Gold Mineralization at the Forecast Hydrothermal Field in Southern Mariana Trough

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Gold-rich (up to 72.6 ppm) massive sulfide and hydrothermally altered host rock were collected by remotely operated vehicle, HAEMIRE, from the Forecast hydrothermal field in Southern Mariana Trough. Gold-rich massive sulfide is featured by Zn-rich (up to 51.1 wt.%) ore, mainly composed of sphalerite, pyrite, chalcopyrite and galena with tennantite and electrum as minor minerals. The altered host rock can be subdivided into sulfide-rich part and altered silicate part. The sulfide-rich part is mainly composed of sphalerite and pyrite with minor chalcopyrite while XRD examination shows that montmorillonite ± anorthite are predominant in the altered silicate part.

The FeS contents in sphalerite represent a decreasing trend as mineralization advanced (6.5–0.3 FeS mole %). Electrums, main phase of gold mineralization, are characterized by two different generations according to mineralogical relationship and chemical compositions. Early-stage electrums are mostly associated with sphalerite whereas galena is main host mineral related to late-stage electrums. On the basis of semi-quantified analysis, the purity of electrum tends to decrease from early stage (930–981 ‰) to late stage (773–811 ‰). Especially the FeS contents of sphalerite associated with electrums are relatively low (< 1.9 FeS mole %) in both stages, suggesting that gold mineralization occurred under high activity of sulfur and/or low temperature conditions. Fluid inclusions study on sphalerite crystals represents that homogenization temperatures and salinities range from 220℃ to 294℃ and 1.4 to 6.7 equiv. wt.% NaCl respectively. Comparison between homogenization temperature and salinity shows evidence that ore-forming process in the Forecast hydrothermal field probably underwent mixing process during fluid evolution. Thus effective gold mineralization in this polymetallic deposits is most likely to be caused by oxidation of $Au(HS)_2^-$ following sustained mixing with seawater at relatively low temperatures.