

「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

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教員・学生と連携し研究教育活動を行うとともに、経済産業省、新エネルギー・産業技術総合開発機構 (NEDO)、石油天然ガス・金属鉱物資源機構 (JOGMEC) 等からの委託を受け共同研究を実施している。

The members of the Environmental Risk Assessment (AIST Collaborative Laboratory) team 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 2019 included (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 engineered geothermal systems (EGS), (c) development of monitoring system of environmental burden associated with geothermal development, and (d) studies on social acceptance of geothermal development. Research and development to simulate industries in areas stricken by the 2011 earthquake have been 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。2040年以降に国内総容量数10GWの商用発電を実現するために、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・国内数地点を対象とした試掘への詳細事前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で、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、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するとともに坑井近傍の超高分解能探査技術の研究開発を実施している。

Research on supercritical geothermal resources

Members of the laboratory have been investigating the feasibility of power generation using supercritical geothermal resources, which have an origin in subduction of oceanic plate, in cooperation with scientists and engineers worldwide. With funding from NEDO, detailed feasibility studies have been conducted to establish several tens of GW of total capacity in/after 2040 from scientific, engineering, and economic perspectives. METI has also funded our team for (a) development of simulators of dynamic and hydraulic behavior of supercritical rock body and (b) development of fundamental technologies and material 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 Yanaizu-Nishiyama Geothermal Site in Fukushima since 2015 to reveal the reservoir's response to treatment 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. Moreover, fluid behavior inside/around the geothermal reservoirs has been successfully imaged.

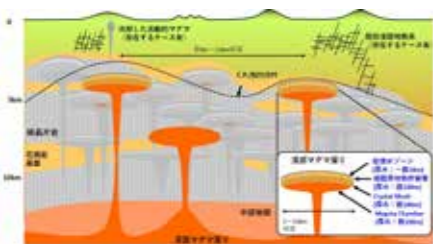


Fig.1 Model of typical supercritical geothermal system

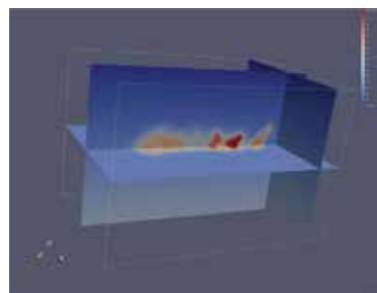


Fig.2 Simulation of creation process of EGS at FORGE site



Fig.3 Field test of binary power plant for hot springs



客員教授 浅沼 宏
Professor
Hiroshi Asanuma



客員教授 張 銘
Professor
Ming Zhang



客員准教授 坂本 靖英
Associate Professor
Yasuhide Sakamoto

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、NEDOからの委託を受け、温泉と地熱発電の関連に関する科学的基礎データ取得・評価のためのAI-IoT温泉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、ニュージー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、JOGMEC 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, PSU, ITB, ISOR 等
- 自治体、NPO 等との連携
福島県、山形県、郡山市、気仙沼市等
- 小中学校等との連携
浅沼: 出前授業 (4回)

Research on proper development of geothermal resources

Studies have been conducted to establish a development methodology under a concept of overall system design (OSD), which has a flexible nature to fit social and subsurface conditions gradually revealed in the development. Gas and hot spring system monitoring, which enables us to collect scientific data for proper development, has also been conducted in the lab.

Technological support of local industries

Technological support for startups of seeds in local industries in areas damaged by the 2011 earthquake and tsunami has been carried out. Geothermal-related technologies have been cultivated under this scheme.

Contribution to international/society and collaboration with other organizations

- International contribution
International contributions have been made to partners in Germany, the US, Italy, New Zealand, and Iceland, mainly in the area of ultra-high temperature geothermal development.
- Social contribution
Prof. Asanuma has been a board member of international/domestic scientific drilling projects. He has also been an evaluation/advisory committee member for governmental agents and local communities.
- Collaboration with other organizations
The laboratory is collaborating with domestic/foreign laboratories, universities, and industries. Mutual visits, web communication, and joint publication are actively done.
- Collaboration with local communities
Collaboration with local communities, mainly in northeast Japan (Tohoku), in the area of education of children and students has a long history in the lab. Prof. Asanuma made three "delivery lectures" about renewable energy.



Fig.4 Monitoring system of hot springs for coexistence of geothermal power generation and hot springs



Fig.5 A prototype of borehole scanner for geothermal wells



Fig.6 Outreach activity at FREA Open-day