Variations in mineral assemblages and oxygen and hydrogen isotopes of wall rock alteration in the Hishikari epithermal gold deposit, Japan

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The Hishikari deposit is an epithermal vein-type gold deposit with extremely high-grade Au ore (30-40g/t of gold), which is composed of three deposits, Honko, Sanjin and Yamada. This work is a challenge to establish a new alteration mineral zoning in the Hishikari mine for more efficient exploration. Samples were collected from almost horizontal four underground crosscuts and inclined twelve drill holes from the Hishikari mine. Detailed analysis of wall rock alteration was conducted by means of microscopic observation, X-ray diffraction (XRD), electron probe micro analyzer (EPMA) and oxygen and hydrogen isotope analysis.

As a result of XRD analysis, major alteration clay minerals are smectite, chlorite, illite, chlorite-smectite interstratified mineral (C/S), illite-smectite interstratified mineral (I/S), among which dominant are C/S and I/S. In the Honko and Sanjin deposits, both are dominant, whereas in the Yamada deposit C/S is more dominant than I/S. The proportions of chlorite in C/S and illite in I/S are variable in each area and depth, including chlorite-rich or illite-rich interstratified mineral, smectite-rich interstratified mineral and regularly interstratified mineral with the chlorite (or illite) and smectite ratio of 1:1. Chlorite and illite slightly contain smectite layers, supported by ethylene glycol treatment in the XRD analysis and EPMA analysis.

In the Yamada deposit, the proportion of chlorite in C/S is tend to increase as being deeper from the surface. In addition, several veins are surrounded by the C/S zone with high proportion of chlorite. Therefore, this could be a useful exploration index especially in the Yamada deposit.

In the southern part of the Sanjin deposit, epidote was remarkably recognized, coexisting with chlorite and illite. This implies the responsible heat source of the Hishikari deposit was located in south-eastern part, and epidote may be a potential new exploration index mineral for the division of alteration zoning in the Hishikari deposit.

The δ^{18} O and δ D values of clay minerals in the wall rock mainly in the Sanjin deposit were measured and the δ^{18} O and δ D values of fluid were calculated by established fractionation factors. The results showed that the values of fluid in this work are closer to the meteoric line than those of clay minerals within veins reported by previous researches. This implies the overlapping of the isotopic fractionation in the Hishikari deposit by convective circulation of meteoric water after the contribution of magmatic derived fluid.

In conclusion, the characteristics of wall rock alteration in the Hishikari deposit are different in each deposit. In the Yamada deposit, the abundance of chlorite in interstratified clay minerals increases with being closer to the veins. In the Sanjin deposit, the temperature of the wall rock alteration was higher than other two deposits. The fluid responsible for the alteration zoning was dominated by meteoric water.

Keywords: Hishikari deposit, wall rock alteration, interstratified clay mineral, epidote, oxygen and hydrogen isotope

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