Co-evolution of organic and inorganic components in the Longmaxi shale from the Sichuan Basin, China: Implications for pore evolution in fine-grained sedimentary rocks

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The preservation of primary pores and development of secondary pores in shale gas system are controlled by diagenesis, which is a co-evolutionary of organic and inorganic components. In order to understand the pore evolution in fine-grained sedimentary rock, a combination of petrographic, geochemical, and pore characterization methods were used to investigate the Longmaxi shale in the Sichuan Basin, China. The results reveal that early diagenesis is characterized by compaction and the precipitation of pyrite, carbonate minerals and kaolinite. Precipitation of authigenic quartz, thermal degradation organic matter, transformation of clay minerals and dissolution of carbonate minerals are the dominant effects in middle diagenesis. Secondary cracking of oil and kerogen is a main diagenetic event in late diagenesis. Early authigenic quartz controls the distribution of migrated OM, subsequently the development and volume of OM pores during gas window in siliceous shale. On the basis of point counts, OM pores are the dominant type in siliceous (proportion ranging from 65.6% to 76.2%) and silty shale samples (proportion ranging from 49.5% to 58.2%). Z aggregates filled in primary pore space and destroyed the interparticle porosity during the early diagenetic stage, but they can restrain compaction and preserve the internal pore structure as a rigid framework. In the oil window, pore in microcrystalline quartz aggregates controlled the filling and distribution of migrated OM, which is beneficial for forming more and larger pores during gas window. The result of the present work implies that the study of co-evolution of organic and inorganic components are better understanding the pore evolution in fine-grained sedimentary rocks.