Superheating water to model soil "immobile" water

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Superheating

The superheated liquids are less stable than their vapour, while their criteria of internal stability are met. They can be produced when an increasing T or a decreasing internal P (including negative pressure, or liquid tension) beyond the stable values is produced in liquid in such conditions that vapor does not nucleate. This nucleation suppression can be reached in nature either during a short time by a very rapid P or/and T variation (phreatomagmatism, for instance), or by decreasing the air humidity at a liquid-air interface located in infra-micronic container (soil capillarity, for instance). The method of choice to experimentally probe superheating is the micro-thermometry of fluid inclusions [1], that can be designed in terms of composition and density of occluded liquids (in quartz). Their volumes are intermediate between macro-systems, in which superheating is restricted to low tensions with very short lifetime, and nanosystems, wherein the host matches the size of the critical vapor nucleus.

Properties and behaviours of interest

The first property available from the present experiments are the surface of the metastable PT domain available for aqueous solutions, that depends on the liquid composition and densities [2]. A second property of interest is the ability of this in-pores tensioned liquids to change the mechanical tensor in the surrounding solid, by recording the SiO_2 Raman bands in quartz during a microthermometric cycle. The third property is the transmission of the liquid tension to the dissolved solutes, again through recording characteristic Raman shifts of solutes with known liquid tension. Consequently, the solubility of gases and minerals in such superheated mixtures changes, and in general increases, with consequences on weathering and external gas cycles. At last, the superheating lifetime, the energy of the critical boiling, and the direct consequences of this return-to-equilibrium to local paragenes are explored.

[1] Roedder (1967) **Science** *155*, 1413-1417. [2] Shmulovich K.I., Mercury L., Thiéry R., Ramboz C., and El Mekki M. (2009) **Geochim. Cosmochim. Acta** *73*, 2457-2470.