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aXis BAGUS Project News

BAGUS Project is now aXis BAGUS Project

aXis BAGUS *- Accuracy Improvement and Demonstration by Boring Survey of Steam-Spot Detection Technology for Locating Drilling Sites of Geothermal Production Wells -*

Greetings from the Leaders

I am very pleased that we can extend and develop furthermore the SATREPS BAGUS project as a new JST aXis (Accelerating Social Implementation for SDGs achievement) project and with a new title, aXis BAGUS project. One of the most blessed point of the new project is that we can confirm the effectiveness and accuracy of the methods for Steam-Spot detection developed by the SATREPS project through an actual drilling survey.

For large decrease of carbon dioxide emission, promotion of the utilization of geothermal power is needed. The new project aims to develop technologies for locating accurately a suitable portion, a Steam Spot for drilling a production well for geothermal power generation from the ground surface using a combination of remote sensing, geochemistry, mineralogy, and numerical simulation. The Patuha geothermal field, West Java, Indonesia is selected as a study area, and the research will be advanced in collaboration with the ITB team including ITB, Geo Dipa Energi, CMCGR* and other collaborators. Research contents include 3D fracture modeling using high-precision topographic data, radon concentration measurement at many shallow drilling points, estimations of reservoir temperature and fluid origin by water and gas geochemistry, simulation for fluid flow and specification of liquid or vapor rich zones, and potential-map production of Steam-Spot existence by integrating these results using geostatistical methods.

Exploration drilling sites are narrowed down to two based on subsurface resistivity distribution by electromagnetic survey at high potential zones. The existence of Steam Spot potential is verified through temperature, pressure, and mineralogical data obtained by the drillings down to about 500 m depth (tentative). Social implementation of the research result will contribute to a large increase of geothermal power generation by reducing resource-exploration cost.

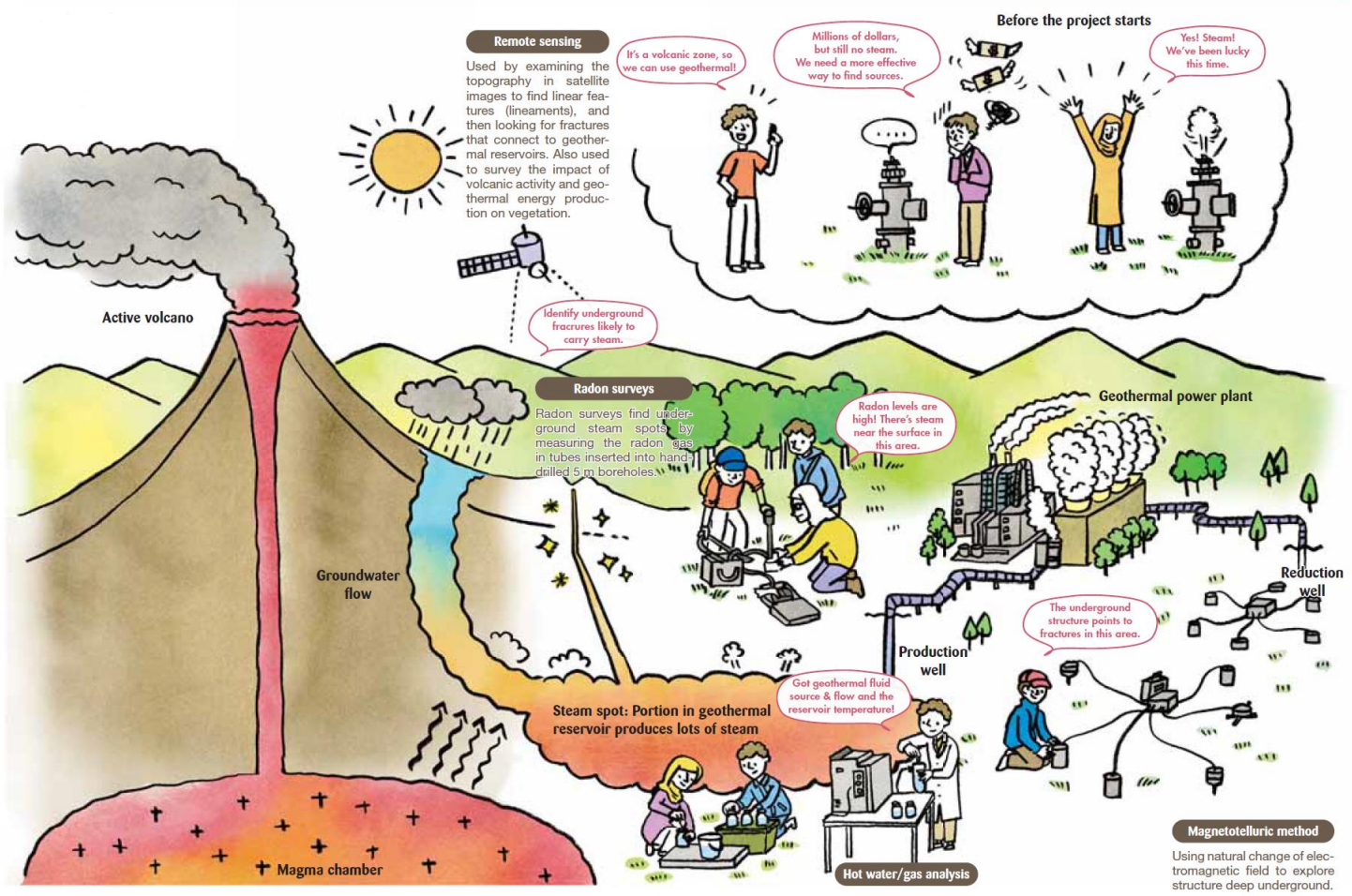
The aXis BAGUS project was officially started in April 2020 and the COVID-19 pandemic has already been prevalent. Because of this, the Kyoto University team has still been unable to visit ITB and Patuha and we cannot predict when the field visits and the joint survey can become possible. Although the situation is not favorable to us at all, we hope that we can advance the SATREPS BAGUS project and obtain excellent research achievements. In addition, I appreciate deeply the great effort and sincere collaboration of the ITB team for proceeding with the project under this situation.

Katsuaki Koike (Leader of aXis BAGUS project, Professor of Graduate School of Engineering, Kyoto University)
Sudarto Notosiswojo (Project Director of Indonesia team, Professor of Faculty of Mining and Petroleum Engineering, ITB)

*CMCGR: Center for Mineral, Coal and Geothermal Resources, Ministry of Energy and Mineral Resources

BAGUS Project appeared in JST's 2020 SATREPS brochure's main pages. Below is a snippet of the article.
See full information on the following page:
https://www.jst.go.jp/global/english/public/shiryo/satreps_brochure_e_web.pdf

Technology Development for Large Enhancement of Steam-spot Detection and Sustainable Resource Use of Geothermal Power Generation in Indonesia



Technology developed for precise identification helps cut initial costs

Identifying locations suitable for geothermal energy production usually requires deep drilling, incurring high initial costs. Moreover, test drilling sometimes fails, and the combination of high initial costs and large operating risk meant that new exploration had not made much progress. This project combined remote sensing techniques with geochemistry and mineralogy techniques to develop technology that could identify optimal locations (steam spots) for geothermal energy production with greater precision. The aim was for technology that cut both initial costs and operating risk, thereby contributing to the progress of geothermal exploration in Indonesia.

Optimization systems help ensure long-term use of geothermal energy

The project developed technology for precisely identifying optimal locations (steam spots) for geothermal energy production. This reduces the number of exploratory drillings required, which can cut initial costs. The project also developed environmental monitoring technology that enables use of geothermal energy in harmony with the environment, and optimization systems that help to ensure that the geothermal energy can continue to be used in the long term. These technologies make it possible to increase the proportion of Indonesia's energy provided by geothermal energy sources, which can help to meet the country's expected growth in demand for energy, and can potentially help to achieve large cuts in carbon dioxide emissions.

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Research Activity Progress

Due to COVID-19, both the ITB and Kyoto University (KU) teams experience severe limitations on their research activities. KU team cannot make fields visits and laboratory works at ITB has been adjusted to comply with the COVID-19 health protocols. Foreign travels, although recently has been conditionally permitted again, the aXis BAGUS project coordinator and KU researchers cannot visit Indonesia yet due to restriction on foreign travel by Kyoto University.

For the time being, the ITB team has been continuously carrying out the research despite some restrictions. ITB has come to an agreement with PT Geo Dipa Energi (GDE) to allow ITB researchers to enter the Patuha site for field research anytime.

On August 6th, 2020, ITB and GDE team had a coordination meeting in the CMCGR office and visited their workshop to check the drilling machine and equipment to be used for the temperature core hole (TCH) drilling survey at Patuha.

ITB and CMCGR team was invited by GDE to have coordination meeting at Ciwidey on August 18th-19th, 2020 to discuss the criteria to define the two TCH drilling sites at Patuha. A site visit to follow up the meeting was conducted as well to check the location of water supply resources.

On October 28th-29th, 2020, the ITB Team conducted a TEM (Transient Electromagnetic) survey at the two locations of TCH sites (TCH-A and TCH-B). The target of this survey is to get the images of subsurface structures which may contribute to a permeability zone of hot steam flow.

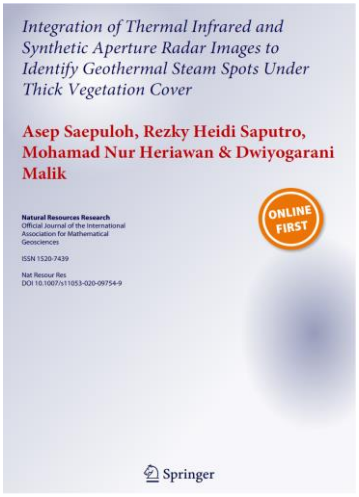
In order to facilitate ITB team in the field research, the KU team is providing a drone and another RAD7 machine. The two equipment will be shipped from Kyoto and available in Bandung in November onward.

The aXis BAGUS team is aiming to finalize drilling work the latest in February 2021.

Auger drilling in Patuha Geothermal Field to monitor radon, mercury and other gases (Photo: July, 2020)

Recent Paper/Journal Acceptance

We are delighted to announce another paper acceptance by aXis BAGUS team. Titled "Integration of Thermal Infrared and Synthetic Aperture Radar Images to Identify Geothermal Steam Spots Under Thick Vegetation Cover" by Dr. Eng. Asep Saepuloh, Mohamad Nur Heriawan, Ph.D, along with Mr. Rezky Heidi Saputro from Batam Indonesia Free Zone Authority (BIFZA) and Mrs. Dwiyogarani Malik from Star Energy Geothermal (Wayang Windu) Ltd., the paper was publised in Natural Resources Research, Official Journal of the International Association for Mathematical Geosciences. See more: https://link.springer.com/article/10.1007/s11053-020-09754-9



Integration of Thermal Infrared and Synthetic Aperture Radar Images to Identify Geothermal Steam Spots Under Thick Vegetation Cover

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Identifying physical properties of geothermal features such as surface temperature and roughness is crucial for geothermal assessment, hydrology, and environmental studies. Surface temperature and roughness-related rock properties strongly influence the thermal infrared and back-scattering intensities, respectively, of synthetic aperture radar (SAR) images. This study aimed to identify geothermal steam spots based on the surface temperature and roughness of altered surfaces, mud pools, and hot springs in tropical conditions. The thermal emissivity separation method was adopted to calculate kinetic temperature using the thermal infrared (TIR) of the advanced spaceborne thermal emission and reflection radiometer (ASTER) data as well as ground temperature data. Surface temperatures calculated by the thermal emissivity separation method were corrected using measured ground temperatures to eliminate the effects of atmospheric absorption, thermal inertia of materials, and/or diurnal temperature in the images. In addition, the linear fitting method was applied to obtain the final surface roughness model based on the calculated determination coefficient (R^2) between the initial surface roughness model derived by Sentinel-1A SAR and field data. The highest R^2 between surface roughness values from Sentinel-1A SAR and field data were selected to calculate spatially the surface roughness of the Wayang Windu Geothermal Field, West Java, Indonesia. The satellite imagery and field measurements showed that surface temperature and roughness features correlate with each other, and high and low thermal features correlate with high and low surface roughness values, respectively. Accordingly, we integrated the TIR and SAR data to propose the thermal resistivity index (TRI) as an indicator of the hydrothermal fluid paths to the surface. Low TRI was encountered at geothermal features and intersections of subsurface faults, which indicated weak zones that radiate heat from the subsurface to the surface.

KEY WORDS: Geothermal, Thermal, Roughness, Radar, Sentinel-1A.