^{53}Mn-^{53}Cr Systematics of Unique Achondrite Northwest Africa 6704

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Northwest Africa (NWA) 6704 is a unique, ungrouped, permafic achondrite whose mineralogy [1] and coupled O-Cr isotopic systematics [2] are indicative of an origin from a previously unsampled parent body. Recent isotopic studies [3,4] have investigated the age of NWA 6704 using the Pb-Pb and Al-Mg chronometers. Here we further characterize this specimen using the short-lived ^{53}Mn-^{53}Cr system to ascertain whether there is concordancy with ages based on the Pb-Pb and Al-Mg chronometers, and to evaluate its potential as a new time anchor for short-lived radiogenic isotopic systems.

Dissolution, separation of Cr, and mass spectrometry procedures followed the same methods described by [5]. High-precision Cr isotopic measurements were completed using a Thermo Triton Plus TIMS at UC Davis.

The ^{53}Mn-^{53}Cr isochron of NWA 6704 is defined by two chromite, one metal, and three pyroxene separates and the NWA 6704 whole-rock point. The whole-rock fraction for NWA 6693, a paried stone, falls along the NWA 6704 mineral-whole rock trend line as well. The regression line through all of these points yields a ^{53}Mn/^{55}Mn ratio at the time of last isotopic equilibration of $(2.59\pm0.34)\times10^{-6}$ (MSWD=1.2) with an initial ε^{53}Cr = +0.14±0.03. Anchoring to D'Orbigny yields a ^{53}Mn-^{53}Cr age for NWA 6704 of 4562.87±0.87 Ma using the D'Orbigny ^{53}Mn/^{55}Mn reported by [6] or 4562.17±0.76 Ma using the D'Orbigny value from [7] and the Pb-Pb age of D'Orbigny [8] calculated using a ^{238}U/^{235}U ratio of 137.79. The ^{53}Mn-^{53}Cr age using the first ^{53}Mn/^{55}Mn value for D'Orbigny is, within error, the same as the reported ^{26}Al-^{26}Mg age (4563.48±0.34 Ma; [4]) and Pb-Pb age (4562.80±0.46 Ma using a ^{238}U/^{235}U ratio of 137.79±0.02; [3]). The excellent agreement among the Pb-Pb, Al-Mg and Mn-Cr ages enhances the potential utility of NWA 6704 as a new time anchor for short-lived systems.

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