Chemical Reaction diversity of geofluid

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Geofluid is composed from multicomponent electrolytes in water and carbon dioxide solutions. Depending on chemical species and concentration of electrolytes, supercritical temperature and pressure have been changed. Tsuchiya et al. (2001) described chemical reaction behavior of supercritical fluid in terms of dissolution and precipitation. WATER DYANMICS in crustal processes involves several meanings such as kinetics of chemical reaction in advance of equilibrium of steady state of the solution system and transport phenomena of geofluid through rock matrix and fractures. We have investigated potential and possibility of variation of chemical properties such as dissolution and precipitation in high temperatures and pressures by both of experimental and field

Multicomponent geofluid system (H2O-CO2-electrolyte solutions) in high temperature region such as active geothermal field, hydrothermal ore deposit, and various condition of metamorphim in middle and lower crust have been recognized as in supercritical condition due to their solution chemistry. Experimental and natural analogue analysis suggested heterogeneous chemical reaction under supercritical fluid condition. Supercritical water-rock interaction, subsequent to conventional water-rock interaction in alteration stage on and near surface, has great role to lithosphere environment in middle and lower crust.

Supercritical water-rock interaction, which is occurring beneath a zone of conventional water-rock interaction (diagenesis and alteration). Chemical condition, in and around pluton under middle and lower crustal condition, was categorized into plutonic and metamorphic reactions, and mechanical behavior was classified into brittle/plastic transition and/or plastic condition due to environmental parameters such as temperature, pressure and strain rate.

We had designed and installed various types of experimental apparatus as follows; batch type autoclave, flow through type autoclave, hydrothermal hot pressing, Flow through apparatus under confining pressure, Autoclave with transparent window for in situ measurement of chemical behavior under supercritical condition. Those new designed experimental equipments could cover wide range of temperature, pressure, flow rate, and chemical properties of geofluid.

According to our dissolution experiments of granite and quartz coupled with equilibrium and kinetic analyses, we highlight state of so-called supercritical field, up to critical temperature and pressure, which can be subdivided into liquid-like region and vapor-like region. A strong water-rock interaction, inferred by the dissolution of granite, was obtained in both sub- and supercritical regions, ranging from 300C to 450C. However chemical reaction processes tend to be relatively weaker in the high temperature region. In the relatively high-pressure region, at supercritical conditions, the fluid shows high potential as a solvent, somewhat similar in the respect to subcritical liquids. In contrast, a weak water-rock interaction is evident at greater temperatures, within the supercritical region. Thus we concluded the existence of an apparent phase boundary within the supercritical region. In the past, the supercritical region has been regarded as a homogeneous state, and neither classified as a liquid phase nor a vapor phase, and this inference may not be appropriate. The vapor-like region, being a relatively low pressure region, at supercritical conditions, has the great role to describe environmental condition of the crust.

Geofluid contains multicomponent. Supercritical region depends on critical temperature and pressure, and CO2 rich fluid shows relatively low critical temperature compared to that for pure water. Characteristics of chemical reaction between rock and rock-forming minerals could be described as diversity of the supercritical region.