A RE-INVESTIGATION OF A CHONDRITIC XENOLITH IN THE MURCHSION (CM2) CHONDRITE: FORMATION BY FLUID-ASSISTED PERCOLATION DURING METAMORPHISM?

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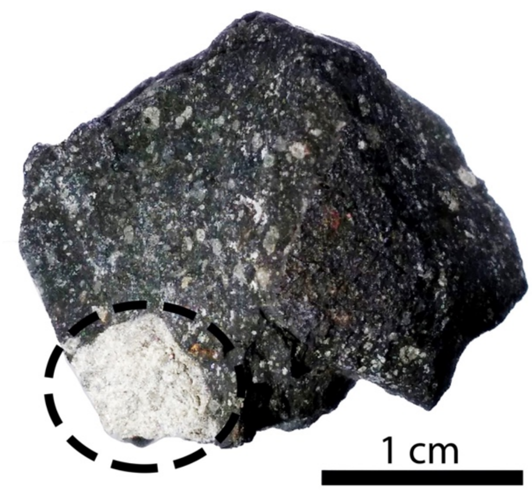
Introduction: The CM chondrites are generally complex impact breccias, in which lithic clasts and mineral fragments showing various degrees of aqueous alteration and possibbly originating from different parent bodies are mixed together (e.g., [1-9]). The occurrence of CM-like clasts in other chondritic and achondritic meteorite breccias is also well-documented (e.g., [4,10-12]), however, reports on the occurrence of foreign clasts in CM chondrites are rare [6-9].



In this study, we reinvestigated the white clast in the Murchison CM chondrite [6,8] and demonstrate that the clast is not related to R chondrites as earlier suggested [7]. In addition to the classification we discuss the origin and the history of its formation by studying several aspects like mineralogy, bulk chemistry, Rare Earth Elements (REE), oxygen isotopes, and the soluble organic compounds.

Results: The petrographic study shows that the white clast consists of two areas with different granoblastic texture: (1) a coarse-grained (average grain size: ~200 µm) and (2) a fine-grained lithology (average grain-size: ~20 µm). The Fa-content of olivine in the clast is the same as Fa within olivine from Rumuruti (R) chondrites (Fa: ~38 mol%); however, the concentrations of the elements Ni and Ca in olivine are significantly different. The fragment also contains Ca-rich pyroxene, ~$An_{30\text{-}38}$-plagioclase/maskelynite, Cr-rich spinel, several sulfide phases, a nepheline-normative glass, and traces of merrillite and metal. The O-isotope composition of the clast falls below the terrestrial fractionation line (TFL) in the field of CM chondrites and is significantly different to data for bulk R chondrites. Considering the soluble organic matter a highly-oxidized carbon chemistry and organomagnesium compounds were found reflecting high temperature and pressure processes.

Discussion and Conclusions: O-isotope composition of the clast falls in the field of CM chondrites ($\Delta^{17}O$ = +0.5 ‰) [13,14] a relationship to R-chondrites ($\Delta^{17}O$ = +5.5 ‰) [15] can be ruled out. The occurrence of nepheline-normative glass and maskelynite in a rock with a well-recrystallized texture is very surprising. Their present in restricted areas of the well-recrystallized rock may indicate remarkable P-T-excursions during shock metamorphism The white clast may have formed in the interior of the (or a CM-like) CM parent body by fluid-assisted percolation during metasomatism triggered by shock-induced annealing.

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Acknowledgements: We thank Bruno Fectay and Carine Bidaut for bringing this sample to our attention. We also thank the DFG for support within the SFB-TRR 170 "Late Accretion onto Terrestrial Planets" (subproject B05).