

「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、新エネルギー・産業技術総合開発機構 (NEDO) からの委託等を受け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・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や遠方場地震の影響評価等を実現するとともに坑井近傍の超高分解能探査技術のFSを実施している。

Research on supercritical geothermal resources

In cooperation with scientists and engineers worldwide, members of the laboratory have investigated the feasibility of power generation using supercritical geothermal resources that originate in the subduction of the oceanic plate. With funding from New Energy and Industrial Technology Development Organization (NEDO), the laboratory has conducted detailed feasibility studies from the scientific, engineering, and economics points of view to establish several dozens of GW of total capacity by 2050. The laboratory's team has also received Ministry of Economy, Trade and Industry (METI) funding to develop (a) simulations of supercritical rock bodies' dynamic and hydraulic behavior and (b) fundamental technologies and materials for supercritical boreholes.

Microseismic and magneto-telluric monitoring of geothermal reservoirs

Since 2015, researchers from the laboratory have carried out microseismic and magneto-telluric monitoring of geothermal reservoirs associated with treatment injections at the Yanaizu-Nishiyama geothermal site in Fukushima in order to reveal the reservoir's response to such water injections. The team members have developed and applied modern techniques in seismic signal processing, including reflection and scattering analyses, to create microseismic data sets for various geothermal sites

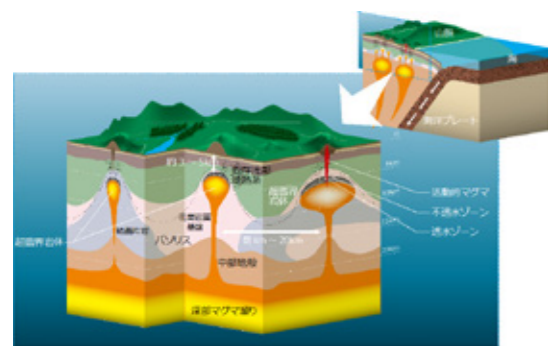


Fig.1 Model of typical supercritical geothermal system in Tohoku (Northeast Japan)

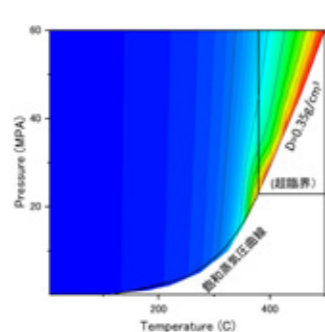


Fig.2 Estimated pH value of subcritical/supercritical fluid

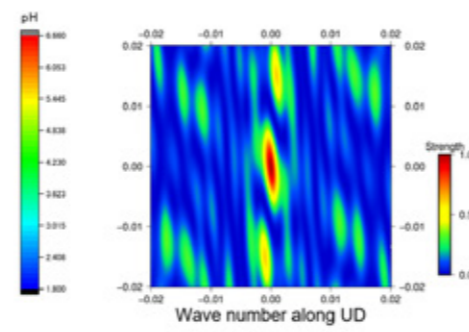


Fig.3 Array response of microseismic monitoring network of geothermal systems



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適正な地熱開発手法に関する研究

地下や地域の特성에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本年度から開始した。

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、フランス等の国立研究所、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、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 (6 回)、公開講座 (1 回)



Fig.4 Semi-commercial model of monitoring system of hot spring

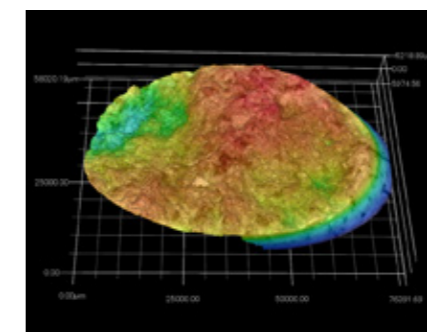


Fig.5 Surface photo of fracture in granite for permeability evaluation



Fig.6 Outreach activity at FREA Open-day

worldwide. They have also successfully imaged the behavior of fluids inside and around geothermal reservoirs to evaluate the impacts of teleseismic earthquakes.

Research on the proper development of geothermal resources

The laboratory is gradually developing studies to establish a development methodology that uses the concept of overall system design, which is flexible enough to fit the social and subsurface conditions. Monitoring of gases and hot springs has also enabled the laboratory's researchers to collect scientific data on the proper development of geothermic resources.

Technological support of local industries

The laboratory has provided technological support regarding seeds to local industries in the areas by the 2011 Tohoku earthquake and tsunami. Many geothermal-related technologies have been developed under this scheme.

Contributions to international society and collaborations with other organizations

- International contribution
The laboratory works with partners in Germany, the US, Italy, France, and Iceland—mainly in the area of ultrahigh-temperature geothermal development.
- Social contribution
Prof. Asanuma is a member of the boards for various international and domestic scientific drilling projects. He is also a member of evaluation and advisory committees for governmental agencies and local communities, as well as a member of the boards of various academic societies.
- Collaboration with other organizations
The laboratory collaborates with domestic and international laboratories, universities, and industrial organizations. This includes mutual visits, active web communications, and joint publications.
- Collaboration with local communities
The laboratory has a long history of collaboration with local communities, mainly in northeast Japan (e.g., Tohoku), to educate children. Prof. Asanuma has also delivered three lectures on renewable energy to students.