Supercritical geothermal energy in subduction zone

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Hydrothermal activities were investigated in order to understand the evolution of supercritical geothermal fluids in certain geological settings. Temperatures over 350 °C are in the “beyond brittle” condition (a temperature of ~350 °C coincides with the brittle–ductile transition), and the ways in which fractures develop under these conditions are unclear.

Porphyry copper deposits represent natural “beyond brittle” experiments where fluids were injected from molten material (magma) into a ductile rock mass at ~600 °C, and where lithostatic pressures caused fractures in the rock mass, creating a stockwork fracture system.

A granite–porphyry system, associated with hydrothermal activity and mineralization, provides a suitable natural analog for studying a deep-seated geothermal reservoir where stockwork fracture systems are created in the presence of supercritical geothermal fluids. Fracture networks and their formation mechanisms would be studied by using petrology and fluid inclusion studies in order to understand “beyond brittle” supercritical geothermal reservoir. To understand the geological properties of a supercritical geothermal reservoir, a granite–porphyry system was investigated as a natural analog. Quartz veins, hydrothermal breccia veins, and glassy veins are present in Neogene granitoids, NE Japan. The glassy veins formed at 500–550 °C under lithostatic pressures, and then pressures dropped drastically. The solubility of silica also dropped, and the quartz veins formed under hydrostatic pressures. Connections between the lithostatic and hydrostatic pressure regimes were key to the formation of the hydrothermal breccia veins, and the granite–porphyry system provides useful information for understanding supercritical geothermal reservoirs and EGS technology.