

Highly Siderophile Elements and Pb-Hf Isotope Systematics of Deccan Flood Basalts: Implications for Fractional Crystallization, Crustal Assimilation and Sulfide Segregation

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The ~66 My old Deccan Volcanic Province (DVP) on the Indian Peninsula is a prime example of intraplate plume-generated volcanism. This short-lived high-volume Continental Flood Basalt (CFB) province is considered to have derived from deep-seated Réunion mantle plume [1,3]. Highly Siderophile Elements (HSE: Re, Os, Ir, Ru, Rh, Pt, Pd, Au) are sensitive indicators for magmatic processes in the mantle and can place important constraints on the genesis of plume-derived volcanic rocks [2]. Here, we present a new HSE dataset for DVP rocks to assess the role of different petrogenetic processes in the DVP.

Samples across 3 DVP subgroups were characterized for their major and trace element compositions as well as Pb and Hf isotopes using well-established methods [1]. The HSE concentrations (except Rh and Au) were determined by isotope dilution using a NiS fire assay digestion technique. All concentration measurements were performed using a Thermo Scientific iCAP Q quadrupole ICPMS at the University of Cologne, Germany. The analytical uncertainties for HSE concentrations are <6% (1RSD), estimated based on replicate digestions of the reference sample TDB-1 (n=3).

Compatible HSE (Ir, Os, Ru), Ni, and Cr display positive correlations with MgO, whereas inverse correlations are observed for the more incompatible HSE (Pt, Pd, Re) and TiO₂. This is best explained by fractional crystallization of mainly olivine, and spinel. The older Kalsubai group basalts show the largest variations of compatible HSE abundances which in combination with low Nb/U of ~20, negative eHf (-3 to -8.9), and previously reported ¹⁸⁷Os/¹⁸⁸Os data [3] most likely reflect incorporation of enriched lithospheric components into their source magmas. Kalsubai and Lonavala basalts exhibit Cu/Zr<1 which may indicate sulfide saturation and segregation.

The younger Wai group has Nb/U of ~40 and is interpreted to represent a more pristine mantle source which is also reflected by positive eHf values (6.8 to 11.9) and less radiogenic ²⁰⁷Pb/²⁰⁴Pb and ²⁰⁶Pb/²⁰⁴Pb. Wai group basalts have Cu/Zr>1 consistent with fractional crystallization with no to little sulfur saturation.

[1] Pakulla, J.J., et al. (2023). *Chem. Geol.* 640.

[2] Day, J.M. (2013). *Chem. Geol.* 341.

[3] Peters, B.J., & Day, J.M.D. (2017). *GPL.* 5(5).