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Structure and Evolution of Initial Low-Angle Normal Fault Systems at Hyper-Extended Area, North Margin of the South China Sea

Yanghui Zhao (1), Jianye Ren (2), Weiwei Ding (1), and Linlong Yang (2)

(1) The Second Institute of Oceanography, State Oceanic Administration, Hangzhou, China (zhaoyh@sio.org.cn), (2) College of Marine Science and Technology, China University of Geoscience, Wuhan, China

Newly acquired, basin-wide 3D seismic data and 2D long cable seismic profiles show the deepwater area of the Baiyun and Liwan sag in the north margin of the South China Sea was bounded by a large-scale low-angle normal fault system, which also induced the crust thinned to less than 7km. This fault system consists of both landward- and oceanward-dipping main faults with low angles (< 30 degrees), and converge on the ductile shear zone (?), or even the Moho (?). A quantitative analysis of the fault geometry has been carried out by fault restoration techniques and construction of balanced section. The analysis reveals that the main faults initialed at low angles, following the first rifting episode of high-angle normal faulting in Early-Eocene. The observation can be best explained by an alternation between a pure shear mode (development of high-angle normal faults) and a simple shear mode (development of low-angle normal faults), with a strong deformation in the hanging wall of the low-angle normal fault making the early faulted-basin structure unclear in the present seismic profiles. This model suggests the lower crust layer was ductile and uneven, and decoupled from the brittle upper crust during the low-angle normal faulting. This conclusion can been supported by P-wave velocity structure and dome-shaped intrusions within the basement. Our results are consistent with the extension characteristics at Iberia-Newfoundland margin despite entirely different faulting mechanisms, since most of the detachment faults at North Atlantic margins were initial high angles following large rotations.