WATER-BEARING, VOLATILE-RICH CLASTS IN HOWARDITES AND POLYMICT UREILITES - CARRIERS OF DEUTERIUM-ENRICHED WATERS NOT SAMPLED BY INDIVIDUAL METEORITES.

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Introduction: Brecciated meteorites can contain unknown material, which is not available in meteorite collections and may be of special interest with regard to the composition and budget of Earth's volatile inventory. These clasts have been identified in various chondrites as well as in differentiated meteorites, e.g., HEDs and polymict ureilites (e.g. [1-5]). In this study the hydrogen isotopic composition of volatile-rich clasts from howardites and polymict ureilites and of the matrices of several other meteorites of petrologic types 1 and 2 was analyzed.

Analytical Techniques: We obtained the D/H ratio of 16 volatile-rich clasts from two howardites (NWA7542 and Sariçiçek) and two polymict ureilites (DaG164 and EET83309) as well as from Ivuna, Bells, Essebi, and Tagish Lake using a Cameca NanoSIMS 50 at the Max Planck Institute for Chemistry in Mainz. Negative hydrogen and deuterium secondary ions have been analyzed using a Cs^+ primary ion beam with a primary ion current of 25-30 pA. The IMF correction was done using synthetic $C_{30}H_{50}O$ and the Ilimaussaq amphibole. Compositional and petrographic information obtained by SEM and EMPA has been published earlier [4,5].

Results: Previously, we identified two types of volatile-rich clasts, which can be distinguished from each other by their mineralogy and texture [4,5]:

(a) CM-like clasts. These lithologies appear to be closely related to CM chondrites based on texture and mineralogy. This link is also supported by oxygen isotopes [7] and by the range of δD values (Fig. 1). CM-like clasts in NWA7542 and Sariçiçek range from ~ -200 to +200 ‰ in δD (Fig. 1). This range is well in that of CM chondrite bulk rocks [e.g. 8,9].

(b) CI-like clasts. These fragments in howardites and ureilites are dominated by fine-grained hydrous matrix. In both meteorite classes they clearly show textural and mineralogical similarities to CI chondrites. However, in general the CI-like clasts from polymict ureilites are significantly more enriched in D compared to those from howardites (Fig. 1). Nonetheless, an inter-clast heterogeneity can be observed within both achondritic groups. It is known that inorganic matter (IOM) is the main carrier phase of the D enrichment in carbonaceous chondrites with δD exceeding 3000 ‰ in CM2 Bells and CR chondrites [11]. The general D enrichment in CI-like clasts from ureilites is in clear contrast to the less enriched "phyllosilicate groundmass" of Ivuna and the ungrouped C2 chondrites Bells, Essebi, and Tagish Lake (Fig. 1). Whether the D enrichment can be attributed to the phyllosilicates themselves or to finely dispersed IOM cannot be specified as our approach cannot discriminate between H from the two phases.

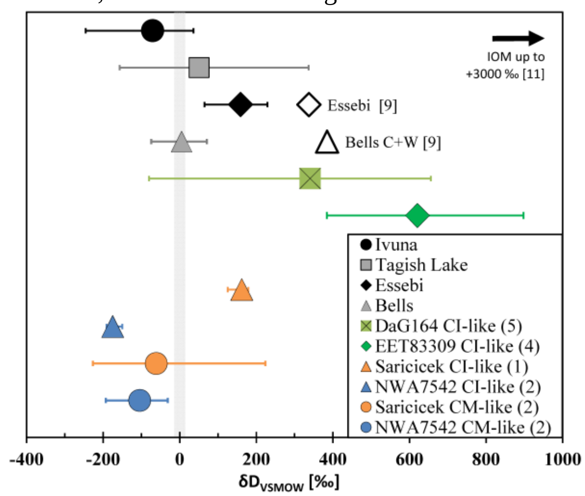

Fig. 1: Mean and range of δD from different clasts and carbonaceous chondrites. See text for details. Number of analyzed clasts in brackets.

Discussion and Conclusion: The link between CM-like clasts and CM chondrites is clearly confirmed by our data. Based on the D/H ratio of CI-like clasts we can unambiguously distinguish between those from ureilites and those from howardites. While CI-like clasts from howardites are comparable to CI chondrites in their D/H as well as in their mineralogy, the CI-like clasts from ureilites are certainly of different origin. The generally higher D enrichment of the latter rules out any link to CI chondrites and, respectively, Bells, Essebi, and Tagish Lake.

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