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Sequence Stratigraphy and Reservoir Prediction of the Giant Tengiz Field, Kazakhstan

The super-giant Tengiz field of western Kazakhstan produces oil from an isolated Devonian and Carboniferous carbonate platform that extends over 160 km^2. Seismic and well data clearly show two principle regions within the buildup—platform and flank—that directly relate to reservoir quality and production characteristics.

The supersequence stratigraphic framework was developed through an integrated interpretation of seismic, core, log and biostratigraphic data. An initial broad Late Devonian platform was followed by punctuated backsteps during the Tournaisian and Viséan. The Serpukhovian is characterized by several kilometers of platform progradation. Drowning in the Early Bashkirian halted carbonate platform growth. Paleotopographic relief from the top of the Bashkirian platform to the basin floor approaches 1,500 meters.

On the platform, hydrocarbons are produced from Upper Viséan through Bashkirian grainstones and mud-lean packstones. Multiple porosity types are recognized, but matrix permeability is controlled primarily by intergranular porosity. Within the flanks, in-place, upper slope, microbial boundstone and transported lower-slope boundstone debris form thick and areally extensive mappable reservoirs. Late Viséan and Serpukhovian reservoirs have distinctive seismic facies and production/performance characteristics. Fractures contribute to non-matrix permeability in these boundstones.

Location map of the super-giant Tengiz field of western Kazakhstan which produces oil from an isolated Devonian and Carboniferous carbonate platform.

The coarse stratigraphic architecture was used to further subdivide the platform portion of the reservoir for better reservoir characterization and reservoir modeling. The temporal and spatial variability in reservoir quality of the platform, as shown by cross sections and maps, is directly related to stratigraphy. 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. ■

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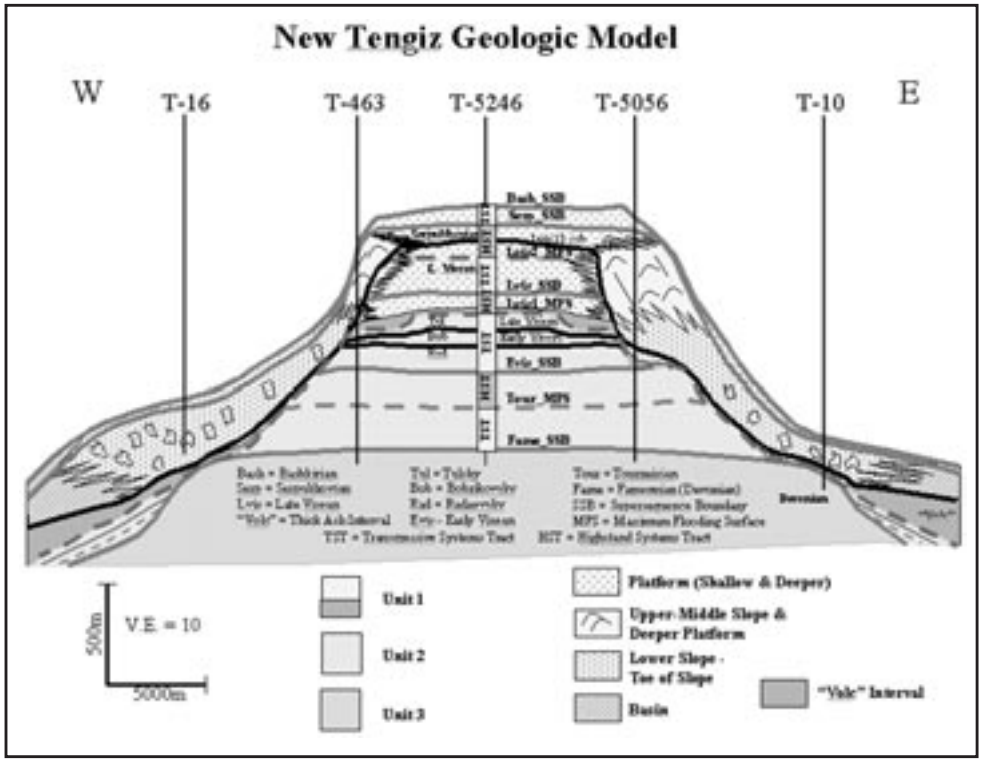
maps for the various reservoir layers, Steve Bachtel interpreted seismic cross sections and maps, and Tom Kane analyzed well production data. Ray Garber and Phil Bassant (ChevronTexaco) provided core descriptions, which were instrumental in our work. We warmly thank Jeroen Kenter (Vrije Universiteit, Amsterdam), Paul Brenckle (Consultant) and Tom Heidrick (TengizChevroil) for the many stimulating technical discussions in the core warehouse facility at Tengiz. Jeroen's knowledge of modern and ancient carbonate slope settings and Paul Brenckle's biostratigraphic data were invaluable to our studies.



Carbonate geological model for Tengiz field.

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Biographical Sketches

Jim Weber works for ExxonMobil Exploration Company as a carbonate stratigraphy expert, specializing in sequence/seismic stratigraphy and reservoir characterization. Jim has been employed in the oil industry for more than 15 years, working for both Exxon and Mobil in production, development, exploration and research organizations. Past work assignments include SE Asia, North and South America, the Middle East and the North Caspian region. His current work assignment involves new play identification in carbonate basins around the world. In a recent assignment, Weber worked with the Abu Dhabi National Oil Company to develop and instruct subsurface and field schools in the UAE and Oman. Dr. Weber received his PhD degree in geology at the University of Tennessee. He received his Master's degree from the New Mexico Institute of Mining and Technology. He completed a BS in geology from DePauw University. He is active in various geological societies, including SEPM and AAPG.

Paul M. (Mitch) Harris, a Carbonate Reservoir Consultant with ChevronTexaco Energy Technology Company in San Ramon, California, performs carbonate technical support projects, consulting, research and training for the various operating units of ChevronTexaco. His work during the last 25 years has centered on facies-related, stratigraphic and diagenetic problems that pertain to carbonate reservoirs and exploration plays in most carbonate basins worldwide. Mitch received his BS and MS degrees from West Virginia University and PhD from the University of Miami, Florida. He has published numerous papers, edited several books and is active in AAPG and SEPM. He has been a Distinguished Lecturer and International Distinguished Lecturer for AAPG, and was awarded Honorary Membership from SEPM. Mitch is also adjunct faculty at Rice University, the University of Miami and the University of Southern California.