# $^{236}$U, $^{239}$Pu, $^{240}$Pu, $^{241}$Pu, $^{241}$Am, $^{2}$H and $^{18}$O in floating ice and its surrounding seawater in the Antarctic Ocean

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Anthropogenic actinides originating mainly from 1950s - 1960s nuclear weapons test are distributed widely in the environment. The distribution and migration behaviors of such actinides vary depending on chemical, physical and biological conditions of compartments in the environment. For comprehensive understanding of the actinides in the environment, accumulation of reliable analytical data is essential. In this study, $^{236}$U, $^{239}$Pu, $^{240}$Pu, $^{241}$Pu and $^{241}$Am in floating ice and its surrounding surface seawater in the Antarctic Sea were analyzed by accelerator mass spectrometry (AMS). $^{137}$Cs was analyzed by gamma spectrometry. $\delta^{2}$H and $\delta^{18}$O in the ice and the seawater were also determined to comprehend the origin of the floating ice.

On January 4, 2015, floating ice and its surrounding surface seawater at the Antarctic Ocean (65°41' – 65°43' S, 169°59' – 170°04' W) were collected by cruise KH-14-6 of research vessel, R/V Hakuho Maru of The University of Tokyo. Analytical results show that $^{236}$U, $^{239}$Pu and $^{240}$Pu exist in the ice and the seawater, although no $^{241}$Pu nor $^{241}$Am was detected. Together with the low atomic ratio of $^{240}$Pu/$^{239}$Pu (< 0.16) found in the samples, this implies that the isotopes are originating from atmospheric weapons test fallout. The activity concentration of $^{137}$Cs in an ice sample (about 30 L melt) was below detection limit (< 0.60 mBq/L). The analytical results of stable isotopes confirm the seawater origin of the floating ice. The values of the ice ($\delta^{2}$H: -3.1 ‰, $\delta^{18}$O: -0.2 ‰) are comparable to the sampled seawater ($\delta^{2}$H: -3.5 ‰, $\delta^{18}$O: -0.3 ‰). If the ice is originating from the continent and formed by precipitation, it would have much lower values (annual average $\delta^{2}$H: <-110‰, $\delta^{18}$O: <-15‰).