Environmental radiation (1-14)

1 Indication of Recent Deep Water Formation Deduced from Temporal Variation of \(^{137}\)Cs in the Japan Sea
Takashi MIYAO, Michio Aoyama, Katsumi HIROSE and Yasuhide IGARASHI; Geochemical Research Department, Meteorological Research Institute

\(^{137}\)Cs data, obtained in the Japan Sea in the period of 1976 to 1996, are divided into five layers ([I] 0-200m, [II] 200-750m, [III] 750-1500m, [IV] 1500-3000m and [V] 3000m-) and their temporal variations are statistically analyzed.

\(^{137}\)Cs concentration in the layers [I] and [II] has been decreasing; also the difference between two layers has been decreasing. On the other hand, \(^{137}\)Cs concentration in the layers deeper than 750m has been increasing. As for the layer [IV], decay corrected concentration of \(^{137}\)Cs increased from 0.2Bqm\(^{-3}\) to 0.5Bqm\(^{-3}\) within the period of 1985 to 1995. These results can be explained that ca. 10% of the water which occupies layer [IV] has its origin in the \(^{137}\)Cs-rich surface water. Thus, the large increas of \(^{137}\)Cs concentration in the deep layer suggests that the deep water formation occurred after 1985.

2 Low level \(^{137}\)Cs measurements in deep seawater samples.
Michio Aoyama, Katsumi Hirose, Takashi Miyao and Yasuhide Igarashi; Meteorological Research Institute

Low level \(^{137}\)Cs measurements in deep seawater samples were examined. We re-examined the ammonium phosphomolybdiate (AMP) procedure because we found decrease of recovery of AMP during these several years. We suggest AMP procedure as follows: pH was adjusted to be 1.6 - 2.0 (40 ml c.HNO3 for 20 liter seawater sample), after that 4g AMP was added to each 20 liter seawater sample with a carrier of 0.26g of CsCl. After that 1 hour bubbling was carried out, then precipitation was recovered after 6 - 24 hours. This procedure showed ca. 98% recovery of AMP for 20 liter samples. Applying this procedure and using the large active volume HPGe coaxial well detector, we can determine the \(^{137}\)Cs activity in 18-20 liter samples from sea surface to just near bottom at St. 1 of IAEA97 cruise in 1997, 34-59.9N and 145-58.4E. The \(^{137}\)Cs activity in surface water and deep water samples were ca. 3.3 Bq m\(^{-3}\) and ca. 0.1 Bq m\(^{-3}\), respectively. This procedure suggest that \(^{137}\)Cs becomes one of the actual chemical and transient tracers for oceanographic purposes.
3 Plutonium in Seawaters of the Western North Pacific
Katsumi HIROSE, Michio Aoyama, Takashi Miyao and Yasuhiro Igarashi; Meteorological Res. Inst.

Plutonium in seawaters of the western North Pacific has been introduced by global fallout due to atmospheric nuclear testing, in which major fallout occurred in early 1960s, although a significant amount of plutonium was injected in seawater by close-in fallout. Plutonium concentrations in seawaters of the western North Pacific have been measured during the period of more than two decades. Plutonium in the water column is controlled by biogeochemical processes such as particle scavenging as well as physical processes. We examine time-series data of surface plutonium to understand factors controlling the distributions of plutonium in the ocean.

Temporal variations of surface plutonium in the western North Pacific were examined for three different sea areas: 20-35°N (Kuroshio and Kuroshio Counter Current), 10-20°N (North Equatorial Current), and 0-10°N (Equatorial Counter Current and others). In the area of 20-35°N, surface plutonium decreased exponentially during the period from 1977 to 1992. In the area of 10-20°N, it gradually decreased during the same period. In the area of 0-10°N, surface plutonium level was almost constant after 1983. These findings suggest that there is no significant meridional distribution of surface plutonium in the western North Pacific in 1990s. Recent spatial distribution of surface plutonium may be controlled by physical processes such as advection and upwelling in addition of geochemical processes.

4 Resuspended Radioactivity in the Air Where does it Come from?
Yasuhiro Igarashi, Michio Aoyama, Takashi Miyao and Katsumi Hirose;
Geophysical Research Department, Meteorological Research Institute

Deposits of 90Sr and 137Cs have been continuously observed at Meteorological Research Institute (MRI) since 1957. After the Chernobyl accident there have been no atmospheric nuclear tests and no severe nuclear accidents, the atmospheric 90Sr and 137Cs concentration level became extremely low in the 1990s. The argument has been focused on the significance of the resuspension in the radioactivity deposition. We analyzed the radioactivity deposition data from the viewpoint of decay time, 137Cs/90Sr activity ratio and radioactivity to stable elements (r/s) ratio. It was concluded that most of 90Sr and 137Cs deposited in the 1990s are from the resuspension. Next argument should be concerning major source of the resuspension; the local or the regional. The comparison of 137Cs/90Sr activity ratio in the deposition and Japanese soil suggests a new hypothesis that a large portion of 90Sr and 137Cs in the deposition may be transported by the aeolian dust from the Asian continent. 90Sr and 137Cs data for some Chinese soil sample is presented and discussed to examine this hypothesis.

5 Concentrations of technetium-99 in Sargassum thunbergii collected in the Coasts of the Japanese Islands

Monitorings of radionuclides were carried out by rocal governments which had nuclear facilities in their domain and concentrations of artificial radionuclides are decreasing in the marine environment in recent years. Although short-lived radionuclides are decreasing their activities those of a long-lived radionuclide such as technetium-99 is not decreasing. We have collected seaweeds from the coasts of Japanese Islands and measured the activity of technetium-99 in the algae. It was found that concentrations of the nuclide in the algae were higher in the coast of the Japan Sea side than in the coast of Pacific Ocean side. However, the difference has seemed to become small in the concentrations of the nuclide in both sides.
6  Approach for kinetics of cesium uptake by mushroom
Hiroshi TERADA, Fumio KATO, Kazuhiro MATSUSHITA, Masami NISHINA, Hideo SUGIYAMA; 1National Institute of Public Health, 2School of Pharmaceutical Science Toho Univ., 3Saitama Medical School

To clarify a mechanism of cesium uptake by mushroom, we investigated the time course of cesium uptake by mycelia of Pleurotus ostreatus (Fr.) Kummer Y-1. Following mycelia were grown in the YMG media at 25 °C for 48 hours, 10^5 Bq/kg of 137Cs and 10 mM of CsCl were added into the media. The media were incubated at 25 °C with shaking. 137Cs concentrations of mycelia (dry) became almost 10 times as high as those in media after 60 min. incubation. Under the presence of 100 mM-KCl, the 137Cs conc. of mycelia were 50% lower than those under absence of potassium for 60 minutes incubation. 137Cs uptake of mycelia was also decreased with 1 mM of 4-aminopyridine (4-AP). From these results, it was suggested that potassium and 4-AP inhibited the 137Cs uptake of mycelia at the early stage of it.

7  Relationship between Radiocesium and Related Stable Elements in Plant Samples Collected in Forest Ecosystems
Satoshi YOSHIDA, Yasuyuki MURAMATSU, Martin STEINER, Maria BELL and Barbara RAFFERTY; 1National Institute of Radiological Sciences, 2Federal Office for Radiation Protection, 3National Environmental Protection Agency and 4Radiation Protection Institute of Ireland

Forest ecosystems are sources of radiocesium discharged through nuclear weapons testing and nuclear accidents. Analyses of stable Cs and related stable elements must be useful to understand the long term behavior of radiocesium. However, the relationships among radiocesium and stable elements in the whole system of forests are still unclear because of the lack of analytical data. In this study, plant samples collected from different parts of trees in Irish and Italian forests were analyzed. Radiocesium was measured with a Ge-detector. Stable alkali (Na, K, Rb and Cs) and alkaline earth (Mg, Ca, Sr and Ba) elements were measured by inductively coupled plasma-mass spectrometry (ICP-MS) and inductively coupled plasma-atomic emission spectrometry (ICP-AES). Good correlation between Cs-137 and stable Cs was observed for both sites. The Cs-137/stable Cs ratios were almost constant for samples collected in the same site, suggesting that distribution of Cs-137 in trees is similar to that of stable Cs. Cesium-137 might be mixed well with stable Cs in the biological cycles of the forests. Relationships among another alkali and alkaline earth elements, and results for plants collected in Japanese forests are also discussed.

8  Effect of Environmental Conditions on Cs-137 Accumulations in Japanese Seabass (Lateolabrax japonicus)
Yuzuru SUZUKI, Yusuke ISHIKAWA, Fujio KASAMATSU, Yutaka NAGAYA, Shimuya SAKAMOTO, Motokazu NAKAHARA and Ryoichi NAKAMURA; 1Marine Ecological Research Institute (MERI), Tokyo and 2National Institute of Radiological Sciences (NIRS), Hitachinaka.

In the results of the marine environmental radioactivity monitoring, Cs-137 concentrations in the muscles ofJapanese seabass, a commercial fish in Japan, are relatively high compared with those of other species of fish. It has also been observed that the concentrations in the Japanese seabass vary widely according to the season and the location.

In order to inquire into the reasons for the high and variable concentrations, the biological behaviour of Cs-137 in the fish was examined in radioisotope tracer experiments in relation to the salinity of the environmental water as the fish migrate from freshwater to seawater in their life cycle. The accumulation and excretion of Cs-137 in the fish taken up from environmental water or from food was observed for about 80 days in seawater mixed with tap water in concentrations of 10%, 50% and 100%. Radioactivity in the whole body and the tissues or organs of the fish was measured by using a 40cm² Ge (Li) detector, the data obtained were processed statistically, and the biological parameters were calculated by applying an exponential model with two components.

As a result of these experiments, the Tb 1/2 in the muscle of Japanese seabass in the case of 10% seawater at 20°C was estimated to exceed 200 days. This shows that Japanese seabass that live in brackish water for a long time not only accumulate a higher concentration of Cs-137 in the muscles than those in 100% seawater but it also is more difficult to eliminate it from the muscles of the fish.
9 Surface air concentration and amount of deposition of $^{210}$Pb in Sakai related to $^3$Be.

Monthly average concentration and monthly deposition amount have been also measured on $^{210}$Pb, decayed products of $^{222}$Rn, and cosmogenic origin $^3$Be at our laboratory in Sakai, in order to monitor the artificial radioactive environmental contamination. The clear seasonal variation of $^{210}$Pb concentrations having a low tendency in summer (May to Sept.) are evident in surface air. It can be estimated that some effect of the earth scale event like eruption of volcano on the environment by comparing the ratios of two nuclides after the event with the correlation of the monthly depositions of $^{210}$Pb and $^3$Be, and their concentration in surface air. The minerals in deposition include quartz, feldspar, clay minerals and gypsum. Clear gypsum peaks were shown in deposition of spring and early winter. G. Zhou and K. Tazaki reported that the reaction between calcite and simulated acid rain solution with pHs of 3, 4 and 5 showed a formation of gypsum in 12h indicating that the conversion of calcite to gypsum is possible in the presence of sulfuric acid or ($NH_4$)$_2$SO$_4$ aerosols during transport from the Asian continent to the Japan Islands.

10 Biogeochemical Cycle of Stable Iodine

Yasuyuki MURAMATSU, Satoshi YOSHIDA, Seigo AMACHI, National Institute of Radiological Sciences and 2National Institute of Bioscience and Human-Technology,

Iodine-129 (half-life: 16 million y) is one of the most important radionuclides released from nuclear industries into the environment. Due to the long radiological half-life of $^{129}$I, this nuclide enters into the geochemical and ecological cycles of stable iodine. We have developed an analytical method by using ICP-MS for the determination of iodine in geological and biological materials. Using this method we have studied the distribution of iodine in the global environment (including the earth's crust) and its geochemical cycling. We have also carried out radiotracer experiments on the transfer mechanisms of iodine in the environments. Microorganisms were found to play an important role in the fixation of iodine on soil and also in the emission of the element as methyl iodide into the atmosphere.

11 Measurement of Environmental Neutrons by Activation of Natural Gold


1LLRL, Kanazawa University, 2South Valley Univ. Egypt, 3Assiut Univ., Egypt

Among the nuclides induced by environmental neutrons, $^{198}$Au ($T_{1/2}$ = 2.7d) was examined as a neutron detector. Gold coins, neck-race, gold grain (1-2mmφ) and sheet (0.7mmτ) were chosen as target material. Before use, all samples were stored more than 1 month in dark underground (270 mwe) to decay-out all of $^{198}$Au. The targets were transported to the measuring point and exposed to environmental neutrons for 20-30 days under various environmental conditions. The 412 keV gamma ray from $^{198}$Au was measured for 4-5 days using extremely low background Ge detectors installed in Ogoya underground laboratory. Number of $^{198}$Au atoms produced per unit weight of gold target was calculated and converted to the neutron flux.

Neutron flux thus estimated varies is varies in the range of (0.2-1.5)×10$^5$cm$^{-2}$/s at ground level depending on the shielding condition of the measuring point. Effect of paraffin moderator and cadmium shield and also altitude dependence were clearly observed. The neutron flux at 11.8km (flight of Jakarta-Denpasar-Kansai and Ishigaki-Naha-Komatsu) was measured to be 100 times higher than that of ground level, which agreed well with expected value.
12 Isolation of tritium gas oxidizing actinomycetes with meso-DAP in cell wall from field soils
Maho KOMURO, Yusuke ICHIMASA, Michiko ICHIMASA; Ibaraki Univ.

About 970 strains of tritium gas (HT) oxidizing bacteria were isolated from four field soil sections using five kinds of culture medium. Some biochemical and morphological characteristics of the isolated strains were investigated. Most of the isolates, about 80% in each soil sections, were actinomycetes with LL-DAP in cell wall. However actinomycetes with meso-DAP in cell wall were isolated from the upper soil sections (0-10cm depth) with occurrence rate of about 12% and about 7% from the lower soil sections (10-20cm depth). The average HT-oxidizing activity in actinomycetes isolates with meso-DAP was somewhat higher than that in actinomycetes with LL-DAP.

13 Fluctuation Characteristics of Rn-222 and Rn-220 concentrations in Air on High Background Radiation Area of China
Taeko KOGA¹, Hiroshige MORISHIMA¹, Tsutomu SUGAHARA¹, Yongling YUAN² and Lexin WEI³; ¹Kinki Univ., ²Health Res. Foundation, ³Lab. Hyg. Inst. of Hunnan Prov. and ⁴Lab. of Ind. Hyg., Ministry of Health, Beijing

As a part of China-Japan cooperative research on radiation epidemiology, we have measured Rn-222 and Rn-220 concentrations in air using cup method, since 1997 for internal exposure dose assessment of inhabitants on high background radiation area. We have carried out the fluctuation characteristics of indoor Rn-222 and Rn-220 concentrations on the distance from the wall and on the height from the floor to enhance the reliability in open houses at Liuzaizhang, Gangpai and Madi hamlets. Rn-220 concentrations indoor on HBRA were decreased suddenly with distance from wall and those at 20cm or more were negligible. Rn-222 concentrations in bed room were higher than those in sitting room. Rn-220 concentrations on Yangxi county were three times higher than those on Yangdong county. On effect of building materials, Rn-222 concentrations were almost same, but those of Rn-220 were increased in older of brick, muddy brick and mud.

14 Behaviour of Rare Earth Elements (REEs), U and Th in Soil Samples of Bryansk region contaminated due to Chernobyl Accident
Osarata Kumar SAHOO¹, Hidenori YONEHARA¹, Katsumi KUROTAKI¹, Kunio SHIRAISHI¹, Valery RAMZAEV², Anatoli BARKOVSKI², ¹Natl. Inst. Radiol. Sci., ²St-Petersburg Inst. Radiol. Hygiene (IRH)

Concentration of rare earth elements, uranium and thorium were determined from fifteen locations which has been classified as kitchen garden, yards, field, pasture and forests in the Bryansk region affected by the Chernobyl accident. The aim of this study is to characterize the processes and phase which controls retention of REEs in the contaminated soils. Moraine hills and rare ridges with acid sandy and loam sand podzolic soils are typical of the area. There are variations in the concentration of REEs, U and Th related to general location within the study area which may be reflective of variations in the concentration of elements in reservoirs rocks at depth.