Subseafloor mineralization in the Shimokawa Cu-Zn ore deposits in Hokkaido

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Many base metal deposits currently mined in the world were formed by ancient submarine hydrothermal activities, most of which have been considered to form on the seafloor as stratabound deposits. Recently, however, a replacement model, in which sulfide minerals were precipitated and concentrated by alteration and replacement of sediments beneath the seafloor, has been proposed in some sulfide deposits both for ancient and modern submarine hydrothermal ore deposits. Although, there is no such deposit reported in Japan, one example may be the Shimokawa base metal (e.g., cupper and zinc) deposit located in the northern part of Hokkaido, which was previously considered to be Bessi-type volcanogenic massive sulfide deposit. Therefore, objective of this study is to examine whether Shimokawa ore deposits were formed in the sub-seafloor based on distribution and petrographic characteristics of ore minerals and alteration products (e.g. clay minerals and decomposed organic matter) of both hanging and footwall rocks. Shimokawa ore deposits consist of Nakanosawa and Ochiaizawa ore bodies. Ore samples and slates from the hanging and footwall rocks used for the analyses were obtained from drill cores on Nakanosawa ore body and crosscut to Ochiaizawa ore body.

X-ray diffraction (XRD) results of the analyzed host rock samples show that chloritization and sericitization took place, not only in the footwall but also hanging wall samples, possibly by hydrothermal alteration. This is supported by increasing iron content in chlorite, which was indicated by its second to first intensity peak ratio in their XRD profiles. Furthermore, results of microscopic observation demonstrated that the hydrothermal activity responsible for the mineralization was divided into two stages: the early stage in which iron was mainly concentrated and the later stage in which copper and zinc was mainly concentrated. Distribution of the ore minerals formed by the later stage hydrothermal fluid, which flowed along diabase sill, indicates that the mineralization occurred epigenetically, after the formation of the sills. These results suggest that Shimokawa ore deposits were formed by hydrothermal activity beneath the seafloor and are, therefore, likely to represent sub-seafloor replacement ore deposits.

Keywords: submarine hydrothermal activity, copper, chlorite, marine sediments

