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SR-XRF analysis of trace element abundances in electrum from epithermal gold deposits, Hokusatsu area, SW Japan

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Introduction

In epithermal Au-Ag deposits of Japan, gold generally occurs as electrum (a mineral having a complete solid solution series between Au and Ag)[1]. Although there have been reported many chemical analyses of electrum, the abundance of trace elements has not been known in detail. This is due to the fact that electrum generally occurs as very fine grains less than 100 μ m across in the epithermal quartz veins, and EPMA analyses usually detect no other elements except Au and Ag. In this study, an X-ray fluorescence technique using synchrotron radiation (SR-XRF) was applied to determine the abundance of trace elements in electrum collected from high grade gold ores of three representative epithermal gold deposits, Hishikari, Oguchi and Kushikino, in the Hokusatsu area, Kagoshima Prefecture, SW Japan.

Experiments

The electrum grains were separated from auriferous quartz and adularia ores by treating with HF, and then with HCl and HNO_3 + H_2SO_4. Obtained samples, six from Hishikari, six from Ohkuchi, and two from Kushikino, were analyzed quantitatively for Au and Ag compositions by EPMA. Then, the XRF mapping method using the X-ray microbeam of 5 x 6.5 μ m was employed, and relative intensity of XRF for trace elements was measured at BL-4A of KEK-PF.

Results

The analytical results show that all electrum samples contain seven trace elements, Cr, Fe, Cu, Zn, Te, Ba and Sb, homogeneously within grains less than several hundred ppm. Relative XRF intensities of these elements revealed difference among three gold deposits. The electrum grains from Hishikari and Ohkuchi have higher Cu and Te and lower Zn and Ba, compared with Kushikino. Moreover, the abundance of Cu and Te appears to correlate with the Au content. These characteristics are considered to reflect chemical behavior of these elements in ore-forming fluids. Based on the HSAB principle[2], it is concluded that Cu and Te form substitutional solid solution, and Cr, Fe, Zn Sb and Ba are trapped as nano-particles forming interstitial solid solution in electrum.

References

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