

Tectonic Features of the Cuu Long Basin, Offshore Vietnam during the Early Cenozoic and its Regional Tectonic Implication

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Abstract

The Cuu Long Cenozoic Basin, a major off-shore petroleum resource, is located within the southeastern part of the continental shelf of Vietnam (Figure 1). The basin is undercovered by thick successions of volcano-sedimentary strata, ranging in age from Eocene to Quaternary, which were successively deposited in differing tectonic environments. The Early Cenozoic deposits have been assigned as parts of 3 formations including the Eocene(?)–Early Oligocene Tra Cu and Ca Coi formations and Late Oligocene Tra Tan Formation (Figure 2). The earlier, which unconformably overlies the pre-Cenozoic basement, comprises dominantly of continental deposits intercalated with the alkaline basalt layers. The later, on the other hand, comprises predominantly of lacustrine deposits that unconformably overlie the older successions.

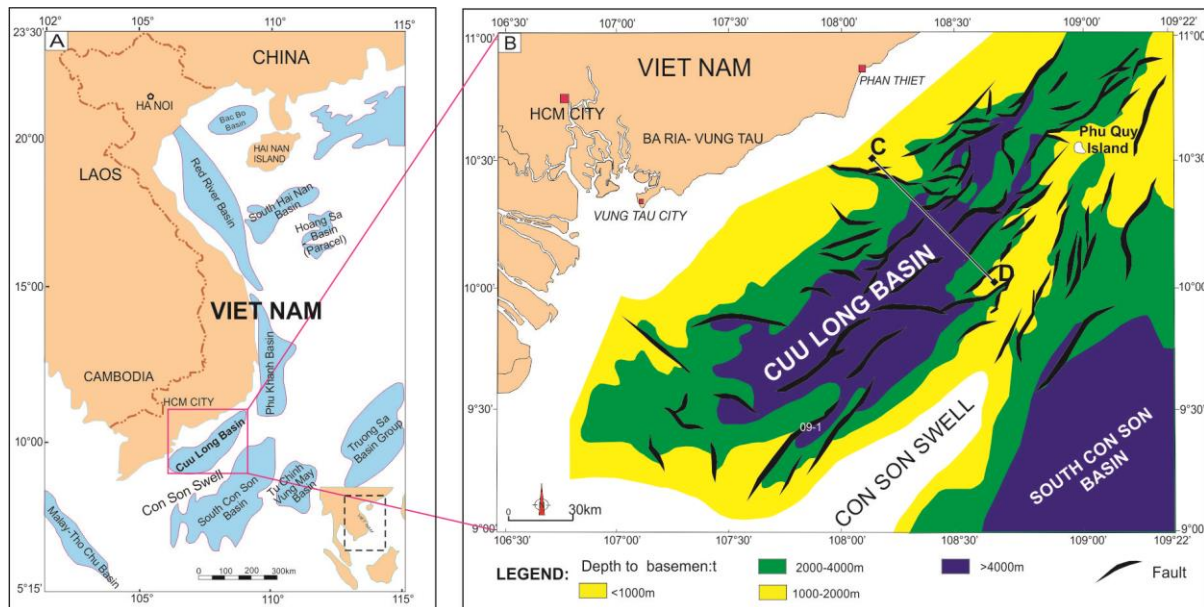


Figure 1. A. Tectonic setting of Cuu Long Basin, off-shore Vietnam. B. Broad configuration of Cuu Long Basin and its relationship with other regional tectonic elements. Line C-D in Figure B is the cross-section described in Figures 2 and 3. Modified from various sources.

These deposits were variably affected by multi-phase deformational history during Early Cenozoic, which took place either during or soon after their formation. At least 4 tectonic events have been identified (Figure 3). The first event, which took place during the late stage of Eocene (?)–Early Oligocene, is characterized by the development of syn-depositional normal faults, which formed during a period of

continental extension and break-up to create NE-SW trending horst and graben systems in which the Tra Cu (+ Ca Coi) Formation deposited (Figure 3A). The second event formed during latest stage of Early Oligocene in a compression regime, which led to tectonic inversion, uplift and erosion of part of Tra Cu Formation (Figure 3B).

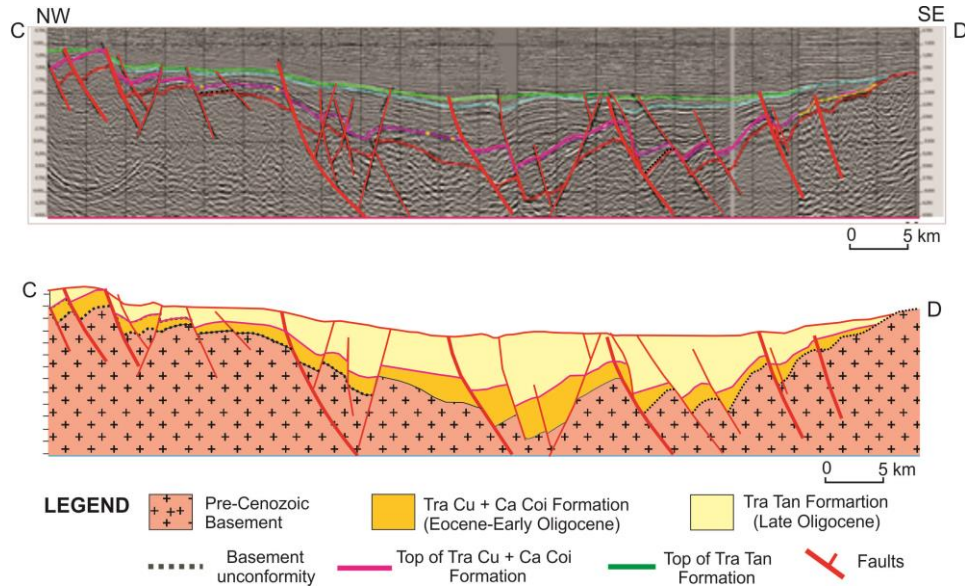


Figure 2. A A Seismic profile along Line CD (Figure 1) showing interpreted stratigraphic and structural breaks in the central part of Cuu Long Basin. B. Interpretive cross-section of CD line showing the nature of the Early Cenozoic Tra Cu (Eocene-Early Oligocene) and Tra Tan (Late Oligocene) formations and their relationship with the syn- to post-depositional structures.

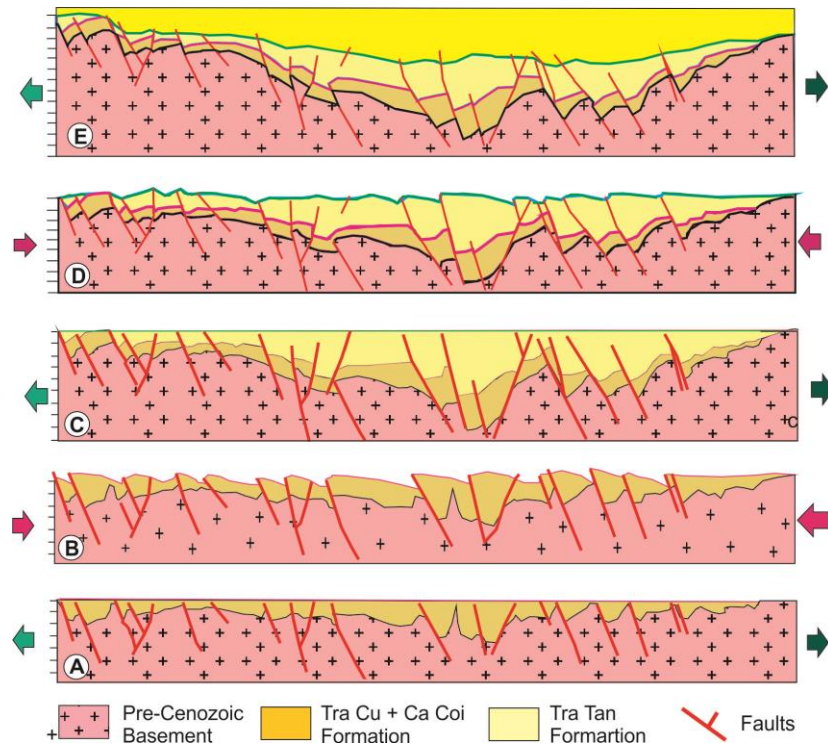


Figure 3. Restoration the cross-section CD (Figure 2) reveal stages of basin development during the Eocene-Oligocene time in the Cuu Long Basin. A. Early continental rifting led to the formation of intracontinental graben infilled by terrigenous deposits and volcanic rocks (Ca Coi and Tra Cu formations). B. Tectonic inversion led to the deformation, uplift, erosion of the Ca Coi and Tra Cu formations and formation of a regional unconformity. C. Renewed extensional regime led to subsidence and deposition of Tra Tan Formation. D. Post Tra Tan regional tectonic inversion led to the reactivation of pre-existing structure and modification of Tra Tan Formation as well as the formation of a unconformity on top of the Tra Tan Formation. E. Post Tra Tan subsidence led to extensive deposition of Miocene sequences above top Tra Tan unconformity.

The third tectonic phase took place during the Late Oligocene in an extensional regime and led to the renewal of basin subsidence to create regional extensive lacustrine environment in which the Tra Tan Formation was accumulated (Figure 3C). The fourth tectonic phase is represented by N-S and E-W trending conjugate strike-slip fault system, formed during an NW-SE trending compressional regime during Late Oligocene. Result of this event includes the deformation and uplifting of Tra Tan Formation and subsequently production of a regional unconformity (Figure 3D). These events were part of complex proto-Southeast Asia regional tectonic evolution during the Early Cenozoic (Figure 4).

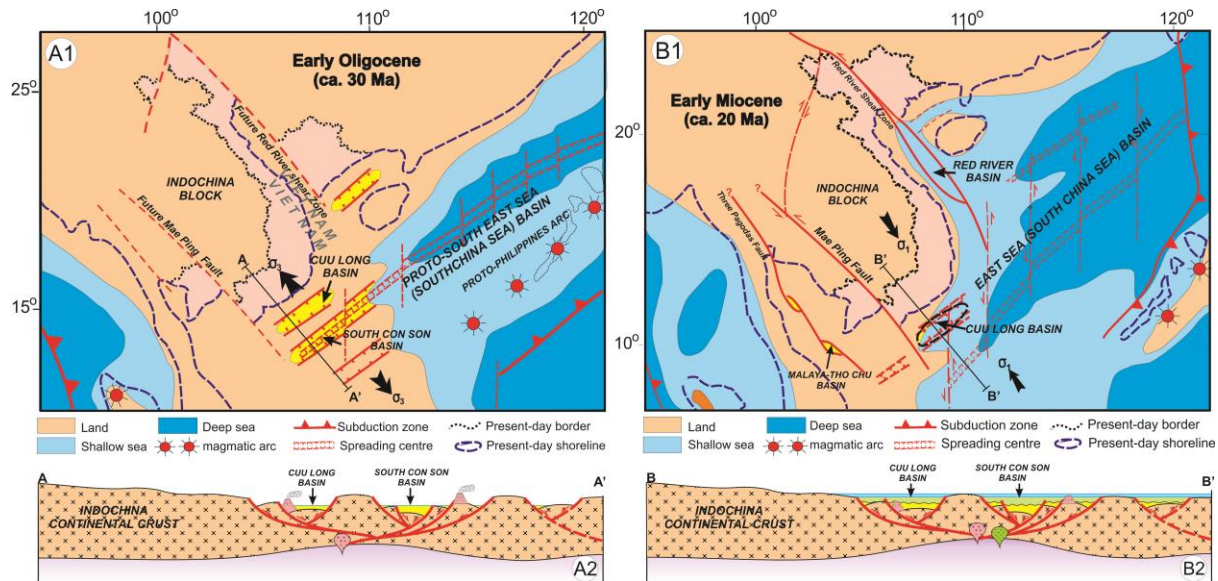


Figure 4. Cartoon model of regional tectonic configuration of Indochina Block and adjacent areas during the Oligocene (A) and Early Miocene (B). A1. Rifting break up of continental crust and initiation of the East Sea (South China Sea) led to the formation of Cuu Long and other intra-continental basins. A2. Cross-section along line A-B on A1, showing position of Cuu Long Basin. B1. Renewed subsidence and opening of East Sea Basin during Early Miocene transformed Cuu Long Basin to a marine basin. B2. Cross-section along line C-D on B1 showing the configuration Cuu Long Basin and its relationship with other tectonic elements during Early Miocene. Modified from various sources.

The above tectonic events had strongly influenced the hydrocarbon system within the Cuu Long basin. The extensional phases created numerous sub-continental sedimentary basins with favourable materials for hydrocarbon sources, traps, and seals for the petroleum systems. The tectonic inverted events, on the other hand either produced structural traps and plays in both sedimentary cover and basement rocks, or creating structural channels for the migration of hydrocarbon out of the source rocks to more favourable hosting environments.