CERAMAH TEKNIK TECHNICAL TALK

Carbon sequestration in conventional and unconventional hydrocarbon fields

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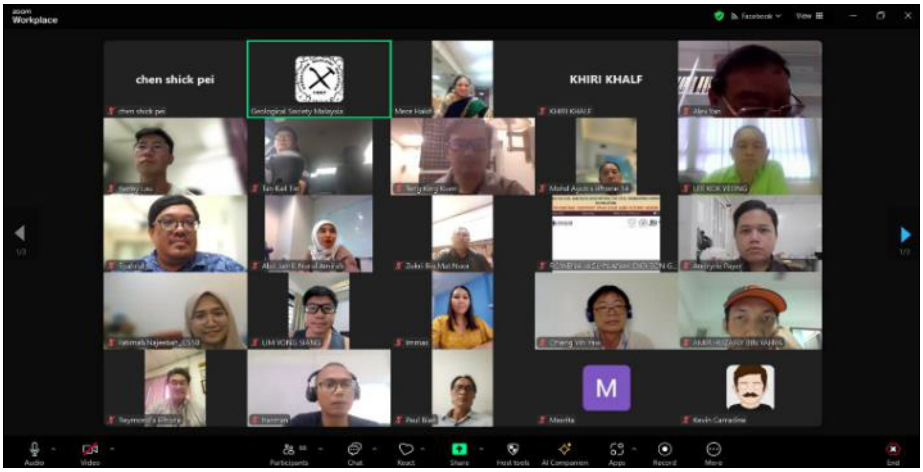
Date: 22 November 2024
Venue: Department of Geology, Universiti Malaya and Zoom

Moderator: Dr. Arindam Chakraborty, Senior Lecturer, Department of Geology, UM

On 22nd November, 2024, Department of Geology, Universiti Malaya in partnership with Geological Society of Malaysia hosted a technical talk titled "Carbon sequestration in conventional and unconventional hydrocarbon field". The talk was delivered by Dr Nimisha Vedanti (CSIR-NGRI) in hybrid mode from the DKG, Department of Geology, Universiti Malaya, Kuala Lumpur. Around 10 members participated offline and 107 online through zoom and others viewed through GSM Facebook live (https://fb.watch/w46AMbaWR9/). Both the online and offline participants interacted with her.

Abstract of the talk: Carbon storage in geological formations is an essential strategy for reducing atmospheric CO_2 emissions, and it involves injecting CO_2 into deep underground reservoirs. These reservoirs can be classified into conventional, unconventional, and basalt formations, each with its own storage mechanisms and potential for CO_2 sequestration. Geophysical data plays a critical role in evaluating and ensuring the efficiency and security of these storage processes. Additionally, unconventional reservoirs offer the added benefit of enhanced recovery of cleaner energy sources such as coal bed methane (CBM) and shale gas while simultaneously storing CO_2. In conventional reservoirs, such as sandstones and carbonates, CO_2 is injected into porous and permeable rocks that are sealed by impermeable caprocks, like shales, ensuring the CO_2 remains trapped. The primary storage mechanisms are structural trapping, where CO_2 accumulates under the caprock, residual trapping, where CO_2 is immobilized in pore spaces, and solubility trapping, where CO_2 dissolves in formation water. Theoretical storage capacity in conventional reservoirs is determined by the total pore volume available for CO_2 injection, but practical storage capacity is typically lower due to operational constraints such as heterogeneity of the reservoir and injection limitations. Geophysical data, including seismic surveys and well logs, are essential for accurately mapping the geometry of the reservoir, assessing the integrity of the caprock, and ensuring the CO_2 is securely stored in the target formation. In unconventional reservoirs, such as coal beds and shale formations, CO_2 is stored in addition to facilitating the recovery of cleaner gas resources. In coal bed methane (CBM) reservoirs, CO_2 injection enhances methane recovery by adsorbing onto coal surfaces, displacing methane in a process known as CO_2-Enhanced Coal Bed Methane Recovery (CO_2-ECBM). This results in a cleaner, higher-quality methane product. In shale gas reservoirs, CO_2 is injected to improve methane production by adsorbing onto organic-rich materials in the shale and by fracturing the formation to enhance permeability. In these reservoirs, theoretical capacity refers to the total adsorptive capacity of the coal or shale, while practical capacity accounts for factors like gas extraction efficiency, fracture performance, and the ability of the formation to retain CO_2. Geophysical techniques like microseismic monitoring and fracture mapping are critical for optimizing gas recovery and ensuring CO_2 remains securely trapped in the formation. Basalt formations present a unique opportunity for permanent CO_2 sequestration through the process of mineral carbonation, where CO_2 reacts with minerals like calcium and magnesium to form stable carbonates, such as calcite and magnesite. This process locks CO_2 in a solid form, effectively immobilizing it for thousands of years. Theoretical capacity in basalts is based on the mineralogical potential of the formation to react with CO_2, but practical capacity is influenced by factors like injection efficiency, reaction rates, and the permeability of the formation. Geophysical data plays a crucial role in selecting suitable basalt sites by mapping the fracture networks and determining the best areas for CO_2 injection, which ensures the process proceeds effectively. Geophysical data is essential throughout all stages of carbon storage. It helps characterize reservoir properties like porosity and permeability, defines potential storage capacities, and monitors the CO_2 plume once injected. Techniques. However, while making recommendations uncertainties associated with the estimates must be considered.

We thank Dr Nimisha for her support and contribution to the Society's activity.



Online participants.

Dr Nimisha presenting.


Felicitating the speaker by Assoc. Prof. Dr. Meor Hakif Bin Amir Hassan.

Prepared by,
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22nd November 2024