Was there really ^{176}Lu burnout in early Solar System materials?

E.E. SCHERER[1]*, R. BAST[1], P. SPRUNG[2] AND K. MEZGER[3]

[1]Institut für Mineralogie, WWU Münster, Germany (*correspondence: escherer@wwu.de)
[2]Institut für Planetologie, WWU Münster, Germany
[3]Institut für Geologie, Universität Bern, Switzerland

The utility of Lu-Hf as a geochronometer for meteorites has been called into question by the fact that it often yields dates that are up to 300 Myr older than the age of the Solar System when using a ^{176}Lu decay constant of (1.867 ± 0.011) × 10^{-11} yr^{-1} [1-3]. The latter value was determined by comparing the Lu-Hf and U-Pb ages of nine well-characterized terrestrial samples, and it is supported by some internal isochrons of meteorites and CAI [e.g., 4, 5]. The spuriously old Lu-Hf ages are broadly reproducible among different laboratories, precluding analytical problems such as improperly calibrated spikes as a cause. A ^{176}Yb decay branch of ^{176}Lu could potentially produce erroneously high ages in the oldest samples, but this has been ruled out by calculation [1] and experiment [6]. An interesting set of hypotheses have focused on the conversion of ^{176}Lu ($t_{1/2}$ = 37 Gyr) to its short-lived isomer ($t_{1/2}$ = 3.7 hr) via irradiation by gamma- [7] or cosmic rays [8]. This process could potentially rotate Lu-Hf isochrons to steeper slopes (thus older ages) without changing the initial ^{176}Hf/^{177}Hf. Irradiation hypotheses can in principle be tested by searching for ^{176}Lu depletion, i.e., comparing the ^{176}Lu/^{175}Lu of samples that are "too old" with that of other samples. An initial study [9] found no variation at the 0.1% level among chrondrites, CAI, eucrites, Martian meteorites, lunar samples, and terrestrial rocks. Recent analytical advances [10] have improved analytical resolution to 0.1 permil, but still no variations in ^{176}Lu/^{175}Lu have been found [11]. Thus there is no positive evidence of ^{176}Lu depletion via irradiation and the cause of the erroneous Lu-Hf dates remains unclear. We are currently investigating the effects of other kinds of disturbance, such as weathering, on the slopes and intercepts of Lu-Hf isochrons.

[1] Scherer *et al* (2001) *Science* **293**, 683-687. [2] Scherer *et al* (2003) *MAPS* **38 (7) suppl.** A136. [3] Söderlund *et al EPSL* **219**, 311-324 [4] Amelin (2005) *Science* **310**, 839-841. [5] Bouvier & Boyet (2013) *Min Mag* **77**, 754. [6] Amelin & Davis (2005) *GCA* **69**, 465-473. [7] Albarède *et al* (2006) *GCA* **70**, 1261-1270. [8] Thrane *et al* (2010) *Astrophys J* **717**, 861-867. [9] Scherer *et al* (2005) *Geophys. Res. Abstr.* **7**, 10486. [10] Wimpenny *et al* (2013) *Anal Chem* **85**, 11258-11264. [11] Wimpenny *et al* (2013) *MAPS* **48, suppl. 1**, A373.