Experimental Constraints on the Redox State and Size of the Angrite Parent Body

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Angrites are silica undersaturated, volatile depleted achondrites [1], key anchors for early solar system chronology [2], which have recently come under increased scrutiny as possible building blocks of the Earth [3]. More generally, the nebular and planetary processes that shaped the angrite parent body (APB) can be relevant to Earth's building blocks [4]. Yet, due to the limited sample set available in earlier work (n=4-6) [5], few constraints exist on the petrogenesis of angrites. The APB is thought to be fairly reduced (~IW+1, [1]) and small (r~100-200 km, [6-7]), and our experimental study aims to constrain these first-order parameters.

With 16 different types of angrites, the current collection allows us to identify two compositional groups of quenched angrites, which can be related by fractional crystallization [8]. Samples in the Group 2 (D'Orbigny, Sahara 99555, NWA 1296) have similar compositions, suggesting that the liquids from which they formed are more evolved than those in Group 1 and were multiply saturated in Ol-Cpx-Plag. A series of 1 atm equilibrium experiments were performed on an oxide mix with D'Orbigny composition, at variable fO_2s and T. Comparison of the Cpx Mg# in the experimental charges and Group 2 angrites indicate that the APB fO_2 was ~IW+1.6, in agreement with previous estimates [1]. At such fO_2, olivine, plagioclase and spinel are liquidus phases and fassaitic pyroxene appears after ~50 % crystallization, far from the liquidus, indicating that the actual crystallization pressure must be greater than 1 atm. Higher P experiments are underway to determine the conditions of Ol-Cpx-Plag saturation, which will provide a lower limit on the size of the APB.

Our initial results suggest that the idea of a small APB [6-7] might need to be reassessed.

[1] Keil (2012) *Chem. der Erde* **72**, 191-218. [2] Tissot et al. (2017) *GCA* **213**, 593-617. [3] Fitoussi et al. (2016) *ESPL* **434**, 151-160. [4] Dauphas et al. (2015) *ESPL* **427**, 236–248. [5] Longhi (1999) *GCA* **63**, 573-585. [6] Weiss et al. (2008) *Science* **322**, 713-716. [7] Scott & Bottke (2011) *MAPS* **46**, 1878-1887. [8] Tissot et al. (2018) *LPSC* #2937.