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Kimberlites: The deepest geochemical probes of Earth

HAYDEN DALTON[1], ANDREA GIULIANI[2] AND D GRAHAM PEARSON[3]

[1]The University of Melbourne
[2]ETH Zürich
[3]University of Alberta

Presenting Author: hayden.dalton@unimelb.edu.au

Kimberlites represent the primary host of diamonds and the deepest mantle-derived melts at Earth's surface, making these rocks unique probes of the convective mantle beneath continents. The complex nature of these rocks and limited access to large sample collections have previously limited knowledge of kimberlite genesis. Here, we present the first *Treatise on Geochemistry* chapter dedicated to these enigmatic rocks.

We utilise a newly compiled, carefully screened, global whole-rock major and trace element database to inspect the effects of various magmatic processes, including contamination by lithospheric mantle and crustal material, on the bulk composition of kimberlites. After comparison with petrogenetically similar magmas, we provide a stricter definition of the range of typical kimberlite compositions. Kimberlites have erupted throughout more than 2 billion years of Earth history making them powerful temporal probes of mantle evolution & dynamics. Consideration of the global radiogenic (including short-lived) and stable isotope data, along with other geochemical data, in a temporal context allows us to explore the origin and evolution of kimberlites, including contributions by ancient material and subducted components, and discuss their bearing on mantle evolution models.

Perhaps most importantly, this work sheds new light on the data 'gaps', ongoing sources of controversy, and open questions concerning the genesis of kimberlites. For example, kimberlite sources within the convecting mantle seem to be robustly constrained, yet the exact nature of these sources is not. How deep and old are these sources? How many components are involved and of which nature? What controls the spatiotemporal variability of kimberlite emplacement? Future global-scale investigations, with an expanding toolkit incorporating novel geochemical tools, and integration of geochemistry, geochronology, petrology and geodynamics will help solve some of these outstanding questions.