

Forming Time, Temperature, and Pressure of Hydrocarbon Accumulations in Ordovician Carbonate Reservoirs of Gucheng in the Tarim Basin, Northwest China

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Abstract

In this article, 25 dolomite and limestone reservoir samples in the Ordovician Yingshan and Yijianfang formations of Gucheng were analyzed by fluid inclusion homogenization temperature, salinity, fluorescence and Laser-Raman spectroscopy, and the results were used to determine hydrocarbon accumulation time, temperature and pressure. The homogenization temperature of oil-associated brine inclusions shows that Gucheng has experienced two periods of hydrocarbon accumulation. In the first period, the charging fluid is mainly of oil with the paleo-temperature of 115°C~150°C, whereas in the second period the charging fluid is mainly of gas with the paleo-temperature of 140°C~170°C. With burial histories, the hydrocarbon charge time is evaluated at the late Caledonian and the Quaternary, respectively. The Laser-Raman analysis of gas-bearing inclusions shows that in the first period the paleo-pressure is about 42.23MPa and the burial depth is 2600~3150m, implying overpressure. In the second period, the paleo-pressure varies between 34.4~107.03MPa at different reservoirs, and the burial depth is 4200~6280m, implying subnormal to overpressure. The salinity of brine fluid inclusions from different formations shows significantly different in the first period, indicating that reservoir fluids inherited from pristine sediment. In contrast, in the second period, the brine inclusion salinity in different formations shows little variation, indicating effective fluid exchange between formations. The Ordovician hydrocarbons in Gucheng are mainly sourced from the Cambrian

Yuertusi shale, and during peak oil generation at late Caledonian, hydrocarbons mainly entered into the Yingshan formation, resulting in overpressure in reservoirs. In this period, the overlying Yijianfang reservoirs had higher fluid salinity and were poorly connected with the underlying formations, resulting in little gas charging. During the Neogene and Quaternary, gases generated by source rocks migrated vertically and horizontally, forming gas reservoirs with normal pressure, whereas gas reservoirs due to oil cracking of paleo oil reservoirs are usually with overpressure. Post fault activity leads to re-migration of gas reservoirs in the Yingshan formation and forming gas reservoirs with low pressure in the Yijianfang formation. The homogeneity of fluid inclusion salinity at the two sets of reservoirs indicates that the vertical connection is effective.