Invisible gold and arsenic in pyrite of the high-grade Hishikari gold deposit

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Microbeam techniques have been increasingly applied to investigate the presence of gold in sulfides associated with lode gold deposits (e.g., [1]). Shimada et al. [2] and Morishita et al. [3] have confirmed the presence of "invisible gold" in pyrite from the Hishikari deposit, and we further investigate the correlation between gold and arsenic in this study.

High-grade Au Deposit and Analytical Method

The Hishikari epithermal gold deposit (ca. 1 Ma), which is world-famous for its high-grade ore (40 g/t), is the largest gold deposit in Japan. The deposit consists mainly of quartz, adularia and smectite with widely distributed pyrite.

Quantitative microanalyses (3 μm by 3 μm field) of the fine-grained arsenian pyrite by secondary ion mass spectrometry (SIMS) and electron probe microanalysis (EPMA) were conducted. Calibration of gold concentration was using external standard samples of pyrite implanted with Au ions, and the relative sensitivity factor was determined. The detection limit for Au analysis is very low (50 ppb), which enables to elucidate detailed relationship with As.

Results and Discussion

SIMS measurements revealed that the Au concentration in pyrite varied from sub-ppm to several thousand ppm. EPMA analyses revealed that the pyrite grains were heterogeneous in As (0 to 6%). Positive correlations between Au and As are universally found in the Hishikari deposit, nevertheless the Au/As ratio varies among ore zones. The Au/As ratio is high in the high Au-grade Sanjin ore zone, while that in the slightly high grade Honko ore zone is medium and that in the average grade Yamada ore zone is low. Moreover the Au/As ratio might depend on the depth of the veins even in the same ore zone. Pyrite grains exist also in the host sedimentary rocks, but they do not contain any Au, regardless of wide variation in As. The variations of the Au/As ratio in the Hishikari deposit will give a convincing restraint for the genesis of the very high-grade gold deposit.

[1] Cabri & McMahon (1995) *Canadian Mineralogist* **33**, 349-359. [2] Shimada, Nakamura, Morinaga & Shikama (2005) *Resource Geology* **55**, 91-100. [3] Morishita, Shimada & Shimada (2008) *Applied Surface Science* **255**, 1451-1454.