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Complex Cainozoic Rifting and Pulsed Inversion in the Northern Song Hong Basin, Vietnam

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Abstract

The far field effects of the India-Eurasian collision on South China Sea marginal basin development are highly controversial. Situated at the tip of the major Red River Fault Zone that originates from the eastern Himalayas, the Song Hong Basin (also referred to as the Yinggehai Basin) is situated excellently to investigate these effects. The evolving Eocene to Recent regional stress regime is reflected in the complex structural style of the northern Gulf of Tonkin including the forces acting on the Red River Fault Zone.

During the Eocene – Oligocene, intense NW- to NE-trending rift-faulting suggests a dominating N–S-trending tensile stress associated with left-lateral transtension across the southern and offshore part of the Red River Fault Zone. During the latter Oligocene to earliest Neogene time, inversion indicates a change to regional NW–SE-compression. The tectonic activity changed during the Miocene, but inversion resumed across NW-trending lineaments during the latter half of Miocene time suggesting the revival of compression. At the same time, moderate E–W-trending normal faulting took place in the northern half of the Song Hong Basin. The structural style observed throughout Eocene to Miocene time is thus compatible with left-lateral motion across the Red River Shear Zone peaking during the Paleogene.

During the Late Miocene, the E–W-trending extension gradually ceased, leaving only compression across NW-trending lineaments to continue to near the end of the Miocene in the northern central part of the Song Hong Basin.

The Plio.–Pleistocene is generally considered as a period of tectonic quiescence. Nonetheless, compressional inversion continues to the present on the NE-trending Bach Long Vi structure offshore comprising the SW-flank of the Beibuwan Basin. At the same time, tens of kilometres of right-lateral displacement has been inferred across the onshore part of the Red River Fault Zone. This is difficult to reconcile with the lack of Plio.–Pleistocene faulting along the offshore part of the Red River Shear Zone. We suggest that up to a few tens of km of the lateral movement could have been accommodated within major NE-trending fault strands onshore similar to that in the Bach Long Vi area from the latest Miocene.