Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.22770

High-Precision Measurement of Actinides and Pu-Am Model Ages in IAEA-384, IAEA-410, and IAEA-412 Marine Sediments Influenced by Weapons Testing in the South Pacific

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We report preliminary results of precise and sensitive mass spectrometric measurements of plutonium, uranium, neptunium, and americium concentrations and isotope ratios in three IAEA reference materials: Fangataufa Lagoon sediment IAEA-384, Bikini Atoll sediment IAEA-410, and Pacific Ocean sediment IAEA-412. We previously presented long-lived actinide nuclide results for several other reference materials in [1]. Measurements were performed in a clean laboratory by isotope dilution, multi-collector thermal ionization and multi-collector inductively coupled plasma mass spectrometry. In general, our results agree with, but lower the uncertainty of, literature or certificate values for these reference materials. However, our measurements of Np-237, Pu-241, and Pu-242 nuclides appear to be novel. There is evidence for material heterogeneity on a ~10 g scale, but nuclide ratios appear to be more uniform than absolute nuclide concentrations. Preliminary results for U isotope ratios in IAEA-410 and IAEA-412 show agreement with natural U.

We measured ^{241}Pu-^{241}Am calendar year model ages of 1952 for IAEA-410, 1961 for IAEA-412, and 1964 for IAEA-384. The 1952 model age date for Bikini Atoll sediment most likely reflects contributions from the 15 Mt Castle Bravo surface test at Bikini Atoll on February 28, 1954 which used Pu purified at a slightly earlier date, as well as other tests (Fig. 1). The 1964 model age date for Fangataufa Lagoon sediment reflects contributions from atmospheric French nuclear weapons tests conducted there from 1966-1970 which also used Pu purified at a slightly earlier date (Fig. 2). The 1961 model age date for Pacific Ocean sediment is nearly identical to the 1960 date for average atmospheric global fallout. General agreement between our model age and surface nuclear testing dates supports the notion that Pu-Am model ages of environmental samples provide a high-fidelity record of past nuclear events and that there was little subsequent Pu-Am elemental fractionation in the environment. However, IAEA-412 provides more evidence for Np/Pu fractionation in ocean sediments and the environment (e.g. [1]).

[1] Goldstein, S.J. et al. (2021), *J. Environ. Radioact.* 237, https://doi.org/10.1016/j.jenvrad.2021.106689.

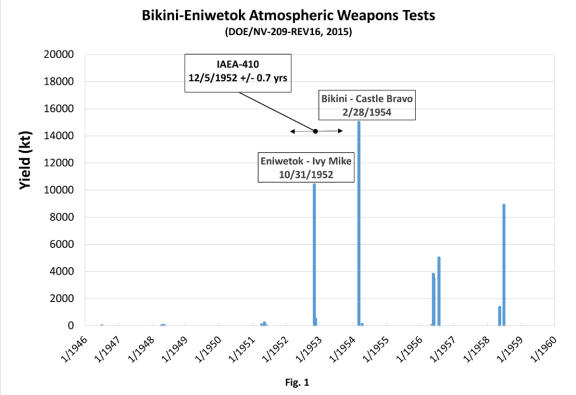

Fig. 1

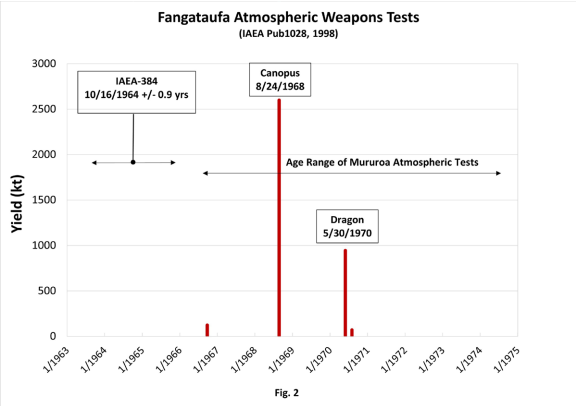

Fig. 2