Wednesday Talk Series
Date: Wednesday, September 17, 2025
Time: 04:00 PM-5:00 PM
Venue: Mithal Hall, Department of Earth Sciences, IIT Roorkee

Influence of Saturation on the Mechanical Properties of Reservoir Rock and its Thermal Response under Inert and Oxic environments

Speaker: Mohd Sharique Siddiqui

Abstract: Geological storage of CO_2 can influence specific mechanical risks during injection into hydrocarbon reservoirs. The mechanical and thermal stability of reservoir rocks is crucial for long-term stability and safety during carbon sequestration. This study examined the mechanical and thermal stability of Dholpur sandstone (DS) and Gondwana sandstone (GS) under different fluid saturation and environments. Several tests were conducted to understand the mechanical properties of DS and GS samples under saturated conditions. Petrographic and X-ray Diffraction (XRD) analysis of DS specimens indicated that this sandstone is primarily constituted of quartz, with low quantities of kaolinite. GS samples predominantly consist of quartz, feldspar, kaolinite, and muscovite. This strength reduction was attributed to the wetting-softening effect under brine and water saturation conditions and due to the corrosive action of CO_2. A maximum strength reduction was reported in GS specimens due to a higher amount of clay mineral dissolution compared to DS specimens. Thermogravimetric analysis (TGA) investigated the weight loss behaviour of both sandstone samples under inert (Argon) and oxic (O_2) environments from 25°C-1000°C. The results indicated that samples treated in an inert environment lost more weight than those treated in an oxic environment for both DS and GS specimens. The Differential Thermal Analyzer (DTA) curve findings illustrated that α-quartz converted to β-quartz (573°C), followed by an endothermic valley during the quartz phase transition and kaolinite dehydrogenation at 470°C-540°C. Overall, the weight loss behaviour of the samples shows that DS specimens are more thermally stable than GS specimens. From the experimental analyses, both DS and GS sandstones with CO_2 saturation showed minimal strength reduction compared to other saturation scenarios, indicating mechanical stability under CO_2 saturation. The experimental findings are anticipated to improve comprehension of the mechanical and thermal stability of reservoir rocks for carbon sequestration.

Brief introduction: Mohd Sharique Siddiqui is a Prime Minister's Research Fellow in the Department of Earth Sciences, IIT Roorkee, working under the supervision of Prof. S.P. Pradhan. He has passed his B.Sc. (Hons.) Geology with distinction from Aligarh Muslim University, Aligarh, and M.Sc. Geology from Banaras Hindu University, Varanasi. His research interests focused on the Influence of Saturation on the Mechanical Properties of Reservoir Rock and its Thermal Response under Inert and Oxic Environments in Vindhyan and Gondwana rock formations.