Applications of trapped-charge dating techniques to hydrothermal mineral deposits collected from active seafloor hydrothermal fields

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Chronological studies of hydrothermal mineral deposits are useful, because accumulation of metal elements to be resource requires duration and evolution of mineralization processes in a time scale of 10^3 to 10^5 years. However, conventional radiometric dating techniques are difficult to be applied for hydrothermal deposits, because they grow up by repeated mineralization. We tried to yield practical applications of trapped-charge dating techniques, expecting they provide appropriate averaged ages. We conducted electron spin resonance (ESR) dating of sulfate minerals (barite) in hydrothermal deposits, expecting they provide ages of hydrothermal mineralization. We also conducted thermoluminescence (TL) dating of quartz in volcaniclastic and siliceous sediment. Quartz of coarse grain in the volcaniclastic sediment is considered to provide igneous ages of original volcanic rocks, whereas quartz of fine grain in the siliceous sediment is expected to provide ages of intense hydrothermal alteration. Our test field is a hydrothermal field in the Okinawa Trough, where mineralization of hydrothermal deposits occurs not only on the seafloor but also within the subseafloor sediment layers. Radiocarbon (^{14}C) datings of planktic foraminifera in the uppermost unconsolidated sediment indicated monotonous sedimentation since ~30ka TL datings of thick volcaniclastic sediment provided ages between 20-50 ka, which are roughly in accordance with the radiocarbon ages. On the other hand, ESR datings of hydrothermal barite obtained from 10 and 20 mbsf (meters below the seafloor) provided rather young ages around 5-6 ka. These results suggest subseafloor mineralization of the barite after sedimentation of the volcaniclastic sediment.

Keywords: electron spin resonance dating, thermoluminescence dating, seafloor massive sulfide deposits, mineralization stage

