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A Solution for Complex Stratigraphic Issues in Tectonically Active Southeast Asian Basins: New Workflows and Wellsite Applications

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This study presents an integrated multidisciplinary workflow for the wellsite resulting from a better understanding of stratigraphic architecture and more effective correlation of wells within Southeast Asia. Chemostratigraphy and mineralogy analyses each have advantages that can be applicable to any lithology in any depositional environment, regardless of sample types. Biostratigraphy independently is a powerful methodology for identifying age, biofacies, key stratal surfaces, unconformities, and palaeoenvironmental changes in any given section, through advanced interpretive techniques such as palynosignals and tectonofacies developed in the region.

A new multidisciplinary approach is described, which can be applied to integrate biostratigraphy, chemostratigraphy and mineralogy on ditch cutting samples. This technique can enable a deeper understanding of the stratigraphy of tectonically active regions such as offshore Sarawak, Sabah and Brunei. This integrated workflow can also be used to better understand lateral relationships between stacked reservoirs through more effective well to well correlation.

We have tested a new approach where we can extend a pre-drill integrated stratigraphy, determined through a pilot study, into a robust real-time and near real-time workflow at wellsite; to maximise cost-efficiency and reduce operation time. Wells previously analysed for biostratigraphy only can be subjected to elemental analysis by x-ray fluorescence (XRF) in a simulated wellsite situation following workflows put forward by Pearce et al. (2023). This results in a robust correlation between biostratigraphy and chemostratigraphy, leading to more confident identification of key stratal surfaces, paleoenvironments and sediment provenance at all scales.

In a case study recently completed in the Gulf of Mexico, integrated results showed the offshore Wilcox Formation can be subdivided into 8 zones and 21 subzones with 22 reservoir layers. In real-time analysis at wellsite this improved integrated stratigraphic resolution can be applied for monitoring progression through the Formation and picking key surfaces such as the top Wilcox sands, the Palaeocene/Eocene boundary, the Big Shale, top Whopper, the placement of casing points, and well TD. Furthermore, stratigraphic zonation of biostratigraphically sparse sandstone sections can be further enhanced by chemostratigraphy, resulting in picking all major intra Wilcox surfaces and providing an independent verification of the stratigraphy. The workflow developed also enables differentiation of distinct packages within the sandstones (placing water wet or reservoir sandstones into Wilcox stratigraphy). The raw data is tested against well logs to assess the true representivity of samples analyzed using real-time ChemGR machine learning algorithms applied to compensate for zones of drilling additive contamination. Elemental data are also routinely converted into mineralogy from which a V-shale, and synthetic density and sonic logs can be reported in real time. All biostratigraphic and chemostratigraphic data acquired at wellsite are combined into a data dashboard (Spotfire) along with MWD data to provide real-time updates.

In summary this presentation demonstrates a strong correlation and cross-validation between biostratigraphy and chemostratigraphy datasets which can improve the definition and dating of major unconformities and / or cyclicity in Southeast Asia through demonstrable novel workflows. Spotfire and

machine learning enhances data modelling This methodology can be shown to significantly enhance stratigraphic zonations and wellsite technical capability.