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Preparation of a database on the distribution of radionuclides in the western North Pacific Ocean and its marginal seas around Japan

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A database on anthropogenic radioactivity in the western North Pacific Ocean and its marginal seas, including the coastal areas around Japan was prepared at the IAEA Marine Environment Laboratory (IAEA-MEL).

This work was to study the results from the first (1994) and the second (1995) Japanese-Korean-Russian Joint Expedition to the radioactive areas where the former USSR, the Russian Federation, Japan and Korea (Republic of) dumped radioactive wastes. The purpose of the expeditions was to help understand the distribution of marine radioactivity in the western North Pacific Ocean.

The database will play an important role in understanding the distribution of anthropogenic radionuclides around Japan from a historical point of view and to link this knowledge to future modeling.

1. Introduction

The database was completed in 1995 using the new database system (in Japanese) for environmental radioactivity in and around Japan at the Japan Chemical Analysis Center (JCAC, ca. 1.39 million data as of April 1995). This database includes the data on marine radioactivity measured by JCAC, compiled by the National Institute of Radiological Sciences (NIRS), measured and published by the Maritime Safety Agency (MSA) and the Fisheries Agency (FA) of Japan and others.

The preparation of a database (in English) at IAEA-MEL is in its final stages. The above-mentioned data and others from several important papers will soon be input.

The new computer network system will soon be operational and the database installed.

2. Outline of the IAEA-MEL database

2.1. Data of NIRS (measured by JCAC)

A summary of the data compiled by NIRS (measured by JCAC) and input into the database by JCAC is as follows ;

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The number of ^{90}Sr and ^{137}Cs data for seawater is 1785, 1408 for sediment and 1966 for biota samples. The sampling took place during 1964-1994. The samples were collected only in coastal areas around Japan.

2.2. Data from MSA and FA

A summary of the data measured and published by MSA and FA, and input into the JCAC database is as follows ; The number of data is 3299 (MSA) for seawater, 1605 (MSA) and 2731 (FA) for sediment, and 1682 (FA) for biota samples, measured for ^{90}Sr, Cs isotopes, $^{239+240}Pu$ etc. The sampling took place during 1981-1994. All the samples were collected in the western North Pacific Ocean and its marginal seas around Japan.

2.3. Data from other sources

Essential data not included in the JCAC database, were taken from the IAEA-MEL database and input. These data were extracted from the papers mentioned in Table 1. The number of data for seawater is 742 and for sediment samples 71.

2.4. A summary outline of the database

The number of data to be input to the database at IAEA-MEL are summarized in Table 1 (as of March 1996). As enumerated in Table 1, the number of data to be input is 5826 for seawater, 5815 for sediment and 3648 for biota samples, making a total of 15289.

Table 1 Number of data to be input to the database at IAEA-MEL (as of March, 1996)

Sample	NIRS* (JCAC)	MSA*	FA*	Papers**	Total
Seawater	1785	3299		742	5826
Sediment	1408	1605	2731	71	5815
Biota	1966		1682		3648
	5159	4904	4413	813	15289

*Data from NIRS (JCAC), MSA and FA were extracted from the JCAC database. **Papers include the original articles published by Y. Nagaya et al., (1981, 1984, 1987), Y. Miyake et al. (1988), T. Nakanishi et al. (1990, 1995), K. Hirose et al. (1992) and M. Aoyama et al. (1995).

3. Information obtained from the database

3.1. Radioactivity concentrations of anthropogenic nuclides in marine samples taken in coastal areas of Japan

The secular changes of radioactivity concentration of ^{137}Cs in surface seawater in coastal areas of Japan are shown in Fig.1-1. It is clear from this figure that the concentration of ^{137}Cs has been decreasing since 1964. The levels become even lower after 1975. The effects of the Chernobyl accident

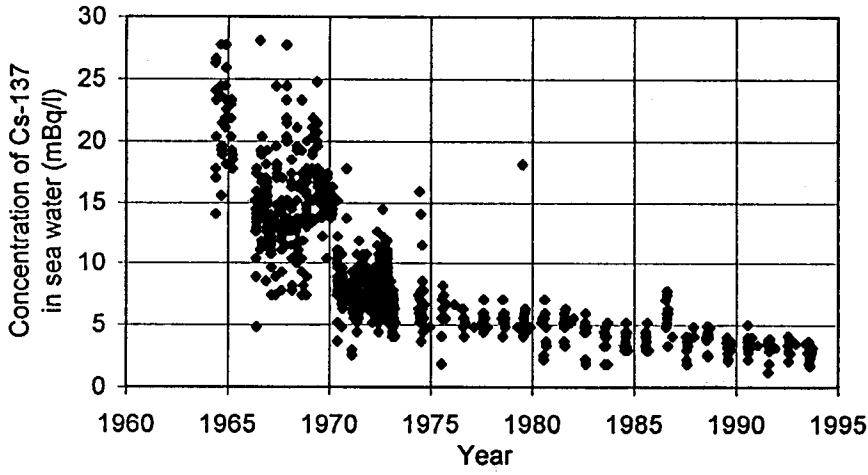

Fig.1-1 Secular changes of the radioactivity concentration of Cs in seawater in coastal areas of Japan.

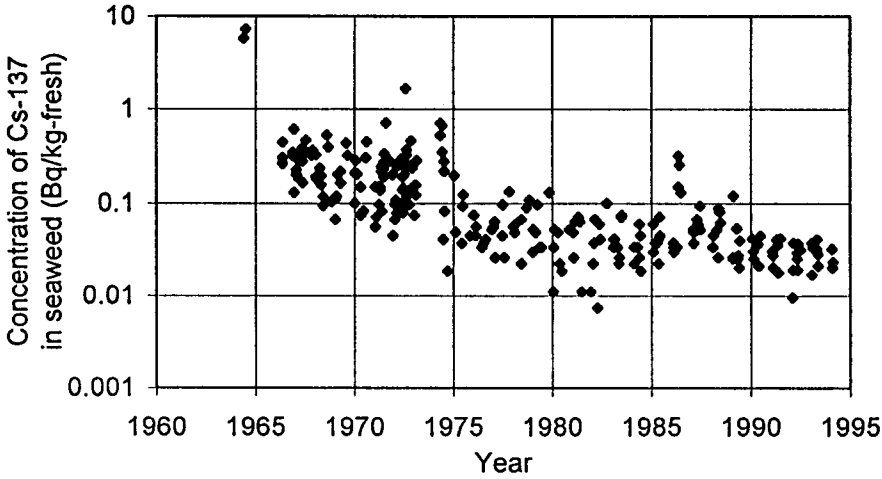

Fig.1-2 Secular changes of the radioactivity concentration of Cs in seaweed in coastal areas of Japan.

in 1986 were obvious for ^{137}Cs but not for ^{90}Sr. It is possible that the reason for this is that the more soluble radioactive nuclide of the two (^{137}Cs) was transported from land to coastal areas by terrestrial waters (rivers). The secular changes for radioactivity concentration of ^{137}Cs in seaweed samples are shown in Fig.1-2.

Concentrations of this nuclide (^{137}Cs) and ^{90}Sr show a tendency to decrease in other samples (sediment and fish) as well as in seaweed. It should be noted, however, that concentrations of ^{137}Cs showed higher values than those recorded before and after the Chernobyl accident. It would appear that seaweed absorbs higher concentrations of ^{137}Cs in surface seawater in coastal areas.

3.2. Distribution of anthropogenic radionuclides in surface seawater in the western North Pacific Ocean and its marginal seas around Japan

The radioactivity concentrations of ^{137}Cs in surface seawater in the western North Pacific Ocean and its marginal seas around Japan are shown in Fig.2-1 for the period 1982-1985, Fig.2-2 for 1986-1989 and Fig.2-3 for 1990-1993.

As these figures show, radioactivity concentrations are mainly in the range of 2.5 to 5.0 mBq/l (ca. 57%-88% of the total number of data) over any time period. While the rates of radioactivity concentrations higher than 7.5 mBq/l were ca. 3% for the years from 1982 to 1985, rising to ca. 6% for the years from 1986 to 1989 and declining to ca. 1% for the 1990's. ^{137}Cs in surface seawater caused by the Chernobyl accident is disappearing.

The radioactivity distributions of ^{90}Sr and $^{239+240}Pu$ in surface seawater around Japan do not show any definite effects from the Chernobyl accident. The radioactivity concentrations of ^{90}Sr are in the range of 2.0 to 4.0 mBq/l and decrease year by year. The radioactivity levels of $^{239+240}Pu$ are on the decrease, too. Those higher than 7.5 μBq/l are 45% for 1982 to 1985, 29% for 1986 to 1989 and 20% for the 1990's.

3.3. Comparison with the analytical results for the first Japanese-Korean-Russian Joint Expedition

The locations of the sampling stations visited by the first Joint Expedition (1994) are the positions of the radioactive wastes dumped by the former USSR and the Russian Federation. Some analytical results, obtained by the first Joint Expedition are summarized in Table 2.

On the other hand, the radioactivity distributions of ^{137}Cs, ^{90}Sr and $^{239+240}Pu$ in surface seawater in the Japan Sea, excluding coastal areas, located relatively near the sampling stations of the first Joint Expedition, are shown in Figs 3-1, 3-2 and 3-3.

Table 2 and Figs 3-1 to 3-3 clearly show that each of the nuclides have the same radioactivity levels as those found in the samples taken during the first Joint Expedition. No serious differences exist between the two sets of results.

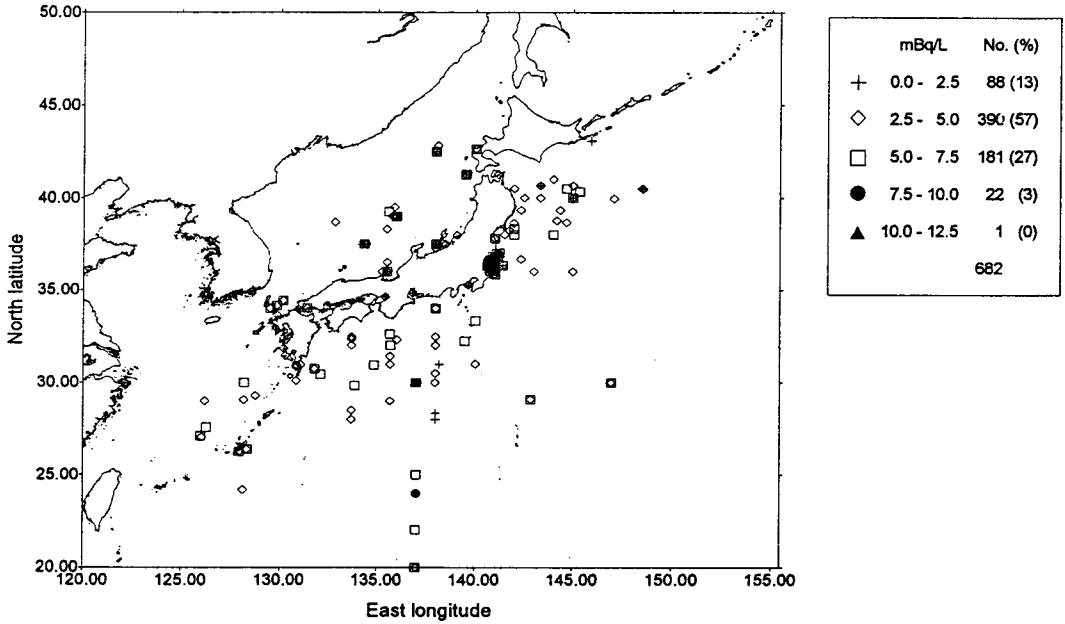

Fig.2-1 Radioactivity distributions of Cs in surface seawater in the western North Pacific Ocean and its marginal seas around Japan (1982-1985).

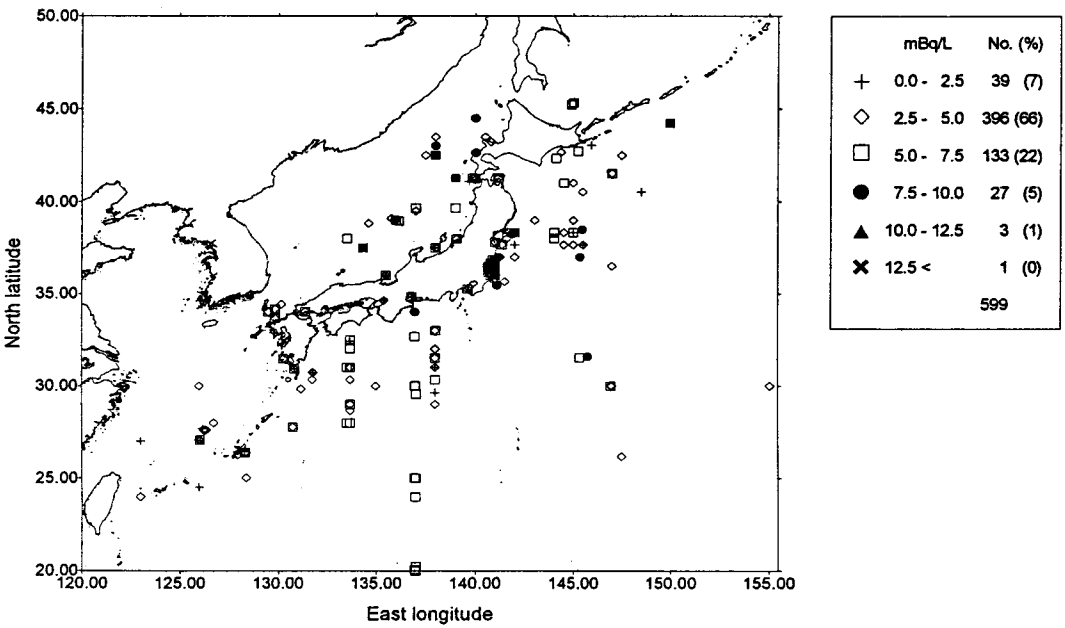

Fig.2-2 Radioactivity distributions of Cs in surface seawater in the western North Pacific Ocean and its marginal seas around Japan (1986-1989).

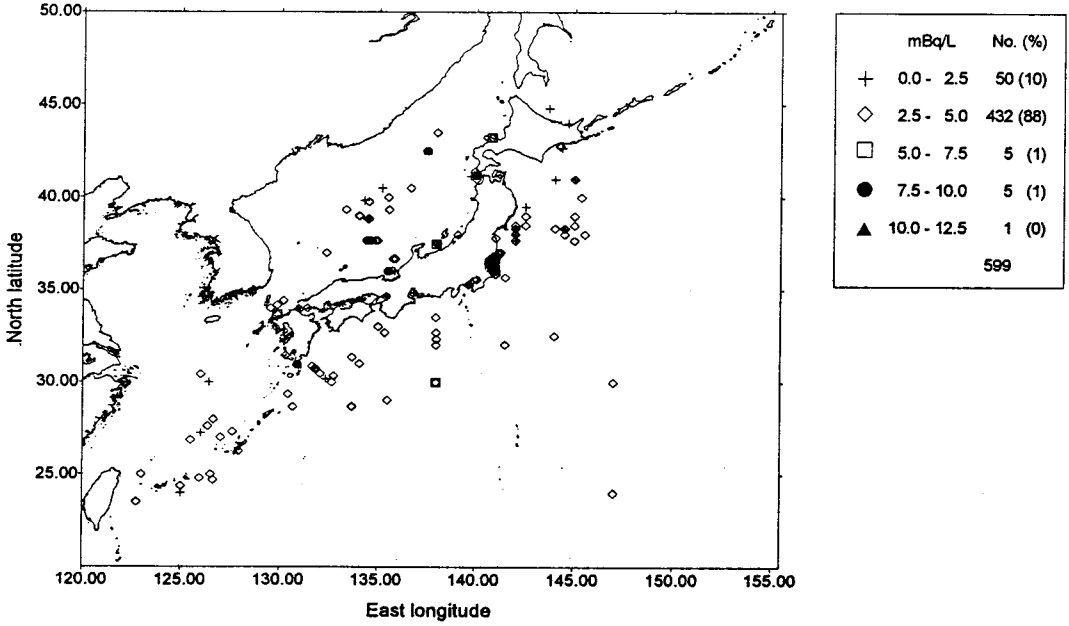

Fig.2-3 Radioactivity distributions of Cs in surface seawater in the western North Pacific Ocean and its marginal seas around Japan (1990-1993).

Table 2 Analytical results (median*) of radionuclide concentrations in surface seawater samples taken by the first Japanese-Korean-Russian Joint Expedition (1994)

Sampling Stn.	^{137}Cs (mBq/l)	^{90}Sr (mBq/l)	$^{239+240}$Pu (μBq/l)
N1	3.2 (2.6-4.2)**	1.7 (1.3-2.7)	24 (16-25)
N2	3.3 (2.2-4.5)	1.9 (1.6-2.5)	17 (5-17)
N3	3.6 (2.4-4.5)	1.9 (1.6-2.5)	18 (9-20)
N5	2.8 (2.3-4.2)	2.0 (0.8-2.6)	21 (20-21)
N6	3.2 (2.4-3.8)	1.6 (0.9-1.7)	25 (22-26)
N7	2.8 (2.3-3.7)	1.6 (1.1-2.0)	22 (21-26)
BG1	3.2 (2.7-4.5)	1.9 (1.2-2.1)	21 (12-21)
BG2	3.0 (2.6-4.0)	1.8 (1.7-2.4)	8 (7-9)

* The median used in this report (July 1995) implies an average of analytical values and not minimum or maximum values, determined by five different laboratories.

** ( ) shows the range of concentrations of reported values.

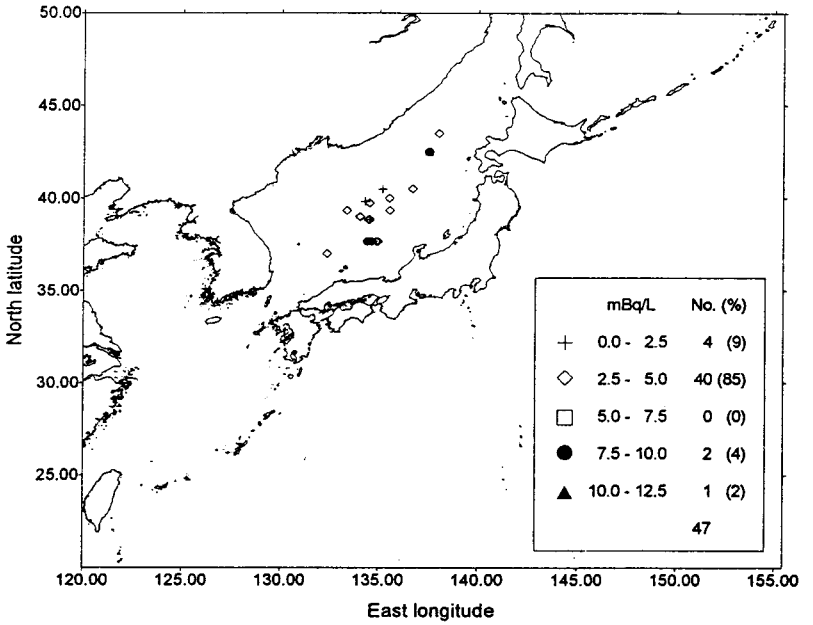

Fig.3-1 Radioactivity distributions of Cs in surface seawater in the Japan Sea excluding coastal areas (1990-1993).

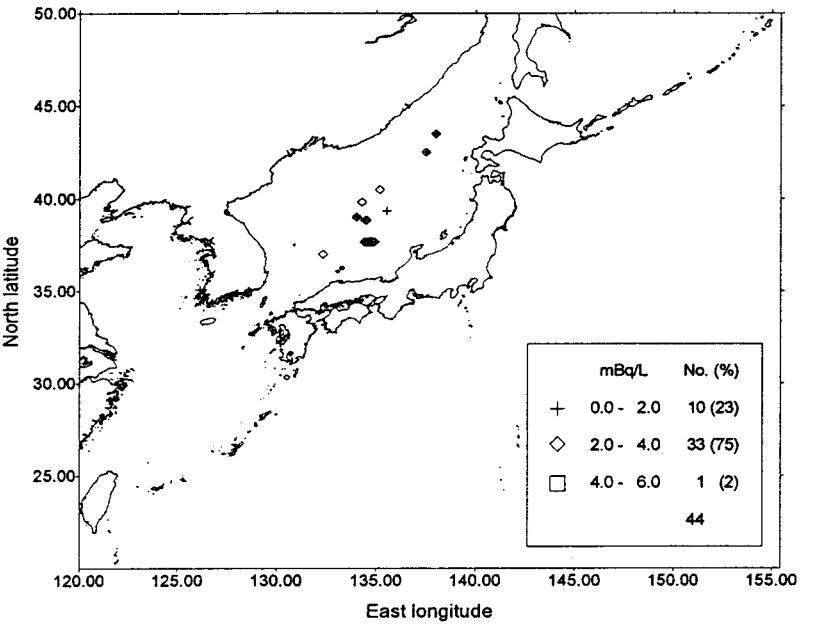

Fig.3-2 Radioactivity distributions of Sr in surface seawater in the Japan Sea excluding coastal areas (1990-1993).

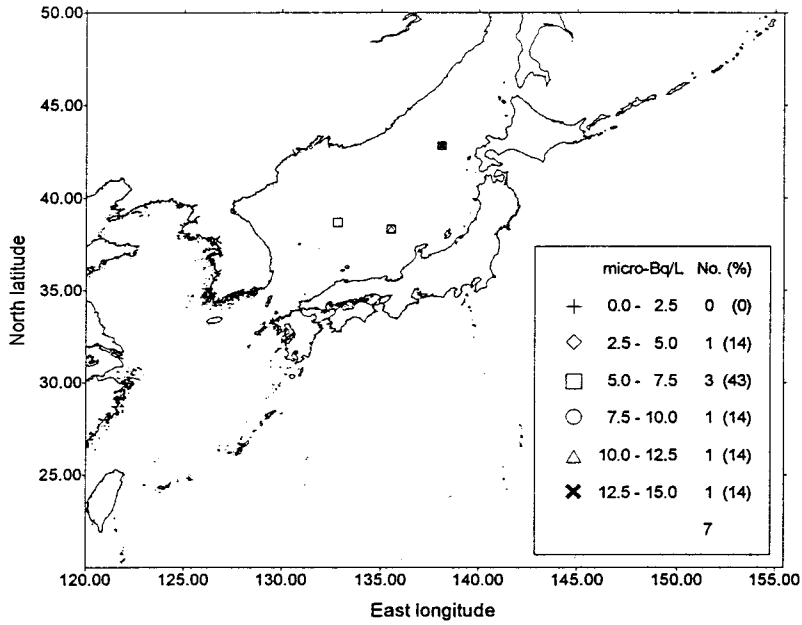

Fig.3-3 Radioactivity distributions of Pu in surface seawater in the Japan Sea excluding coastal areas (1982-1985).

3.4. Supplementary aspects to be studied

1. the secular changes of radioactivity in sediments
2. the vertical distribution profiles of radioactivity in radioactive nuclides such as ^{137}Cs, ^{90}Sr and $^{239+240}Pu$ etc.
3. the inventories of radioactivity in the water column should be studied.

4. Future Tasks

Some essential tasks of work to be performed in the future are summarized below:

1. The input of data on marine radioactivity obtained from samples collected in the Far Eastern sea areas around Russia, Korea and China, not at hand at present, into the database at IAEA-MEL and to link this data to the modeling on marine radioactivity in future.

2. The carrying out of radiological assessment by calculating the concentration factors using the data on biota samples.

3. The input of the GEOSECS project data and other important data into the database.

4. The input of data on natural radionuclides, such as ^{226}Ra, ^{210}Po and ^{210}Pb, into the database and cover all information on marine radioactivity.

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