

「安全・安心」な地熱エネルギー・地殻の利用を目指して

Studies in the utilization of safe and secure geothermal energy and the earth crust

当講座には国立研究開発法人産業技術総合研究所・地質調査総合センター・地圏資源研究部門(茨城県つくば市)、および再生可能エネルギー研究センター(福島県郡山市)所属の研究者が兼務し、教育・研究活動を行っている。現在、本講座では先進社会環境学専攻および先端環境創成学専攻の教員・学生との連携し研究教育活動を行うとともに、「安心・安全」な地熱開発や地殻利用を目指し、基礎研究から応用研究までを一体的に実施している。

The Environmental Risk Assessment (AIST Collaborative Laboratory) is operated by researchers of the National Institute of Advanced Industrial Science and Technology (AIST), affiliated with the Research Institute for Geo-Resources and Environment (GREEN), Geological Survey of Japan (GSJ), in Tsukuba, Ibaraki, as well as the Renewable Energy Advanced Research Center (READ) in Koriyama, Fukushima. These researchers are engaged in both educational and research activities. Currently, the laboratory collaborates with faculty members and students from the Department of Environmental Studies for Advanced Society and the Department of Frontier Sciences for Advanced Environment. With the goal of promoting safe and secure geothermal development and the Earth's crust utilization, we pursue an integrated approach spanning from fundamental research to applied studies.

超臨界地熱発電に関する研究

本講座設立以来、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システムを利用した発電(超臨界地熱発電)の可能性を探ってきた。2021度からNEDOからの委託を受け、3年間の計画で国内有望地点での詳細事前評価および調査井の仕様策定等を行った。2020年代後半における調査井掘削・試験等を通じて超臨界地熱資源の存在実証を目指す。その後、2040年までに国内数か所での商用発電を実現し、さらに2050年には全国複数地点において10~20万kW規模の発電を行い、脱炭素、エネルギー安全保障に貢献する。

微小地震や自然電磁波による地熱貯留層の高度モニタリング技術開発

本講座では2015年以来、福島県奥会津地域や岩手県葛根田地域など国内の複数地熱地域において、微小地震モニタリングを通じた貯留層モニタリングや地下構造評価等を実現してきた。高精度地

Research on supercritical geothermal power generation

We have worked with domestic and international researchers to explore supercritical geothermal systems. Since fiscal year 2021, a three-year project commissioned by NEDO has focused on detailed evaluations of promising sites in Japan and on developing specifications for exploratory wells. Through well drilling and testing in the late 2020s, the project is intended to demonstrate the existence of supercritical geothermal resources.

Looking ahead, commercial power generation by 2040, followed by nationwide deployment by 2050 will contribute to decarbonization and energy security.

Microseismic and magneto-telluric monitoring of geothermal reservoirs

Since 2015, this laboratory has carried out reservoir monitoring and subsurface structural evaluation through micro-seismic monitoring at multiple geothermal fields in Japan, including Okuaizu in Fukushima and Kakkonda in Iwate. Our research includes identifying high-

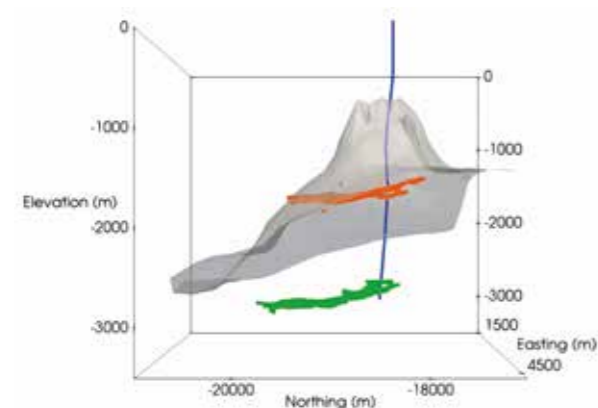


Fig. 1 Seismic reflectors originating from a possible supercritical geothermal reservoir within the Kakkonda granite.

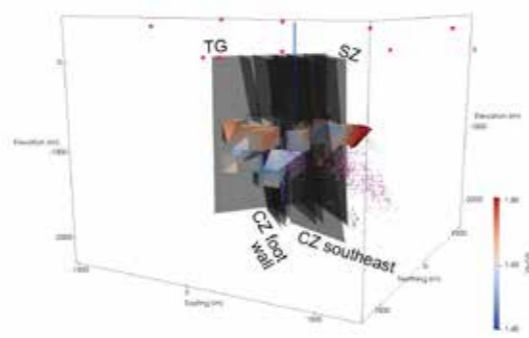


Fig. 2 Macroscopic fluid pathways in a geothermal reservoir identified by seismic wave tomography



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震波トモグラフィによる高透水領域の把握、深層学習による地震波到来時刻検出法の開発、地震統計学に基づく注水効果の評価など、多岐に渡る研究開発を実施した。また、地熱地帯における自然電磁波を用いた貯留層高度評価に関する研究や、機械学習を用いた次世代型地熱貯留層評価手法の研究も実施中である。

生分解性キレート剤を用いたCO₂地中貯留・鉱物固定促進に関する研究

エネルギー資源学講座・エネルギー資源リスク評価学分野(渡邊研究室)との連携の下で、CO₂地中貯留・鉱物固定促進を目的として、室内試験の結果に基づき、生分解性キレート剤の利用による鉱物溶解挙動に関する数値解析モデルの構築に取り組んでいる。

被災地企業の技術支援

F-REIからの委託事業として、被災地企業が有する地熱関連技術シーズの実用化支援を実施している。

国際連携、社会貢献、他機関との連携等

- 国際連携
岡本: Academia Sinica (台湾)主催のワークショップでの招待講演、および次年度以降の共同セッション(JpGU)の開催等。
- 社会貢献
岡本: 物理探査学会学術講演委員、日本地熱学会総務委員等
- 他機関との連携
岡本: 福島県主催の展示会でのセミナー開催、郡山市歴史情報博物館での企画展示への協力、他大学・民間企業との共同研究等

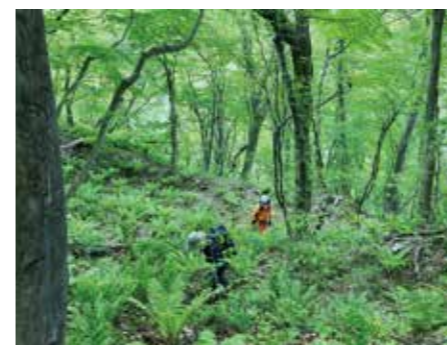


Fig. 3 Magnetotelluric (MT) survey conducted in a mountainous area

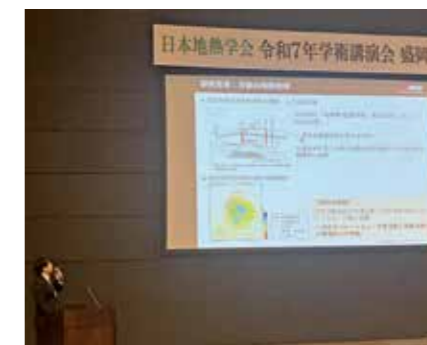


Fig. 4 Student presentation (Naoki Aoyagi, D2) at the annual meeting of the Geothermal Research Society of Japan



Fig. 5 Best Paper Award of the Society of Exploration Geophysicists of Japan awarded to Assoc. Prof. Okamoto

permeability zones using high-resolution seismic tomography, developing deep-learning-based methods for seismic arrival time detection, and evaluating injection effects based on statistical seismology. We are also pursuing advanced reservoir characterization using natural electromagnetic signals and next-generation geothermal evaluation methods based on machine learning.

Research on the promotion of CO₂ geological storage/CO₂ fixation by mineral matter through the utilization of the biodegradable chelating agent

In collaboration with the Laboratory for Resources and Energy Security (Watanabe lab.), for the purpose of promotion of CO₂ geological storage/CO₂ fixation by mineral matter on the basis of the results of laboratory experiments, we are developing the numerical analysis model for the dissolution behavior of mineral components through the utilization of biodegradable chelating agent.

Technological support of local industries

Under a commissioned project from F-REI, we support the practical application of technological seeds held by companies in disaster-affected regions by the 2011 earthquake and tsunami.

Contributions to international society and collaboration with other organizations

- International contributions
Okamoto: Invited lectures at workshops organized by Academia Sinica (Taiwan) and the organization of joint sessions at the upcoming JpGU meeting.
- Social contributions
Okamoto: Service as a committee member of the Society of Exploration Geophysicists of Japan and of the Geothermal Research Society of Japan.
- Collaboration with other organizations
Okamoto: Organization of seminars at exhibitions hosted by Fukushima Prefecture, cooperation in special exhibitions with Koriyama City, and collaborative research with other universities and private companies.