

Understanding Talus Formation from Analysis of Wells Data and Conventional Core Descriptions in A Pinnacle Carbonate Reservoir, Central Luconia, Sarawak

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Abstract

Talus formations hold potential for hydrocarbon reserves yet drilling and assessment in these areas are not commonly favoured. Central Luconia's carbonate fields have seen limited talus appraisal. The field of study is one of few fields in here drilled and appraised talus as part of its development drilling campaign. Insights derived from this campaign offer valuable data to address and mitigate various uncertainties on depositional concept and assess future regional potential.

Six wells were drilled during the development campaign in the study area, with two specifically targeting the appraisal of the talus zone. These wells underwent comprehensive logging programs and conventional coring. Pressure data and fluid sampling were conducted to ascertain connectivity between the talus and reef pinnacle, essential for volumetric reserve estimations. Biostratigraphic descriptions of the cores offer valuable evidence for identifying the origin of talus materials, aiding in concluding the depositional concept. Additionally, correlation between field data and regional events, such as sea level variations and wind direction, was studied to strengthen the depositional model.

The conventional core biostratigraphy analysis reinforces the depositional theory of talus formation. Core features provide compelling evidence supporting this theory. Talus zones are primarily characterized by skeletal packstone and skeletal wackestone lithofacies, with prominent allochems such as skeletal fragments dominated by red algae, forams, echinoderms, occasional mollusc fragments, and bryozoans. Physical structures like solution seams and stylolites indicate chemical compaction, leading to decreased porosity. Solution seams often accompany organic cumulates and occasionally clay lenses.

Talus originates from eroded carbonate fragments and reef debris, deposited at flanks in deeper waters. Its composition includes non-skeletal particles (carbonate grains, mud, and clasts) alongside erosional skeletal particles (mollusc, foram, algae, echinoderm, coral fragments). Talus generally exhibits lower reservoir quality due to poor sorting and chemical compaction. Absence of sub-aerial exposure limits diagenesis processes altering porosity.

In most cases, little emphasis has been given on the variation of salinity in perched water and regional aquifers. It is speculated that perched water shall have similar salinity as free water level before and after the hydrocarbon migration. This assumption contradicts Well-A3 perched water result, as freshwater found in talus. Moore (2001) described hydrologic settings in two phases, known as immature phase and mature phase. Immature phase is developed during sea level high stands and is dominated by island floating fresh-water lenses. Mature phase is developed during sea level low stands where entire carbonate platforms are exposed to meteoric water on a regional scale. It is postulated that the freshwater lenses are trapped in Field-X talus during immature phase with the evidence of talus is never exposed to the surface. In the region of high rainfall of tropical climate, water tends to move through the vadose zone very quickly, and dissolution is a dominant process. The calcium carbonate removed by dissolution is transported downward, and reprecipitated as calcite cement which forms impermeable barrier to prevent de-watering.

Through this appraisal campaign, the presence of hydrocarbon potential in talus formations has been proven. With limited wells drilled for talus appraisal in Central Luconia, this study serves as a valuable reference for other fields where talus occurs. Offering essential insights and lessons learned, this study provides critical information applicable

to all carbonate fields featuring talus. Understanding talus formation is crucial for fostering confidence in future appraisal programs and optimizing development and production strategies effectively.