

The volatile inventory and hydrogen isotope composition of apatite in the Brachina meteorite

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Water is essential for life as we know it. Therefore, understanding the origin(s) and transport of water across the Solar System is of primary importance, and is an overarching science question driving the Solar System exploration. Models investigating this issue generally rely on the records preserved in meteorites sourced from the asteroid belt, and notably in the volatile-rich carbonaceous chondrite meteorites, because they are thought to 'best' represent the starting composition of the protosolar nebula [1]. However, the parent bodies of these samples accreted relatively late compared with some other asteroidal bodies [2]. Thus, it is important to investigate alternative records accessible in 'older' meteorite reservoirs.

Partially-melted asteroids, sampled by the achondrite meteorites, provide us with such a complementary archive. The asteroidal parent bodies of achondrites such as the angrites and the ureilites accreted very early, within *ca.* 1 million years (Myr) after the start of Solar System formation (compared to *ca.* +3-4 Myr for carbonaceous chondrites parent bodies [2]). Recent secondary ion mass spectrometry (SIMS) studies have established the water inventory and H isotope composition of meteorite samples from the howardite-eucrite-diogenite and the angrite parent bodies [3-5], which appear to share a common origin with water in volatile-rich carbonaceous chondrites. To complement this limited achondrite dataset, we used SIMS to investigate the F-Cl-OH abundance and H isotope composition of apatite in Brachina, whose parent-body partially melted within *ca.* 1 Myr after the start of Solar System formation [6]. Our results show that Brachina apatite is Cl-rich, containing ~5.8 wt.% Cl and ~0.6 wt.% F. Apatite H₂O abundances range between ~40 and 3000 µg.g⁻¹, and are negatively correlated with δD values decreasing from ~ +3500 to -150‰. We will discuss these results further at the conference.

References: [1] Robert (2006) *Meteorites and the Early Solar System II*, Univ. Arizona Press, p. 341. [2] Sugiura & Fujiya (2014) *MaPS* 49, p. 772. [3] Sarafian *et al.* (2014) *Science* 346, p. 623. [4] Barrett *et al.* (2016) *MaPS* 51, p. 1110. [5] Sarafian *et al.* (2017) *PTRS A* 375, p. 20160209. [6] Dunlap *et al.* (2017) *LPSC XLVIII*, Abstract #2981.