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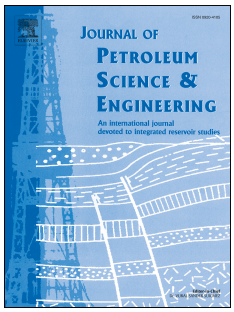

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The wettability of shale by NMR measurements and its controlling factors

Siyuan Su[a,b,c] , Zhenxue Jiang[a], Xuanlong Shan [b,c,*], Yunfeng Zhu[d], Peng Wang[e], Xuan Luo[e], Zheng Li[f], Rifang Zhu[f], Xiaoyong Wang[g]

[a]*Unconventional Natural Gas Institute, China University of Petroleum, Beijing 102249, China*
[b]*College of Earth Science, Jilin University, Changchun, Jilin Province,130012, China*
[c]*Key Laboratory for Evolution of Past Life and Environment in Northeast Asia (Jilin University), Ministry of Education, Changchun, Jilin Province,130012, China*
[d]*Wireline logging company of Daqing Oilfield Company Limited. Daqing, Heilongjiang Province,163000, China*
[e]*Jilin Oilfield, PetroChina Co. Changchun, Jilin Province,130012, China*
[f]*Shengli Oil Company, SINOPEC, Dongying, Shandong Province 257015, China*
[g]*Liaohe branch of CNPC Logging company Limited. Panjin, Liaoning Province,124010, China*

Abstract: In this study, shale samples from the Zhanhua Sag in the Jiyang Depression of the Bohai Bay Basin were used to test the wettability of shale by nuclear magnetic resonance (NMR). The organic matter abundance, movable hydrocarbon content, clay content and carbonate content of shale samples with different wetting characteristics were compared. The results demonstrated that the TOC content of shale samples with mixed wettability was greater than that of water-wettability samples. This finding indicates that with the increase in TOC content, pores can be changed from water-wetting to oil-wetting, and the inorganic pores become organic. The above analysis demonstrates that the existence of organic matter is the basic reason that shale porosity exhibits oil wettability. Further, the shale samples with mixed wettability were higher in mobile hydrocarbon content (S_1) than were those with only water wettability. The shale samples with mixed wettability showed higher clay content than did those with water wettability, indicating that organic matter is associated with clay minerals. However, the samples with water wettability had greater carbonate content than those with mixed wettability, indicating that inorganic pores are formed primarily by carbonate rock. In summary, shale with mixed wettability in the Zhanhua Sag