Report on “Radiation Disaster Recovery Studies”

Course: Radioactivity Environmental Protection Course
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I. Regarding “Radiation Disaster Recovery Studies”

In the Phoenix Leading Program, I learned radiation disaster medical treatment, environmental radiation measurement and risk communication in addition to specialized research. These subjects are essential knowledge and skills as experts in radiation disasters. I made use of the knowledge and examined the present situation, issues, and possible future issues, the policy of reconstruction after the Great East Japan Earthquake.

1) Reconstruction situation and its issues

I visited and interviewed the Reconstruction Agency in order to know the progress and issues of reconstruction. Mr. Tamura, assistant counselor, responded to my interview. He is in charge of subsidies. The subsidy is a budget to be distributed from the Reconstruction Agency to prefecture governments. The amount of the subsidy and the progress of reconstruction are closely linked, which is the reason why I interviewed him.

The reconstruction of the Great East Japan Earthquake is being advanced mainly by prefecture governments. Based on the Great East Japan Earthquake Disaster Reconstruction Basic Law, the Reconstruction Agency has created a 5-basic policy [1). “1. Support for Evacuees” is physical and mental care, support for reconstruction of life. “2. Housing Reconstruction & Community Development” is rebuilding of houses, reconstruction of medical care and nursing care, infrastructure improvement. “3. Reviving Industry & Livelihoods” is regeneration of industries and occupations, promotion of tourism, restoration of sales route of marine processed goods, and reconstruction of agriculture. “4. Revitalizing and Reconstructing Fukushima” is decommissioning of nuclear reactor, removal of radioactive materials, termination of evacuation instructions and return. “5. Creation of a new Tohoku” is the spread and development of people, know-how owned by companies, universities, NPOs and private companies in affected areas.

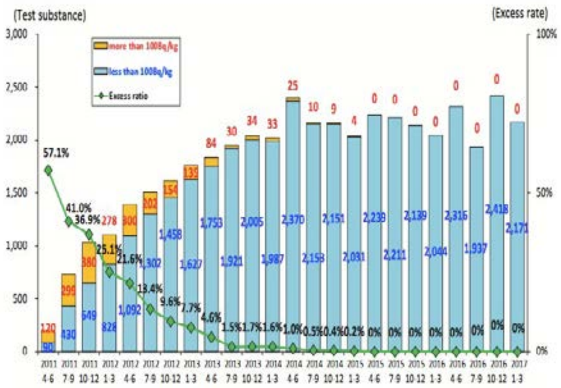

Fig. 1 Results of Surveys of Marine Fishery Products in Fukushima Prefecture.

<Reconstruction Agency, Eliminating Negative Reputation Impact, pp11-12, April, 2017>

"1. Support for Evacuees", "2. Housing Reconstruction & Community Development" and "5. Creation of a new Tohoku" are carried out as planned. In April 2011, the number of temporary housing residences was a maximum of approximately 124,000 units, but in December 2016 it decreased to approximately 45,000 units, the relocation to permanent housing is steadily advanced. However, "3. Reviving Industry & Livelihoods" is not sufficiently advanced. The Great East Japan Earthquake had a huge impact on the fishery. The accumulation of rubble in the fishing ground, the loss of the fishing boat, the collapse of the fishing port and the collapse of the marine processing facility occurred. Restoration and reconstruction have been strongly advanced in the fishery industry, and rubble of fishing grounds has been removed. More than 90% of fishing boats are restored. 98% of the fishing port became usable. 91% of marine processing facilities have been resumed. However, the sales of marine products are only 30% compared with the situation before Fukushima accident.

Table 1 Economic situation of Miyake Island

<Toshiaki Sakuma, http://miyake-furusato.net/files/uploads/.pdf Access 17 Jun 2017>

(a) Population change by census

Number	1995	2005	2016
0-19 age	836	484	271
20-59 age	1,878	1,294	1,111
60-74 age	990	822	654
75 age over	350	589	583

(b) Change in tourists

Year	1986	1999	2015
Tourist	78,701	79,250	36,000

(c) Changes in farm products and marin products

thousand Yen	1998	2011	2013
Farm Products	343,005	218,000	256,733
Marin Products	304,960	172,005	152,358

Fig.1 shows the results of survey of marine products in Fukushima prefecture [2]. The green line in the Fig.1 shows Excess ratio = (the number of samples exceeding the standard limit (100Bq/kg)) / (the total number of samples). From April to June, 2011 soon after the disaster, the percentage of excess ratio was 57.1 %. This percentage has continued to decline, and has fallen to 0 % since April, 2015. Seafood exceeding the standard value has not been detected for about two years, but Fukushima prefecture has continued the trial operation yet. The reason is due to the reputation impact. I think that the 30% reduction of the sales of marine products in the all area of Tohoku is due to the reputation impact.

After the earthquake, the supply of marine products from the Tohoku region decreased, therefore the area of supplier for marine products changed from the Tohoku region to other regions. In addition, sales of marine products in the Tohoku region decreased due to the reputation impact. To restore sales, it is necessary to stop polluted water from Fukushima Daiichi Nuclear Power Plant (FDNPP) by "4. Reconstruction and revitalization of Fukushima". I think that the preconception must be gone away from the feeling of citizens.

Fig.2 shows the number of foreign tourists in Japan and Tohoku [4]. A recovery trend is observed. However, the trend is smaller compared with Japan (232.5%). According to the analysis by the Reconstruction Agency, there is a reputation impact at abroad, and its impact is still present.

In order to analyze the progress of reconstruction, I attempted to classify each application into hardware and software categories. Hardware category includes rubble

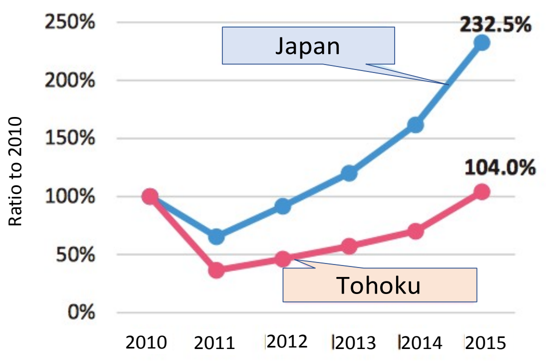

Fig.2 Number of foreign guests for sightseeing.

< Reconstruction Agency, Reconstruction situation and efforts from the Great East Japan Earthquake, pp8-9, January 2017 >

treatment, rebuilding of houses, reconstruction of medical care and nursing care, infrastructure improvement. Software category includes return of residents, development of sales channels, restoration of tourism, improvement of reputation impact. Commitments of the hardware are construction and civil engineering, and the contracts are signed to progress as planned. Commitments of the software are related to the awareness of citizens, therefore reconstructions often do not progress as planned. In the future, many budgets should be used for reconstruction of software. I think that the most important thing is the heart of the reconstruction.

2) Precedent case

The Fukushima accident was the greatest disaster in Japan. Although the scale of accident is different, I will introduce the precedent case that will be helpful for future issues. It is a volcanic eruption in Miyake Island in 2000. In this case, long-term evacuation and impact by ejection are similar to Fukushima accident. Miyake Island is about 200 km far from Tokyo. Islanders are around 2,000 people. Miyake Island erupted in 2000, and all islanders were evacuated from the island. The evacuation periods became more than four years. In 2005, the evacuation order was canceled and the islanders were able to return to Miyake Island. However, some issues occurred. Table 1 shows the changes in the economic situation of Miyake Island [5]. 20 % of islanders did not return, they settled down in an evacuation place. Tourists were anxious about the influence of volcanic gases, and the number decreased. The farmer decreased, and the farm products decreased, too. The victim was evacuated for a long term. The influence on health with the volcanic gases is worried. There is still a no-entry area.

3) Future issue in the Great East Japan Earthquake Disaster

Miyake Island is much smaller than Fukushima. However, Miyake Island eruption is an important precedent case because there are many similarities with the Fukushima accident. The future problem of the Great East Japan Earthquake may already have occurred in Miyake Island. I think that the following things will be an issue in the disaster area of the East Japan great earthquake disaster. In Miyake Island, the population of 20 - 59 years old in 2016 is 1,111 people, but this number includes about 40% of civil servants and their families. The reconstruction plan of the Great East Japan Earthquake will end in 2020, the population of the Tohoku region will decrease greatly at that time. Many families with children moved to areas outside the Tohoku region. In the future, the elderly will move to their children’s house, the population will further decrease. When the reconstruction plan is over, the victim will not be able to receive sufficient support. As a result, the number of people receiving welfare protection will increase. From the present situation of Miyake island, we should learn the issue that will occur in the future at Tohoku.

References

1) Reconstruction Agency, Reconstruction situation and efforts from the Great East Japan Earthquake, pp2-13, January 2017.
2) Reconstruction Agency, Elimination Negative Reputation Impact, pp11-12, April 2017.
3) MLIT HP, https://wwwtb.mlit.go.jp/tohoku/chikoushin/18chikoushin/ks-chikoushin18-07.pdf, Access 17 Jun 2017.

4) Reconstruction Agency, Elimination Negative Reputation Impact, pp8-9, April 2017.

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II. Summary of Doctoral Thesis

Title: Studies on Migration Pathway from the Japan Sea to the Sea of Okhotsk of Radioactive Cesium Derived from the Fukushima Daiichi Nuclear Power Plant.

1) Introduction

In the reconstruction situation of the Great East Japan Earthquake, there are steady policies and delayed policies. There is a possibility that a part of policies are delayed by the reputation impact. Equally, tourists had decreased due to reputation impact in Miyake island's precedent case. Risk Communication is important to reduce the reputation impact. In addition it is important that the stakeholders share the correct information. Unfortunately, consumers do not properly understand the radioactivity in the ocean. Sales of marine processed goods in Tohoku have not been recovered by the reputation impact. This is the reason why I investigated the radioactivity of ocean to provide the information to the stakeholders. Because the information in the Japan Sea and the Sea of Okhotsk is particularly less, I selected the places as the research sea areas. I think that the migration pathway of radioactive materials and the concentration of radioactive cesium in the seabed soil are useful as information to be shared by stakeholders and such study will contribute to the reduction of the reputation impact. I also believe that the investigation on the radioactivity in the environment will contribute to radiation protection.

2) Purpose of the study[5) 6) 7)]

In the accident of FDNPP that occurred in 2011, a large amount of radioactive materials was released into the environment. The radioactive materials were migrated in the environment and were taken up in organisms, causing external radiation exposure and internal radiation exposure. To clarify the migration pathway is important for Phoenix leader education program for Renaissance from Radiation Disaster, and radiochemistry can contribute.

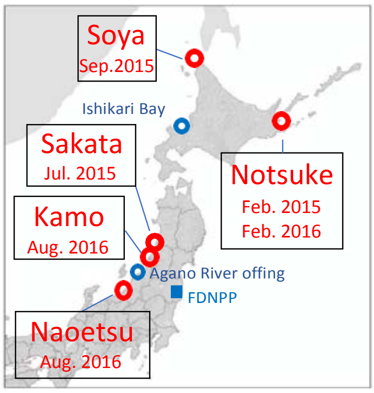

Fig.3 Sea areas of radioactive survey.

^{134}Cs specific to accident at nuclear power plant was detected from the seabed soil of Ishikari Bay at Hokkaido. Many measurements and research have been reported on the diffusion situation and the migration pathway of radioactive materials in the Tohoku region and the Pacific Ocean. However, I do not know the study on the radioactive material migration pathway in the Japan Sea and the Sea of Okhotsk. Radioactive materials derived from FDNPP were not detected from farms in Hokkaido, so I could not to think that it is via the atmosphere. Therefore, the purpose of this study is to clarify the migration pathway of FDNPP derived radioactive materials from Fukushima to the Ishikari Bay and from the Ishikari Bay forth.

3) Experiment

Total of 43 seabed soils were collected in the Sea areas of Fig. 3 to clarify the migration pathway of radioactive cesium. The seabed soil was dried and radioactivity was measured with a Ge semiconductor detector. Measurement time was from 80,000 seconds to 600,000 seconds, and 100 or 2000 cm^3 of seabed soil was measured. Radioactive cesium may not be adsorbed depending on the type of seabed soil even if it moves in the sea. Therefore, the grain size distribution of seabed soil was investigated. Sieves were used for grain size analysis and the seabed soil was classified into Coarse sand, Medium sand, Fine sand and Clay - Silt, and the ratio was measured. To clarify that radioactive cesium is migrating and diffusing by ocean current, a simulation was performed for the concentration of ^{134}Cs in the seabed soil using the advection diffusion equation.

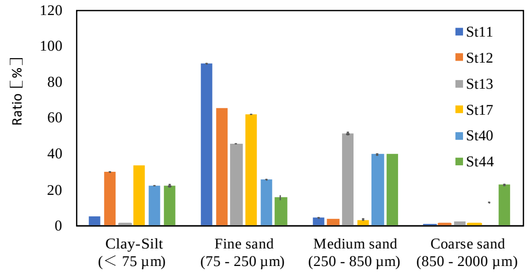

Fig.4 Grain size distribution of seabed soil in which ^{134}Cs was detected.

4) Results and discussion

In seabed soils other than Naoetsu offing, there were seabed soils where ^{134}Cs was detected. Fig. 4 shows the results of classification of seabed soil in which ^{134}Cs was detected. In the seabed soil where ^{134}Cs was detected, it is found that the ratio of Clay-Silt and Fine sand is high. However, in seabed soil where ^{134}Cs was not detected, it is found that Clay - Silt, Fine sand ratio was low. On the other hand, ^{134}Cs was not detected even at the point where Clay - Silt ratio was high at the Naoetsu offing.

Fig. 5 shows the relation between the ratio of Clay-Silt in Sakata offing and Kamo offing close to the distance and the concentrations of ^{134}Cs and ^{137}Cs. The concentration of ^{137}Cs is higher than the concentration of ^{134}Cs because of global fallout. There was a high correlation between the concentration of Clay-Silt having the smallest grain size and the concentration of radioactive cesium. In general, radioactive cesium is easily adsorbed to Clay-Silt. Therefore, it is suggested that Clay-Silt of seabed soil also adsorbs more radioactive cesium.

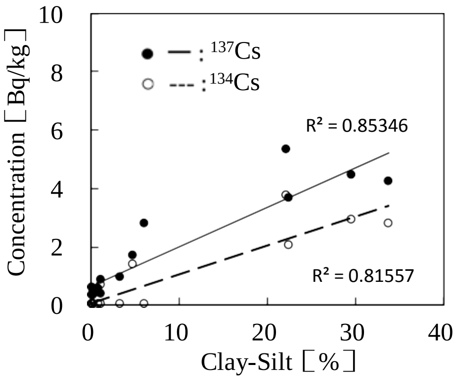

Fig.5 Relationship between Clay-Silt ratio and ^{134}Cs, ^{137}Cs concentration in the soils at Sakata and Kamo.

Fig. 6 shows the relationship between the values of the points where the ^{134}Cs concentration is the highest and the migration distance in the sampling sea areas. As the migration distance increased, the ^{134}Cs concentration decreased, and a phenomenon similar to advection / diffusion was observed. However, because ^{134}Cs was not detected from the seabed soil of Naoetsu offing and the Tsushima warm current flows to east at the Naoetsu offing, the source of the outflow in the Japan Sea was

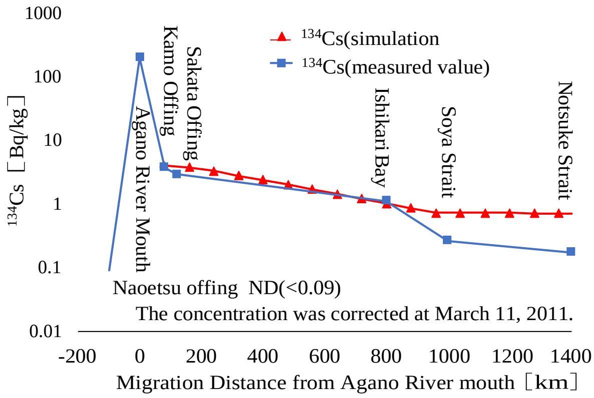

Fig.6 ^{134}Cs concentration vs migration distance.

limited to the area east than Naoetsu. Simulation was calculated on the ^{134}Cs concentration in the seabed soil. Fig.6 shows measured values and simulation values, and similar decreasing trends were observed in these values. Because the simulation is calculated by ocean current, it was suggested that the water mass including ^{134}C migrated by ocean current. Measurement values are lower than the simulation values in the Soya Strait and the Notsuke Strait. I think that the reason is that Tsushima warm current is divided, a part of it becomes Soya warm current, the Okhotsk surface low salinity water etc. mix.

5) Conclusion

A part of the radioactive cesium derived from Fukushima Daiichi Nuclear Power Plant flowed out into the Japan Sea from the region east than Naoetsu, and migrated to Notsuke Strait by the Tsushima warm current and the Soya warm current.

References

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