

Heterogeneous Fluids in Supercritical Binary and Ternary Water-Salt Systems

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Different types of liquid-liquid immiscibility that can exist separately or along with liquid-gas equilibria can explain the diversity of fluid phase behavior in most hydrothermal systems. Usually by fluids we identify gas (vapor) or liquid (melt) phases, which undergo transition from gas (vapor) to liquid (melt) (and back) through two-phase equilibria where the both phases coexist. Besides that, there is so called "supercritical fluid" (SCF), which transforms continuously from gas-like to liquid-like conditions with pressure increasing and takes place in any systems at temperatures above the critical points of all components. However, in some binary systems (type 2), where the melting temperature of nonvolatile component is above the critical temperature of volatile one, the supercritical fluid equilibria arise at much lower temperature as a result of critical phenomena in solid saturated solutions in the vicinity of the critical temperature of the volatile component. The studied binary water-salt systems, which belong to type 2, are characterized not only by "low-temperature" supercritical fluid equilibria, taking place in the temperature range between critical end-points p and Q, but also by the metastable immiscibility region of type d and stable equilibria L1-L2-S, L1-L2 and L1=L2. In the case of binary systems of type 1 (with or without the immiscibility phenomena), the melting temperature of the nonvolatile component can be above or below the critical temperature of volatile one, and the "low-temperature" SCF equilibria as well as the critical phenomena between liquid and gas in solid saturated solutions are absent. The combination of two binary water-salt systems of types 1 and 2 gives three classes of ternary systems with one volatile component (water) 1-1-1, 1-2-1 and 1-2-2, designated by types of three binary subsystems. While changing from one subsystem to another, the phase diagrams of the binary subsystems must undergo continuous topological transformations in the three-component region of composition. Using the theoretical method of the continuous topological transformation and available experimental data the following transformations of sub- and supercritical phase equilibria in ternary mixtures will be discussed:

1. A disappearance of immiscibility regions of different types in ternary systems of classes 1-1-1.
2. A transition of metastable immiscibility equilibria into stable ones in ternary systems of classes 1-2-1 and 1-2-2.
3. A heterogenisation of homogeneous supercritical fluid in ternary systems of classes 1-2-1 and 1-2-2.
4. An appearance of nonvariant critical and noncritical equilibria in ternary systems of classes 1-1-1, 1-2-1 and 1-2-2.