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Maharaja-Lela Intra Platform basin: Relationships between Tectonic, Sedimentation and Pressure Regimes

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Maharaja Lela Field (MLJ) is within a highly subsident intraplatform basin located in the northeastern part of the Brunei conventional offshore.

The fill of this basin occurred contemporary to a quite intense tectonic activity which heavily affected sediment paths, accommodation and pressure regimes. The movement of the basin is controlled by Frigate/Perdana, Maharaja Lela and Champion fault systems, which in turn accommodate a major deep extensional phase probably associated to the old subduction zone that was active along this margin.

The sediments filling this intraplatform basin range between Upper Miocene to Recent, and were deposited in fluvio-estuarine to shelfal environments. Syn-tectonic sedimentation caused 3 main types of anomalies in the stratigraphic evolution: 1- Formation of "prodelta" shale wedges in response to substratum tilt; 2- Stratigraphic expansions; 3- Unstable sediment transport paths. Associated to this tectonic and depositional setting is the development of abnormal pressure cells, thought to be caused by compaction disequilibrium in the sites of high shale sedimentation.

Prodelta shale wedges are observed at different stratigraphic levels on seismic. They are typically thought to represent buried "paleo-shelfedeges" indicating the position of older seaward limit of the continental platform. In places though, these shale wedges may be interpreted as the response to slope changes of the equilibrium profile ("healing wedges", Posamentier & Allen, 1993) caused by fault-related tilting. Understanding the difference is important and may lead to the

generations of new plays. The fault related shale wedges have only a local distribution and they represent a tricky pitfall while attempting to outline the extension of the platform sands and, most importantly, of the vertical evolution of sand bearing units.

The stratigraphic expansions observed across growth faults indicate that the sedimentation rates were high enough to compensate rapid tectonic movements along off-shore dipping faults cutting through active, pre-existing depositional areas. Stratigraphic expansion across fault in these contexts can get to stunning proportions; it nevertheless appears to bear no significant depositional environment change and if stratigraphic surfaces can be traced across these features, sound sand presence predictions are possible, maybe even beyond thinkable after a quick look observation.

Sediment transport paths were strongly affected by substratum movements and highly variable progradation directions are shown by seismic data throughout the filling history of this intraplatform basin. The sediment distribution system, most of the times, was probably made of small scale coalescing apparatuses growing and prograding at the margins of the newly generated depressions. As a consequence, in a tectonic active system, besides the larger, steadier deltas, smaller systems may be developed and the larger deltas themselves may experience sharp lateral changes.

This highly unstable geological framework is reflected on a quite complicated pressure regime framework. While MLJ Basin is in hydrostatic conditions for most of its thickness, overpressures increase in a quite different way across short distances below 4000m. On one side of the Maharaja Lela field, the observed abnormal pressure regime seems to be related to compaction disequilibrium, as suggested by the increased shale content of the stratigraphic column; on the other side, the increased sand content there doesn't allow to consider this hypothesis. The preferred explanation is a lateral overpressure migration from a disequilibrium compaction cell downdip, sealed on top by a regional shaley interval. These "disequilibrium compaction cells", appear to be associated to the shale wedges scattered throughout the platform. They may transmit their abnormal pressure regime through continuous and well connected sandy parasequences quite far from where you're drilling. In spite of some pressure charge loss, they may still be deadly enough to kill an exploration project.

In conclusion, within a highly mobile and highly subsident basin, a good knowledge of your regional depositional and structural setting may not only provide a sound, new exploration play, but a closer look to the related possible consequences in terms of pressure regime may also allow to prepare in advance for difficult times.