Title

Stress evolution of a geological nuclear waste repository in a creep-prone shale formation

ISBN

9780979497575

Authors

Sasaki, T
Rutqvist, J

Publication Date

2022

The impact of the anisotropy of shale creep on the long-term stress evolution of a geological nuclear waste repository

Tsubasa Sasaki [a, *] and Jonny Rutqvist [a]
[a] Earth Sciences Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA, 94720, USA
[*] Corresponding author. E-mail address: tsubasasasaki@lbl.gov

Abstract

Shale creep plays an important role in the long-term behavior of geological nuclear waste repositories by reducing the stress concentrations around the disposal tunnels caused by the decay heating of nuclear waste. However, shale is inherently an anisotropic material due to the presence of bedding layers and the magnitude of shale creep is dependent on the anisotropy. It is thus crucial to incorporate the anisotropic shale creep into the long-term performance assessment of geological nuclear waste repositories. In this study, we developed a new constitutive model for anisotropic shale creep based on the power-law creep, which is an empirical model for one-dimensional shale creep, and the anisotropic metal plasticity theory. The developed anisotropic shale creep model was implemented in the TOUGH-FLAC simulator to carry out a thermo-hydromechanically (THM) coupled simulation to evaluate how anisotropic shale creep affects the long-term (~10,000 years) stress evolution of a geological nuclear waste repository. We examined three different dip angle values of the shale bedding plane (0º, 5º, 10º) and their effect on the stress evolution around the disposal tunnel. Results suggest that the stability of nuclear waste repositories significantly changes not only with the type of shale creep but also with the shale creep anisotropy.