Geochemical map of Aichi Prefecture, central part of Japan - Minor elements

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Geochemical map is a useful tool for geoenvironmental assessment. Major elements tend to express the geological background. Minor elements, on the other hand, are expected to reflect artificial activities effectively. 27 trace elements, Sc, Cr, Co, Ni, Zn, As, Br, Rb, Sr, Zr, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Yb, Lu, Hf, Ta, W, Au, Th and U were analysed for 1500 stream sediments by INAA, being supported by JAERI Program #3137. The sample powder is the same aliquot which was used for major element analysis[1]. The stream sediment contains a varieties of minerals hardly dissolving in acid. The non-destructive INAA is the reliable method for analysis. The precision and accuracy for analysis is better than +/-3~5%. The data reproducibility for multiple sampling at the same site is about 10%. A big amount of samples, more than 100mg, was used for analysis to avoid chemical heterogeneity. The following discussions, however, are based on the elemental variations bigger than 30% to several tens time.

Cobalt and zinc are rich in the eastern and western parts, where the sedimentary rocks and volcanics are distributed. These distributions are correlated well with those of Fe and Mg. High concentration of these elements are observed sporadically in the area without any relation to the basement geology. Scandium and hafnium distributions are correlated well with those of Ca and Fe. These areas correspond to the geology of the Obara granite and of mafic part of the Inagawa granite. Cesium distribution is reversely correlated with above elements. La distribution looks like that of Ce. The distribution differs from that of Yb. The distribution of Sm does not show intermediate one between La and Yb. Several groups of independent magmatic differentiation must be there.

Arsenic and Gold can be determined by INAA with reagent standards. Arsenic distributes with Au and Sb at Tsugu area, the eastern part of the study area. This suggests the origin of the elements related with geothermal activity. Au is also observed without any correlation of As and Sb at several parts in granite area. Arsenic is observed at the northwestern part of the study area without any correlation with Au. The different combinations of these elements indicate different origins at each location.

Reference

[1] Yamamoto, K. et al., (2003) This volume.

An investigaton for isotopic discrimination effect during ICP ionization

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Inductively coupled plasma source mass spectrometry (ICPMS) is a recently developed technique initiated for the determination of trace element abundances [1] using the strength of its argon plasma source, which achieves high ionization efficiency of >90 % for most elements as calculated from the Saha equation. The magnetic sector multiple-collector ICP mass spectrometer is designed to provide high precision isotopic data by eliminating the instability of ICP by simultaneous ion detection. The mass discrimination of the instrument remains relatively constant over time, and is dependent on relative mass difference of isotopes [2]. Though no theoretical model has been published to explain the mass discrimination effect, the space-charge effect is assumed to have the strongest influence [3].

Here we have determined an absolute isotopic composition of zinc by the double-spike method to investigate the influence on the mass discrimination during the ionization process, because the ionization efficiency of zinc by the argon ICP is ~70 %. Synthetic isotope mixtures prepared from highly enriched isotopes (^{64}Zn and ^{68}Zn) were used for the calibration of the instrument (Nu Plasma), and the absolute isotopic composition was estimated from natural zinc reagents.

The resultant composition is clearly different from those of conventional mass spectrometric measurements [4,5]. Our mass discrimination correction factor of zinc agrees well with a mass discrimination trend in the same mass range from nickel to gallium, while large deviations are recognized if the previous zinc isotope ratios are referred. This result suggests that the mass discrimination is not produced during ionization, and the currently recommended isotopic composition by IUPAC [4] should be revised.

This result was published in part [6].

References

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