O-ISOTOPE COMPOSITION OF CI- AND CM-LIKE CLASTS IN UREILITES, HEDS, AND CR CHONDRITES.

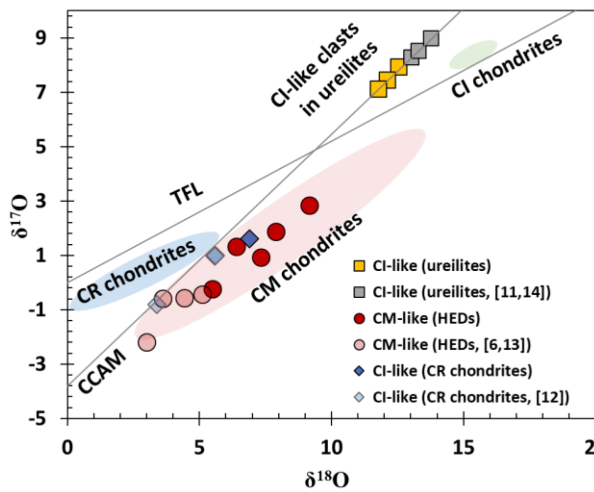
M. Patzek[1], A. Pack[2], A. Bischoff[1], R. Visser[3], and T. John[3], [1]Institut für Planetologie, University of Münster, Wilhelm-Klemm-Str. 10, D-48149 Münster, Germany. [2]Universität Göttingen, Geowissenschaftliches Zentrum, Goldschmidtstr. 1, D-37077 Göttingen, Germany. [3]Freie Universität Berlin, Institut für Geologische Wissenschaften, Malteserstr. 74-100, 12249 Berlin, Germany. E-Mail: markus.patzek@uni-muenster.de

Introduction: Brecciated meteorites can contain unknown material, which is not available in meteorite collections (e.g., [1-4]). CI- and CM-like clasts have been identified in various chondrite breccias as well as in differentiated meteorites, e.g., brecciated HEDs and polymict ureilites (e.g., [5-10]). In this study the bulk oxygen isotope compositions of volatile-rich, CI- and CM-like clasts from HEDs, polymict ureilites, and CR chondrites were analyzed.

Analytical Techniques: We obtained the oxygen isotope composition of five volatile-rich, CM-like clasts from four howardites (NWA 6695, NWA 7542, NWA 8736, and PRA 04402), three volatile-rich, CI-like clasts from the polymict ureilite DaG 164 and one CI-like clast from the CR chondrite Acfer 097 by IR-Laser fluorination.

Results: Previous studies have shown that three different types of volatile-rich clasts can be distinguished from each other by their mineralogy and δD signatures [9,10].

(a) CM-like clasts in HEDs share similar mineralogy and δD signatures with CM chondrites. The obtained oxygen isotope data of the analyzed clasts plot in the field of common CM chondrites and are similar compared to previous data ([12]; Fig. 1). (b) CI-like clasts from CR chondrites are mineralogically indistinguishable from those in polymict ureilites but plot closer to the CR and CM field (Fig. 1; see also [12]). (c) CI-like clasts from polymict ureilites are dominated by a fine-grained, hydrous matrix and a D enrichment of up to +1000 ‰ [10]. Their bulk oxygen isotope composition plots on the extension of the CCAM (Fig. 1).



Discussion: By combining mineralogy, δD signatures, and bulk oxygen isotope data the CM-like clasts in HEDs are most likely of CM origin and may represent fragments of CM-impactors. The mineralogy and δD signatures of CI-like clasts from polymict ureilites and those from CR chondrites are very similar; however, they can clearly be distinguished based on their oxygen isotope signature (Fig. 1). While the δD signatures of CI-like clasts from CR chondrites are more similar to those of their CR host rocks, the CI-like clasts from polymict ureilites are significally heavier in ^{17}O and ^{18}O than clasts from CR chondrites as also found by [12]. The obtained data are in good agreement with previous data on a CI-like clasts from the polymict ureilite Nilpena and of two fragments of the Almahata Sitta strewnfield (Fig. 1; [12,14]). The heavy oxygen isotopic composition plotting along the CCAM indicates a mixing of "normal" ^{16}O-rich anhydrous silicates with ^{16}O-poor ices formed in the outer solar system in a low-T environment. The ^{16}O-poor bulk composition of the CI-like clasts requires higher water/rock-ratios than those proposed for the aqueous alteration processes triggering the formation of phyllosilicates in CI and CM chondrites. Unlike CI and CM chondrites, the oxygen isotope composition of the ices was not fractionated during or before incorporation of the CI-like clasts into the parent body(ies).

Conclusion: CI-like clasts in ureilites are truely a component not available as individual samples in today`s meteorite collections. Their unique oxygen isotope composition and the homogenous D enrichments prove their primitive nature and formation from ^{16}O-poor ices, whose oxygen isotopic compositions have not been fractionated.

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