Image analysis for the study of radiocesium distribution in coniferous trees: two years after the Fukushima Daiichi Nuclear Power Plant accident

Haruka Minowa
Radioisotope Research Facility, The Tokyo Jikei University School of Medicine

Abstract – The accident at the Fukushima Daiichi Nuclear Power Plant in March 2011 resulted in the deposition of radioactive fallout over wide area in eastern Japan. Environmental samples were examined with an imaging plate to investigate the characteristics and the behavior of fallout deposits. In the autoradiographs, so-called “hot particles” were evident in many samples. There were no particulate contamination on new leaves which grown after the accident. The state and adsorption amount of fallout was different depending on the locality and the timing of sampling. The results of this study confirm that deposition on the leaves and the barks would remain several years and radiocesium concentration would be decrease with the growing of new leaves.

Keywords – radiocesium, autoradiography, coniferous tree

I. INTRODUCTION

Radioactive fallout from the March 2011 disaster at the Fukushima Daiichi Nuclear Power Plant (NPP) spread across much of eastern Japan. Deposition of fallout on land was affected by rain, wind, and geographical features [1]. The purpose of this research is to investigate the characteristics and behavior of the fallout. Because it was early spring in eastern Japan at the time of the accident, many trees were bare of leaves except for evergreen trees include coniferous trees. Radioactivity on the perennial leaves of coniferous trees would be an appropriate indicator for the monitoring of the radionuclides in the environmental system.

II. SAMPLES AND METHODS

Samples were collected at Naraha-machi, Hirono-machi and Iwaki city in Fukushima prefecture, which are located approximately 20 to 50km in south or southwest side from Fukushima Daiichi NPP. It was considered that the dried deposition were more principal than the wet deposition in these area [2]. As a typical coniferous tree, Pine trees (Pinus thunbergii, Pinus densiflora), Japanese cypress (Chamaecyparis obtusa), Japanese cedar (Cryptomeria japonica), and Chinese juniper (Juniperus chinensis) were selected.

Samples were flattened and covered with a wrapping film and exposed to an imaging plate BASIII 2040 (Fujiﬁlm Co., Tokyo, Japan) for time periods ranging from overnight to one week. Autoradiographs were scanned using an image analyzer Typhoon FLA7000 (GE Healthcare Japan Co., Tokyo, Japan).

III. RESULTS AND DISCUSSION

Autoradiographs are shown in Figure 1 and 2. Samples were collected from Naraha-machi at Nov. 2012. It was observed that the fallout seemed to be granular, so-called “hot particles”. These radioactive particles had not moved from the initial site of adhesion on the leaf despite repeated exposure to rain. Particulate contaminations were distributed only the bottom leaves spread before the accident and did not seen in the top leaves grown after the accident. This confirms that particulate deposition on the leaves and the barks would remained several years and radiocesium concentration would be decrease with the growing of new leaves.

Fig. 1. Leaves of Juniperus chinensis from Naraha-machi at Nov. 2012. Particulate contaminations were seem only on the bottom leaves and not seem on the top leaves.

Fig. 2. Tree barks of Chamaecyparis obtusa from Naraha-machi at Nov 2012. Heterogeneously contaminations were visible throughout on the bark.