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Analysis of the geological structure and tectonic evolution of Xingning-Jinghai sag in deep water area, northern South China Sea

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Recent years, oil and gas exploration of the Pearl River Mouth Basin in the northern margin of South China Sea continuously achieved historic breakthroughs. The Xingning-Jinghai sag, which is located in southeast of the Pearl River Mouth Basin, is a deep-water sag with a great exploration potential. Its tectonic evolution is extremely complex. It experienced Mesozoic subduction to Cenozoic intra-continental rifting background, and finally evolved into a deep-water sag of the northern continental margin of South China Sea. The geological characteristics and the tectonic evolution of Xingning-Jinghai sag was closely related to the process of formation and evolution of the passive continental margin of the northern South China Sea. It is confirmed by many geophysical data that compared with adjacent Chaoshan depression, the crustal thickness of Xingning-Jinghai sag was rapidly thinning, and it developed detachment faults with later magmatic intrusion. The development of detachment faults have dynamic significance for the spreading of the South China Sea. Based on the seismic geological interpretation of 2D seismic data in the study area, the characteristics of detachment fault and supra-detachment basin have been proposed in this study. The characteristics of the detachment fault are low angle and high ratio between heave and throw. The geometry of the detachment fault is a typical lisric shape, with the dip of fault decreasing generally from the seismic profile. The detachment basin where sediments are not deposited over a tilting hanging-wall block but onto a tectonically exhumed footwall which is different from the typical half graben basin. Seismic profiles indicate two different structural styles in the east and west part of Xingning-Jinghai sag. In the west of the sag, there developed two large detachment faults, which control their detachment basin systems and the typical H block, and the two detachment faults are dipping landward and seaward, respectively. In the east, affected by the later volcanic activities, Xingning-Jinghai sag deformed complicatedly and developed a series of landward dipping faults, showing the compound graben structure. Combined with the fault activity quantitative calculation, basin subsidence history and other advanced technology, the basin tectonic evolution has been divided into rift stage and post-rift stage. Considering the extension development evolution of Xingning-Jinghai sag and the extension and thinning of lithosphere under the background of spreading of the South China Sea, we argue that the northern margin of the South China lithosphere experienced an intense stretching and thinning stage. At this period, the subsidence of the Xingning-Jinghai sag was controlled by the detachment faults, indicating a rifting stage. With the development of the detachment faults, the thickness of crust was extremely thinned. After the spreading of the South China Sea the whole sag entered into the depression period which was characterized by thermal subsidence.