XENOLITHIC FRAGMENT IN THE CM CHONDRITE MUKUNDPURA: GREETINGS FROM THE TUCSON PARENT BODY?

S. Ebert[1], M. Patzek[1], and A. Bischoff[1]. [1]University of Münster, Institut für Planetologie, Wilhelm-Klemm-Str. 10, 48147 Münster, Germany; samuel.ebert@uni-muenster.de

Introduction: In general, CM chondrites are complex impact (mostly regolith) breccias. The lithic clasts are typically related to CM chondrites, but can show different stages of alteration (e.g., [1-3]). On the one hand, CM-like clasts are widespread within other achondrite (HEDs) and chondrite groups (ordinary and carbonaceous) as xenoliths (e.g., [4-7]). On the other hand, xenolithic fragments of other meteoritic groups are rare in CM-chondrites [8,9]. Here, we will present data of an achondritic fragment with distinct exsolution lamellae from the CM chondrite Mukundpura (Fig. 1). This work will study the history and origin of this achondritic fragment considering the major element and REE concentrations and O-isotope data of the clast.

Results: The small achondritic fragment (Fig. 1) measures 65 x 78 µm. The fragment stands out from the matrix by its distinct exsolution lamellae. The low-Ca pyroxene lamellae is up to ~2.8 µm wide ($Fs_{61}Wo_{6.5}$) and the darker (Fig. 1) Ca-pyroxene lamellae is up to ~1.4 µm wide ($Fs_{36.5}Wo_{35}$). O-isotopes of two spots on the achondritic fragment and of one spot on a mafic silicate from the matrix close to the fragment were measured by Cameca IMS 1280-HR at the University of Heidelberg. Both pyroxene measurements show similar O-isotope values with -2.62 and -3.00 ‰ in δ^{17}O and 0.62 and 0.71 ‰ in δ^{18}O, respectively. The mafic silicate from the matrix has a different O-isotope signature with $\delta^{17}O = 0.22$ and $\delta^{18}O = 4.84$ (Fig. 2). The CI-normalized REE pattern of the fragment shows an enrichment in heavy-REEs (HREEs) compared to light-REEs (LREEs) with a negative Eu anomaly.

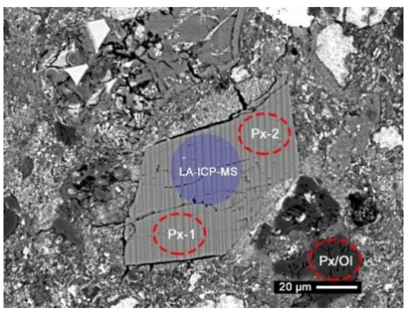

Figure 1: BSE-image of the achondritic fragment. Blue circle: LA-ICP-MS measurement; Red dotted lines: O-isotope measurements.

Discussion and Conclusions: The O-isotope data clearly show, that the achondritic fragment does not originate from the CM formation region whereas the mafic silicate from the matrix plots within the CM-field (Fig. 2). Thus, the achondritic fragment in Mukundpura originates from a completely different parent body. Silicate inclusions within the iron meteorite Tucson have similar oxygen isotope signatures and show similar REE-patterns and enrichments [13]. These surprisingly similar characteristics imply that the achondritic fragment may originate from the same parent body as the Tucson meteorite.

If this assumption is correct, the achondritic fragment yields further information about the Tucson parent body. The pyroxene exsolution lamellae can also be used as a "Two-Pyroxene Geothermometer" at 1atm after [14]. Since the lamellae of the Ca-pyroxene are very thin, a contamination with the surrounding low-Ca pyroxene was unavoidable. However, a crystallization temperature of the pyroxene of ~1075 °C and a closing temperature for the exsolution of ~800-900 °C can be estimated. Changes in the pressure can increase the derived temperatures by 2-4 °C/kbar. Thus, the estimated temperatures can be seen as their lower limits. The HREE-enriched pattern and the negative Eu-anomaly are similar to the low-Ca and Ca pyroxenes from the Mars meteorites Shergotty and Zagami [15]. This kind of pattern strongly suggests a progressive fractional crystallization, during which the pyroxene is co-crystallising with plagioclase.

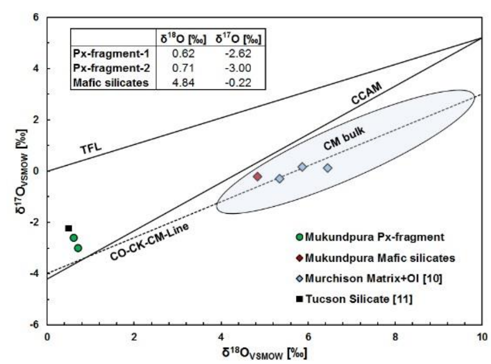

Figure 2: 3-oxygen isotope plot of the achondritic fragment. CM chondrite bulk data are from [12]

References: [1] Metzler K. et al. (1992) *Geochim. Cosmochim. Acta* 56:2873-2897. [2] Zolensky M. E. et al. (2017) *Lunar Planet. Sci.* 48:#2094. [3] Bischoff A. et al. (2017) *Meteoritics & Planetary Science* 52:A26. [4] Zolensky M. E. et al. (1996) *Meteoritics & Planetary Science* 31:518-537. [5] Rubin A. E.and Bottke W. F. (2009) *Meteoritics & Planetary Science* 44:701-724. [6] Patzek M. et al. (2018) *Meteoritics & Planetary Science* (re-submitted). [7] Patzek M. et al. (2018) *Meteoritics & Planetary Science* (this issue) [8] Bischoff A. et al. (2018) *Meteoritics & Planetary Science* (this issue) [9] Kerraouch I. et al. (2018) *Meteoritics & Planetary Science* (this issue) [10] Clayton R.N. and Mayeda T.K. (1984) *Earth and Planetary Science Letters* 67:151-161 [11] Clayton R.N. and Mayeda T.K. (1996) *Geochimica et Cosmochimica Acta* 60:1999-2017 [12] Clayton R.N. and Mayeda T.K. (1999) *Geochimica et Cosmochimica Acta* 63:2089-2104 [13] Kurat G. et al. (2011) *Meteoritics & Planetary Science* 45:1982-2006. [14] Lindsley D. H. and Andersen D. J. (1983) *JGR: Solid Earth* 88:A887-A906 [15] Wadhwa M.et al. (1994) *Geochimica et Cosmochimica Acta* 58:4213-4229.