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Mineralogical and Geochemical Study of Hydrothermal Ores from the Hatoma Knoll Hydrothermal Field in the Okinawa Trough

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Hydrothermal activity at the Hatoma Knoll in the ca. 1500 m water depth of southern Okinawa Trough is characterized by abundant sulfate (anhydrite and barite) mineralization associated with active venting of significantly Cl^-depleted hydrothermal fluid up to 300 oC. Since exclusive sulfate mineralization would be explained by less participation of metal species into the vapor phase during the phase separation of hydrothermal fluid, sulfide mineralization below or just above the seafloor could be expected. In order to investigate potential for sulfide mineralization at the Hatoma Knoll, we intensively collected hydrothermal sulfide/sulfate ores which were half buried within a sediment-covered seafloor. We report mineralogical and geochemical features of these brecciated mound ores and collapsed chimneys.

Our samples were collected during dive expeditions of YK07-04, NT08-13, NT11-20 and KY14-02, employing the manned submersible SHINKAI 6500 or ROV (remotely operated vehicle) Hyper-Dolphin 3000 of JAMSTEC. Constituent mineral of the collected samples was identified by microscopic observation and X-ray diffractometery (XRD), and chemical composition of specific sulfide minerals was determined by an Electron Probe Micro Analyzer (EPMA).

Based on the mineral assemblage and its texture, the hydrothermal ores can be classified into five types. Type I (fine-grained sulfide ore) is characterized by dendritic texture which suggests precipitation under the quenching condition. Type II (sulfide dominant ore) is dominated by abundant sulfide minerals of sphalerite, galena and tetrahedrite. Among this type of ores, some specific ores were recognized and identified as following two sub-types; (1) Type II' (Sb-rich chimney) is characterized by abundant occurrence of Sb-contained sulfide minerals such as tetrahedrite, and (2) Type II" (coarse-grained sulfide ore) is distinctive from other samples by substantially larger grain size of sphalerite up to 1 cm. Type III (barite dominant As-rich chimney) is characterized by abundant occurrence of barite with arsenic sulfide minerals (orpiment and realger).

Two interesting features were recognized with respect to the chemical composition of sulfide minerals. Sphalerite crystal in the Type I chimneys often exhibits an anomalously high Mn content up to 11.4%. Moreover, tetrahedrite in the Type II' sample contains high Ag content ranging from 8.27 to 18.90 %. Ag content and Sb/(Sb+As) ratio in the tetrahedrite crystal shows a positive correlation, although some ore samples showed an unusually high Ag content. Some Ag-Sb bearing sulfide minerals other than tetrahedrite were also identified, which supports strong correlation between Ag and Sb.

Keywords: Okinawa Trough, Hatoma Knoll, Seafloor massive sulfide ore deposit, Ag-rich tetrahedrite