

*Paper 31***Wrench-faulting and compressional features in an extensional basin:
the Mekong Basin, Vietnam**

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The granites of southern Vietnam, including those in the basement of the Mekong Basin were mainly emplaced in the Cretaceous and during the transition time into the Palaeocene were subjected to physical weathering under semi-arid conditions. The Mekong Basin is a Tertiary extensional rift basin located at the eastern edge of the Southeast Asian continental Plate. The oldest known strata are Upper Oligocene sediments that lie at depths of about

10 km. Pre-Middle Miocene deposition comprised lacustrine, fluvial to coastal sediments and gave rise to the Middle Tra Tan source rocks. In the Langhian, significant reorganisations of plate motions changed the originally transtensional stress environment into transpressional that caused strike-slip reversals on some of the regional transcurrent faults and structural inversions in parts of the basin. There is evidence of change of compression direction into a near-orthogonal trend. Regional sea-level also rose, causing the deposition of shallow, holomarine sediments.

NNW-strikes predominate among Topaz North - 1X basement fractures. Other fracture strikes are easterly with moderate dips towards North or South. The granitic basement top of the Topaz North prospect imaged by the VoxelGeo software was shown to consist of four major lineament (fracture) directions. Three of these fracture directions neatly correspond with those predicted to develop as second-order structures produced by right-lateral wrenching along the N060°E elongation of the Topaz basement horst block.

Seismic sections across the Topaz Prospect show local reverse faulting but at other locations normal faulting is clearly evident along the strike of its Northwestern boundary fault. We interpret that the established right-lateral, strike-slip boundary fault generates compression at restraining and extension at releasing bends, and attribute reverse or normal faulting to those respective locations. Seismic sections across the Azurite prospect and published illustrations of the Bach Ho field also indicate occasional reverse faulting (compression) and normal (extensional) faulting along their westerly facing boundary faults. Su Tu Den, the major field of which Azurite is its eastern extremity, strikes East-Northeast and its prominent NE-striking, en echelon fractures indicate left-lateral wrenching of this basement high. The Ruby field strikes Northeast and en echelon, large sigmoidal fracture system across its granitic basement top also indicates that the entire horst experienced dextral wrenching.

Prominent structural inversion of an Oligocene unconformity surface and the Middle Miocene marker is observed at the west end of a regional E-W line across the northern ends of the Mekong and Nam Con Son basins and strongly suggest that genuine tectonic compression exists.

Analyses of slickenside patterns on fault planes, well-bore elongations in over a dozen basement-penetrating wells in Carigali's acreage, orientation of drilling-induced fractures, and en echelon fault patterns on structural maps support the following structural development of the northern Mekong Basin. Throughout the Palaeogene, regional compression had been dominantly NW-SE, possibly associated with Southeast-ward extrusion of the Indosinian Plate, but more than once it temporarily alternated with NE-SW regional compression. The latter direction may have been associated with N-S spreading of the East Vietnam (or South China) Sea Basin that according to the known magnetic stripes occurred between 32 and 17 Ma. Alternation of dominance between these almost orthogonally orientated regional compressions probably resulted from interaction of plate-movements in this part of Southeast Asia. Throughout most of the Cenozoic, its neighbouring plates have been converging onto Southeast Asia. The Indian Ocean-Australian Plate encroaching from the West and from the South, the Pacific Plate westward thrust becoming effective after cessation of spreading of the Philippine and East Vietnam basins at about the Langhian, while as result of the collision between the Indian Subplate and the Eurasian Plate, crustal slabs of Indosinia have been differentially extruded Southeast-ward. After the Langhian, the greater Mekong Basin area was only subjected to relatively slight crustal movements.