Investigation for Characteristics of Alteration Zone and Rock of Bentonite Study Area for Natural Analogue

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1. Introduction

Bentonite, primarily composed of montmorillonite, plays a crucial role as one of the engineering barrier materials. The advantageous properties of montmorillonite, such as its swelling capacity, low permeability, and low thermal conductivity, make it a key component as a buffer material for physically and chemically isolating high-level radioactive waste from the surrounding natural environment [1].

As deep geological repository (DGR) system must remain in a stable state and isolated from the ecosystem for an extended period until the heat and radioactivity emitted by high-level radioactive waste decrease to the levels emitted by rocks in nature, it is required to conduct the fundamental scientific research and experiments in natural analogue study sites. Therefore, this study aims to investigate the mineralogical characteristics of the alteration zone and rock in the bentonite study area for a natural analogue.

2. Method and Results

In this study, we analyze the rock distribution and alteration properties of two bentonite deposits: Yeonil 33 (Donghae mine) at Pohang (Fig. 1) and Gampo 46 (Naah mine) at Gyeongju (Fig. 2).

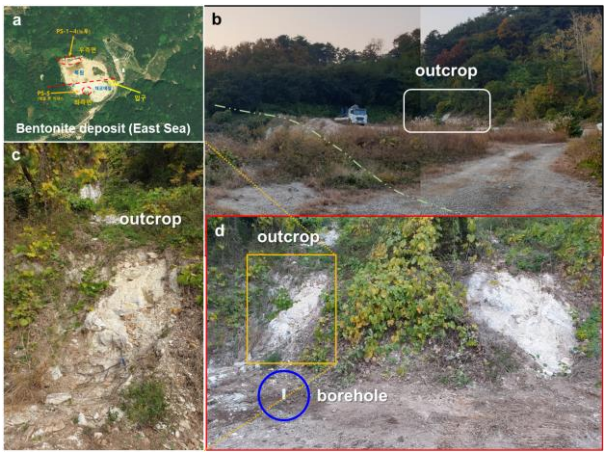

Fig. 1. Field photographs showing the locations of the outcrop and borehole at bentonite deposits in the Donghae mine. (a) satellite image, (b) overview of the examined outcrop, (c) outcrop, and (d) borehole.

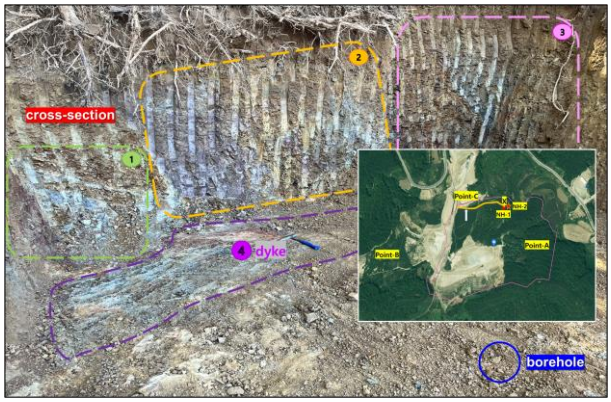

Fig. 2. Field photographs showing the locations of the cross-section (trench) and borehole at bentonite deposits in the Naa h mine (inset shows a satellite image).

To understand the formation and alteration processes of domestic bentonite deposits, we conducted a comprehensive investigation analyzing their geochemical and mineralogical properties. This study involved detailed examinations of outcrops and boreholes at the Donghae mine, as well as analyses of cross-sections (trenches) and boreholes at the Naah mine. The mineralogical analysis revealed distinct characteristics between the two locations. Specifically, the bentonite from the Donghae mine was found to contain montmorillonite (with a d_{001} spacing of approximately 15.2 Å), cristobalite, quartz, and amorphous materials. In contrast, the bentonite from the Naah mine exhibited a composition of montmorillonite (with a d_{001} spacing of approximately 14.7 Å), albite, muscovite, and quartz. These findings suggest varied formation and alteration processes across the studied regions, as indicated by the differing mineralogical compositions of the bentonite deposits.

3. Conclusive Remarks

We determined the basic characteristics of bentonite collected from two bentonite deposits. These results are significantly important for understanding the long-term evolution of bentonite and are expected to provide valuable information regarding the stability of bentonite, contributing to the safety of the DGR.

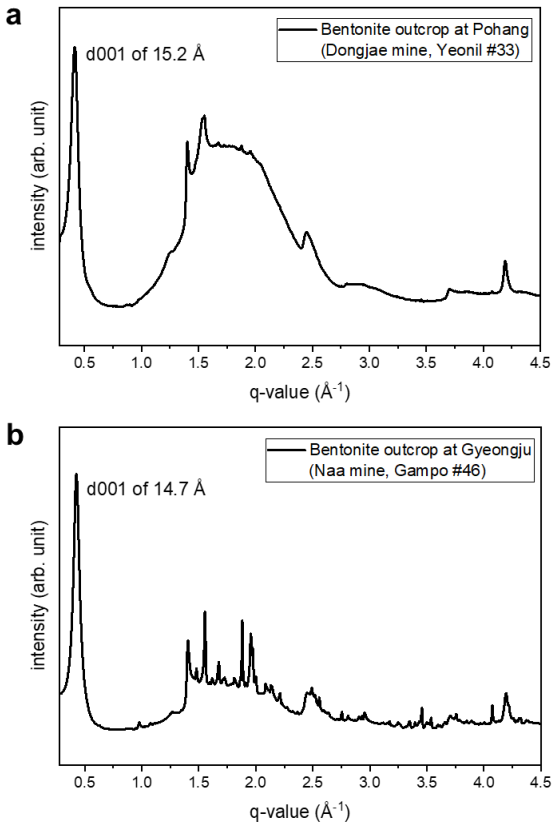

Fig. 3. X-ray diffraction patterns of bentonite from the outcrops of (a) Donghae mine and (b) Naah mine.

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