AAPG HEDBERG CONFERENCE
"Deepwater Fold and Thrust Belts"
October 4-9, 2009 – Tirrenia, Italy

Present-day Stress and Neotectonics of the Baram Delta and Deepwater Fold-Thrust Belt System, NW Borneo

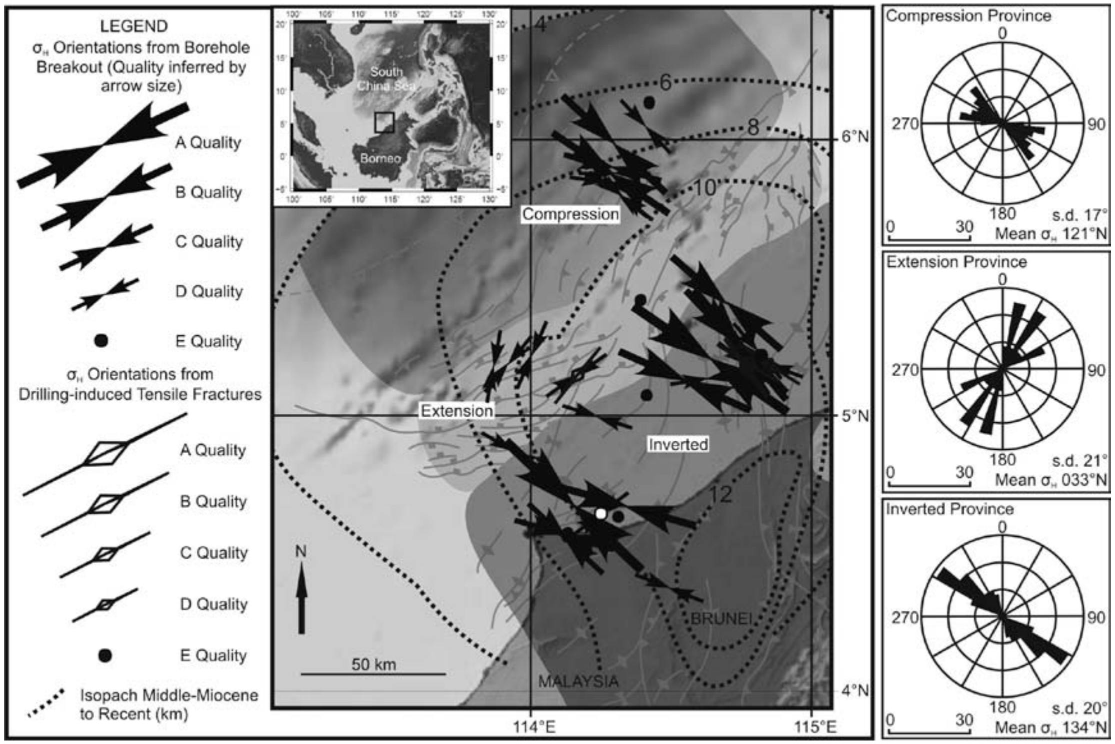
Rosalind King [(1)], Richard Hillis [(1)], Mark Tingay[(2)] and Chris Morley[(3)]
(1): Australian School of Petroleum, University of Adelaide, SA, Australia
(2): Department of Applied Geology, Curtin University of Technology, Perth, WA, Australia
(3): Geological and Geophysical Services, PTTEP, Bangkok, Thailand

Maximum horizontal stress (σ_H) orientations across gravity-driven delta systems are expected to rotate from margin-parallel on the extensional delta top to margin-normal in the compressional delta toe (or deepwater fold-thrust belt); forming two neotectonic provinces, an extension province and a compression province. We present the first present-day σ_H orientations across a delta and deepwater fold-thrust belt (DWFTB) system, which have been determined using borehole image logs from 56 petroleum wells.

Stress and neotectonic data over NW Borneo demonstrate two 90° rotations of σ_H and defines three discrete neotectonic provinces. The outer shelf and slope to basin floor form the extension and compression provinces, respectively, that are expected in a gravity-driven delta system. The extension province is consistent with the delta top and demonstrates a present-day NE-SW (margin-parallel) σ_H orientation. This margin-parallel σ_H orientation is reflected by seismic-scale normal growth faults, with strike lengths ranging from kilometres to 10's of kilometres. These faults strike NE-SW (margin-parallel) and have moderate to steep basinward NW dips. They appear to detach within the pro-delta shale. Evidence of active deltaic extension is observed on NW-SE trending seismic lines, which witness significant sea-floor topography formed by fault scarps of normal faults. There is little or no sedimentary healing/growth strata across the faults indicating the slip has been recent in this environment of high sedimentation rates.

The compression province is consistent with the deepwater fold-thrust belt (or delta toe) and demonstrates a present-day NW-SE (margin-normal) σ_H orientation. Seismic-scale thrust faults are observed in the delta toe compression province, striking NE-SW and dipping shallowly to the SE (landward); forming an imbricate thrust sheet system. Each thrust fault is associated with a fault propagation fold. Thrust faults have been observed to detach in the thick pro-delta shale. Seismic lines across the thrust sheets demonstrate that the fault-propagation folds have developed significant sea-floor topography. There is relatively little sedimentary healing of the most distal folds, suggesting that there has been recent deformation of the most distal thrust sheets. We interpret the delta top and delta toe data to reflect that compression in the deepwater fold-thrust belt is coupled to delta top extension.

The inner shelf and onshore regions of Brunei form the inverted province. The inverted province demonstrates a present-day NW-SE (margin-normal) σ_H orientation. The structures observed in the province are predominantly NE-SW striking, inverted, seismic-scale, normal faults many with associated fault-bend folds or fault-propagation folds. These large normal faults were once part of the active delta and DWFTB system and have since been inverted during the Miocene-Pliocene due to far-field compression and subsequent uplift of the hinterland. We interpret that the inverted province reflects the unique location of the Baram Delta System on an active margin.



Map of the Baram Delta System, NW Borneo, demonstrating the location and extent of the three neotectonic provinces and the maximum horizontal stress orientations that have been determined using image logs from 56 petroleum wells.