

Detection of Plutonium-239 in the Antarctic Snow by Inductively Coupled Plasma-Sector Field Mass Spectrometry

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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 ²³⁹Pu 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 ²³⁹Pu 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 ²³⁹Pu owing to uranium hydride (²³⁸UH⁺) formation. In this study, we found that the interference effect of ²³⁸UH⁺ was negligible when the ²³⁸U concentrations lower than 10 pg g⁻¹. In the snow pit samples, the ²³⁸U concentrations were lower than 0.5 pg g⁻¹. Accordingly, ²³⁹Pu signals were detected without ²³⁸UH⁺ interference. These suggest that this method can be widely used for the reconstruction of the fallout history of ²³⁹Pu and for the age constraint in other Antarctic Plateau sites.

KeyWord : Plutonium, ICP-SFMS, snow, Antarctica