Geochemical characteristics of black shales from Wufeng and Longmaxi Formation in Xishui area, Guizhou Province, China and their significance to shale gas development

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A total of 47 shale samples from wells XK1 and XK2 in Xishui area of Guizhou Province were selected to test their organic carbon contents, trace elements, isotopes of organic carbon and lipid biomarkers. The results indicate that the Wufeng and lower part of Longmaxi Formation shale have a relatively high total organic carbon (TOC), with an avearge of 4.13% for XK1 and 4.19% for XK2, respectively, and contain type I kerogen with a high mature to over mature status. The biomarkers including n-alknaes, hopanes and steranes and their derived proxies show that the marine algae made a significant contribution to the organic matter, which is consistent with type I kerogen as revealed by the ligh isotope values of organic carbon (< 27.5‰). Additionally, the V/(V+Ni) ratio ranges between 0.65 and 0.86, 0.49 and 0.88, with an average value of 0.73 and 0.74, respectively, for well XK1 and XK2, indicating that the black shale were deposited in a anoxia environment. This was confirmed by the Eu/Eu* and δCe values. The Eu/Eu* and δCe′ values of samples from XK1 and XK2 are 0.45- 0.87 (average 0.60), 0.40-0.74 (average 0.53), and 0.83-0.93 (average 0.88), 0.82-0.98 (average 0.90), respectively. The TOC-Mo crossplot also imply that all the samples sedimented in a moderate to strong restriction area, which further delineated that the reduing environment prevailed during the deposition in favor of sedimentation of organic matter. The TOC in the high gas-bearing interval from the Wufeng to lower part of Longmaxi Formation is high (generally > 2.0%), resulting from an increase contribution from marine algae, indicating a good correaltion with between TOC and shale gas content. In summary, these results demonstrated that the Wufeng and lower part of Longmaxi Formation in Xishui area, Guizhou Province has a significant potential for shale gas exploration.