Hydrothermal gold mineralization in island arc environment: case study in Western Java, Indonesia

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Western Java area occupies a part of Sunda Banda magmatic belt, and is well known for the prevailed hydrothermal gold mineralizations where active gold mines of the Gunung Pongkor, and Cibaliung and formerly produced mines of the Cikidang the Cirotan and the Cikotok are located. And several other areas are under exploration such as Arinem, Cineam, Cipunagara, Ciemas and Gunung Subang.

Hydrothermal gold ore deposits of western Java are mainly distributed along the NNE-SSW strike-slip faults cutting Miocene to Pliocene volcanic and plutonic formations. The ore veins are hosted mainly in calc-alkaline andesitic and dacitic volcanic breccia and tuff, less commonly in limestone, sandstone, claystone and microdiorite intrusive. Pervasive hydrothermal wall rock alterations are well developed in the mineralized area. An intensive silicic, propylitic and argillic alterations are generally observed in the most of deposits, indicated by chlorite/smectite and/or illite/smectite, epidote, sericite, kaolinite and locally montmorillonite.

The mineralization ages are ranging from 1.7 to 11 Ma based on the K-Ar dating among the deposits. The deposits are extensively in the form of gold bearing quartz veins of epithermal low sulfidation type characterized by the occurrence of sericite, adularia and manganese oxide, and also in the quartz-carbonate-polymetallic gold bearing veins of epithermal to shallow mesothermal and/or transition to porphyry tin type environment.

In the former low sulfidation type deposits, the ore is composed mainly of gold and silver minerals. This type deposits are estimated to be formed under the shallow (180-350m in depth) epithermal conditions from low salinity (<4 wt% NaCl eq.) fluids in the temperature from 170 to 250°. Gold might be transported as $Au(HS)^{2-}$ under nearly neutral pH and relatively high fS_2 (10^{-14} to 10^{-11}) and fO_2 (10^{-30} to 10^{-45}) in conditions. On the other hands, the latter mesothermal and/or transition to porphyry type ore is characterized by the occurrence of not only gold and silver minerals, but also the presence of tin minerals such as canfieldite and cassiterite, wolframite, and bismuth and tellurium minerals. This type deposits are estimated to be formed at the depth below 400m from slightly higher salinity (1.5 to 7.5 wt% NaCl eq.) fluids in the temperature at 260 to 350°. Gold might be transported under neutral to slightly acidic and relatively high fS_2 (10^{-20} to 10^{-10}) and fO_2 (10^{-30} to 10^{-40}) in conditions.

The Pb, S, and C isotope ratios indicate the magmatic source for associated metals, while the association of tin-minerals, wolframite and bismuth minerals suggest the recycling of older continental crust underlying the Malaysia-Sumatra porphyry tin belt as the source of the metals. The oxygen stable isotope ratio suggests a mixing of hydrothermal fluids with meteoric water in the ore depositions.

The mineralization ages (Pongkor: 2.7 to 8.6Ma, Cikidang: 2.4Ma, Cipanglengseran: 2.1Ma, Cirotan: 1.7Ma, Cibaliung: 11 Ma, and Arinem 8.8 Ma) indicate a lateral shift of volcanic front, where they are getting young toward south of Java island. The time-spatial change of hydrothermal activity with gold mineralizations corresponds to magmatic activity in the Sunda-Banda magmatic arc, which was caused by subduction of the oceanic plate under the continental crust. The crust is relatively thin and young with mostly intermediate composition accompanying a few ignimbrite deposits, such as in the Bayah dome where most of gold mineralizations are localized in western Java.