

RARE EARTH ELEMENTS, YTTRIUM AND H, O, C, Sr, Nd, AND Pb ISOTOPE STUDIES IN MINERAL WATERS AND CORRESPONDING ROCKS FROM NW-BOHEMIA, CZECH REPUBLIC

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Rare earth elements, yttrium, and H, O, C, Sr, Nd, and Pb isotopes in natural sparkling waters from five boreholes in the area of Kyselka near Karlovy Vary at western slopes of the Doupovské hory Mts., Bohemia (Czech Republic), and CO₂-poor waters from two underground boreholes in the shaft Svornost at Jáchymov, Krušné hory, Bohemia, have been studied. The elemental and isotopic compositions of these waters are compared with those of their probable source rocks, and with leachates produced experimentally from the latter. The REE and Y in mineral waters from granites and basalts show distinctly different patterns and anomalies compared to the supposed parent rocks and their leachates. Normalized REE contents of mineral water from basalts of the Kyselka area decrease from La to Eu and increase slightly to Lu, whereas those from granites either increase or decrease from La to Lu. Negative Eu anomalies are typical of granite-derived waters and leachates. Positive Ce anomalies are only observed in granite-derived waters. High chondrite-normalized Y/Ho ratios are typical of all studied mineral waters. Positive Gd anomalies are only noticed in waters, which were derived from strongly hematized basalts. Non-chondritic Y/Ho ratios result from slightly differing behaviour during adsorption and desorption processes. The positive Ce anomaly of the Jáchymov water is caused by dissolution of Ce-enriched surface coatings that formed earlier under sufficiently oxidising conditions, whereas the trivalent REE have been partially leached. The waters from the wells in Jáchymov represent water from rocks that are intensely leached and depleted in easily soluble REE-bearing minerals, whereas the granites and basalts from Kyselka still contain such minerals. A comparison of REE/Ca patterns of the experimental leachates with those of the mineral waters elucidate the high retention of REE by mineral surfaces in natural water–rock interaction.

Lead isotope abundances in water and rock leachates from the Jáchymov area indicate that ²³⁴U was (and probably still is) mobile in excess to the equivalent of ²³⁸U, i.e., radioactive disequilibrium dominated.

The plot of ⁸⁷Sr/⁸⁶Sr ratio versus ¹⁴³Nd/¹⁴⁴Nd allows us to calculate the proportion of “granitic” and “basaltic” water from the different wells at Kyselka. The granite-derived waters contain about 5 % of basalt-derived REE, whereas the basalt-derived waters are mixed with up to 40 % of granite-derived REE. In the δD versus δ¹⁸O plot, data points scatter along the meteoric water line.

The observed δ¹³C of -7.3 ‰ from Jáchymov corresponds to a mantle-derived carbon, whereas the Kyselka samples with +2 ‰ indicate considerable input of inorganic carbon from carbonates.