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Radioactivity analysis following the Fukushima Dai-ichi nuclear accident

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HIGHLIGHTS

- 118 samples were analyzed using HPGe γ spectrometry.
- Trace amount of ^{131}I was detected in rain and surface soil samples.
- No ^{131}I was detected in milk, drinking water, seawater or marine biota samples.
- Result indicate it pose no threat to public health.

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ABSTRACT

A total of 118 samples were analyzed using HPGe γ-spectrometry. ^{131}I, ^{134}Cs, ^{137}Cs and ^{136}Cs were detected in aerosol air samples that were collected 22 days after the accident with values of 1720 μBq m^{-3}, 247 μBq m^{-3}, 289 μBq m^{-3} and 23 μBq m^{-3}, respectively. ^{131}I was detected in rainwater and soil samples and was also measurable in vegetables collected between April 2 and 13, 2011, with values ranging from 0.55 Bq kg^{-1} to 2.68 Bq kg^{-1}. No ^{131}I was detected in milk, drinking water, seawater or marine biota samples.

1. Introduction and objectives

At 2:46 pm (JST) on March 11, 2011, Japan experienced one of the most powerful earthquakes in recorded history, now known as "the Great East Japan Earthquake" (Monateersky, 2011; Ozawa et al., 2011). Following a successful shut down of the reactors, power for cooling the Fukushima Dai-ichi nuclear power station was lost due to flooding from the tsunami generated by this earthquake. Fuel degradation led to hydrogen explosions at units 1, 3 and 2. These occurred at 3:36 pm on March 12, at 11:01 am on March 14, and at 6:14 am on March 15, respectively. Fission products, including ^{133}Xe, ^{131}I, ^{134}Cs and ^{137}Cs were released from the reactor buildings into the environment (Butler, 2011). Since March 12, 2011, traces of radionuclides were recorded in the air by a number of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) Preparatory Commission radionuclide monitoring stations. Fission products were detected in parts of the northern hemisphere.

Aerosols, rainwater, food, drinking water and milk are usually considered as standard environmental media for radioactive emissions monitoring. These are the same media in which radionuclide concentrations are likely to be observed soon after deposition and the point where radionuclides enter the food chain. To study the possible impact of the accident on China, radiological monitoring was conducted by the National Institute for Radiological Protection (NIRP), China CDC. During the emergency, samples of aerosols, rainwater, food, drinking water and soil were collected and analyzed for radionuclides from Fukushima. Following the Fukushima Dai-ichi nuclear accident, traces of fission products radionuclides were first detected in the air of northeastern China and then in Beijing. This paper mainly reported the results of radioactivity analysis done by NIRP following the accident.

2. Materials and methods

2.1. Sampling

Sampling sites are shown in Fig. 1. Aerosol air samples were collected on the roof of the NIRP building by using several portable

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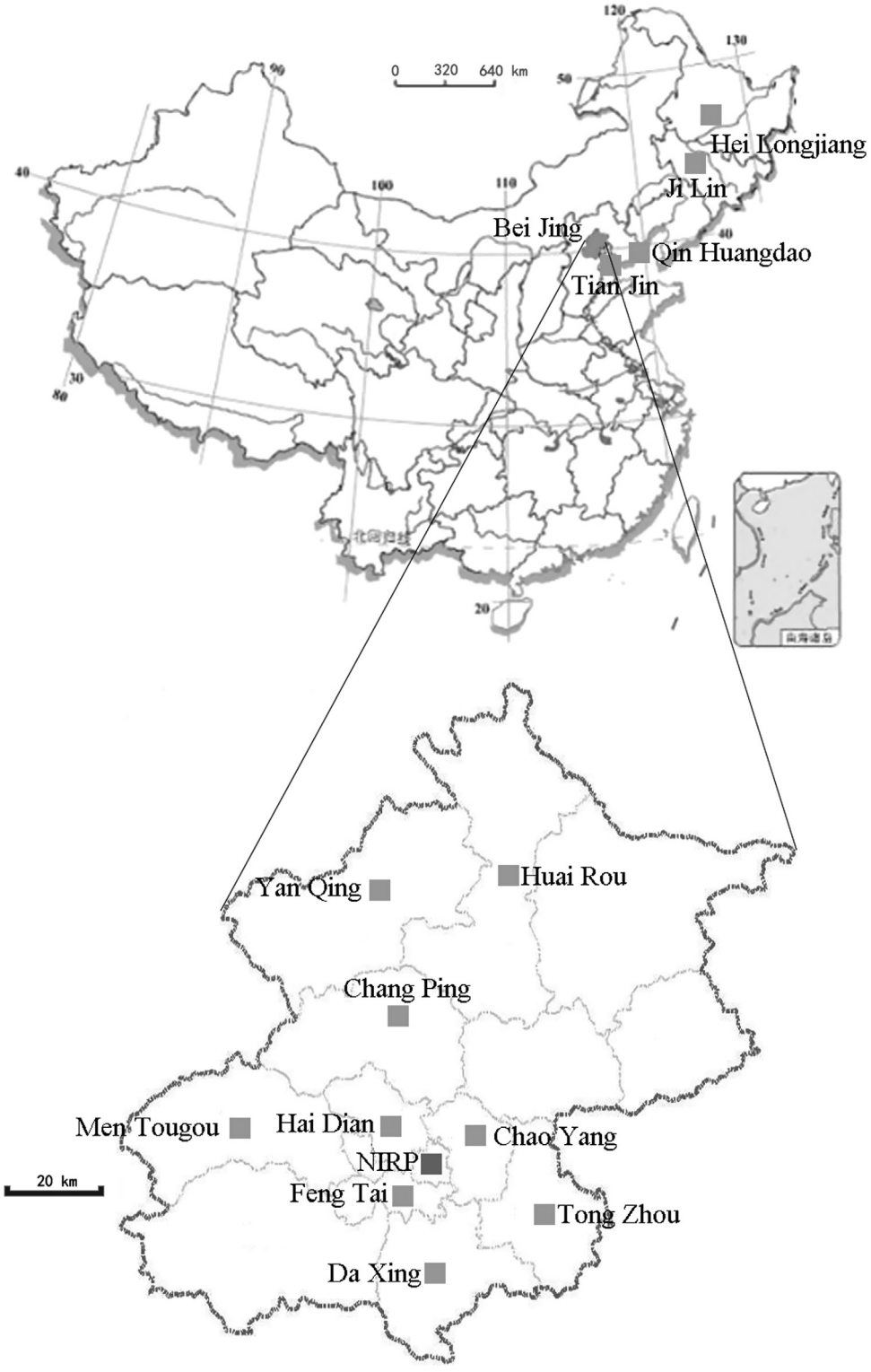

Fig.1. Map showing the location of NIRP sampling sites (indicated by gray squares) at several provinces in the northeastern China (Hei Longjiang, Ji Lin, Qin Huangdao, Tian Jin) and Beijing area.

Staplex TF1A type (Clover company) high volume air samplers, with maximum sampling flow rate of 2 m^3 min^{-1}. The aerosol air sampling was using only a membrane filter, no charcoal cartridge was used. After sampling, the membrane was placed in a stainless steel mold, and pressed into a round thin slice with diameter of 50 mm by using a hydraulic press. Water samples, including rainwater, drinking water, seawater and irrigation water (for vegetable gardens) were collected. Samples of rainwater were gathered in the city of Beijing on the roof of NIRP laboratories' building, by using two stainless steel deposition collectors. To prevent evaporation, the samples were sealed immediately after rainfall. Drinking water was collected at the exit pipe from water supply companies with eight sites were sampled. Seawater was collected at depths of 0.5 m and 5 m at positions from 300 m to 1000 m from the coast by using a 2,500 mL stainless steel sampler. After sampling, hydrochloric acid was added immediately to stabilize the samples. Vegetable and