

Mobilization of manganese and iron in marine sediments and tuffs by dolerite in Hokuroku District.

TSUKAMOTO, Yuya^{1*} ; KAKEGAWA, Takeshi¹

¹Graduate School of Science, Tohoku University

Mn rich sediments are often used to evaluate the presence of submarine hydrothermal activities and the redox state of paleoenvironment in the sea. The oldest Mn ore deposit occurs 2.4 billion years ago as the banded manganese formation, corresponded to oxidation of Precambrian ocean water. Those studies suggest that Mn geochemistry is important to consider not only the Earth history but also paleoenvironment evaluation.

Hokuroku district is famous for Kuroko deposits which is rich in metals such as Zn, Cu, and Pb. During the hydrothermal activities, metals of forming Kuroko precipitated in closed area around ores, on the other hand Mn and Fe can be transported in distal by hydrothermal plume, as a result of formation of Mn and Fe rich sediments on the Kuroko horizon without heavy metal deposition. Therefore, the first purpose of this research is to evaluate the exploration potential of Kuroko deposits using Mn, thus the examination of spatial relationship between Mn and Kuroko ores. Presence of Mn rich layers is also known in the Hokuroku district. Their origin was completely unknown. Mn rich layers were potentially formed submarine hydrothermal activities related post Kuroko ore forming activities. Therefore, the second purpose of this research is to discuss whether the submarine hydrothermal activity was present even after Kuroko ore formation and if they are responsible for Mn enrichment in post Kuroko mudstone.

I have investigated the "M2" mudstone which is often overlaid with Kuroko deposits. For the first purposes, 6 Samples of "M2" mudstones were collected from 3 areas. Moreover, I have investigated the Mn rich layer to discuss the second purpose. 31 Samples of "R2", "T2", dolerite, and mudstone were collected from Koyukizawa areas. The mineral and chemical compositions of the samples were examined by standard petrographic microscopy, SEM, and EPMA. Chemical composition of samples were determined by energy dispersive X-ray spectrometry, and EDXRF. Mineral assemblage is determined by X-ray diffraction (XRD).

For the first purpose, Mn concentrations in "M2" mudstones are found to be about 0.04 wt%, which is low concentrations. I can't find the change of Mn concentrations according to the distance from ores. Therefore, it suggested that Mn is not the exploration index of Kuroko deposits at this stage. For the second purpose, the geological survey was performed in the area of Koyukizawa (route A and route B). Tuff breccia and pumice tuff are abundant in this area associated with mudstones. Those were intruded by dolerite. Red to brown alteration are common even in dolerite representing hydrothermal alterations in route A. I could find the Mn rich layers (3.7 wt%, 1.8 wt%) by chemical analyses. Partial Mn enrichments were also found in rocks on the boundary between "T2" and dolerite. On the other hand, I can't find the red alteration in dolerite route B. From those findings, Mn rich layer was formed by the recycle of Mn by heat generated from the intruding dolerite. Mn was enriched in rocks when circulated hydrothermal water was oxidic enough. Moreover, by EDXRF, Mn and Fe have similar behavior, and Mn was oxidized prior to Fe on the oxidative environment.

Keywords: banded manganese deposit, Hokuroku district, Kuroko, hydrothermal activity, redox state