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Geochemical Characteristics of Gas Accumulation of Giant Tight Sandstone Gas Reservoir in China

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Tight sandstone gas reservoir, being a kind of unconventional gas reservoir, has great potential in its resource. Giant tight sandstone gas fields of which the reserve is larger than $1000x10^8m^3$ have been found in upper Paleozoic of Ordos basin and Xujiahe formation of Sichuan basin, and breakthrough is made in the exploration of tight sandstone gas reservoir in Kekeya area of Tuha basin.

In this paper, we study accumulation of giant tight sandstone gas reservoir in China with geochemical method. Based on lots of research, we can conclude that accumulation of extensive tight sandstone gas reservoir has the following characteristics: (1) near-source accumulation: experimental data (including natural gas composition, carbon isotopic, maturity of source rock) has confirmed that the tight sandstone gas accumulates in near-source area. (2) overpressure-charged: simulation experiment of pressure evolution shows that overpressure generated from hydrocarbon- generation process provide driving force for gas migration, gas saturation is the power function of charging pressure, only if the charging pressure was high enough, gas could accumulate in reservoir rocks of low porosity and permeability. (3) pore-fracture transportation: excellent pore-fracture system constructed by proper disposition of interlayer fissures in mudstone and pores and fissures of sandstone offers channel for hydrocarbon migration. (4) non-Darcy seepage migration of low velocity: simulation experiment demonstrates that migration of natural gas in low-permeability sandstone is non-Darcy seepage migration of low velocity and the lower the permeability of sandstone is the higher pressure gradient is needed for natural gas to migrate in it. (5) dynamic trap: dynamic trap is a kind of three-dimensional space of low-permeability reservoir rock where petroleum is charged and trapped. (6) accumulation over large area and many factors control it: structure, sedimentary facies and permeability grade control enrichment of reservoir. Petroleum prefers to fill the parts of relatively better property and then spread to other parts. All these characteristics contribute to the high accumulating efficiency of such reservoirs, and giant gas field may exist even when its source rock's hydrocarbon generation intensity is smaller than $20x10^8m^3/km^2$. Accumulation model is established in upper Paleozoic of Ordos basin and Xujiahe formation of Sichuan basin through detailed researches (fig.1 and fig.2).

Giant tight sandstone gas fields mainly develop in the areas where there are relatively stable tectonic setting, large-scale lakes deltas or sea deltas and coal-bearing formations. The advantageous sedimentary facies are braided river channel, distributary channel in delta, mouth bar, tidal bar. Medium to coarse grain are favorable lithofacies for tight sandstone gas reservoir. Better diagenetic facies and well-developed fissures dominate distribution of sweet points of gas reservoirs. Fine capping formation and premium reservoir-capping rock combination are prerequisites for the development of giant tight sandstone gas fields. Resource potential of tight sandstone gas is appreciable (about $12\times10^{12}m^3$). Tight sandstone gas is widespread in Sichuan basin, Ordos basin, Songliao basin, Tuha basin, Junggar basin, Tarim basin and has broad exploration prospect.

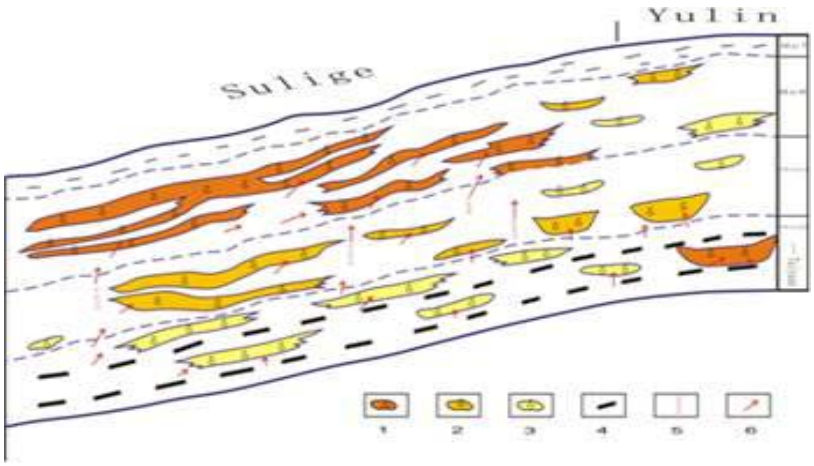

Fig.1: Accumulation model of tight sandstone gas field in upper Paleozoic of Ordos basin
1.) Type I gas field, Φ>10%; 2.) Type II gas field, Φ6~10%; 3.) Type III gas field, Φ5~7%;
4.) Coal; 5.) Microfissure; 6.) Migratory direction of petroleum

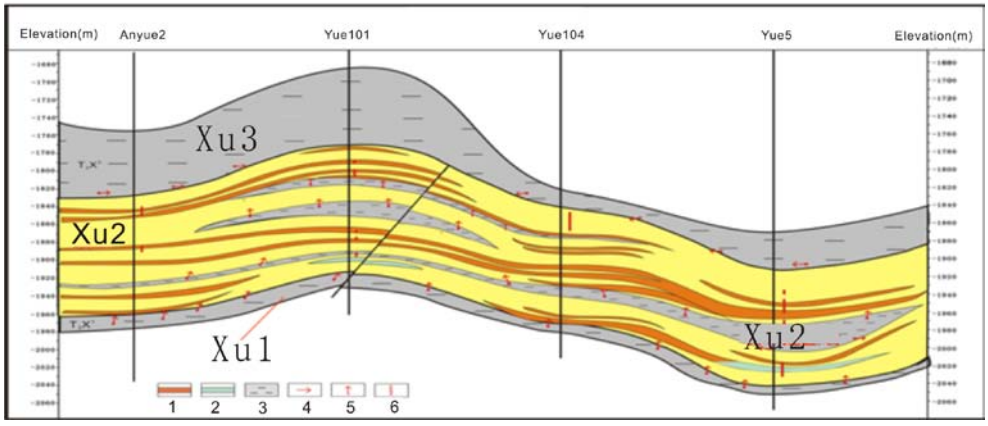

Fig.2: Accumulation model of tight sandstone gas field in Xujiahe formation of Sichuan basin
1.) gas bearing formation 2.) water bearing formation 3.) mudstone
4.) direction of secondary migration 5.) direction of first migration 6.) fissure