Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36935

Deciphering the original chemical signature of the Belingwe greenstone belt komatiites (Zimbabwe)

MATEO ESTEBAN[1], ALEXANDER V. SOBOLEV[1], ADRIEN VEZINET[1], VALENTINA G. BATANOVA[1], RUPASHREE SAHA[2], FRANÇOIS FAURE[3], ALEKSANDR V. CHUGUNOV[1], EUAN G. NISBET[4], NICHOLAS T. ARNDT[1] AND EVGENY V. ASAFOV[5]

[1]Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, IRD, Univ. Gustave Eiffel

[2]Institute of Northern Engineering, University of Alaska Fairbanks, Fairbanks

[3]CRPG-CNRS-Université de Lorraine

[4]Royal Holloway, University of London

[5]Vernadsky Institute of Geochemistry and Analytical Chemistry RAS

The original chemical and isotopic complexity of mantle-derived melts is often overprinted by syn- and post-magmatic processes such as assimilation and/or secondary alteration. The early onset of olivine crystallisation in these melts commonly traps near-primitive melts as inclusions, which are ideally suited for studying the initial content of volatile and fluid-mobile elements that would otherwise be lost through decompression and alteration.

Here, we present new results for more than 350 olivine-hosted melt inclusions from the 2.69 Ga Belingwe greenstone belt komatiite, Zimbabwe. The chemical composition and Sr isotopic signatures of experimentally re-homogenised inclusions were determined by EPMA, Raman spectroscopy, and LA-ICP-MS, along with the chemical composition of the host phenocrysts (EPMA and LA-ICP-MS).

The MgO content of the reconstructed melt ranges from ca. 19 to 25.2 wt%. Most elements correlate uniformly with the MgO content, suggesting that the fractionation of magnesian olivine dominates the chemistry of the flow, as expected from the mineralogy of komatiites. However, some inclusions exhibit intricate relative enrichment patterns in Na2O, K2O, Cl, and H2O, indicating the superimposition of multiple processes that control the abundance of these elements in the melt. Applying machine learning methods to the dataset, we will attempt to isolate potential uncontaminated melts and discuss the subsequent contamination history of the flow.

Age-corrected $^{87}Sr/^{86}Sr$ isotopes of 84 analysed melt inclusions range from 0.70027 ± 0.00083 (2SE for all numbers below) to 0.70342 ± 0.00052 for an MSWD of ca. 3, suggesting the heterogeneity of the sample population. Inclusions were discretised into four homogeneous subsets using an error-based clustering approach. Results show significant correlations between cluster Sr isotopes and elemental ratios, suggesting heterogeneity in the mantle source. The unradiogenic population of 19 inclusions, with an initial $^{87}Sr/^{86}Sr$ average of 0.70102±0.00016, is interpreted as a mantle component, yielding a model age of separation from the bulk silicate Earth of 3.5 ±0.1 Ga. This component has high Nb/Th (9.2 ± 0.3) and Ce/Pb (15.9 ± 0.7) relative to BSE (7.6; 9.2; Hofmann, 1988), consistent with a mantle source depleted by continental crust extraction. This implies significant continental crust formation prior to the Paleoarchean.