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Remote sensing for energy resources: Introduction

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Editorial

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Energy resources are critical for human existence. The energy that we use is obtained from the Earth, its atmosphere, or the Sun. Some of these energy resources we obtain from the subsurface through the mining or extraction process, like gas, coal, oil, geothermal, and uranium. Furthermore, we also harness from the surface like wind, solar, and tidal. Geoscientists and geological engineers play a critical role in developing energy resources, maintaining its operation, and evaluating their environmental impacts. In recent years, the advancement in satellite and aerial remote sensing is a tool that is widely used by geoscientists and engineers to address various aspects of energy resources. The application of remote sensing to energy resources, starting from reconnaissance to detailed studies, utilizing multispectral to hyperspectral and radar to LiDAR techniques, have gained significant importance. Some remote sensing applications include identifying potential source of fuels used in the energy

Like detection of the coal fire; surface exposure of oil; spouting of thermal water in hot springs; site characterization to construct power plants like thermal, nuclear, and hydropower; and identification and monitoring of geohazards associated with the energy sector like subsidence due to the extraction of oil and ground instability during the operation of energy resources.

In this special issue of *Energy Geoscience* we include eight articles dealing with the application of remote sensing techniques in the field of energy resources. Energy resources deal with determining the available capacity of energy production given all resources. As several different energy sources are available, characterizing their spatial distribution and understanding the various factors that impact them is critical for energy security. Remote sensing tools are widely used for earth and planetary observations. The global coverage and the high spatial and temporal resolution that remote sensing provides make them an ideal tool for monitoring and managing resources. This special issue includes case studies that demonstrate the innovative application of remote sensing tools for energy resources starting from energy resources associated with meteorite impact craters to hydroelectric power projects.

Studying mineralization associated with meteorite impact craters has an equally-matched function: mineral deposits can aid the recognition of impact craters, and craters can also help identify more mineral deposits. The study focuses on select craters that host mineralization, focusing on minerals used for energy resources and showing how remotely sensed images are used to identify the mineral-hosting. James et al. 2022, this issue provides a holistic view of the mineral and energy resources associated with meteorite impact craters utilizing remote sensing techniques. Apart from a global review, the paper mainly presents the application of remote sensing to identify the mineral deposits associated with some impact craters.

Spectroscopy techniques are widely used in different disciplines of earth sciences. Tohm et al. 2022, this issue presented a review of the used in the agriculture, landfill, nuclear power, mining, and ground contamination industries to produce energy. This paper provides a general overview of how spectroscopy is used in each industry, its benefits, and limitations. The paper presents a framework that can be utilized for characterizing energy resource sites.

Interferometric Synthetic Aperture Radar (InSAR) has become an unparalleled and uncompetitive technique in remote sensing. Aswathi et al. 2022, this issue provide a review of InSAR, a microwave remote sensing technique to monitor the condition of hydroelectric power projects that are a critical energy resource infrastructure. The paper highlights the benefits of the InSAR-based monitoring that provide data at all times of day or night, in all weather conditions, and for large spatial extends with mm-scale precision. The paper also points out some of the limitations, such as the maximum deformation rate that can be monitored and the location for monitoring cannot be dictated. In addition to the review, the paper also presents case studies from Southern India to demonstrate the capabilities of InSAR to monitor dam health directly.

Roy et al. 2022, this issue illustrate the applicability of thermal remote sensing in understanding the seasonal and temporal variations of the temperature difference between the discharge of warm water from the thermal power plant and the ambient seawater. The analysis was carried out for 11 months of 2018 for a Coastal Gujarat Power Limited project. Results show consistent patterns in most months.

Contrarily to the benefits of harnessing energy resources, mining of certain energy-producing mineral deteriorate the environment. Alam and Sepulveda 2022, this issue investigate Laguna Santa Rosa's (LSR) vulnerability resulting from the ongoing metal mining operation that requires a large volume of water extracted from local aquifers, in addition to a high evaporation rate in the area. The region has several Lithium (Li) mining operation that puts enormous pressure on the region's fragile and poorly understood wetland ecosystems. The study concludes that close monitoring of the wetlands like LSR is essential to ensure their sustainability considering the anthropic and climatic factors.

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Mazumder and Misra 2022, this issue present a detailed spectral and GIS-based analysis to identify areas of microseeps indicating potential hydrocarbon accumulations in the northern part of the Chambal valley. The results of this analysis have been validated using extensive fieldwork and geophysical data. Based on the spectral and morphostructural analysis, a number of potential areas of hydrocarbon exploration have been identified in the area.

Nabeel et al. 2022, this issue present the evaluation of shale types on hydrocarbon potential using well logs and cross-plot approach at Halewah oilfield, Sab'atayn Basin, Yemen. The study utilizes gamma-ray log and neutron-density porosity cross-plots to estimate a reservoir's shale volume (Vsh). Results show that the quantitative assessment of shale type distribution and Vsh by crossplot approach could not furnish correct information to evaluate massive shale intervals.

Praveen et al. 2022, this issue present an excavation carried out in a proposed concrete gravity dam site on the right bank slope of the Punatsangchhu River in western Bhutan. The site experienced several slope failures that forced the need for real-time monitoring of the slope to facilitate further excavation. Thus, Interferometric Survey-Frequency Modulated (IBIS-FM) radar was deployed at the study location. The study showcases the efficiency of IBIS-FM radar in monitoring slope instability during excavation at the dam site with sub-millimeter accuracy on a near real-time basis.

The guest editors would like to express our sincere appreciation to the Editor-in-Chief, Dr. Z.Q. Feng, for the guidance throughout the process. Prof. M. Santosh, Advisor to Energy Geoscience, is highly thanked for the motivation and involvement in accomplishing the requirements for this special issue. The leadership provided by the Journal was valuable in organizing the articles and publishing the issue within the schedule. We also want to take this opportunity to thank the reviewers for their time and effort in the review and critique of the submissions to carry out a rigorous peer-review process. The journal support staff has helped us in the timely processing of all the articles. We hope the issue will be valuable for the research community and will encourage further explorations on the application of remote sensing for energy resources.

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