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Highly siderophile element abundances in nakhlite and chassignite meteorite sulfides

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Nakhlites and chassignites are martian igneous cumulative rocks and are the only recognized coherent genetic suite of rocks from Mars. They derived from low degree partial melting of hydrated and metasomatized depleted mantle lithosphere, whereas shergottite melts sample deeper mantle sources [e.g., 1]. Highly siderophile elements (HSE: Au, Re, Pd, Pt, Rh, Ir, Ru, Os) are sited within sulfide assemblages in magmatic rocks like martian shergottites, and can be used to address the nature of sulfide fractionation and parental melt compositions for these rocks [e.g., 2]. To date, only limited HSE abundance data exist for whole-rock nakhlites and chassignites [3-5], and sulfide assemblages in these meteorites have not been characterized. We report chalcophile, siderophile and highly siderophile element abundances for sulfide mineral assemblages within twelve nakhlites and two chassignites measured by laser ablation ICP-MS to examine parental melt compositions, sulfide saturation and fractionation in these rocks, and to compare them with shergottites. Chassignite sulfides have elevated and broadly flat HSE abundances relative to CI-chondrites, with enrichments in Pt and/or Ru, whereas nakhlite sulfides have more strongly fractionated HSE patterns with lower abundances, and high Re+Pd+Pt relative to Ru+Ir+Os. Bulk HSE compositions for nakhlites and chassignites can be estimated, combining sulfide modal and HSE abundances. Fractional crystallization models calculated assuming a starting composition similar to the chassignites are consistent with the concept of limited HSE from S-saturated melts from an S-poor mantle source. This result supports distinction from shergottite melt compositions and the requirement of low-degree partial melting of a depleted source [1] for the chassignites and nakhlites. Nakhlite HSE compositions can be interpreted as deriving from higher degrees of S fractionation of more HSE-depleted melts than shergottites [2] (between 50 and 55% of the shergottites HSE inventory, and ~150-200 ppm of S).

[1] Day et al. (2018) *Nat. Comm.,* **9**, 4799. [2] Paquet et al. (2021) *GCA*, **293**, 379-398. [3] Jones et al. (2003) *Chem Geol*, **196**, 21-41. [4] Dale et al. (2012) *Science*, **336**, 72-75. [5] Mari et al. (2019) *GCA,* **266**, 416-434.