Fractionation of radiogenic Pb isotopes induced by acid leaching: A pervasive phenomenon in Pb-isotopic dating of meteorites

Y. AMELIN[1], Q.-Z. YIN[2], P. KOEFOED[1], R. MERLE[1], M.H. HUYSKENS[2], T. IIZUKA[3]

[1]Research School of Earth Sciences, The Australian National University, yuri.amelin@anu.edu.au; [2]Department of Earth and Planetary Sciences, University of California-Davis, USA; [3]Department of Earth and Plnetary Science, The University of Tokyo, Japan

Pb-Pb isochron dating is the only method of extant radionuclide chronometry of meteorites capable of precision better than ±1 Ma. Accurate Pb-isotopic age determination depends on efficient removal of all non-radiogenic Pb components. Separation of Pb isotope components is usually accomplished by sequential leaching in acids and varying their concentration, temperature, and duration of treatment [1-3]. Application of sequential dissolution relies on assumption that this treatment does not cause isotopic fractionation within individual Pb isotope components, most importantly in radiogenic $^{207}Pb^*/^{206}Pb^*$ ratio. This assumption was long considered self-evident, however there is a growing number of examples where certain steps of acid treatment, especially those steps that release substantial fraction of the total content of radiogenic Pb, cause measurable fractionation of radiogenic $^{207}Pb^*/^{206}Pb^*$ ratio. First observed in extensive leaching of the Allende CAI SJ-101 in hot concentrated HBr [4], this fractionation was thought to be an artefact of that particular treatment, until $^{207}Pb^*/^{206}Pb^*$ fractionation of similar magnitude was observed in leaching of Allende CAI A63 [5] and pyroxene from achondrites Asuka 881394 [6] and NWA 6693 and NWA 10132 (unpublished data of the authors) in dilute HF – a standard part of currently used partial dissolution schemes. The nature of this fractionation is uncertain, but it may be caused by the difference in the decay track sizes between the ^{235}U and ^{238}U decay chains [7]. The effects of fractionation can be circumvented by numeric recombination of leaching steps, but developing alternative treatments that are free from $^{207}Pb^*/^{206}Pb^*$ fractionation would be a better solution.

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