Key Subsurface Data Integration in Legacy Oil Fields, Northern Shelf, Permian Basin*

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Search and Discovery Article #11231 (2019)**
Posted July 22, 2019

*Adapted from oral presentation given at AAPG 2019 Annual Convention & Exhibition, San Antonio, Texas, May 19-22, 2019
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Abstract

The Permian Basin remains a petroleum-producing jewel in the United States. This is largely due to innovations in thinking, technology, and data integration over the last decade. The fields in this basin have produced for almost 100 years and operators continue to find new plays. However, “Legacy Oil” production has declined by 250,000 bbl/day since 2009 due to a lack of capital for Permian conventional reservoirs or expired mineral rights. Such fields should be re-evaluated for un-exploited potential using modern data integration techniques to include 3D re-processed seismic data for seismic facies interpretation, core data, well log correlations, paleontological reports, mudlogs, and production data. We used this approach to re-evaluate one of Oxy’s legacy oil fields. From this evaluation, we generated a ranked list of prospects, one of which will be drilled in fall 2018.
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Contributions from David Smith, Mike White, and Duong Nguyen

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May 21, 2019

www.usgs.gov/media/images/shoals-complex
Agenda

• Study Area
• Available Data
• Sub-regional Geology
  • Seismic Data
• Analog Reservoir
  • Core Data
• Integration
  • Results
• Summary
Background

Tested and produced along the shelf margins surrounding The Permian Basin since 1950s.

Best 2 producing fields around the Midland Basin are Kingdom and Oxy’s Slaughter Consolidated.

The Abo Play is Lower Leonian in age and possibly charged from Wolfcamp Source Rock.
Available Data

Map Highlighting Producing Formations

Stratigraphic Chart indicating Producing Formations

Map Illustrating Log and Rock data available

3D SURVEY ~ 625 mi^2

Image Logs
- QCOM - 7k +
- TCOM - 7k +

Wells with PEF

Rock (all)
• The Abo Clinoform Complex is composed of at least 5 depositional sequences (progadational clinoforms).
  • ~ 21 miles wide
Shelf Margins and Abo Depositional Model

• Case studies from other Abo producing fields were helpful in developing a geologic model in the AOI.

Illustration of a shelf-margin through geologic time.

Depositional fairways delineation is key for initial scoping.

From C. Robertson 1989- Permian and Penn Shelf Margins

Approximate location of Kingdom Survey and seismic line

Progradational carbonate depositional sequence and seismic response.

DB = Delaware Basin  CBP= Central Basin Platform  MB= Midland Basin
3D Seismic was used to map structure, thickness and seismic facies, and tied to rock and production data for prospecting.
Oil saturated grainstones are a producing target in analog field.

Pursuing same target to the North. We see continuity of reservoir presence based on seismic data and well logs.

Grainstones encountered in analog fields.

Primary Target reservoir in AOI.
Seismic Line Parallel to Shelf Edge

- Abo top shows good seismic continuity.
  - Internal seismic character challenging to map.
- Several well penetrations in the southern part of the trend.
- Lack of deep well control along Abo trend.
Reservoir Development is the main Geologic Risk.
Prospect Results

- Geologic success.
- Still assessing play potential.

**Upper Abo – Main Target**

- Other intervals with oil shows found by Drilled Prospect

### Reservoir Trend Map

- **Secondary F. Analog** 2.5 MMBO
- **Shoals Fairway**
- **Drilled Prospect**
- **Producer #1** Cum 150 MBO
- **Producer #2** Cum 198 MBO
- **Primary Analog** 22 MMBO (currently under CO2 flood)

### Drilled Prospect

- **Depth** in ft
  - 6000
  - 7000
  - 8000
  - 9000

- **Parameters**
  - **Gross Thickness**
    - Pre-Drill: 500 ft
    - Post Drill: 583 ft
  - **Net Reservoir**
    - Pre-Drill: 90 - 160 ft
    - Post Drill: 192 ft
  - **AVG Porosity**
    - Pre-Drill: 2 - 4%
    - Post Drill: 5.4%
  - **AVG Permeability**
    - Pre-Drill: <1 md
    - Post Drill: No actual data
  - **AVG SW**
    - Pre-Drill: 40 - 60%
    - Post Drill: 30%
  - **Oil API**
    - Pre-Drill: 31
    - Post Drill: 30

- **Parameters**
  - **Pre-Drill**
  - **Post Drill**
Summary

• Platform areas that were discovered in the 1950’s have been heavily drilled.
  • Integration of all available data including modern seismic should be re-evaluated and it may unveil additional reservoir potential.

• Understanding the regional to sub-regional picture and integrating geoscience and engineering data calibrated with production is key for prospecting.

• It is essential to do field analog studies and understand why they were developed in a specific manner to understand lessons learned and allow for optimized future development.

• All disciplines must work together in performing an integrated evaluation to achieve optimal results.