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Spinodal decomposition of supercritical fluid forms melt network in a silicate-H_2O system

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Supercritical fluid in silicate-H_2O systems, with composition intermediate between silicate melt and aqueous fluid, has distinctive physicochemical properties and can be an important agent of mass transfer in Earth's interior. Decreasing temperature and pressure drive supercritical fluid to a miscibility gap and cause unmoving into coexisting melt and fluid. With a hydrothermal diamond anvil cell, we observed that unmixing of a supercritical fluid with 37 to 51 wt% aluminosilicate formed a silicate melt network, a phenomenon never documented before. Th melt network was stable over a range of cooling rates, although further cooling led to disintegration of the network to dispersed melt droplets. The melt network was unlikely to be formed by nucleation-growth at discrete sites, but probably derived from an early stage of spinodal decomposition characterized by high phase interconnectivity. Also key to the stabilization of melt network was elastic stress supported by polymerized silicate component. The occurrence of a silicate melt network with uneven fluid-melt boundaries may facilitate heterogeneous entrapment of melt and fluid. Spinodal decomposition and formation of melt network provide an efficient mechanism for fluid-melt separation and mineralization in magmatic-hydrothermal systems.