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The status of the Archean LIP record and comparison with the younger terrestrial LIP record and with Venus

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Over the past two decades, there has been a dramatic expansion of the Archean LIP record through precise U-Pb dating, new approaches to geochemical characterization, improved reconstruction constraints (based on paleomagnetism and matching of magmatic events), and a better understanding of LIP plumbing system architecture. Key criteria for the recognition of Archean LIPs are volcanic sequences with associated komatiites (indicating a high temperature mantle source), geochemistry consistent with intraplate origin (with potential modification by lithospheric mantle or crust), large inferred magmatic volume, and the presence of large mafic dyke swarms. We provide an overview of the Archean LIP record back to 3.8 Ga, assess this record for periodicity and specific age matches (and therefore potential reconstructions) between multiple crustal blocks.

By comparison with the younger LIP record, we speculate on broader issues, such as the role of Archean LIPs in a range of major geodynamic processes, including influence on the lithosphere, continent breakup, dramatic climate and environment changes and as proxies for natural geological time boundaries, major regional topographic changes, formation of major ore deposits, and as an analogue for planetary volcanism, particularly on Venus.

Mafic dyke swarms (radiating and circumferential) of Proterozoic and Phanerozoic age are useful to locate mantle plume centres, and estimate the size of their flattened plume heads. We consider whether similar large radiating and circumferential dyke swarms are present in the Archean, with the goal to assess the size of Archean plume heads in comparison with those at younger times.

Notable Archean dyke swarms include the 3.32 Ga Kelly dyke swarm in East Pilbara terrane, the 2.95 Ga Badplaas swarm of SE Kaapvaal craton, the 2.78 Ga Black Range dykes of the Pilbara craton, the 2.73 Ga Ahmeyim Great Dyke of Mauritania in the Reguibat shield of the West African craton, the 2.70-2.66 Ga Rykoppies fanning swarm focussed on the eastern lobe of the Bushveld, and the Great Dyke of Zimbabwe (2.58 Ga). At least two of these events, the 2.95 Ga Badplaas swarm, the 2.70-2.66 Ga Rykoppies swarm can be used to locate mantle plume centres.