Characterization of Artificial Radionuclides and Sedimentation in Sediment Core of Crater Lake

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Introduction
In this study, we investigated the distribution of 237Cs, 237Np, 239+240Pu activities, and 228Pu/239Pu atomic ratio and sedimentation characteristics in sediment cores collected in crater lake, Baengnokdam of Mt. Halla, Korea from September to November 2004.

Methods

* Sampling site and Crater lake core: (33°21'32.25", 126°32’5.69”)

* Measurement of radioactive isotopes

HPGe measurement

- Sectioned at 10 cm intervals
- Drying
- Sieving by 200 um sieve

Ashing 1:1 HNO3 extraction 1st TEVA resin separation

Sample introduction: ARIDUS-II (desolvator)

2nd TEVA resin separation MC-ICP-MS (NEPTUNE, Finnigan) measurement

Results & Discussion

Evaluation of Sedimentation Rate

- A(x) = A_0 \exp(-t/\lambda) \quad (1)
- A(x) = \text{accumulated excess } 210Pb \text{ at depth}(x)
- A_0 = \text{total accumulated } 210Pb \text{ in the core}
- Activity of excess 210Pb at depth(x)
- t = (1/\lambda)\ln(A_0/A(x)) \quad (2)
- t : age of sediment
- V = A(x)/P(x) \quad (3)
- P(x) : excess 210Pb activity at depth(x)

Sedimentation rate : 0.86 cm/y (0 ~ 35cm), 0.20 cm/y (35 ~ 55cm)

Conclusion

The maximum 137Cs per unit sediment by the site varied from 19.0 to 214 Bq/kg. For all sediment cores except for 10m distance station from the zero station, the results on 237Np, 239+240Pu activities ranged from 0.0518 to 7.15 mBq/kg-dry, and from 0.00686 to 5.128Bq/kg-dry, respectively. 228Pu/239Pu atomic ratios averaged 0.159 less than the global fallout ratio (0.176). 239+240Pu and 228Pu activity ratios averaged in 0.033 and 0.0086, respectively. Using Constant Flux Model, the sedimentation rates of core at 30 m were estimated as 0.86 cm/y (0 ~ 35cm) and 0.20 cm/y (35 ~ 55cm).

Figure 1. Vertical profiles of 137Cs and 40K at the sampling sites in the crater lake

Figure 2. Vertical profiles of 239+240Pu and 137Cs activities at the sampling sites in the crater lake

Figure 3. Horizontal variation of sum of clay and silt contents in soil sediments

Figure 4. Vertical profiles of 226Ra, 210Pb activities and 228Pu/239Pu atom ratio at 30 m site

Figure 5. Three dimensional distribution of 239+240Pu activities in the crater lake

Figure 6. Vertical profiles of 137Cs and 210Pb activities in reference soil samples collected in Jeju Island

Figure 7. The age of soil sediment using Constant Flux Model (Robbins, J. A., 1978)