Geochemical characterization of the Papuan Ultramafic Belt: A supra-subduction zone ophiolite analogue?

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The Papuan Ultramafic Belt (PUB) was one of the archetypes on which the obduction concept was founded back in the early 70's. Several studies have interpreted the PUB and associated rocks to be fragments of a supra-subduction zone (SSZ) ophiolite complex. However, due to limited outcrop accessibility in Papua New Guinea, and an incomplete ophiolite stratigraphy, understanding the exact origin and emplacement of these rocks is difficult. Located in the Northern section of the Owen Stanley Range in eastern Papua, the ~60 Ma PUB also forms part of the convergent plate margin between the Australian and Pacific plates, and potentially documents the subduction related accretionary system, which formed along the southeastern margin of Gondwana during the Cenozoic.

This project analyses a unique whole-rock geochemical dataset of peridotite and gabbroic rocks from three exposures of the PUB (Mt Suckling, Madang, and Kokoda), to provide insights on the emplacement mechanisms of the PUB. Some peridotites at Mt Suckling display Cr values up to ~44,200ppm, PGE contents of ~500ppb, and are characterized by a flat REE pattern and Eu/Eu* of 0.7-1.3 when normalized to Primitive Mantle (PM). These REE features are similar to other Pt bearing complexes such as the Ural Mountains, Russia. The Madang and Kokoda peridotites however display low Cr values (~3,000 to 3,250ppm), ΣPGEs (~2.0 to 25ppb), and they are significantly lower in ΣREE (<0.5ppm), similar to other SSZ type ophiolites along the circum-pacific margin, such as the Luobusa in Tibet.

Gabbros and pyroxenites from Mt Suckling formed as cumulates, indicated by their mineralogy and strong Zr and Hf depletions (3 to 4 times PM values). These rock suites also have Nb and Ta depletions (~4 times PM values), reflecting the low solubility of Nb and Ta in water-rich fluids at subduction zones. The Mt Suckling samples also display positive Sr anomalies (~120-1,800 times MORB values) attesting to a continental crust affinity.

Geochemical features of the sample set studied are consistent with a SSZ ophiolite. However, the anomalous Cr and PGE enrichments in Mt Suckling support a more complex origin of the mafic-ultramafic packages in PNG than previously thought.