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Impact of hygrometry changes on creep behaviour of a porous rock and associated acoustic emission.

D. Grgic (1) and D. Amitrano (2)

(1) ENSG, Nancy Universite, LAEGO, France. (dragan.grgic@ensg.inpl-nancy.fr: 00 33 3 83 59 63 00) , (2) Universite J Fourier, LGIT, Grenoble, France (david.amitrano@ujf-grenoble.fr, 0033-4-76-62-52-52)

Static fatigue of a polycrystalline porous rock (iron ore) was studied by performing multi step uniaxial creep tests under partially saturated conditions, and the impact of water saturation was analyzed. The samples were, in a first step set to a partial water saturation of 90%. In a second step, the samples were saturated completely in order to simulate the impact of flooding corresponding to the conditions of abandoned iron mines. We recorded axial and transversal strain and acoustic emission (EA). The experimental results show that the water saturation induces a strong increase in AE activity and dilatant inelastic volumetric strain. This is associated with a notable decrease in Young's modulus and in the b-value of the Gutenberg-Richter law (i.e., the relative number of large-amplitude events increases) as the rock approaches failure, indicating that microfracturing plays an important role in the creep process. Water saturation accelerates static fatigue through hydro-mechanical coupling and subcritical stress corrosion cracking. The chemical reactions involved in the corrosion of iron ore and leading to a decrease in its intrinsic mechanical properties are described. These reactions play a major role in the static fatigue of iron ore, which on a large scale is probably the main mechanism explaining certain collapses in underground iron mines. It is also shown that creep straining of iron ore is partially reversible after stress removal, indicating that it results also from time-dependent viscoplastic mechanism (i.e., dislocation creep).