Strontium isotope systematics and tectonics of epithermal gold deposits in Kyushu, Japan

Y. MORISHITA[1] AND T. NAKANO[2]

[1]Geological Survey of Japan, AIST, Central 7, Tsukuba 305-8567, Japan y.morishita@aist.go.jp
[2]Institute of Geoscience, University of Tsukuba, 305-8572, Japan (nakanot@arsia.geo.tsukuba.ac.jp)

Many epithermal gold deposits are distributed in Kyushu of southern Japan. They are considered to have formed in association with the activities of andesite to dacite magmas. The Kushikino deposit, a representative gold deposit, is located in the southwestern region of Kyushu and is composed of fissure-filling veins of low sulfidation type. The deposit occurs in Neogene andesitic volcanics, which unconformably cover the basement sedimentary rocks of Cretaceous age. The veins consist of gold- and silver-bearing quartz and calcite with minor amounts of adularia, sericite and sulfides. Although the oxygen and carbon isotopic data of the veins indicate that the ore fluid was meteoric origin (Matsuhisa et al., 1985), a tectonic simulation analysis concluded that the vein system might be formed by a magma intrusion (Morishita and Kodama, 1986). Since the $^{87}Sr/^{86}Sr$ ratio of veins is a function of the $^{87}Sr/^{86}Sr$ ratios of both the source hydrothermal fluid and the surrounding rocks that might react with the fluid, we examined the strontium isotope systematics in the Kushikino and contrastive areas in order to investigate the nature and evolution of the hydrothermal system.

The strontium isotopic comparison among the veins, intrusive andesite responsible for the ore-formation and the basement sedimentary rocks shows that the $^{87}Sr/^{86}Sr$ ratios of the Kushikino veins (0.706-0.707) are lower than those of the basement sedimentary rocks, whereas the Noya veins from the northern Kyushu (no basement sedimentary rocks) have low and constant $^{87}Sr/^{86}Sr$ ratios (0.704) that are indistinguishable from those of the mineralizing intrusive andesite. As oxygen and carbon isotopic ratios of the Kushikino and contrastive veins are compared with the $^{87}Sr/^{86}Sr$ ratios, the main ore veins can be distinguished from veins in off-centered regions by the correlation between the $^{13}C/^{12}C$-$^{18}O/^{16}O$ trend and $^{87}Sr/^{86}Sr$ ratios. Thus the multi-isotope systematics is much powerful in estimating the center of hydrothermal activity and the origin of hydrothermal fluids.

References

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Lower crustal xenoliths from Oki-Dogo, southwest Japan

T. MORIYAMA[1] AND E. NAKAMURA[2]

[1]PML, Institute for Study of the Earth's Interior, Okayama university at Misasa takeru@pheasant.misasa.okayamau.ac.jp
[2]eizonak@misasa.okayama-u.ac.jp

Introduction

In order to understand the formation of the lower crust beneath southwest Japan, xenoliths from Oki-Dogo, SW Japan, transported from the deep-seated condition to the Earth's surface by late Cenozoic alkali basalt were inverstigated. In previous studies, it has been suggested that formation of the lower crust beneath SW Japan has no relationship to subduction magmatism because of an absence of hydrous minerals, in contrast to NE Japan (e.g. Takahashi, 1978).

Classification of xenoliths

The late Cenozoic alkali basalt includes abundant mafic to ultramafic xenoliths. These xenoliths were divided into igneous and granoblastic types, based on the petrographical textures. The two textural types also are discriminated clearly by trace element and isotope compositions. The igneous-type xenoliths are relatively enriched in highly incompatible elements and depleted in Sr and Nd isotope compositions ($^{87}Sr/^{86}Sr$: 0.70457 ~ 0.70498, εNd: -1.5 ~ 0.1) compared with those of the granoblastic type ($^{87}Sr/^{86}Sr$; 0.70578 ~ 0.70826, εNd: -5.4 ~ -2.9). The granoblastic-type xenoliths have slightly low Pb isotope compositions ($^{206}Pb/^{204}Pb$: 17.72 ~ 17.93) compared with those of the igneous type ($^{206}Pb/^{204}Pb$: 17.86 ~ 18.5).

Formation of the lower crust beneath Oki-Dogo

The isotope compositions of the igneous-type samples are close to the compositions of the late Cenozoic alkali basalt (characterized by "intra-plate" type magmatism; $^{87}Sr/^{86}Sr$: 0.70464 ~ 0.70487, εNd: 0.2 ~ 0.6, $^{206}Pb/^{204}Pb$: 17.85 ~ 18.00) from Oki-Dogo. The petrological and geochemical observations suggest that the igneous-type xenoliths were derived from the late Cenozoic alkali magma(s). Alternatively, isotopic and trace element compositions of the granoblastic-type xenoliths suggest that generation of the their protolith magmas involved fluid processes associated with subducting slab, and that the granoblastic xenoliths were formed by recrystallization of cumulate crystals from arc magma that assimilated basement rock. From these constraints, we considered that the lower crust beneath Oki-Dogo was formed by the pre-Miocene subduction-related magmatism on the convergent margin, before Cenozoic alkali basalt magmatism.

References

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