Characteristics and microstructure of tight gas reservoir in the Upper Triassic Sichuan Basin, Western China

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The western Sichuan Basin is a foreland basin formed in the Late Triassic at the front of the Longmen Mountain in the western Sichuan Province of China. The Upper Triassic Xujiahe Formation in the basin is an ultralow-permeability and low-porosity tight sandstone and shale gas reservoir. Tight gas reservoirs are often defined as gas-bearing sandstones or carbonates having in situ permeabilities to gas less than 0.1 mD. This article offers an integrated approach to describe microstructure characteristics of a tight sandstone and shale gas reservoir. In particular, the primary and secondary porosity of tight gas sandstone is identified and quantified in three dimensions using X-ray Nano-CT imaging and visualization of core material at the pore scale. 3D images allow one to map in detail the pore and grain structure and interconnectivity of primary and secondary porosity. Once the tomographic images are combined with SEM images from a single plane within the cubic data set, the nature of the secondary porosity can be determined and quantified. In situ mineral maps measured on the same polished plane are used to identify different microporous phases contributing to the secondary porosity. Once these data sets are combined, the contribution of individual clay minerals to the microporosity, pore connectivity and petrophysical response can be determined. Insight into the producibility may also be gained. This illustrates the role 3D imaging technology can play in a comprehensive reservoir characterization program for tight gas. Three types of microfractures, intragranular, grainedge and transgranular microfractures, developed in the tight-gas sandstones of the western Sichuan Basin. Microfracture formation reflects tectonism, overpressuring, and diagenetic processes. Tensional microfractures related to overpressure formed in the Middle-Late Cretaceous. The existence of overpressure reduced effective stress, promoting opening-mode fracture growth. The existence of tension fractures can also be used as an indicator of ancient overpressure in a sedimentary basin. Diagenetic fractures formed from the Late Triassic, when the foreland basin of the western Sichuan Basin formed to the Early Cretaceous.

Biography

Qi Li is currently working as a Professor of China University of Geosciences, China. His research is mainly focused on characterization and modeling of fractured reservoir, sequence stratigraphy and marine sciences. He has earned his BS degree in Geology from Chengdu College of Geology in 1992 and obtained PhD in Sedimentology from Chengdu University of Technology in 1999. He has completed his Postdoctoral studies on Petroleum Geology and Marine Science in China University of Geosciences and China University of Ocean from 1999 to 2006.

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