Predicting Interwell Heterogeneity in Fan-Deltaic Reservoirs: Outcrop Analogues and Applications of Lidar Technology in the Kuqa Foreland Area, Northwestern China

Qinglu Zeng[1] and Ronghu Zhang[1]

[1]Department of petroleum geology exploration, PetroChina Hangzhou Research Institute of Geology, Hangzhou, Zhejiang, China.

ABSTRACT

The fan-deltaic reservoirs are widely developed in Cretaceous Bashenjiqike formation in the Kuqa foreland area, Northwestern China, which are also the advantageous places of oil and gas accumulation. However, the reservoirs have showed strong heterogeneity and complex relationship between oil and water in the oilfield development process. In case of few drillings, large interwell spacing and low seismic resolution, outcrop analogues can provide detailed information on sand body architecture, geometry and connectivity that is not directly available in the subsurface. In addition, the aim of this study is to define the best approach to rebuild realistic reservoir heterogeneity models. Utilizing Lidar technology for a full coverage scanning in a typical outcrop to acquire three-dimensional data, matching with the measured geological information and sampling analysis data, the digital outcrop model has been built and the sand body architecture has been revealed effectively. The results indicate that the sand body configuration of fan-delta front performances as multiple underwater distributary channels stacked vertically, accompanied by a few mouth bars and distal bars. There is a good negative correlation between the sand thickness and width-thickness ratio. Three different sand body architecture types are presented as incomplete stacked stitching, side stitching and isolated formula, during which there is the stable and lateral distribution of mudstone, while the sand body connectivity are very different owing to the architecture differences. Despite the sand distribution features as large area and good continuity with the content of more than 80%, some physical property interlayers are easily formed in the channel bottom and side interface due to the higher clay content. The sand bodies are locally connected with each other but not smoothly, even not connected. The application of Lidar technology has improved the reservoir model accuracy greatly than ever and provided a strong basis for further study of reservoir quality distribution and their controlling effects of remaining oil distribution. It will help the old oilfield of high water cut to further enhance oil recovery.