

The Role of Play-Based Exploration in Heartland Portfolio Rejuvenation, Offshore and Onshore Sarawak, Malaysia

S. J. Gough* (Sarawak SHELL Berhad), E. W. Adams (Sarawak SHELL Berhad) & T. Evers (Sarawak SHELL Berhad)

Shell has a long history of exploration in Sarawak, with the first discovery being made over one hundred years ago. Historically, exploration has largely focused on three main plays: Central Luconia carbonates situated above a maximum flooding surface known as the mid-Miocene unconformity (MMU), post-MMU clastics in the Baram Delta, and pre-MMU clastics in the southern Balingian region. Continued recent discoveries in the mature Balingian acreage to the south and, more importantly, recent high profile discoveries proving a working petroleum system in North Luconia, pointed to yet un-creamed pre-MMU plays and the potential for large discoveries in an area previously unexplored by Shell.

For these reasons, Shell has recently renewed its focus on heartland portfolio rejuvenation, using play-based exploration (PBE) techniques to assess the remaining exploration potential of the pre-MMU stratigraphy of onshore and offshore Sarawak. This paper shows how fully integrated regional studies based on a PBE approach can effectively quantify existing and identify new plays in a varied and complex basin environment. This play-based approach to portfolio rejuvenation culminated in Shell being awarded coveted exploration blocks during the recent Malaysia exploration bid-round.

Regional evaluation work focused on offshore and, subsequently, onshore Sarawak. Access to a large regional well and 2D seismic dataset, combined with recent advances in our biostratigraphic understanding of the region allowing reliable correlation between wells throughout the basin, presented an opportunity to undertake a fully integrated re-interpretation and a full revision of the biostratigraphy, tectonostratigraphy and sequence stratigraphy of Sarawak, and a simultaneous enhancement of the (mega-) regional structural framework. This built a strong foundation on which to redefine a number of megasequences, within which were developed a series of gross depositional environment maps, recording our understanding of the palaeogeographic evolution of the basin and, ultimately, helping to describe and constrain a number of key plays. The fresh interpretation of >65 key pre-MMU wells drilled in the basin since 1960 formed the basis of a comprehensive well look-back evaluation, incorporating results from parallel studies such as re-interpretation of overpressure trends, estimation of depth to basement (including potential fields modeling), and basin modeling. Expansion of the regional evaluation to include older Eocene to Early Miocene stratigraphic units onshore Sarawak also provided an opportunity to enhance our understanding of central and northern Sarawak, thus rapidly expanding and

refining our evaluation. Together, this enabled the creation of a detailed set of play maps showing the location and extent of sweet-spots throughout the basin, providing focus for prospect maturation, and culminating in the fast delivery of defined prospect portfolios in coveted acreage.

The study confirmed the legacy view that the objective pre-MMU sequence in Central Luconia has poorly developed, deep and highly overpressured reservoir potential. Three main pre-MMU sweetspots were identified in Sarawak. One, the shelfal clastics play in the southern Balingian region, was confirmed as being largely creamed. A potential Oligocene-Early Miocene carbonate play in southeast Sarawak was not pursued, steered partly by regional play-based views of this carbonate from elsewhere in the basin. In contrast, high-graded Cycle I and II shelfal clastics play segments in North Luconia have few well penetrations, and several large undrilled structures have been identified as having big cat potential.

Figure 1 shows the palaeogeographic evolution of Sarawak, from Late Eocene to Mid Miocene. In the Late Eocene (Pre-Cycle I), speculative isolated thrust-top platform carbonates developed within widespread marine shales in front of the Rajang accretionary wedge. By the Late Oligocene (Upper Cycle I), a relatively stable, regionally extensive coastal plain and shelf system was established, with parallel coastline and shelf edges trending northwest-southeast. In the Early Miocene (Lower Cycle II), extensional and transtensional faulting and in some areas major uplift took place, the clastic shelf system retreated to the southwest, and widespread passive shelf-margin carbonate deposition occurred in distal northeast Sarawak, before being largely smothered by prograding shelf clastics. In the early Mid Miocene (Cycle III), Sarawak was dominated by shale-rich topset beds during a flooding stage.

In conclusion, by integrating all available data using a PBE workflow, a solid regional understanding of the Sarawak basin has been established, including a modified tectono-stratigraphic framework distinguishing two megasequences, and a revised understanding of palaeocoastline and shelf evolution. Based on these strong foundations, a series of easily updateable play and CRS maps has been compiled. These have enabled identification of sweetspots in previously overlooked plays, the definition of an internally consistent new lead portfolio, and the addition of a ranked list of coveted acreage for these plays, primarily focusing on potential big cat opportunities in pre-MMU Cycle I and II shelfal clastic plays in North Luconia.

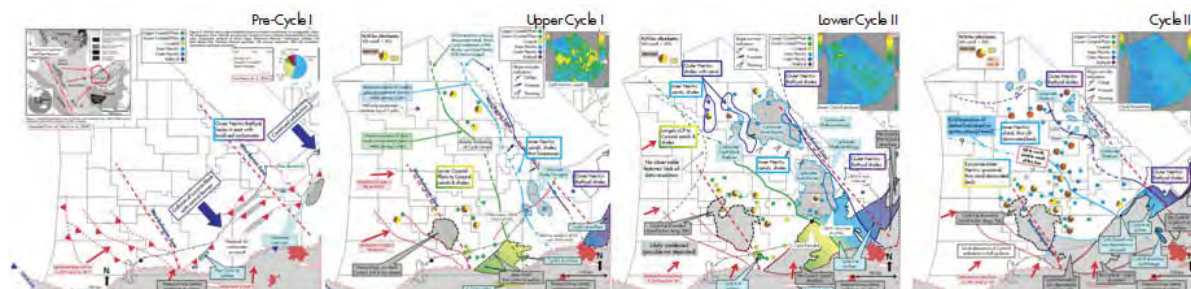


Figure 1: Gross Depositional Environment (GDE) maps illustrating the palaeogeographic evolution of the pre-Mid Miocene unconformity ("pre-MMU") stratigraphy of Sarawak.