環境リスク評価学分野（産業技術総合研究所）　Environmental Risk Assessment
(National Institute of Advanced Industrial Science and Technology)

「安全・安心」な地熱エネルギーの利用を目指して

Studies for utilization of safe and secure geothermal energy

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当講座は国立研究開発法人産業技術総合研究所，福島再生可能エネルギー研究所 (FREA)，再生可能エネルギー研究センター，および地圏資源環境研究部門（つくば）所属の研究者が兼務し，教育・研究活動を行っている。現在，本講座では環境科学専攻の博士課程学生1名をリサーチアシスタントとして雇用するとともに，福島再生可能エネルギー研究所産業人材育成事業等の枠組みを利用して共同研究を実施している。

The members of the Environmental Risk Assessment (AIST Collaborative Laboratory) are carrying out studies to enhance safe and secure utilization of geothermal resources mainly by investigating technologies for ultra-resolution reservoir monitoring and rock-mechanical simulation of hydraulic fracturing/stimulation. Major research activities in 2017 include (a) scientific and engineering studies for large-scale power generation from subduction-origin supercritical geothermal resources; (b) simulation, microseismic monitoring, and rock mechanical studies for monitoring and management of geothermal reservoirs; (c)development of a system for monitoring the environmental burden associated with geothermal development; and (d) studies for social acceptance of geothermal development. Research and development to simulate industries in tsunami-stricken areas was also conducted.

超臨界地熱開発に関する研究

国内外の研究者と連携して、沈み込み帯に起源を有する超臨界地熱資源による発電の可能性を探っている。2050 年に国内総容量数 10GW の商用発電の実現を目標に NEDO からの委託を受け、科学的、技術的、経済的視点からの実現可能性詳細検討を実施している。また、経産省からの委託事業として超臨界地熱資源開発時の岩体挙動シミュレータの開発、高温坑井用坑内機器用基礎技術・素材の開発等を実施している。

微小地震や自然電磁波による地熱貯留層の高精度モニタリング

福島県柳津西山地熱フィールドにおいて、貯留層への涵養注水時の微小地震および自然電磁波計測を実施している。これにより、貯留層への注水の効果をモニタリングしている。また、国内外の地熱フィールドで取得した微小地震に散乱・反射解析等の最先端の技術を適用し、貯留層内での流体挙動の把握を実現した。

Research on supercritical geothermal resources

Members of the laboratory have been investigating the feasibility of power generation using supercritical geothermal resources that originate in the subduction of oceanic plates in cooperation with scientists and engineers worldwide. Funded by NEDO, detailed feasibility studies are being carried out to establish several tens of GW of total capacity in 2050 from scientific, engineering, and economical points of view. METI has also funded our team for (a) development of simulators of dynamic and hydraulic behavior of supercritical rock bodies and (b) development of fundamental technologies and materials for supercritical boreholes.

Microseismic and magneto-telluric monitoring of geothermal reservoirs

Microseismic and magneto-telluric (MT) monitoring of geothermal reservoirs associated with treatment injection has been carried out at the Yanaizu-Nishiyama geothermal site in Fukushima since 2015 to reveal the response of the reservoir to water injection by researchers in the lab. Modern techniques in seismic signal processing, including reflection and scattering analyses, have been developed and applied to microseismic data sets from various geothermal sites worldwide, and the behavior of fluid inside and around geothermal reservoirs has been successfully imaged.

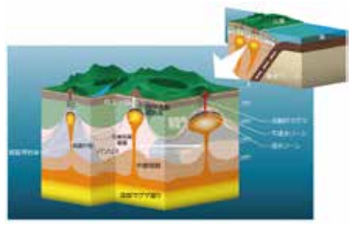

Fig.1 Typical supercritical geothermal system in Tohoku (Northeast Japan)

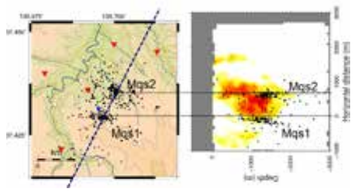

Fig.2 Microseismic imaging of geothermal reservoirs

Fig.3 Field experiment of monitoring system of hot-springs

適正な地熱開発手法に関する研究

地下や地域の特性に応じて総合的かつ柔軟に地熱システムの設計・開発を行うための方法論（Overall System Design: OSD）や加圧注水による貯留層の能力改善に関する研究を実施している。また、温泉と地熱発電の関連に関する科学的基礎データ取得を目的として温泉モニタリングシステムの開発や温泉・地熱地域用硫化水素モニタリングシステムの開発を行っている。

被災地企業の技術支援

復興予算を使用して、被災地企業が有する技術シーズの実用化支援事業を実施している。

国際貢献、社会貢献、他研究機関との連携等

●国際貢献
ドイツ、米国、イタリア、アイスランド等の国立研究所、大学、民間企業との国際共同研究を行っている。
●社会貢献・社会連携
浅沼：ICDP 委員，J-DESC 陸上掘削部会執行部委員，JFES Board Member，JOGMEC 地熱貯留層探査技術推進委員会委員，福島県における地熱資源開発に関する情報連絡会専門家部会委員，日本地熱学会評議員，同企画委員，同総務委員等
●他研究機関との連携
GFZ, LBNL, LLNL, BNL, SNL, USGS, BRGM, ベルリン自由大学，チューリッヒ工科大学，MIT, ITB, ISOR 等
●自治体，NPO 等との連携
福島県，山形県，郡山市，気仙沼市
●小中学校等との連携
浅沼：出前授業（3 回），公開講座（1 回）

Research on proper development of geothermal resources

A development methodology based on the concept of overall system design (OSD), which has a flexible nature to fit to social and subsurface conditions gradually revealed in the development, has been studied. We have also developed systems for monitoring gas and hot springs, which has enabled us to collect scientific data for environmentally/socially appropriate development.

Technological support of local industries

Technological support has been provided to seeds in local industries in the area damaged by the great 2011 earthquake and tsunami. Geothermal-related technologies have been developed under this scheme.

Contribution to international/society and collaboration with other organizations

●International contribution
International contribution to partners in Germany, the US, Italy, and Iceland have been made mainly in the area of ultra-high-temperature geothermal development.
●Social contribution
Prof. Asanuma has been a board member of international and domestic scientific drilling projects. He has also been a member of evaluation and advisory committees of governmental and local community agencies as well as a board member of academic societies.
●Collaboration with other organizations
The laboratory is collaborating with domestic and foreign national laboratories, universities, and industries. It is actively engaging in mutual visits, web communication, and joint publications.
●Collaboration with local communities
The lab has a long history of collaboration with local communities, mainly in northeast Japan (Tohoku) in the area of education of children and students. Prof. Asanuma has made three “delivery lectures” about renewable energy.

Fig.4 Development of optical fiber distributed sensor for supercritical geothermal wells

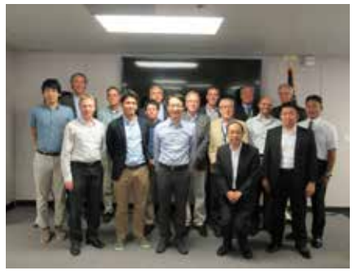

Fig.5 WS with researchers in US-DOE laboratories

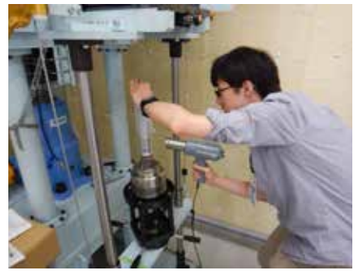

Fig.6 Experiment at FREA, AIST by graduate student of GSES