Late-Stage Tectonic Inversion and Its Geodynamic Significance: Evidence from the Uplifting and Denudation History of the Songliao Basin

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The Songliao Basin is one of the biggest lacustrine basins in the world. It was formed due to the Jurassic rifting, the early Cretaceous subsidence and the late Cretaceous-Cenozoic inversion. it is due to the late stage tectonic inversion that resulted in the forming of the Daqing Anticline in the central depression. The discovery of the Daqing Oilfiled has played an important role in both the development of the petroleum industry and the advancement of the non-marine petroleum geologic theory of China.

The thickness of the late-stage denudation is reconstructed by means of the vitrinite reflectance and the porosity-depth relationships in shales. The late-stage inversion history is reconstructed by the evolution of two regional cross-sections from the east margin to the west.

Research results indicate that the thickness of denudation is big in the east uplifted zone and small in the central depression zone and the west slope zone. It decreases from the east to the west. The thicknesses of the northeast uplifted zone, the southeast uplifted zone vary between 800-1500m with the maximum thickness of 1650m found on the east margin, while the thicknesses of the west slope zone and the central depression vary between 400~600m, with the minimum thickness of 200m found in the Gulong depression.

The denudation history reconstructed by the evolution of two regional cross-sections indicates that the late-stage tectonic inversion has undergone three stages of east-west migration. The tectonic inversion in the east uplifted zone occurred at the end of the Nenjiang period (77-73Ma), while the tectonic inversion in the central depression began at the end of the Cretaceous(65Ma) and became intense at the early stage of the Eocene(45Ma), and that of the west slope break zone was relatively slight and occurred at the end of the Paleogene.

The characteristics of the east-west variations of denudation and episodic uplifting are the far-field responses to a series of plate reorganizations in the Mesozoic-Cenozoic. The first episode of the rapid uplifting and denudation was in response to the subduction of the Izanazi Plate and died out underneath the Eurasian Plate. The second episode is in response to the major episode of the Yanshan Movement when the absolute moving direction of the Pacific Plate changed from NNW to NWW and orthogonally dived underneath the Eurasia Plate. And the last episode is in response to the extension and closure of the Japan Sea.