

**PS The Genetic Mechanisms and Characteristics of Hydrocarbon Migration
Induced by Overpressure in the Yinggehai Basin, South China Sea***

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Abstract

The Yinggehai Basin is a Cenozoic high temperature and high pressure strike-slip basin with rapid subsidence and many of fluid diapirs. Most of the gas fields discovered confirmed that the reservoirs are charged by vertical pathways which were induced by overpressured fluids. By using 3D seismic attributes, including coherence and curvature cubes, two main types of hydrocarbon migration systems induced by overpressure-driven fractures are recognized and characterized in the sag region of the Yinggehai Basin, which are the diapir system and the deep pre-existing fracture system reactivated by late overpressure, respectively. The diapir system mainly distributes in the central depression of the basin, can be divided into five evolution stages including pressurization, punctuation, equilibrium, relief and collapse according to the recovering and modeling of diapiric structures. The deep pre-existing fracture system mainly distributes in deep, high-pressure intervals which are located in the margin of the basin.

By using geochemical methods such as natural gas isotopes and inclusions uniform temperature, it is confirmed that there are at least three phases of natural gas charging since the Pliocene. By comparing the hydraulic fracture pressure coefficient from boreholes, it is indicated that the distribution of gas-bearing beds has a significant correlation with the hydraulic fracture pressure coefficient, which suggested that the larger the hydraulic fracture pressure coefficient of the caprock, the more likely the natural gas leaks, and the higher migration efficiency. Synthetically utilizing the overpressure forming time, the hydrocarbon charging time and regional tectonics, firstly, it is suggested that the Pliocene dextral strike-slip extension was conducive to the increase of deposition rate, the formation of regional un-equilibrium overpressure, and the induced generation of local tension fractures which triggered the development of diapirs that enlarged and increased the fracturing degree and in turn improved the migration efficiency. Secondly, it is suggested that the Miocene sinistral strike-slip movement created dense tension fractures in the deep intervals which reactivated under the late overpressure and acted as vertical pathways for natural gas migration. Whether or where nature gas accumulation occurs is determined by hydraulic fracture pressure coefficient rather than the pre-exist fractures.

The Genetic Mechanisms and Characteristics of Hydrocarbon Migration Induced by Overpressure in Yinggehai Basin

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I. Geological Background

The Yinggehai Basin is a Cenozoic high temperature and high pressure strike-slip basin with rapid subsidence and lots of fluid diapirs. Most of the gas fields discovered confirmed that the reservoirs are charged by vertical pathways which induced by overpressure fluids.

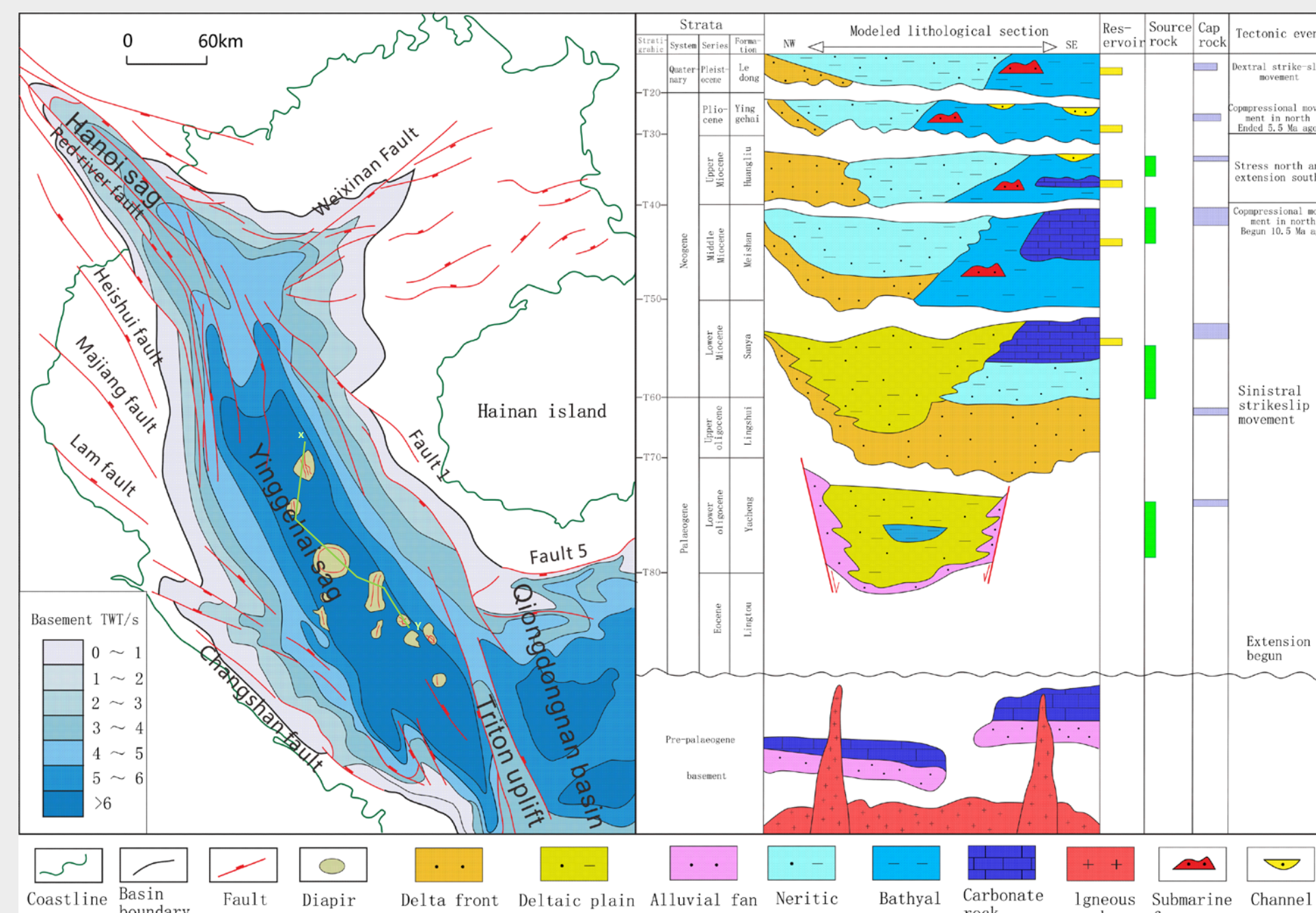


Fig. 1. Location and stratigraphic features of Yinggehai Basin.

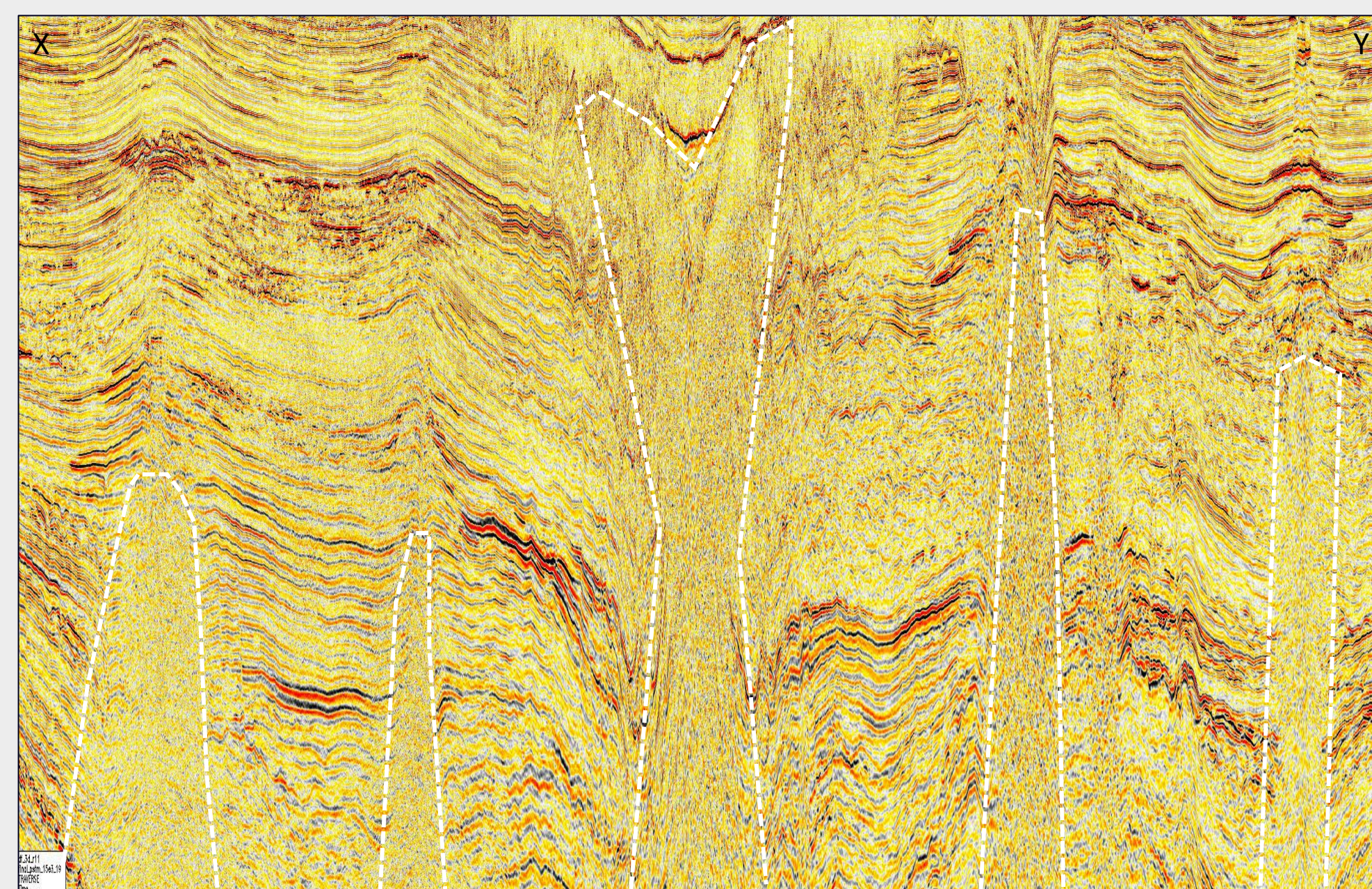


Fig.2 Overpressure diapir distribution of Yinggehai basin

Seismic Characteristics and Evolution

By using 3D seismic attributes including coherence and curvature cubes, two main types of hydrocarbon migration systems induced by overpressure-driven fractures are recognized and characterized in the sag region of the Yinggehai Basin, which are the diapir system and the deep pre-exist fracture system reactivated by late overpressure, respectively. The diapir system, mainly distributes in the central depression of the basin, can be divided into five evolution stages including pressurization, punctuation, equilibrium, relief and collapse according to the recovering and modeling of diapiric structures .

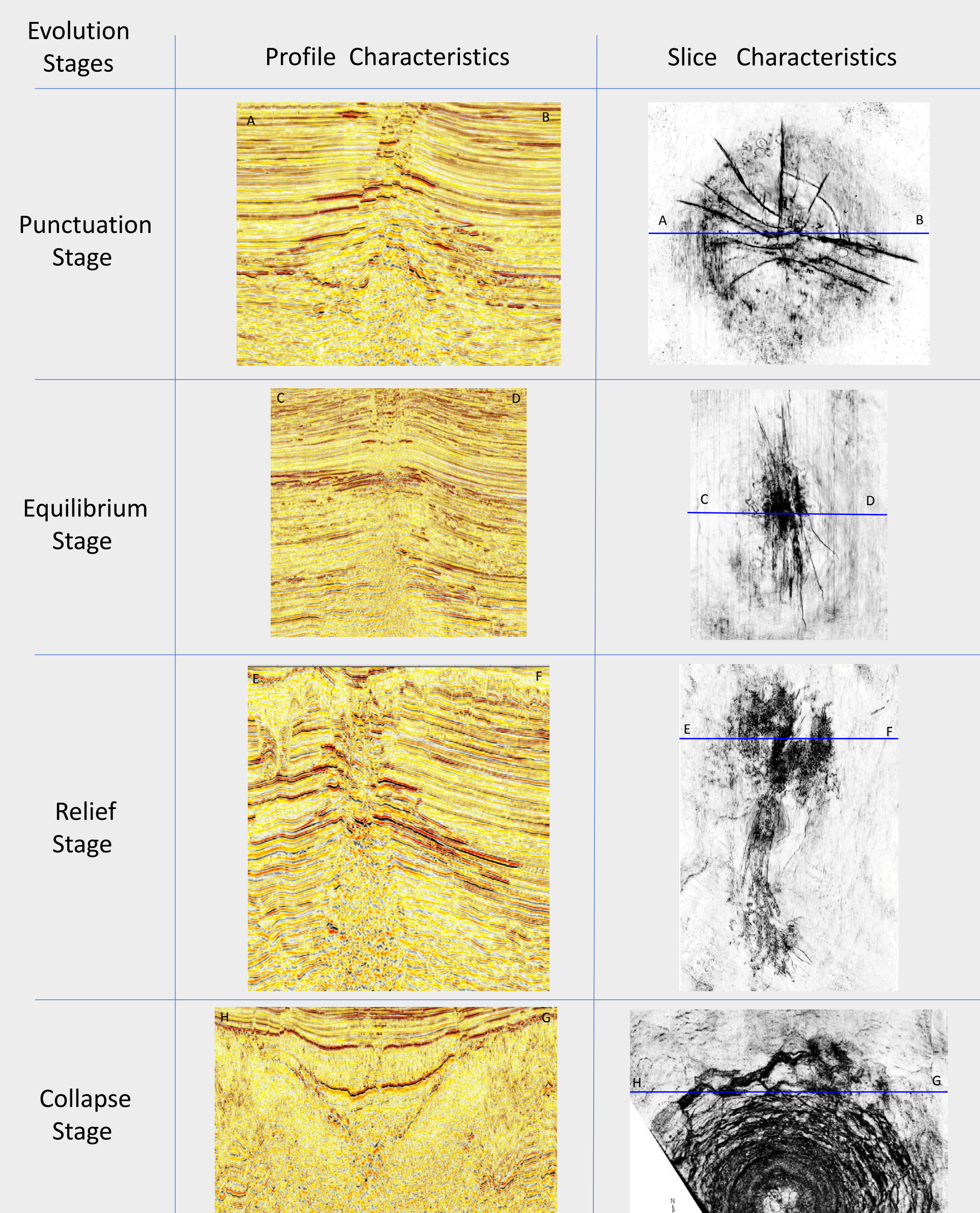


Fig.3 Morphological characteristics of diapir of different evolution stages

Mechanisms and Migration

By using geochemical methods such as natural gas isotopes and inclusions uniform temperature, it is confirmed that there are at least three phases of natural gas charging since Pliocene. By comparing the hydraulic fracture pressure coefficient from boreholes, it is indicated that the distribution of bearing gas-beds has a significant correlation with the hydraulic fracture pressure coefficient, which suggested that the larger the hydraulic fracture pressure coefficient of the caprock, the more likely the natural gas leaks, and the higher migration efficiency.

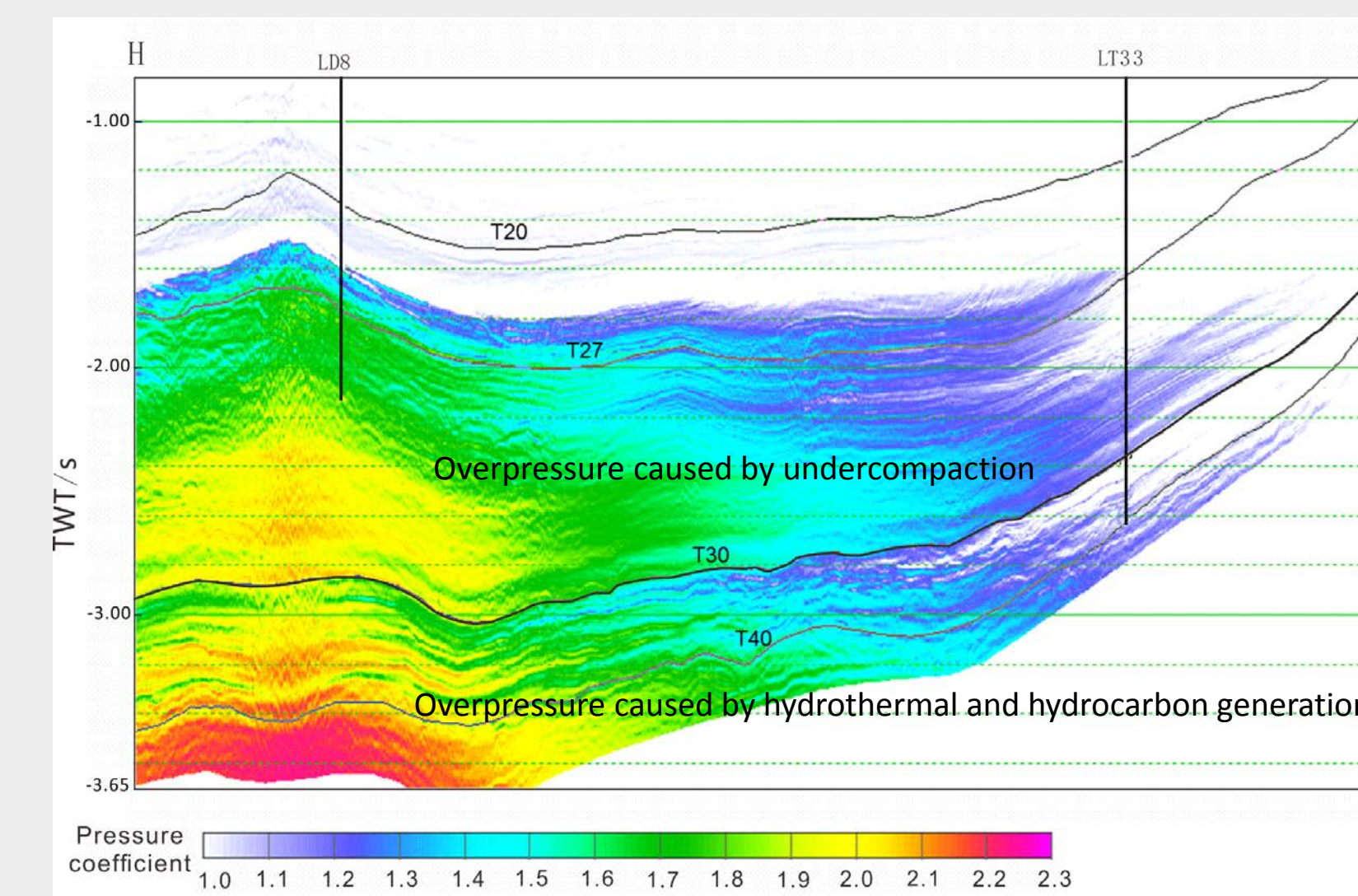


Fig.4 Pressure coefficient section of overpressure formations induced by two types in Yinggehai basin

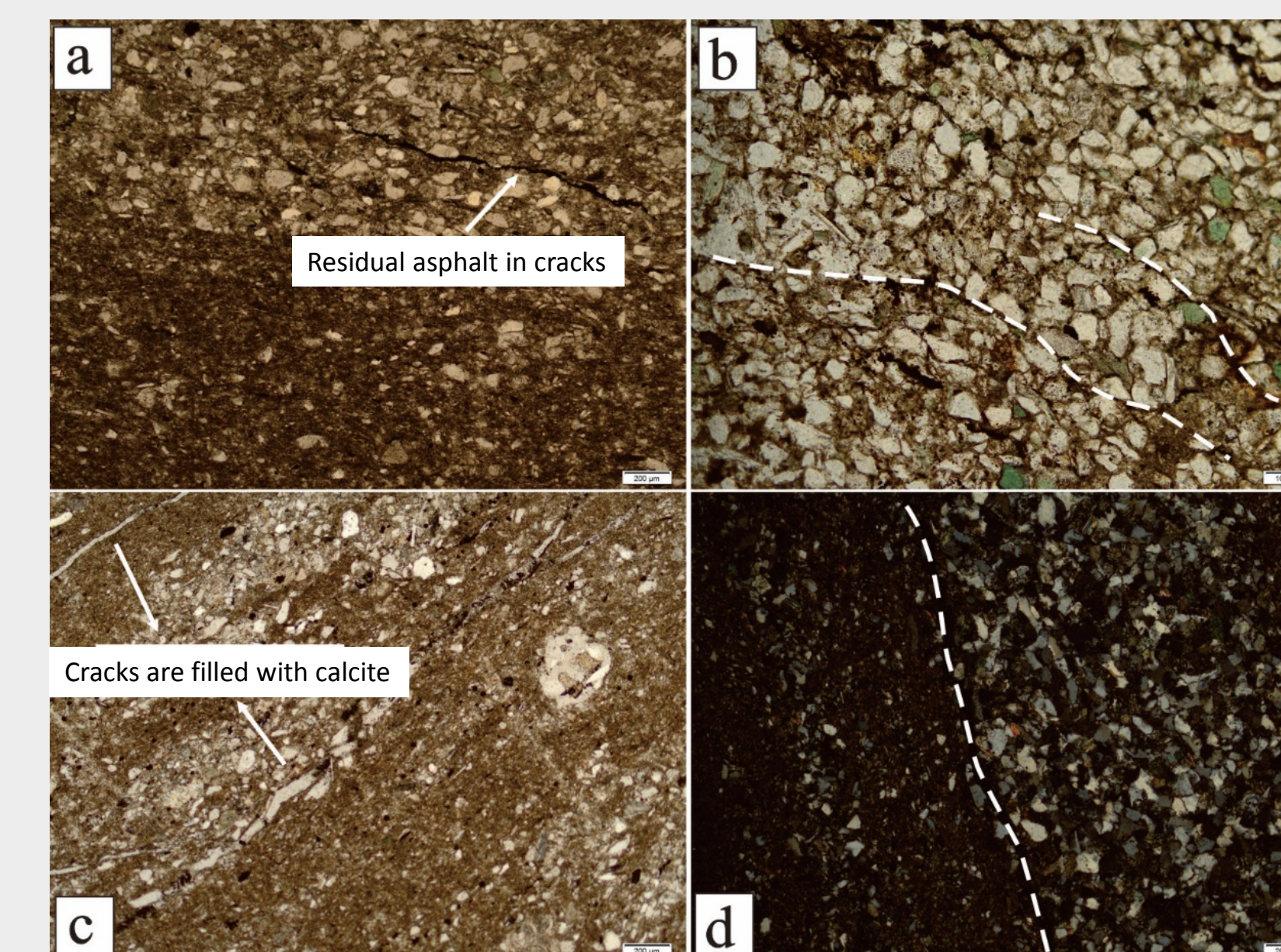


Fig.5 Microfractures formed by hydrofracturing and fillings in Yinggehai basin

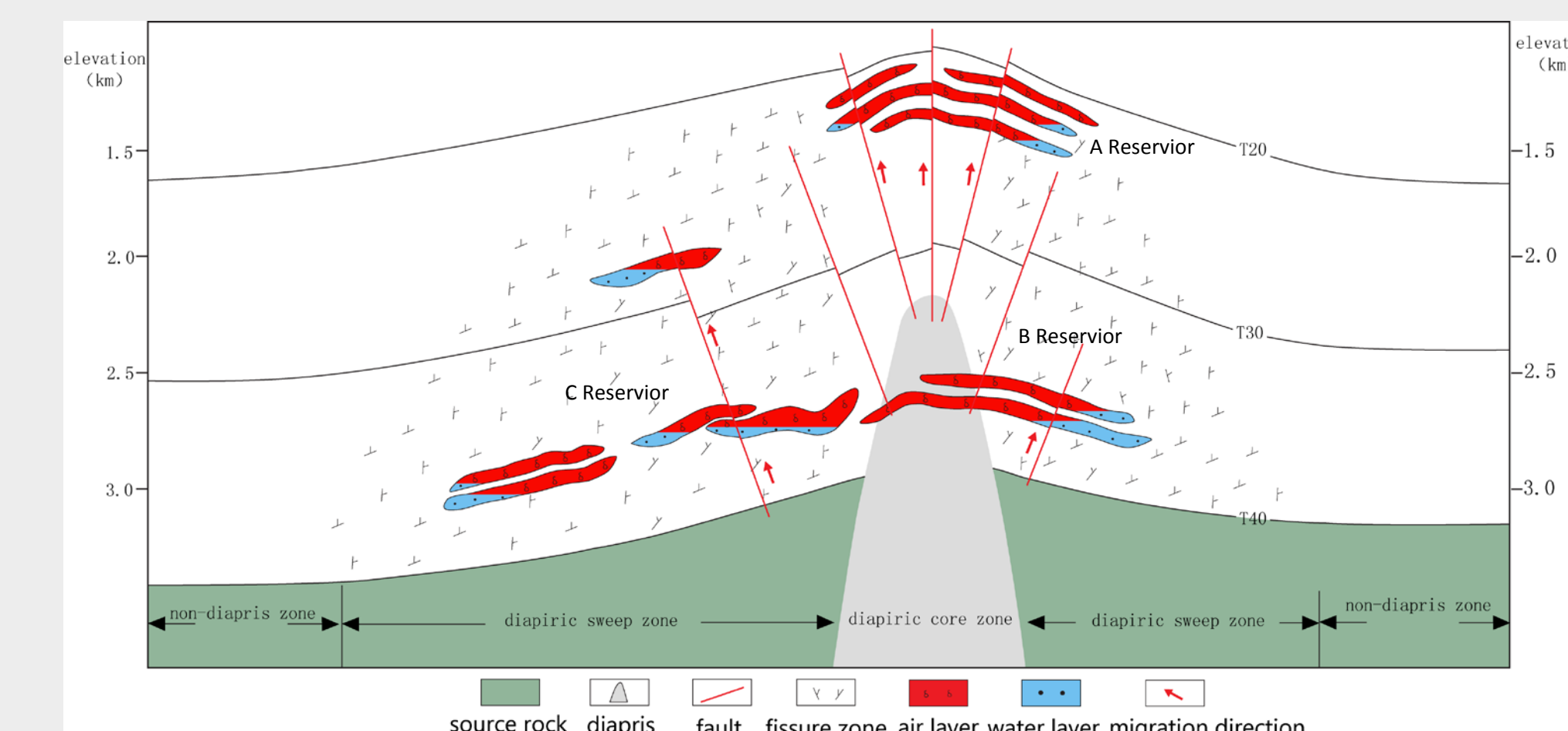


Fig.6 Accumulation model of vertical migration system of overpressure diapir in DF gas field

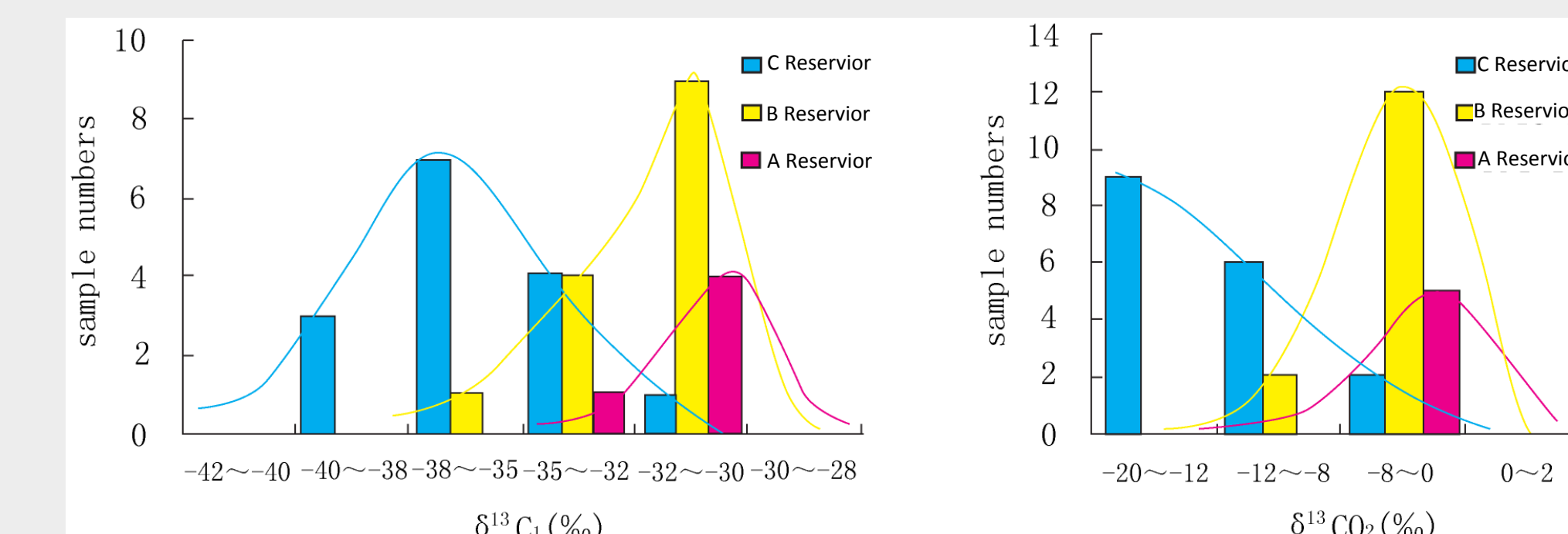


Fig.7 Gas charging sequence of vertical migration system of overpressure diapir in DF gas field

Conclusions

Synthetically utilizing the overpressure forming time, the hydrocarbon charging time and regional tectonics, firstly, it is suggested that the Pliocene dextral strike-slip extension was conducive to the increase of depositional rate, the formation of regional un-equilibrium overpressure, and the induced generation of local tension fractures which triggered the development of diapirs that enlarged and increased the fracturing degree and improved the migration efficiency in turn. Secondly, it is suggested that the Miocene sinistral strike slip created dense tension fractures in the deep intervals which reactivated under the late overpressure and acted as vertical pathways for natural gas migration. Whether or where nature gas accumulation is determined by hydraulic fracture pressure coefficient rather than the pre-exist fractures.