Geochemical characterization of the heterogeneous source rocks in petroleum system modeling

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Kinetic organifacies concept and classification by Pepper & Corvit (1995) were widely applied in petroleum system modeling, and individual kinetic organiface are broadly related to sedimentary face, but sedimentary organifacies geochemical characterization is impeded by vertical significant variation of quantity and quality of organic matter. Simple statistic of geochemical screen analysis data or more complicated chemical kinetical model cannot solve the characterization problem of heterogeneity of source rocks. We have revealed that universal covariant relationship of HI and TOC exist for lacustrine and marine mudstone source rocks, to the less degree for terrestrial source rock. Therefore, characterization of type or hydrocarbon potentials of source rocks can be simplied to their counterparts TOC description. HI appears to increase with increasing TOC, asymptotic to 650-700mg/gTOC for above 3 wt% TOC lacustrine mudstones in immature phase, HI distribution and activation energy are peculiar for different TOC interval (0.5-1%, 1-2%, 2-3%, more than 3%) mudstone, Four TOC interval kinetic organofacies, each characterized by HI, TI, GOGI and bulk petroleum generation kinetics, have been established for lacustrine source rocks, which can be related to evaluation of source rock on wireline logs. Kinetic calibration to observed HI, TI and PI trend for different TOC interval source rocks can constrain hydrocarbon generation kinetics model and restore the initial HI and TOC. Two case studies will be presented to illustrate how to describe heterogeneous lacustrine source rocks, the first case is the upper Cretaceous lacustrine source rocks in Songliao Basin, where the thickness of four source rock members (K2qn1, K2qn2+3, K2n1 and K2n2) with different TOC intervals were calibrated with ΔlogR algorithms for about 800+ wells, The second case is Paleocene lacustrine source rocks in Baihai Bay basin, where the thickness of four source rock members (Ed3, Es1, Es3 and Es4) with different TOC intervals were calibrated for more than 1000+ wells. The high-resolution distribution model of lacustrine source rocks were established integrated with stratigraphic architecture and sedimentological facies..

Fluid-rock interaction in the deep-burial overpressured system of the central Junggar Basin

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In the central Junggar Basin, the secondary porosity zones develop in the sandstones between the depths of about 4400-6000m near the top seals of overpressure with the thicknesses of about 300-350m (Figure 1), the secondary pores were formed due to the dissolving of intergranular calcite cements and feldspar, and the formation of megapores were mostly caused by the dissolution of plagioclase, rather than K-feldspar.

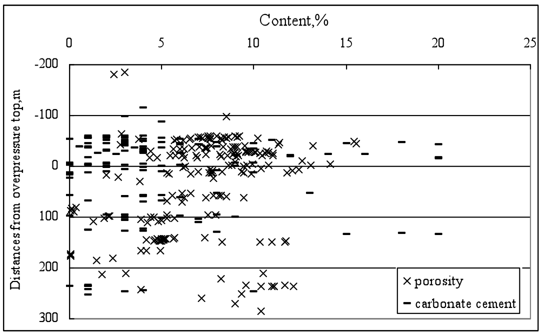

Figure 1: Relationships of carbonate cements, porosities and distances from the top of overpressure in the studied area.

Though the carbonate cements and dissolved porosity was negative correlation, the analyses of thin sections and fluid inclusions demonstrated that most carbonate cements precipitated during the early diagenesis and were dissolved with the secondary pores formation in the deep-burial conditions. Owing to intensive decarboxylation at the temperatures of 105-145°C[1], increasing of P_{CO2} (P = partial pressure) and decreasing of pH in the overpressured system resulted in more early carbonate cements dissolving and formed of 5-10% secondary porosity, and dissolution of feldspar further improved porosity. With the periodical releases of overpressured fluids, the zones of high secondary porosity and carbonate cements were superimposed in the depths near the top of overpressured system [2, 3].

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