Stratigraphy, Lithofacies, and Reservoir Distribution - Tengiz Field, Kazakhstan*

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Search and Discovery Article #20059 (2008)
Posted July 1, 2008

*Adapted from poster presentation at AAPG Annual Convention, Salt Lake City, Utah, May 11-14, 2003

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Abstract

A supersequence-scale stratigraphic framework is developed for the super-giant Tengiz field of western Kazakhstan through the integrated interpretation of seismic, core, log, and biostratigraphic data. Tengiz produces oil from an isolated carbonate platform (areal extent of 580 km²) of Devonian and Carboniferous age. An initial broad Late Devonian platform exhibits vertical growth and was followed by punctuated backsteps during the Early Carboniferous (Tournaisian and Viséan). The uppermost Lower Carboniferous (Serpukhovian) is characterized by several kilometers of platform progradation seaward of the Late Viséan platform break. The basal Upper Carboniferous (Bashkirian) platform succession was aggradational. Drowning in the Early Bashkirian halted carbonate platform growth. Paleotopographic relief on the top of the Bashkirian platform to the basin floor approaches 1500 meters within several kilometers lateral distance.

The stratigraphic architecture defined in this study is used to subdivide the reservoir. The reservoir is also partitioned, based on geographic position along a platform-to-basin profile. Time-slice mapping of synchronous depositional facies provides the basis for predicting reservoir distribution and continuity. On the platform, hydrocarbons are produced from Upper Viséan, Serpukhovian, and Bashkirian reservoirs in grainstone and mud-lean packstone lithofacies of the Shallow Platform and in packstone lithofacies of the Deeper Platform. Multiple pore types are recognized in Tengiz, but matrix permeability is controlled primarily by intergranular porosity. In-place, upper-slope microbial boundstone and transported lower-slope boundstone debris form thick and areally extensive mappable reservoirs (Late Viséan and Serpukhovian) that have distinctive seismic facies and production/performance characteristics. Fractures contribute to non-matrix permeability in these boundstones.
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**Objectives**

- Predict Reservoir Quality
  - Impact: Optimize positioning of development wells to maximize rate; mitigate geologic risk for location and expansion of gas displacement projects.
- Reservoir Architecture & EOR Polygons as Framework for Deterministic 3-D Geologic Model
  - Population of O zones
  - Transformation of O to matrix K.
- Impact: Develop best possible 3-D model w/ data-constrained geologic inputs to fluid flow simulation leading to definable matrix of reserves and expected recovery.

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**Platform Morphology**

- Comparison Between T-5246 & T-220

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**Platform Cycle/High Frequency Sequence**

- T-220 Wall

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**Sequence Stratigraphy and Platform Reservoir Prediction**

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**Maps and Prediction of Reservoir Quality**

- **Conclusions/Impact**
  - New Geologic Model Tested
  - Reservoir Prediction of Reservoir Quality, T-5086
  - 12 Layers, Logs, and Logs
  - Higher Resolution Shaping Possible
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  - Presentation of Shaping Possible

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**Acknowledgements**

This study was a team effort. We especially thank the ExxonMobil "Tengiz team" for their hard work and many discussions of all aspects of Tengiz geology. Kevin Patel made porosity and isopach maps for this volume, and Steve Bachtel prepared seismic cross-sections and maps, and Tom Quain analyzed well production data. Ray Gerber and Phil Basset (ChevronTexaco) provided core descriptions, which were instrumental in our work. We warmly thank James Korten (Vrije Universiteit, Amsterdam), Paul Winch (Consultant), and Tom Hurkx (Tangai Serkay) for the many stimulating technical discussions at the core laboratory facilities at Tengiz. Ivan’s knowledge of modern and ancient carbonate settings, and Paul von der Embse’s stratigraphic data were invaluable to our studies.

We also appreciate the significant contributions of many additional people (ChevronTexaco, ExxonMobil, Kaminou) and RPL/Arco for support of our studies and assistance to publish this paper. Special thanks to Paul from ExxonMobil for the design and layout of the maps.

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**Reservoir Quality Summary**

An example of the maps that have been used in this study: (A) average porosity, (B) Isopach, (C) rock description, (D) EOD, and (E) average porosity from geocellular model.