Revealing thresholds of petroleum mobility in shale: An experimental study

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Petroleum occurrence in shale is mainly in the free and adsorbed states and is closely correlated with shale pores. Difference in strength with which petroleum adheres to mineral grains causes the petroleum mobility is varied greatly, leading the petroleum mobility in shale to be a critical problem in unconventional petroleum exploration and exploitation. However, shale is a low porosity and permeability reservoir rock and the pores within shale are predominantly on the nanometer scale, the relationship between petroleum and shale pores is poorly understood.

To characterize petroleum mobility in self-sourcing reservoirs, a suite of mature Oligocene shales was selected and subjected to organic solvent extraction, and both the raw and solvent treated samples were followed by pyrolysis, N2 adsorption and X-ray diffraction measurements. Analyses show that the pore surface area and pore volume of these shales are mainly controlled by their clay and quartz content, rather than their organic matter content, and are suppressed by carbonates. Correlations of soluble organic matter with pore surface area and volume after solvent extraction indicate that petroleum mobility in self-sourcing reservoirs is initiated when the petroleum content reaches 0.70 wt.% and the pore diameter is over 12.1 nm. This work discusses the correlation between petroleum and pore spaces and reveals the thresholds of petroleum content and pore diameter for petroleum mobility. These findings are useful in the assessment of petroleum producibility and are of great significance for unconventional petroleum exploration and exploitation.

This work was funded by the National Natural Science Foundation of China (NSFC) (41372130), the Major Project of National Petroleum in China (2016ZX05006-001-003), the China Postdoctoral Science Foundation (2016M601650) and the National Science and Technology Major Project (2016ZX05027001-008).