The regional characterization of volcanic glass shards for the forensic science by trace element analysis

*Teppei Nogami[1], Yoshinari Abe[1], IZUMI NAKAI[1]

1.Tokyo University of Science Graduate School of Chemical Sciences and Technology

Because the soil is widely distributed over the ground surface, the soil has been regarded as one of important evidential matters which links a person with a place in the field of the forensic science. We have developed a nationwide forensic soil sediment database for Japan using stream sediments collected at 3024 points across Japan. While we have previously focused on trace heavy element compositions reflecting the geological background of the soil, we newly focused on the volcanic glass contained within the soil as a new indicator to achieve further regional characterization of soils. The volcanic glass is an amorphous pyroclastic material produced by a rapid cooling of a magma. It is expected that the volcanic glass will be good indicator for soils from all over Japan, because Japan is one of the most famous volcanic countries in the world. In addition, because a chemical composition of the volcanic glass could vary in each volcanic mountain, it is believed that the regional characterization of the volcanic glass is achieved by chemical compositional analysis as shown in previous studies using EPMA. In the present study, we introduced a laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), a powerful analytical technique for trace element analysis of a minute specimen (< 100μm), to analyze the individual volcanic glass shard.

4 samples (Samples A, B, C and D) collected in the *Kanto Region* were used in the present study. Sampling points are shown in Fig. 1. Samples A and B are stream sediments collected from the *Arakawa River* and they were chosen from 3024 stream sediments for the forensic soil sediment database. They are indistinguishable using the heavy element and heavy mineral compositions. Samples C and D are soils. Sample C contains a volcanic ash from *Mt. Asama* while Sample D contains ashes from *Mt. Fuji* and *Mt. Hakone*. After mesh controls, heavy minerals in these samples were removed by heavy liquid separation (SG ~2.4). Residues were embedded into resin and the surface was polished. 50 particles of volcanic glass were identified for each samples using a polarizing microscope and a micro Raman spectrometer for trace element analysis by LA-ICP-MS. Twelve elements were selected to analyze based on the previous study.

Here we examined the characterization using two elements, ^{89}Y and ^{90}Zr. It has been pointed out that the tephra deposits of the Kanto Region can be separated into two groups bordering the northern latitude of 36 degrees (see Fig.1): the ash from *Mt. Asama* for north side, the ashes from *Mt. Fuji* and *Mt. Hakone* for south side. Figure 2 shows a plot of intensities of ^{89}Y and ^{90}Zr (normalized to the intensity of ^{29}Si) of volcanic glasses in Samples C and D. As shown in Fig. 2, there are different compositional tendency between the volcanic glasses in Samples C (Group N) and D (Group S). We confirmed the significant difference between these two groups using an analysis of variance. Because the crystallization differentiation of the magma in *Mt. Asama* was promoted compared to those in *Mt. Fuji* and *Mt. Hakone*, it is considered that the volcanic glasses in Sample C were rich in Y and Zr as incompatible elements. We built a linear discriminant to discriminate two groups of volcanic glasses using the normalized intensities of ^{89}Y and ^{90}Zr of volcanic glasses in Samples C and D and applied it for volcanic glasses in Samples A and B. As the result, 85.4% of the volcanic glasses in Sample A were classified into Group N while 75.9% of those in Sample B were Group S. Therefore, we could successfully distinguish 2 stream sediments having same heavy element and heavy mineral composition using the trace elemental difference of volcanic glass shards measured by LA-ICP-MS.

Keywords: volcanic glass

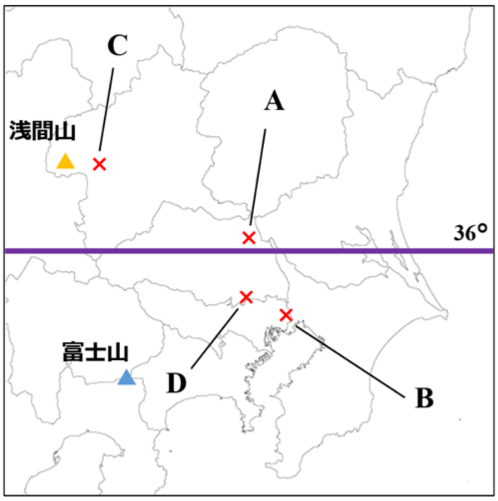

Fig. 1 土砂採取地

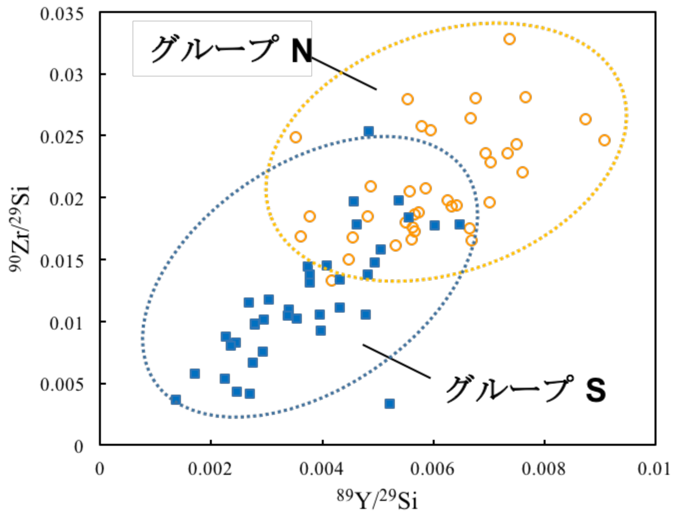

Fig. 2 試料C, Dの比較