# Tracing the Charging History of the Continuous Hydrocarbon Accumulation in Rift Lacustrine Basin: A Case Study from the Third Member of Shahejie Formation in the Dongpu Depression, Bohai Bay Basin, China

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## ABSTRACT

The continuous hydrocarbon accumulation over a large area in lacustrine rift basin was recently been found in the Shulu Sag in the Bohai Bay Basin in China. The continuous hydrocarbon accumulation is featured by huge oil & gas resources, however, studies on the geochemistry, origin, and charging history of the continuous hydrocarbon accumulation in lacustrine rift basins are still lacking, which limits the further exploration for continuous hydrocarbons.

Dongpu Depression is a Mesozoic–Cenozoic lacustrine rift basin with an exploration area of 5,300km2. The Third member of Paleogene Shahejie (Es3) Formation is the main source rock and reservoir, and also is the target layer in this project. The Es3 Formation had a thickness of 1500-3500m, and its maximum burial depth could reach 6200m. Some major breakthroughs have been made in the Es3 Formation recently that some commercial oil and gas wells were not only drilled in the deep tectonic uplift and slope, but also in the sag centers, showing great potential in the deep continuous hydrocarbons exploration.

Taking the Third member of Shahejie Formation of the Dongpu Depression as an example, this project firstly investigates the basic geological features of the oil & gas plays from tectonic uplift, slope to sag center, and then the typical oil & gas plays were selected, in which the systematic source rock, reservoir, oil and gas sampling was carried out. Secondly, the biomarker (n-alkanes, sterane, terpane, and aromatic hydrocarbon) and organic carbon isotope experiments (n-alkanes carbon isotopes, saturated hydrocarbon, aromatic hydrocarbon, nonhydrocarbon, asphaltene, oil, and kerogen) were conducted to analyze the oil & gas - source correlation (GC, GC-MS, and isotropic spectrum techniques). Thirdly, combined with basin modelling (PetroMod 10), the fluid inclusion (homogenization temperature, Laser Raman, and palaeopressure simulation) and quantitative fluorescence experiments (quantitative grain fluorescence (QGF), quantitative grain fluorescence on Extract (QGF-E)) were conducted to reconstruct the hydrocarbon charging history. From the above, the hydrocarbon accumulation model of the continuous hydrocarbon accumulation in the lacustrine rift basin is established. The forecast result was that: all of the hydrocarbons in uplift, slope and sag center are sourced from the sag center's source rocks, but with distinguishable maturity. The maturity of hydrocarbons increase from the uplift, slope to sag center progressively. The charging history is that: Firstly, when the reservoir was not tight, the oil and gas generated in the sage center migrated to the uplift under the buoyancy (Displacement Mode). Secondly, when the reservoir was tight, the buoyancy did not play a major role in oil & gas migration, and the oil and gas from the sage center migrated to the slope under hydrocarbon expansion force (Piston Mode). Thirdly, when the reservoir is extremely tight, the oil and gas (mainly gas) would retain in the sandstone adjacent to the source rocks or the source rocks.

This project will not only enrich theoretical studies of hydrocarbon accumulation mechanisms of the continuous hydrocarbon accumulation in the lacustrine rift basins, but also provides significant guidance for the further continuous hydrocarbons exploration in the Dongpu Depression or lacustrine rift basins in other parts of the world.