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Creep of Rock Salt at Low Deviatoric Stresses

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Abstract

The vast majority of rock salt creep tests have been conducted at deviatoric stresses above 6 MPa, yet the long-term behaviour of waste repositories, mines and caverns is dominated by creep below 6 MPa. Steady-state creep rate in this range is very slow (around 10^{-6} /d or lower) and is easily overwhelmed by other effects, such as dilatancy and long transient phases. Hence, a careful experimental approach was developed to measure creep at low stresses that includes

- an isotropic compression step to consolidate the sample,
- high confining stresses to avoid dilating the sample during deviatoric stress steps,
- elevated temperature in the first deviatoric stress step to speed up transients,
- and several temperature steps to obtain several creep rates and activation energies from a single sample. Since dislocation microstructure depends only weakly on temperature, there are essentially no new transients in the later load stages.

By the paper we discuss the procedure in detail and present a long-term creep test (duration almost five years) at 4 MPa (580 psi) that validates the procedure. These tests should help calibrate rock salt constitutive models and derive parameter sets for creep laws, and hence allow them to predict long-term structural performance with greater confidence.

Key words: rock salt, salt creep, salt caverns, cavern abandonment, rock mechanics