【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Engineering)

Title of Project : Science and Technology for Geothermal Energy Frontier

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Research Area : Earth and Resource System Engineering
Keyword : Geothermal Energy, Brittle-Ductile Transition, Supercritical Geofluid

【Purpose and Background of the Research】

EGS has been highlightened as a most promising method of geothermal development recently because of applicability to sites which have been considered to be unsuitable for geothermal development. Meanwhile, some critical problems have been experimentally identified, such as low recovery of injected water, difficulties to establish universal design/development methodology, and occurrence of large induced seismicity. Future geothermal target is supercritical and superheated geothermal fluids in and around ductile rock bodies under high temperatures.

Ductile regime which is estimated beyond brittle zone is target region for future geothermal development due to high enthalpy fluids and relatively weak water-rock interaction. It is very difficult to determine exact depth of Brittle-Ductile boundary due to strain rate, however, ductile zone is considered to be developed above 400C and below 3 km in geothermal fields in Tohoku District.

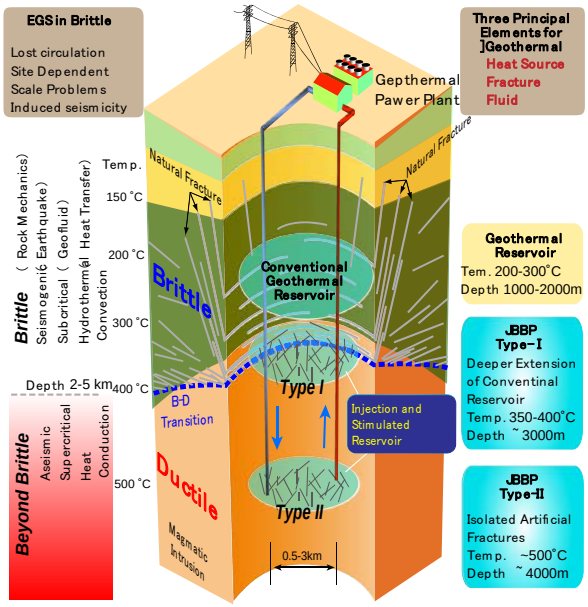
【Research Methods】

Hydrothermal experiments associated with additional advanced technology will be conducting to understand 'Beyond brittle World' and to develop deeper and hotter geothermal reservoir.

【Expected Research Achievements and Scientific Significance】

We propose a new concept of the engineered geothermal development where reservoirs are created in ductile basement, expecting the following advantages: (a)simpler design and control the reservoir, (b)nearly full recovery of injected water, (c)sustainable production, (d)cost reduction by development of relatively shallower ductile zone in compression tectonic zones, (e)large quantity of energy extraction from widely distributed ductile zones, (f)establishment of universal and conceptual design/development methodology, and (g) suppression of felt earthquakes from/around the reservoirs.

In ductile regime, Mesh-like fracture cloud has great potential for heat extraction between injection and production wells in spite of single and simple mega-fracture. Based on field observation and high performance hydrothermal experiments, our research goals are 1)Analysis and understanding of geothermal structure and geofluids in ductile condition of the Japanese Island arc, 2)Fundamental technologies of drilling under ductile region for geothermal reservoir, 3) Development of geothermal reservoir simulator of two phase and multiphase flow including supercritical state through rock fracture, 4) Lab scale support for ICDP-JBBP, 5) Application of new EGS technologies to conventional geothermal fields as recovery from the 2011 Great East Japan Earthquake and energy crisis in Japan.



【Publications Relevant to the Project】

- Tsuchiya, N. and Hirano, N. (2007), ISLAND ARC, 16, 6-15.
- Okamoto, A. *, Saishu, H., Hirano, N. & Tsuchiya, N. (2010) *Geochimica et Cosmochimica Acta*, 74, 3692-3706.
- Majer, E.L., Baria, R., Stark, M., Oates, S., Bonner, J. Smith, B. & Asanuma H., (2007) *Geothermics,* 36, 185-222.
- Watanabe, N.*, Hirano, N. Tsuchiya, N. (2009) Journal of Geophysical Research B: Solid Earth, 114(4), B04208.

【Term of Project】

FY2013-2017

【Budget Allocation】

420,200 Thousand Yen

【Homepage Address and Other Contact Information】

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