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Further insights into the chromium stable isotope composition of enstatite chondrites.

MATTHEW JERRAM[1], PIERRE BONNAND[2] AND ALEX N HALLIDAY[1]

[1]Columbia University
[2]University of Brest
Presenting Author: mj2964@columbia.edu

Recent work has greatly expanded the inventory of enstatite mass dependent chromium isotope measurements (δ^{53}Cr), and shows they are isotopically heavier than Earth and other chondrite bodies [1,2]. This is in contrast to a growing body of isotopic evidence that the Earth formed from enstatite chondrite like material. While mass dependent isotopes can be fractionated by accretionary processes, δ^{53}Cr is not affected by metal-silicate differentiation [2], and volatile loss under reducing conditions will lead to isotopically heavier δ^{53}Cr [3]. Therefore, the δ^{53}Cr of enstatite chondrites cannot be reconciled with the composition of Earth. This discrepancy requires further investigation into the behaviour of Cr in the enstatite chondrites.

We present high precision measurements of (12) enstatite chondrites including 4 EH (petrological grade 3-5) and 7 EL (petrological grade 3-6) as well as 1 anomalous sample (Happy Canyon). Our samples show similar results to previous studies [1,2]; with enstatite chondrites being heavier than other chondrite groups, and with a greater range in δ^{53}Cr compared to other chondrites.

Chromium is chalcophile at the reducing conditions of enstatite chondrite formation. Therefore, Cr rich sulphides, such as troilite and daubréelite, play a significant role for the behaviour of Cr in the enstatite chondrites. Zhu et al., 2021, showed that sulphide phases contained isotopically heavy Cr. Analysis of δ^{53}Cr with chalcophile element concentrations and petrological data show that enstatite chondrites with a greater fraction of Cr in daubréelite are isotopically heavy, while enstatite chondrites rich in other sulphides are isotopically light. Any model for the reconciliation of δ^{53}Cr between the composition of Earth and enstatite chondrites, must carefully consider the role of sulphides.

[1]Zhu et al. (2019), *ApJ* 923, 1-14. [2] Bonnand et al. (2016), *EPSL* 435, 14-21. [3] Sossi et al. (2018), *PNAS* 115, 10920-10925.