Petrological Characteristics of the Bou-Azzer Ophiolite, Anti-Atlas, Morocco: Nature of Proterozoic Oceanic Lithosphere

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The Late Proterozoic Bou-Azzer ophiolite is one of the first described Precambrian ophiolites. It forms WNW – ESE elongate belt of 60 km long and 5 km wide (Fig. 1). The Bou-Azzer ophiolite offers a continuous sequence, particularly at Wadi Ait-Ahmane, from the mantle section below the mafic crust upward to the sedimentary cover overlying basalts.

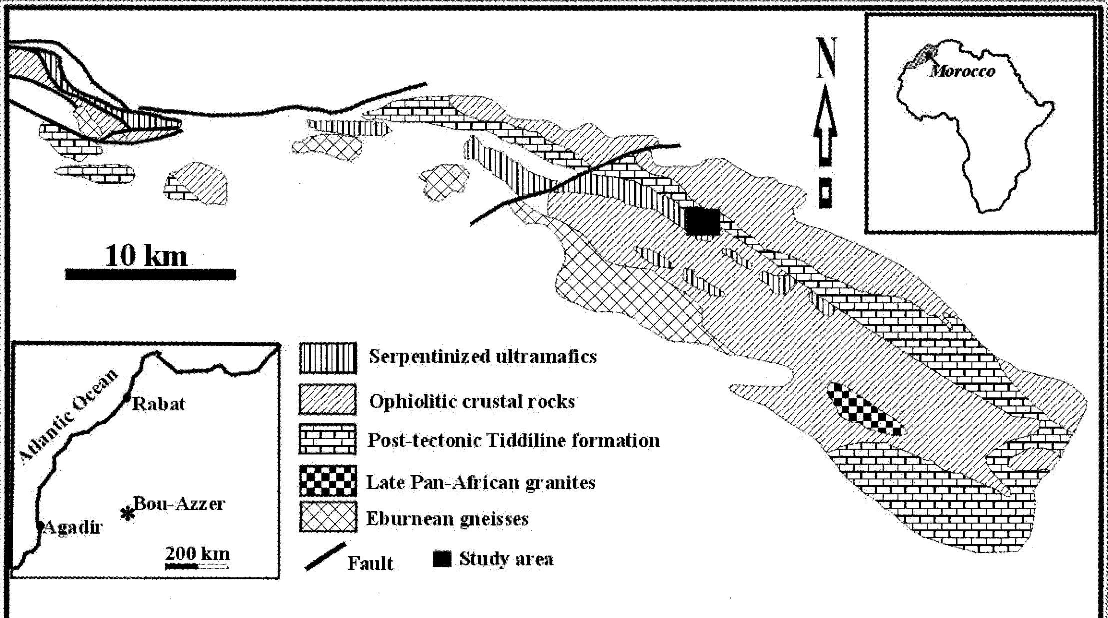

Figure 1 Generalized geological map of Bou-Azzer ophiolite, Morocco (after Bodinier et al., 1984).

The Bou-Azzer mantle section is severely serpentinized and dominated by harzburgite with small dunite lenses. Small-scale concordant chromitite pods and discordant pyroxenite dykes are sparsely distributed in the mantle section (Fig. 2). The late stage wehrlitic intrusions have been observed in the crustal gabbro (Fig. 2). Due to the severe serpentinization, almost all the primary silicates have been converted to the serpentine–magnetite assemblage. We were, however, able to identify the primary lithologies by the aid of relic textures and chromian spinel chemistry and morphology. Two types of unique style vein-like magnetite deposits, I and II, have been discovered: magnetite is fibrous and nickeliferous in Type I, but is stout or idiomorphic, Ni-free and Mn-rich chromian spinel bearing in Type II. Mode of occurrence and petrography indicate they had formed filling the open space of cracks.

In general chromian spinel in both chromitites and the associated peridotites exhibits a very restricted compositional range, although it is more uniform in chemistry in the former than in the latter. Spinel is highly chromian (Cr# = 0.83 ~ 0.85) and highly magnesian (Mg# = 0.57 ~ 0.74) in chromitites. Likewise, it is highly chromian (Cr# = 0.65 ~ 0.77) and moderately to highly magnesian (Mg# = 0.2 ~ 0.5) in the associated peridotites. Furthermore, it is generally poor in Ti and Fe^{3+} both in chromitites and in the associated peridotites. These lines of evidence show that the Bou-Azzer upper mantle was highly refractory. The Bou-Azzer chromitites display a steep negative slope of PGE distribution patterns, testifying the high degree of partial melting. Serpentinized dunites and harzburgites generally display flat

PGE distribution patterns with slight negative slopes from Ir to Pd, suggesting the removal of partial melt enriched in Pt and Pd. On the other hand, the Bou-Azzer magnetites exhibit a positive slope of PGE distribution patterns with a general marked Au enrichment, as a result of hydrothermal activity. Moreover, it is believed that the PGE patterns of such magnetites may represent the primary PGE distribution in magmatic Fe-Ni sulphides or arsenides in mantle peridotites (e.g. Fischer et al., 1988).

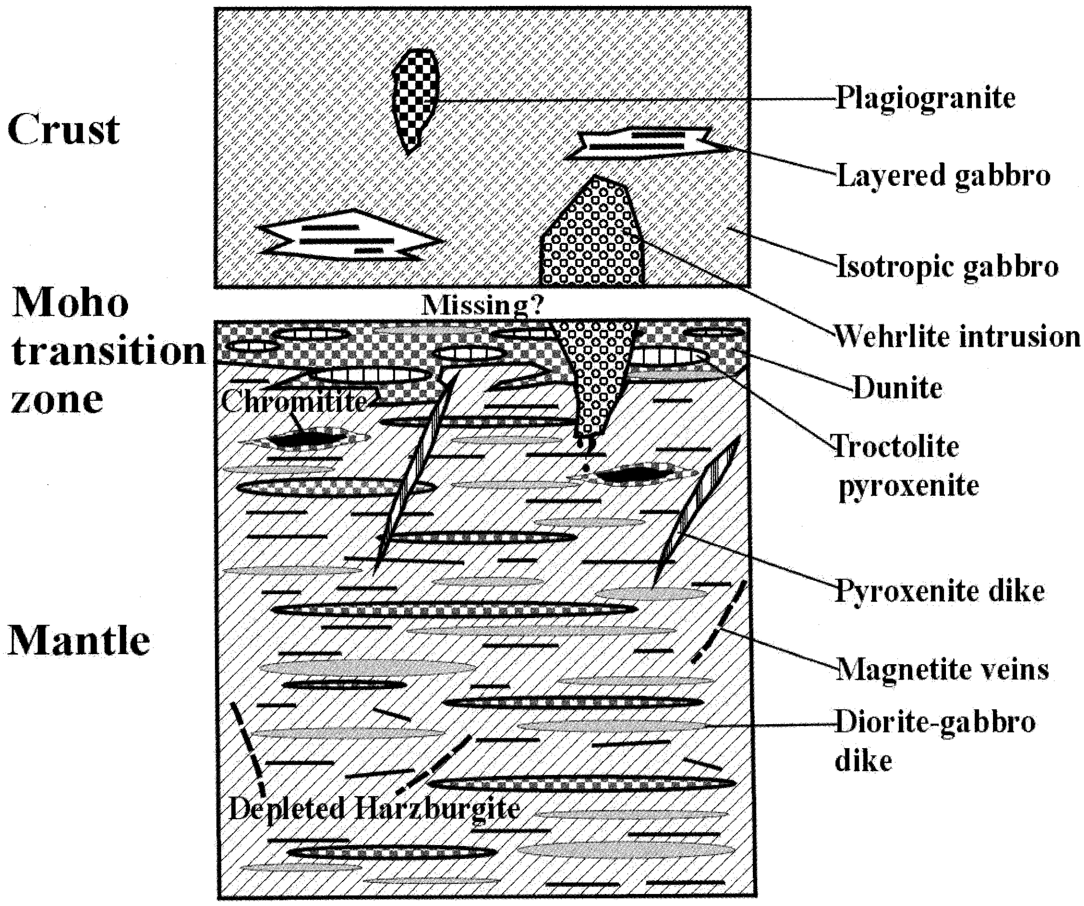

Figure 2 The lithostratigraphic column of the Bou-Azzer mantle section, MTZ and lower crust.

Given the above characteristics, the general petrological characteristics of the Late Proterozoic Bou-Azzer chromitites and the associated peridotites are similar to those of the Phanerozoic ophiolites. The high Cr# combined with the low-Ti character of spinel suggests the formation of Bou-Azzer ophiolite in a supra-subduction zone environment. The formation of magnetite vein deposits and the enrichment of spinel with Mn are the result of hydrothermal activity accompanied with the obduction of the Bou-Azzer oceanic lithosphere.

References

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