

# Distribution, Timing and Periodicity of Archean Large Igneous Provinces (LIPs) and Their Mafic Dyke Swarms

RICHARD E. ERNST<sup>1</sup>, HAFIDA EL BILALI<sup>1</sup>, KENNETH L. BUCHAN<sup>2</sup>, KEVIN R. CHAMBERLAIN<sup>3</sup>, PROF. RAJESH K. SRIVASTAVA, M.SC., PH.D.<sup>4</sup> AND DAVID A.D. EVANS<sup>5</sup>

<sup>1</sup>Carleton University

<sup>2</sup>273 Fifth Ave.

<sup>3</sup>University of Wyoming

<sup>4</sup>Banaras Hindu University

<sup>5</sup>Yale University

Presenting Author: [richard.ernst@ernstgeosciences.com](mailto:richard.ernst@ernstgeosciences.com)

Key criteria to recognize Archean LIPs are volcanic sequences with 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 inferred presence of large mafic dyke swarms. LIP “fragments” can be identified based on proxy criteria (e.g. average dyke width >10 m). Based on such criteria, there are a minimum of 100 Archean LIP fragments on various crustal blocks from the 3.8 to 2.5 Ga period. They fall into >34 age groups (provisionally, 2500-2510, 2540-2550, 2575, 2620, 2660-2670, 2680-2720, 2725, 2740-2750, 2770-2780, 2790-2800, 2820, 2840, 2860, 2900, 2920-2930, 2960, 2970-2990, 3110, 3150, 3240-3260, 3290-3300, 3320, 3340-3350, 3420, 3460, 3470-4480, 3500, 3510-3520, 3560, 3640, 3660, 3700, 3750, 3825 Ma), with each age group potentially representing a single reconstructed LIP that may span multiple crustal blocks. This represents an average of one LIP fragment every 15 myr and a minimum of one (potential) reconstructed LIP event every 40 myr. These values are remarkably similar to the post-Archean continental record of one LIP fragment per 20 myr, and age groups (representing potentially reconstructed LIPs) of about one per 30 myr. In both the Archean and post-Archean periods information on LIPs is incomplete. In the post-Archean time (except for the past 200 myr), the oceanic LIP record is only preserved as fragments in collisional belts. While the Archean LIP record may include oceanic LIPs, a full understanding of this aspect of the geological record is hindered by the more extensive history of metamorphism, deformation and crustal fragmentation.

Archean dyke swarms are particularly valuable in recognizing and characterizing mantle plumes. We currently identify nearly 40 dyke swarms from the 3.51-2.5 Ga period, which can be grouped by age across different crustal blocks and represent a minimum of 17 different events (2500-2510, 2550, 2575, 2620, 2660, 2680-2700, 2710-2720, 2725, 2740-2750, 2770-2780, 2860, 2920, 2960, 3260, 3320, 3470, 3510 Ma), each likely linked to a mantle plume. Two Archean plume centres have been identified based on radiating swarms, both located in the Kaapvaal craton (at ca. 2.96 and 2.70-2.68 Ga).