On the mysterious ^{176}Hf excesses

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Anomalous old Lu-Hf ages of meteorites are found in some meteorites that crystallized before 4.56 Ga. It was proposed that irradiation effects could produce ^{176}Hf excesses [1], and alternative Lu-Hf parameters for the Solar System and present-day BSE were suggested [2]. These effects are nevertheless not observed in selected CAIs [3], the oldest solids that condensed within the protoplanetary disk, as well as in some internal isochrons of angrites [4]. Such irradiation process would thus have to be rapid (within a few Ma) or localized in some regions of the protoplanetary disk.

We investigated the Sm-Nd and Lu-Hf isotopic compositions of several reduced enstatite chondrites and achondrites which, based on their O isotopic compositions, accreted within the Earth's forming region of the protoplanetary disk. Although they appear unshocked and unbreciated, we also carried out the ^{40}Ar/^{39}Ar chronometry of these meteorites to constrain their thermal history.

When taking all litterature Lu-Hf data on bulk chondrites [5-8], we find an apparent age of 4848 ±120 Ma and ^{176}Hf/^{177}Hf$_i$ = 0.27962 ±8. When selecting only the types 1-3, we find 4636 ±150 Ma and ^{176}Hf/^{177}Hf$_i$ = 0.27975 ±10 consistent with the value deduced from modern CHUR values [7]. Pristine type 3 EH & EL chondrites have Lu-Hf and Sm-Nd averages comparable to CHUR values of [7], and corrected ^{142}Nd/^{144}Nd$_i$ of –7 ±7ppm relative to terrestrial standard. Using the most fractionated basaltic meteorite Itqiy and E chondrites, we find a formation model Lu-Hf age of 4762 ±61 Ma and ^{176}Hf/^{177}Hf$_i$ = 0.27967 ±7, and Sm-Nd apparent age of 4593 ±62 Ma with μ^{142}Nd= 342 ±13ppm. Preliminary single-grain ^{40}Ar/^{39}Ar data suggest a closure age >4.0 Ga for Itqiy. Our observations suggest that anomalous slopes and initial values for Lu-Hf bulk and internal isochrons are the consequence of secondary thermal processes. Additional results will be presented at the conference. AB acknowledges NSF award EAR-1119135.

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