

Supporting Information

**Isotopic compositions of ^{236}U , ^{239}Pu , and ^{240}Pu in soil contaminated by the
Fukushima Daiichi Nuclear Power Plant accident**

Guosheng Yang ^{1,2}, Hirofumi Tazoe¹, Kazuhiko Hayano³, Kumiko Okayama³,

Masatoshi Yamada^{1,*}

¹Department of Radiation Chemistry, Institute of Radiation Emergency Medicine,

Hirosaki University, 66-1 Hon-cho, Hirosaki, Aomori 036-8564, Japan

²Division of Nuclear Technology and Applications, Institute of High Energy Physics,

Chinese Academy of Sciences; Beijing Engineering Research Center of Radiographic

Techniques and Equipment, Beijing 100049, China

³Mutsu Analytical Sciences Laboratory, Japan Chemical Analysis Center, 4-24

Minatomachi, Mutsu, Aomori 035-0064, Japan

Number of pages	Number of tables	Number of figures
8	4	1

*Corresponding author. Tel.: +81 172 39 5405; Fax: +81 172 39 5405.

myamada@hirosaki-u.ac.jp

Table S1. Pu and U isotopic compositions in fuels loaded in three reactor cores of the Fukushima Daiichi Nuclear Power Plant, cited from the literature ¹. The reference gave no uncertainties for the values.

	Core 1	Core 2	Core 3
Isotopic abundance (%)			
²³⁴ U	3.19×10 ⁻⁴	1.96×10 ⁻⁴	1.08×10 ⁻³
²³⁵ U	1.69	1.90	1.88
²³⁸ U	98.3	98.1	98.1
Atom ratio			
²⁴⁰ Pu/ ²³⁹ Pu	0.343	0.319	0.355
²³⁶ U/ ²³⁹ Pu	0.804	0.789	0.639
Activity ratio			
²³⁶ U/ ²³⁹⁺²⁴⁰ Pu	3.67×10 ⁻⁴	3.75×10 ⁻⁴	2.86×10 ⁻⁴
²³⁸ Pu/ ²³⁹⁺²⁴⁰ Pu	2.92	2.39	2.31

Table S2. The details of U and Pu isotopes for the soil samples with clear Pu contamination due to the FDNPP accident ($^{240}\text{Pu}/^{239}\text{Pu}$ atom ratio, 0.245–0.312; $^{238}\text{Pu}/^{239+240}\text{Pu}$ activity ratios, 0.859–1.62). Error bars on the soil sample values indicate 1σ .

Sample	$^{240}\text{Pu}/^{239}\text{Pu}$ atom ratio	^{238}Pu activity (Bq kg ⁻¹)	$^{239+240}\text{Pu}$ activity (Bq kg ⁻¹)	^{236}U activity ($\times 10^{-5}$ Bq kg ⁻¹)	$^{236}\text{U}/^{238}\text{U}$ atom ratio ($\times 10^{-8}$)
S12	0.256 $\pm$ 0.034	0.076 $\pm$ 0.018	0.047 $\pm$ 0.003	7.36 $\pm$ 0.35	3.55 $\pm$ 0.16
S46	0.258 $\pm$ 0.037		0.020 $\pm$ 0.001	3.91 $\pm$ 0.50	2.53 $\pm$ 0.32
S54	0.268 $\pm$ 0.060		0.043 $\pm$ 0.005	18.7 $\pm$ 6.3	3.53 $\pm$ 1.19
S273	0.245 $\pm$ 0.014	0.160 $\pm$ 0.027	0.131 $\pm$ 0.004	3.74 $\pm$ 1.82	2.27 $\pm$ 1.09
S275	0.312 $\pm$ 0.044	0.081 $\pm$ 0.019	0.052 $\pm$ 0.004	6.32 $\pm$ 3.05	3.32 $\pm$ 1.60
S277	0.255 $\pm$ 0.030	0.055 $\pm$ 0.016	0.059 $\pm$ 0.003	5.59 $\pm$ 3.78	1.97 $\pm$ 1.33
S279	0.267 $\pm$ 0.018	0.470 $\pm$ 0.045	0.375 $\pm$ 0.013	14.1 $\pm$ 2.7	13.5 $\pm$ 2.6

Table S3. The results of α -spectrometry and ICP-MS for ^{239}Pu and ^{240}Pu . Error bars on the soil sample values indicate 1σ .

Method	ICP-MS		α -spectrometry
Sample	^{239}Pu activity (Bq kg $^{-1}$)	^{240}Pu activity (Bq kg $^{-1}$)	$^{239+240}\text{Pu}$ activity (Bq kg $^{-1}$)
S12	0.024 $\pm$ 0.002	0.023 $\pm$ 0.002	0.047 $\pm$ 0.003
S273	0.069 $\pm$ 0.001	0.062 $\pm$ 0.003	0.120 $\pm$ 0.022
S275	0.024 $\pm$ 0.001	0.028 $\pm$ 0.004	0.059 $\pm$ 0.015
S277	0.030 $\pm$ 0.001	0.028 $\pm$ 0.003	0.064 $\pm$ 0.015
S279	0.189 $\pm$ 0.011	0.186 $\pm$ 0.007	0.430 $\pm$ 0.043

Table S4. Collection locations of soil samples.

ID	Latitude (°N)	Longitude (°E)	Collection date (year/month/day, time)
S2	37.3944	140.3752	2011/3/17 15:27
S3	37.7628	140.4685	2011/3/17 17:40
S6	36.8886	140.7674	2011/3/18 14:30
S7	37.4847	139.9451	2011/3/18 17:35
S8	37.1221	140.2285	2011/3/19 13:15
S9	37.8278	140.7239	2011/3/19 15:45
S12	37.5744	140.8822	2011/4/12 16:15
S13	37.5744	140.8822	2011/4/12 16:20
S14	37.5419	140.8594	2011/4/12 16:51
S15	37.5733	140.7931	2011/4/13 11:20
S16	37.6036	140.7844	2011/4/13 13:00
S19	37.5538	140.7216	2011/4/13 21:50
S20	37.5538	140.7216	2011/4/13 21:56
S23	37.5538	140.7216	2011/4/13 22:10
S27	37.5538	140.7216	2011/4/13 22:44
S29	37.5538	140.7216	2011/4/13 23:10
S35	37.5538	140.7216	2011/4/14 00:06
S36	37.5538	140.7216	2011/4/14 00:30
S37	37.5538	140.7216	2011/4/14 00:50
S39	37.5561	140.7398	2011/4/14 03:00
S40	37.5519	140.7159	2011/4/14 20:30
S42	37.5519	140.7159	2011/4/14 21:00
S44	37.5519	140.7159	2011/4/14 21:20
S45	37.5561	140.7398	2011/4/15 00:30
S46	37.5651	140.7839	2011/4/15 03:46
S48	37.5651	140.7839	2011/4/15 06:20
S49	37.5881	140.7919	2011/4/15 12:20
S54	37.6161	140.7672	2011/4/16 03:04
S55	37.1221	140.2285	2011/4/26 16:50
S57	37.3706	140.3752	2011/4/27 01:16
S58	37.7628	140.4685	2011/4/27 06:30

S60	37.4847	140.9451	2011/4/27 21:00
S63	37.7741	140.4710	2011/6/6 17:30
S65	37.7508	140.4679	2011/6/6 18:20
S66	37.7637	140.4686	2011/6/7 17:20
S81	37.7643	140.4483	2011/6/9 13:30
S83	37.8166	140.4149	2011/6/9 13:55
S92	37.3980	140.3560	2011/6/16 15:30
S273	37.5402	140.8646	2012/7/18 10:00
S275	37.5484	140.8422	2012/7/18 11:15
S276	37.5538	140.7365	2012/7/18 13:20
S277	37.5338	140.8685	2012/7/19 10:50
S279	37.5165	140.8854	2012/7/19 11:10
S280	37.5076	140.9330	2012/7/19 11:40
S282	37.4876	141.0383	2012/7/19 13:15
S283	37.4872	141.0297	2012/7/19 14:40

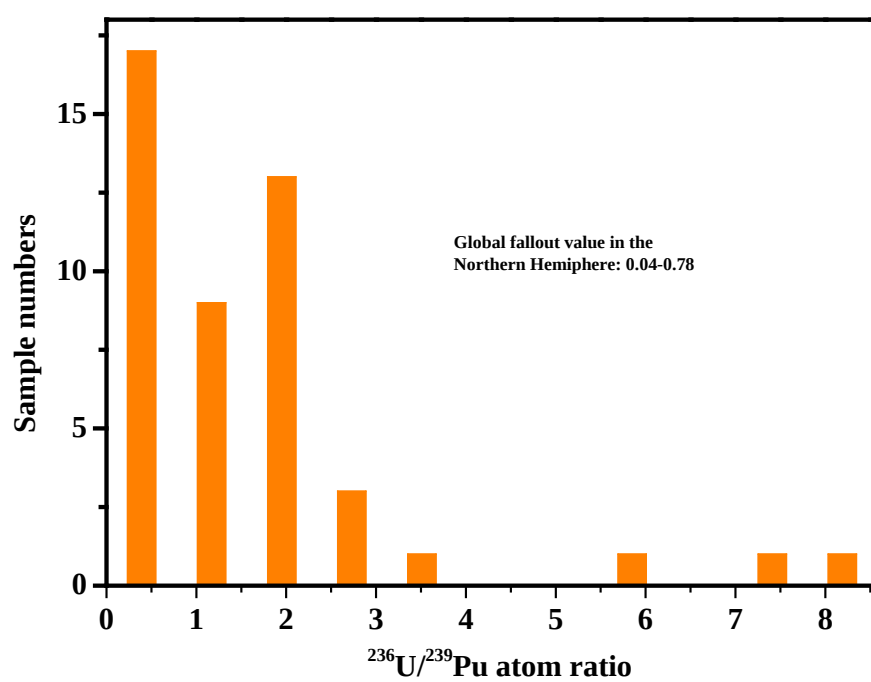


Figure S1. The frequency distribution of $^{236}\text{U}/^{239}\text{Pu}$ in soils samples collected after the FDNPP accident.

References

1. Nishihara, K., Iwamoto, H. & Suyama, K. Estimation of fuel compositions in Fukushima-Daiichi Nuclear Power Plant. JAEA-Data/Code 2012-018 (2012).