

2nd World Congress on Petrochemistry and Chemical Engineering

October 27-29, 2014 Embassy Suites Las Vegas, USA

Heterogeneity of fine grained sediment and its hydrocarbon generation and expulsion: A case from Dongying depression

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At present, the research on hydrocarbon generation and expulsion is often confined to limited samples from source rocks of tested geochemical information. This limited geochemical information, however, is unable to reflect the complex geological condition objectively for the complexity of hydrocarbon expulsion problem, and is very difficult to have a high resolution evaluation on the vertical continuous heterogeneous distributed source rocks effectively.

As the logging curve has characteristic of vertical high resolution, the total content of organic carbon (TOC) of source rocks can be calculated from the logging data. On the basis of TOC, some models were built combined with other geological and geochemical information to calculate the hydrocarbon generation and expulsion potential of every data point in the profile of hydrocarbon source rocks, thus realizing the high resolution study on the hydrocarbon generation and expulsion of source rock. This work is started with the relationship from measured geochemical information and logging information, to realize the transformation from logging information to residual organic carbon content, original organic carbon content, original hydrocarbon generation potential, original hydrocarbon expulsion potential and hydrocarbon expulsion efficiency.

This method can be used to investigate the hydrocarbon generating and expelling from shale. For instance, lacustrine condensed sections are composed by fine particles deposited in extremely low velocity in the expansion of lake with the deposits of dark color and laminated bed reflecting the closed standing water circumstances. Dark-brown oil-shale is the main form of lacustrine condensed sections. Clear downlap structure occurs above the condensed sections manifesting as strong seismic amplitude of reflection phase, low frequency, high continuity on seismic profile shows as low potential, low resistivity and high gamma ray on electrical property. In Dongying Sag Es₃, from the top down gradually the apparent resistivity decreases, in which two spikes stand for the existence of oil-shale whose stacking thickness reaches 120 m, getting thinner from center of the sag to margin gradually. The time when oil-shale formed responded to the stage of max under-compensation, the lake was the largest, few terrigenous deposit supplied and sediment deposited in extreme low velocity, so they are favorable resource formation with rich organic matter well preserved due to multiple kinds and great quantities of tiny plankton and alga.

Analysis on the geo-chemical data from Es₃ in the Well Niu 38 shows that, obvious electricity property occurs in the oil shale, featured in the increase of acoustic DTL interval transit time and decrease of density logging compared to other layers. The geochemistry study shows the oil-shale has higher TOC (the total content of organic carbon, more than 5%), So (original hydrocarbon generation potential, over 50 mg/g), SP (original hydrocarbon expulsion potential, generally over 20 mg/g) and hydrocarbon expulsion efficiency (30%~60%).

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