STRUCTURAL PETROLOGY OF THE OTHRIS PERIDOTITE (GREECE): MELT IMPREGNATION IN MANTLE LITHOSPHERE

Arjan H. Dijkstra, Martyn R. Drury and **Reinoud L.M. Vissers**

Vening Meinesz Research School of Geodynamics, Structural Geology and Tectonics Group, Universiteit Utrecht, Budapestlaan 4, 3584 CD Utrecht, The Netherlands.

ABSTRACT

We present the results of a structural and petrological study of mantle rocks of the strongly dismembered Othris Ophiolite (Central Greece). The Othris Ophiolite is a remnant of the Mesozoic Tethyan ocean basin. It overlies a series of thrust sheets, which have the characteristics of an Upper Triassic-Jurassic passive margin sequence overlying Triassic volcanics associated with rifting. Earlier work on the mantle rocks of the Othris Ophiolite (e.g. Menzies, 1973) has revealed a wide range of compositions, from strongly depleted harzburgites to fertile plagioclase-lherzolites. Menzies (1973) interpreted these plagioclase-bearing rocks - which contain abundant melt-relics - as fertile mantle rocks undergoing incipient melting and incomplete melt-extraction ('MORB-source' rocks).

Our mapping of the mantle section of this ophiolite has confirmed its compositional heterogeneity. In addition, we find a large (micro)structural variability. The geometry of the mantle massif is dominated by a km-wide mantle shear zone, juxtaposing two blocks with distinct compositional and microstructural characteristics. The western block comprises coarse grained harzburgites with large (100 m scale) dunite bodies. These harzburgites contain interstitial orthopyroxene, and late stage amphibole. In contrast, the eastern block comprises harzburgitic tectonites, which are generally fine-grained. The top of this block consists of plagioclase-lherzolites and -harzburgites. The plagioclase-lherzolites contain abundant melt relics, such as plagioclase ± clinopyroxene in small lenses and gabbroic dykes. We favour an interpretation in which plagioclase and clinopyroxene in these rocks are the cumulate phases of a basaltic melt which impregnated previously depleted harzburgites, rather than that they represent the products of incipient melting of fertile peridotites. Some of these plagioclase-peridotites are heavily serpentinised, and intruded by (unaltered) doleritic dykes, suggesting that this (seafloor) serpentinisation pre-dated the cessation of magmatic activity, and that the plagioclase-peridotites were emplaced to shallow levels in the ocean.

The composition of ophiolitic mantle sections are usually interpreted to reflect degree of melt-extraction. It is generally assumed that mainly harzburgitic mantle sections are formed by a high degree of melt depletion corresponding to fast spreading environments. Ophiolites with lherzolitic mantle sections are thought to correspond to low degrees of melt extraction in slow spreading or rift settings. In Othris, however, we argue that the compositional variability reflects degree of melt-impregnation and refertilisation rather than depletion.

Microstructural analysis shows that the melt impregnation recorded in the Othris mantle rocks occurred mainly at sub-solidus temperatures. This indicates that the thermal lithosphere may have reached well into the mantle during magmatic activity, suggesting the presence of a thin crust and/or a thick lithosphere at the Othris paleo-ridge. Freezing of melt in the mantle part of the oceanic lithosphere will lead to incomplete separation of residual mantle and magmatic crust, and a thick Moho Transition Zone (MTZ). Such a situation can be expected at a ridge with a relatively cold structure, i.e. at a slow spreading ridge, in particular near a transform fault (Fig. 1). In contrast, at fast spreading ridges - such as the Oman paleo-ridge - super-solidus conditions exist up to the Moho level and possibly into the lower crust during magmatism. This leads to a narrow MTZ, as observed in the Oman Ophiolite (Boudier and Nicolas, 1995), a well-developed cumulate sequence and a thick crust.

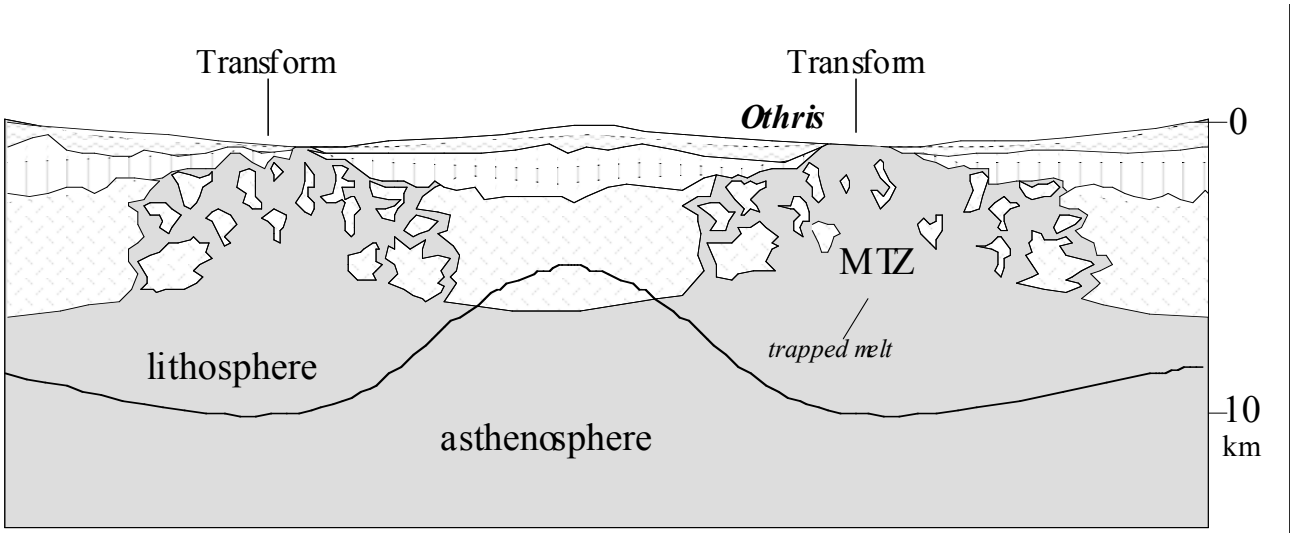

Figure 1 - Along axis section of a typical slow spreading ridge (modified from Ghose et al., 1996).

REFERENCES

Boudier F. and Nicolas, A., 1995. Nature of the Moho transition Zone in the Oman Ophiolite. J. Petrol., 36: 777-796.

Ghose I., Cannat M. and Seyler M., 1996. Transform fault effect on mantle melting in the MARK area (Mid-Atlantic Ridge south of the Kane transform). Geology, 24: 1139-1142.

Menzies M.A, 1973. Mineralogy and partial melt textures within an ultramafic-mafic body, Greece. Contrib. Mineral. Petrol., 42: 273-285.