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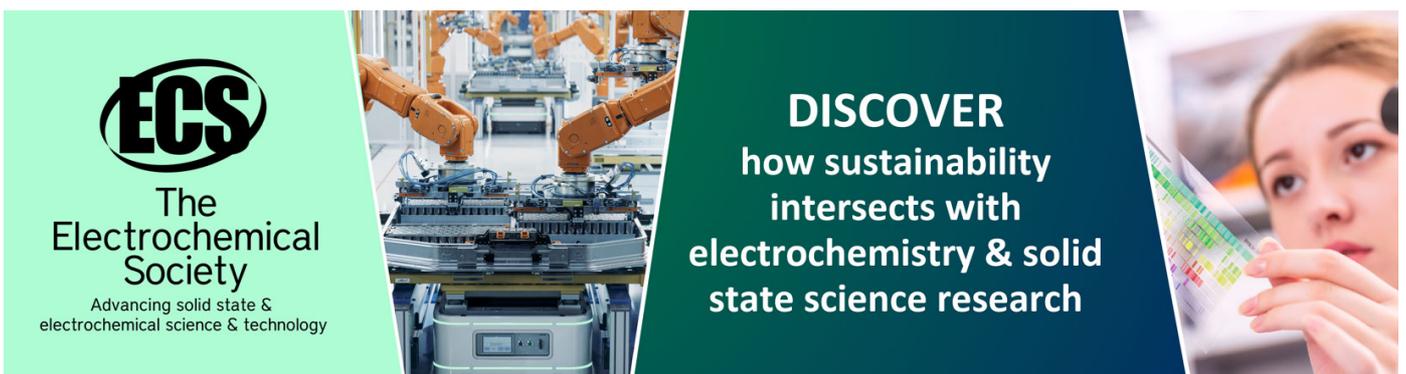
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New play discoveries in the South Sumatra Basin, Indonesia- Exploration case study in CNPC Jabung Block

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Abstract. The Jabung block is located in the Jambi depression in the northern part of the South Sumatra Basin. According to the tectonic evolution characteristics and the characteristics of the resource/reservoir/trap, together with the trap structure and the hydrocarbon enrichment characteristics of the South Sumatran Basin, the hydrocarbon play of the basin can be divided into the pre-rift period play, the rift period play and depression period play. The pre-rift period play mainly refers to the basement play. The rift-period play mainly refers to the Lahat play, the Lower Talang Akar play and the Upper Talang Akar play. The depression play mainly refers to the Batu Raja play, the lower Gumai play, the upper Gumai play and Air Benakat play. The main hydrocarbon discoveries in the Jabung block are concentrated in the Lower Talang Akar play and the Upper Talang Akar play in the rift period. In recent years, with the exploration activities in the Jabung block, some new discoveries in stratigraphical traps have been made in the basement play in pre-rift period and the Batu Raja play and the Gumai play in the depression period.

1. Introduction

The Jabung block is located in the Jambi depression in the northern part of the South Sumatra Basin. The main hydrocarbon discoveries in the Jabung block are concentrated in the Lower Talang Akar play and the Upper Talang Akar play in the rift period. In recent years, with the exploration activities in the Jabung block, some new discoveries in stratigraphical traps have been made in the basement play in pre-rift period and the Batu Raja play and the Gumai play in the depression period. The well NEB-X-1 was tested in the basement section with an open hole test, with a daily gas production of 2.1 million cubic feet and condensate of 124 barrels. The two sections of Batu Raja of the TX-2 well test totaled 602 barrels of oil and 10.56 million cubic feet gas per day. Through the post-drilling comprehensive geological and geophysical evaluation, the enrichment of these three new plays are summarized in the following paper.

2. Tectonic Evolution and play types of Jabung Block

The Jabung block is located in the Jambi depression in the northern part of the South Sumatra Basin. The basement is formed in the pretertiary era. Early Permian, the Middle Tethys opened, and the Sibumasu land was separated from the Gondwana continent. Middle Permian, the ancient Tethys



Ocean gradually disappeared, and the Sibumasu and Indosin plates were brought closer. During the Late Permian-Middle Triassic, the Middle Tethys continued to expand, the Sibumasu land mass collided with the Indosin plate, forming a collisional hyperplasia zone, and the Bentong-Raub suture gradually formed. Early Triassic - Early Jurassic, the expansion of the Middle Tethys, prompted the West Sumatra land mass to spin right to the Sibumasu land mass to form the Middle Sumatra Tectonic Zone(MSTZ)structural belt^[1]. There are three main tectonic evolution stages in the tertiary era. From early to Late Oligocene, the regional sag was starting and NE-SW normal faults were formed in the rift stage. From late Oligocene to Mid-Miocene, the continued regional subsidence wa happened in the post-rift stage. From Mid-Miocene to Present, the NW-SE thrust faults were formed in compression and inversion stage. The basement play is the pre-rift period play. The Lahat Play, the Lower Talang Akar play and the lower Talang Akar play belong to rift period play. The Air Benakat play, the upper gumai play, the Lower Talang play and the Batu Raja play are the Depression Period play^{[2][3]}(Figure 1)

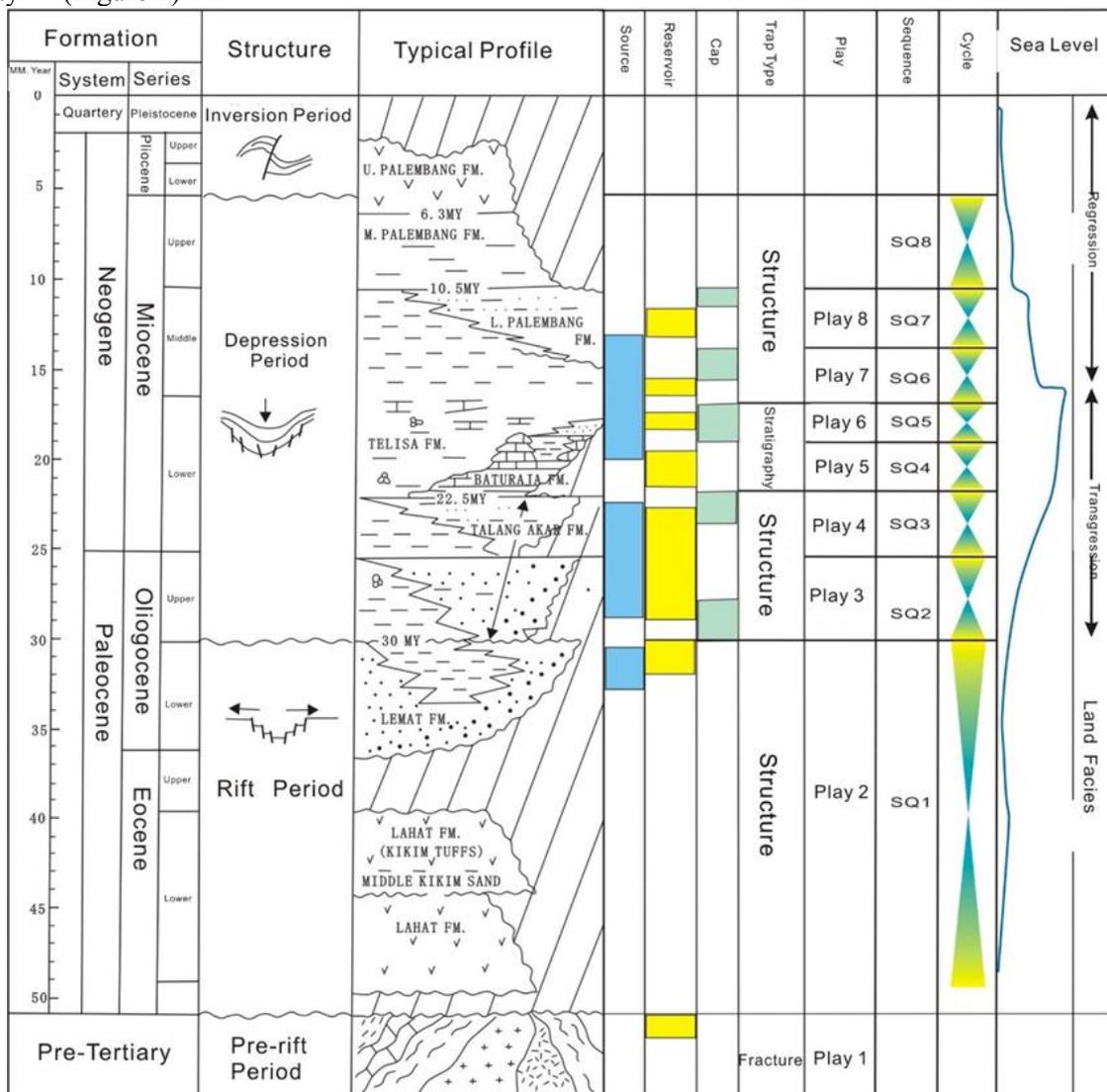


Figure 1. Play Type in South Sumatra Basin

3. New Discovery in Pre-rift period basement Play

NEB-X-1 was tested in the basement section with an open hole test, with a daily gas production of 1.453 MMSCF and condensate of 124 Barrels. This well is located at the basement high structure

position in the east western uplift belt of Jabung block (Figure 2). The following basement hydrocarbon enrichment rules are summarized: (1) The NE-SW normal fault controls the distributions of hydrocarbon kitchen, and hydrocarbons in basement are distributed around kitchen depressions. (2) The lithology of basement in Jabung block is mainly granite, metamorphic rocks, carbonate and metamorphic quartzite. The hydrocarbon in basement is mainly accumulated in granite and metamorphic rocks. The NE-SW compressions in the Late Miocene is the key to the forming of basement fractures, and the degree of fracture development is proportional to the deformation strength of the basement, the fractures in basement are mainly developed in the area near the NW-SE faults. (3) The basement buried hill is far away from the provenance, and the buried hill is directly covered by mudstone or tight carbonate rock, which has good preservation conditions^[4] (Figure 3). The fracture is the main seepage channel in the basement, so the fracture prediction in the basement is very important.

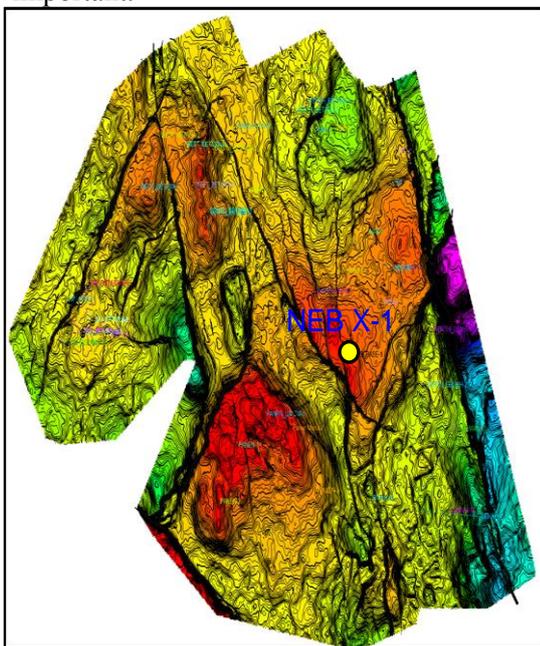


Figure 2. Structure Map of Basement

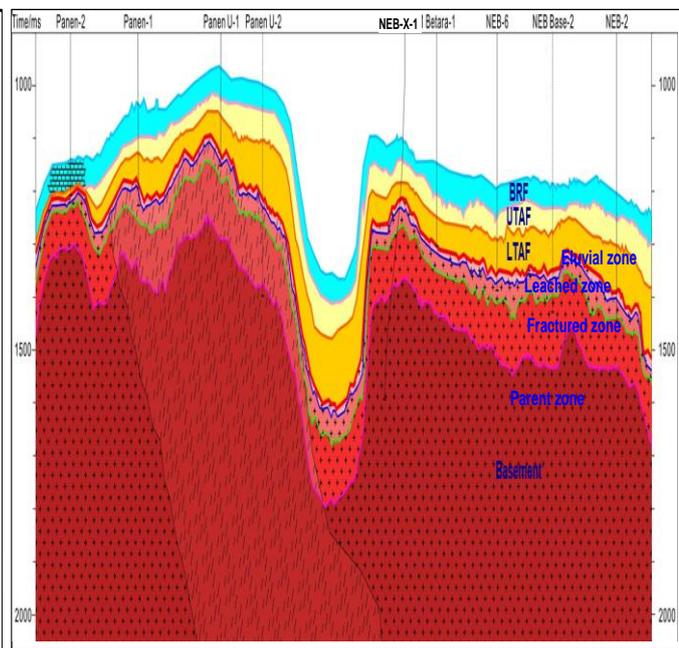


Figure 3. Seismic cross-section of NEB-PANEN

During the Jurassic-Cretaceous period, the magma invaded to form granite. During the Cretaceous-Early Paleocene, the W Betara and Panen-2 wells were structurally high, weathered and denuded, and the late Miocene tectonic compression, Panen U-1 the well structure has the highest uplift and the crack may develop (Figure 4). The NEB X-1 is also located in the Structure high of basement, the fractures is also developed in the basement section of NEB-X-1.

According to the petrophysical property and seismic characteristics, the basement section can be divided into four zones in the Jabung granitic basement. The four zones are eluvial zone, the leached zone, the fractured zone and parent rock zone. The characters of the four zones show in the following:

- (1) Eluvial zone: the thickness of the eluvial zone is about 25 meters, and the weathering intensity is strong, the porosity is often higher than 10% and there are good continuity and high frequency in the seismic profile. The main lithology of eluvial zone is conglomerate.
- (2) Leached zone: the thickness of the leached zone is about 70 meters, and the weathering intensity is moderate, the porosity is about 8-15% and there are good continuity and high frequency in the seismic profile. The disintegrated rocks with intensely developed fractures and pores often developed in this zone.
- (3) Fracture zone: the thickness of the fractured zone is about 200 meters, and the weathering intensity is weak, the porosity is almost less than 5% and there are sub-chaotic reflections

and low frequency in the seismic profile. The disintegrated rocks with a few pores and abundant micro-fractures which are fully or partially filled.

- (4) Parent rock zone: the thickness of the parent zone is thickest in the basement, and there is no the weathering intensity, the porosity is almost less than 3% and there arechaotic reflections in the seismic profile. There are complete rock mass, which lacks pores, fractures, and cavities in the parent rock zone.

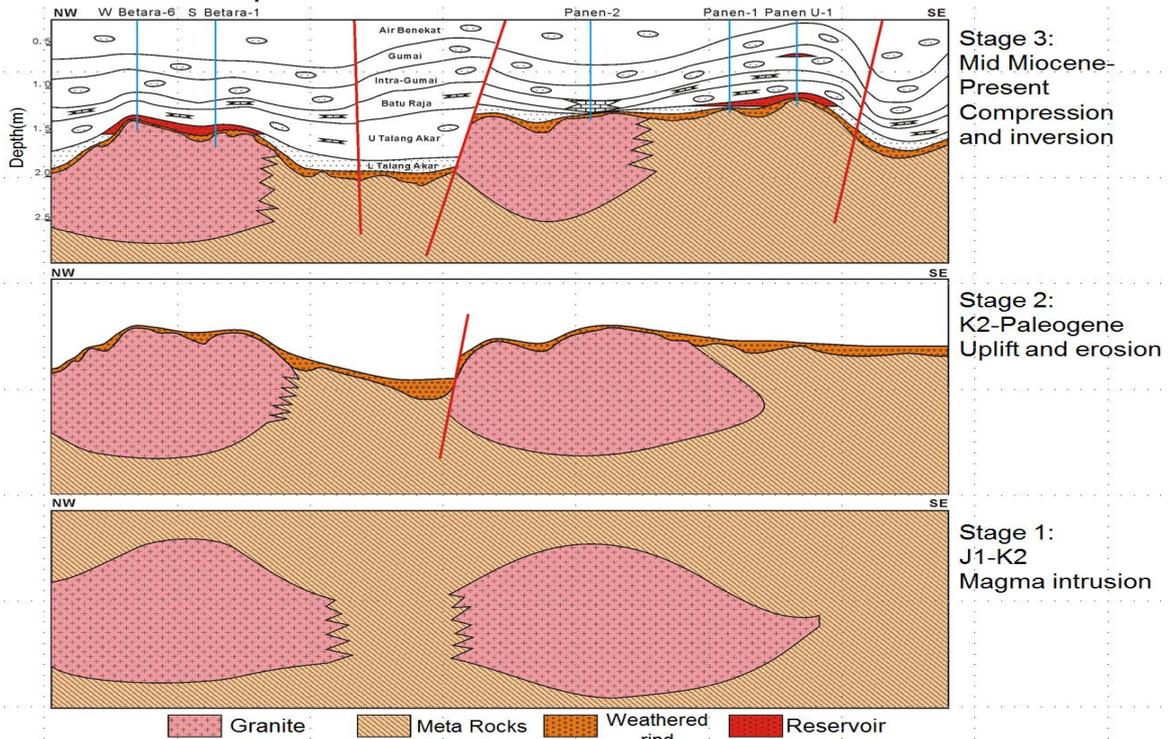


Figure 4. Sketch map of intruded granite evolution in Jabung Block

| Configuration | Weathering intensity | Thick-ness m | NEB Base-1 | Log | Porosity | Representative section | Characteristics |
|----------------|----------------------|--------------|------------|-----|----------|------------------------|--|
| Overlying | | | | | | | Sedimentation |
| Eluvial zone | Strong | 25 | | | | | Conglomerate |
| Leached zone | Moderate | 70 | | | | | Disintegrated rocks with intensely developed fractures and pores |
| Fractured zone | Weak | 200 | | | | | Disintegrated rocks with a few pores and abundant micro-fractures which are fully or partially filled. |
| Parent rock | NO | ~ | | | | | Complete rock mass, which lacks pores, fractures, and cavities |

Figure 5. The Basement divisions and geophysical characters

4. New Discovery in Depression Period Batu Raja Play

The TX-2 well is located in the batu raja structure high position of TX Structure of Jabung block(Figure 6).The two sections of the TX-2 well test totalled 602 barrels of oil and 10.56 million cubic feet gas per day. The carbonate reservoir developed with isolated distribution, with medium porosity and medium permeability (Figure 7).

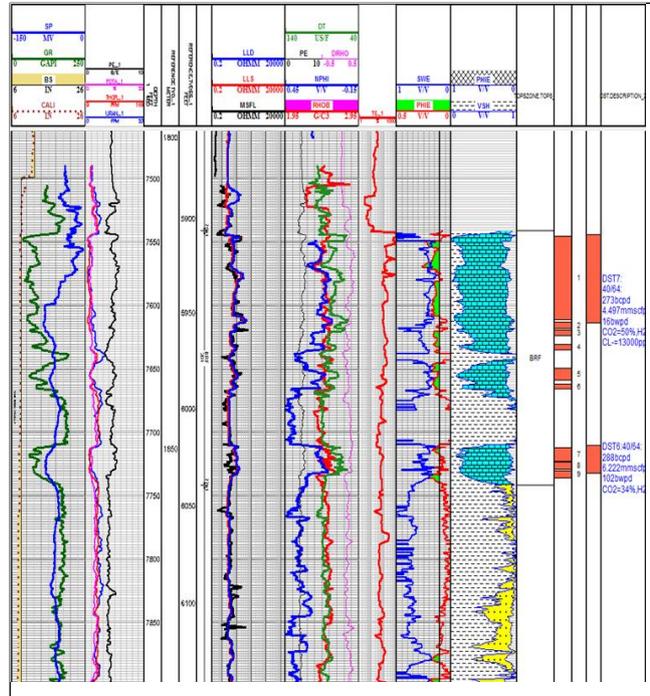
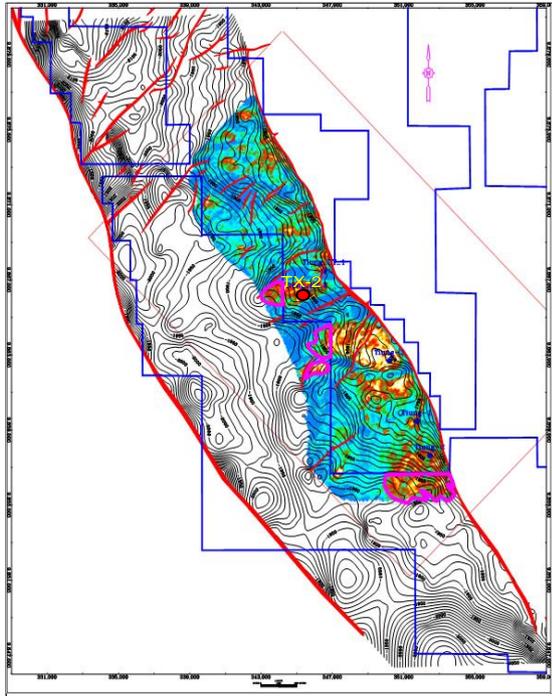


Figure 6. BRF Favorable Target in TX Structure **Figure 7.** Petrophysical Result of TX-2

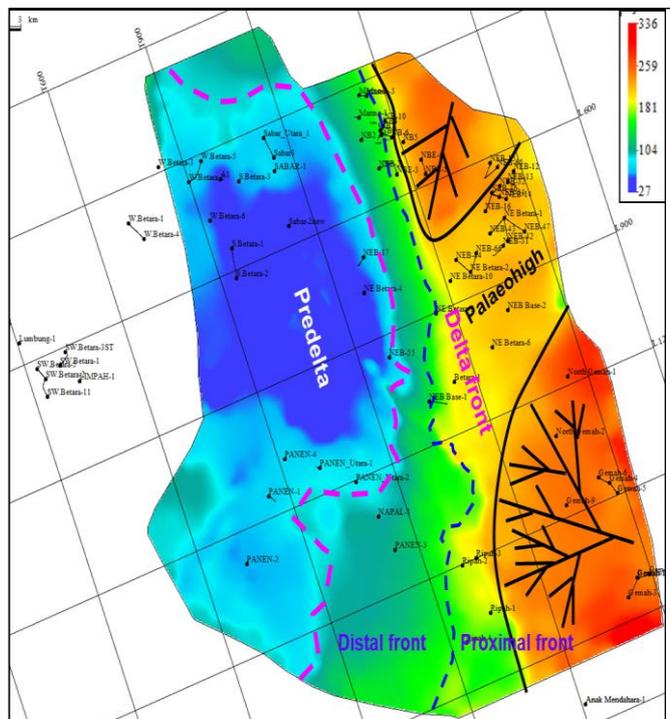
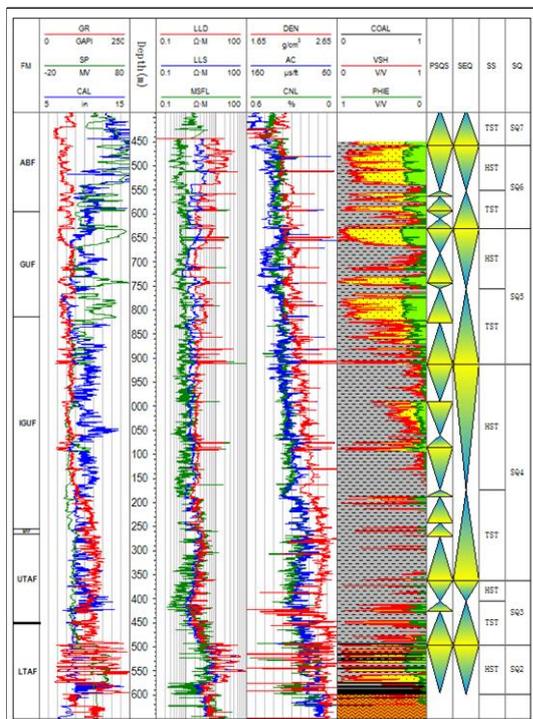


Figure 8. Sequence stratigraphic division **Figure 9.** SQ5 Thickness and deposition system overlay map

5. New Discovery in Depression Period Gumai Play

Gumai sandstone play of delta front faces in the PX stratigraphic traps is discovered in the western uplift belt. The two sections of the PX-3 well test a total of 1800 barrels of oil and 1.56 million cubic feet gas per day. The Gumai hydrocarbon discovery is light oil reservoir with a layered distribution and medium porosity and medium permeability. A multi-level sequence boundary seismic identification technology is established^{[5][6]} (Figure 8). The favourable combination of the delta front thin sand body and the structure forms a series of tectonic-lithologic reservoirs. Structural traps, sand body distribution and cap rock conditions controlled oil and gas accumulation (Figure 9).

6. Conclusion

(1) Pre-rifted Period Basement Play: Paleo-geomorphology and post-reconstruction control of basement reservoir development and hydrocarbon migration and accumulation. Early weathering leaching and late tectonic deformation form two types of effective reservoirs, Basement and overlying TAF formation constitutes a differential accumulation of oil and gas.

(2) In the depression period Bata-Raja play, the dual source of Betera Deep and Geragi Deep mainly develops the platform carbonate, and the lateral and vertical physical properties of the carbonate reservoir change rapidly.

(3) In the depression period Gumai Play, a multi-level sequence boundary seismic identification technology is established. The favourable combination of the delta front thin sand body and the structure forms a series of tectonic-lithologic reservoirs. Structural traps, sand body distribution and cap rock conditions controlled oil and gas accumulation.

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