The Recognition and Formation Mechanism of Break-up Sequence –an example from the Baiyun Sag in Northern Margin of South China Sea

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1.Introduction

The South China Sea (SCS) is one of the largest marginal sea in southeast Asia. The northern continental margin of the SCS has been considered an intermediate between the magma-poor and magma-rich end members. Baiyun sag is located in the deep water area where the northern continental crust had been hyper-thinned to < 12km. The syn-rifting deposition in the Baiyun sag shows distinct features to a classic rift basin at the shallow water area. Based on the high-resolution 3D seismic data interpretation and drilling logging analysis, we interpret a structural sequence corresponding to the hyper-thinning process before the final breakup of the continent. This sequence is bounded by a classic breakup unconformity and a regional transgression surface in the syn-rift strata of the Baiyun Sag; within the sequence, a set of foreset reflectors suggesting a prograding shelf-margin delta. Analog to the Iberia margin of North Atlantic, we use the definitions of Lithospheric Breakup Surface (LBS) and Breakup sequence (BS) and determine the distributions of the LBS and BS in the Baiyun sag. Based on the logging results, we apply subsidence back stripping to recover the palaeogeomorphology background with the development of BS. Finally, based on isostasy, we restore the basin structure using the balanced section technique and analyze the controlling factor of coarse-grained deposition distribution. Our results refine the deposition process related to the hyper-extension and the final breakup of the continental margin.

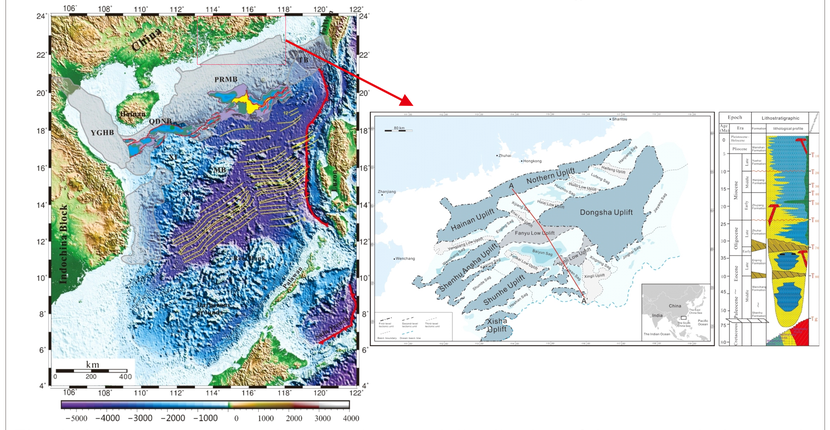

Fig. 1 a) bathymetry map with superimposed distribution of deepwater baisns and magnetic anomalies ; b) Location of the study area (left) and vertical chronological and lithologic characteristics of the study area (right)

2 Sequence stratigraphy and basin structure

The BS is closely related to tectonic events after lithospheric cracking, it records the isostatic adjustment process of the lithosphere from the beginning of lithospheric cracking to the beginning of thermal relaxation controlling discrete edge subsidence.

T70 (an unconformable interface) —The bottom interface;

MFS18.5(maximum flooding surface)—the top interfacethe ;

T60 (second-order sequence boundary);

ZHSB2, ZHSB3, ZHSB4, ZHSB5, ZHSB6 and SB21 (third-order sequence boundaries).

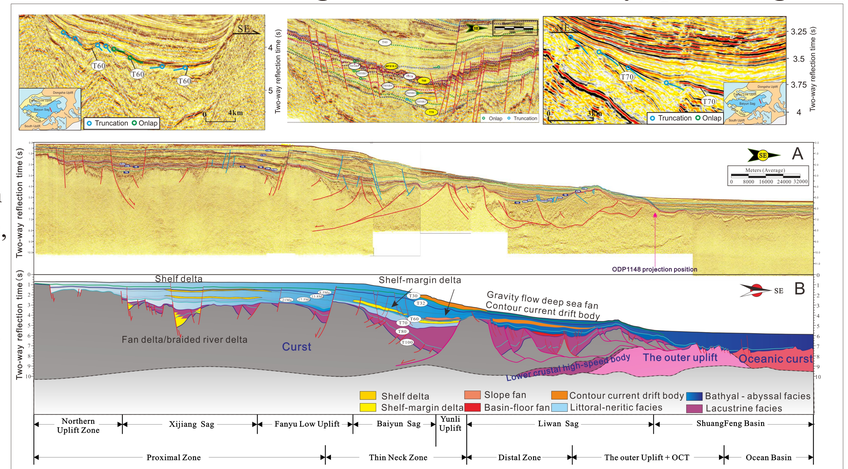

Fig. 2 the profile across Xijiang sag to Liwan sag shows the insight of tectono-stratigraph frame work and sedimentary squence

3 Distribution characteristics of the BS

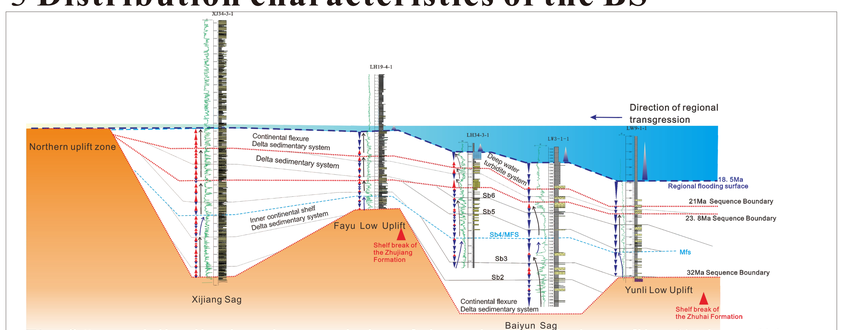

Fig. 3 Lateral distribution characteristics of six typical borehole profiles.1)The well log profiles show that T60's upper and lower sedimentary systems and logging curves have undergone obvious changes 2)The Xijiang Sag-Baiyun Sag mainly developed multiple sets of accretionary, superposed, deposits. 3)The characteristics of the seaward reverse cycle are obviously gradual, and a large number of sediments with progressive deposition as the main superposition mode are developed.

4 Paleogeomorphologic characteristics of the BS period

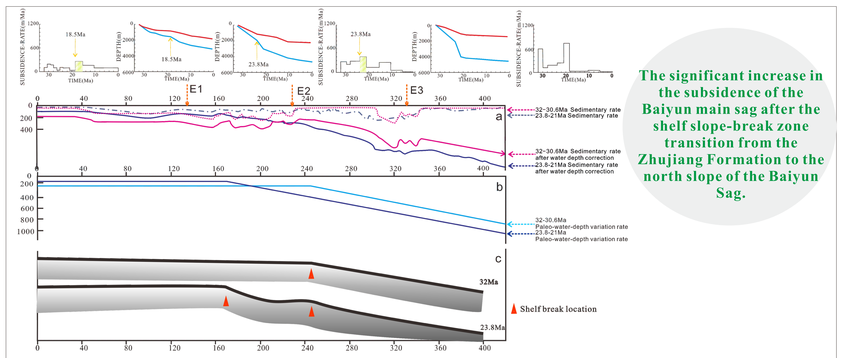

Fig. 4.1 Regional section subsidence history, paleobathymetric correction and paleogeomorphologic restoration of BS development.

The significant increase in the subsidence of the Baiyun main sag after the shelf slope-break zone transition from the Zhujiang Formation to the north slope of the Baiyun Sag.

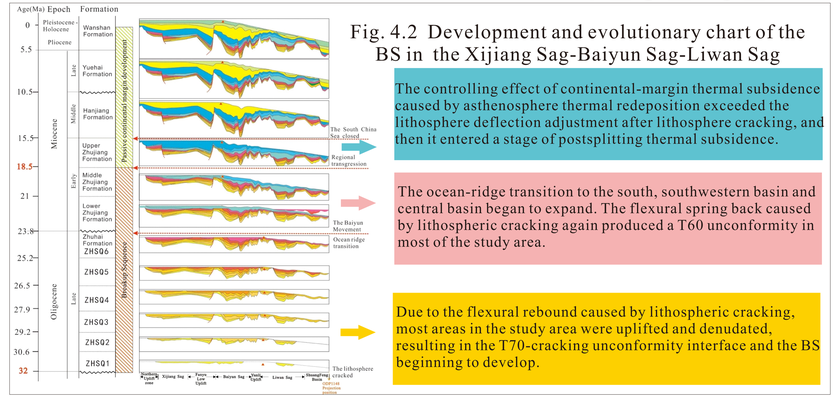

Fig. 4.2 Development and evolutionary chart of the BS in the Xijiang Sag-Baiyun Sag-Liwan Sag

The controlling effect of continental-margin thermal subsidence caused by asthenosphere thermal redeposition exceeded the lithosphere deflection adjustment after lithosphere cracking, and then it entered a stage of postsplitting thermal subsidence.

The ocean-ridge transition to the south, southwestern basin and central basin began to expand. The flexural spring back caused by lithospheric cracking again produced a T60 unconformity in most of the study area.

Due to the flexural rebound caused by lithospheric cracking, most areas in the study area were uplifted and denudated, resulting in the T70-cracking unconformity interface and the BS beginning to develop.

4 Discussion

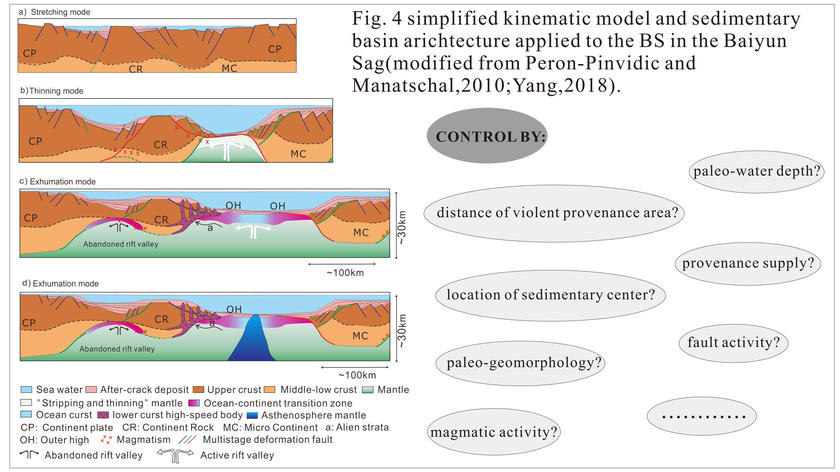

Fig. 4 simplified kinematic model and sedimentary basin arichtecture applied to the BS in the Baiyun Sag(modified from Peron-Pinvidic and Manatschal,2010;Yang,2018).

5 Conclusions

1.We discussed the Lithospheric Breakup Surface and Breakup Sequence in the depositional sequence of the deep-water basins in the northern of the South China Sea, and established the sequence stratigraphic framework of the Breakup Sequence.

2.The Breakup Sequence in the Baiyun Sag is mainly controlled by the marginal rebound caused by the two lithospheric fractures at 32 Ma and 23.8.The BS developed between the continental shelf slope- breaks

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