A xenolith from an early formed parent body in the CM carbonaceous chondrite LaPaz Icefield 02239

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Background: Most of the clasts in CM meteorite breccias are of CM lithologies. Xenoliths are rare, and the majority are lithologically similar to CI meteorites [1,2].

Here we describe a xenolith in a thin section of LAP 02239 that is distinct from both CM and CI lithologies. Furthermore, the xenolith is probably from a parent body that accreted significantly earlier than the CM parent body(ies).

Xenolith Properties: LAP 02239 is a mildly aqueously altered CM with a petrologic type of 1.5 [3]. The sample studied contains a 1.5 x 0.6 mm xenolith with a ~0.15 mm thick fine grained rim (FGR) (**Fig. 1**). The xenolith is similar to a CM lithology in that it has chondrules, olivine & pyroxene grains, and spinel (±hibonite) CAIs in a fine-grained matrix. It differs from the CMs because its chondrules and CAIs lack FGRs, tochilinite and calcite are absent, and its fine-grained matrix has a higher Mg/Fe ratio than the host meteorite (**Fig. 1**). Its matrix is also is heavily fractured.

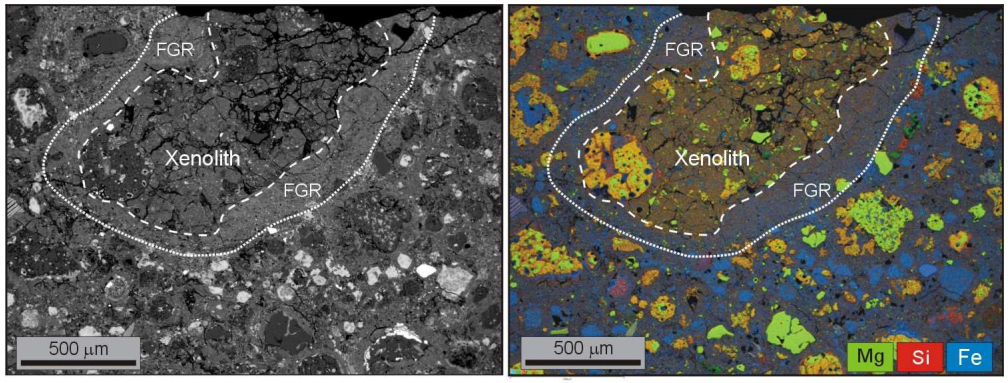

Fig. 1. BSE image (left) and false coloured X-ray map (right) of the xenolith in LAP 02239.

Interpretation: As the xenolith has a FGR it must have been broken from a lithified parent body, and was free-floating in the nebula when it encountered a region of rim-forming dust (**Fig. 2**). The same dust also formed FGRs on chondrules and CAIs prior to their accretion into the LAP 02239 CM parent body.

The xenolith's chondrules and CAIs lack FGRs because its parent body accreted: (i) very early, and before the dust was present, and/or (ii) in a region of the protoplanetary disc where rim-forming dust was absent (**Fig. 2**).

It is unclear whether the xenolith was aqueously altered in its parent body or after it accreted into the LAP 02239 parent body.

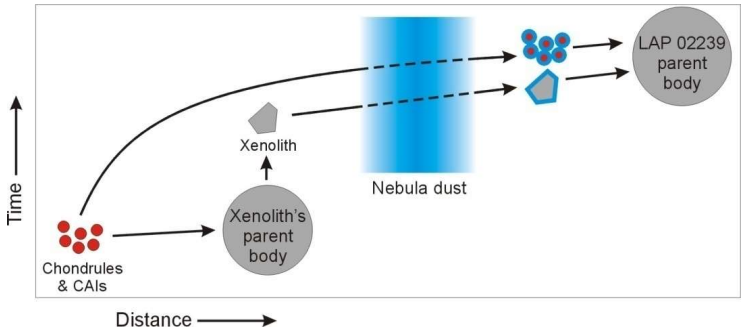

Fig. 2. Model of the origin of the xenolith and other rimmed constituents of LAP 02239.

Implications: (1) This xenolith gives a glimpse into the multiphase chronology of carbonaceous chondrite parent body formation. (2) The presence/absence of FGRs can help to unravel the accretion history of various objects in the CMs.

[1] Lentfort, S. *et al.* (2020) *MAPS* 56:127-147. [2] Bischoff A. *et al.* (2006) In Meteorites and the early solar system II, The University of Arizona Press. pp. 679–712. [3] Howard K. T. *et al.* (2015) *GCA* 149:206–222. Acknowledgements: We are grateful to NASA/JSC for the loan of LAP 02239.