BENTONITE REACTION IN NATURAL HYPERALKALINE GROUNDWATERS: EXAMPLES FROM THE PHILIPINNES

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Bentonite is one of the key components of the engineered barrier system in the disposal concepts developed for many types of radioactive and chemo-toxic wastes. The choice of bentonite results from its favourable properties (including plasticity, swelling capacity, colloid filtration, low hydraulic conductivity, high retardation of key radionuclides) and its stability in relevant geological environments. However, bentonite is unstable at high pH, a potential problem for the host of repository designs which include cement and concrete barriers. This is due to the fact that standard OPC (Ordinary Portland Cement) reacts with groundwater to produce initial leachates with pH>13 (later falling to around pH 12.5) and these could clearly react with the bentonite engineered barrier.

This has driven recent interest in low-alkali cements, because the pH of the leachate is somewhat lower than OPC, lying around pH 10-11. It is hoped that this lower pH will reduce bentonite degradation, so allowing the use of low-alkali cements in close proximity with bentonite. This is currently being tested in the laboratory, but the very slow reaction rates means that these data require support from long-term experiments, such as that obtained by studying natural systems, the so-called natural analogue approach (see Miller et al., 2000, for details).

Here, details of a new study of long-term bentonite reaction in the natural hyperalkaline groundwaters of the Zambales ophiolite in the Philipinnes are presented. Widespread active serpentinisation, resulting in hyperalkaline springs at several locations, is ongoing in the ophiolite. Groundwater pH values up to 11.1 have now been measured, falling into the range typical of low-alkali cements that are presently being developed for use in waste disposal. In addition, bentonite has been analysed from several sites which show clear evidence of reaction of the clay in the hyperalkaline groundwaters and these data will be presented here for the first time and, where possible, comparison with appropriate short-term laboratory data will be made. In addition, the relevance of the data to waste repository designs and long-term performance of the engineered barriers will be directly addressed.

Miller,W.M., Alexander,W.R., Chapman,N.A., McKinley,I.G. and Smellie, J.A.T. (2000). Geological disposal of radioactive wastes and natural analogues. Waste management series, vol. 2, Pergamon, Amsterdam, The Netherlands.

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