Mantle source in Oman ophiolite: insight from pyroxenite layers and dykes, and chromitite minipods from the Miskin massif

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Long debate have been hold about the tectonic setting of the Oman ophiolite. Some researcher outlining the MORB affinity of most magmatic features in favour of a mid-ocean ridge setting and other insisting on the ultra-depleted nature of the mantle and the petrological and chemical characteristics of the metamorphic sole as support for a supra-subduction zone setting. Recent studies have suggested that the tectonic settings may have switched from an open ocean to a subduction zone, explaining most of the characteristics of the ophiolite as well as that of the metamorphic sole. The presence of abundant pyroxenites in the mantle section of the northern massifs and of dykes and lava with andesitic to boninitic affinity suggest a stronger subdcution-related influence in the north and a stronger oceanic influence in the southern massifs of the ophiolite.

The Miskin massif is a small body localized in the central part of the ophiolite. The magmatic dykes contained in its mantle section are almost exclusively pyroxenitic and its crustal section is rich in depleted Opx-rich gabbros suggesting a strong subduction-related magmatic (andesitic or boninitic) influence. Pyroxenitic layers are pyroxene-rich bands parallel to the mantle structures, they show melting relics texture and are ubiquitous in the mantle section of the Miskin massif. Textural and chemical similarities with the mantle harzburgites show that they are in complete equilibrium with the mantle and that they result from the melting of some pyroxene-rich lithologies rather than the crystallisation of a melt intruded in the mantle. At some locations, pyroxenitic layers are transformed into dunite showing that they reacted with a Si-undersaturated melt. Chromitite mini-pod (a few tens of cm wide) may be present in the dunite, which is otherwise devoid of Cr-spinel, suggesting that the pyroxenitic layers melting may have played an important role in chromitite formation.

Discordant pyroxenitic dykes show primitive chemical characteristics with a narrow range of pyroxene Mg# or a rather large scatter in minor and traces elements. Gabbronorite and olivine-gabbro dykes are scarce but, when present, exhibit respectively depleted and MORB chemical compositions. This outline the presence in the Miskin massif of the two MORB and depleted series already described in the Oman ophiolite. Pyroxenite dykes may crystallize from both series, minor and trace element-rich end-member is probably related to the MORB series whereas depleted pyroxenites crystallised from andesitic or boninitic melts. The pyroxenitic nature of some cumlates crystallising from MORB-like melt may be explained in the frame of pyroxenitic layers melting during ridge activity, giving a melt richer in Si and saturated with clinopyroxene.

All these results suggest that pyroxenitic layers are likely to be relics of the melting of pyroxene-rich lithologies previously present within de the mantle, probably recycled subducted crust. This pyroxenitic source may have played a significant role in the formation of mantle dykes, in the magmatic history of the Oman ophiolite and may account for the source dichotomy observed at the whole ophiolite scale.

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