The Genesis of Podiform Chromitites From the Baryulgil Serpentinite, NSW, Australia

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The Baryulgil Serpentinite in New South Wales, Australia, hosts small podiform chromitite deposits that have been largely understudied, despite their petrogenic value and potential to host platinum group elements (PGEs) mineralisation. The major, minor, and trace element geochemistry of 13 chromite samples from six chromitite deposits reveals that the chromitites are of the high-Al type, with Cr# ranging from 11 to 57 (mean = 48ppm) and show a notable depletion in Ti content, ranging from 211 to 1,391 ppm (mean = 630 ppm). Parental melt composition estimates indicate Al_2O_3 content between 15.4 and 17.3 wt.% (mean = 16.2 wt.%) and TiO_2 content between 0.16 and 0.61 wt.% (mean = 0.33 wt.%). These results suggest a mid-ocean ridge basalt (MORB) affinity for the chromitite parent melts; however, the Ti content is more depleted than typical MORB values, indicating a more complex melt evolution. Batch and fractional melting models suggests that the Baryulgil chromitites formed through a two-stage melting process. Initially, melt extraction from a fertile mantle source produced high-Al, high-Ti magmas, leading to Ti depletion in the mantle. A subsequent, more limited phase of partial melting generated low-Ti magmas, whilst still rich in Al. This process likely occurred during subduction initiation in a nascent fore-arc setting, where such melt evolution is feasible. The extent of partial melting does not suggest significant PGE extraction into the parental magmas, and petrographic studies show no magmatic sulphides within the chromitites, indicating limited potential for PGE mineralisation.