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Fluid–fluid Immiscibility Induces Fast Mass Segregation in Hydrothermal Fluids

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An unusual salt-rich (SR) and salt-poor (SP) fluid immiscibility (FFI) could occur in a variety of hydrothermal fluids[1-4], including some sulfate-bearing and carbonate-bearing fluids. The separated SR fluid resembles hydrosaline fluid or aquatic molten salt in composition (concentration of several to tens molarities) and exhibits strong capability to scavenge some ore elements from the SP fluid and the surrounding rocks. Consequently, the occurrence of the FFI and the subsequent segregation of SR fluid from the SP fluid provides a potential mechanism for substantial mass enrichment during relevant ore forming processes (e.g., carbonatite REE deposits). However, the physical properties of SR and SP fluids, which determine the hydrodynamic behaviors of the unmixed fluids, have not been well constrained. This study adopted in situ optical observation, quantitative Raman analysis, integrated with the mass conservation law to derive the density of the SR and SP fluids. On this basis, falling sphere viscometry was further employed in the fused silica capillary capsules to determine the viscosity of the SR fluid. Results show that SR fluid exhibited an obviously higher density (with density difference above 0.8 g/cm^3) but comparable viscosity to the water-like SP fluid. The low viscosity of the SP fluid and the contrast density difference between the SR and SP fluid endow the SR fluid extremely strong tendency to segregate from the SP fluid. Consequently, the FFI is speculated to contribute tremendously to mass enrichment during fluid evolution.

Reference

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