Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 192
© 2000 Cambridge Publications

Dating of Phosphatic Material by the Lu-Hf Isotopic System

Gry Hoffmann Barfod[1], **Francis Albarede**[2] & **Robert Frei**[3]

[1] Danish Lithosphere Center, Øster Voldgade 10L, DK-1350 Copenhagen, Denmark,
[2] Ecole Normale Supérieure de Lyon, 46 Allée d'Italie, 69364 Lyon Cedex 7, France.
[3] Geological Institute, Øster Voldgade 10, DK-1350 Copenhagen, Denmark, G75 0QF

Using a new technique for separation of Hf and Lu from phosphates, we show that the Lu-Hf isotopic system can remain closed in fossilized teeth and sedimentary phosphorites. On the contrary, fossilized bones in general show a tendency to yield young - presumably diagenetic - ages (authors unpublished data, Otero, pers. com.). The recent discovery of the earliest known embryos and microscopic fossils of animals preserved in the phosphorite rocks of the Doushantuo Formation, South-central China, show that animals were diverse and abundant well before the Cambrian explosion about 540 Ma ago. The precise age of this formation is essential to the understanding of the timing of the origin of multicellular life, which two groups of molecular evolutionists propose occurred at 670 Ma or closer to 1.2 Ga years ago. The depositional age of the Doushantuo Formation is broadly constrained by U-Pb dates on tuffs from the underlying Liantuo Formation (748 ±12 Ma) and bentonites from the overlying Zhongyicun Formation (539 ±34 Ma). The only direct ages of the Doushantuo formation include a Rb-Sr isochron age (693 ±66 Ma) and a controversial Sm-Nd age on phosphorites from the upper part (645.4 ±23.6 Ma). Based on the C-isotopic profile of the Doushantuo formation and the correlation of this with microfossil assemblages in age-constrained deposits in Namibia, later studies however suggest that the age of the Doushantuo is around 580 Ma (e.g. Knoll et al., 1995; Li et al., 1997).

Regression of $^{176}Lu/^{177}Hf$ and $^{176}Hf/^{177}Hf$ data from five individual sections of the Doushantuo formation (including the Wangjiayuan section that contains the three-dimensionally preserved animal embryos) yields a Lu-Hf age of 660 ±18 Ma. We caution that the age could reflect a late-stage loss of Lu, which would result in an age that is apparently too old. However, based on the general observation that diagenetic altered fossils consistently yield young ages and that the individual Doushantuo profiles yield identical Lu-Hf ages even though they are separated by up to 50km, we speculate that the age could be real. We are very grateful to A.H. Xiao and A. Knoll for providing us with the set of Doushantuo samples.

Knoll AH, Grotzinger JP, Kaufman AJ Kolosov P & Kolosov, *Precamb. Res.*, **73**, 251-270, (1995).
Li C, Chen J & Hua T, *Science*, **279**, 879-882, (1998).

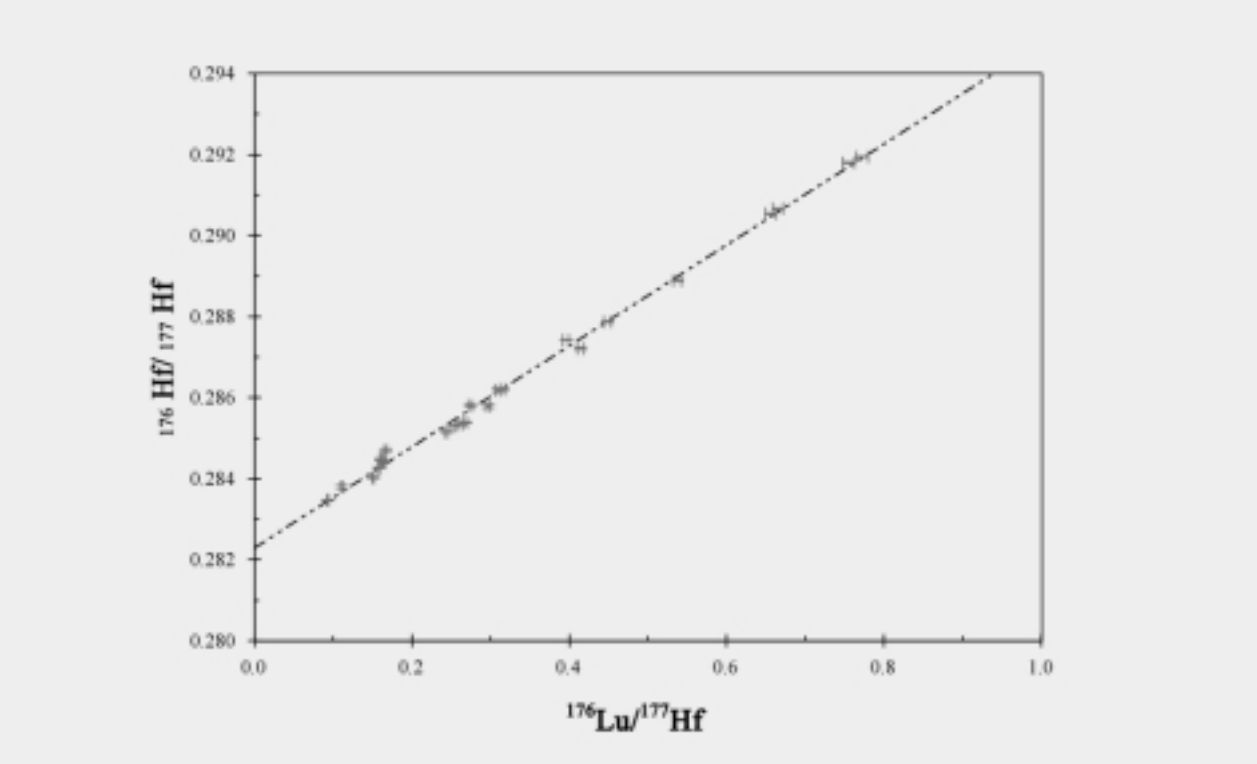

Figure 1: $^{176}Lu/^{177}Hf$ and $^{176}Hf/^{177}Hf$ for the Doushantuo samples, which yields an age of 660 ±18 Ma, MSWD = 67 and an initial $^{176}Hf/^{177}Hf$ of 0.28229 ±0.00013.