The effects of calcium carbonate on petroleum phase in reservoirs

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Carbonate rocks (especially the limestone) are widely occurred in the Cambrian-Ordovician strata in Tarim basin, China. The exploration practice showed that the lower Paleozoic strata in this area is rich in oil and gas resources, with various petroleum phases. The prediction of petroleum phase at a particular location of reservoirs is very valuable to the development of oil and gas reservoirs. Generally, data from thermal pyrolysis of pure oil were widely used to speculate the petroleum phase in reservoir. However, the effects of minerals existed in reservoirs on the evolution of petroleum phase is still problematic. This study used the thermal simulation experiments of two typical crude oils (light crude oil from well TZ62 and heavy crude oil from well H601) with and without calcium carbonate to investigate the influence of calcium carbonate on the phase evolution of crude oil. The kinetic parameters of methane (CH_4) and total gaseous hydrocarbon (C_{1-5}) generation in crude oil cracking experiments were fitted by using the software of kinetics 2000. The phase evolution of crude oil cracking process was established by using PVTsim software.

The results show that calcium carbonate can slightly increase the CH_4 and the C_{1-5} yields of heavy crude oil by 1−5% in the high temperature stage (> 480 ^{o}C), but almost not affect those of light crude oil. Compared with the pure crude oil series, the average activation energies of C_{1-5} generation of the two types of crude oil with calcium carbonate were increased by 2−4 Kcal/mol, whereas the activation energies of methane generation were no significant change. Thus, the existence of calcium carbonate increased the activation energy of oil cracking to some extent, and lagged the process of oil cracking. In addition, calcium carbonate also not significantly affected the phase diagram envelope evolution of the investigated oil samples. In conclusion, though calcium carbonate can slightly promote the degree of heavy crude oil cracking, but almost not affect the phase of petroleum in the reservoirs. This indicated that the thermal simulation results of pure crude oil can be directly used to infer the petroleum phase in the limestone reservoir.

This work is supported by the Strategic Priority Research Program of the Chinese Academy of Sciences Grant No. XDA 14010103.