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The 1501 Ma Kuonamka Large Igneous Province of northern Siberia: U–Pb geochronology, geochemistry, and links with coeval magmatism on other crustal blocks

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Abstract

A new large igneous province (LIP), the 1501 ± 3 Ma Kuonamka LIP, extends across 700 km of northern Siberia and is linked with coeval dikes and sills in the formerly attached São Francisco craton (SFC)–Congo craton to yield a short-duration event 2000 km across. The age of the Kuonamka LIP can be summarized as 1501 ± 3 Ma (95% confidence), based on 7 U–Pb ID-TIMS ages (6 new herein) from dolerite dikes and sills across the Anabar shield and within western Riphean cover rocks for a distance of 270 km. An additional sill yielded a SIMS (CAMECA) age of 1483 ± 17 Ma and sill in the Olenek uplift several hundred kilometers farther east, a previous SIMS (SHRIMP) age of ca. 1473 Ma was obtained on a sill; both SIMS ages are within the age uncertainty of the ID-TIMS ages. Geochemical data indicate a tholeiitic basalt composition with low MgO (4–7 wt%) within-plate character based on trace element classification diagrams and source between E-MORB and OIB with only minor contamination from crust or metasomatized lithospheric mantle. Two subgroups are distinguished: Group 1 has gently sloping LREE ($(La/Sm)_{PM} = 1.9$) and HREE ($(Gd/Yb)_{PM} = 1.8$) patterns, slightly negative Sr and moderate TiO_2 (2.2 wt%), and Group 2 has steeper LREE ($(La/Sm)_{PM} = 2.3$) and HREE ($(Gd/Yb)_{PM} = 2.3$), strong negative Sr anomaly, is higher in TiO_2 (2.7 wt%), and is transitional from tholeiitic to weakly alkaline in composition. The slight differences in REE slopes are consistent with Group 2 on average melting at deeper levels. Proposed reconstructions of the Kuonamka LIP with 1500 Ma magmatism of the SFC–Congo craton are supported by a geochemical comparison. Specifically, the chemistry of the Chapada Diamantina and Curaça dikes of the SFC can be linked to that of Groups 1 and 2, respectively, of the Kuonamka LIP and are consistent with a common mantle source between EMORB and OIB and subsequent differentiation history. However, the coeval Humpata sills and dikes of the Angola block of the Congo craton represent a different magma batch.

Keywords: magmatism; dikes; sills; igneous province; northern Siberia

Introduction

Large Igneous Provinces (LIPs) represent large volume (>0.1 Mkm^3; frequently above >1 Mkm^3), mainly mafic (ultramafic) magmatic events of intraplate affinity, that occur in both continental and oceanic settings, and are typically of short duration (<5 m.y.) or consist of multiple short pulses over a maximum of a few 10s of m.y. (Ernst, 2014 and references therein). They comprise volcanic packages (flood basalts), and a plumbing system of dikes, sills and layered intrusions, and can be associated with silicic magmatism, carbonatites and kimberlites. LIPs are linked with continental

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