A new perspective of gas sources - retained hydrocarbons

W. Z. ZHAO*

Research Institute of Petroleum Exploration & Development, Beijing, 100083, China
(*correspondence: zwz@petrochina.com.cn)

Retained hydrocarbons here refer to scattered liquid hydrocarbons that have not been expelled from the source rocks. As the source rocks become over-mature, the retained hydrocarbons will eventually be cracked into gas, which is believed to be a major source for oil-type gas. The amount of oil that can be retained in source rocks is quite controversial (Leythaeuser et al., 1984; Jarvie et. al., 2007). Conventionally, the retained hydrocarbons were determined using either the Rock-Eval pyrolysis S1 value or the chloroform bitumen 'A' from extraction, each of which only represents part of the total retained hydrocarbons. We determined the retained hydrocarbons using three methods: expulsion simulation experiments in a semi-open system, in-situ NMR (Nuclear Magnetic Resonance) detection, and source rock pressure-generation modelling and mass balance calculation (Robert and Nunn, 1995; Guo et. al., 2011). The results show that (1) the retained hydrocarbons can account for 40%-60% of the total hydrocarbons generated, 1.3-1.5 times of that recovered from chloroform bitumen 'A'; (2) when half of the 40%-50% of the liquid hydrocarbons are expelled, the pressures in and outside the source rocks are balanced and liquids cease to expel; and (3) the retained hydrocarbon can crack when R_o reaches 1.6%-3.2%.

This finding provides a favorable scenario for the formation of marine petroleum systems in China, which are characterized by old age and high maturity. The retained oil in the source rocks was cracked into gas and remained in the source rocks to become large shale gas plays, i.e. the proliferous Silurian System Longmaxi shale gas play with an estimated reserve of 1.8×10^{13} TCF in the Southeast Sichuan Basin, or be part of the source of the gas reservoirs, i.e. the Cambrian Anyue giant Gas Field in the Center Sichuan Basin with a reserve of 1.6×10^{13} TCF. Considering the contribution of the retained liquid hydrocarbons in the source rocks, the natural gas potential of the marine strata in the Tarim Basin is projected to be 2.3 times of the current estimation (6.3×10^{13} TCF).

[1] Leythaeuser et al. (1994) *Nature* **311**, 745-748. [2] Jarvie et al. (2007) *AAPG Bulletin* **91**, 475-499. [3] Robert and Nunn. (1995) *Marine and Petroleum Geology* **12**, 195-204 [4] Guo et al. (2011) *Organic Geochemsitry* **42**, 1343-1350.