Chromium isotope variation in the components of unequilibrated ordinary chondrites

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Positive $\varepsilon^{53}Cr$ (0.21±0.10, 2SD) and negative $\varepsilon^{54}Cr$ (-0.37±0.10) of bulk rocks of unequilibrated ordinary chondrites (UOC) suggests that UOC contain different proportions of ^{54}Cr enriched and depleted carrier phases and different radiogenic contributions compared to carbonaceous chondrites. In order to constrain the variation of the Cr isotope carriers in the components of UOC, metal and silicate fractions from four UOC, WSG 95300 (H3.3), QUE 97008 (L3.05), Ceniceros (L3.8) and Parnallee (LL3.6) were studied.

Whole chondrules and various magnetic and non-magnetic fractions of chondrule fragments and matrix of different grain sizes were separated from nearly 1 g sized meteorite chips and dissolved in reverse aqua-regia in a high-P asher system (which also digests spinels). The Mn/Cr of the components was determined on an Element XR™ ICP-MS using standard addition. Precise Cr isotope ratios were measured on a Triton TIMS after purification of Cr on anion and cation exchange resins.

$\varepsilon^{53}Cr_{NIST\ 3112a}$ and $\varepsilon^{54}Cr_{NIST3112a}$ in the components range from -0.31 ± 0.02 to 0.57 ± 0.07 and -0.91 ± 0.23 to 0.56 ± 0.19, respectively. The ^{53}Mn-^{53}Cr systematics is disturbed in most components, likely due to parent body alteration after ^{53}Mn has decayed. Metal-rich and silicate-rich fractions do not show systematic differences in $\varepsilon^{54}Cr$ and $\varepsilon^{53}Cr$. Magnetic fractions typically show $\varepsilon^{54}Cr$ and $\varepsilon^{53}Cr$ similar to bulk rocks of UOC. In contrast, slightly magnetic and chondrule fractions show a large spread in $\varepsilon^{54}Cr$ and $\varepsilon^{53}Cr$. Separates from all UOC except one slightly magnetic fraction of QUE 97008 show negative $\varepsilon^{54}Cr$. The depletion of ^{54}Cr in nearly all components suggest that the precursors of all UOC components are likely derived from a common ^{54}Cr depleted region in the solar nebula, which did not undergo significant exchange of material with the carbonaceous chondrite reservoirs.