Water Wet Solid Interfaces Dissolving Under Pressure -- Measurements of Interface Structure and Material Transport

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Solids with solubility in water that increases with pressure will preferentially dissolve at points of contact with other solids when the solid contacts are at higher pressure than the fluid pressure. If the water -- solid system is closed and saturated, material will dissolve at the contacts and be transported out of the contact and precipitated elsewhere. This process, in geosciences known as pressure solution, is the main process responsible for converting sediments into sedimentary rocks and it is thought to be important in healing the strength of faults in earthquake zones. Sedimentary rocks are a class of what have been described as ``mesoscopically elastic'' materials. The elasticity of such materials does not only depend on the bulk elasticity of its constituents, but also on the bond structure. The bond structure -- the properties of the contacts and the distribution of contacts in an aggregate -- is forged by pressure solution and is thought to cause the observed (nonlinear) hysteretic elasticity of such rocks.

Pressure solution produces water wetted solid interfaces where there is material transport by diffusion. The interface structure and the nature of the confined water film have been subject to much discussion, but few careful, systematic measurements. We present measurements on rock salt using two *in situ* high resolution techniques in combination -- capacitance dilatometry and X-ray reflectivity. The techniques have Ångstrøm resolution normal to the interface and parallel to the interface, respectively. We measure the rate of material transport, thickness of interface water film, and dynamic change in interface roughness. We show that the change in interface structure is responsible for the change in transport rate, and we discuss the stability of the interface structure upon a change of normal load.