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Investigating lower crustal evolution through high field strength element analysis and phase equilibrium modelling

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The lower continental crust could be a critical reservoir for controlling the high field strength element (HFSE) distribution of the silicate Earth. The development of the continental crust's low Nb/Ta has been suggested to occur through the foundering of rutile-rich, high Nb/Ta lower crust [1]. However, the deep crust's composition is poorly constrained and there is limited data for ultralow concentration elements, such as W and Ta, in lower crustal mafic granulites [2]. More precise data is needed to better constrain the lower crust's HFSE budget and the role it may play in the continent's geochemical evolution.

Here, we present trace element and high-precision isotope dilution mass spectrometry HFSE data for lower crustal xenoliths from previously studied localities in eastern Queensland, Australia and the Kola Peninsula, northwest Russia. We also present data for xenoliths from the Eifel Volcanic Field, western Germany, which hosts diverse xenolith suites that have received comparatively little investigation. These samples provide broad insight into the evolution of the deep crust across regions of different crustal ages, thicknesses and tectonic settings. We combine these data with phase equilibrium modelling to investigate the role of lower crustal melting and hybridisation with intruding or underplating basaltic magmas at varying pressure-temperature conditions. Stoichiometric melting reactions of this crustal restite-basalt hybridisation process can be used to investigate trace element patterns of the residual lower crust and escaping melts [3]. These melting reactions provide important constraints on the consumed, residual and peritectic phases (e.g., rutile, amphibole) controlling the HFSE budget in the crust. This integrated approach offers unique insight into the role of the lower continental crust with respect to HFSE distribution.

[1] Tang et al. Nat. Commun. (2019) **10,** 235.
[2] Emo et al. Lithos (2023) **436-437,** 106976.
[3] Emo & Kamber (2022) **594,** 117742.