

Mark H. Holtz, Bureau of Economic Geology, John A. and Katherine G. Jackson School of Geosciences, The University of Texas at Austin, Austin, TX 78713-8924

Constructing 3-D Reservoir Models in Cyclic Carbonate Stratigraphy, Example from Keystone East, Holt Reservoir

The Keystone East (Holt) reservoir produces from the Leonardian Restricted Platform Play, one of the most prolific producers in the Permian Basin. Although this play has produced large volumes of oil, its reservoirs are complex and produce by solution-gas drive, thus requiring both high well density and secondary and tertiary recovery methods to enhance recovery efficiency. A 3-D geocellular model based on detailed reservoir characterization provides a strong framework for effective application of these recovery techniques.

Construction of a 3-D computer geocellular reservoir model at Keystone East (Holt) began with a core description. Then, by applying core facies information, a detailed cyclic, chronostratigraphic framework was constructed. Next, mapping of structures and isopachs in each cycle established the reservoir architecture. A petrophysical interpretation was then undertaken that included wireline log normalization and core-to-log porosity modeling. A 3-D computer geocellular reservoir model was subsequently constructed from the cycle architecture and wireline petrophysical data.

The most productive rock types in the reservoir are dolomudstones and dolomite packstones\grainstones. Mudstones occur as fine dolomite crystals less than 10 microns in size, with poikilotopic anhydrite and intercrystalline porosity. Packstones and grainstones consist of 100-micron grains made up of fine crystalline dolomite less than 10 microns in size. Pore types within both of these facies are a combination of moldic, interparticle, and intercrystalline. Mineralogy includes dolomite, anhydrite, and poikilotopic gypsum, with localized shale, and minor silt. The reservoir architecture of Keystone East Holt reservoir consists of 16 separate correlatable, high-frequency, upward-shoaling cycles. These cycles are upward-shoaling facies assemblages, consisting of basal subtidal packstones to grainstones, and capped with tidal-flat mudstones. The cycles range from 5 to more than 40 feet in thickness, with gross thickness thinning on-structure and thickening off-structure. The conformance between present-day structure and cycle thickening was used to infer the direction of a paleo-shoreline. That direction was then used as a trend direction for interpolating interwell porosity, cycle by cycle. The trend direction was varied for each cycle, resulting in the modeling of a porous grainstone bar complex changing strike direction for each cycle.