

Natural analogue project on long stability of bentonite under hyperalkaline water condition in northwestern Luzon

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1. Preface

It is an important problem in performance (safety) assessment of geological disposal of radioactive wastes to improve understanding of processes of alteration for the long-termed stability of bentonite in contact with hyperalkaline groundwater. For understanding and predicting the long-termed processes of alkaline-alteration, it is useful to use a natural analogue.

Our attention is paid to ophiolite as providing analogous geological environment to the generation process of hyperalkaline leachates from cement. The field survey of the natural analogue was carried out in northwestern Luzon in the Philippines where bentonite is close to ophiolite complex.

2. Field

The Zambales ophiolite complex in the west-central Luzon is a large complete ophiolite with sediments of pelagic limestone overlain by ophiolite-derived turbidites and volcano-clastic rocks. At Mangatarem located in Northwestern Luzon for study area, the Aksitero formation, which consists of medium to thin alternating beds of calcareous tuffaceous sandstone, siltstone and claystone, overlies conformably on the Zambales ophiolite. Saile mine at Mangatarem is the largest exploited bentonite deposit in the Philippines. In the immediate vicinity of the bentonite deposit, hyperalkaline groundwaters derived from the ophiolite by serpentinisation come along the fractures to the surface. Mangatarem is a favorable natural analog site for the reason why the geology is analogous with the environment where bentonite is in contact with hyperalkaline groundwater in the engineered barrier system.

3. Study and Results

Field survey at Mangatarem was in two areas, Saile mine and Bigbiga areas.

In Saile mine area and its surrounding area, root mapping, groundwater, drilling and trench surveys were carried out. It was directly observed in three trenches that bentonite contacts with the pillow lava of ophiolite complex. And the fracture at the bottom in a trench consists of calcite at the central part and serpentine at the border part. This means the evidence to have occurred hyperalkaline groundwaters along the fracture in the past and probably, hyperalkaline groundwaters contacted with the bentonite right above. In other two trenches, the traces of hyperalkaline groundwater channels in the pillow lava reach to bentonite layer. From XRD analysis, zeolite was identified with smectite in a part of bentonite layer, but most of bentonite exist maintaining swelling capacity, which was supported from XRD analysis after ethylene glycol treatment.

In Bigbiga area, root mapping, geochemical surveys of groundwater were carried out. From there surveys, hyperalkaline groundwater exists at the well close to bentonite layers.

Saile mine area where bentonite contacted with hyperalkaline groundwater in the past is regarded as a Fossil Type, while Bigbiga area where bentonite is very likely to keep in contact with hyperalkaline groundwater is regarded as a Active Type natural analogue sites, respectively. We continue the survey at both sites and examine alteration process of bentonite due to the interaction

bentonite and hyperalkaline groundwater.

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