The abundance and isotopic composition of water in Howardite-Eucrite-Diogenite (HED) meteorites and implications for the volatile inventory of the Earth-Moon system

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Recent advancements in analytical instrumentation and techniques have enabled high-precision volatile measurements [e.g. 1]. Water contents and hydrogen (H) isotopic composition of volatile-bearing accessory phases, such as apatite [2-4], can now be measured in extra-terrestrial samples. These investigations have brought about a paradigm shift in our understanding of volatile inventory of the inner solar system bodies [2, 4, 5-7]. On-going research on lunar basalts [3, 4, 7] suggests asteroidal sources for water in the Earth-Moon system. Magma degassing on an airless planetary body such as the Moon [3] is believed to play the dominant role in the isotopic fractionation of this water. The Howardite-Eucrite-Diogenite (HED) suite of meteorites is the only set of meteorites with a strong link to a parent body, namely 4 Vesta [8-9]. Vesta is believed to have undergone similar differentiation as the Moon, making it an excellent analogue [10-11]. In order to fully evaluate and assess the volatile inventory of the inner solar system it is therefore necessary to investigate the basaltic samples from the HED suite of meteorites for their OH contents and H isotopic composition. Apatite grains from HED basaltic samples will be analysed on the Cameca NanoSIMS 50L at the Open University, using the methods from [3]. Results from this study will be compared to those from [4, 7], using the same instrument. This will minimise any inter-laboratory biases and provide more reliable data. Understanding the OH contents and H isotopic signatures of the HED parent body will provide greater constraints on the source of volatiles in the early Earth-Moon system.

References

[1] Saal et al., (2008) Nature, 454, 192-195
[2] McCubbin et al., (2010) GCA, 75, 5073 - 5093
[3] Tartèse and Anand (2013) EPSL, 361, 480 - 486
[4] Barnes et al., (2013) Chem. Geol., 337-338, 48 – 55
[5] Boyce et al., (2010) Nature, 466, 466-470
[6] Greenwood et al., (2011) Nat. Geo., 4, 79-82
[7] Tartèse et al., (2013) GCA, 122, 58-74
[8] McCord, (1970) Science, 168, 1445-1447
[9] Binzel & Xu, (1993) Science, 260, 186-191
[10] Ruzicka et al., (1997) LPI conference abstracts, 28, 1215
[11] Mandler and Elkins-Tanton, (2013) MAPS, 48, 2333-2349