Petroleum system analysis of the Hunton Group in West Edmond field, Oklahoma

Stephanie B. Gaswirth and Debra K. Higley

Faith Pardini

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Dr. Taylor

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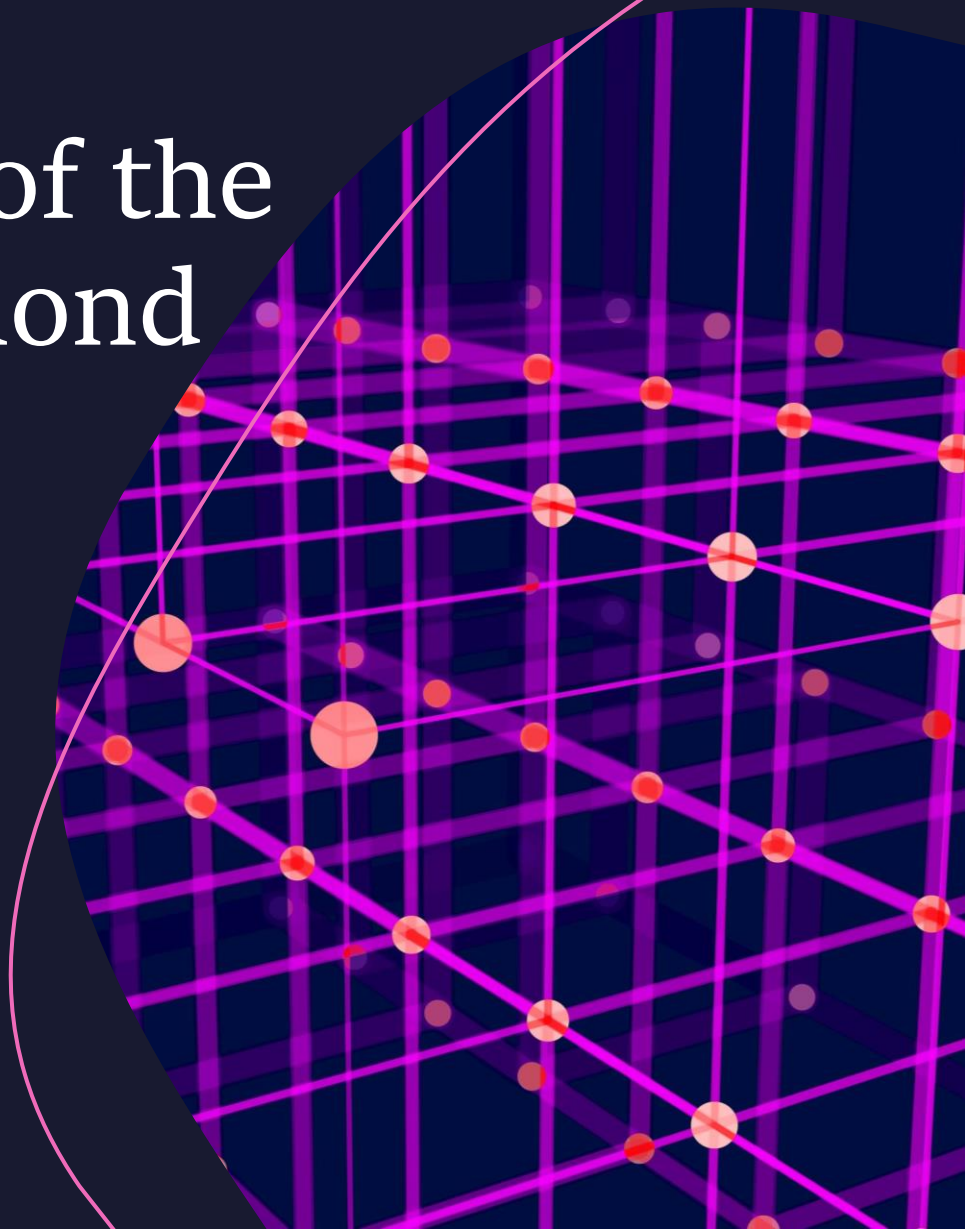
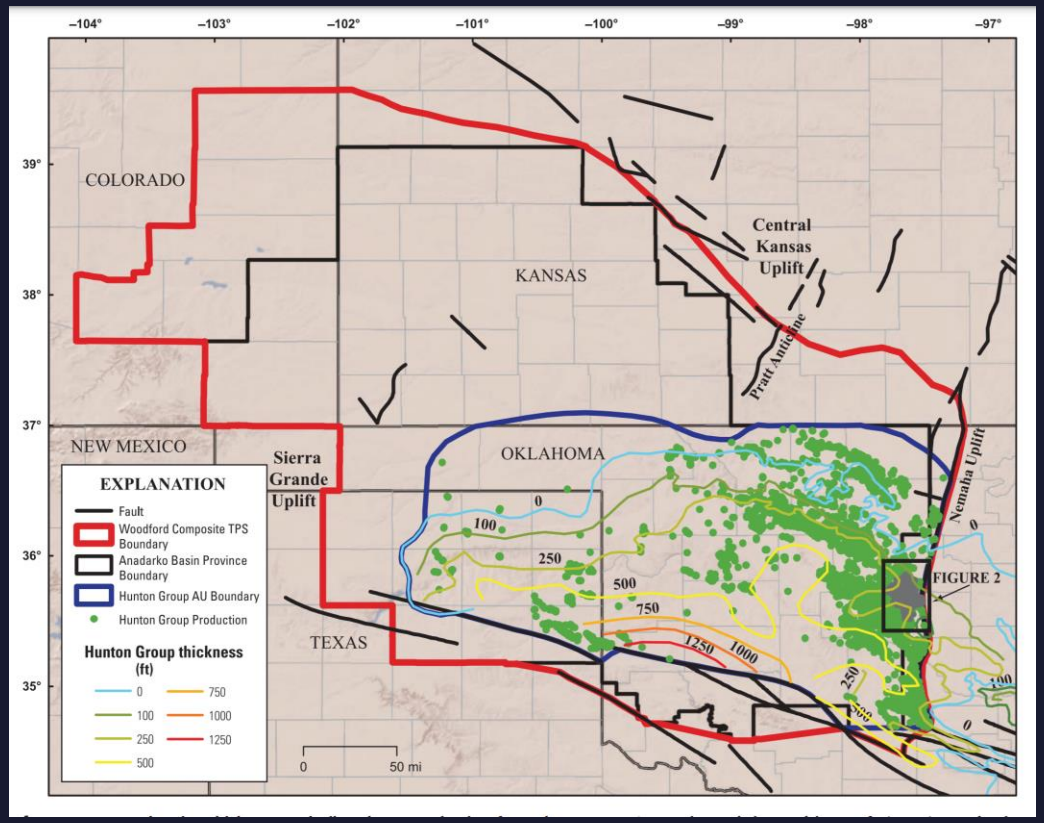
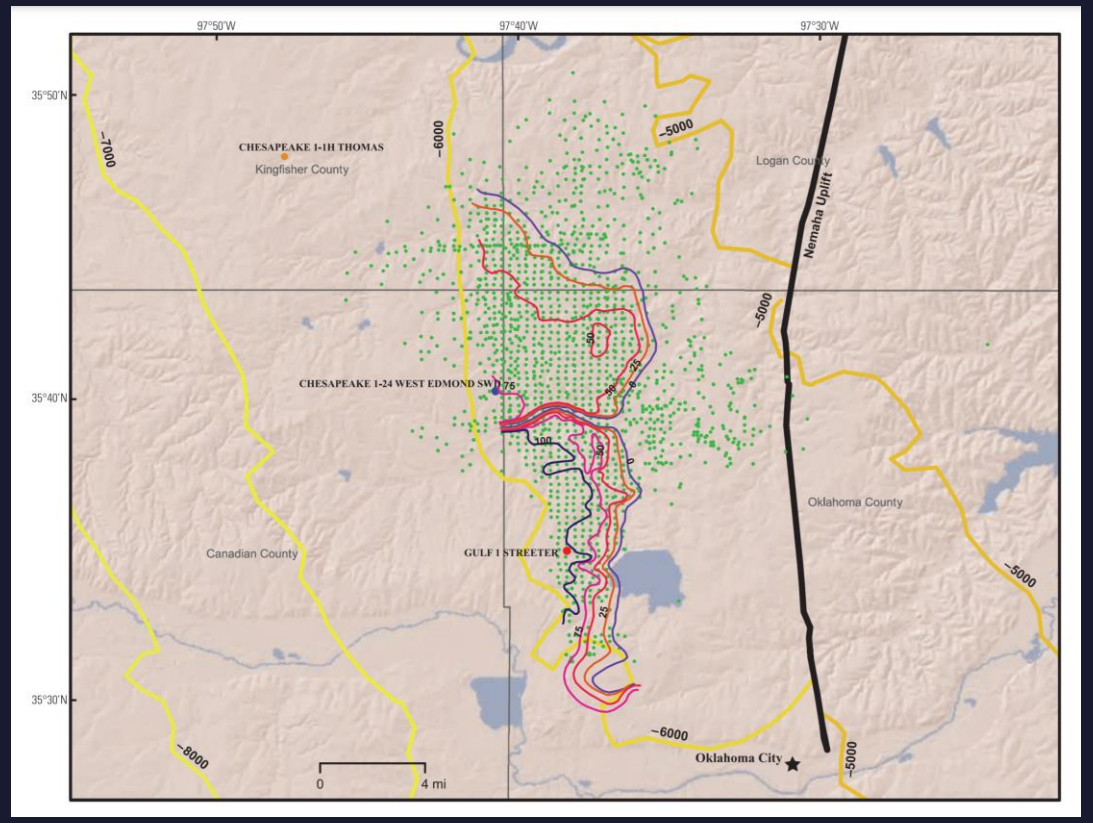


Abstract

- Located in central Oklahoma
- West Edmond Field is one of the largest oil accumulations in the Silurian–Devonian Hunton Group in this part of the Anadarko Basin
- Oil and gas are stratigraphically trapped to the east against the Nemaha uplift, to the north by a regional wedge-out of Hunton strata, and by intraformational diagenetic traps
- Well cores indicate complex diagenetic relations influence permeability and reservoir quality
- The source rock is marginally mature to mature for oil generation in the area of the West Edmond field, and migration of Woodford oil and gas from deeper parts of the basin also contributed to hydrocarbon accumulation

Introduction to the System



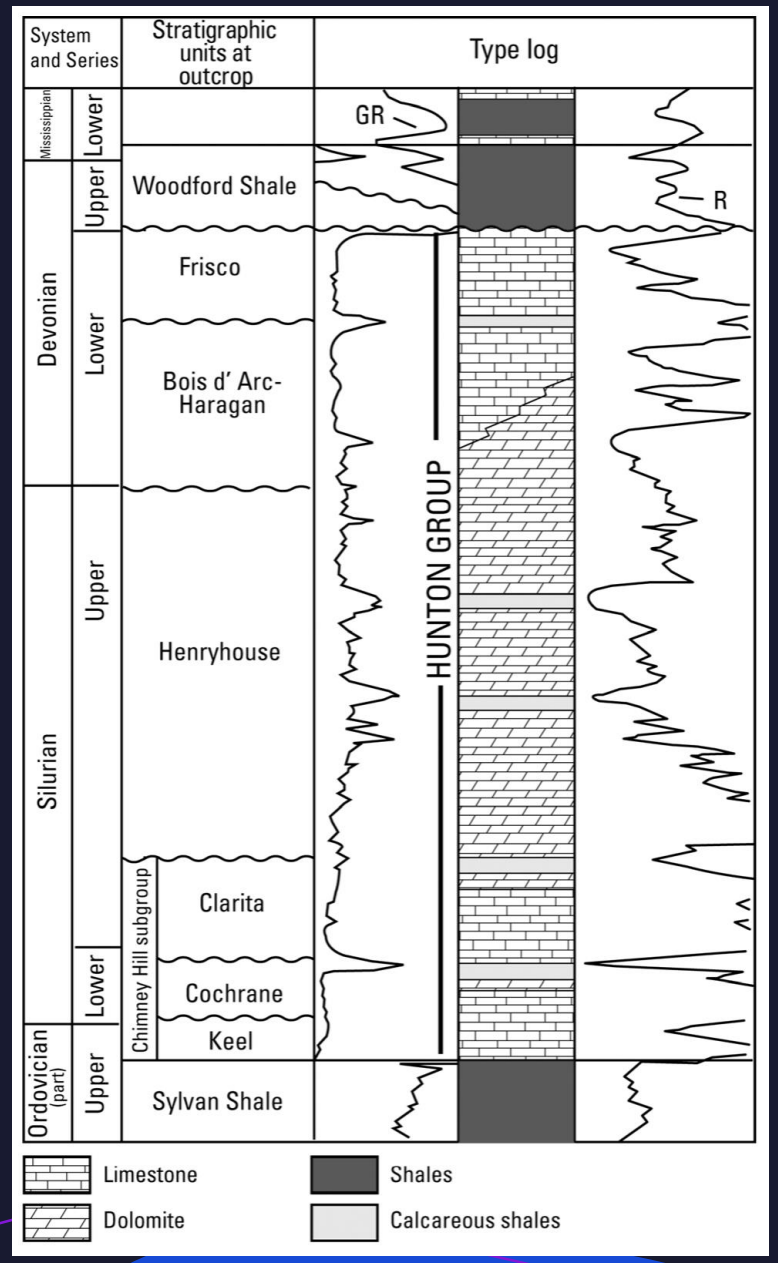


Introduction

- The Hunton Group is a prolific oil- and gasproducing unit in the mid-continent -- it is critical to the USGS assessment of undiscovered petroleum resources in the Anadarko Basin province.
- The main objectives of this study are to (1) determine the reservoir facies of Hunton Group reservoirs in the West Edmond field; (2) define the controls on hydrocarbon trapping; and (3) understand the sources(s), generation, migration, and trapping of hydrocarbons into this major Hunton Group field.
- The Anadarko Basin is a markedly asymmetrical sedimentary basin that originated during the Precambrian as the southern Oklahoma aulacogen.

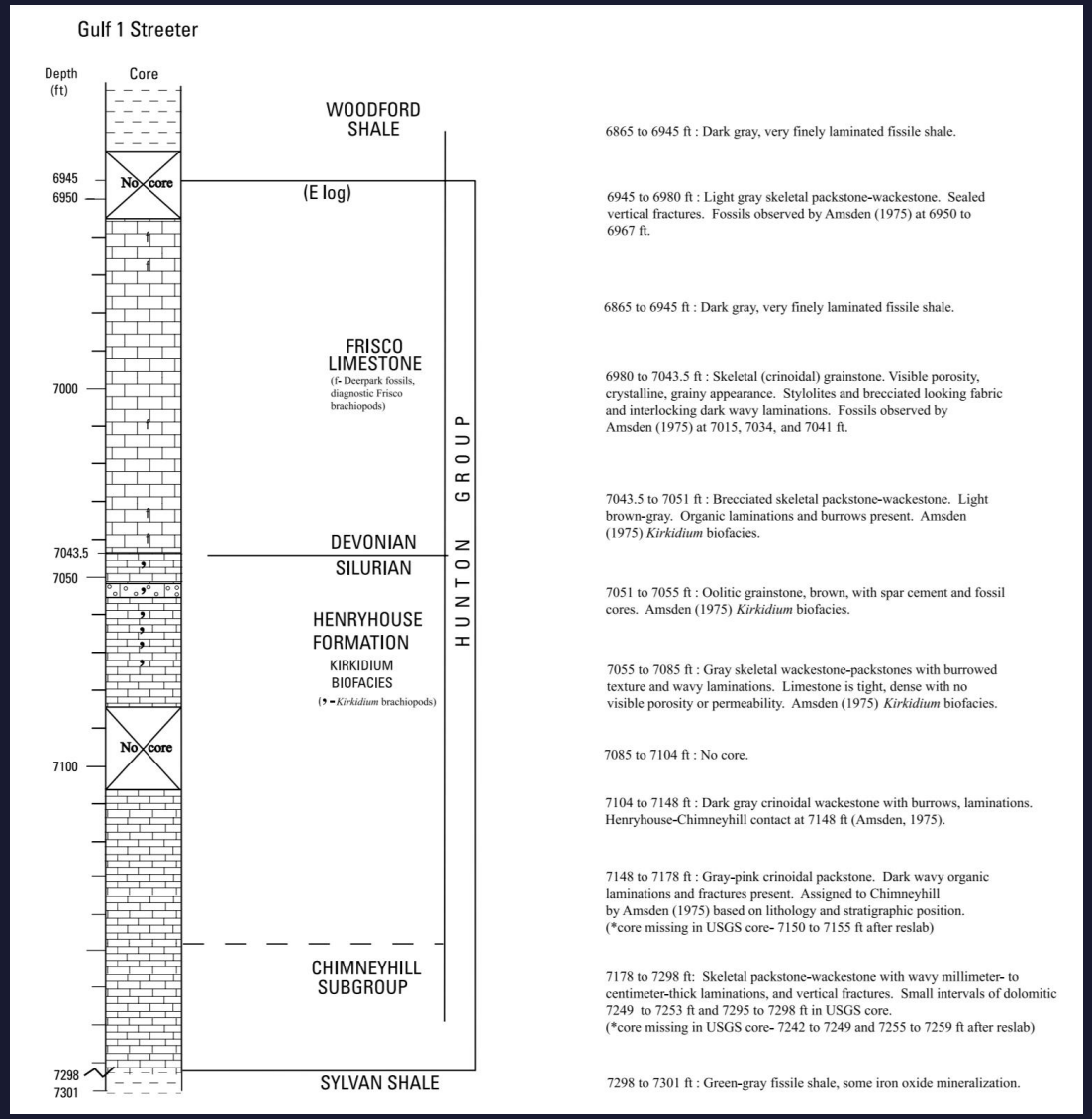
Introduction

- Hunton Group ranges from 4000 ft (1200 m) below sea level to 24,000 ft (7300 m) in the deep basin.
- The Hunton Group consists of sequences of dolomite, limestone, and calcareous shale and is divided into several formations
- The overlying Devonian–Mississippian Woodford Shale is both a seal and petroleum source for the carbonates over most of the extent of the Hunton Group.
- In West Edmond Field, Hunton reservoirs are dominated by grainstones and packstones in the southern part of the field, with dolomitized facies more common but forming lower-quality reservoirs in the northern part of the field



Gulf 1 Streeter Well

- Indicates that zones of highest porosity in the upper part of the Hunton Group may be in the Frisco Limestone
- A variety of facies is present in the Hunton Group section, including skeletal packstones and wackestone and crinoidal grainstone with visible porosity in the Frisco Limestone
- Primary and secondary porosity is observed within the Limestone facies



Diagenetic Alteration

- Porosity traps can be in the same unit in which secondary dissolution or diagenesis has enhanced or decreased porosity and permeability
- Facies changes, as well as variable dolomitization, impact reservoir development.
- A Dual porosity system may be enhancing reservoir quality in certain beds of the Hunton Group
- Two Chesapeake Energy Corporation cores were examined
- Production is from the upper and lower Hunton and is concentrated in the northern part of the field, north of the incised channel
- West Edmond is unique from other Hunton fields in Oklahoma in that production is primarily from limestone
    - other Hunton fields are mostly dolomitized, a process that increases reservoir quality through porosity enhancement in these fields
- Dolomitization in West Edmond is sporadic, but does not have a substantial impact on the porosity development or the reservoir quality of the field.

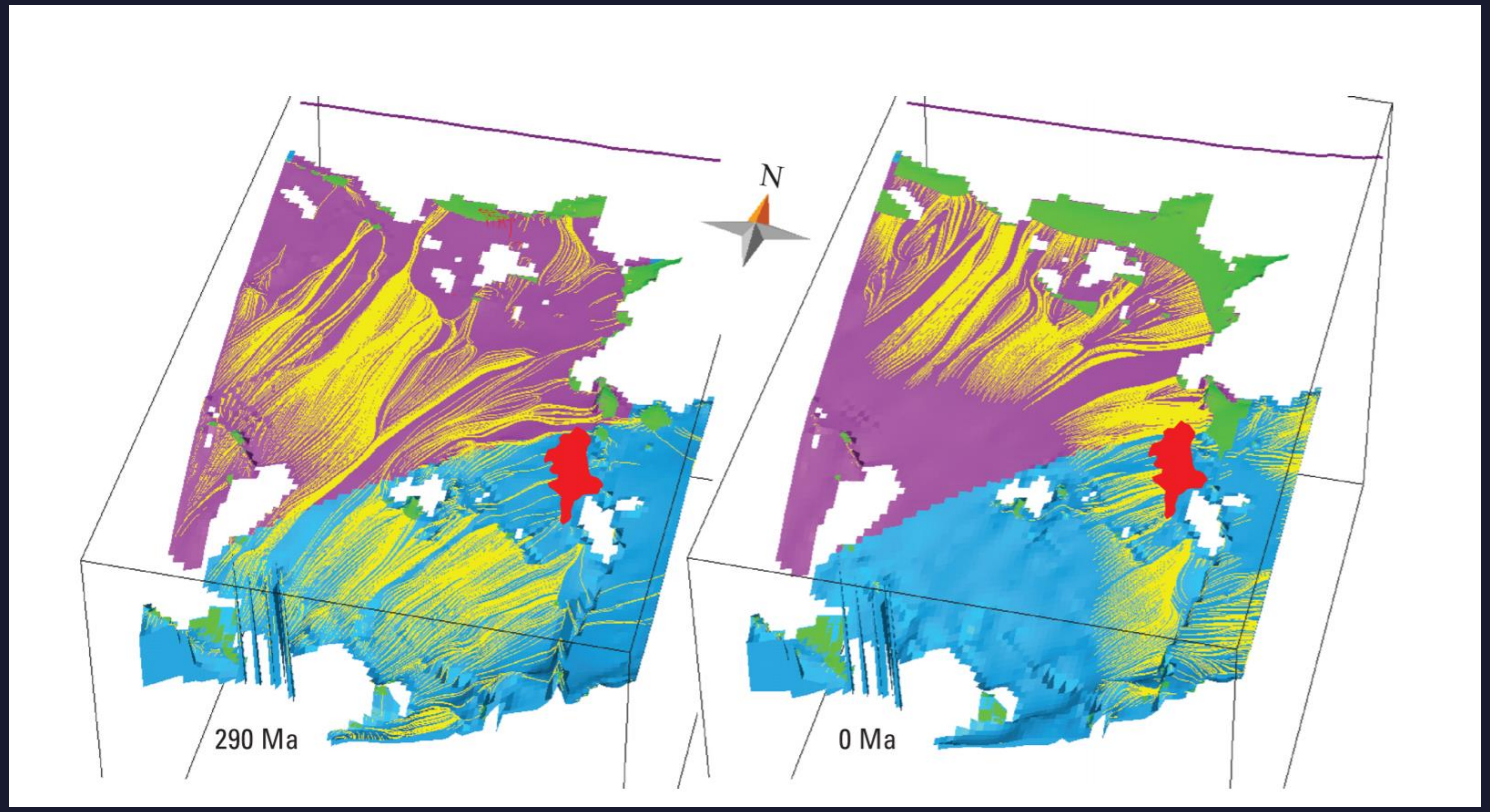
Woodford Shale

- The Devonian–Mississippian Woodford Shale unconformably overlies the Hunton Group in the study area and is the major source for the West Edmond field
- The strata are organic rich, with abundant type A, type I (Tasmanite alginite) and amorphous type II kerogen, and minor type III kerogen
- The hydrocarbons likely migrated from the deep basin into Hunton reservoirs

4-D System Model

- Models were calibrated to Woodford Shale using:
  - (1) Ro data from Cardott (1989), Price (1997), and two wells in the Edmond West field
  - (2) temperature data from Carter et al. (1998), Gallardo and Blackwell (1999), and Price (1997); and
  - (3) drillstem tests and corrected borehole temperatures.
- Oil and gas generation in the Anadarko Basin began in the deep basin of southern Oklahoma and eastern Texas at approximately 35 Ma for the Woodford Shale
- The dolomite generally has greater permeability and porosity than the limestone, and the flow path modeling shows greater accumulation in the dolomite facies
- The Woodford Shale is the present-day primary source for Hunton Group accumulations, with approximately 83% of the petroleum

Oil & Gas Migration



Conclusions

- Secondary dissolution has enhanced porosity and permeability of limestones in the upper part of the Hunton Group
- Vuggy porosity, in skeletal packstones, and preserved primary porosity in ooid grainstones are observed in the north and south of the channel that cuts through the center of West Edmond field and creates good reservoir quality
- Significant vertical and horizontal variability in the porosity over short distances is common, contributing to reservoir heterogeneity and the potential success of horizontal infill wells
- The Woodford Shale in West Edmond field is mature for oil generation. Oil and gas also likely migrated into the field from the southwest, from the deep Anadarko Basin.