Chemical stability of montmorillonite buffer clay under repository-like conditions-A synthesis of relevant experimental data

Pusch R., Kasbohm J., Thao H.T.M.
Geodevelopment International AB, Lund, Sweden; Greifswald University, Greifswald, Germany; Hanoi University of Science, Hanoi, Viet Nam

Abstract: A current semi-empirical model of conversion of smectite to illite implies that the process is associated with formation of quartz and chlorite and will not cause significant illitization in the hydrothermal period of a repository if the activation energy is of the commonly assumed magnitude and the temperature is lower than about 100 °C. The model is supported by several natural analogues and hydrothermal experiments in laboratories and field tests. In all the experiments, which were conducted under open chemical conditions, the confined clay was exposed to thermal gradients for at least 1 year. Most of the tests were small-scale and of "1D-type", one being performed with strong gamma radiation, and the others with different porewater compositions. One was a Mock-up experiment simulating the KBS-3V concept on 50% scale, and one a full-scale KBS-3V field experiment at 400 m depth in granitic rock. They all showed that while smectite remained the major clay mineral a number of processes changed the physical properties in bulk, the most important changes being reduction of the expandability and increase of the hydraulic conductivity of the hottest part of the buffer. The latter is concluded to have been caused by contraction of clay aggregates that became permanent by precipitation of silica and iron compounds, the cementing agents emanating from dissolved accessory minerals as well as from montmorillonite. Fe-rich montmorillonite underwent particularly important dissolution. © 2008.
Author Keywords: Cementation; Clay; Hydrothermal; Mock-up; Montmorillonite; Radiation; Smectite
Index Keywords: Cementation; Cementing agents; Chemical conditions; Clay aggregates; Expandability; Experimental data; Field experiment; Field test; Gamma radiation; Granitic rocks; Hydrothermal; Illitization; Pore waters; Semiempirical models; Smectites; Activation energy; Cementing (shafts); Cements; Chemical stability; Dissolution; Experiments; Gamma rays; Iron compounds; Minerals; Oxide minerals; Quartz; Silica; Silicate minerals; Clay minerals; accessory mineral; analog model; cementation; chemical analysis; experimental mineralogy; experimental study; hydrothermal system; illite; illitization; laboratory method; montmorillonite; radiative forcing; repository; smectite; temperature effect; temperature gradient

Year: 2010
Source title: Applied Clay Science
Volume: 47
Issue: 2-Jan
Page : 113-119
Link: Scorpus Link
Correspondence Address: Pusch, R.; Geodevelopment International AB, Lund, Sweden; email: pusch@geodevelopment.ideon.se
ISSN: 1691317

CODEN: ACLSE
DOI: 10.1016/j.clay.2009.01.002
Language of Original Document: English
Abbreviated Source Title: Applied Clay Science
Document Type: Article
Source: Scopus
Authors with affiliations:

- Pusch, R., Geodevelopment International AB, Lund, Sweden
- Kasbohm, J., Greifswald University, Greifswald, Germany
- Thao, H.T.M., Hanoi University of Science, Hanoi, Viet Nam

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