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# Propagation of Crack in Glasses under Creep Conditions

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The context of our study is the observation of the mechanical behaviour of glass used for the storage of radioactive wastes. This implies to measure the crack propagation characteristics in glass. Results on the investigation of the micromechanics of creep under triaxial loading conditions are presented in the framework of this study.

We performed the experiments in a triaxial cell, with pore fluid pressure, on boro-silicate glass. The chemical composition of the investigated glass is very close to the composition of waste vitrified packages. The matrix of the original glass (OG) is perfectly amorphous, without porosity. A few isolated air bubbles are trapped during the glass flow. Cracks are introduced in the OG through thermal shocks. The evolution of deformation (axial and radial strain) is measured using strain gages. The elastic P and S wave velocities and the acoustic emissions (AE) are also recorded.

An experiment in dry conditions was performed (the pore fluid was argon gas) with a confining pressure fixed at 15 MPa. Stress step tests were performed in order to get creep data. A similar experiment was performed in water saturated conditions.

Crack-closure is first observed at very low strains. Then elastic deformation is observed up to a stress level where elastic anisotropy develops. This can be clearly detected from $\varepsilon$ Thomsen parameter increase. At last, at a deviatoric stress of 175 MPa (in dry conditions), we observe dilatancy. This behaviour has never been observed in original glass. Indeed, the OG behaviour is perfectly elastic and brittle. In addition, the constant stress tests show that dilatancy develops during a time constant that depends on the stress level.

It can be inferred that crack propagation takes place during the constant stress steps. This behaviour is under investigation. We are also quantifying the velocity of the crack propagation by modelling this phenomenon. Indeed, the crack density can be expressed as a volumic strain, $\varepsilon_v = \pi\xi\rho_c$. Then, using a model of penny shaped cracks of a radius, "a", we can express the crack density as: $\rho_c = N/Va^3$ (for N cracks in a volume V). Knowing that $\xi$ is the crack aspect ratio we can estimate $\varepsilon_v$ using in a first approximation that $\xi$ is a constant. Thus the variation of $\varepsilon_v$ with time can be directly related to crack propagation $\dot{a}$.