Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Stress Corrosion Fracture of Silicate Glasses: How Far Can Water Penetrate? ELISABETH BOUCHAUD, CEA-Saclay ESPCI ParisTech, CINDY ROUNTREE, FABRICE COUSIN, CEA-Saclay, FREDÉRIC LECHENAULT, ENS Paris, STEPHANE CHAPULIOT, AREVA, LAURENT PONSON, I D Alembert Paris, JEAN-PHILIPPE BOUCHAUD, CFM Paris — Although glass can be considered as homogeneous at scales as small as a few tens of nanometers, since it exhibits no density fluctuations beyond, its amorphous structure makes it a disordered material with respect to fracture properties. Fluctuations of the orientations of Si-O bonds with respect to the external stress make it unlikely that bonds closest to the crack tip break first, despite the high stress concentration. As a consequence, glass behaves in a quasi-brittle manner rather than in a purely elastic way. *In situ* Atomic Force Microscopy experiments tracking the slow progression of a stress corrosion crack seemed to show indeed the opening and growth of nano size flaws ahead of the tip. However, these results are controversial, because of artifacts which may seriously affect the observations. Furthermore, the low diffusion coefficient of water in silica should forbid hydrolysis at a distance from the crack tip, except at the free surface. Nevertheless, our recent neutron reflectivity experiments show that water actually penetrates into the material during stress corrosion fracture. Comparing two experiments performed for different crack velocities shows that the diffusion coefficient is hugely increased under stress, allowing for bond breakings at ∼ten nanometers ahead of the main crack tip.

Elisabeth Bouchaud
CEA-Saclay & ESPCI ParisTech

Date submitted: 01 Dec 2011 Electronic form version 1.4