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Petrological and chemical evolution of oceanic crust above a spreading axis: an example from Wadi Mahram, Oman Ophiolite

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The Maqsad (or Sumail) massif composes the largest block of the Oman ophiolite. It is characterised by a structural mantle diapir elongating along an axis orientated 120^{o} to the North. This mantle diapir represents the axis of the former Oman spreading centre. Previous geological mapping revealed right above the diapir and from the mantle up to the sheeted dyke, a gabbroic crustal section mainly composed of olivine-rich, probably primitive, lithologies. Troctolites are particularly abundant in this section, and crop out at any level of the lower and the upper crustal section. We sampled in Wadi Mahram a transect of this troctolite-rich oceanic crust right above the diapir, thus of the last crust that was formed precisely above the spreading axis.

The lower most section, below 800 m above the mantle-crust transition zone (MCTZ), is mainly composed of a layered dunite-troctolites series characterized by strong variation in their modal composition. In spite of the local presence of olivine-poor gabbroic to anorthositic layers, the section remains dominated rich in olivine-rich facies. Locally, the layered section is cross-cut by discordant olivine gabbro dykes and veins.

From 800 to 2000 m above MCTZ, a stronger diversity is observed in the lithological facies, which varies in the range of plagioclase-free dunite-wehrlite to troctolite and olivine-free isotropic gabbro. Dolerite dykes are observed in the uppermost lithologies whatever their nature (troctolitic, wehrlitic or gabbroic) showing that the sheeted dyke complex roots equally in primitive and differentiated formations. Orthopyroxene is almost absent from the lower most section but appears and becomes abundant above 800 m above MCTZ, its coronitic to poikilitic texture suggest that it comes partly as the reaction product between melt and olivine and as the crystallisation product of late stagnant melts.

The mineral chemistry show that the lower section exhibit on average more primitive characteristics than the upper section. However, the most differentiated lithologies are found below 500 m above the mantle-crust transition zone where they crop out as dykes cross cutting troctolite layered blocks, showing that differentiated melt may be injected directly from the mantle in the lower crust. The upper half section is characterized by a great chemical scatter also reflected by the lithological variability that may be compatible with magma mixing and differentiation. Olivine gabbros are sometimes more primitive than troctolites, which may overlie them, showing that these two lithologies are not strictly linked by a same parental magma. The variation of the mineral chemical composition with depth shows that injection of primitive or differentiated magmas occurred at various level in the crust. The genesis of the crust directly above the spreading axis was driven by complex processes involving successive injections of primitive and differentiated magmas within a crystallising mush, magma mixing and more or less strong melt-rock reaction.

キーワード: Oman Ophiolite, Gabbro, Oceanic crust genesis, Spreading axis, Ocean ridge, Troctolite
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