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Variation of magma source in the Oman ophiolite inferred from distribution of magmatic dykes in the mantle

Marie Python (1), Bénédicte Abily (2), Georges Ceuleneer (2), and Shoji Arai (3)

(1) Hokkaido University, Department of Natural History Sciences, Sapporo, Japan (marie@mail.sci.hokudai.ac.jp, +81117460394), (2) Observatoire Midi-Pyrénées, Géosciences Environnement Toulouse (GET), Toulouse, France, (3) Kanazawa University, Department of Earth Sciences, Kanazawa, Japan

Magmatic relics are ubiquitous in the mantle of the Oman ophiolite. They include discordant and concordant dykes showing sharp contact with their host. Their lithological nature is extremely variable but can be classified into four lithological types: troctolites, olivine gabbros, pyroxenites and gabbronorites with euhedral Opx (i.e. where Opx appears early in the crystallisation sequence).

The distribution map of the magmatic dykes show that troctolites and olivine gabbros crop out in two localized area, the main one is centred on the Maqsad mantle diapir. Pyroxenites are highly dominant in the mantle section of the Oman ophiolite but Opx-rich concordant and discordant dykes are abundant only in the northern massifs. On the other hand, these features are scarce or absent in the southern massifs where troctolite and olivine gabbro dykes are abundant. The dykes chemical composition show that they can be linked to two different magmatic series: one is similar to a typical MOR magma, and the other, richer in Si and poor in incompatible elements, is closer to an andesitic to boninitic magma. The dykes lithological nature is partly related to the nature of the parental magma and troctolites and Opx-free olivine gabbros crystallised exclusively from the MOR magma. However, pyroxenites are ubiquitous and may have crystallised from both types of magma. This is in particular reflected in Cr-spinel chemistry, which Cr# is higher and Ti contents lower, and the higher amount of Opx when the parental magma is andesitic. The dyke distribution all over the mantle section of the Oman ophiolite show a clear magmatic dichotomy between the southern and northern parts of the ophiolite. MOR-type magma was preponderant southward to the Nakhl massif while the northern areas are dominated by andesitic to boninitic magma. Mineral chemistry in the lower crust show characteristics intermediate between the two types of melt that circulated in the mantle, suggesting that magma mixing hardly occur in the mantle but may be an important process of ocean crust building. In the lower crust, the most MOR-like gabbros are to the area close to the Maqsad mantle diapir and the andesitic end-member becomes dominant in the northernmost massif, far from the Maqsad diapir. This North-South chemical gradation shows that mixing occurs along the ridge axis, implying that magma can circulate on significant distances along the ridge axis at crustal level.