



Wednesday Talk Series

Date: Wednesday, October 29, 2025

Time: 04:00 PM-5:00 PM

Venue: Mithal Hall, Department of Earth Sciences, IIT Roorkee



Application of Rock Physics and Digital Rock Physics in the Geological Carbon Storage

Speaker: Nitin Nagarkoti



Abstract: Geological carbon storage (GCS) is a critical strategy for reducing atmospheric CO₂ emissions and mitigating climate change. Basaltic formations have emerged as a promising reservoir due to their high reactivity with CO₂-rich fluids, leading to rapid mineralization and permanent sequestration. This study shows conventional rock physics and digital rock physics (DRP) approaches to evaluate and predict the CO₂ storage potential in basalt reservoirs. Rock physics modeling is employed to quantify elastic property variations induced by changes in pore structure, saturation, and mineralogical alteration during CO₂ injection. These models help establish robust relationships between seismic and petrophysical parameters, enabling reliable monitoring of reservoir integrity. Complementarily, DRP techniques, including micro-computed tomography (micro-CT) imaging, image segmentation, and numerical simulation, are utilized to capture pore-scale heterogeneity, fluid flow behavior, and geomechanical responses. By combining laboratory ultrasonic measurements with pore-scale simulations and field-scale well log interpretation, this study demonstrates a comprehensive workflow for assessing CO₂ trapping efficiency, permeability evolution, and long-term storage security in basalt. The integrated methodology enhances predictive accuracy and reduces uncertainties in subsurface characterization, ultimately supporting the safe deployment and monitoring of CCS projects in basalt formations.

Brief introduction: Mr. Nitin Nagarkoti is a Ph.D. Scholar in the Department of Earth Sciences, IIT Roorkee, working under the supervision of Prof. Ravi Sharma. His doctoral research focus on the change in seismic properties of basalt formations upon the CO₂ injection. His work integrates cores, well logs and digital rock volumes to characterize pre- and post-CO₂ injected basalts. He has done B.Sc. Physics (Hons.) from Deen Dayal Upadhyay College, Delhi University and M.Sc. (Tech.) Applied Geophysics from Kurukshetra University.