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## The Chemistry of Earthquakes: Chemical role of Water in Dilatancy Diffusion model

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The Dilatancy Diffusion model of Scholz et al (1973) is a model describing saturated rocks behaviour under differential tectonic stress in time domain, and one of the first trial of earthquake precursory phenomena listing and explanation. After around 50 years, improvements, outline and structure of this however successful model are still a reference point of many researcher. The role of water has been explained only as a pressure transducer, acting on host rocks, during the various stages of dilatancy diffusion, acting as a pressure cycle.

Theme of present model is the water active chemical role in DD.

A temperature pressure diagram of water aggregation state could be drawn as a section of the earth crust. Assuming that the brittle ductile transition line could be localised even close to 500 °C isotherm, most hypocentre are surely localised in liquid phase area, while some main shock localisation may fall even in water supercritical region.

I modelled the water isothermal behaviour in relation of most relevant variable acting on water in dilatancy diffusion: pressure. Pressure acting on water could drop drastically as soon as microcraks open. Then, water flow into newly created fractures, and, since tectonic load continues, pressure rise again, before main shock. In this pressure cycle, water chemical response, could be splitted into two diverse fields: liquid and supercritical, resulting however in a rock weakening.

- 1) **Liquid**. The entity of depressurisation makes the difference. According to Scholz et al (1973), and Brace et al (1966), the entity is high. It is a matter of water quantities and of volumetric geometry of microcracks. Ionic solubility depends slightly from pressure. Going into vapour phase is equal to a distillation process: when pressures rise again, this kind of water is extremely aggressive toward newly opened rock surfaces. If not, water could maintain most, not all, solute in. In every case, molecules like CO<sub>2</sub> and H<sub>2</sub> migrates away from water and, thanks to their characteristics (radius and electrostatic field), following the path of extremely little fissurations, normally secluded to water. Resulting water changes its chemical content.
- 2) **Supercritical**. Molecular structure of this aggregation state makes this fluid compressible. That is, its density varies highly with pressure. Solvent capability varies highly with density: supercritical water acquires polar solvent power with growing density. Solubility depends highly from pressure, with all consequences.

**Subcritical crack growth.** It is a common point of 1) and 2), and it could be a function of dissociation grade of water too. In an environment, with freshly created surfaces, quartz and silicates are subjected to a further weakening due to high dissociated water.

The integration of water chemistry in dilatation diffusion model is a needed upgrade and depict a situation in which, as soon as new crack creates, the chemical action of water can trigger a near irreversible process of rock weakening accelerating the main shock, since rock resistance could be lowered well below original breaking load.