Diapiric Pathway System and Its Constraints on Migration and Accumulation of Natural Gases in the Yinggehai Basin, South China Sea

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Regional diapir activities, deep overpressure systems and high geothermal gradients in the Yinggehai Basin, South China Sea had important influences on the generation, migration and accumulation of the natural gases in the basin. The Miocene source rocks rich in terrestrial organic matters in the basin are within an over-pressured zone.

Geophysical and geochemical data indicate that the diapiric faults and fractures that cut through the Miocene sediments provide major pathways for upward gas migration with abnormal pressure with sand bodies connected with the faults and fractures acting as relaying conduits. Overpressure is the main driving force for vertical and lateral migration of the gases. Episodic discharge of the deep over-pressured fluids caused the faults and fractures to react periodically, resulting in multiple filling episodes in the reservoirs. The confined episodic gas migration has significantly increased the hydrocarbon expulsion efficiencies and provided favorable conditions for large-scale gas accumulation within the diapric structures in a short time. The compositional heterogeneities and carbon stable isotope data of the gases indicate three phases of gas migration: initially biogenic gas, followed by thermogenic hydrocarbon gas, and then CO_2-rich gas. The filling processes occurred within approximately 1.5 to 0.1 Ma based on the kinetics modeling. As the gas migration and distribution were controlled by faults associated with diapiric activities, the transitional pressure zones around the shale diapir structures are on the gas migration pathways and may therefore be favorable zones for gas accumulation in addition to the shallow diapir structures in the Yinggehai Basin.