Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SMP47-06 会場:203 時間:5 月 22 日 12:30-12:45

能動的地熱増産システム開発における物理探査の役割
The role of geophysical exploration in detecting and monitoring enhanced geothermal system (EGS)

茂木 透[1*], 内田 利弘[2]
Toru Mogi[1*], Toshihiro Uchida[2]

[1] 北大．理, [2] 産総研
[1]Fac.Sci.,Hokkaido Univ., [2]AIST

The discovery of enhanced geothermal systems (EGS) prescribes the need for novel technology to detect high-temperature areas and monitor fluid contents at depth. To minimize cost and risk, engineers attempt to predict reservoir performance, for both planning and evaluation of geothermal resource development projects. Correct predictions of reservoir performance hinge on how well the reservoir is understood and has been described in the models used for fluid-flow simulation. An important role of the geophysical survey is to provide basic data for a reservoir simulation.

Imaging hot rock and fracture zones and monitoring fracture growth deep in the earth at 3 to 5 km is not a simple task. Regional survey methods such as gravity and airborne magnetic surveys are usually used to delineate regional geologic settings. Some researchers have examined the feasibility of using Curie isotherm depths, estimated from magnetic anomalies, as a proxy for lithospheric thermal structure.

The three-dimensional (3D) magnetotelluric (MT) survey method provides a relatively inexpensive way to obtain accurate images based on electrical conductivity, but the resolution in deeper areas is inherently low. MT is sensitive to conductors, making it a prime method for detecting electrically conductive fluids at depth. The areal extent of a reservoir at depth can be estimated by measuring the MT response before, during, and after fluids are injected. Forward modeling and repeatability estimates will be covered.

The 3D seismic survey method allows for imaging deep fractures with higher resolution. A P-wave reflector is detected at the top of a deep fractured layer, which must lie at the brittle?ductile transition and may be common in areas with magmatic activity. However, performing 3D land seismic surveys in areas with topographic variation is challenging. Even if such a survey could be performed, it would be difficult to image fractures in a crystalline formation because the aperture of the fracture is likely to be thinner than a quarter of the wavelength of the surface seismic wave. Most significantly, it may not be practical to monitor the growth of a fracture using 3D seismic surveys because of high cost.

Reflection imaging with micro-earthquakes generated during stimulation is a possible method for defining major flow paths in deep crystalline formations. The advantage of micro-seismic imaging is its higher frequency spectrum (up to several hundred hertz), meaning that thin fractures can be imaged.

Reservoir characterization, particularly in terms of reservoir architecture, flow paths, and fluid-flow parameters is the key to good reservoir engineering. Geophysical methods will play a central role in future reservoir characterization and in improving EGS monitoring.

キーワード: 物理探査, 地熱資源, 能動的地熱増産システム
Keywords: Geophysical Exploration, Geoteramal Resource, Enhanced Geothermal System