Eucrite Sm-Nd and Lu-Hf ages and constraints on excesses of ^{176}Hf

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Eucrites are the crustal rocks of the Howardite-Eucrite-Diogenite (HED) parent body. Excess ^{176}Hf correlated with Lu/Hf ratios have been reported in the eucrite QUE 97053 [1]. This suggests that the HED parent body experienced an event [2,3] that caused an accelerated decay of ^{176}Lu and a corresponding excess of ^{176}Hf. The Lu-Hf systematics of three other eucrites (CMS 04049, EET 87053, and GRO 95533) have also been investigated [1], and these eucrites show no evidence of excess ^{176}Hf, but have variable initial ^{176}Hf/^{177}Hf that range from -4.1±0.4 to -1.1±0.3 ε^{176}Hf units.

Samarium-Neodymium measurements were made on the same whole-rock and mineral aliquots as those used for the Lu-Hf analyses. The Sm-Nd data yield 2σ ages and initial Nd isotope compositions of:

4629±94 Ma, $\varepsilon^{143}Nd_I$=-0.1, MSWD =1.9 for QUE 97053;

4457±69 Ma, $\varepsilon^{143}Nd_I$=-0.1, MSWD =2.3 for CMS 04049; 4537±55 Ma, $\varepsilon^{143}Nd_I$=+0.2, MSWD =2.9 for EET 87053; and 4500±110 Ma, $\varepsilon^{143}Nd_I$=+0.1, MSWD=0.8 for GRO 95533. The plagioclase fraction of QUE 97053 was excluded from the age calculations as they show signs of Sm-Nd disturbance (e.g. [4]).

Samarium-Neodymium internal isochron ages of CMS 04049, EET 87053, and GRO 95533 are in good agreement with the more precise Lu-Hf ages [1, 5] and zircon U-Pb and Pb-Pb ages [6]. The larger error on the Sm-Nd ages are mainly due to a small spread of Sm/Nd ratios between different mineral phases. The Sm-Nd age of QUE 97053 also agrees with the age interval of eucrite formation [5]. Because QUE 97053 has an apparent Lu-Hf isochron 'age' of 4808±69 Ma [1] but a Sm-Nd age that agrees with the age of eucrite formation, this discrepancy is unlikely due to weathering and/or alteration. If it were due to irradiation, QUE 97053 would have crystallized before the irradiation event. By contrast, the other analyzed eucrites would either have formed after the event or were shielded from it.

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