BENTONITE REACTION IN NATURAL HYPERALKALINE GROUNDWATERS: EXAMPLES FROM CYPRUS

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Bentonite is a 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 solutes) and its stability in relevant geological environments. However, bentonite is unstable at high pH, a potential problem for repository designs which include cement and concrete barriers. This is due to the fact that conventional cement reacts with groundwater to produce initial leachates with pH> 12.5 – values at which extensive and rapid alteration of bentonite is to be expected.

This has driven recent interest in low-alkali cements, because the pH of the leachate is somewhat lower, lying around pH 10-11. It is hoped that this lower pH will reduce bentonite degradation, or slow it sufficiently that loss of performance will be insignificant over relevant timescales. This is currently being tested in the laboratory, but the very slow reaction rates means that these studies require support from longer-term datasets, such as that obtained in natural analogue (NA) studies.

Here, details of a new investigation of long-term bentonite reaction in the natural hyperalkaline groundwaters of the Troodos ophiolite in Cyprus are presented. Active serpentinisation results in hyperalkaline springs at several locations across the island. Groundwater pH values up to 11.1 have been measured recently and values of up to 11.5 have been reported previously (Neal and Shand, 2002), falling into the range typical of low-alkali cements that are presently being developed for use in waste disposal (cf. Alexander et al., 2008). In addition, bentonite samples analysed from several sites show clear evidence of hyperalkaline reaction of the clay; this paper will present these data for the first time and, where possible, compare them with appropriate short-term laboratory data. Data from another bentonite NA study in the Philipinnes will be presented in parallel papers. Relevance of this work to the long-term performance of the waste repository engineered barriers will be discussed.

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Keywords: Bentonite, Hyperalkaline reaction, Natural analogues