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**The Formation Conditions of Shallow Gas and Controlling Factors of Its Reservoirs in the Songliao Basin, NE China**

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The Songliao basin lies in the northeastern part of China with a total area of 260 thousands square kilometers. The Cretaceous sediments dominated in the basin, with much thinner layers of Tertiary and Quaternary strata. The biggest oilfield of China-the Daqing oilfield was founded there. After many years of exploration, especially the studies performed in recent years, it is clear that not only abundant oil accumulated in the Songliao Basin, considerable quantity of natural gas was also discovered in the shallow layers of the Cretaceous strata less than 1500m, including the Heidimiao, Saertu and Putaohua oilbeds, where the vitrinite reflectance (Ro) of the rock is lower than 0.6%. The discovery of these shallow gas proved that the shallow strata are also an important field for oil and gas exploration, which will provide new basis for the development of the already-matured oilfield.

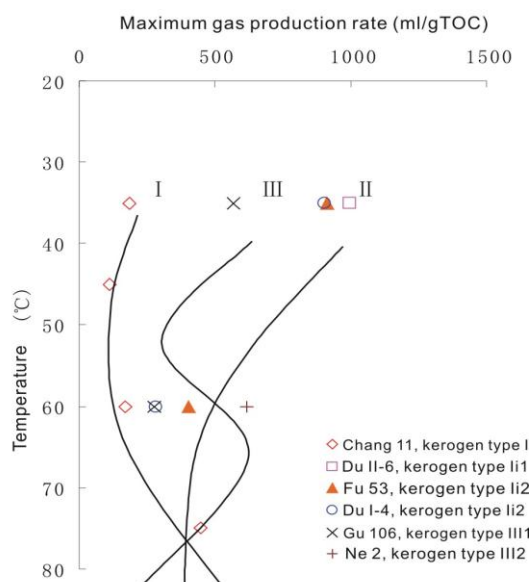


Fig.1 Gas production rate of simulation on the microbial degradation of source rock from Songliao Basin

The shallow gas of Songliao basin are mainly of biogenic origins, including biogenic methane gas originated from source rocks, biogas from the degradation of crude oil and sub-biogas equivalent to immature and low mature gas. The types of natural gas in the Songliao Basin are similar with the results reported from other basin by domestic and foreign scholars while the formation and distribution of shallow gas in the Songliao Basin do have their own features. At first, the gas reservoir in the Songliao Basin formed relatively old and mainly in the Cretaceous, though most biogas of China distribute in the Tertiary and Quaternary stratum. Secondly, the source rocks distributed widely and stably with little lateral variation for they were deposited during the period when large area of depression developed in this basin, but the gas reservoirs are mainly dominated by thin sandstones with a large lateral changes. Thirdly the currently discovered shallow gas reservoirs have the characteristics of high production, low abundance, small scale and wide distributions. Obviously all of these features are different from other large biogas reservoirs discovered in the world. For example the biogas reservoirs in middle and upper Miocene of Italy are mainly of structural trap and the shallow natural gas reservoirs of upper Devonian in Michigan

basin are closely related to fractures, while the biogas reservoirs in Quaternary system of Qaidam Basin are characterized by numerous thin layers, which are only slightly affected by the tectonic activities and faults. Therefore, the further geological and geochemical study to elucidate the formation conditions of shallow gas and controlling factors for their accumulation in the reservoirs of Songliao Basin will not only accelerate the exploration of shallow gas in the basin, but also improve our understanding on the formation and distribution of shallow gas reservoirs.

The shallow layers of Songliao Basin refer to the late Cretaceous and Tertiary stratum buried less than 1500m. At present, many gas reservoirs and evidences showing the existence of gas which is of biogenic origin are discovered in the Cretaceous stratum. The formation conditions of shallow gas and controlling factors for its accumulation in the reservoirs in the Songliao Basin are studied in the paper with the combination of geological, geochemical and biochemical methods. The result shows that the higher pH in the strata of the basin plays negligible roles on biogas formation. The type II kerogen of hydrocarbon source rock has the highest producing rate of biogenic gas, with a maximum of 997.25ml/gToc. Secondly are the type III and Ikerogen of hydrocarbon source rock with producing rate of 615.95ml/gToc and 447.89ml/gToc, respectively (Fig.1). There are two peaks of the biogas formation in the basin: one is 35°C and the other is 60°C. The biogas formation of the type IIIkerogen is chiefly at the first one. The immature to low mature source rocks are widely distributed in the basin. The thick Unit 1 of Qingshankou formation and Unit 1-2 of Nenjiang formation with higher abundance and various types of organic matter have shown the most important potential for the biogas formation. The shallow gas reservoirs in the Songliao Basin are mainly of lithologic and structural-lithologic type. The formation of the gas reservoirs are chiefly controlled by the gas generating intensity of the source rock, the distribution of sand body, and the occurrences of faults. It is suggested by the work that Songliao Basin are of high prospective potentials for the exploration of shallow gas.