

Mechanism and evolution process of supercritical fluid

October 15 2021, by Liu Jia

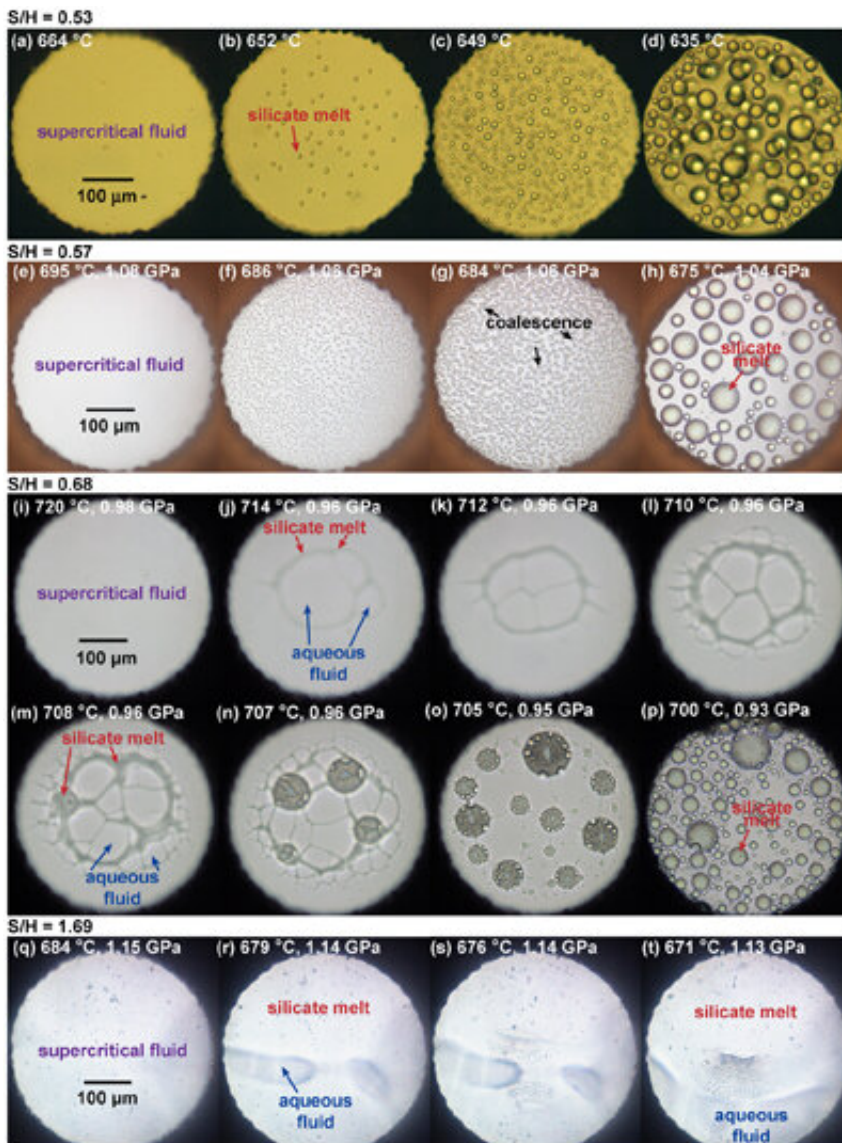


Figure 1. Phenomena observed during cooling and unmixing of supercritical fluid with different silicate to H₂O mass ratios (S/H). (a–d) S/H = 0.53,

nucleation of silicate melt droplets followed by independent growth. (e–h) $S/H = 0.57$, spinodal decomposition with homogeneously dispersed silicate melt droplets followed by coalescence. (i–p) $S/H = 0.68$, spinodal decomposition and development of a silicate melt network, later disrupted into melt droplets. (q–t) $S/H = 1.69$, spinodal decomposition with large portions of silicate melt and aqueous fluid. Credit: DOI: 10.7185/geochemlet.2119

Fluids are like the "blood" inside the solid Earth, playing an important role in the transportation of matter and energy. Due to the compositional difference, rocks that composed mainly of silicate and common fluids have a typically low level of miscibility.

Under the high temperature and pressure conditions deep in the Earth, [silicate](#) and fluids can be completely mixed, forging a supercritical geological [fluid](#) with the composition "thicker" than magmatic melts and "thinner" than aqueous liquids. However, much remains to be done to reveal the evolution process of supercritical fluid because of the difficulties in experimenting.

In a study published in *Geochemical Perspectives Letters*, a research team led by Prof. Ni Huaiwei from University of Science and Technology of China (USTC) of the Chinese Academy of Sciences found mechanism and the unmixing process of supercritical fluid.

Prof. Ni's team observed the phase separation process of silicate-water system with the decreasing of temperature and pressure.

The experiment showed that besides regular nucleation-growth mechanism, supercritical fluid could be separated through spinodal decomposition. Due to the difference of dynamic property between silicate and water, the silicate composition with a low relaxation could

support the elastic stress and form a network of silicate melts in the fluids. But when the temperature further dropped, the [interfacial tension](#) increasingly enlarged, leading to the disintegration of melt networks.

This kind of melt network can facilitate the simultaneously capture of silicate melts and aqueous fluids with different proportions when mineral crystallizations crystallize. Meanwhile, the spinodal decomposition of the integral decomposition mechanism will significantly contribute to the efficiency of the melt-fluid phase separation, which may have important implications for the formation of magmatic hydrothermal deposits.

This [study](#) reported for the first time the spinodal [decomposition](#) of supercritical fluid and the formation of magmatic network.

More information: Q.X. Wang et al, Spinodal decomposition of supercritical fluid forms melt network in a silicate-H₂O system, *Geochemical Perspectives Letters* (2021). [DOI: 10.7185/geochemlet.2119](https://doi.org/10.7185/geochemlet.2119)

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