# 3D Structure of the Mesozoic Tan-Lu Fault Zone and Its Impact on Basin Evolution: Insights from the Southern Bohai Bay Basin, NE China

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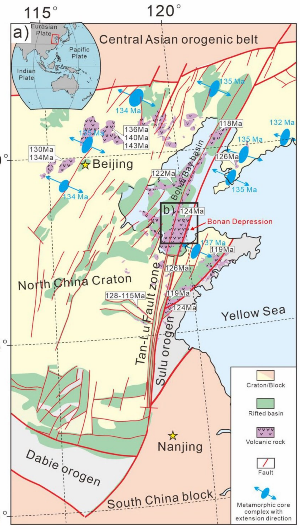
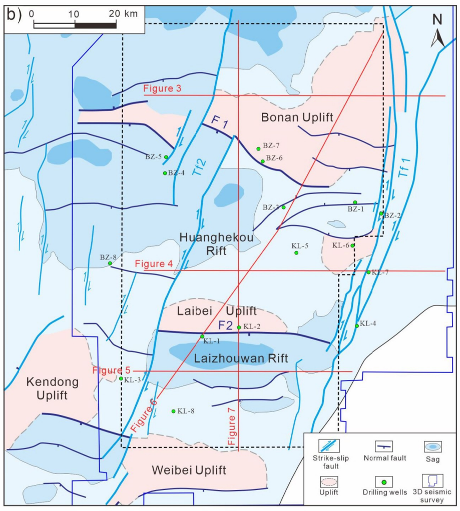
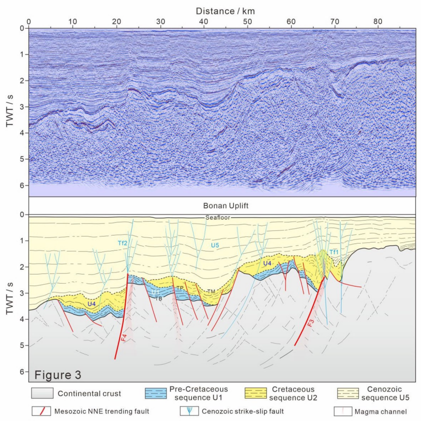
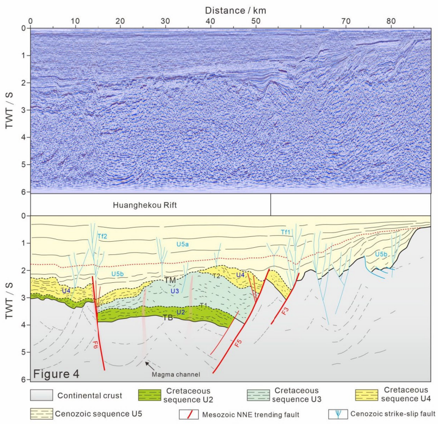


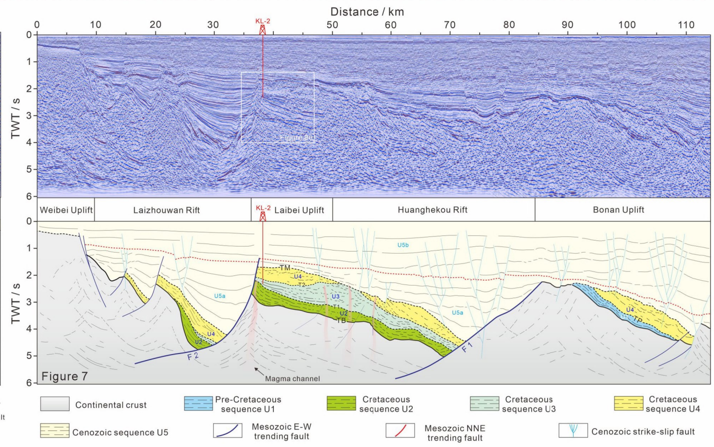



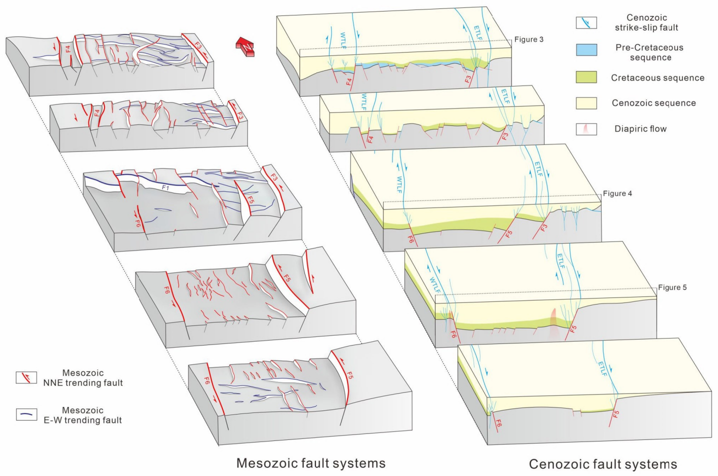

## Abstract

The Cenozoic Tan-Lu Fault Zone, as the largest strike-slip fault system in eastern China, features complex deformation patterns and mechanisms and a tectonic evolution that has been investigated by previous studies. Here, we present high-resolution seismic profiles across the whole southern Bohai Bay basin, where the Tan-Lu Fault Zone traverses, enabling the identification of two types of Mesozoic normal fault systems: an E-W trending fault set, and a NNE trending fault set. Considering the tectonic events that have happened since the Mesozoic and the intersection relationship between the two fault systems, we propose that the E-W trending normal faults originated from the Triassic collision between the South China Block and the North China craton. The NNE trending normal faults were derived from strike-slip faults formed under transpression, due to multiple phases of subduction of the Pacific plate during Jurassic to Late Cretaceous. Both fault systems were subsequently reactivated and transformed into normal faults during the Early Cretaceous rifting, leading to the formation of a cross-graben rift. The widespread Early Cretaceous extension promoted volcanic activity, allowing significant volumes of deep-seated magmatic material to rise along these two sets of faults and to erupt onto the surface. The spatial distribution of the volcanic products was structurally controlled by fault boundaries, leading to the formation of a large-scale, quadrangular Mesozoic volcanic basin.




The basin is characterized by three principal fault systems: the E-W trending Mesozoic normal faults, the NNE trending Mesozoic normal faults, and the NNE trending Cenozoic strike-slip faults. The E-W trending Mesozoic normal faults originated from the Indosinian Orogeny, whereas the NNE trending Mesozoic normal faults were derived from Yanshanian Orogeny. Both of them underwent reactivation and transformed into normal faults during the Early Cretaceous rifting (~135-102 Ma). The majority of Cenozoic faults inherited the spatial distribution patterns of earlier structures and remained tectonically active, particularly in regions characterized by deep-seated and large-scale fault zones.

Mesozoic basin within the southern Bohai Bay basin is a cross-graben rift basin formed through differential subsidence along two sets of normal faults intersecting at high angles (60°–90°) under the influence of regional extensional stress.

The evolutionary history of the Mesozoic basin can be divided into three distinct tectonic stages: (1) The Indosinian orogeny resulted in the development of a series of E-W-trending thrust faults, accompanied by widespread uplift and erosion of pre-existing structures; (2) During the Yanshanian orogeny, the left-lateral strike-slip motion of Tan-Lu Fault was significantly enhanced, generating displacements on the order of hundreds of kilometers, with the associated strike-slip deformation overprinting and offsetting the earlier E-W-trending thrust faults; (3) In the early Cretaceous period (~135-102 Ma), extensional tectonism induced a structural transformation of the two intersecting fault systems within the basin, leading to normal faulting and the formation of a cross-garben rift basin.