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The compositional dichotomy of ca. 3.3 Ga komatiites from the West Pilbara

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Komatiites are excellent probe to estimate the chemical composition of the Archean mantle. Their Al_2O_3/TiO_2 ratio have led to their classifications as :(1) Al-depleted type; (2) Al-undepleted type; and (3) Al-enriched type. Although only a single komatiite type occurs within most of komatiite suites, two or three komatiite types occur within some komatiite suites (e.g., the Komati Formation). Based on the estimated melt depth, Sossi et al. (2016) argued that co-occurrence of two discrete komatiite is linked to multiple melt events at different depths [1]. However, more examples are needed to constrain the petrogenesis of multiple types of komatiites.

In the West Pilbara Granite-Greenstone Terrane (WPGGT), Al-depleted komatiites from the Ruth Well and Regal Formations have been widely recognized [2]. We conducted the field study in the Ruth Well Formation and identified komatiite lava sequences from four sections (named as Ruth Well, Mornong Well, Mount Hall, and Mount Wangee). Although the Ruth Well komatiite lacks any indication that they interacted with continental crust based on trace element and radiogenic isotope compositions [3], a komatiite flow in the Mount Hall section has a close association with siliciclastic rocks, indicative of its emplacement on a continental setting.

Although olivines are completely serpentinized in all studied sections, their whole-rock major and trace element variations display clear trends formed by olivine fractionation, suggesting igneous compositions are largely preserved. We identified that the Mornong Well komatiites are Al-undepleted type, whereas those from other three sections are Al-depleted type. Thus, co-occurrence of two discrete komatiite types within a single suite was confirmed in the WPGGT. The estimated melting pressure of Al-undepleted komatiites (6 GPa) is lower than that of Al-depleted komatiites (8.5 GPa), and they appear to plot on a single ascent path defined by the melting pressure and degree of melting (Figure). Therefore, as suggested for the Komati Formation, co-occurrence of two discrete komatiite types may reflect multiple melt events at different depths.

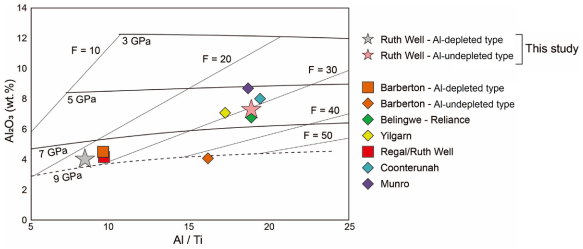

Figure. Diagram of Al/Ti ratio vs Al2O3 content. Pressure and melt fraction lines are calculated in Sossi et al. (2016) [1]. The gray star represents estimated parental magma composition of Ruth Well Al-depleted komatiites (Ruth Well, Mount Hall, and Mount Wangee) and the pink star represent averaged estimated parental magma composition of Al-undepleted komatiites (Mornong Well).

[1] Sossi et al. (2016), *Journal of Petrology* 57, 147-184
[2] Puchtel et al. (2022), *Geochimica et Cosmochimica Acta* 320, 238-278
[3] Arndt et al. (2001), *Geological Society of America* 352, 359-387