14-13 Search for the Migration of ^{129}I on the Earth
—Estimating Relative Sizes of ^{129}I Original Sources—

Fig.14-29 Accelerator Mass Spectrometer (AMS) at Aomori Research & Development Center
This AMS can measure ^{129}I in environmental samples which could not be measured previously.

Table 14-3 The relative sizes of sources of ^{129}I in seawater
More than 80% of ^{129}I originated from overseas reprocessing plants.

Origin	offshore from Sekine	Toyama Bay
Natural	2.2	1.8
Weapons testing	8.9 - 12.2	9.2 - 13.8
Reprocessing Plants	85.6 - 88.9	84.5 - 89.1
Total	100	100

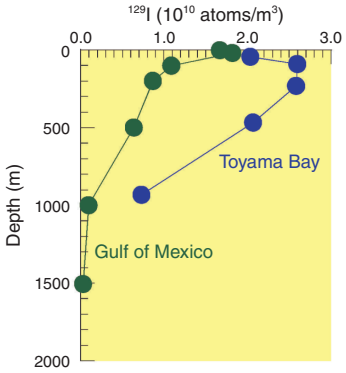

Fig.14-30 The vertical profiles of ^{129}I in seawater
The inventory of ^{129}I in the Japan Sea is three times higher than that of the Gulf of Mexico.

Iodine-129 (^{129}I) is a long-lived radionuclide with a half-life of 15.7 million years which is produced naturally by the interaction of cosmic-rays with xenon and by spontaneous fission of uranium. ^{129}I was released from nuclear weapons testing in the 1950s - 60s and is released from commercial and military nuclear fuel reprocessing plants. Because the amount of ^{129}I released from reprocessing plants is larger than that of other sources, reprocessing plants are point sources in models of iodine circulation on a global scale. The released ^{129}I from reprocessing plants, therefore, proved useful information for general studies of global circulation of substances. On the other hand, there has been no technique to measure ^{129}I in environmental samples with high sensitivity. We thus modified the Accelerator Mass Spectrometer (AMS: Fig.14-29) at the Aomori Research and Development center of the Japan Atomic Energy Agency for ^{129}I measurement, established technology to measure iodine isotopic ratios (^{129}I/^{127}I) with detection limit below 10^{-14}, and applied this technique to seawater samples.

^{129}I/^{127}I in surface seawater was measured offshore from Sekine and in Toyama bay. The ^{129}I/^{127}I ratios were fifty times higher than that of natural level. Because the excess of ^{129}I is due to the released amounts from nuclear weapons testing and reprocessing plants, the ratio of contributions of these sources was estimated. The estimated ratio was natural: nuclear weapons testing: reprocessing plants = 2 : 10 : 88 (Table 14-3). This study shows that more than 80% of the ^{129}I originated from reprocessing plants. Because large reprocessing plants are operated in England, France, and U.S.A., the ^{129}I released from those plants was transported via the atmosphere. Therefore, this study shows that the ^{129}I released from reprocessing plants are transported on a global scale and that iodine diffuses over long distances via atmospheric movement.

Next, the concentration of ^{129}I in seawater was measured vertically at Toyama Bay (Fig.14-30). The inventory of ^{129}I in Toyama bay was three times higher than that in the Gulf of Mexico. The surface seawater in the Japan Sea sinks in the winter, and the Japan Sea is largely enclosed by land; these are likely causes of this higher inventory.

This development of high sensitive ^{129}I measurement technique using AMS at Aomori Research and Development center allowed us to measure ^{129}I in seawater with higher sensitivity than ever before. This technique will be useful not only in obtaining new information about iodine migration but also in oceanographic studies using iodine as a tracer. Moreover, AMS is expected to be increasing useful various other studies in the future.

Reference

Suzuki, T. et al., Measurement of Iodine-129 in Seawater Samples Collected from the Japan Sea Area Using Accelerator Mass Spectrometry: Contribution of Nuclear Fuel Reprocessing Plants, Quaternary Geochronology, vol.3, issue 3, 2008, p.268-275.