The role of high-resolution biostratigraphy in the delineation of reservoir architecture and the potential use of calcareous foraminifera in identifying system tracts

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This work was originally conceived as a research-based BSc (Honours) project in conjunction with RMA Group to characterise reservoir architecture of the West Linapacan oil-field, hosted by Lower-Middle Miocene, fractured, siliciclastic and calciclastic sediments of the Northwest Palawan Basin, Philippines. The main carbonate-turbidite reservoir unit was previously modelled with a “layer-cake” stratigraphy, despite a calciclastic submarine fan depositional model and the internal heterogeneity that is often associated with turbidite deposits in this environment. This study aimed to evaluate this stratigraphic model by assessing the vertical and lateral heterogeneity between four wells across the field, utilising a variety of techniques. Understanding the lateral heterogeneity of the reservoir was essential for the optimisation of development wells.

The stratigraphy was analysed using foraminiferal biozonations, high-resolution biostratigraphy, petrographic analysis of cuttings and well logs. Four distinct stratigraphic packages (Packages A-D) of various thicknesses (30-60 m) were identified within the reservoir unit. Each package varied in carbonate grainsize (calcarenite-calcilutite) and fabric (packstone-mudstone), gamma response and the presence of key bioevents. Three of these packages (A-C) could be correlated to nearby wells. However, minimal penetration of the reservoir unit in some deviated wells prevented the correlation of the deeper stratigraphy around the field. Though this research supports a coarse scale layer-cake stratigraphy on a scale >10 m, lateral variations in carbonate grainsize, fabric and texture, as well as gamma ray response, indicate that there is significant variability on the finer-scale (<10 m). Understanding this variability is an important step towards re-defining the depositional model for the field.

The application of high-resolution biostratigraphy, utilising planktonic foraminifera from cuttings samples, revealed a distinct pattern between the abundance of *Globoquadrina venezuelana* through time and changes in biozone throughout the wells. Large increases in the proportion of *G. venezuelana* (10-30%) in counts ranging from 100-200 specimens occurred just prior (3-10 m) to changes in planktonic foraminiferal biozone. These also coincided with major lithological changes and are indicative of a significant perturbation in palaeoenvironment. Smaller fluctuations (5-10%) in species abundance were also noticed within the upper reservoir and occur in close proximity (3-10 m) to changes in lithology, most notably, prior to increases in coarser-grained facies identified in thin section. Increases in *G. venezuelana* are interpreted to represent parasequence boundaries, suggesting that the shedding and transport of calcareous material via turbidity currents increased during times of reduced sea-level.

This study demonstrates the importance and versatility of high-resolution biostratigraphy in aiding the identification of internal stratigraphic architecture. Additionally, the study of select taxa can be used to understand the controls and influences of carbonate turbidite depositional systems, or, potentially, siliciclastic systems and how these relate to sequence boundaries in deep water sediments with uninterrupted sediment deposition.