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Research Advances

Stratal Slice Recognition of Thin Shallow-Water Delta Sandbodies in the Songliao Basin

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Objective

China's petroleum exploration has entered a new stage of finding deeply buried thin sandbodies for the abundant oil resources they contain. Here thin sandbodies refer to those less than 10 m in thickness, or even less than 1–2 m. It is difficult to depict thin-layer sandbodies of different genetic types using conventional core, well logging and seismic data due to their limited vertical resolution in petroliferous basins. However, seismic sedimentology provides a new research method especially for thin sandbody interpretation, i.e., validating interpreted sedimentary sandbodies from 3D seismic data based on horizontal resolution, stratal slice and seismic geomorphology interpretation. At present, a series of studies on seismic sedimentology in North America marine basins and elsewhere have been completed successfully and are relevant to the exploration and development of oil and gas fields. As the resolution of 3D seismic data improves, thinner sandbodies and their geometries and sedimentary evolution will be better interpreted. Seismic sedimentology has shown similarly incomparable advantages in the identification of thin sandbodies and depositional history in continental basins.

Methods

Shallow-water delta sandbodies have become an important target for exploring lithologic oil and gas reservoirs such as in Cretaceous of the Songliao Basin. The recognition of thin sandbodies has become a major problem for the successful exploration of lithological traps, and the following seismic sedimentology methods have therefore been taken to describe them. Key techniques of seismic sedimentology include: (1) 90° phasing of seismic data or seismic inversion to relate seismic traces with log-lithology profiles, and (2) seismic stratal slicing using Recon Stratal Slice software, i.e., to obtain seismic attribute images of approximate depositional surfaces in continental seismic geomorphology and to interpret thin sandbodies based on core-logging calibration of stratal slices. Stratal slicing is an important technique in the study of seismic geomorphology of shallow delta in the Songliao Basin.

Results

It is demonstrated that thin shallow delta sandbodies in the Cretaceous Qingshankou Formation of the Songliao Basin can be recognized based on the interpretation of stratal slices. In Fig. 1, red amplitude (peak) indicates high-velocity sand-prone facies and black amplitude (trough) indicates low-velocity mudstone-prone facies; the number beside wells indicates the thickness (m) of thin delta distributary channels in drilling wells. Through refined well-seismic calibration, the morphology and distribution characteristics of the distributary channel

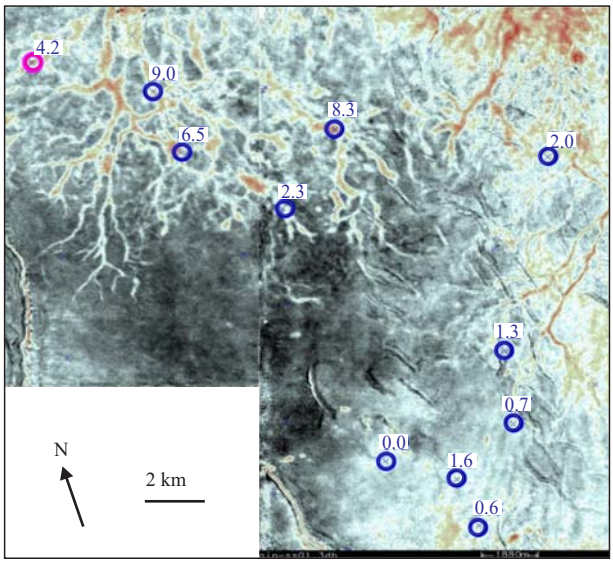

Fig. 1. A stratal slice from the upper part of Qingshankou Formation, Cretaceous in Songliao basin, displays the typical sedimentary geomorphology of shallow-water delta channel.

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sandbody of a 2–9 m-thick shallow-water delta were depicted using stratal slices.

Conclusion

Stratal slices from seismic sedimentology were applied to determine the dispersal patterns of the Cretaceous thin sandbodies in the Songliao Basin and their wide distribution characteristics. This study also manifests that the thin delta front channel sandstone which is near to oil source and faults will be the favorable exploration targets for Cretaceous lithologic traps in the Songliao Basin.

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