

Stable Cr isotope fractionation during magmatic differentiation of 2.7 Ga komatiites from the Belingwe Greenstone Belt, Zimbabwe

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Cr stable isotope fractionation during Cr³⁺/Cr⁶⁺ cycling has been used extensively to elucidate the oxygenation of the Earth's atmosphere-hydrosphere system through geologic time. In high-temperature environments Cr also exists in two valence states: Cr²⁺ and Cr³⁺. Thereby, the abundance of Cr²⁺ relative to Cr³⁺ during partial mantle melting is strongly dependent on the prevailing oxygen fugacity [1]. Thus variable amounts of Cr²⁺ relative to Cr³⁺ caused by magmatic differentiation may result in Cr isotope fractionation, which in turn may serve as a potential proxy for the prevailing oxygen fugacity. It has been shown that Cr stable isotopes correlate with Mg# in lunar rocks [2,3] and peridotites [4,5], but a detailed investigation of Cr isotope fractionation in a suite of co-genetic igneous rocks is missing so far. Consequently this study aims to investigate to what extent high degrees of partial mantle melting (up to 40 %) and subsequent melt differentiation induces stable Cr isotope fractionation.

We analyzed a suite of 20 co-genetic samples of komatiite, komatiitic basalt, and tholeiite from the 2.9-2.7 Ga Belingwe Greenstone Belt, Zimbabwe, for their stable Fe and Cr isotope composition. Trace element patterns distinguish between a LREE-depleted and a LREE-enriched/HFSE-depleted group. The LREE-depleted group shows slight trends of $\delta^{53}\text{Cr}$ with indices of magmatic differentiation, such as Mg#, Al₂O₃ and trace element ratios such as La/Yb_{PM}. No correlation was, however, observed regarding their Fe isotope compositions. It needs to be further assessed whether the observed fractionation of Cr stable isotopes can be attributed to different degrees of partial melting or fractional crystallisation of Cr²⁺- and Cr³⁺-bearing phases driving Belingwe tholeiites towards lighter Cr isotope compositions.

[1] Berry et al. (2006); *Amer. Min.*, 9, 1901-1908. [2] Bonnard et al. (2016); *GCA* 175, 208-221. [3] Sossi et al. (2018) *PNAS* 115, 10920-10925. [4] Schoenberg et al. (2016); *GCA* 183, 14-30. [5] Xia et al. (2017); *EPSL* 464, 103-115.