
The Origins and Charging Processes of Oil-Gas in the Songdong and Baodao Regions in the Eastern Qiongdongnan Basin, South China Sea

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ABSTRACT

The found oil-gas pools in the Songdong and Baodao regions in the eastern Qiongdongnan Basin, South China Sea, have almost failed to realize expected commercial value due to low abundance or high carbon dioxide (CO₂) content. Origins of oil-gas and evolution of petroleum system are complicated. To assist in further exploration, the genetic type, source, and charging processes of oil-gas have been investigated based on analysis of chemical compositions, carbon isotopes, light hydrocarbons, basin modeling, and fluid inclusions. The results show that there are three representative types of gases in the Songdong and Baodao regions. The first type is located in the BD13 and ST24–1 areas in the Songdong region and consists of biogenic gas derived from degradation of Miocene marine mudstones and moderate-high maturity oil-derived gas from Eocene lacustrine mudstones in the Songdong sag. The second type is predominantly found in well BD19–2–3 in the BD19–2 area in the Baodao region and composed of coal-derived gas generated from coal-measure source rocks in the Yacheng Formation and oil-derived gas from Eocene lacustrine source rocks in the Baodao sag. The third type is found in gas pools in the BD15–3 and BD19–4 areas, and well BD19–2–3 in the BD19–2 area and consists of high amounts of volcanic mantle-derived CO₂ and little organic hydrocarbon gas. The identification of oil-derived gas directly confirmed that there exist the Eocene lacustrine mudstones in the eastern Qiongdongnan Basin.

The charge of normal mature oil generated from Eocene lacustrine mudstones in the Songdong sag occurred circa Miocene, and that of moderate-high maturity oil-derived gas and condensate circa during the Pliocene and Quaternary. The biogenic gas was formed during the middle Miocene to Pliocene. The overlying thick mudstones in the Huangliu and Yinggehai formations began to be deposited in late Miocene. Therefore, the normal mature oil almost leaked out, and only small amount of oil-derived gas and biogenic gas were preserved. That may be a critical factor for current gas pools with low abundance in the Songdong region.

The oil-gas generation of Eocene lacustrine source rocks and coal-measure source rocks in the Yacheng Formation in the Baodao sag began to occur circa the middle and

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late Oligocene, respectively. Strong activity of the No. 2 fault and absence of overlying thick mudstones in the Huangliu and Yinggehai formations gave rise to the escape of a large quantity of oil-gas from the middle Oligocene to middle Miocene. During the late Miocene-Pliocene, the injection of hydrocarbon gas continuously occurred. Meanwhile, the No. 2 fault activity became very weak, and the overlying mudstone caprocks were also gradually formed. Therefore, some amounts of hydrocarbon gas may be preserved. Due to volcanic activity in the Quaternary, mantle-derived CO₂ was injected into the reservoirs via the No.2 fault. The previous hydrocarbon gas was driven by CO₂ in various degrees, which is believed to be mainly responsible for current situation that some gas pools with high CO₂ content in the Baodao region.