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# Characteristics of Magmatic Hydrothermal System at Southeastern Martabe High Sulfidation Epithermal Deposit, Indonesia

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The Martabe Au-Ag deposit, North Sumatra Province, Indonesia is a high sulfidation epithermal deposit, which is hosted by Neogene sandstone, siltstone, volcanic breccia, and andesite to basaltic andesite of Angkola Formation. The deposit has six ore bodies that occur as silicified massive ore (enargite-luzonite-pyrite-tetrahedrite), quartz veins (tetrahedrite-galena-sphalerite-chalcopyrite), banded sulfide veins (pyrite-tetrahedrite-sphalerite-galena) and cavity filling. All ore bodies were controlled by N-S and NW-SE trending structures. The Barani and Horas ore bodies are located in the southeast of the Purnama ore body. Fluid inclusion microthermometry and alunite-pyrite pairs sulfur isotopic geothermometry show slightly different forming temperature among the ore bodies. Formation temperature of the Purnama ore body ranges from 215 to 260$^{o}$C and salinity from 5 to 8 wt% NaCl equivalent. Formation temperature of the Barani ore body ranges from 200 to 240$^{o}$C and salinity from 0 to 2.5 wt% NaCl equivalent and those of the Horas ore body ranges from 240 to 260$^{o}$C and from 2 to 3 wt% NaCl equivalent, respectively. The general sequences of mineralization at Martabe are divided into the early stage as main high sulfidation mineralization stage and the late stage of oxidation and brecciation, which were followed by weathering. Sulfides (enargite-luzonite-pyrite-tetrahedrite) that were associated to gold and silver are abundant at the Purnama ore body. The Barani and Horas ore bodies are less silicified and sulfide abundance is less than the Purnama ore body. The salinity and sulfur isotopic values indicate a mixing trend among different fluids. Salinity of fluid inclusion decrease from higher salinity (› 5 wt% NaCl equivalent) in the Purnama ore body to lower salinity (‹ 3 wt% NaCl equivalent) in the Barani ore body which is directly located in southeast of the Purnama ore body. The sulfur isotope ratio values of sulfide and sulfate in Purnama range from -4.2 to +5.5 ‰ and from +1.2 to +26.7 ‰ , and those in the Barani range from -4.3 to +26.4 ‰ and from +3.9 to +18.5 ‰, respectively. The Horas ore body shows low salinity but higher formation temperature compared to Barani which possibly indicate different mixing condition unrelated with Purnama and Barani ore bodies. The sulfur isotope ratio values of sulfide and sulfate in the Horas ore body range from -11.8 to +3.5 ‰ and from +1.37 to +25.7 ‰. At the Purnama and Barani ore bodies, alteration assemblages consist of quartz-kaolinite-dickite - alunite - illite - pyrophillite and ore mineral assemblages are mostly composed of enargite-luzonite-pyrite-tetrahedrite. In contrast, mineralization style at the Horas ore body including the alteration assemblages (quartz - alunite - illite - dickite - muscovite) and ore forming temperature is different from the Purnama and Barani ore bodies.

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