An Integrated Basin Screening Approach to Identify Carbon Storage Potential in the Java Sea

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Abstract

Indonesia is a rapidly industrialising economy, which also needs to balance its carbon emissions in line with climate legislation, including the recent COP28 obligations (UNFCC, 2023). Therefore, it's critical to explore carbon abatement options including advantaged hydrocarbons, transitioning to renewable energy sources, and offsetting existing carbon emissions though CCS.

Offshore Java has multiple mature petroleum provinces within the Northwest Java Basin and East Java Basin (Schenk et al., 2020). Studies suggest there are several stacked reservoirs of Miocene age present for potential carbon storage including the Parigi, Massive, Main and Batu Raja formations in Northwest Java Basin (Marbun et al., 2012). Also, the Ngrayong and Kujung formations in the East Java Basin (Santoso et al., 2018). The presence of saline aquifers and depleted petroleum fields in the region, coupled with existing production infrastructure aids the strategic advantage for future industrial-scale carbon sequestration projects, including the recent collaborative agreement to develop a decarbonization program with a CCS hub in the Java Sea (Reuters, 2023).

This presentation highlights our improved understanding of the carbon storage potential and ranks the key Miocene reservoir zones within the Northwest Java and East Java basins, using composite common chance maps created from an integration of subsurface models and paleoenvironmental facies maps.

To address this challenge, work done by the authors investigated geological factors at the broad-scale for tectonostratigraphic architecture and the evolution of Eocene–recent half graben infill of the Sunda Shelf and Java volcanic arc development. Key elements including reservoir burial to supercritical depth for carbon storage coupled with risk factors including sediment overpressuring, high geothermal activity, seal integrity and active tectonics were all investigated. Additionally, operational factors were combined to rank basin storage potential across the region.

A 3D, basin-scale subsurface model of the Java Sea area was also built upon public domain well and geophysical data, as a foundation for depth screening. These data were interpreted within a consistent sequence stratigraphic framework, to produce a series of depth surfaces, isochronous to the important reservoir intervals. The intra-surface isopach maps help model from areas of data control into data light areas and were used as a predictive tool to inform a series of paleoenvironmental facies maps. These are used to highlight the spatial distribution and sediment thickness of key geological formations, including the Miocene aged, coarse-grained clastic lithology in the Ngrayong, Main and Massive formations and the Miocene carbonate facies of the Parigi, Batu Raja and Kujung formations.

Integration of these components help predict reservoir suitability and provide greater insight into a burgeoning region of carbon abatement potential.