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THE MONTGENEVRE OPHIOLITE MANTLE SECTION. FROM GENESIS TO LATER PROCESSES: PETROLOGICAL AND STRUCTURAL CONSTRAINTS

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ABSTRACT

The Alpine Piedmont Ligurian ophiolites are considered to be remnants of the Jurassic Tethyan ocean. Numerous similarities with northern Apennines ophiolites have been emphasized, particularly with the external belt. The most typical features of these ophiolites are: (1) a lherzolitic mantle section, (2) a reduced cumulate high level-type gabbroic portion, without well defined layering, (3) a lack of a sheeted-dyke complexes; (4) a reduced and discontinuous MORB crustal section. An upwelling of lherzolitic mantle with a low degree of partial melting, in a slow-spreading ridge environment, is generally proposed for the genesis of such a succession. The minor proportion of gabbros together with their high-level type characteristics are considered to be the result of crystallization in small magma chambers dispersed within the lherzolitic upper mantle. Except for minor exceptions, primary contacts between upper mantle and gabbro sections are not observed. This is due to modifications during oceanic and alpine tectonism.

The Montgenèvre ophiolite complex (MOC) is well known for having largely escaped Alpine metamorphic overprinting. Comprising several tectono-lithological units, it presents a complete pseudo-stratigraphy. Thus it is a favourable context for the study of primary features and oceanic transformations.

Peridotitic rock-types are intensely serpentinized (> 90% most often, locally up to 70% only). Mantle peridotites are mainly lherzolites, but minor associated wehrlitic, harzburgitic, and dunitic zones are associated. Plagioclase-bearing peridotites are common. Serpentinites crop out either: (1) in the basal complex of the MOC, which is characterized by ophiolitic masses, and detritus, incorporated within the supra-ophiolite sedimentary cover and the schistes lustrés, or, (2) mainly, in the upper tectonic unit, or klippe, essentially composed of the ophiolitic succession. The serpentinized peridotites are dominantly exposed at the eastern part of the upper unit. At the western part, with dominant submarine volcanites, serpentinites, often crushed, are localized only at the contact zone with the basal complex or along the contacts between lithological units, particularly between gabbro and serpentinized peridotite, testifying for a tectonic relationship.

Several primary characteristics are still recognizable within the serpentinites: (1) type of original peridotite, (2) impregnation or not of basaltic liquid, (3) mantle tectonite or ultrabasic cumulate textures, (4) reworked serpentinites sometimes capped by a supra-ophiolite sedimentary cover. Moreover, as classically observed, pyroxenitic and troctolitc-gabbroic levels, gabbro and dolerite more or less rodingitic dykes, and albitite are associated within the mantle section. Petrological and structural considerations are obtained from the study of such relationships.

The macroscopic and microscopic structures observed within the Montgenèvre ophiolite upper mantle ultrabasic rocks, in a context apparently close to the petrological Moho, are mostly of tectonite type with high temperature plastic deformation of olivine and orthopyroxene, typical of asthenospheric conditions. Sometimes mylonitization developed in the oceanic environment, certainly during transverse or longitudinal fracturing of the lithosphere. The latter observation is typical of slow spreading ridge environments as observed for instance in the MAR Vema fracture zone. Magmatic liquid percolation locally modified the peridotitic rocks (e.g., impregnated lherzolites) and can, in some cases, when very close to the Moho, produce troctolitic lithologies belonging to the lowermost part of the cumulate section. Such rocks are sometimes difficult to differentiate from mantle peridotitic types exhibiting major melt impregnation, or even more or less diffuse melt “pockets”, and also caracterized by cumulate textures. There is no difference in primary mineralogical composition or in textural features, but the troctolitic rocks in the mantle suffered from rodingitic recrystallizations, whereas they are saussuritized in the lowermost crustal section. Another discriminant way is structural, based on lattice study of olivine crystals which should be undeformed (or very slighly plastically deformed) with low concentration of intracrystalline defects when related to the lowermost cumulate crustal section. For comparable mantle related ultrabasic cumulates, olivine is indeed strongly plastically deformed (with high intracrystalline defects concentration).

Other presented petrological considerations are mainly based on geochemical data (major, trace and rare earth elements, and lead isotopes analyses).