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Fallout isotopes $^{239-241,244}\text{Pu}$ and ^{236}U in a lake sediment from New Zealand

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Fallout from nuclear weapons tests in the 1950s and 1960s has been used for many years as a chronological marker in sediment cores. ^{137}Cs in fallout has been detected by gamma spectroscopy, and used to validate ^{210}Pb dating [1]. However, with its half-life of 30 years, ^{137}Cs activity is reducing and it is now difficult to detect with good precision, especially in the southern hemisphere where fallout is significantly less than in the north.

With the use of AMS, plutonium fallout is readily detectable and has been used increasingly in place of ^{137}Cs [2, 3]. The high sensitivity of the Vega AMS system at ANSTO enables the detection of the rarer isotopes ^{241}Pu and ^{244}Pu in such sedimentary records, in addition to the ^{239}Pu and ^{240}Pu that has been measured in the past. For some studies, the fallout isotope ^{236}U has also been measured [3].

In the current study, a detailed profile of the isotopes $^{239-241,244}\text{Pu}$ and ^{236}U has been obtained. The sediment core was taken from Lake Marion, a sub-alpine lake with a small catchment in a natural forest environment, in the Doubtful Range in the northern part of the South Island, New Zealand.

The data show distinct variations in isotopic ratios with depth in the core. These can be interpreted as reflecting the transition from PPG-dominated fallout to Arctic-dominated fallout through the atmospheric weapons testing period. The $^{244}\text{Pu}/^{239}\text{Pu}$ ratio is strongly correlated with $^{240}\text{Pu}/^{239}\text{Pu}$, as may be expected, while the $^{236}\text{U}/^{239}\text{Pu}$ appears to be anti-correlated with $^{240}\text{Pu}/^{239}\text{Pu}$.

[1] P.G. Appleby, Three decades of dating recent sediments by fallout radionuclides: a review, *The Holocene* 18 (2008) 1.

[2] S.G. Tims et al., Plutonium as a tracer of soil and sediment movement in the Herbert River, Australia, *Nucl. Instr. and Meth. B* 268 (2010) 1150.

[3] S.K. Marx et al., Examining the response of an eastern Australian mangrove forest to changes in hydro-period over the last century, *Estuarine, Coastal and Shelf Science* 241 (2020) 106813.

Student Submission

No

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