

Geochemistry of the cold CO₂-rich water in the volcanic aquifer system (Far East of Russia)

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Gornovodnoe spa is the largest CO₂-rich mineral water resource in the Russian Far East. The studied area is located within the Eastern Sikhote-Alin volcanic belt and is confined to a system of faults of north-western direction. These faults probably experienced postmagmatic reactivation, which led to the formation of a decompaction zone.

The high pCO₂ groundwaters of area are cold (5.8-10 °C), pH 5.9-6.5, belong to Ca-Mg (Ca-Na)-HCO₃ type, and have high contents of silicon and iron. TDS varied from 1.2 to 2.7 g/l. The total REE concentration of the CO₂-rich groundwater is rather high. Distribution profiles smoothed out with stable enrichment towards HREE.

δ¹⁸O and δD prove that the water is of meteoric origin. Helium, neon and carbon isotope systematics suggest the predominantly mantle origin for associated free gas. According to our estimation, more than 50% He in the Gornovodnoe area comes from mantle sources, at about 40% He is crustal and less than 2% He has an atmospheric origin. The geological setting of the territory confirms the mantle source of CO₂.

So, new data on geology, mineralogy, hydrogeology and hydrogeochemistry, alone with isotope data of aquifer and gas phases, allow us to specify that the cold high pCO₂ water in the volcanic aquifer system within the Eastern Sikhote-Aline ridge is the result of interactions between the freshwater of meteoric origin, mantle gasses and the host volcanic rocks. It thus highlights connectivity between deep and shallow fluids along with deep fractures related to ancient terrane boundaries.

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