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How Many Planetesimals are at the Origin of Carbonaceous Chondrites?

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Carbonaceous chondrites (CCs) are thought to represent fragments of planetesimals that accreted beyond the orbit of Proto-Jupiter [1]. Although most of these small bodies have unlikely remained intact since their formation, we can still make estimations regarding their abundance by analyzing the diversity of petrographic and geochemical characteristics of individual CCs [2]. Indeed, the parents of CCs formed at various different heliocentric distances, thus sampling distinct chemical reservoirs and different mixtures of chondrules, refractory inclusions, ice and fine-grained matrix [3]. On the basis of these characteristics, CCs have been subdivided into nine "groups", each ideally meant to represent fragments of a single primordial planetesimal [2]. Although, more possible groups are being uncovered (e.g. [4]). Furthermore, a subset of CCs, called "ungrouped", do not fit the criteria of these groups, possibly reflecting fragments of additional planetesimals. In this work, we include *(i)* petrographic observations of sections (Fig. 1), *(ii)* bulk elemental analysis (e.g. Ni, Co, Ga, Cr: Fig. 2) and *(iii)* bulk oxygen isotopic composition (including literature data) of over 50 CCs (particularly "ungrouped" CCs) in efforts to discuss the abundance of primary planetesimals sampled by CCs in our collection. Based on our current analysis, it is possible that tens of planetesimals may be at the origin of CCs, several of which may have only accreted subtly different mixtures of material. This suggests that multiple planetesimals may have accreted in close proximity. We further couple our analysis with FTIR spectroscopy, with the objective of detecting hydrated silicates (e.g. phyllosilicates), in order to evaluate the extent of aqueous alteration that occurred within each of these bodies. This provides information regarding the abundance of ice accreted by these objects, as well as their thermal history.

[1] Kleine, Budde, Burkhardt, et al. (2020), *Space Science Reviews* 216, 55

[2] Greenwood, Burbine & Franchi, et al. (2020), *Geochemica and Cosmochemica Acta* 277, 377–406

[3] Scott & Krot (2014), Chondrites and their components (66 - 125).

[4] Irving, Gattacceca, Ziegler, et al. (2022), *LPS LIII,* Abstract #2046.

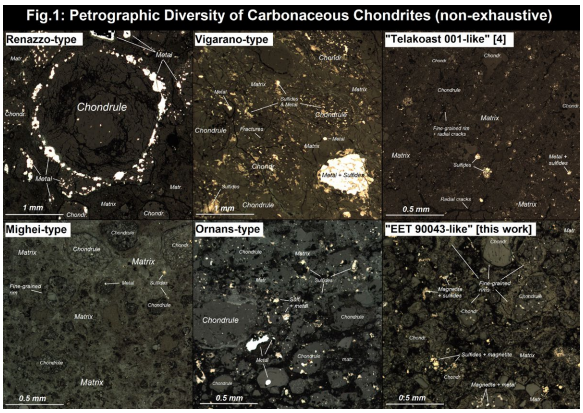

Fig. 2: Bulk Ni/Co-Ga/Cr Composition of various CCs