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Geochemistry and tectonic significance of lherzolites from New Caledonia Ophiolite

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The association of rocks with contrasting geodynamic affinities is a quite common feature in ophiolites and it has been documented in several ophiolitic complexes, such as Pindos (Greece), and Lycian and Antalya ophiolites (Turkey) (Saccani, Photiades 2004; Aldanmaz et al. 2009).

New Caledonia hosts one of the World's largest ultramafic terrane termed "Peridotite Nappe" belonging to an "atypical" ophiolitic sequence of presumed Late Cretaceous- Early Eocene age. It is dominated by mantle lithologies, mostly harzburgite and minor spinel and plagioclase lherzolite, together with some mafic and ultramafic cumulates. Despite their ultra-depleted nature, some efforts were devoted to characterize the mantle rocks from a geochemical point of view. A supra-subduction affinity is generally accepted for harzburgites (Marchesi et al. 2009; Ulrich et al. 2010); in contrast, the origin and evolution of lherzolites still remain a matter of debate. This presentation will focus on the petrological and geochemical characterization of the lherzolitic rocks.

Lherzolites are mainly found in northern massifs, where spinel lherzolites extensively crop out in association with minor plagioclase lherzolites. These rocks are low-strain porphyroclastic tectonites, locally grading into protomylonite.

They likely record an asthenospheric HT origin followed by sub-solidus re-equilibration, which is also testified by geothermometric estimates (870-1080°C and 830-980°C for porphyroclastic assemblages and recrystallization in the spinel facies, respectively).

Spinel lherzolites are relatively undepleted, as attested by the presence of 7-8 vol% of Na and Al-rich clinopyroxene (up to 0.8 wt% Na_2O; 3.1-6.7 wt% Al_2O_3), low Fo in olivine (88.5-90.0 mol%) and Cr# in spinel ([100 • Cr/(Cr+Al)]= 13-17).

Major element mineral compositions (e.g. Mg# (Ol) vs Cr# (Spl), Cr# (Spl) vs Mg# (Spl)) coupled with Cpx and whole-rock REE geochemistry show that the lherzolites are akin to abyssal peridotites. In particular, the spinel lherzolites have REE patterns characterized by MREE and HREE enrichment over LREE (Nd_N/Sm_N = 0.18-0.27, Nd_N/Yb_N = 0.02-0.70) for Yb_N = 1.0-1.3. The REE patterns of clinopyroxenes have strong LREE depletion (Nd_N/Yb_N= 0.001-0.05) and nearly flat HREE segments for Yb_N = 5.5-5.9.

Melting modelling based on REE compositions of Cpx and whole-rock indicate that HREE patterns can be explained by 8-10% fractional melting of a DMM source in the spinel stability field. However, slight MREE/HREE fractionation suggest that melting may have initiated at higher pressure, in the garnet stability field.

Whole-rock Nd isotope ratios (ε_{Nd} = 6.98-11.86) also suggest derivation from a relatively homogenous MORB-type depleted mantle that experienced a recent depletion event, leading to variable $^{147}Sm/^{144}Nd$ ratios.

The aforementioned features point out an origin in a spreading ridge environment, probably related to pre-Early Eocene marginal basin development within the Southeast Gondwana margin.

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