COMPOSITION AND PETROGRAPHY OF RECENT TYPE 1 AND 2 CARBONACEOUS CHONDRITE FALLS

F. Wombacher[1], I. Kerraouch[2,3], and A. Bischoff[2], [1]Institut für Geologie und Mineralogie, Universität zu Köln, Zülpicher Str. 49b, 50674 Köln, Germany (fwombach@uni-koeln.de), [2]Institut für Planetologie, Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, [3]ARES, NASA Johnson Space Center, Houston TX, 77058, USA.

Introduction: We analysed the recent carbonaceous chondrite falls Flensburg C1, Kolang CM1/2, Aguas Zarcas CM2, Winchcombe CM2 [1] and Tarda C2 together with the two earlier CM2 chondrite falls Murchison and Paris for their chemical composition using ICP-MS and for Hg abundances using a direct mercury analyser. We expected that recent falls, uncontaminated by Hg, can help to indirectly infer the CI chondrite Hg abundance. Chemical variations were evaluated considering new and existing petrological and mineralogical information [2,3].

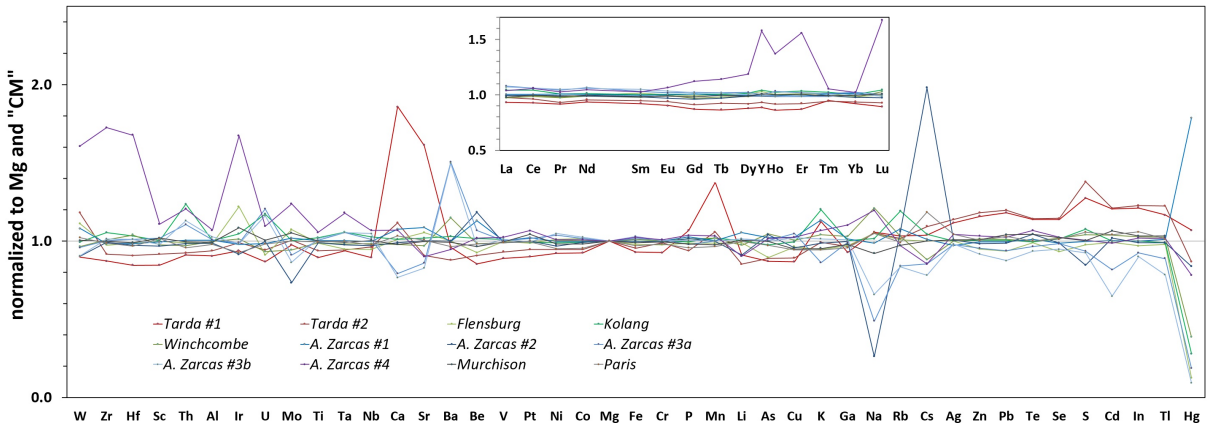

Fig. 1: Elemental data normalised to Mg and the median of all samples except Tarda and Aguas Zarcas 3 and 4. Mercury was normalised assuming a similar depletion as observed for plateau volatile elements.

Results and discussion: In general, the elemental compositions (Hg is discussed below) of Flensburg, Kolang, Aguas Zarcas #1 and 2, Murchison and Paris display a typical CM composition with a uniform depletion of the plateau volatile elements with half condensation temperatures between 800 and 500 K [4] down to 0.48 x CI (when normalised to Mg). For the Flensburg C1 chondrite, this result agrees with previous observations [2]. The depletion of Na and the enrichment of Cs in Aguas Zarcas #2 suggests the influence of aqueous alteration, but it is unclear whether this occurred on the parent body or on Earth. However, deviations for Ca, Sr, Ba, Na, Rb, and Cs in the prerain samples Aguas Zarcas #3a and 3b rather suggest that these elements were mobile within the parent body. Aguas Zarcas 3a and 3b are fusion crust-rich samples that lost some of the most volatile elements, particularly Cd and Hg, during atmospheric passage. Aguas Zarcas #4 corresponds to the metal-rich lithology Met-1 from [3]. The data reveal no systematic enrichment in siderophile elements, but peculiar enrichments of refractory elements, most significantly for Zr, Hf, W, Ir and some heavy REE. Tarda shows less depletion of moderately volatile elements (Fig. 1) than CM samples and Flensburg, more similar to the ungrouped C2 chondrite Tagish Lake [5]. The enrichment of Ca, Sr, Mn and Mg esp. in Tarda #1 mainly reflects the high abundance of carbonates observed in this sample. The mineralogy of Flensburg is characterised by its intense aqueous alteration [2]. However, and unlike for Tarda and some Aguas Zarcas samples, Flensburgs CM composition was not affected by this intense aqueous alteration.

In Fig 1, Hg was plotted relative to a reference value assuming a CI chondrite value of 258 ng/g [6] and a depletion of Hg as observed for the plateau volatile elements in CM2 chondrites. Mercury, the most volatile element shown in Fig. 1, displays the largest scatter. Aguas Zarcas #1 is enriched in Hg relative to the reference value, while Flensburg, Kolang (a CM2.5 lithology), Winchcombe [1] and the fusion crust-rich samples Aguas Zarcas #3a and 3b are depleted. The Hg contents in Aguas Zarcas #2 and 4 and both Tarda specimens are roughly similar to those expected for plateau volatile elements in these samples, with a best fit if a CI Hg content of about 210 ng/g is assumed. On the other hand, the larger variation of Hg compared to other plateau volatile elements suggests that Hg is more sensitive to alteration, that may have occurred on the parent bodies.

References: [1] Bates et al. (in prep) *Meteoritics & Planetary Science*. [2] Bischoff A. et al. (2021) *Geochimica et Cosmochimica Acta* 293:142–186, [3] Kerraouch I. et al. (2021) *Meteoritics & Planetary Science* 56:277-310. [4] Braukmüller N. et al. (2018) *Geochimica et Cosmochimica Acta* 239:17–48. [5] Marrocchi Y. et al. (2021) *Astrophysical Journal Letters* 913:L9. [6] Lauretta D. S. et al. (1999) *Earth and Planetary Science Letters* 171:35–47.