CHROMIUM ISOTOPES AND TRACE ELEMENT CONCENTRATION OF XENOLITHIC CI CLASTS IN BRECCIATED CI CLASTS AND ACHONDrites.

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Introduction: CI- and CM-like clasts have been identified based on petrographic criteria in various chondrite and achondrite breccias including CR and OC chondrites as well as ureilites and HEDs [1-4]. Despite their similar mineralogy, CI-like clasts from different host meteorites and CI chondrites exhibit different H and O isotope signatures as well as different S isotopic distributions of their sulfide grains [5-7]. Altogether, these clasts are better referred to as CI clasts rather than CI-like. In this study, Cr isotope data and trace element concentrations of one CI clast from the DaG 1064 ureilite (C1a) and one from the CR chondrite Acfer 311 (C1b) will be discussed. Additional data on a CM-like clast from the polymict eucrite NWA 7542 will be presented.

Samples and Methods: Cr isotopic compositions as well as previously obtained O isotopic compositions have been investigated for three extracted clasts: Dar al Gani (DaG) 1064-C (C1a), Acfer 311-C (C1b), and Northwest Africa (NWA) 7542-G (CM-like). A three-step ion exchange chromatography (anion and cation resin) was used to separate Cr from the matrix. The isotopic compositions were analyzed using a Thermo Scientific Triton Plus TIMS at the Freie Universität Berlin. The Rare Earth Element (REE) abundances are analyzed on an Element XR ICP-MS.

Fig 1: (a) $\varepsilon^{54}\text{Cr}$ vs. $\Delta^{17}\text{O}$ plot showing data that define the carbonaceous (CC) and non-carbonaceous (NC) meteorite reservoirs and data of individual clasts (this study) from different meteorites (colored). Literature data from [8-9 and references therein]. (b) REE abundances of the studied clasts normalized to average CI chondrite values [11].

Results and Discussion: DaG 1064-A (C1a) yielded $\varepsilon^{54}\text{Cr}$ of 2.84 ± 0.12 and $\varepsilon^{52}\text{Cr}$ of 0.66 ± 0.0. The high $^{54}\text{Cr}$ excess for DaG 1064-A is remarkable since similar material from Almahata Sitta (AhS CC) exhibits lower excesses (Fig. 1a; [8]). This high excess might have been caused by a heterogeneous distribution of $^{54}\text{Cr}$ excess in the carrier phases from the sample, since our aliquot is smaller compared to those of [8-10]. Acfer 311-C (C1b) shows a less pronounced excess in $^{54}\text{Cr}$ and $^{53}\text{Cr}$ with $\varepsilon^{54}\text{Cr}$ of +1.43 ± 0.36 and $\varepsilon^{53}\text{Cr}$ of 0.39 ± 0.11, respectively. The similarity in its $^{54}\text{Cr}$ excess as well as in H and O isotopes [6] compared to CR chondrites favors a genetic relation between the clast and the host CR chondrite (Fig. 1a). CM-like clast NWA 7542G exhibits only minor (if any) excesses in $^{54}\text{Cr}$ and $^{53}\text{Cr}$ with $\varepsilon^{54}\text{Cr} = 0.29 ± 0.39$ and $\varepsilon^{53}\text{Cr} = 0.29 ± 0.05$, respectively, maybe due to contamination with HED material during separation. REE concentrations of clasts A311-C and DaG1064-A are roughly chondritic showing a slightly decreasing trend from La to Lu (Fig. 1b). The REE data of CM-like clast NWA 7542-G show a pattern similar to those of group II Ca,Al-rich inclusions, which may dominate the pattern in the analyzed aliquot (Fig. 1b).

Take Home Messages: C1a clasts in ureilites are enriched in $^{54}\text{Cr}$ and they show chondritic REE concentrations. Together with O and H isotope data [5,6] it is clear that this material is of very primitive nature. The C1b clast in the CR chondrite shows an excess in $^{54}\text{Cr}$ similar to the data of CR chondrites. The O and H isotope data of the same clast also indicate a genetic relationship between the clast and the host. CM-like clasts in HEDs are closely related to “common” CM chondrites considering petrology, O, H, and partly their Cr isotopes.