

A natural analogue of iodine migration: The source and behavior of iodine in the Mobara gas field, Japan

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Methodology

As a natural analogue of long-term migration behaviour of iodine in sedimentary rock formations, the author investigated groundwater and mineral assemblage of the Mobara gas-field, eastern Japan. The groundwater contains considerable amount, around 100 mg/L, of iodine besides dissolved methane. Twelve groundwater samples from gas-producing wells to the aquifer within the Kazusa Group, classified into Plio-Pleistocene, were analyzed for iodine, pH, Eh, HCO_3^- , NH_4^+ , $\text{SiO}_2(\text{aq})$, δD , $\delta^{18}\text{O}$, $\delta^{13}\text{C}_{\text{CH}_4}$ and seventeen elements. The sample collection horizon was different from one another.

To estimate the evolution process of the groundwater chemistry, a thermodynamic calculation was carried out by use of the PHREEQC (Parkhurst, 1995) for the chemical composition of water which attained equilibrium with the rock forming minerals.

Result and Discussion

The molar ratio of I/Cl in the groundwater increased from 1.0×10^3 to 2.2×10^3 with changing the depth from 2000 to 1000 meters below the surface and turned to decrease from 2.2×10^3 to 1.8×10^3 with going up from 1000 to 500 meters. The pH and Eh (vs.SHE) ranged of 7.56 to 7.94 and of -21 to -73 mV, respectively. Chemical compositions, δD (-3.2 to +6.7‰) and $\delta^{18}\text{O}$ (-2.61 to -1.90‰) indicated that this groundwater was fossil seawater with little permeating surface water. Calculated composition of the groundwater was different from the measured that especially in Eh, S, K, Se, Ba and I. The $\delta^{13}\text{C}_{\text{CH}_4}$ (-66.0 to -68.6‰) suggested the decomposition of organisms by microbe activities. Moreover, there was a good agreement between each elemental concentration in seawater and that in living marine algae.

These suggested a decomposition of algae taken in a sediment could significantly contributed to evolution of chemical composition of the groundwater. Principal source of the iodine might be, therefore, algae buried in the sediments and the iodine was discharged to the porefluid during decomposition of the tissue. As mentioned above, the [I] in each sample was remarkably different from one another, as well as $[\text{HCO}_3^-]$, $[\text{NH}_4^+]$ and so on. The variation trend of [I] with changing water-collection horizon, furthermore, was resemble to those of $[\text{HCO}_3^-]$, $[\text{NH}_4^+]$ and organic carbon in the rock. These facts suggested little migration of iodine since the depositions of these geologic formations.

References

Parkhurst, D.L.(1995): U.S. Geological Survey, Water-resources investigations report 95-4227.

The origin of bedded radiolarian chert from the Middle Permian Gufeng Formation, Chaohu area, Anhui Province, China

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Geochemical and sedimentary petrological studies of sedimentary rocks from the Middle Permian Gufeng Formation in the Chaohu area, Yangtze Platform, China, have been carried out.

The Gufeng Formation is subdivided into the Phosphate nodule-bearing mudstone Member (PNMM) and the Siliceous rock Member (SRM). The basal part of the PNMM consists of mudstone including pellets of glauconite, which shows the deposition under aerobic shallow marine conditions. The upper part of the PNMM is composed of phosphate nodule-bearing mudstone. The presence of phosphate nodules suggests the deposition under slightly deep marine (e.g. outer shelf) and anoxic conditions. These anoxic conditions were possibly caused by the upwelling. The SRM consists of alternating beds of chert and mudstone. The cherts show black-gray in color, including abundant radiolarians and organic matter. The SRM rarely intercalates nectic chert (porous chert) layers which include abundant rhombohedral cavities. These cavities are presumably dolomite pseudomorphs that were formed during early diagenesis.

Cherts and nectic cherts from the SRM have high SiO_2 contents (average 96.6 wt% and 93.6 wt%). They have high Mo, Ni, Cu and Zn, and high concentrations of normal paraffin. These results suggest that the chert deposited under sulfate reducing conditions.

The location of the Chaohu area suggested by the paleomagnetic data was northwestern part of the Yangtze Platform, and was east side of the Paleotethys in the Permian time. The upwelling occurred around the eastern margin of the Paleotethys, and it brought about high biogenic activities in the sea surface. The results of investigation suggest that the origin of chert in the Gufeng Formation is biogenic, and sedimentary rocks of the Gufeng Formation deposited under anoxic conditions.