Refined Screening Criteria for Carbonate Buildups as Potential CO_2 Storage Sites: Insights from Central Luconia, Malaysia

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Abstract

Central Luconia province, off the coast of Sarawak, Malaysia offshore is a prominent petroliferous basin which hosts several Mid-Miocene Carbonate buildups with production is being done for decades now. Some of these carbonate build-ups (depleted as well as saline aquifers) are presently being assessed to be potential storage sites for CO2 storage in the region as a part of decarbonisation initiative. A regional study in the Central Luconia province has provided deeper insight to the storage potential of both depleted and saline aquifers in these carbonate buildups.

This integrated study encompassed extensive 3D seismic data over the region and available well data. Published literatures and inhouse reports have been used exhaustively to finalize criteria for screening the storage sites.
The study identifies several build ups to be suitable for CO2 storage sites.

Based on the preliminary investigation more than twenty (20) criteria were identified. Some of the parameters which have greater impact on these storage sites are, (i) faults cutting across the carbonate buildups, (ii) Subsidence due to long term production, (iii) carbonate talus and thief sands, (iv)Geochemical reaction, (v) Postproduction Contact and (vi)Wells and Facility integrity.

Whilst the carbonate structures of Luconia have many similarities there are subtle variations in the geological history and character across each field which means assessment of each site needs to be on a case-by-case basis.

A simple traffic light system has been developed using the identified criteria, which can be used to generate Common Risk Segment (CRS) maps for CCS site screening. Three levels of indicator are applied, a green positive indicator where a criterion poses low risk based on the evidence available to the study; an amber cautionary indicator refereeing to moderate risk of leakage or limitations to the CO2 storage capacity without mediating action and a red negative indicator flag where the criterion raises concerns of a high risk of leakage or significant limitations in CO2 storage capacity without mediating action.

Temperature and pressure are critical for injecting CO2 in a super critical phase. All fields in the study area meet the depth and temperature thresholds that would enable CO2 to be stored in the most efficient supercritical phase there are few fields which in their current depleted states lie below the supercritical pressure threshold, a managed pressure build-up later is required to achieve supercritical pressure. The study found

presence of potential carbonate talus can be the cause for leakage from the storage site. As very limited data is available for the talus, seismic attributes are being used to interpret the carbonate talus and possible leakage. For some of the carbonates the biggest risk is seabed subsidence resulting from pore collapse which is threatening the longevity of the surface infrastructure as well as compaction affecting porosity in the reservoir level.

Assuming the risks highlighted here can be mitigated through new data acquisition, studies etc. these carbonate fields present an opportunity to develop further hub-and-spoke type CCS clusters that would enable the depleted fields to be repurposed and reused for CO2 storage and thus delay decommissioning with the potential upside of opening-up surrounding contaminant rich fields for development.