Semi-quantitative detection of ^{239}Pu in the Antarctic plateau snow

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Plutonium is a useful time marker for dating ice cores and snow pits because it in the environment mainly originates from atmospheric nuclear weapons tests carried out since the 1950s. To determine ^{239}Pu in snow pit samples, collected every 5 cm down to 4 m, covering ~50 years (1957-2007), at Dome Fuji in East Antarctica, we used an inductively coupled plasma-sector field mass spectrometer (ICP-SFMS) coupled to a high-efficiency sample introduction system. The main advantages of ICP-SFMS technique are rapidity of analysis and simple sample preparation method for ^{239}Pu at femtogram levels in small-volume samples from snow/ice. However, this technique is prone to spectral interferences. The existence of high content of uranium in sample could lead to significant interferences with ^{239}Pu owing to uranium hydride ($^{238}UH^{+}$) formation. In this study, we found that the interference effect of $^{238}UH^{+}$ was negligible when the ^{238}U concentrations lower than 10 pg g^{-1}. In the snow pit samples, the ^{238}U concentrations were lower than 0.5 pg g^{-1}. Accordingly, ^{239}Pu signals were detected without $^{238}UH^{+}$ interference. For the calculation of ^{239}Pu concentration, semi-quantitative method was used. It is based on assumption that the ionization energy for Pu and U are very close and therefore they should have a similar behavior when ionized in the plasma. Consequently, the ^{239}Pu records related to nuclear weapons tests were reconstructed at femtogram levels in the Antarctic snow pit sample by the application of a semi-quantitative method. It is demonstrated that ICP-SFMS technique represents a useful for the analysis of ^{239}Pu in the Antarctic samples.