

# Using Seismogeology Technique to Characterize Superdeep Source Rock: Taking the Yuertusi Formation Source Rock in Tarim Basin, Northwest China as an Example

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

## Abstract

Source rock characterization is critical to the hydrocarbon exploration in Tarim Basin. Previous study reveals that Yuertusi Formation (YF) of Lower Cambrian is a set of high-quality source rock in Tarim Basin. However, due to the complexity of the basin and the limitation of well data and seismic data, research about the distribution of this set of source rock is restricted. In recent years, with the improving of seismic data acquisition method, the SNR and resolution of deep seismic data are greatly enhanced, especially those newly merged basin scale seismic profiles, which make it possible to predict distribution of YF source rock. This research focus on the YF source rock in Tarim Basin. A new integrated workflow based on well drilling, outcrop, geochemistry data, forward modeling, seismic attribute and seismic inversion was proposed to characterize superdeep source rocks. This workflow mainly includes following four steps. 1) Sequence stratigraphy analysis based on the outcrops data, drilling data and seismic data, and establish sedimentary model. 2) Seismic facies analysis according to seismic attribute, the boundary of different sedimentary facies can be recognized. Calibration of synthetic seismogram and forward modelling reveal that seismic facies of source rock were characterized by strong amplitude and continuous reflectance. And then the macroscopic distribution characteristic of source rock can be determined. 3) Extract

well logging parameters that can identify shales after the well logging data is calibrated by core data, and then the distribution of YF source rock can be predicted by multiparameter seismic inversion. 4) Source rock quality prediction based on the technology that combined logging, geochemistry test data and seismic data to predict the TOC contents and the distribution characteristics in areas covered by 3D seismic. Application in Tarim Basin shows that the distribution characteristics of YF source rock can be revealed and the accuracy is greatly enhanced. The results indicate that YF high quality source rock is formed in a sedimentary environment of a middle gentle slope to a low gentle slope and is mainly developed in the northeast of Tarim Basin with area of  $11 \times 10^4 \text{ km}^2$ , with thickness of 10~200m and with TOC content of 0.5%~16%. This prediction results are consisting with drilling results of new wells. The advantages of this workflow lie in integrating multidisciplinary data include outcrops, drilling, well logging, seismic data and geochemistry data, not only to enhance the prediction accuracy of distribution but also quality of superdeep source rocks. It is useful for resource evaluation and exploration plan making in petroleum exploration in Tarim basin.