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Technical Conference Paper

LABORATORY EXPERIMENTS ON MICROSCALE DEFORMATION MECHANISMS OF ROCK SALT

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Abstract

Mechanical parameters of rock salt are the basis for designing and ensuring the long-term stability of energy storage facilities and waste repositories in the salt caverns. Previously conducted research has shown that rock salt samples from the same formation, deposit, or even bed exhibit variable mechanical parameters in standard laboratory tests. This variety is linked to the petrological features such as impurity content and distribution within the sample, as well as structural and textural patterns as grain size, shape, and arrangement. In some cases, macroscopically similar samples display different mechanical parameters. Therefore, an understanding of rock salt deformation process and the effect of petrological features on microdamage is necessary to ensure safety of storage operations. To study this issue a device enabling uniaxial compression tests with simultaneous observations under the microscope was designed. Experimental tests were carried out on pink rock salt from Kłodawa salt dome and grey rock salt from Lublin-Głogów Copper District (LGOM). The pink rock salt is characterised by the occurrence of fluid inclusions (FIs) of various size and shape at the grain boundaries and within halite grains. The light grey and grey rock salt from LGOM contains anhydrite (below 2%) as an admixture. Anhydrite crystals occur in varying quantities along grain boundaries and are dispersed within halite grains. Additionally, there are FIs at grain boundaries and inside halite grains. The experiment showed that damage process is initiated at halite grain boundaries and consists of three phases. Moreover, only FIs located along halite grain boundaries were active during the entire test. The anhydrite located in large quantities along halite grain boundaries of grey rock salt has a significant impact on the damage and deformation process, as well as an increase in mUCS. Results from the performed tests provided insight into rock salt deformation mechanisms at the microscale, as well as the development of porosity and permeability, which are pathways for fluid migration. The findings described in this paper are particularly important for the safety of energy storage caverns. These days, this issue is particularly crucial in the context of hydrogen storage in salt caverns, which is part of the decarbonisation strategy.

Key words: mechanical parameters of rock salt, deformation process, micro scale, petrological features, salt caverns