Pb isotope ratios of the Akeshi Au deposit, Kagoshima, Japan: Implication for gold mineralization

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Elucidating the origin of the deposits can provide a crucial key constraint in exploration for new mineral deposits. It is previously considered that the epithermal deposits are formed by ore-forming fluids originated from hydrous magmas and/or created by the circulation of meteoric water within the shallow crust. The fluids extract metals from magmas and/or host rocks and then move to the shallower part of the crust, resulting in deposition of valuable metals due to reduction of pressure and temperature [1]. The previous mineralization model has been proposed on the basis of isotopic study of relatively light elements (e.g., H and O) in ore-forming fluid. However, recent isotopic studies on heavy metals (e.g., Pb, Sr and Nd) suggest the involvement of another important component, i.e., slab-derived fluid, to the formation of epithermal ore deposits [2]. For example, based on Pb-Sr isotopic compositions, Hosono and Nakano [3] suggested that deep crustal fluid contributes to the formation of Hishikari gold deposits. In addition, Fujinaga et al. [2] pointed out a possibility that slab-derived fluid contributes to the formation of hydrothermal deposits in Japan, based on Pb isotope compositions of ore samples.
In the present study, to detect direct information of source of metals contributing to the formation of epithermal gold deposits, we study Pb isotopic compositions of sulfide ores from the Hishikari and Akeshi gold deposits. The Hishikari and Akeshi gold deposits both in Kagoshima prefecture, Japan, are the typical of the Hokusatsu-type and Nansatsu-type gold deposits, respectively. Especially, the Hishikari deposit is known as one of the world's highest-grade gold deposits [4].
Analytical result shows that the ore samples have three trends centering the host rock in $^{206}Pb/^{204}Pb$–$^{207}Pb/^{204}Pb$–$^{208}Pb/^{204}Pb$ isotopic compositional space. Trend-1 constitutes a mixing trend between the host rock and the bed rock (Shimanto Supergroup), which is consistent with the previous ore-forming model. Trend-2 extends from host rock to an inferred composition of PHS-fluid (slab-derived fluid from Philippine Sea plate [5]). This trend implies that the slab-derived fluid contributes to mineralization of hydrothermal ore deposits as suggested recently [2]. Trend-3 cannot be explained by any geochemical end-member considered here, so more detailed investigation is required. A relationship between Pb isotopic ratio and Au concentration suggests that both the bed rock and the PHS-fluid contribute to Au mineralization.

References

[1] Hedenquist and Lowenstern (1994) *Nature* 370, 519-527.
[2] Fujinaga et al. (2013) *GEOFLUID 3*.
[3] Hosono and Nakano (2004) *Earth Planet. Sci. Lett.* 222, 61-69.
[4] Izawa et al. (1990) *J. Geochem. Explor*. 36, 1-56.
[5] Nakamura et al. (2008) *Nat. Geosci.* 1, 380-384.

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