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PETROGENETIC RELATIONSHIPS BETWEEN PERIDOTITES, GABBROS, ALBITITES AND BASALTS IN ALPINE OPHIOLITES (VANOISE AND BRIANÇONNAIS): TRACE ELEMENT AND ISOTOPIC (ND, SR) EVIDENCES

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ABSTRACT

Alpine ophiolites from the Western Alps attests for the existence of an ocean at slow spreading rate during the second part of Mesozoic times (170 - 60 Ma) (Lagabrielle and Lemoine, 1997 and ref. therein). This ocean, the Ligurian Tethys, was located between the European plate and the Apulian microplate, a northern promontory of the African plate. The ophiolitic complex is now found within several nappes thrusted upon the European margin. Its subduction- and collision-related metamorphic evolution varies from low-grade to blueschist and eclogite facies from external to internal belts respectively. However, these different segments of the oceanic lithosphere did not suffer an excessive alpine deformation, such that the geometric relationships between its main terms -peridotites, gabbros, albitites, basalts and volcano-sedimentary deposits- are always rather well-preserved. The ophiolitic serie is composed of peridotites intruded at different levels by sills or laccoliths of gabbros, crosscut by an "erosion surface" (descriptive sense) and overlaid by pillow basalts and related volcaniclastic and sedimentary deposits. Albitites are found as sills or dykes intrusive within peridotites or/and basalts.

The aim of this geochemical and isotopic study, the preliminary results of which are presented here, is to decipher the petrogenetic relationships between these mantle and crustal rocks in order to constrain the formation process of the oceanic lithosphere in the slow-spreading ridge model.

Detailed mapping at 1/10 000 and sampling of the ophiolitic serie have been done in several nappes from the internal (3 nappes in the blueschist facies in Vanoise) and external (2 nappes in the low grade facies in Briançonnais) belts inasmuch as they represent spatially distinct zones from the same ocean and as it was possible to test the mobility of trace elements on similar rocks within a same metamorphic facies and through the metamorphic evolution.

Petrographic analysis reveals that, even in the high pressure metamorphic facies, the protolith is identifiable. Serpentinized peridotites are harzburgites sometimes crosscut by diopside veins. When present, diopside is frequently well-preserved in low grade assemblages of peridotites but also gabbros. In the high grade facies, gabbros and basalts look like prasinites, with plagioclase ocelli in a epidote-, amphibole- and titanite-bearing matrix. In gabbros matrix remains interstitial, while it is predominant in basalts. Whatever the metamorphic grade, the plagioclase is albite, sometimes anorthite. Albitites are made of albite (90%), amphibole, titanite and zircon.

Major and trace element compositions of these rocks are consistent with those of representative rocks in present oceanic contexts and display a very good homogeneity within a same group of rocks. This suggests that even high grade metamorphism has not induce any lost or gain in major and trace element, unless perhaps slight lost in Na_2O and gain in Rb.

Serpentinized peridotites have harzburgitic compositions with CaO < 1 wt% and 1 to 3wt% Al_2O_3; gabbros are rather poor in SiO_2 (46.7 - 51.5 wt%) and rich in MgO (8.5 - 16 wt%), rather sodic (2 - 3.5 wt%) and poor in TiO_2 (<0.3 wt%); basalts are sometimes very poor in SiO_2 (42 - 51.5 wt%), rich in Na^2O (2 - 5.7 wt%) and TiO_2 (1.1 - 2.5 wt%); at last albitites are sodic syenites with around 65 wt% SiO_2 and 10 wt% Na_2O.

In terms of trace element compositions:

– basalts display patterns typical of Mid-Oceanic Ridge Basalts (MORB). They originate from partial melting of a residual mantle devoid of any crustal contamination. The absence of any negative Sr and Eu anomaly excludes an origin by fractional crystallization of gabbroic melts.

– gabbros have similar or lower trace element contents than PM; they display either the same depleted patterns as MORB without any anomaly, or most often patterns with positive anomalies in Rb, Ba, Th, U, Sr and Eu even if their La/Yb ratio mostly remains <1. This means that some gabbros represent the product of total crystallisation of an intrusive melt while others represent plagioclase cumulates. Trace element analysis on separate minerals (now in process) in several gabbros will enable to go further in this interpretation. Besides, it can be assumed that these gabbros originate either from the same mantle as basalts, or a slightly metasomatized residual mantle accounting for the Th and U positive anomalies.

– peridotites have trace element contents lower than PM with La/Yb ratio <1 and also positive anomaly in U with Th/Ta ≥1; besides strong negative anomalies in Ba, Sr, Hf, Zr and Ti often exist; all these features characterize a metasomatized residual mantle which cannot be the source of basalts or gabbros.

– albitites are either much poorer in trace elements than peridotites, with Th/Ta and La/Yb <1 and positive anomalies in Rb, Ba, U, Sr, Hf, Zr and Ti, or very rich in trace elements (up to 100*PM) with flat patterns and negative anomalies in Rb, Ba, Sr and Ti. The absence of any Sr and Eu anomalies in both cases excludes that they are cumulates or that they are residual melts after crystallization of gabbros. Nevertheless these patterns remain enigmatic until now.

Sm-Nd and Rb-Sr isotopic analysis on whole rocks and

mineral separates of each group of rocks are now in process and the results will be presented during the workshop.

REFERENCES

Lagabrielle Y. and Lemoine M., 1997. Alpine, Corsican and Apennine ophiolites: the slow-spreading ridge model. C. R. Acad. Sci. Paris, Earth Planet. Sci., 325: 909-920.