

## Activity of large scale supercritical CO<sub>2</sub> and its impact on hydrocarbon accumulation

DONGYA ZHU, QUANYOU LIU, QINGQIANG MENG,  
BING ZHOU

State Key Laboratory of Shale Oil and Gas  
Enrichment Mechanisms and Effective  
Development, Petroleum Exploration and  
Production Research Institute of SINOPEC,  
Beijing, 100083

Accumulation of large volumes of CO<sub>2</sub> related to mantle degassing, metamorphic reactions or magmatic processes had been found in many hydrocarbon-bearing sedimentary basins around the world, such as the Otway Basin in Australia, Shabwa Basin in Yemen, Santos Basin in Brazil and Songliao, Bohai Bay, north Jiangsu and Pearl river mouth Basins in China. The entrapment of CO<sub>2</sub> has impacted hydrocarbon accumulation and leads to co-existence of CO<sub>2</sub> and hydrocarbon in many reservoirs. Huangqiao reservoir, in the north Jiangsu Basin, is a typical one that contains supercritical CO<sub>2</sub> and light oil mainly in the Permian Longtan Formation (P<sub>2</sub>l). However, how the supercritical CO<sub>2</sub> impact hydrocarbon accumulation has not been well studied.

Calcite and quartz veins in P<sub>2</sub>l show positive Eu anomaly, relatively light in oxygen isotope and rich in radiogenic <sup>87</sup>Sr. The maximal frequency of homogenization temperature of the fluid inclusions in calcite and quartz veins is 170°C to 180°C, indicating the activity of CO<sub>2</sub> at relatively high temperature.

The CO<sub>2</sub> caused significantly dissolution of feldspar in P<sub>2</sub>l to create large amount of secondary pores. Consequently, the reservoir quality was greatly enhanced with porosity as high as 12.3%. The typical mineral, dawsonite, related to alteration of albite under high CO<sub>2</sub> partial pressure was observed.

The temperature and pressure of P<sub>2</sub>l are higher than 60°C and 17MPa, respectively, and as a result the CO<sub>2</sub> should be in supercritical state. The supercritical CO<sub>2</sub> can extract oil from hydrocarbon source rocks and consequently accelerate migration of oil to reservoir. The fluid inclusions in quartz and calcite veins contain oil as well as CO<sub>2</sub>, suggesting existence of such process. The CO<sub>2</sub>, carrying oil, migrates upward and accumulates in reservoir in P<sub>2</sub>l.

The gravity of the oil in the Huangqiao reservoir is 0.7933 ~ 0.8255 and the abundance of saturated hydrocarbon is 90.1% ~ 97.4%. However, in the nearby Jurong reservoir without CO<sub>2</sub>, the gravity of the oil is 0.8696 ~ 0.9293 and the abundance of saturated hydrocarbon is 50.2% ~ 78.7%. The comparative signatures indicate the supercritical CO<sub>2</sub> mainly carries light oil. As a result, many wells in the Huangqiao reservoir produce more than 1000m<sup>3</sup> CO<sub>2</sub> and 1 ton light oil.