Petrographical and chemical evolution of a troctolites rich section of oceanic crust located directly above a spreading centre, example from Wadi Mahram, Oman ophiolite

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The Maqsad or Sumail massif in the Oman Ophiolite is known for its well defined mantle structural diapir and other other petrographical and chemical data perfectly matching this structure. The diapir allowed us to locate the axis of the former Oman spreading centre. However, most of the studies conducted on this famous massif concerned the mantle section and published data include mantle harzburgites and mantle dykes and intrusions petrology and chemistry. The crustal section in this massif was mapped with strong details during the 90’ s but its chemistry is only locally known in its lowest part located near the mantle/crust boundary. In this study, we conducted a sequential study of the 2 km thick Wadi Mahram crustal section (from mantle-crust boundary to sheeted dyke transition) located directly above the mantle diapir, i.e. directly above the Oman spreading axis.

The crustal column above the Maqsad diapir is exceptionally rich in troctolites as this lithology represent more than the three quarters of the observed facies and is present at any level from the basis to top of the section. Troctolites are layered in the lower levels, close to the mantle-crust transition zone, intercaled with minor olivine gabbros layers, and the layering is crosscut by centimetre scale olivine gabbro dykes. From the middle to the top of the section, vary textured troctolites progressively become become isotropic at the boundary with the sheeted dyke complex. Meter scale olivine gabbros and olivine-free layers are more abundant at the top. Dolerite dyke cutting troctolite and gabbro structures are abundant near the sheeted dyke complex and probably represent its root system.

Down section mineral chemistry evolution show a considerable contrast between the troctolites and the olivine gabbros. The troctolites chemical characteristics seem to be evolving on a large scale with 2 superposed main bodies at the top and the bottom of the section, about 800 m thick, showing a regular evolution probably in relation to magmatic differentiation during fractional crystallisation. A minor block between these 2 main troctolite bodies show a strong chemical scatter in association with variable textures and mineralogies suggesting that melt mixing and melt/rock reaction were the dominant processes during its formation. Between the layers of troctolites, olivine gabbros layers show petrographical and chemical properties that could have been acquired by local magmatic processes like differentiation in small scaled trapped melt pocket or local melt/rock reaction during melt migration to the surface. As it was already shown by studies on magmatic dykes in the mantle, the presence of differentiated dykes cutting the layered structure at the section bottom show that significant differentiation degree may be reached within the mantle and differentiated melt can be injected from the mantle into the crust. These differentiated melts melt s are however injected during during the late magmatic history of the section as they cut already cooled lower troctolite. Traces of mixing with these differentiated melts are found only at 2 levels kn the crust: at the intermediate vary textured level or at the topmost level, below below the sheeted dyke complex.

Keywords: Oman ophiolite, Troctolite, Lower ocean crust

