AAPG HEDBERG CONFERENCE
"DEEPWATER FOLD AND THRUST BELTS"
OCTOBER 4-9, 2009 – TIRRENIA, ITALY

Detached Folds in the Baram Delta Domain of the Northwest Borneo Fold and Thrust Belt: A Possible Example of Hinterland Influence on Structural Style

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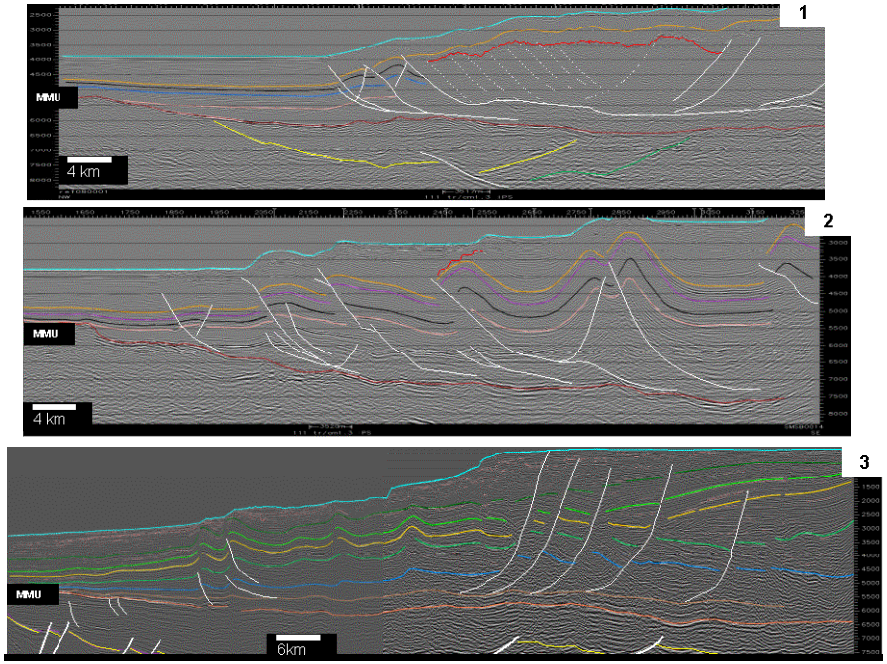
Stretching 450 km along strike from the West Baram Line to the Balabac Line, the 70 km wide NW Borneo deepwater fold and thrust belt rises from the underfilled Northwest Borneo Trough to a 100 km wide shelf. The fold and thrust belt deforms Middle Miocene to Recent deepwater clastic sediments. Up dip there is an extensional deltaic province. Although, these two systems ultimately sole into a common detachment, the amount of shortening exceeds extension, which is consistent with regional Neogene tectonic compression inferred from published neotectonic strain analyses. The fold and thrust belt is generally at critical taper above a weak basal detachment that is treated here a Middle Miocene interval within the Setap Shale. The Setap Shale overlies attenuated continental crust of the Dangerous Grounds and Reed Bank. Despite these shared characteristics and fairly simplistic, consistent bathymetric expression, the underlying geology reveals very complex relations. The fold thrust belt can be divided into at least 3 transverse structural domains (Figure 1). To the northeast, Domain 1, often called "the allocthon," consists of a highly an imbricated succession that is unconformably draped by Latest Miocene and Pliocene pelagic(?) shale that is in turn gently folded in places. Domain 2, a proven world-class deepwater petroleum system, is characterised by strongly folded sea floor and diverse assemblage of compressive structures that include fault-bend folds, fault-propagation folds, and triangle zones. Domain 3 (to the southwest approaching the West Baram Line) is also marked by strongly a folded sea floor (except where beheaded and re-graded by the Brunei Slide). This domain is down dip from growth faults of the Baram Delta, which has well imaged deep detachment. Faulting in the deepwater succession, however, is markedly reduced and deformation best characterized as detached folds. An additional contrast with the other domains is the presence of a thick late-synrift sag sequence between the detachment and the rifted crust.

Such along strike contrasts in structural style can be attributed to a changes in a multitude of factors, including but not limited to: strength of the basal detachment, depth to the detachment, structural elements in the underlying attenuated crust, deformation events in the hinterland, and/or the mechanical stratigraphy within deformed the deepwater sediments. In all probability the contrast in structural style reflect both the spatial and temporal interplay between combinations of these factors. Regional geological studies integrating offshore seismic sequence mapping with onshore geology and drainage analysis indicate that the Baram River to have been

the major source of sediment for Domain 3, with a hinterland drainage area dominated by a thick (>2000m) succession of Oligocene to Early Miocene shale. These shales (Setap and Temburong Formation) are the shelf and slope facies of the shallow marine Nyala Formation sandstones that were deposited at a time when the regional shoreline ran SE-NW, approximately perpendicular to the Middle Miocene to Recent depositional trends. The trend of the Oligocene depositional shoreline appears to be controlled the West Baram Line, which is a major tectonic feature related to collision of Luconia with Borneo during the Eocene Sarawak Orogeny. The shale-prone nature of the hinterland for Domain 3 contrasts sharply with that of the sand-prone Crocker Formation, which was the dominant source for the Champion-Padas wave and tidal dominated shoreface systems that delivered sediment to Domain 2. The observation of the bland seismic facies in the deepwater detached folds of Domain 3 coupled with multiple levels of detachment and thickening in the cores of these folds is suggestive of a weak, low viscosity contrast stratigraphy; probably shale considering the provenance of this domain. It is also interesting to note that there is folding below the decollement, which itself is reverse faulted in places; clear indications of deeper tectonic compression. As the depositional patterns and provenance in the hinterland of Baram Delta domain are controlled by an older tectonic feature, this part of the Northwest Borneo fold and thrust belt offers what may be an elegant example of feed back between tectonics, sedimentation, and structural evolution.

Figure 1



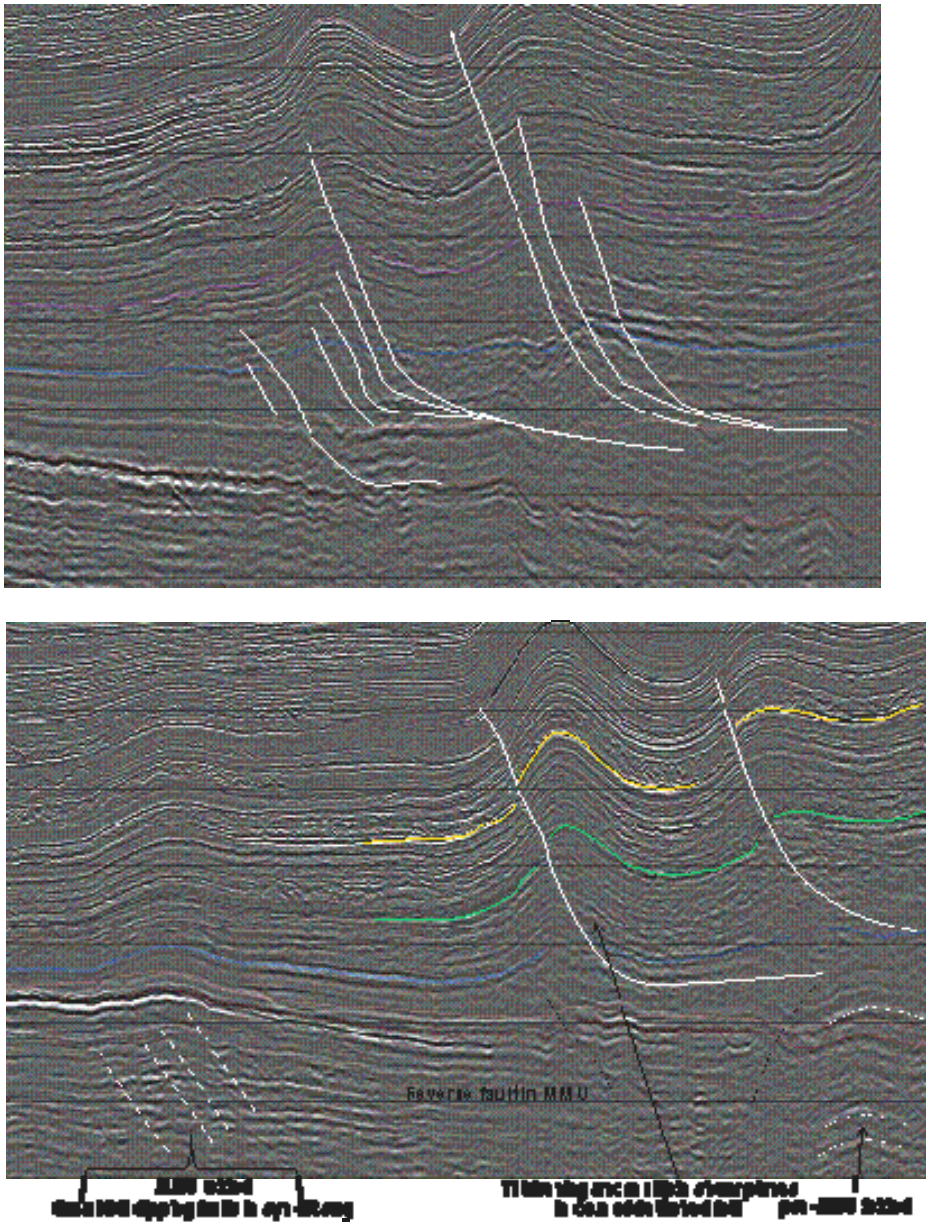


Figure 2