# Hydrothermal alteration, mineralogical description and ore-forming conditions of the Utanobori gold deposit in northern Hokkaido, Japan

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The Utanobori gold deposit is a low-sulfidation type epithermal gold deposit located in northern Hokkaido, Japan. In this study, we investigated geological features of gold-mineralized quartz-adularia veins and hydrothermally altered host rocks from viewpoints of mineral association and paragenetic sequences, bulk chemical compositions, mineral chemical compositions and physicochemical conditions in order to reveal characteristics of gold mineralization and ore-forming environment.

The study area and its surroundings are composed of slate of the Cretaceous to Paleogene Hidaka Supergroup, the Miocene Esashi Formation, the Kemomanai Lava, the Kinkomanai Lava, the Pliocene Penke Formation and the Quaternary terrace and alluvial deposits (Osanai et al., 1963). The gold-mineralized quartz veins are hosted in silicified conglomerate, sandstone, mudstone and tuff of the Esashi Formation. Previous studies based on K-Ar dating reported an ore-forming age of 12.1±0.6 Ma on adularia from the Utanobori deposits, and a same formation-age of 12.1±0.6 Ma on a bulk dacite from the Kinkomanai Lava (Ministry of International Trade and Industry (MITI), 1997).

The Esashi Formation, host rocks of mineralization in the Utanobori deposit, shows hydrothermal alteration with zoning distribution such as 1) quartz + K-feldspar ±chlorite-smectite mixed layer, 2) quartz + K-feldspar + illite ±smectite, 3) quartz + kaolinite ±illite ±smectite, and 4) quartz + plagioclase + chlorite-smectite mixed layer ±calcite, in order from the silicified zone to the periphery zone.

A representative high Au-Ag grades quartz-adularia vein shows three mineralization stages of Stages I, II and III with subdivided twelve sub-stages. Among them, the Stages I and II are the main gold mineralization stages. The veins are composed of gangue minerals of quartz and adularia and ore-minerals of electrum, naumannite, chlorargyrite and Fe-Sb-oxide or hydroxide. Quartz shows fine-grained equigranular, mosaic, microcrystalline, colloform and comb textures. Electrum shows average Au/(Au+Ag) compositions of 52.5, 65.7 and 55.5 atomic % in the Stage I-b, Stage I-d and Stage II-a, respectively. XRF spot analysis along the mineralization sequences revealed that 1) the amount of adularia gradually decreases from the Stages I to III, 2) the gold deposition is not directly associated with adularia, and 3) the highest concentrations of Au, Ag, Se and Sb were observed in a sulfide band of the Stage I-d. On the basis of the fluid inclusions microthermometry data by MITI (1997), frequent ranges of homogenization temperatures are 260-270℃ and 220-230℃ in the Stages I and III, respectively. Fugacity of selenium based on the electrum tarnish method was estimated to be $\log f Se_2$ = -14.2 to -12.8 and -13.1 to -11.6 atom for the Stages I-b and I-d, respectively.

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