The geochemistry of rare earth elements in groundwater from northen Sikhote-Alin (Far East of Russia)

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The Muhen River catchment, located in the northern end of Sikhote-Alin mountain system, is characterized by Ca-Mg-HCO_3 and Na-HCO_3 types of cold mineral CO_2-rich groundwaters issuing from drilled wells close to each other (at about 60 m). Groundwater of the Ca-Mg-HCO_3 type is characterized by low TDS (300-1700 mg/L) with pH 5.3 and enriched by Fe, Mn, Ba, Si. In contrast, the Na-HCO_3 type has a very high TDS (up to 14000mg/L) with pH 7 and elevated contents of Li, B, Sr, Br and I. Concentration of rare earth elements for both types of groundwater and surface water were determined firstly from filtered samples and then as unfiltered samples.

The unfiltered samples general indicate higher concentrations than filtered ones, with larger variations for the HREE. The total value (Σ *REE* + *Y*) range from 0.768 µg/L to 7.070 µg/L. The highest concentration of REE are found in the Ca-Mg-HCO_3 type of groundwater. In all samples the REE concentration becomes greater with increasing atomic number. The observed enrichment in the HREEs compared to the LREEs is believed to result from formation of stronger-carbonate complexes with increasing atomic number. Speciation calculations have shown that the complexes with carbonate species dominate REE speciation in the studied groundwaters.

Ce anomalies were clearly found in the REE patterns of the filtered samples, but their is absent in the REE pattern of unfiltered samples. This reflects the reducing conditions of the underground environment where the both types of groundwater evolved. In addition, Ce anomalies are clearly observed in the Na-HCO_3 type of groundwater in contrast to the Ca-Mg-HCO_3 type of groundwater. This suggests that Na-HCO_3 type evolved under more reducing conditions than Ca-Mg-HCO_3 type of groundwater. Positive Eu anomalies are evident for all water and basalt samples.

The REE concentration and shale-normalized signature for both types of groundwater are alike and closely resemble the REE signature of basalt rocks from northern Sikhote-Alin. This is likely related to a common path of groundwater evolution via basalts.

Geochemistry of thermal waters of Mendeleev Volcano (Kuril Islands)

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The Kuril Islands with intense volcanic activity are one of the most isolated and understood scientifically of all the Circum-Pacific. We present results of trace elements and data on H, O, S, and He isotopes ratios for hydrothermal system of Mendeleev Volcano. Among the thermal water types, three main groups can be distinguished: 1. Acid waters (pH <2.3); 2. Alkaline sodium-chloride waters; 3. Neutral, sodium-chloride-sulphate-bicarbonate. They have distinguished contents of trace elements. Contents of rear earth elements control by pH. In the alkaline and thermal waters are the lowest REE contents. The highest level is found in the acid sulphate waters. According with hydrogen and oxygen isotopic data thermal waters have atmospheric origin. Sulfur isotopic data indicate magmatic origin of the sulfur in acid waters. The high values of $^3He/^4He$ ratio mean very high percentage of mantle helium in waters. Thus, the chemical composition of the thermal waters is formed under influence of the country rocks and abyssal fluids. The flow of gaseous fluid which combine with infiltration waters not only bring the additional components, but also change the physical-chemical parameters of the solution influencing significantly the reaction run in the water-rock system.

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