LEWIS CLIFF (LEW) 85332 AND MILLER RANGE (MIL) 090001, A NEW GROUPLET THAT IS DISTINCT FROM THE CR CHONDRITES?

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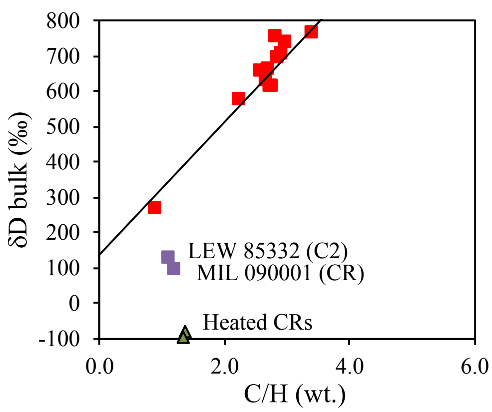
Introduction: Lewis Cliff (LEW) 85332 and Miller Range (MIL) 090001 are classified as C2 [1] and CR2 [2], respectively. LEW 85332 is thought to have affinities with the CRs, largely based on its ^{15}N-rich bulk composition. Here bulk and IOM H-C-N elemental abundances and isotopic compositions are used to re-examine the relationships between these two meteorites and the CRs.

Results: A large sample of MIL 090001 was acquired and analyzed for comparison with a previous measurement [3]. The IOM was isolated from the original MIL 090001 sample using the standard CsF technique [4]. The new MIL 090001 sample has a lower H content than the previous one and a more D-rich isotopic composition. Otherwise, the bulk compositions are very similar.

Table 1. The bulk and IOM compositions of LEW 95332 and MIL 090001. The LEW 85332 bulk and IOM compositions are from [3] and [4], respectively. The IOM C contents are for the bulk meteorites.

Bulks	H (wt.%)	δD (‰)	C (wt.%)	δ^{13}C (‰)	N (wt.%)	δ^{15}N (‰)
LEW 85332	0.52	125	0.58	-13.7	0.040	244
MIL 090001	0.58	96	0.70	8.3	0.050	243
IOM	H/C (at.)	δD (‰)	C (wt.%)	δ^{13}C (‰)	N/C (at.)	δ^{15}N (‰)
LEW 85332	0.719	3527	0.196	-23.7	0.0319	309
MIL 090001	0.683	3118	0.388	-26.5	0.0396	271

Discussion: The new MIL 090001 sample has a similar bulk H content and isotopic composition to LEW 85332, probably because the new MIL 090001 sample is less altered and/or less weathered than the previous one. Either explanation is consistent with the fact that there was 1.3 wt.% metal >100 µm in the new MIL 090001 sample but none in the original one. LEW 85332 contained 2.6 wt.% >100 µm metal. The bulk N abundances and isotopic compositions are also very similar. The biggest differences between the bulk compositions are in the C abundances and isotopic compositions. This reflects differences in carbonate abundances – the previous MIL 090001 sample contained 0.2 wt.% C in carbonate (δ^{13}C=71 ‰) compared to 0.04 wt.% C in LEW 85332 (δ^{13}C=11 ‰) [5]. Both meteorites have C contents, minus carbonate, that are roughly half of what is typical for unheated CRs minus their carbonate (~1 wt.%) [5, 6]. [7] suggested that LEW 85332 was heated to 500-700°C and [3] suggested that MIL 090001 may also have been heated. The H/C of IOM is sensitive to heating. The H/C of IOM from these two meteorites are slightly lower than typical for CRs, but are similar to or slightly higher than unheated CMs. The isotopic compositions of the IOM in these two meteorites are similar to those in the CRs, particularly GRO 95577 and the anomalous CM Bells [4, 8].



Conclusions: It is clear from the figure that both LEW 85332 and MIL 090001 fall below the unheated CR water-IOM mixing line, but not as low as for heated CRs [6]. It cannot be entirely ruled out that these meteorites are CRs that are more heated, weathered and have anomalously low matrix contents (low bulk C) compared to typical CRs. However, their IOM compositions and retention of metal would seem to belie these explanations and at present it seems more likely that they come from a distinct parent body that accreted water with a lower δD value than the CRs.

References: [1] Rubin A.E. and Kallemeyn G.W. (1990) Meteoritics 25:215-225. [2] Keller L.P. et al. (2012) LPS 43, Abstract #2065. [3] Alexander C.M.O'D. et al. (2013) Geochimica et Cosmochimica Acta, 123:244-260. [4] Alexander C.M.O'D. et al. (2007) Geochimica et Cosmochimica Acta 71:4380-4403. [5] Alexander C.M.O'D. et al. (2015) Meteoritics & Planetary Science 50:810-833. [6] Alexander C.M.O'D. et al. (2012) Science 337, 721-723. [7] Tonui E. et al. (2002) Antarctic Meteorite Research 15:38-58. [8] Alexander C.M.O'D. et al. (2010) Geochimica et Cosmochimica Acta 74:4417-4437.