

Electromagnetic exploration for supercritical geothermal systems

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SUMMARY

Recent geothermal research has focused on technologies for harnessing the significant energy of high-temperature, high-pressure fluids in the deep subsurface for next-generation geothermal power generation. Geothermal fluids with temperature and pressure conditions exceeding the critical point of pure water (374°C, 22.1 MPa) are called supercritical geothermal fluids, and research aimed at utilizing them for power generation has recently been conducted in many countries. The Iceland Deep Drilling Project drilled two deep wells in Iceland and confirmed the presence of supercritical geothermal fluids. Note that supercritical (also called superhot) geothermal fluids are not necessarily supercritical, because they contain dissolved components. One technology required for practical supercritical geothermal generation is an efficient exploration technique for supercritical geothermal systems. Electromagnetic exploration, as typified by the magnetotelluric (MT) method, is a promising exploration method for supercritical geothermal systems. Conventional shallow geothermal systems are characterized by a low-resistivity clay cap layer and an underlying geothermal reservoir with relatively high resistivity. In contrast, supercritical geothermal reservoirs have self-sealing cap rock with high resistivity owing to silica precipitation, which is very difficult to detect using MT exploration. However, supercritical geothermal fluids can be conductive because they include magmatic fluids of a certain salinity. Therefore, resistivity exploration of supercritical geothermal systems should focus on low-resistivity bodies that indicate reservoirs, and careful investigation is needed of the properties of supercritical geothermal fluids. This review summarizes the results of studies on the resistivity of supercritical geothermal fluids and that of rocks that contain them, explorations conducted using the MT method to investigate supercritical geothermal systems, and their interpretation.

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