GEOCHEMICAL AND SR-ND-PB ISOTOPE INVESTIGATION OF THE NEW CALEDONIA PERIDOTITE NAPPE: UNRAVELLING THE HISTORY OF A POORLY KNOWN MANTLE SECTION

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The New Caledonia ophiolite hosts one of the largest and best preserved mantle sections in the world, offering a unique insight into upper mantle processes. Mantle lithologies are dominated by harzburgites, with minor lherzolites, and are locally capped by a mafic-ultramafic intrusive sequence. Although the New Caledonia ophiolite has been the subject of several petrological and geochemical investigations starting from the 1980s (e.g. Prinzhofer et al., 1980; Dupuy et al., 1981), its ultra-depleted nature prevented an adequate geochemical characterisation for long time. However, a renewed phase of interest has recently led to the publication of new works, thereby improving considerably our knowledge on the Peridotite Nappe (Marchesi et al., 2009; Ulrich et al., 2010; Pirard et al., 2013; Secchiari et al., 2016, 2018, submit.).
This contribution results from a 5 year lasting collaboration among Montpellier, Parma and New Caledonia Universities. Here we present a comprehensive petrological and geochemical dataset obtained on fresh or little serpentinized peridotites. Spinel lherzolites are slightly depleted rocks, as attested by the presence of 7-8 vol.% of clinopyroxene, moderate Fo content of olivine (88.5-90.0 mol.%) and low Cr# of spinel (13-17). The harzburgites exhibit a highly refractory character, testified by the notable absence of primary clinopyroxene, high Fo content of olivine (90.9-92.9 mol.%), high Mg# of orthopyroxene (89.8-94.2) and high Cr# of spinel (44-71). Mineral compositional variations and REE geochemistry indicate abyssal-type and supra-subduction zone affinity for lherzolites and harzburgites, respectively. Melting models show that the lherzolites underwent 8-9% degrees of fractional melting of a DMM source, starting in the garnet field. By contrast, the harzburgites record exceedingly high melting degrees (i.e. 15% degree of dry melting and up to 18% degree of hydrous melting). On the other hand, concomitant enrichments in FME, L-MREE and Zr-Hf were likely inherited during interaction with slab-derived silicate-bearing fluids, as supported by the frequent occurrence of secondary interstitial Al_2O_3, CaO and Cr_2O_3-poor orthopyroxene and Na_2O, Al_2O_3, TiO_2-poor clinopyroxene. Nd isotopes are in the range of the DMM for the lherzolites ($+6.98 \leq \varepsilon_{Ndi} \leq +10.97$). For the harzburgites, heterogeneous Nd isotopic ratios ($-0.80 \leq \varepsilon_{Ndi} \leq +13.32$) coupled with Pb isotopes, trending from DMM toward sediment-like compositions, support a derivation from a DMM reservoir variably modified by subduction fluids. The geochemical features of the lherzolites suggest an origin in a MOR setting, i.e. in a marginal basin formed before Eocene subduction. Conversely, the geochemical signature shown by the harzburgites reflects the evolution of a highly depleted fore-arc mantle wedge contaminated by fluid inputs in the subduction zone. Based on our data, a possible genetic link among the peridotites remains difficult to establish.

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