

Smectite and C-S-H formation under hyperalkaline conditions at Narra in Palawan, Philippines

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Smectite will play an important role in engineered barriers for the geological disposal of radioactive wastes due to its low permeability and its high cation-exchange capacity. However, it has been considered that hyperalkaline fluids from cementitious components in the engineered barrier would affect the stability of smectite. Therefore, the study site where both smectite and hyperalkaline fluids are observed can be considered as analogues in geological disposal environments. In this context, trenches were excavated and solid and fluid samples were collected at Narra in Palawan, Philippines, where several hyperalkaline springs produced by modern-serpentinization were observed.

Chemical analysis of fluids collected from the trenches showed that the fluid is Ca-OH type with pH above 11. This was similar to that of fluid from low alkali cement. XRD analysis of the solid samples from the trenches revealed the presence of Fe-saponite and C-S-H (calcium silicate hydrate) as secondary minerals in ultramafic sediments. Based on SEM and EPMA, both of the minerals were precipitated as authigenic in pore of the sediments, and some Fe-saponite formed by alteration of primary ultramafic minerals. Thermodynamic calculations of the fluid compositions supported the in-situ formation of Fe-saponite and C-S-H. This implies that Fe-saponite would be formed and stable at Fe (II)-bearing hyperalkaline condition, although dioctahedral montmorillonite as a candidate smectite in bentonite buffer material, may be not stable and alter to other minerals. In future, the extent of Fe-saponite formation at the site would be fully quantified to assess the rate of Fe-saponite formation.

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