Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS27-P07 会場:コンベンションホール 時間:5 月 24 日 17:15-18:30

延性領域での能動的地熱利用を目指す Japan Beyond-Brittle Project (JBBP) の概要
Outline of the Japan Beyond-Brittle Project (JBBP) for geothermal energy development in ductile zone

浅沼 宏 [1*], 村岡洋文 [2], 伊藤久男 [3]
ASANUMA, Hiroshi[1*], Hirofumi Muraoka[2], Hisao Ito[3]

[1] 東北大学・大学院環境科学研究科, [2] 弘前大学・北日本新エネルギー研究所, [3] 海洋研究開発機構
[1]Graduate School of Environmental Studies, Tohoku University, [2]North Japan Research Institute for Sustainable Energy, Hirosaki University, [3]JAMSTEC

Geothermal energy is one of the most promising solutions for global warming, shortage of energy resources, and national energy security. Utilization of geothermal energy has not been promoted during the last 10 years in Japan because of cost consideration, amount of generated electricity per a power plant, various uncertainties and risks, although Japan has 3rd world largest potential of hydrothermal energy. Engineering approach to artificially create geothermal reservoirs (EGS: engineered geothermal systems) in granitic basement has been highlightened recently because of applicability to many of the sites where permeable fracture system and satisfactory water charge can not be found, and EGS projects are under way in many countries. However, some critical problems have been experimentally identified, such as low recovery rate of injected water, unexpectedly small improvement in permeability, and occurrence of large induced seismicity (Majer et al., 2007).

We understood that such problems in the EGS development can not be evaded because they are highly related to the nature of brittle rock mass, and, hence, propose a new concept of the engineered geothermal development where reservoirs are created in ductile basement (see figure). We expect that power generation using the EGS reservoirs in ductile zone especially in Northeast Japan have advantages, namely: (a) homogeneous rock properties and stress make it simpler to design and control the reservoir, (b) nearly full (100%) recovery of injected water from hydraulically closed reservoir can be achieved, (c) sustainable energy production would be realized by controlling water injection rate, (d) shallower brittle-ductile transition depth in the Northeast Japan (Muraoka and Yano, 1998) can effectively reduces costs for drilling and operational risks, (e) widely distributed ductile zones in relatively shallow depth in the Northeast Japan have potential for a large quantity of power generation, (f) possible common characteristics of the ductile zones brings universal design/development methodology free from the site dependency, and (g) induced/triggered earthquakes with disastrous magnitude do not occur from/around the reservoirs.

Scientific and technological breakthroughs are indispensable to realize the EGS system in ductile zones. Hydraulic stimulation, the most important process to create artificial fracture systems, has been commonly used in geothermal and oil industries, and experimental/theoretical studies have been made to understand physics behind the stimulation. Meanwhile, few investigations on the hydraulic stimulation in the ductile zone have been ever made. Control factors of the human created fracture systems in the ductile zone, including stress, constitutive laws, homogeneity of physical properties, and presence of liquid/gas, should be clearly investigated, and methods for design and modeling of the EGS reservoir should be derived based on the clarified control factors. Monitoring of the reservoir extension is another key issue to be considered. Induced seismicity has been widely used for monitoring in the previous EGS projects, however, considering the depth and temperature of the target and expected magnitude of the seismicity, the seismic monitoring may not have sufficient ability to provide information on the behavior and characteristics of the reservoir. New principles and technology development for the monitoring must be investigated.

We referred to the development of EGS system in the ductile zone as ”Japan Beyond-Brittle Project (JBBP)” and have initiated project preparation. First few years will be spent for scientific investigation and technology development, and deep borehole will be penetrated into ductile zone in Northeast Japan afterwards. We expect that feasibility of the EGS system in the ductile zone can be demonstrated from information from the borehole and multi-level hydraulic stimulation in the brittle-ductile transition zone.

キーワード: 涵養地熱系, 延性領域, 能動的地熱開発, 水圧破砕
Keywords: EGS, JBBP, Ductile zone, Hydraulic stimulation, Geothermal power generation

MIS27-P07 会場:コンベンションホール 時間:5 月 24 日 17:15-18:30