

## **Stable Isotope (O, D, S, Cu) Geochemistry of Selected Gold Deposits from Eastern Turkey**

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Isotopic analysis of sulfur-rich phases and quartz have been conducted to understand the genesis of diverse gold deposits in Eastern Turkey, including VMS deposit of Cerattepe, low sulfidation epithermal deposits of Mastra, Olucak, Akoluk, and Sayaca, high sulfidation epithermal deposit of Sisorta, Carlin-type deposit of Kaletas, and IOCG type deposit of Bakır Tepe.

$\delta^{34}\text{S}$  values of samples from the VMS deposit, the low sulfidation epithermal deposits, the high sulfidation epithermal deposits, and the Carlin-type deposit are respectively -11.7 to -0.4‰, -16.1 to +20.6‰, -10.0 to +22.0‰, and -14.4 to -10.2‰. Sulfur isotope values in sulfides and sulfates are compatible with igneous sulfur in all deposits. The low end of the pyrite number (-5.7) from low sulfidation Mastra gold deposit may reflect assimilation of sedimentary pyrite during ascent of magmas through the crust. In both the low and high sulfidation epithermal gold deposits, S-bearing minerals from early stages of mineralization generally have lower  $\delta^{34}\text{S}$  values relative to those from late stages of mineralization. This suggests that magma-derived S changed due to temperature and/or redox variations in the final stages of the hydrothermal system.

$\delta^{18}\text{O}$  of quartz from the VMS deposit, the low sulfidation epithermal deposits, the high sulfidation epithermal deposits, the Carlin-type deposit and IOCG deposit are +7.9 to 10.8‰, +8.9 to +13.3‰, +7.1 to +15.6‰, +6.8 to +18.6‰, and +6.2 to +13.3‰, respectively. In contrast,  $\delta\text{D}$  values of waters trapped in quartz and/or K-Al alunite are -69 to -78‰ for the VMS deposit, 70 to -97‰ for the low sulfidation epithermal deposits, -25.3 to -77‰ for the high sulfidation epithermal deposits, -76 to -80‰ for the Carlin-type deposit and -75 to -55‰ for the IOCG deposit. Combining  $\delta^{18}\text{O}$  and  $\delta\text{D}$  from analyzed minerals, we propose that the ore fluids were dominated by magmatic-hydrothermal waters almost in all deposits. However, fluids in the Bakır Tepe deposit responsible for formation of the gold mineralization were dominated by metamorphic-derived waters, which is typical for IOCG type gold deposits.

$\delta^{65}\text{Cu}$  values from copper-bearing minerals in Sisorta associated with gold mineralization range from -5.50 to +3.03‰, but the values range from -3.47 to +2.34‰ in Cerattepe. Copper isotopic compositions do not show significant variation (<1 per mil) at depth, whereas they are highly variable in the upper parts of the system indicating copper enrichment due to supergene processes.