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Is it representative of the Earth? -Necessity of ultrahigh-speed massive analysis in petrology-

KOGISO, Tetsu[1*]

[1]HES, Kyoto Univ.

Earth and planetary sciences target at very large-scale subjects, such as the evolution of the Earth and the Solar system, but we usually treat very small samples taken from the Earth and the outer space. This means that we have to read various phenomena of the spatial scale order-of-magnitude larger than the samples we can have. In petrology, we usually use rock samples smaller than palm size. In addition, it's difficult to take rock samples from the whole globe like those of the ocean and atmosphere, because we have to take rocks from underground. In other words, petrologists is forced to understand large-scale phenomena using data from a limited number of rocks taken from limited areas. Therefore, we always have to question ourselves "are those samples representative of things and phenomena we want to know about?"

I have been interested in the behavior of platinum-group elements in the mantle, which would provide us with a key to understand the early-Earth differentiation and subsequent chemical evolution of the Earth's interior. Platinum-group elements in mantle peridotites are concentrated in base-metal sulfides (BMS) and platinum-group minerals (PGM). So it is very important to reveal the stability and genesis of BMS and PGM in order to understand the behavior of platinum-group elements in the mantle. Because BMS and PGM are very small both in size and amount, it has been quite difficult to describe the occurrence of them in peridotites. Recent developments in small-scale analyses, such as FE-SEM, laser-abrasion ICP-MS and synchrotron micro XRF, enable us to analyze BMS and PGM in submicrometer scale, and we are getting to know the occurrence and genesis of BMS and PGM in peridotites. However, we can still analyze only limited number of BMS and PGM in small portions of a sample because of their smallness in size and amount, and therefore we don't know whether the BMS and PGM we observe are representative of the sample they are included in, not to mention of the Earth's mantle. Even if we get able to analyze much smaller-size minerals, it is uncertain whether we can know better about BMS and PGM in the mantle. What we want to know is the behavior of platinum-group elements in the mantle, not genesis of them in a particular sample.

Then, what should we do? It's not to advance the methods for small-scale analyses with much higher precision, but to develop methods for analyzing a large number of samples in limited time. In other words, we need "ultrahigh-speed" analysis of rock samples. We don't need to care so much about precision and accuracy, because, at least in the case of platinum-group elements, concentration data even with +/- 100% precision would tell us much about geochemistry of platinum-group elements. The way petrologists and geochemists must go is not only to higher precision and accuracy, but also to ultrahigh speed.

Keywords: small-scale analysis, wide-area analysis, massive analysis, mantle, heterogeneity