Study on soil to crop transfer factor of plutonium by literature review and field investigation

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Plutonium is a radionuclide of high chemical toxicity, and it is important to study its soil to crop transfer for the purpose of radiological assessment. In 2010, IAEA published the Technical Reports Series No. 472 (TRS 472), to provide transfer factors (TFs) for natural and artificial radionuclides. In TRS 472, however, the utilized TF data entries of Pu are very limited. Thus, more TF data of Pu are in urgent need in order to improve the reliability of TRS 472 database.

Since 2007, the latest reference year of TRS 472, several studies on soil to crop TF of Pu have been carried out. Here, in this study, recently derived soil to crop TF (2008-2016) were collected from literature and statistically analyzed to compare them with TRS 472. The comparison showed that these newly obtained transfer factor data were able to enrich the TRS 472 database to some extent. However, several problems related to the database still remain unsolved. (1) Most of newly reported TF data of Pu are beyond the TRS 472 data coverage, pointing out to the limited representativeness of TRS 472 because of the inadequate data entries. (2) Rice is an essential food in Asian food structure, and is of great importance to study the soil to rice transfer factors for different radionuclides. However, no TF for Pu was reported.

To supplement the soil to crop TF data of Pu, we carried out field investigations at 6 prefectures in Japan. In the experiment, Pu was separated from the sample matrix by a two-stage anion-exchange chromatographic method and followed by Pu determination using SF-ICP-MS. The determined soil to rice TFs (in a dry weight basis) of Pu, in a range of 2.0×10^{-5} to 8.2×10^{-5}, were the first data-set on soil to rice TF of Pu ever reported for Japanese soil. For vegetable and fruit, the TFs ranged from 1.1×10^{-4} to 7.5×10^{-4}. The soil to crop TF data of Pu obtained in this study improved the present Pu TF database, but more data should be obtained in further studies to extend the current Pu TF database and improve the representativeness of the existed data.

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