

Digitalization Trends in North American Shale Development: A Case Study of Alberta Basin 2 Shale Play

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Abstract

As the North American shale oil and gas industry enters a stage of high-efficiency development, many formations that were targeted during the early exploration phase have progressed into an era of high-resolution geological modeling and digital transformation. Advances in artificial intelligence have substantially improved the depth and breadth with which accumulated geological knowledge can be synthesized, while reducing the traditional dependence on complete field-development histories before reliable geological understanding can be achieved. This study presents an in-depth analysis of the exploration and development processes of two shale play in the Alberta Basin, Canada, Devonian Duvernay Formation and the Triassic Montney Formation. The technical workflows and corresponding outcomes are systematically reviewed to examine the evolution of shale oil and gas exploration and development methodologies, and to investigate the relationship between digital methods and geological knowledge-based construction. For Duvernay Formation, a resource-assessment model can be established through integrated geological mapping by well database. The most prospective target areas can then be identified by clustering the key geological and engineering controlling factors, performing analogue-based ranking against established high-productivity areas. This workflow provides a basis for automating the construction and iterative updating of a geological knowledge base. For the Montney Formation, depositional-facies models can be calibrated against historical drilling and production data, subsequently integrated with numerical simulation results and knowledge-base-derived expertise to predict previously unrecognized reservoir sweet spots. This approach supports the development of knowledge-based-driven engineering designs and operational strategies. By establishing an integrated geology–engineering workflow platform, this study further evaluates the potential to integrate paleo-geographic/modern-geographic mapping within a sequence stratigraphic framework and to assimilate large scale well log and seismic datasets. Such integration may facilitate the coupling of exploration and development workflows, as well as the integration of geological modeling and numerical simulation. On this basis, a unified Digital Earth framework incorporating environmental, social, and governance considerations is proposed to support the digital transformation and sustainable development of hydrocarbon resources.

Keywords

Shale Gas, Digital Earth, Sequence Stratigraphy, ESG, Canada