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A new flow law for Bischofite

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Bischofite exits in the upper crust with its related minerals carnallite, sylvite and halite, and is known as the most ductile material within the halide family of minerals. It is normally extracted from the subsurface by solution mining in underground caverns. Abandonment of the caverns causes the wall rock to creep towards the inside due to overburden stress, which in turn results in subsidence at the surface. In order to allow reliable prediction of the creep of Bischofite at cavern walls, a well-defined flow law is required that can be applied at strain rates at least as low as 10^{-9} s^{-1}. Such rates are difficult to achieve in the laboratory. We have conducted new, conventional axi-symmetric compression tests on as-received polycrystalline Bischofite samples from natural cores. The experiments have been carried out at near real *in situ* conditions of temperature and pressure (70^{o}C and 40 MPa, respectively), using a range of strain rates from 10^{-5} to 10^{-8} s^{-1}. All experiments were strain rate stepping experiments including stress relaxation after every step down to strain rates of 3×10^{-9} s^{-1}. In the relaxation part of the experiments, the deformation piston was arrested at fixed position and the stored elastic energy in the sample and in the machine was allowed to relax through plastic deformation of the sample. The measured mechanical data were used to obtain the stress exponent (n) as included in a conventional (Dorn-type) power law. We observed that during the stress relaxation, the n-value gradually changed from n >5 at 10^{-5} to n ∼1 at 10^{-9} s^{-1}. The absolute strength of the samples remained higher if the relaxation started at a higher stress, i.e. at a faster rate within the range tested. We interpret this as indicating a difference in microstructure at the initiation of the relaxation, notably a smaller grain size related to dynamical recrystallization during the constant strain rate part of the test just before relaxation. The data thus suggest that there is gradual change in mechanism with decreasing strain rate, from grain size insensitive (GSI) dislocation creep to grain size sensitive (GSS) pressure solution creep. We propose that a hybrid flow law in which strain rate is equal to $A'\sigma^{n}$exp(σ/B) should best be applied to describe the flow of Bischofite at *in situ* conditions of 70^{o}C, 40 MPa and slow strain rate. Best fit analysis resulted in values n=3.4, A'= $10^{(-8.519)}$ and B = 2.26.