenoliths from Veneto Volcanic Province (North-East Italy)

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The Veneto Volcanic Province (VVP; e.g., Beccaluva et al., 2007) is one of the widest Cenozoic magmatic districts of the Adria (or Apulia) plate. From late Paleocene to early Miocene, the VVP magmatic activity developed within several volcanic districts: Val d'Adige, Lessini Mts., Marosticano, Berici Hills, and Euganean Hills. Magma generation appears to have been triggered by decompression related to extensional deformation in the Southalpine foreland in response to the general north-south compression during the Alpine orogenesis. Most of the volcanic products are relatively undifferentiated lavas, from nephelinites to tholeiites (Beccaluva et al., 2007). VVP alkaline lavas commonly carry mantle xenoliths. According to previous studies on Val d'Adige and Lessini Mts. peridotites, the mantle beneath the VVP exhibits geochemical features typical of off-craton mantle variably affected by Na-alkaline silicatic metasomatism. However, a newly-discovered suite of anhydrous, spinel-bearing mantle peridotites from the Marosticano district revealed unexpected characteristics (Brombin et al., 2018). These xenoliths exhibit highly refractory compositions comparable with those observed for cratonic peridotites worldwide. In addition, the high forsterite contents of their olivine (Fo: 91-93) indicate high degrees of partial melting (>25%) that should have led to the complete consumption of clinopyroxene and sulphide. Therefore, the occurrence of clinopyroxene in the Marosticano rocks implies metasomatic re-enrichment. In particular, the i) LREE-enrichments of Marosticano clinopyroxene and ii) the dissolved CO_2 mole fractions (up to 1.0) of the inferred clinopyroxene-forming melt are consistent with metasomatism by carbonatite/CO_2-rich silicate melts. The latter could be responsible for the equilibration temperatures and oxidizing conditions, which are anomalously high for a cratonic environment but similar to the off-craton VVP xenoliths. Another intriguing link between VVP on-craton (Marosticano) and off-craton (Lessini Mts. and Val d'Adige) mantle domains is the similarity of the Re-Os ages. Sulphide Re-Os isotopic in situ measurements, performed for the first time on the VVP mantle domain, allow dating of the main melting event that affected this mantle section, i.e. transformation of fertile asthenospheric material into a depleted, buoyant lithosphere (Alard et al., 2002). The Re-Os model ages (TMA) for the entire VVP domain range between 2.0 and 2.8 Ga, with one value at 3.1 $\pm$ 0.08 Ga, confirming the derivation of Marosticano peridotites from ancient (cratonic) mantle and also suggest a "hidden" cratonic signature for Val d'Adige and Lessini Mts. lithospheric mantle. These results allow a re-interpretation of the geodynamic evolution of the VVP lithosphere. The Marosticano domain can be interpreted as a vestige of an Archean/Proterozoic cratonic keel, whose signature was not erased by the carbonatite/CO_2-rich silicatic metasomatism, whereas the xenoliths from the Lessini Mts. and Val d'Adige are remnants of circumcratonic domains compositionally rejuvenated by infiltration of asthenosphere-derived melts, whose upwelling could be induced by the retreat of the subducting European slab below the Adria plate.

References

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