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Hydrous mafic-ultramafic intrusives in a nascent arc (Massif du Sud, New Caledonia ophiolite).

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The New Caledonia ophiolite hosts one of most complete sections of a nascent arc, representing an excellent natural laboratory for investigating the origin and the evolution of subduction systems. The sequence, originated during the onset of the Eocene subduction [1, 2], is composed of ultra-depleted forearc harzburgites [3] overlain by a dunite-dominated transition zone (500m thick), in turn overtopped by mafic-ultramafic cumulate lenses. The ultramafic rocks of the transition zone (mainly dunites and wehrlites) most likely resulted from melt-peridotite reactions involving primitive arc tholeiites and boninitic magmas [2]. By contrast, dunite-pyroxenite and gabbro-norite cumulates derive from H₂O-poor depleted melts transitional between boninites and arc-tholeiites [2, 4].

In this contribution, we report the first occurrence of amphibole-bearing ultramafic lithologies in the New Caledonia arc sequence. Our study deals with a petrological and geochemical characterisation of a 2.5km x 5km composite, roughly snowball-shaped, intrusive body, consisting of pyroxenite, dunite, wehrlite, hornblendite and associated mafic-ultramafic, locally sheared, dikes from the Plum area (Massif du Sud). The pyroxenite component, which forms the core of the intrusion, consists of coarse-grained websterites, mainly composed of weakly oriented orthopyroxene (~ 30-75 vol.%) and clinopyroxene (~ 20-40 vol.%), with variable amounts of edenitic amphibole (~ 2-30 vol.%). The amphibole generally occurs as poikilitic crystals or develops as coronas on pyroxenes. Highly calcic plagioclase (An= 83-96 mol %) is scarce in the pyroxenite body (~ 2 vol. %), but more abundant in the associated dikes (~ 10-50 vol.%). Clinopyroxene shows variable Mg# (0.82-0.92) and low Al₂O₃ (0.99-2.00 wt%). Likewise, amphibole yields high Mg# (0.712-0.865). Estimated equilibrium temperatures based on conventional pyroxene thermometry range between 870-970°C, whereas amphibole-plagioclase pairs provide slightly lower values (800-910 °C).

Whole rocks have moderately high Mg# (71-82) and REE concentrations one to five times chondritic values. The websterites of the main body show LREE-depleted (La_N/Nd_N = 0.5-0.8), weakly concave downward patterns, with flat HREE segments (Lu_N/Tm_N = 1.1-1.3). The mafic-ultramafic dikes display similar patterns, bearing depleted to flat LREE segments (La_N/Nd_N = 0.6-1) and positive Eu anomalies. For all the investigated lithologies, extended trace element diagrams

indicate enrichments for FME (i.e. Rb, Ba, U) and Th, coupled to Zr-Hf depletion. Strong Sr positive spikes are only observed for the crosscutting dikes, while the pyroxenite body yields Sr negative anomalies.

Geochemical modelling shows that the putative liquids in equilibrium with the websterites have intermediate Mg# (57–63) and incompatible trace element patterns sharing remarkable similarities with the New Caledonia CE-boninites [5]. However, they significantly differ from the equilibrium melts reported for the other intrusive rocks of the sequence [1, 4], suggesting greater compositional variability for the liquids ascending into the Moho transition zone and lower crust. Our results support the notion that petrological and geochemical heterogeneity of magmatic products may be distinctive features of subduction infancy.

References

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