VARIABLE HIGHLY SIDEROPHILE ELEMENT ABUNDANCES AND SUBCHONDRITIC $^{187}Os/^{188}Os$ IN THE ANGRITE PARENT BODY.

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Introduction: We report new highly-siderophile element (HSE; Re, Os, Ir, Ru, Pt, Pd) abundance and $^{187}Os/^{188}Os$ data for six angrites to constrain metal-sulfide-silicate partitioning in these relatively oxidized, early-formed meteorites [1]. Precise Pb-Pb age constraints demonstrate that angrites are some of the oldest Solar System materials, broadly synchronous with CAI formation [2-4]. We have performed detailed mineralogical characterization of quenched (weighted mean age of 4562.1 ± 0.4 Ma; D'Orbigny and Sahara 99555), and slowly-cooled angrites (weighted mean age of 4557.7 ± 0.2 Ma [4]; Angra dos Reis [AdoR], NWA 4590, NWA 4801), as well as NWA 4931 (paired with texturally anomalous NWA 2999).

Petrology, HSE abundances, and Os isotopes: Mineralogical study of AdoR, D'Orbigny, and Sahara 99555 confirms previous work on other portions of these meteorites, and is consistent with limited impact disturbance (e.g., [5]). All angrites have broadly chondrite-relative HSE patterns, but differ considerably in absolute abundances of these elements (D'Orbigny and NWAs: 0.01-0.1 x CI-chondrite, AdoR and Sahara 99555: <0.001 x CI). Present day $^{187}Os/^{188}Os$ compositions for D'Orbigny, NWA 4590 and NWA 4801 are subchondritic (0.105-0.120), whereas those for AdoR and Sahara 99555 are suprachondritic (0.157-0.171). NWA 4931 has the highest HSE abundances (~0.1 x CI) and a chondritic $^{187}Os/^{188}Os$ value (0.1285). There appears to be no relationship between textural groups, HSE abundances, and $^{187}Os/^{188}Os$ values.

Discussion: Chronological constraints of angrites illustrate that they are samples of an ancient differentiated body (e.g., [1]). AdoR and Sahara 99555 have low-HSE abundances (<0.24 ppb Os) and elevated $^{187}Os/^{188}Os$, broadly consistent with derivation from a parent body that has witnessed metal-silicate equilibrium, comparable to lunar basalts [6]. The higher HSE abundances of D'Orbigny, NWA 4590, NWA 4801, and NWA 4931 (>2.4 ppb Os) could reflect meteoritic additions to an otherwise HSE-depleted precursor lithology (analogous to the HSE composition of Sahara 99555). NWA 4931 has previously been shown to contain up to 10 vol.% metal [7], which combined with our results may imply some degree of meteoritic contamination. However, the non-chondritic Os isotopic compositions of most studied angrites either require additions from impactors with fractionated Re/Os, or reflect magmatic processing in their parent body. If angrites are derived from a single parent body [5], and represent high-degree partial-melt products, their mantle source must have had variable HSE abundances with variably fractionated Re/Os, possibly as a consequence of inefficient metal-silicate equilibration. The relatively oxidized assemblage of angrites may play a role in setting relative HSE abundances, and is the subject of continuing investigations.

References: [1] Amelin, (2008) *GCA*, 72; 221-232. [2] Connelly et al. *GCA* 72; 4813-4824. [3] Brennecka et al. (2010) *LPSC* abstract # 2117. [4] Markowski et al. (2007) *EPSL* 262; 214-229. [5] Mittlefehldt et a. (2002) *MAPS* 37; 345-369. [6] Day et al. (2007) *Science* 315; 217-219. [7] Humayan et al. (2007) LPSC abstract #1221.