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Olivine-rich troctolites from the Internal Liguride ophiolites (Northern Apennine, Italy)

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The Internal Liguride ophiolites from Northern Apennine represent an intra-oceanic domain of the Middle to Late Jurassic Ligure-Piemontese basin. These ophiolites are characterised by morphological highs made of gabbroic rocks preserving intrusive relations with mantle peridotites (Cortesogno et al. 1987). The gabbroic plutons consist mostly of coarse-grained gabbros to olivine-gabbros and contain, at different stratigraphic levels, sill-like lenses of olivine-rich troctolites. These lenses are commonly tens of metres in thickness and hundred of metres in length. The olivine-rich troctolites are mainly composed of rounded to polygonal olivine (generally 70-90 vol%), anhedral plagioclase, minor poikilitic clinopyroxene and accessory spinel (Bezzi and Piccardo 1971). They are locally associated with layers (up to tens of centimetres in thickness) that vary modally from troctolite to anortosite and chromitite. One of the studied olivine-rich troctolite lenses shows a metre-scale layer displaying a “harrisite” pegmatoid texture, in which huge skeletal olivines (up to 30 cm) are intergrown with plagioclase (Bezzi and Piccardo 1971). In addition, gabbroic dykelets (mm- to cm-scale in thickness) displaying fuzzy contacts towards the olivine-rich troctolites occur in places.

Olivine from the olivine-rich troctolites has forsterite ranging from 88 to 85 mol% and NiO concentrations of 0.3 wt%. Spinel has Cr# and TiO2 varying from 54 to 46 and from 2.7 to 1.0 wt%, respectively. Clinopyroxene displays Mg# ranging from 90 to 86 and high amounts of Al, Cr and Ti; its REE pattern is LREE-depleted with nearly flat HREE, thus showing equilibrium with MORB-type melts. Increasing total REE abundances in clinopyroxene are associated with the development of negative Eu anomaly. The outermost rim of clinopyroxene is Al- and Cr-depleted and Ti-enriched compared to the core. Accessory Cr- and Ti-rich amphibole is locally present, as rim around spinel and as inclusion within spinel. Other silicate inclusions in spinel are Cr- and Ti-rich phlogopite, Cr- and Ti-rich Na-phlogopite and Al-poor orthopyroxene. As a whole, the compositions of silicate inclusions in spinel document the involvement of melts rich in H2O, alkalies and SiO2.

The olivine-rich troctolites from the Internal Liguride ophiolites bear textural and compositional similarities to the olivine-rich troctolites from modern ocean core complexes in slow and ultraslow spreading ridges. We show that the olivine-rich troctolites of the present study are not cumulates that developed under closed system conditions. Their formation most likely requires a complex interplay of petrogenetic processes, such as porous flow migration into an olivine-rich matrix, as recently envisaged for the olivine-rich troctolites from the Atlantic Massif (e.g. Suhr et al. 2008), melt entrapment and fractional crystallisation, as well as the involvement of primitive MORB and alkaline hydrous melts.

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