

Submarine Gold Mineralization Near Lihir Island, New Ireland Fore-Arc, Papua New Guinea

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Abstract

Gold-rich, siliceous veins with disseminated polymetallic sulfides and pyritic stockwork mineralization have been recovered from the top of Conical seamount, a shallow (1,050-m water depth) submarine volcano located about 10 km south of Lihir island, Papua New Guinea. Grab samples from the summit of Conical seamount contain the highest concentration of gold yet reported from the modern sea floor (max 230 ppm Au; avg 26 ppm, $n = 40$). The gold occurs in sulfide-rich veins of black amorphous silica hosted by intensely altered, high K calc-alkaline basalts. Sulfides in the veins consist of sphalerite, galena, pyrite, chalcopyrite, marcasite, and a variety of Cu-Pb-As-Sb sulfosalts. The gold occurs as native gold and electrum in the amorphous silica and as inclusions in the sulfides. The highest gold concentrations are associated with high Ag, As, Sb, and Hg. Zoned alteration adjacent to the veins consists of illite, smectite, amorphous silica, K feldspar, secondary plagioclase, minor chlorite, and trace carbonate. The association of gold with illite, smectite, amorphous silica, and K feldspar indicates deposition from near neutral pH hydrothermal fluids. However, the auriferous polymetallic sulfide veins and the associated alteration are overprinted on stockwork pyrite mineralization that is associated with earlier acid alteration containing alunite, aluminum phosphate sulfates, kaolinite, and other clay minerals. The platy habit of the alunite in this assemblage, the presence of aluminum phosphate sulfate minerals, and the sulfur isotope ratios of the crystalline pyrite (-8.6 to -0.2‰ $\delta^{34}\text{S}$, $n = 28$) and alunite (7.5 and 6.4‰ $\delta^{34}\text{S}$) are consistent with a contribution of magmatic volatiles in the earliest stages of the hydrothermal system. Framboidal pyrite within and at the margins of the mineralized zone has $\delta^{34}\text{S}$ values suggesting involvement of biogenic activity (-11.6 to -13.9‰ $\delta^{34}\text{S}$).

The gold-rich veins at Conical seamount are distinct from sea-floor massive sulfide deposits and represent a new style of mineralization on the modern sea floor. The mineralogy, alteration, geochemistry, and texture of the veins resemble those of some subaerial epithermal gold deposits and indicate that features long considered to define a subaerial setting can also form in a submarine environment. The proximity of Conical seamount to the giant Ladolam epithermal gold deposit on nearby Lihir island also raises the possibility that both subaerial and submarine gold mineralization in the region may be related to the same district-scale magmatic events.

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