Recognition and Application of a Single Channel in a Compound Meandering Channel Based on Small Scale End-Stage Channel Characterization Technology

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Abstract

Single channel characterization in compound meandering river is an important prerequisite for studying reservoir configuration, single point bar and lateral strata. However, it is difficult to directly characterize single channel with seismic data due to the limitation of seismic data scale. Previous scholars mostly used curve shape contrast method under high density well pattern combined with sedimentary model to identify the end-stage channel. Uncertainty always exists in various methods that can not directly identify the end-stage channel, which affects the subsequent study of reservoir configuration and remaining oil distribution. In this study, a high-precision small-scale edge detection method is used to directly characterize the end-stage river. Firstly, the phase of seismic data volume is rotated to - 90 degrees, so that the reflection axis interface corresponds to the lithologic interface, which is conducive to the accurate interpretation of the top envelope of sand body. Then the gradient of amplitude variation is obtained along X, Y and Z directions, and the small difference is amplified by convolution algorithm, which is helpful for describing the small-scale end-stage channel and lithologic boundary. Finally, the edge detection attributes of the top surface of the sand body are obtained, which reflect the distribution the final channel and lithologic boundary. Isochronous slices along the top surface of the sand body can be made to visualize the development and evolution of the river channel and the relationship between the channel migration and the development of the sand body.

The direct measurement width of the small-scale channel with high curvature shown on the attribute slices in the study area is 30 meters, and the logging curves confirm that the thickness is 2.5 meters, which is completely consistent with the relationship between the width and depth of the channel with curvature greater than 1.7 proposed by Leed: W = 6.8H1.54. According to the statistics of drilling in 100 wells, the coincidence rate of lithologic characteristics and fusion attributes is over 95%. According to the principle of channel migration, combined with the location of the last stage channel, the sedimentation process of point bar is reduced. It is pointed out that the combination of logging curves in different parts of a single point bar is not entirely consistent, and the idea of mini-strata correlation only based on logging curves is not entirely accurate. Based on this understanding and combined with the curve characteristics of horizontal wells, the single channel, abandoned channel and point bar side deposits in flake sand body can be identified. Finally, the sedimentary microfacies maps of sand bodies are made into comprehensive maps reflecting the structure, genesis and evolution of the deposits.