Introduction

Malaysia's Carbon Capture and Storage (CCS) strategy requires the identification of suitable geological formations with high storage potential. The Mega Carbonate Platform (MCP) saline aquifer has emerged as a strong candidate due to its favorable geological setting, existing infrastructure, and strategic location. However, evaluating its suitability poses significant challenges, including limited well control, variable seismic data quality, and complex carbonate facies such as talus deposits.

To address these uncertainties, seismic reservoir characterization was selected as the starting point for subsurface evaluation. This paper outlines the integrated geoscience workflow developed to assess the MCP's storage capacity and reservoir quality under data-constrained conditions. The results highlight the critical role of seismic analysis in enabling early-stage CCS screening and advancing the understanding of carbonate saline aquifers in Malaysia.

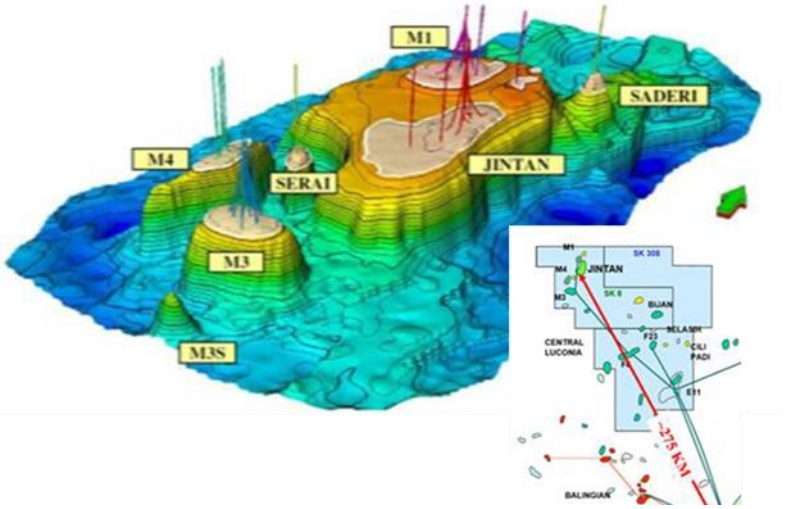

Figure 1: Mega Carbonate Platform location in Sarawak basin

Method

Due to the absence of well data at the target saline aquifer level, Anisotropic Pre-Stack Depth Migration (APSDM) seismic velocities were employed as the primary input for constructing low-frequency models essential for seismic inversion. This approach enabled a data-driven foundation for reservoir property prediction in a complex carbonate setting.

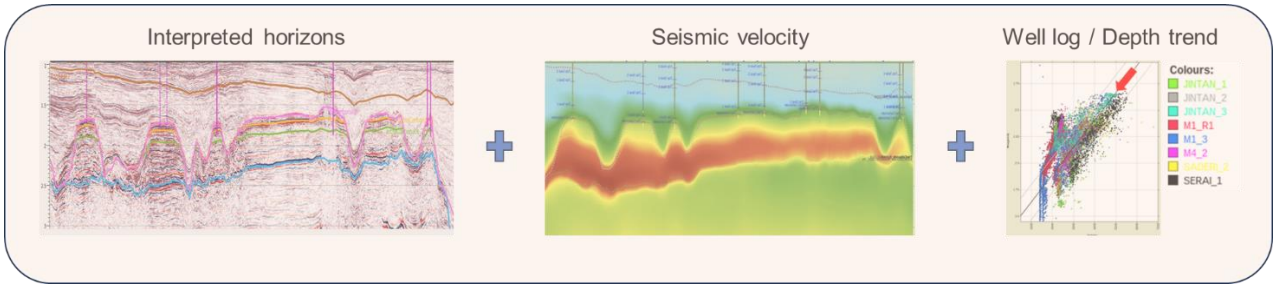

Figure 2: Multi-discipline data inputs for seismic characterization process

A rigorous, multidisciplinary quality assurance and quality control (QA/QC) process followed, focusing on the interpretation of the Top Carbonate surface and intra-carbonate stratigraphy. This phase integrated insights from carbonate sedimentology and petrophysical analysis to refine seismic interpretation and ensure geological consistency across the reservoir framework. The porosity volume derived from seismic inversion was identified as a critical input for static reservoir modeling. To enhance model accuracy, available 4D seismic data were incorporated to characterize and calibrate properties within the talus-dominated reservoir zones. Additionally, shallow well log data were utilized to support calibration, improving both static and dynamic modeling outcomes through better vertical property distribution and facies representation.

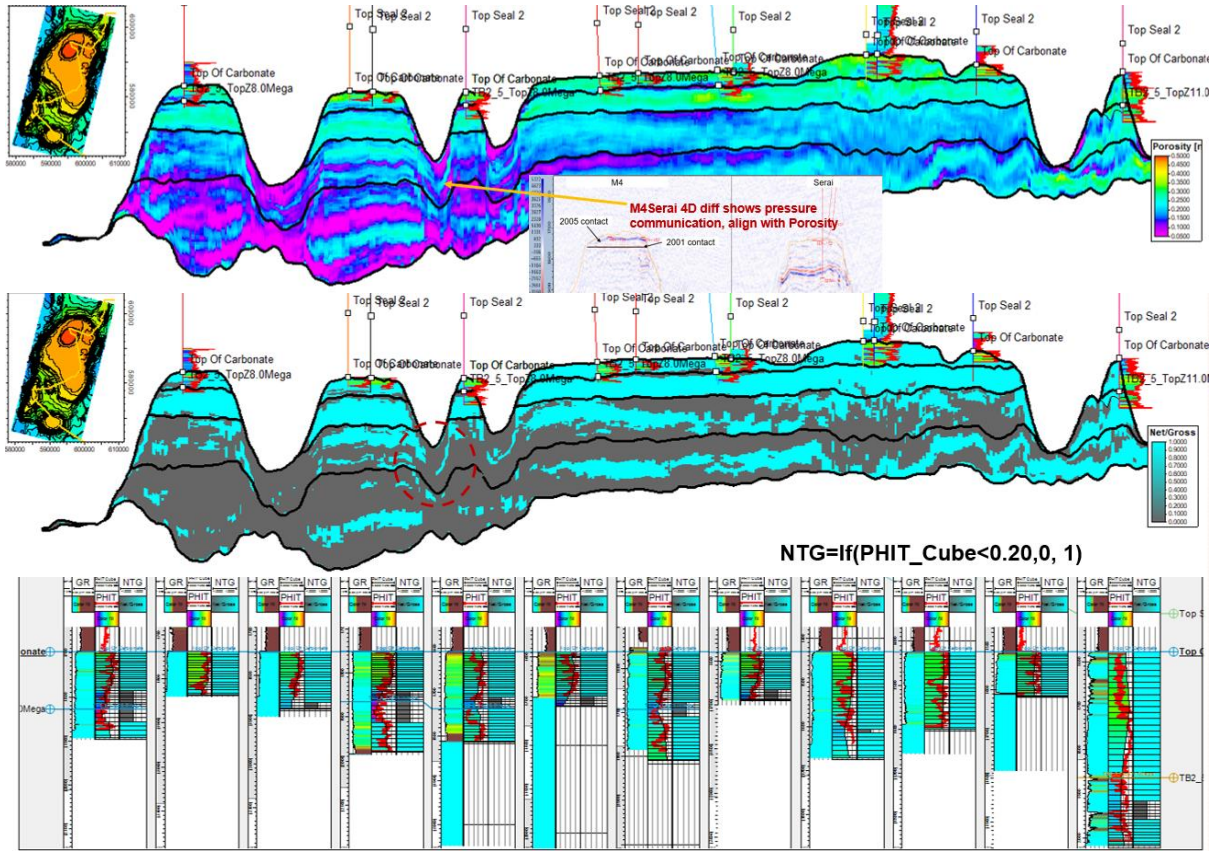

Figure 3: Integrated inputs for reservoir modeling results

Conclusions

This study confirms that a seismic-led, multidisciplinary approach can effectively address data limitations in early-stage CCS screening of carbonate saline aquifers. The MCP evaluation showcases how integrated reservoir characterization can yield reliable property volumes to inform storage capacity assessments.

- APSDM seismic velocities and inversion techniques successfully compensated for the lack of well data at deep interval, enabling the generation of 3D porosity volumes for static modeling.
- Rigorous QA/QC integrating sedimentology and petrophysics ensured robust seismic interpretation and geological consistency.
- The MCP workflow provides a scalable framework for evaluating other data-limited carbonate saline aquifers within Malaysia's CCS roadmap.

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