

A Research on the Controlling Factors for Organic Matter Enrichment in the Lower Silurian Longmaxi Formation, Sichuan Basin

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The Lower Silurian Longmaxi Formation is an important layer for shale gas exploration in Sichuan Basin. The abundance of organic matter has been believed to be one important factor affecting the development of organic pore and gas accumulation in shale. In this research, the vertical variation of lithology, organic geochemistry parameters, and trace element contents were analyzed to explain the paleo-sedimentary environments and explore the major controlling factors for organic matter enrichment in Longmaxi Formation.

There is a good correlation between the abundance of organic matter and redox conditions. All the lithological and geochemical evidence show that the bottom organic-rich part (TOC=2.2%~7.76%) of Longmaxi Formation was deposited in anoxic conditions of deep water. For example, the lithology of this part is black carbonaceous shale, being rich in graptolite fossils. And the geochemical characteristics show a lower pristane/phytane ratio (0.16~1.24) and a higher gammacerane index (0.1~0.22). Moreover, the redox-sensitive elements (Mo, U, V, Ni, Co, Cr) are significantly enriched and the ratios of trace elements such as Ni/Co, V/Cr, and U/Th are 11.89~21.83, 4.12~9.76, and 1.53~4.70, respectively. However, in the middle and upper part (TOC=0.81%~1.83%) of Longmaxi Formation, the contents of carbonaceous matter and the abundance of graptolite fossils decreased, while the contents of sandy matter increased relatively. Meanwhile, the ratios of Ni/Co (2.8~4.0), V/Cr (1.29~1.94), U/Th (0.62~0.77) and the higher pristane/phytane ratio and lower gammacerane index also turned to indicate the shallow water oxidizing conditions.

The stable P contents and excess Ba(Ba_{xs}) in shale demonstrate a higher bioproductivity in the sedimentary stage of Longmaxi formation. However, the TOC values are not varied with the changes of them. The results of the biostratigraphical analysis show that the deposition rate of the lower part and middle-upper part of Longmaxi Formation were about 0.75~13.67m/Ma and 14.37~384.4m/Ma respectively. Therefore, the redox conditions and deposition rate were the major factors for difference enrichment of organic matter in Longmaxi Formation.