OUTCROP-CONSTRAINED CHARACTERIZATION OF STRATIGRAPHIC ARCHITECTURE IN DELTAIC GAS RESERVOIRS, LAKE CREEK UNIT, TEXAS

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ABSTRACT

The Lake Creek Unit of the Houston Embayment, Texas, encompassing 4.3² mi and containing 47 wells that penetrate deltaic sandstones of the Wilcox Group (lower Eocene), offers an exceptional opportunity to assess reservoir heterogeneity in gas reservoirs. Stratigraphic architecture of the G sandstone, 1 of 18 gas-condensate reservoirs ranging in depth from approximately 9,200 to 14,500 ft, was determined using wireline logs and cores. Models of deltaic architecture developed in outcrops of the analogous, deltaic Ferron Sandstone (Cretaceous), Utah, were used to constrain the subsurface interpretation.

The G sandstone, approximately 300 ft thick, is one of several upward-coarsening intervals in the lower Wilcox. Mud-rich intervals that separate deltaic intervals and represent local flooding of abandoned, foundering delta lobes allow delineation of four parasequences. Each parasequence comprises genetically related depositional facies showing dimensions and spatial distribution comparable to those in outcrops of the Ferron Sandstone. The youngest parasequence is thinner and contains more abundant, marine-influenced facies than do underlying parasequences, indicating depositional landward stepping similar to that of the upper Ferron sandstones. The upper and lower parts of the parasequences are interdistributary-bay and shelf mud-rich facies, locally lignitic, and crevasse-splay and delta-destructional sandstones. They bound sand-rich intervals comprising delta-front facies locally overlain or replaced by channel-mouth-bar facies, in turn locally overlain or replaced by distributary-channel facies. Permeabilities range from about 20 md to less than 1 md but are mostly less than 1 md, the best values generally corresponding to channel-mouth-bar and distributary-channel sandstones.

Deltaic sandstones and intervening bay/shelf shales result in stratified reservoirs. Similar to the Ferron Sandstone, fluid-flow barriers and baffles locally develop because of contrasting permeabilities across facies boundaries within the parasequences and the occurrence of low-permeability, mostly mud-rich intervals interbedded with the deltaic sandstones. Stratigraphic heterogeneity and low-permeability, small-drainage radii locally result in untapped and incompletely drained compartments.