IN-SITU H, C AND N ISOTOPIC NANOSIMS MAPPING OF THE CM2 METEORITE COLD BOKKEVELD.

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Introduction: We have analysed the H, C and N isotopic compositions of multiple regions within a single CM2 meteorite, Cold Bokkeveld [1]. Previous studies of organic material have been conducted on demineralised samples [2-5]. However, investigation of the distribution and signatures of the organic material in-situ, while fraught with contamination issues (e.g. where cracks and holes in the sample surface have been unintentionally sampled), will provide insight into the nature and origin of isotopically anomalous organic matter in chondritic meteorites. Recent work has linked trends between the bulk H, C and N elemental and isotopic compositions of CM and CR chondrites [6] with varying degrees of aqueous alteration. We discuss our most recent measurements in the context of such observations.

Analytical Techniques: Multiple chondrules were identified in the sample, of which four were selected for more detailed analyses. A number of inter-chondrule matrix areas were also mapped. Back scattered electron images were acquired with an FEI Quanta 200 3D microscope, and then used to identify regions of interest. H, C and N isotopic ratios of these regions were determined using a Cameca NanoSIMS 50L [1].

Results and Discussion: Many of the Cold Bokkeveld areas exhibit higher C/H ratios and δD values than the bulk CM data previously published [6-7]. The Cold Bokkeveld values plot along a spectrum between bulk carbonaceous chondrite values [6-7] and extracted organic material [4], possibly defining a mixing trend between organic and silicate materials. Alternatively, these results could be due to post-accretionary remobilisation of D-rich IOM [8]. The latter explanation would be consistent with the altered nature of Cold Bokkeveld previously inferred, for example, on the basis of O isotopes [9]. The $\delta^{15}N$ compositions of the Cold Bokkeveld areas have a relatively wide range of values, but are broadly consistent with bulk CMs [6-7].

The chondrule interiors generally have lower δD and $\delta^{15}N$ compositions than the chondrule rims, more similar to bulk CM chondrite compositions [6-7]. Furthermore, while δD hotspots were identified in several of the chondrule rims and matrix locations, no hotspots were identified in the chondrule interiors. This indicates that any post-accretionary remobilisation [5] occurring during alteration of the meteorite did not lead to preferential movement of isotopically anomalous material to the chondrule interiors.

References: [1] Snape J. F. et al. 2014. Abstract #1987. 45th Lunar & Planetary Science Conference. [2] Busemann H. et al. 2006. *Science* 312:727–730. [3] Nakamura-Messenger K. et al. 2006. *Science* 314:1439–1442. [4] Alexander C. M. O'D. et al. 2007 *Geochimica et Cosmochimica Acta* 71:4380–4403. [5] Remusat L. et al. 2010. *Astrophysical Journal* 713:1048–1058. [6] Alexander C. M. O'D et al. 2013. *Geochimica et Cosmochimica Acta* 123:244–260. [7] Alexander et al. 2012. *Science* 337:721-723. [8] Alexander C. M. O'D. et al. 2010. *Geochimica et Cosmochimica Acta* 74:4417–4437. [9] Clayton R. N. and Mayeda T. K. 1999. *Geochimica et Cosmochimica Acta* 63:2089–2104.