

## Japan Beyond-Brittle Project

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New conventional geothermal energy projects have not been actively promoted in Japan for the last decade because of perceptions of high relative cost, limited electricity generating potential and the high degrees of uncertainties and associated risks of subsurface development. More recently however, EGS (Enhanced Geothermal System) geothermal has been identified as a most promising method of geothermal development because of its potential applicability to a much wider range of sites, many of which have previously been considered to be unsuitable for geothermal development. Meanwhile, some critical problems with EGS technologies have been experimentally identified, such as low recovery of injected water, difficulties in establishing universal design/development methodologies, and the occurrence of induced seismicity, suggesting that there may be limitations in realizing EGS in earthquake-prone compression tectonic zones.

We propose a new concept of engineered geothermal development where reservoirs are created in ductile basement. This potentially has a number of advantages including: (a) simpler design and control of the reservoir, (b) nearly full recovery of injected water, (c) sustainable production, (d) lower cost when developed in relatively shallower ductile zones in compression tectonic settings, (e) large potential quantities of energy extraction from widely distributed ductile zones, (f) the establishment of a universal design/development methodology, and (g) suppression of felt earthquakes from/around the reservoirs.

To further assess the potential of EGS reservoir development in ductile zones we have initiated the "Japan Beyond-Brittle Project (JBBP)". It is intended that the first few years of the JBBP will be spent in basic scientific investigation and necessary technology development, including studies on rock mechanics in the brittle/ductile regime, characterization of ductile rock masses, development of modeling methodologies/technologies, and investigations of induced/triggered earthquakes. We expect to drill a deep experimental borehole that will penetrate the ductile zone in northeast Japan after basic studies are completed. The feasibility of EGS reservoir development in the ductile zone will then be assessed through observations and experimental results in the borehole. An ICDP supported workshop on JBBP has been held March 12-16 in Sendai, Japan, where feasibility, necessary breakthroughs, and roadmap has been discussed from scientific and technological points of view.

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