TOPICS Fukushima 8 Aug 2014 No.50

Mapping the radioactivity distribution at the bottom of irrigation pond for farming

There are about 3,700 reservoirs for agriculture in Fukushima Prefecture. Among them, there are some reservoirs which contain radioactive materials in the bottom sediment. The Japan Atomic Energy Agency (JAEA) has developed a technique which can efficiently measure the radioactivities in these materials and map the distribution of radioactivity at the bottom of reservoirs. This technique is applicable to the assessment of the situation of radioactive materials, so JAEA is now transferring the technique to Midori Net Fukushima*.

*: Local organization that promotes agriculture. “Midori” stands for water, land and hometown.

Three years have passed since the accident of the Fukushima Daiichi Nuclear Power Station. In relation to the restoration of agriculture in the disaster-stricken area, there are concerns over the migration of radioactive cesium in the environment. Most of the radioactive cesium in natural water is considered not to be dissolved in the water, but to be accumulated in the bottom sediment. So it has become one of the significant issues to know the amount of radioactive materials in the sediment and their migration behavior as precisely as possible (e.g. website of Farmland Management Division, Fukushima Prefecture, http://www.pref.fukushima.lg.jp/sec/36045d/noutikannri017.html (in Japanese)). Until now, a general method to measure the concentration of radioactive cesium in bottom sediment of a reservoir was to take out the sediment samples and measure the radioactivities in laboratories. However, it was difficult to know the cesium distribution throughout the reservoir with this method. As the shielding effect against gamma-rays is stronger in water than in air, in order to precisely measure the radioactive cesium concentration directly in water, the detector should be set close to the radiation sources.

JAEA has developed new detectors called “p-Scanner” and “J-subD”, which can measure radioactivity in water. Concentration of radioactive cesium in water can be measured by setting these detectors close to bottom sediment. p-Scanner is equipped with a plastic scintillation fiber at the detecting part, which can measure the radioactivities in a line. Measurement of radiation doses in a two-dimensional plane can be obtained by moving the fiber parallel. J-subD is

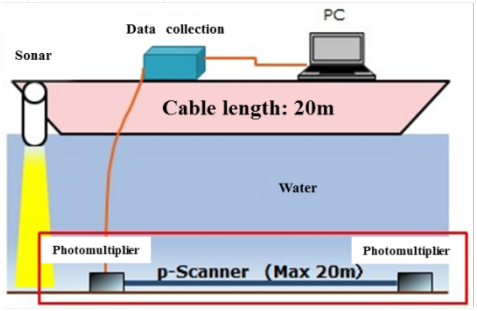
equipped with the detector which can analyze gamma-ray spectrum, so it can evaluate the real state of the waterbed. By combining them, it has become possible to make maps of the radioactivity distribution in reservoirs.

Details were summarized as JAEA report which is available on the website http://jolissrch-inter.tokai-sc.jaea.go.jp/pdfdata/JAEA-Research-2014-005.pdf (in Japanese)

Using these detectors, the concentrations of radioactive cesium in real reservoirs were measured before and after dredging. It was found that the concentration of radioactive cesium was reduced after the dredging, as shown in the figure below.

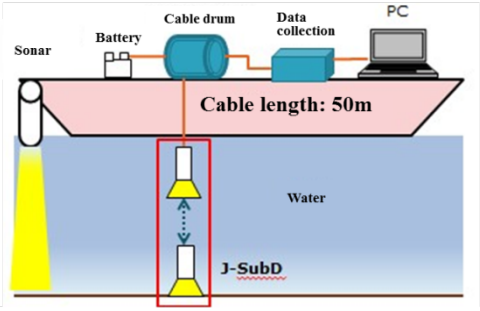
JAEA is transferring these techniques to Midori Net Fukushima by making a contract of technical supports with the organization. JAEA is going to develop the technology and provide supports which are necessary to utilize these techniques for the measures against radioactive materials in reservoirs in Fukushima Prefecture.

・Instrument for line measurement (p-Scanner)



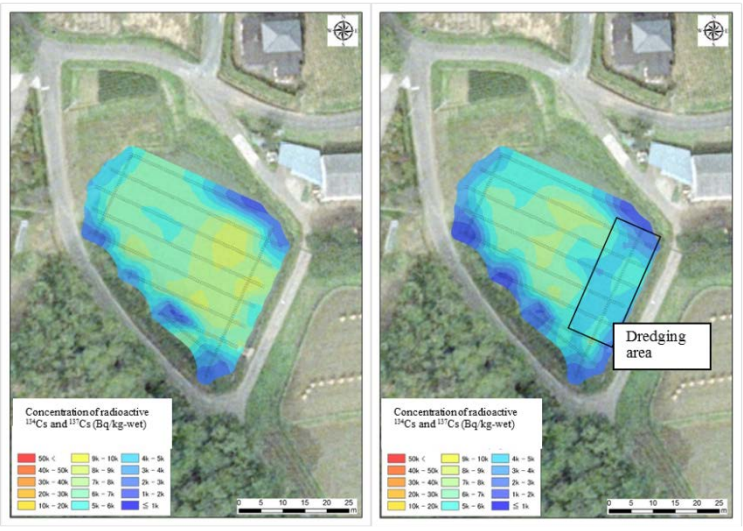
- Plastic fiber scintillator is used in the detector
- The maximum length of the detector is 20 m
- The validity of the instrument was already checked on land.

・Instrument for dot measurement (J-SubD)



- LaBr3 (Ce) scintillator is used in the detector
- Spectrum analysis is possible
- It is possible to analyze the response character by using the calculation code and evaluate the real state of the waterbed by simulation.

Mapping of the concentration of radioactive materials in waterbed is achieved by combining p-Scanner and J-subD.



Example of radioactivity measurements before and after dredging. Left figure: before dredging. Right figure: after dredging. The maps were made based on the data measured with the p-Scanner at five-meter intervals. Values between measuring points were interpolated by the use of commercial GIS (geographical information system) software.

Plastic Scintillation Fiber（PSF）

The instrument can measure radiation doses not only in a dot but also in a line and two-dimensional plane by using optical fiber as a detector. The maximum length of the detector (optical fiber) is 20 m. Radiation doses in a two-dimensional plane can be measured by moving the optical fiber parallel keeping it in a straight line. Measurements are also possible at the curved terrain or in water as it is waterproof.

J-SubD（Underwater Gamma Ray Spectrometer）

Instrument to measure radiation doses in water. The LaBr scintillator is used as a detector. It can be used in water up to 300 m depth. The instrument can measure precise gamma-ray spectra, so radioactive cesium can be distinguished from other natural radioactive materials.

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