

Geology Paper 9

SEQUENCE OF SLOPE INSTABILITY AND HEALING: KEY TO PREDICTING DEEP-WATER RESERVOIR DISTRIBUTION IN NW BORNEO

MARTIN GRECUA, SENIRA KATTAH, MARK GRIFFITHS, BILL WILKS, HOMERSON UY, KUSWADI HEDEIR,
HONG CHIN-WENG, KELLY MAGUIRE, PETER OSTERLOFF, ELEANOR ROLLETT AND PETER SHINER
Shell Malaysia, Sarawak Shell Bhd, Locked Bag No.1, Lutong, 98009, Miri, Sarawak

Drilling results in deep-water Sabah acreage have proved the presence of sizeable turbidite reservoirs in the NW Borneo basin-slope environment. The reservoir distribution and quality, however, show significant spatial and temporal variation. Spatial heterogeneity is related to different source terrains, shelf dynamics and the location of entry points into the upper slope. The temporal heterogeneity is ultimately linked to the episodes of tectonic deformation and subsequent geomorphologic healing by gravity flow deposition.

The slope accommodation in NW Borneo was episodically created by the thrust-propagation folding as well as by the local extensional faulting, preceding the compression. The instability phase of a depositional sequence is typically marked by the truncation or disconformable surface, overlain by mass-transport deposits (MTDs). These slumps and debris flows were derived either locally, from the growth-anticline limbs, or from the shelf-edge collapses. The healing phase of a sequence contains turbidite aprons and unconfined slope wedge deposits. Depending on the volume and shape of the slope accommodation, the aprons may be vertically stacked above the MTDs or laterally offset. In the former case, the reservoir may show significant thickness variation due to the rugosity of the underlying surface. Presence of reservoir facies in the aprons is dependent on connection between accommodation and an active sand fairway – if the connection is not established, the apron deposits are dominated by muddy turbidites and thin-bedded unconfined sands. The healing phases of the depositional sequences contain several regionally continuous seismic events, which are interpreted as hemipelagic drapes, and thought to represent periods of limited sand supply to the slope environment. The drape-interval recognition is critical for the establishment of regional sequence stratigraphic framework.

The instability events during the deposition of the prospective interval of the NW Borneo slope typically produced relatively subtle syn-depositional topography, which predetermined the character of slope healing. Most of the healing-phase aprons are transient in nature and often bypassed and dissected by later channelised flows. As their thickness is often at the limit of seismic resolution, very detailed seismic mapping is necessary to detect them.

Accumulated learning from the ongoing exploration activity in the region suggests it is necessary to integrate all existing datasets and develop scientifically well-founded conceptual depositional models. It is the recognition of the genetically linked deformation-and-healing depositional sequences, followed by careful reconstruction of the accommodation and its filling patterns, that enables us to increase the chance of finding good reservoirs in this challenging environment. This also opens the way to recognizing and exploiting new stratigraphic play concepts in the NW Borneo basin.