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Seismic evidence for hyper-stretched crust and mantle exhumation offshore Vietnam.

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The Phu Khan basin is one of the sub-basins opened during the rifting of the South China Sea during the Eocene. The basin is located against the East-Vietnam Boundary Fault (EVBF) to the west and the oceanic crust to the east. Good quality seismic lines allow us to observe structures which highlight the rifting history of the South China Sea margin and the processes of crustal boudinage.
A Moho rise is the prominent feature of the Central part of the basin. The mantle is shallowest in the center of the basin and at places is directly in contact with the sediments, via a large low-angle detachment fault which separates several crustal blocks. The axis of the Moho rise is roughly parallel to the South China Sea propagator direction. As a consequence, the upper and lower crusts are strongly extended by large crustal boudins. The network of normal fault is dense in the upper crust and propagates into the lower crust occasionally. However, the lower crust seems to be missing at some places. At the apex of the Moho rise, several indicators of fluids circulations have been observed, including volcanic edifices and gas escapes features. The seismic facies just above this Moho rise looks poorly stratified and might be affected by a certain degree of metamorphism.
Three stages of extension are clearly identifiable, with age constrained by wells calibration of the horizons: the oldest rift sequence is identified from basement to Oligocene horizons; a second from Oligocene to Mid Miocene (15.5 Ma), and a third from Mid-Miocene to Upper Miocene (10.5 Ma). These three rifts have been formed with at least two directions of extension, a first which is North-South and a second NW - SE The well imaged 15.5 Ma horizon is tilted, as well as part of the subsequent in-filling which is fan-shaped. These are in turn sealed by the 10.5Ma unconformity. Although tectonic activity appears diachronous from north to south, we suggest that cessation of rifting and opening did not occur before 12 - 10.5 Ma, at variance with models derived from magnetic anomalies recognized over the oceanic portions of the South China Sea (15.5 to 20 Ma).

keywords : South China Sea, Vietnam, Phu Khan Basin, mantle exhumation, polyphased rifting