LU-HF SYSTEMATICS OF THE NWA 5073 EUCRITE REFLECT A COMPLEX THERMAL HISTORY.

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Introduction: Multi collector-inductively coupled mass spectrometry (MC-ICPMS) was used for determining Lu-Hf isotopic systematics of NWA 5073. This sample is a basaltic, unequilibrated eucrite that is intermediately weathered (W2-3) and weakly shocked (S2). It has the coarsest texture ever found among eucrites [1].

Analytical methods: All isotope measurements were performed on a total sample mass of 2.2 g, comprising ten mineral concentrates and one whole rock sample. Pyroxene (px) and plagioclase (plag) were concentrated using magnetic separation and heavy liquids. The whole rock fraction was digested with HF-HNO_3 at 180°C in a steel-jacketed Teflon bomb, whereas mineral concentrates were digested in Teflon vials on a hotplate using alternating HF-HNO_3-$HClO_4$ and HCl. The latter procedure was used to digest the bulk of the sample while leaving any zircon grains largely intact. Thus, zircon, which may predate the last equilibration event, is essentially excluded from the analysis. Chemical separation and isotopic analysis procedures were those of [2] and [3]. The accuracy and 2 s.d. external precision of Hf isotope analyses as a function of Hf concentration were evaluated by repeated measurement of standard solutions at different intensities [4]. Ages were calculated using a decay constant of 1.867×10^{-11} $year^{-1}$ for ^{176}Lu (e.g., [3, 5]).

Results: Lu-Hf data for the whole rock, a hand magnet fraction, and mixed fractions ranging from mostly px to mostly plag do not define a simple isochron. The three highest Lu/Hf fractions (mostly px) trend toward the whole rock, yielding an apparent age of 4.68 ± 0.14 Ga and $^{176}Hf/^{177}Hf_i$ = 0.27976± 13(2σ). The whole rock analysis lies on the "isochron" defined by all published wr eucrite data, and the $^{176}Hf/^{177}Hf_i$ is similar to estimates for eucrites. In contrast, all mineral fractions excluding the whole rock yield 4.31 ± 0.14 Ga and a higher $^{176}Hf/^{177}Hf_i$ of 0.28020 ± 8(2σ). The whole rock lies below this trend, suggesting the presence of a relatively unradiogenic, low-Lu/Hf phase such as zircon in the bomb-digested wr. Mineral fractions digested on a hotplate lack this component, giving a younger age and a higher-than-expected $^{176}Hf/^{177}Hf_i$. This is consistent with a late partial re-equilibration of Lu-Hf among major silicate minerals, but with zircon remaining an essentially closed system during this event. Such a scenario is consistent with our observation that NWA 5073 is petrographically complex due to thermal- and shock metamorphism [1]. Zircon and ilmenite are currently being analyzed and should shed additional light on the Lu-Hf systematics of NWA 5073, particularly the $^{176}Hf/^{177}Hf_i$ value.

Conclusions: Petrologic complexities in eucrites make them challenging to date by Lu-Hf and therefore poor candidates for use in the determination of the ^{176}Lu decay constant by age comparison

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