

Redistribution of rare earth elements in aquifers in Sikhote-Alin Range, Russia

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In this paper we present new results of study on REE behavior in bicarbonate groundwaters located in the Sikhote-Alin Range, Far East of Russia. To do so, the REE-values in bedrock samples were determinate and then ones were compared with REE-values in groundwater. All studied aquifers are associated with Mesozoic sedimentary and volcanic rocks and circulate at depth from 70 to 130 m. Plagioclase is the predominant mineral in these bedrocks.

According to $p\text{CO}_2$ in groundwater, studied groundwaters are split into two groups: fresh (with low $p\text{CO}_2$ and TDS) and mineralized (with high $p\text{CO}_2$ and TDS) groundwaters. All investigated water samples have very low concentration REE, although fresh samples indicate higher concentration than mineralized ones. The highest concentration of REE are found in samples fresh groundwater from Jurassic aquifer with low TDS 400 mg/l and pH 5.3 located at northern end of Sikhote-Alin Range. In all samples the REE concentration becomes greater with increasing atomic number.

All studied bedrock samples is enriched by HREE and depleted by LREE whereas groundwater samples on the contrary are enrichment of HREE in comparison with LREE. This enrichment in the HREEs compared to the LREEs is believed to result from formation of stronger-carbonate complexes with increasing atomic number. However, difference in concentration between HREE and LREE is higher in mineralized groundwaters than in fresh ones. This is probably due to preferential aqueous transport of HREE, which form stronger aqueous carbonate complexes than LREE.

All samples of groundwaters show a more and less horizontal pattern with an extremely low negative Ce-anomaly and high positive Eu-anomaly. Negative Ce is probably caused by the removal of Ce from the waters onto Fe or Mn-hydroxides. The anomaly is especially prominent for the high mineralized Na-HCO₃ water type and only slightly negative for the Ca-Mg-HCO₃ water-type. Comparison REE-value in water and rock samples indicates that positive Eu anomaly is probably reflect the extreme weathering of plagioclase especially in presence $p\text{CO}_2$. In this case, it is not clear however, why there is no difference in Eu contents in groundwaters with various $p\text{CO}_2$ values, since the $p\text{CO}_2$ appears to affect the dissolution rate of plagioclase.

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