Evolution of the early continents and localisation of Ni-Cu-PGE systems

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In the Yilgarn Craton of Western Australia, three periods of komatiite volcanism and associated Ni-Cu-PGE mineralisation are recorded at: (1) ca. 2.9 Ga; (2) ca. 2.8 Ga and (3) 2.7 Ga. Each event has a well-constrained spatial control: The 2.9 Ga event is localised in the central Yilgarn (Southern Cross Domain); the 2.8 Ga event is dominantly focused at the western edge of the Burtville Terrane of the Eastern Goldfields Superterrane; and the 2.7 Ga event (forming two world-class Ni-Cu-PGE camps) is localised at the eastern edge of the Youanmi Terrane, within the Kalgoorlie and Kurnalpi Terranes of the Eastern Goldfields Superterrane.

U-Pb SHRIMP geochronology and LA-ICP-MS Hf isotopes on zircons from felsic magmatic rocks reveal the source character of the Archean crust of the Yilgarn Craton in space and time. These data, in conjunction with regional geology and geophysics, demonstrate that evolving lithospheric architecture controls the localisation of the large mineralised komatiite systems.

The time-resolved Lu-Hf maps demonstrate that the major komatiite systems at 2.9 and 2.7 Ga are both localised in isotopically juvenile terranes adjacent to more evolved crust. This suggests that the older, thicker crust localised the plume-sourced melts into the adjacent thin crust, creating linear belts of high-temperature, high-flux komatiite.

The 2.8 Ga system appears to be slightly different. Geology and geochronology suggest the Burtville Terrane that hosts the 2.8 Ga komatiites was once part of the Youanmi Terrane. We suggest that the major lithospheric margin that localised the 2.7 Ga komatiites also controlled the location of the 2.8 Ga flows. The Burtville Terrane became disassociated from its primary craton margin (Youanmi Terrane) and moved eastward due to massive juvenile input and rifting at ca. 2.73 Ga. This event separated the Youanmi and Burtville Terranes and ultimately created the Kalgoorlie-Kurnalpi Terranes.