CALCAREOUS NANNOFOSSILS: AN INVALUABLE TOOL IN THE EXPLORATION OF THE EASTERN VENEZUELA BASIN

Nieves María Di Gianni Canudas

High-resolution studies using calcareous nannofossils are being conducted in the Eastern Venezuela Basin in order to date different tectonic events that affected sedimentation, calibrate seismic data, and enhance the understanding of the petroleum systems present in the area. This paper describes a systematic and detailed study using calcareous nannofossils to establish the relationships between 11 wells located strategically in the lower shale section of the Carapita Formation, the reservoir seal, in the Maturín Subbasin. The study is based on the observation of 874 ditch-cuttings shale samples, taken from 237 levels, each at 100' intervals.

The study has indicated the presence of a thick interval where the *Sphenolithus heteromorphus* and *Helicosphaera ampliaperta* markers are observed. These taxa correspond to the upper Burdigalian (uppermost part of the Early Miocene, Martini's Biozone NN4) in all the wells located to the S of the study area. This interval correlates with Foraminifera Biozones N7/N8 and represents the deepest water conditions during the Miocene. This interval reaches 20000', closest to the depocentre of the basin for the Early Miocene.

The lower part of the Carapita Formation is characterised by an increase in conductivity. In this interval, the change from NN4 (*Helicosphaera ampliaperta* Zone) to NN3/2 was observed using the last occurrence of *S. belemnos*. Close to the upper limit of the 'high conductivity zone', the highest calcimetric value is observed, and this is related to the high calcareous biological productivity associated with the transgression. The presence of *S. belemnos* is also correlated to the most important glauconitic levels in the area, associated with the palaeoenvironmental change from outer neritic to upper bathyal. In addition, it was determined that the thickness from the top of NN3/2 to the top of the Naricual Formation varies from 1300 to 1600'. This finding can facilitate the drilling process, since it can help to establish the reservoir prognosis.

Separation between NN3 and NN2 cannot be established due to the absence of the age-diagnostic taxa, *Discoaster druggii* and *Triquetrorhabdulus carinatus*. The influence of shallow water conditions in this interval reduces plankton productivity, which explains the absence of the markers used to define NN1, or the Aquitanian. Furthermore, tectonic complexities make it even more difficult to establish a continuous biostratigraphic framework. The shortening (Well I), and thickening through repetition and absence (Wells H and A) of the sections is evidence of tectonic influence detected by the nannoflora assemblages.

NN4 has been determined in all of the analysed wells S of Well X (Wells A, B, C, D, E, F, G, H, I and J). Its absence in Well X represents an anomaly which is located between 16700' and 17830'. From this last depth, the well exhibits a normal sequence for the Carapita Formation, passing through NN3/2 upwards to 19520'. This anomaly coincides with the depths at which a tectonic-structural model, based on seismic interpretations, predicts the existence of an intra-Carapita wedge and thus can be used in favour of the validity of the proposed model. On the other hand, the existence of major faults could favour the percolation of fluids capable of dissolving calcareous material, explaining the low diversity and low abundance of calcareous nannofossils, and the absence of NN4 in the interval.

Calcareous nannofossils are an invaluable tool in the prediction of reservoirs, the detection of faults, dating of tectonic events and the validation of structural models.