[PS]Production Profiles and Geologic Characteristics of the Wolfcamp and Bone Spring Plays of the Delaware Basin*

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Search and Discovery Article #11238 (2019)**
Posted August 5, 2019

*Adapted from poster presentation given at 2019 AAPG Annual Convention and Exhibition, San Antonio, Texas, May 19-22, 2019
 DOI:10.1306/11238Popova2019

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Abstract

Increasing drilling and completion operations within the Wolfcamp play is responsible for much of the crude oil and associated natural gas production growth in the Permian Basin since 2005. In mid-2018, Wolfcamp accounted for about 1 million barrels of crude oil per day (MMb/d), and almost 4 billion cubic feet of natural gas per day (Bcf/d), about 1.6 million barrels of oil equivalent per day (MMBOE/d), of hydrocarbon production in the Permian basin. The U.S. Energy Information Administration (EIA) is in the process of updating maps of the major tight oil and shale gas plays of the lower 48 states using publically available geologic data and a commercial well-level database. Thematic maps on production trends from the Eagle Ford, Bakken, Marcellus and Utica plays have recently been published at the EIA Maps webpage. Maps for the Permian Basin plays are under construction and additional maps are planned for the remaining major shale and tight oil plays for which sufficient well, production, and geologic data are available.

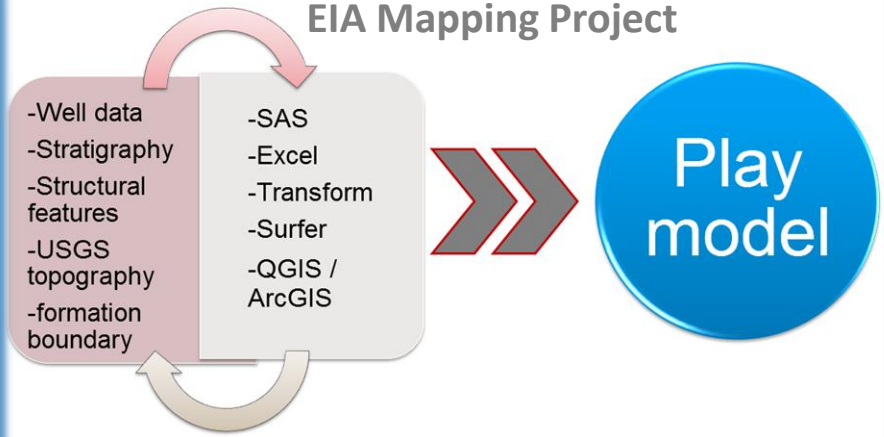
For the Wolfcamp formation, geologic elements derived from literature and commercial well-level database are used to create a contoured elevation of the top of the formation, isopachs, major structures and tectonic features, play boundaries, and location and gas-to-oil ratios of wells producing from January 2005 to September 2018. Wolfcamp depth and thickness varies significantly across the formation extent. The formation's subsea depth varies in the Delaware Basin from 0 feet in the west to -9,500 feet in the central areas, while in the Midland Basin it varies from -2,000 feet in the east along the Eastern Shelf, to 7,000 feet along the basin axis near the western basin edge. Wolfcamp thickness ranges from about 800 feet to over 7,000 feet thick in the Delaware Basin and from 400 feet to over 1,600 feet thick in the Midland Basin, varying from 200 feet to 400 feet in the adjacent Central Basin Platform. Wolfcamp source rocks are classified as dominantly sapropelic marine type II kerogens and composed of low-permeability shales, dolomites, mudstones, and sandstones deposited within the Permian Basin during the Late Pennsylvanian and Wolfcampian epochs (306 to 284 Ma). Total organic carbon (TOC) has been observed up to 8% and formation porosity ranges from less than 1% to 12%. Natural fractures, clay content, formation depth, and thickness all influence production Wolfcamp benches profiles.

Independent Statistics & Analysis
U.S. Energy Information Administration

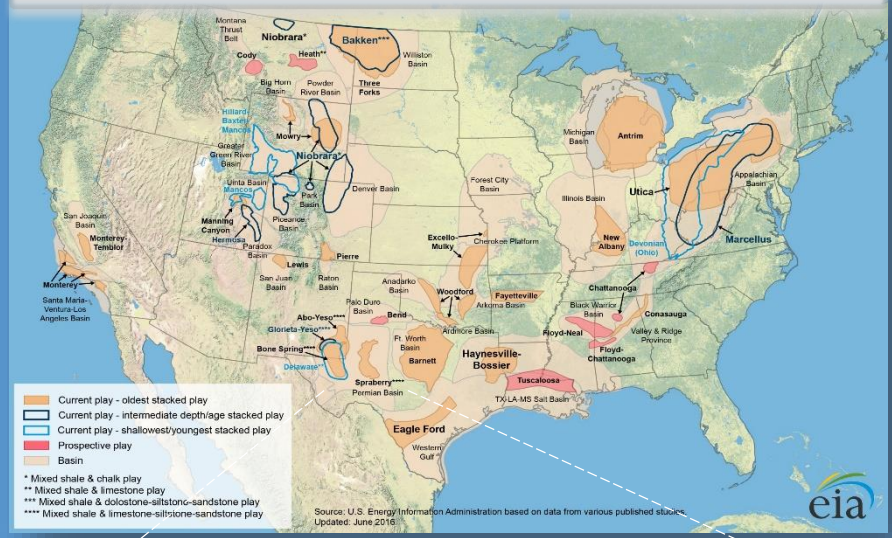
Production Profiles and Geologic Characteristics of the Wolfcamp and Bone Spring plays of the Delaware Basin

Dr. Olga Popova, Emily Geary, April Patel, Gary Long, Jeffrey Little, Steven Grape, Elizabeth Panarelli

EIA Mapping Project

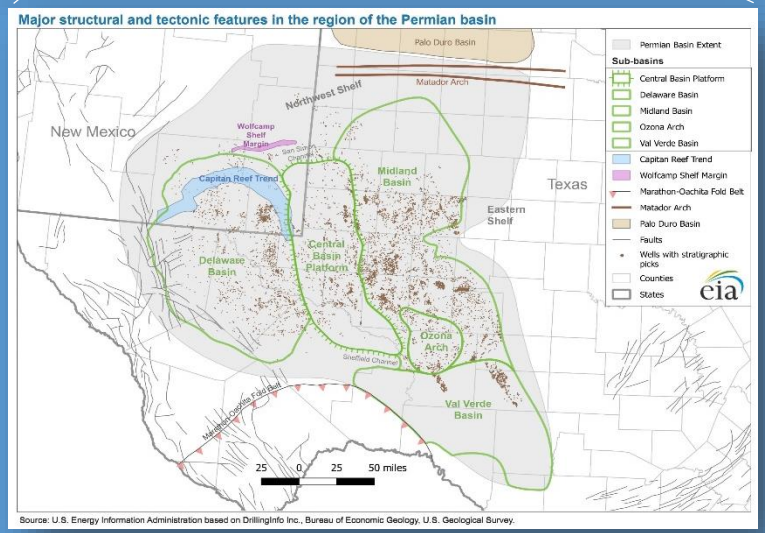


Low permeability plays of U.S. Lower 48 States



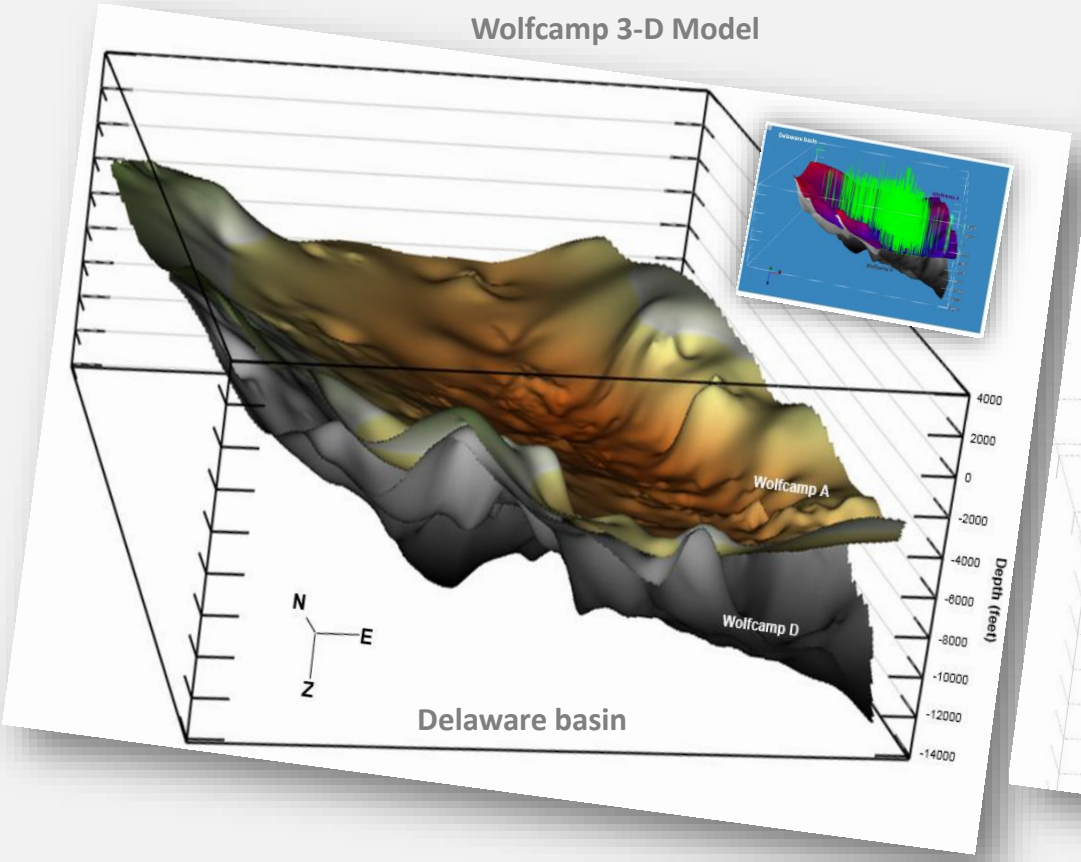
EIA's Annual Energy Outlook

Data Integration

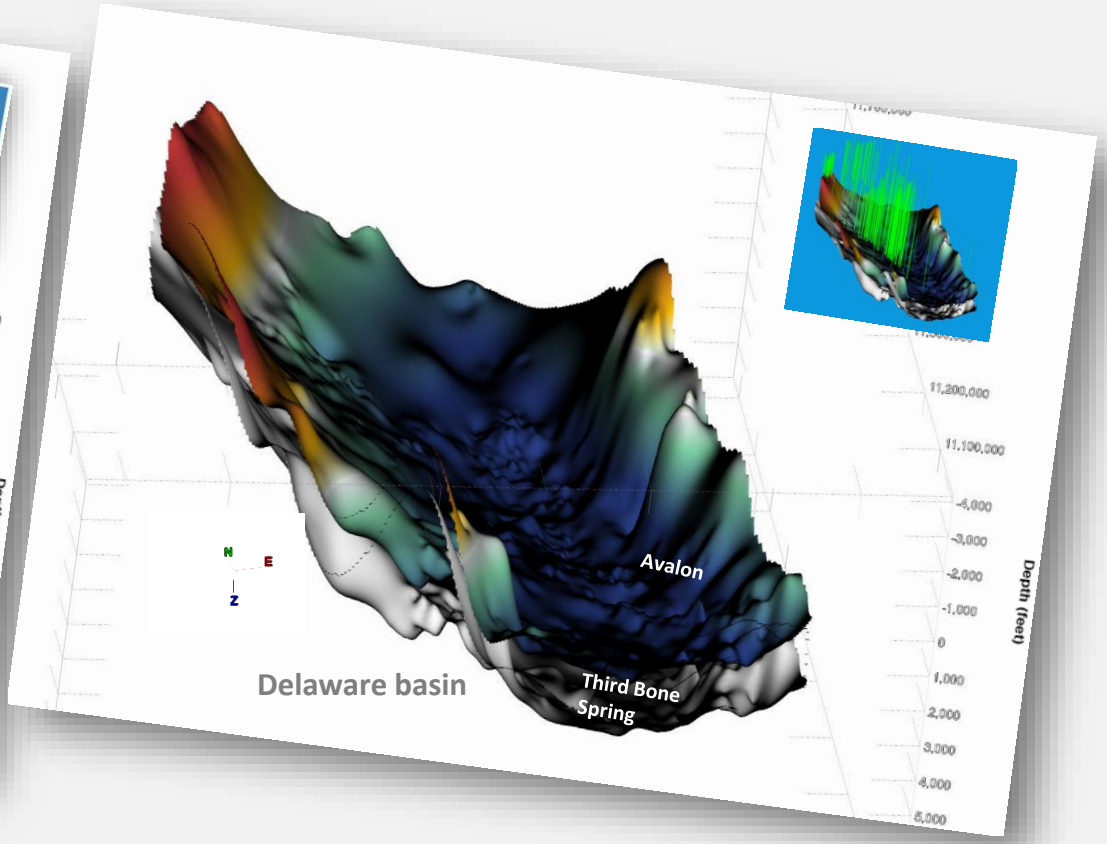


AAPG ACE, May 19-22, 2019 San Antonio, Texas

Wolfcamp 3-D Model



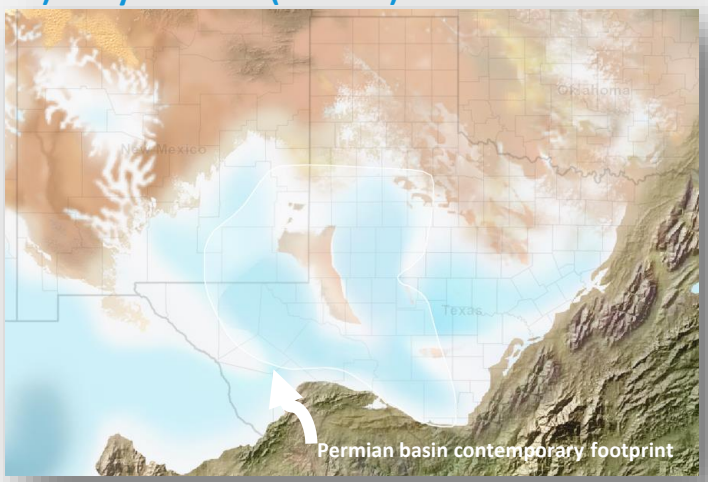
Bone Spring 3-D Model



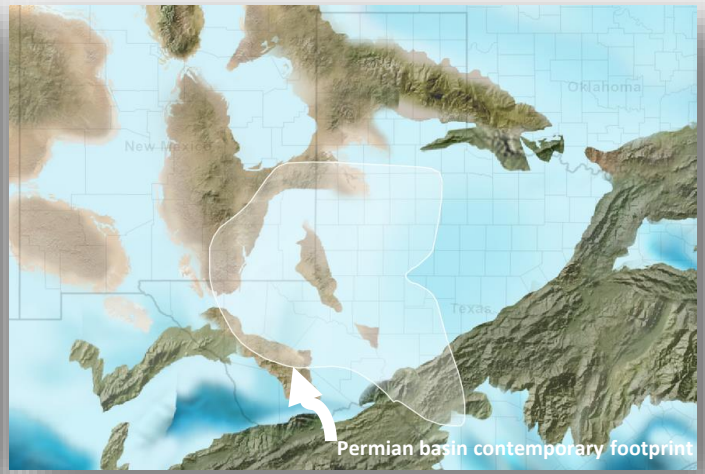
Source: EIA based on DrillingInfo Inc., State Agencies, and U.S. Geological Survey

Paleogeographic reconstructions exhibiting the southern part of North America. Modified after Blakey (2011)

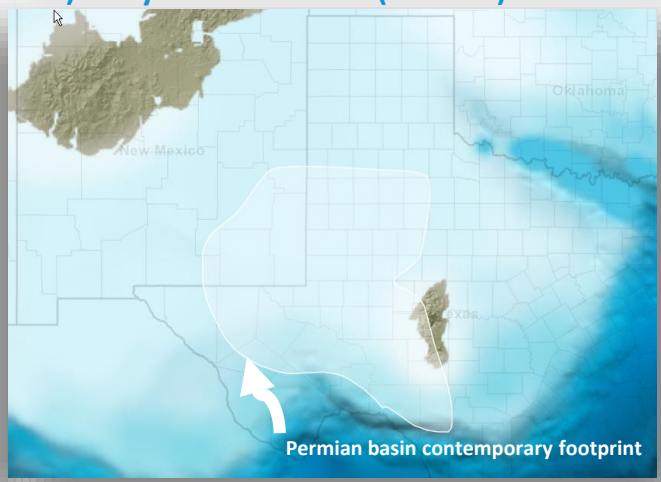
a) Early Permian (280 Ma)



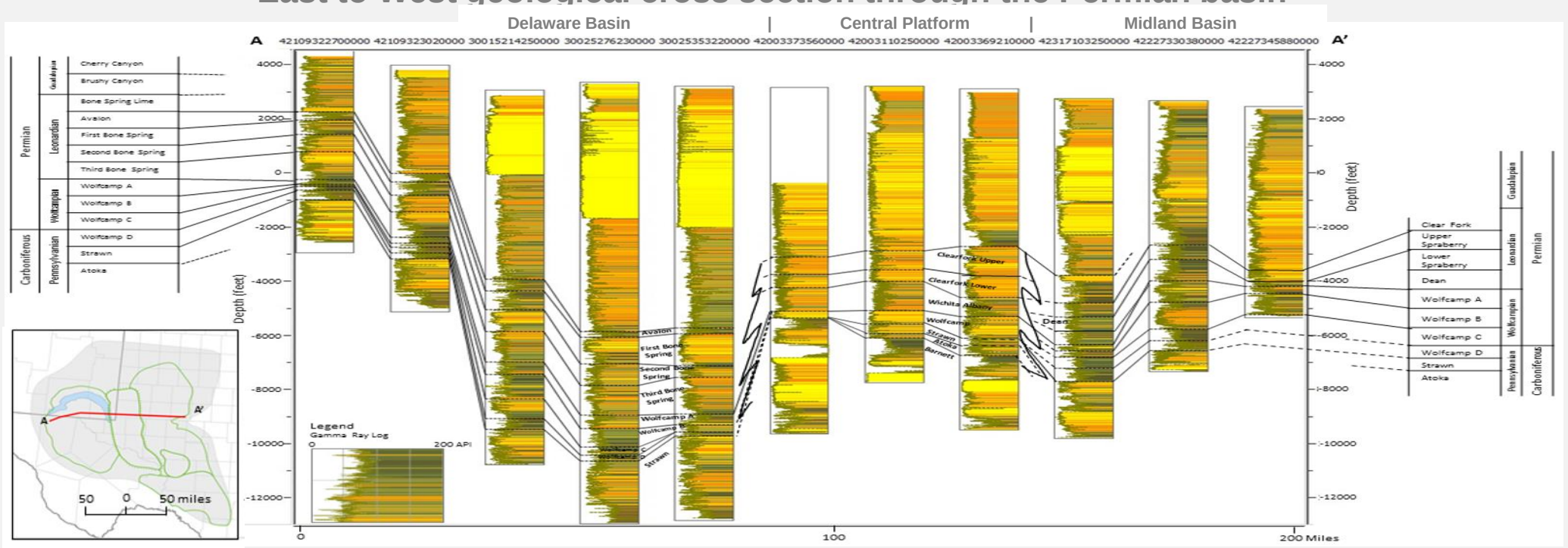
b) Middle Pennsylvanian (305 Ma)



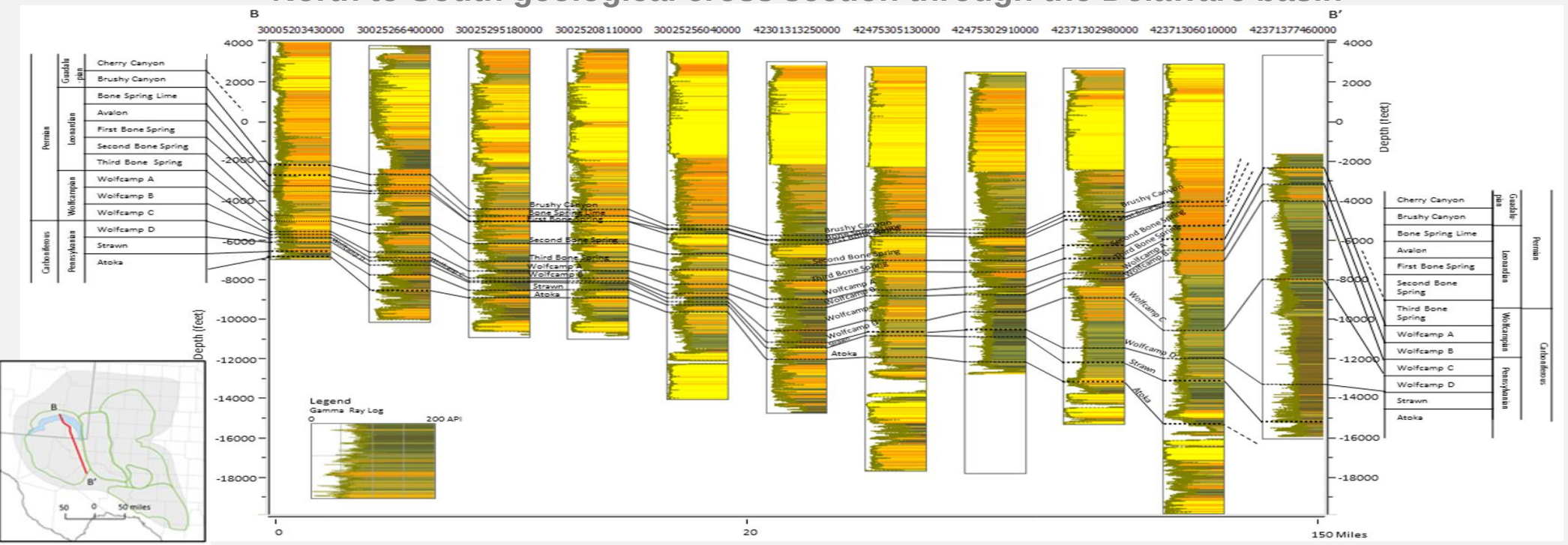
c) Early Carboniferous (345 Ma)



East to West geological cross section through the Permian basin



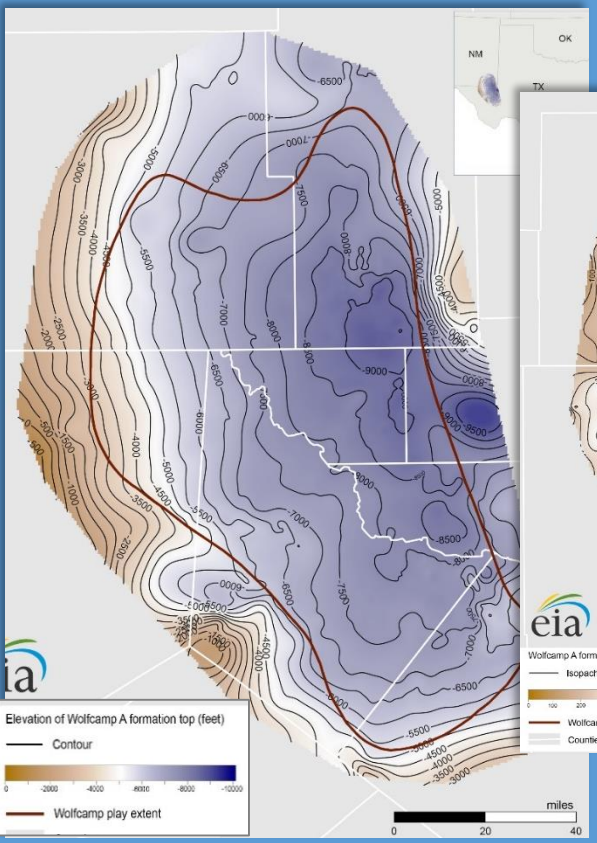
North to South geological cross section through the Delaware basin



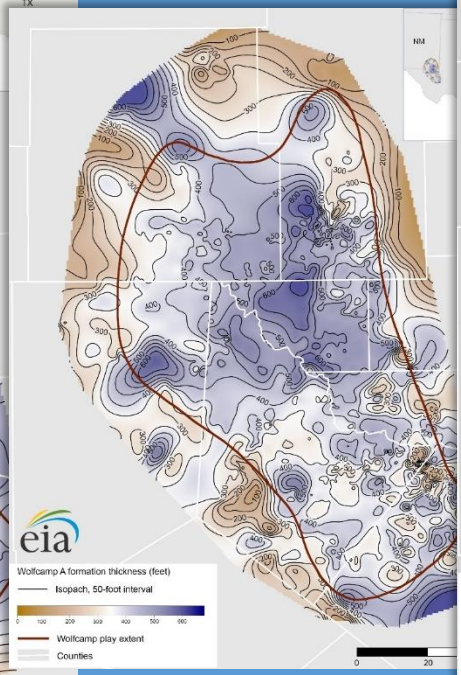
Source: EIA based on DrillingInfo Inc., State Agencies, and U.S. Geological Survey

Wolfcamp A, Delaware Basin

Structure map

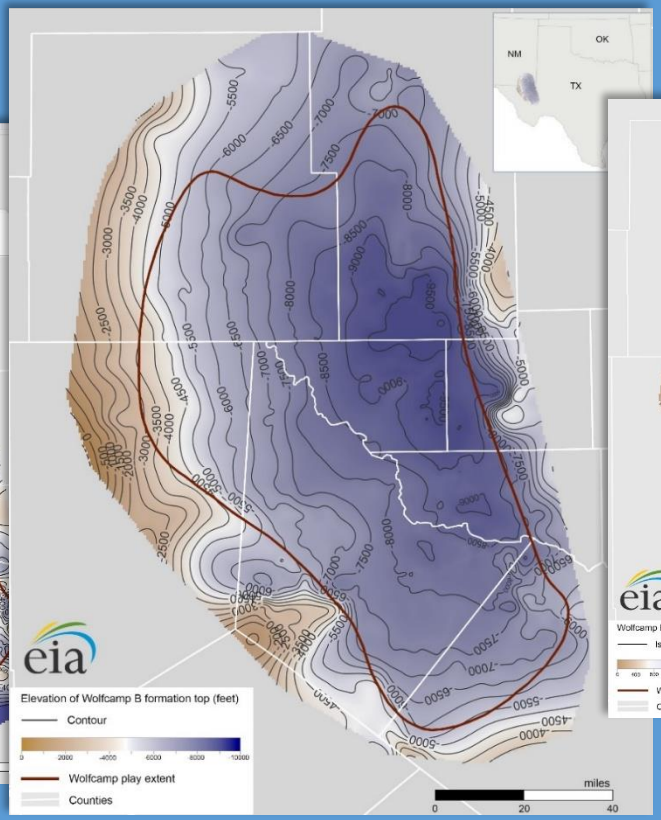


Thickness map

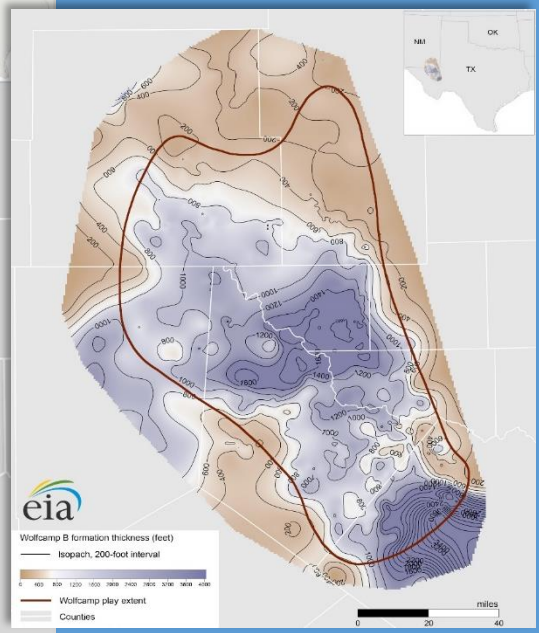


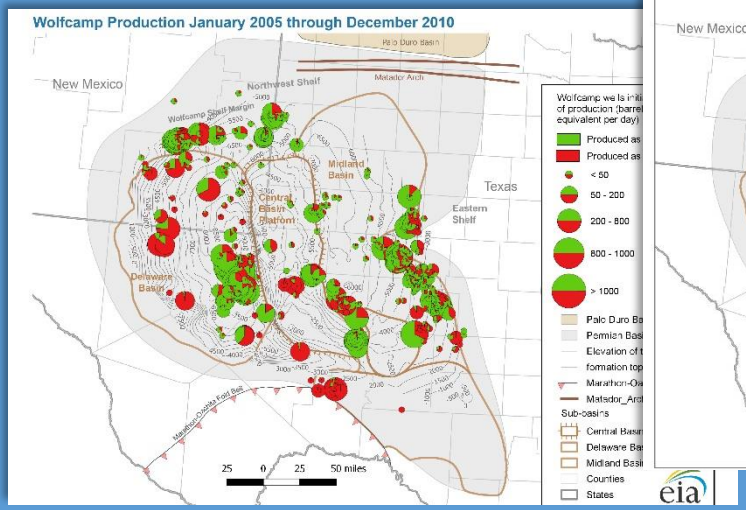
Wolfcamp B, Delaware Basin

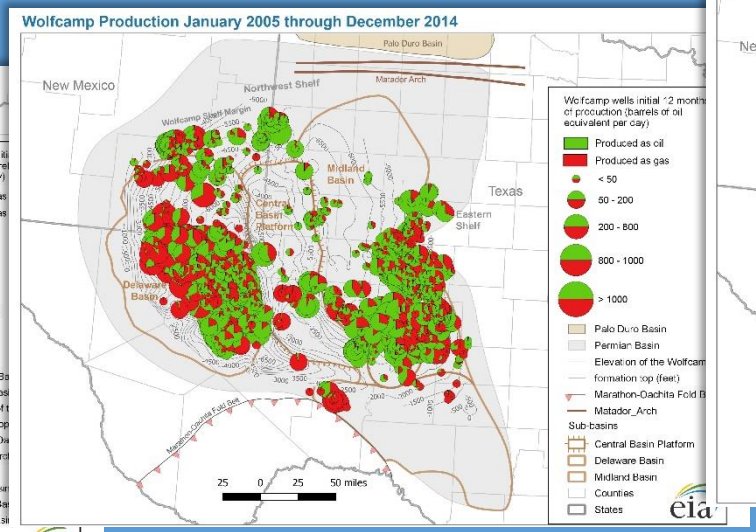
Structure map

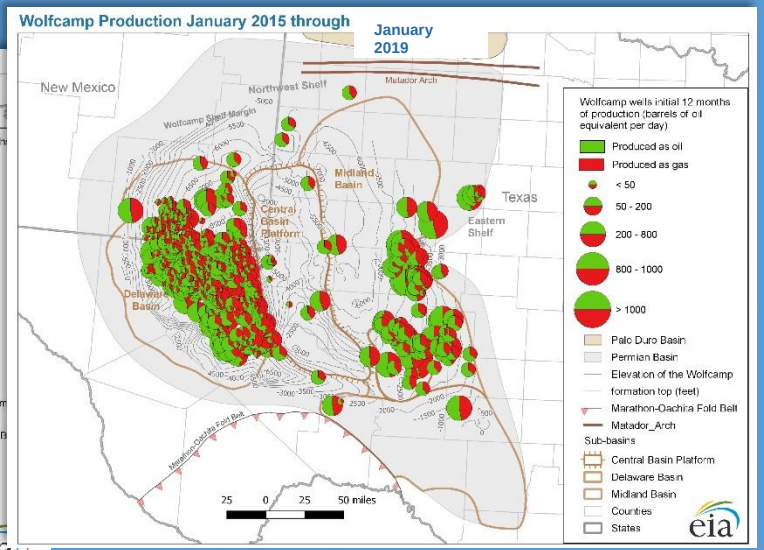


Thickness map





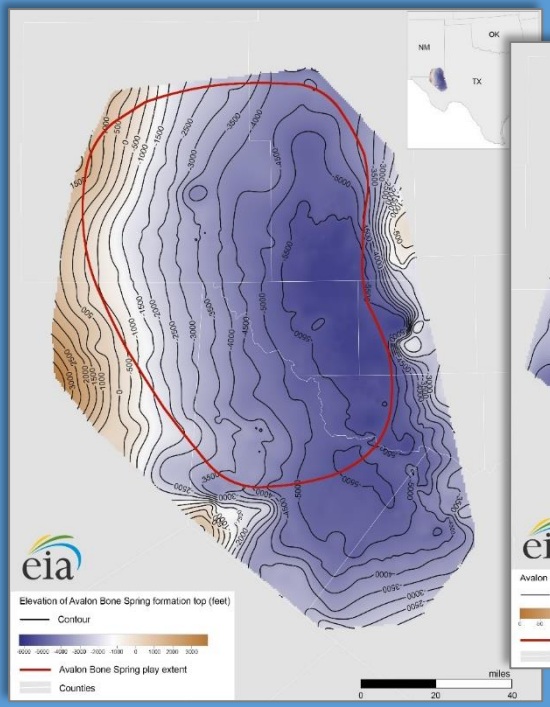




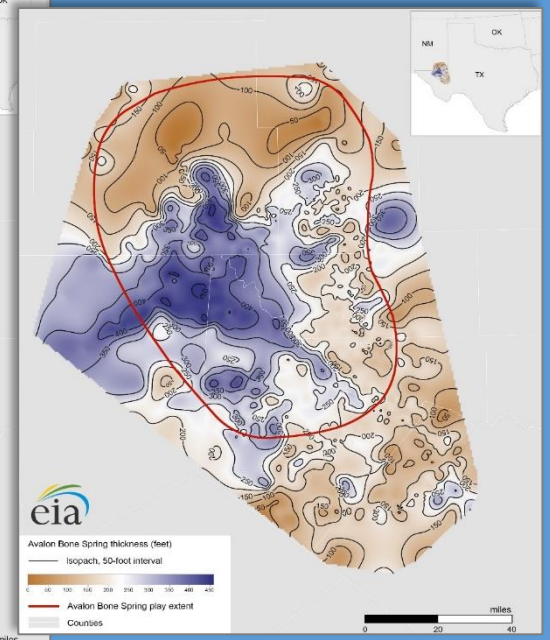
Source: EIA based on DrillingInfo Inc., State Agencies, and U.S. Geological Survey

Avalon, Delaware Basin

Structure map

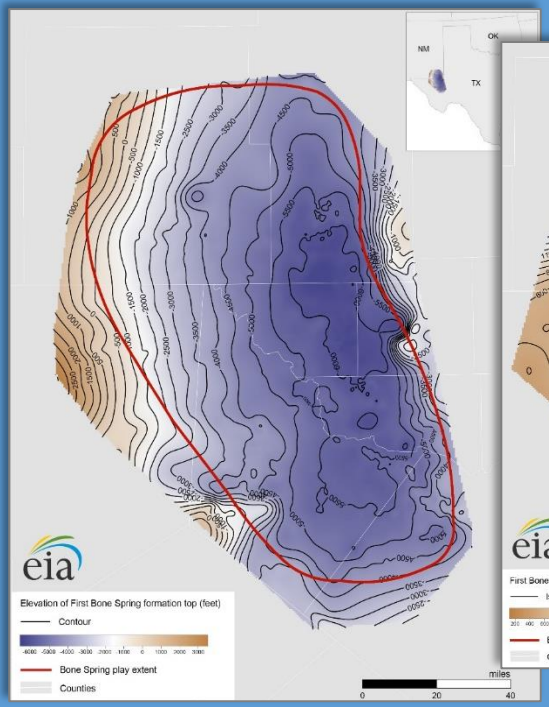


Thickness map

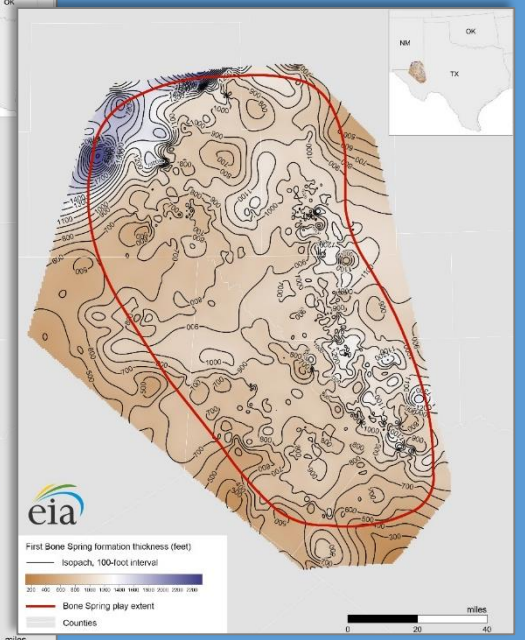


First Bone Spring, Delaware Basin

Structure map

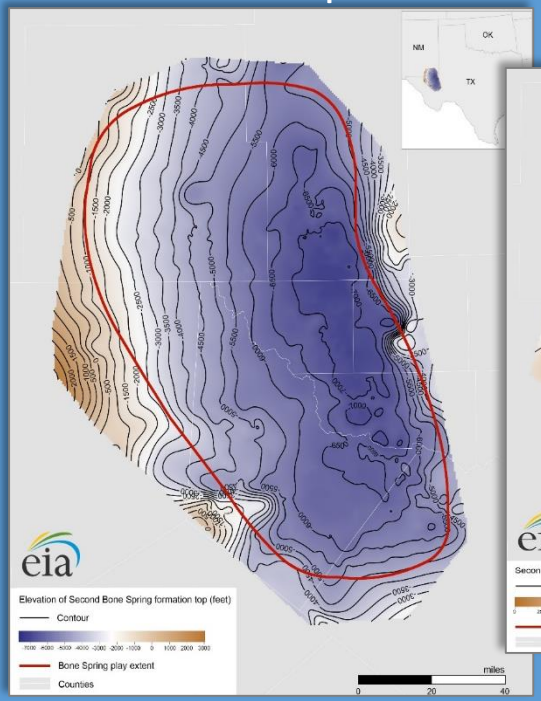


Thickness map

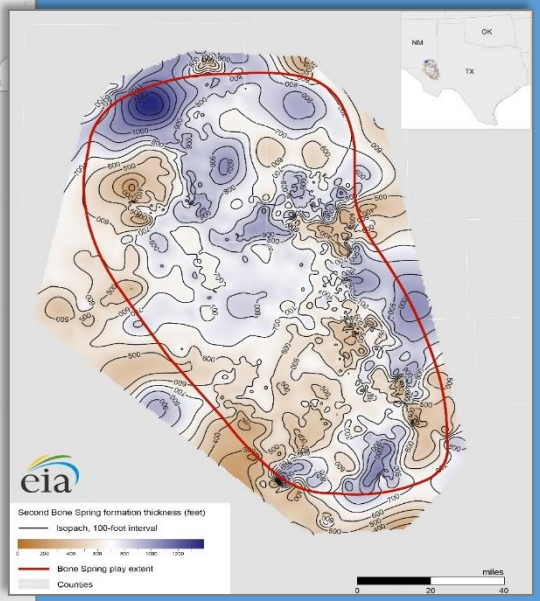


Second Bone Spring, Delaware Basin

Structure map

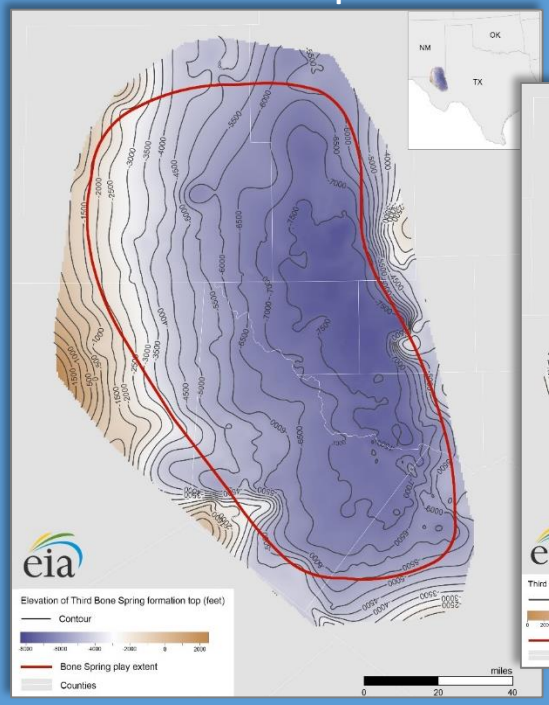


Thickness map

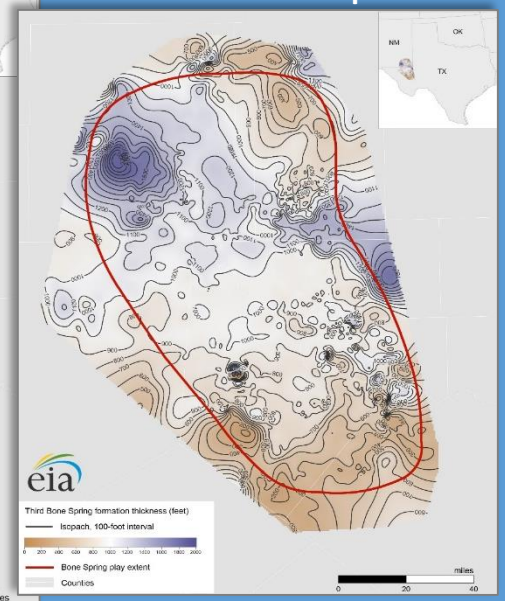


Third Bone Spring, Delaware Basin

Structure map

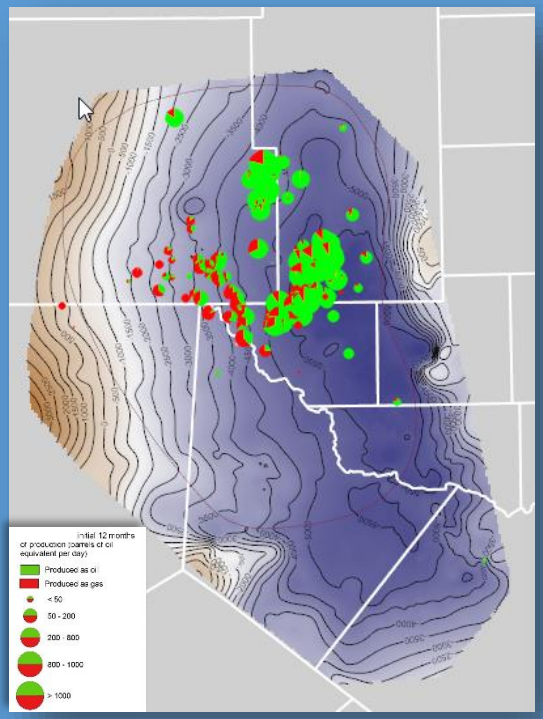


Thickness map

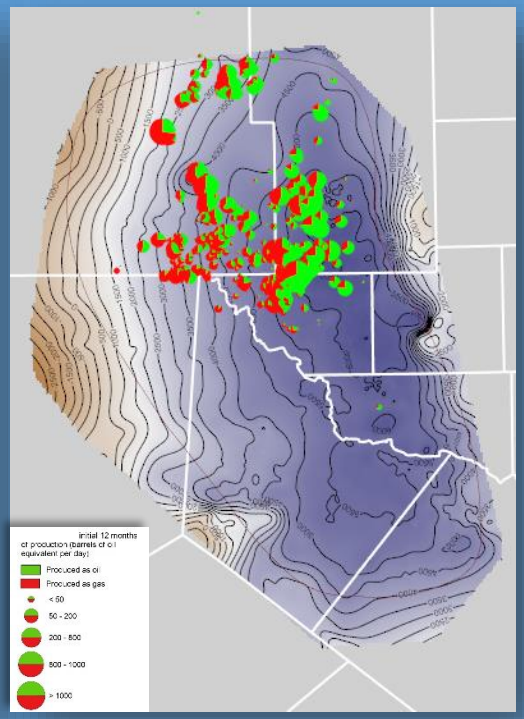


Source: EIA based on DrillingInfo Inc., State Agencies, and U.S. Geological Survey

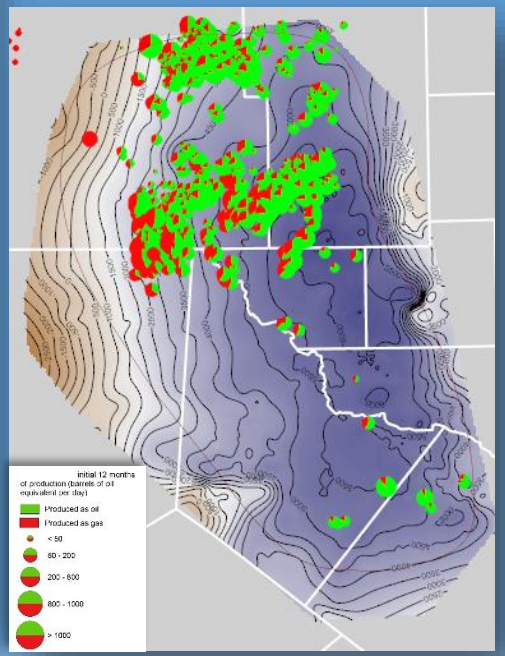
Avalon production Jan 2008 through Jan 2019



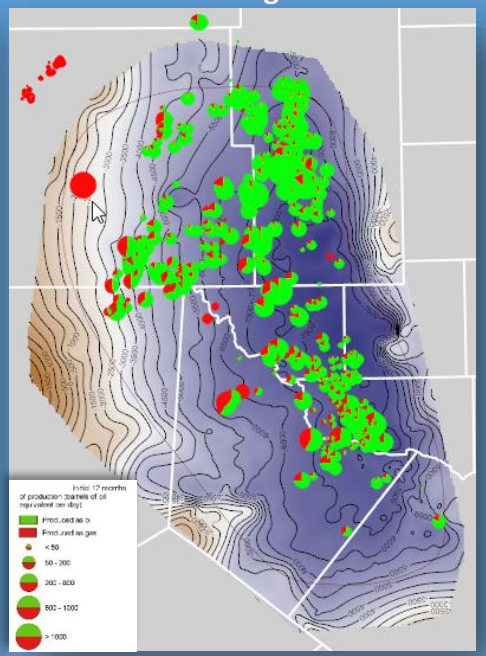
Second Bone Spring production Jan 2008 through Jan 2019



First Bone Spring production

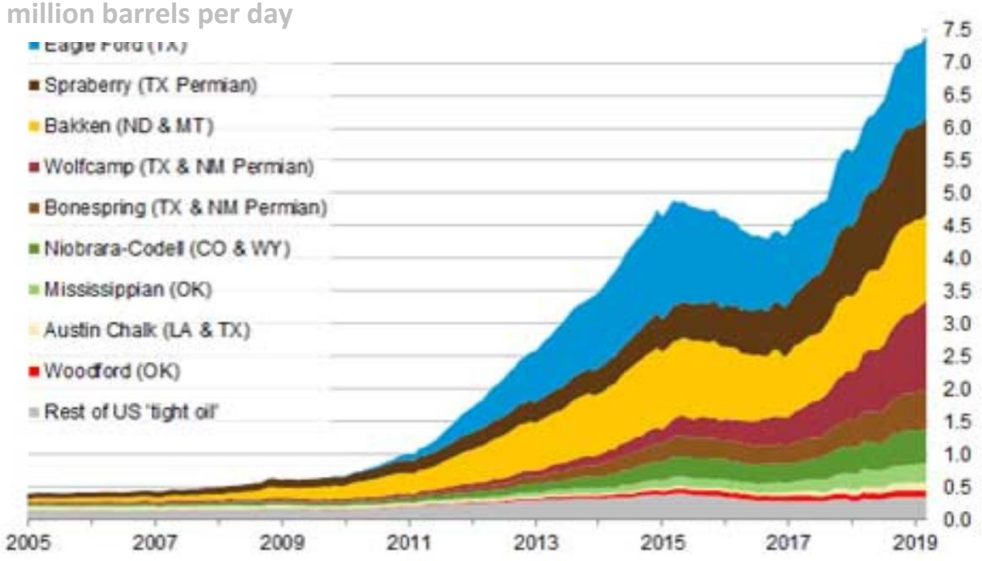


Third Bone Spring production Jan 2008 through Jan 2019



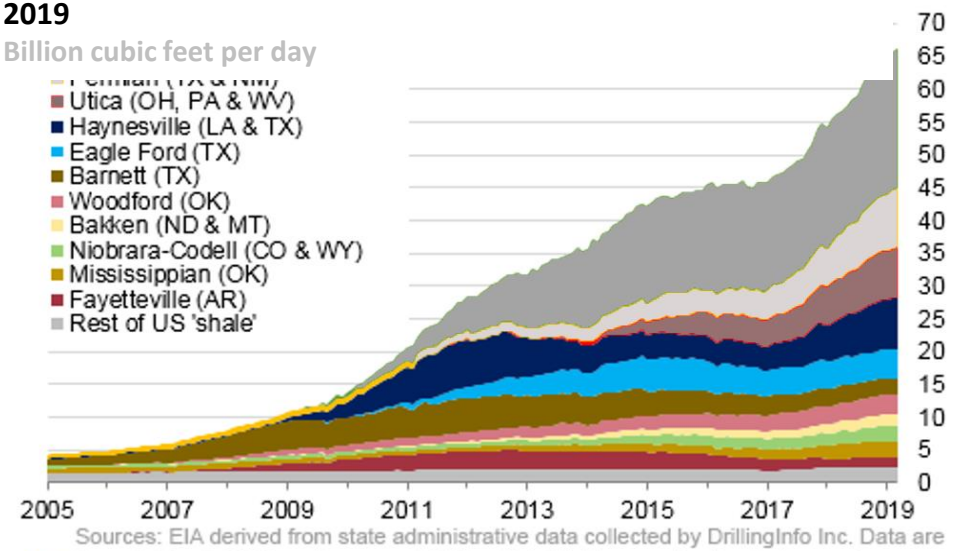
U.S. tight oil production – selected plays through February 2019

million barrels per day



U.S. dry shale natural gas– selected plays through February 2019

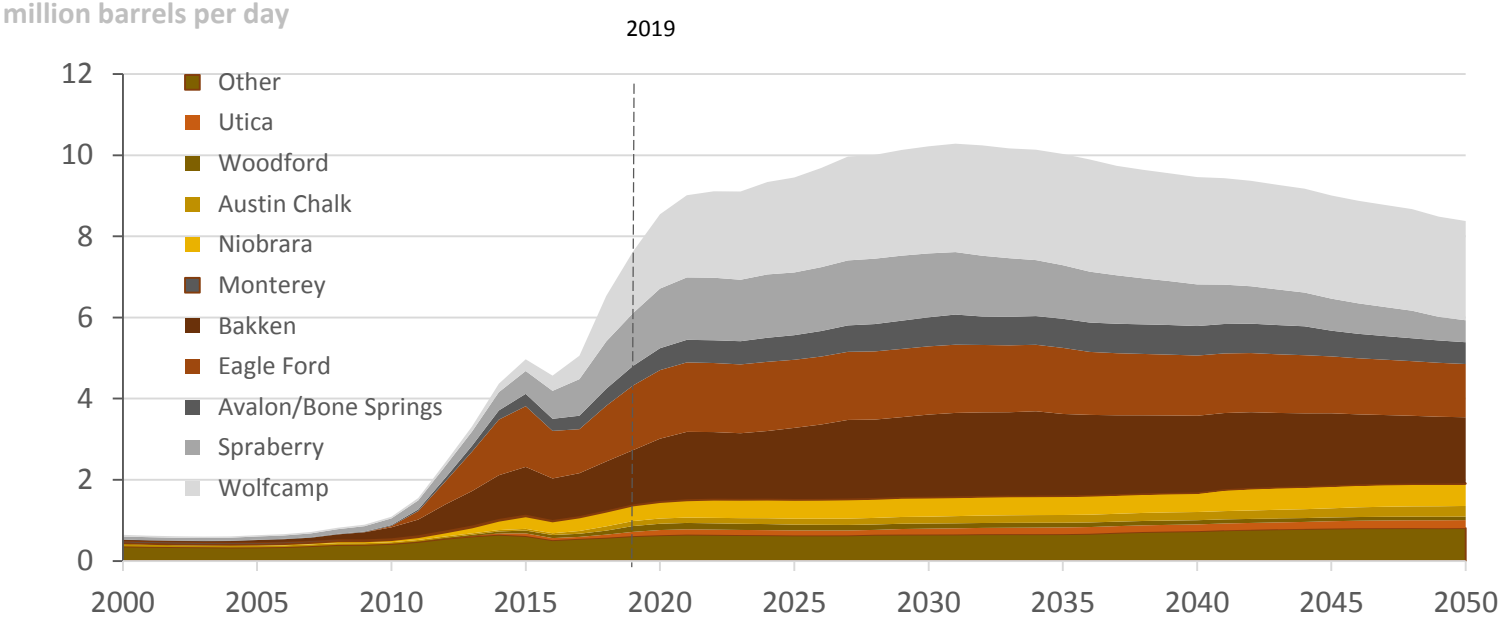
Billion cubic feet per day



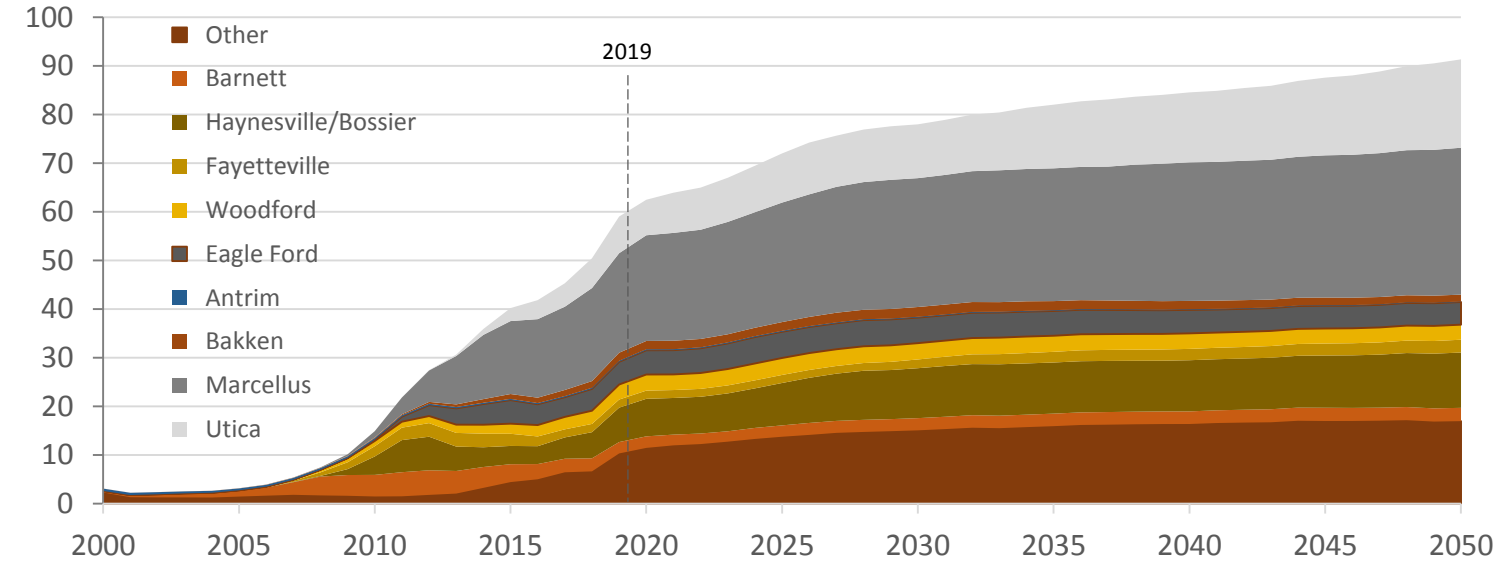
Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through March 2019 and represent EIA's official tight gas estimates, but are not survey data. State abbreviations indicate primary state(s).

eia

U.S. tight oil production forecast through 2050
AEO reference case 2019



U.S. shale dry natural gas production forecast through 2050
AEO reference case 2019



Source: EIA AEO 2019

U.S. Energy Mapping System:
www.eia.gov/special/shaleplays

EIA's maps web page:
www.eia.gov/maps/maps.htm#field

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Acknowledgment:
The authors thank State Geological Agencies for data sharing and expert opinion: Kristin Carter; Susan Pool, Phillip Dinterman, Mary Behling, Jessica Moore, Eric Lewis, Mohammad Fakhari, Svetlana Ikonnikova and Scott Tinker. The authors are grateful to EIA peers: Kip Platto, Chris Peterson,, Meg Coleman, Jack Perrin, Jozef Lieskovsky, Barbara Mariner-Volpe, Troy Cook, John Staub, Aloulou Faouzi, Shirley Neff, Debra Coaxum, Josh Latimore, and Tom Leckey