ABSTRACT

The influence of temperature and hydration on the long term stability of the buffer material was studied during two experimental studies – "Mock-Up-CZ" experiment and "Long-term stability of engineering barriers" project. The objectives of these studies is to identify mineralogical, chemical and geochemical changes and describe transformation processes in the bentonite materials due to heating and interaction with various saturation media (with different chemical composition) under controlled laboratory and in situ conditions. The Rokle bentonite suitability for its use in the Czech deep repository of high-level radioactive waste was investigated. Mineralogical changes in the bentonites were evaluated by X-ray diffraction.

The material of the barrier of the Mock-Up-CZ experiment is a mixture of non-activated Rokle bentonite (85 vol.%), quartz sand (10 vol.%) and graphite (5 vol.%). The barrier has been subjected to thermal stress (up to 90 °C) and synthetic granitic water for 45 months. No sample from 70 analysed samples taken at different depth levels and distances from the source of the heat and/or water showed measurable transformation of original smectites. Newly formed gypsum bordered by illite aureole was detected in the upper part of the experimental set-up (backfill samples), i.e. in the zone in direct contact to the source of the water.

During the second study, three bentonite buffer materials (Rokle bentonite, FEBEX bentonite, and Mock-Up-CZ mixture) interacted with natural water collected from Josef Underground Educational Facility, and four different types of artificial groundwater enriched in K^+ and/or Mg^{2+}. The experimental material was prepared in the form of (1) highly compacted samples, (2) dispersion of bentonites (both at temperature of 95 °C), (3) drill hole filling during in situ tests at the Josef UEF (at ordinary temperature), and (4) common batch laboratory experiments (at 20 °C and at 80–90 °C). Partial samples were extracted after 3, 6, 12, and/or 18 months of interaction in the first three set-ups, and after 1 week, 2 weeks, 1month, 2months, 3months, 4months, 5months, 7months, 10months, and 12months in the batch experiment. In the first three experimental set-ups, no changes were identified. For the batch experiment, formation of illite was detected in FEBEX bentonite saturated with artificial groundwater with K^+ concentration of 1083 mg/L. By using the same saturation medium, gypsum and/or bassanite formed in the Rokle and FEBEX bentonite.