Interpretation of Occurrence of Barite and Quartz in the Submarine Hydrothermal Ore Deposits in Terms of a Coupled Fluid Flow-Precipitation Kinetics Model

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Barite and quartz occur in different parts of submarine hydrothermal ore deposits. For instance, the abundance of barite increases stratigraphycally upwards in the massive ore bodies of the Kuroko deposits (black and yellow ores), while quartz is abundant in lower parts (stockwork siliceous ore). The different occurrences of barite and quartz in the Kuroko ore deposits in Japan cannot be explained by thermochemical equilibrium calculations on the precipitated amounts of barite and quartz due to the mixing of ascending hydrothermal solution with cold ambient seawater.

The coupled fluid flow-precipitation kinetics model was used to calculate the amounts of quartz and barite precipitated from hydrothermal solution mixed with seawater, assuming the reasonable values of temperature, precipitation rate, fluid flow rate, mineral surface area / fluid mass ratio (A/M) and initial concentrations of hydrothermal solution and seawater. The model calculations indicate that barite tends to precipitate more efficiently than quartz from the discharging fluids with relatively higher flow rate, lower temperatures, and lower A/M on the seafloor (black ore), whereas quartz can precipitate from the solution with lower flow rate, higher temperatures, and higher A/M under the seafloor (siliceous ore) and in the ore body (barite ore, ferruginous chert ore) rather than above the seafloor. The results of calculations are in agreement with the occurrences of barite and quartz and chemical features of discharging fluids in the submarine hydrothermal system.