

The Role of Deep-Seated Half-Grabens in the Evolution of the Northern Tian Shan Fold-and-Thrust Belt and Its Implications to Exploration, Northwest China

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Abstract

The northern Tian Shan fold-and-thrust belt, which is located in the southern Junggar Basin, has formed in response to contraction during Late Cenozoic. However, the tectonic environment for its formation before Late Cenozoic is still controversial. In this paper, we use surface data, recently collected and processed subsurface seismic reflection data, isopach map of Lower Jurassic and balanced sections to propose pre-existing half-graben system developed in the Lower Jurassic with this fold-and-thrust belt. We also use results of a series of scaled sandbox analogue models, where industrial CT apparatus was used to monitor deformation, to simulate the evolution of this fold and thrust belt. We suggest that the segmented shape of the northern Tian Shan fold-and-thrust belt is a response to the presence of thrust ramps, which were formed during early Jurassic. During late Cenozoic shortening, the Lower Jurassic syn-rift sediments served as major detachment horizon, making a pre-existing normal fault act as a stress concentration zone leading to steeping of a thrust-ramp over the normal fault and cover detachment overstep the underlying half-grabens. Modeling results reveal that the presented structural framework has close resemblance with paleostructures especially in the intracontinental environment, which underwent a complex multicycle evolution process, and provide a new prospective for the interpretation of natural examples. The samples in the Lower Jurassic reveal they are organic rich mudstone with TOC distribution between 0.6-1.6%. And thermal history shows that they

generated oil and gas during Cretaceous and Late Cenozoic, respectively. The northern Tian Shan fold-and-thrust, which oversteps deep seated Lower Jurassic half-grabens, has great potential at exploration.

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