CSPG Canada's Energy Geoscientists
TOURMALINE OIL CORP.
CORECONFERENCE
16-17 May 2019 • AER Core Research Centre • Calgary, AB
Celebrating 50 Years

A Tale of Two Cores: Control of Basin Geography on Depositional Features and their Signatures in Petrophysical and Geophysical Space from the Midland Basin

Nicole Allen, David Katz, TJ Dewane
Encana, Oil & Gas Co., Denver, CO, USA

Abstract

Over 480 rigs are currently operating in the Permian Basin with Q1 average total oil production of ~4000 MBOPD (U.S. EIA, 2019); thus, the Permian is dwarfing activity in all other North American Basins. This high level of activity in the Permian Basin is a direct result of high quality, oil prone reservoirs close to markets. Operators are employing "occupation" style horizontal drilling and completions accessing multiple horizons from well pads.

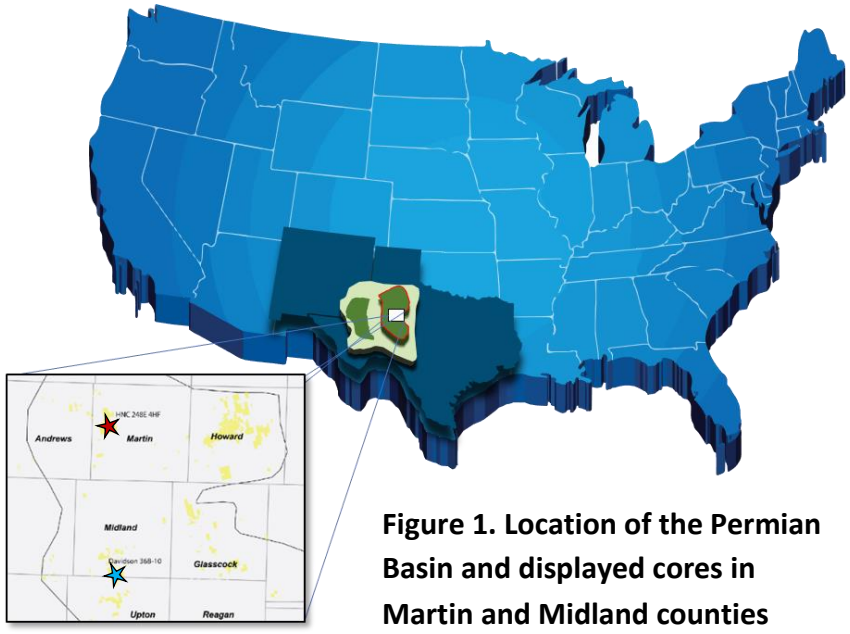

Figure 1. Location of the Permian Basin and displayed cores in Martin and Midland counties

The purpose of this display is to document two primary depositional themes from Midland & Martin county cores (Figure 1): A), interaction of high energy allochthonous carbonate margin and slope derived breccias and turbidites with lower energy autochthonous organic rich silt-to-mudstones of the Wolfcamp and B), lower energy autochonous

organic matter rich silt-to-mudstone variability of the Lower Spraberry. Both end member depositional products manifest similarly in log space yet have significantly different reservoir and mechanical properties. We will examine the control of basin geography on the distribution of these depositional products and related reservoir quality distribution (Figure 1).

Geologic Setting

The Permian Basin of West Texas and Southeast New Mexico is comprised of the Delaware Basin (west), Central Basin Platform (CBP; middle), and Midland Basin (east). During Pennsylvanian and Wolfcampian time both the Delaware and Midland Basins experienced rapid subsidence and the CBP experienced uplift, causing abrupt changes in lithology and thickness of these strata.

The Midland Basin is bound by carbonate margins on most sides: CBP on the west, North Basin Platform, and Eastern Shelf, including the Glasscock Nose. The carbonate shelf and margins developed in Early Permian at the end of intense tectonic movement and widespread siliciclastic sedimentation (U.S. EIA, 2018). Midland Basin Wolfcamp through Spraberry rocks are very heterogeneous, consisting of interbedded clastic and carbonate rocks. Overall, basin geography plays a large role in the resulting lithofacies and reservoir quality.

Core Analysis

Debris flows are evident in both the LWCA and WCC core intervals in Midland county (Figure 2a). Debris flow lithofacies range from allochtonous clasts in martin-derived collapse and/or slope failure to reworked basinal material within allochtonous crinoidal slope-derived debris.

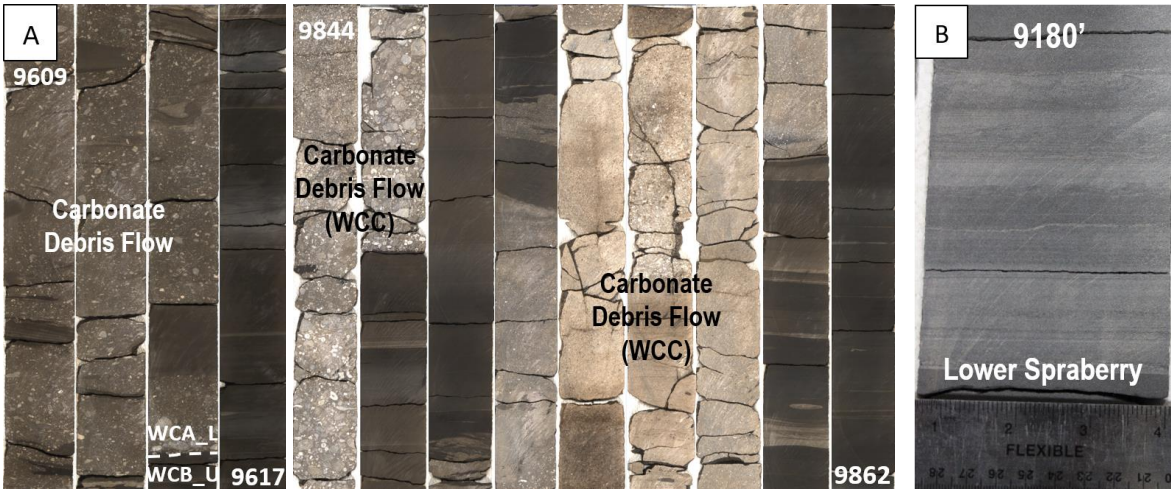

Figure 2. "Transitional" units in log space appear from significantly different depositional environments with varying reservoir and geomechanical properties. (a) Debris flows evident in Midland county LWCA and WCC core intervals (b) Detrital, calcareous silt- to -mudstone form the Lower Spraberry in Martin county.

In contrast, the Lower Spraberry in Martin county lacks any significant debris flows, and geomechanical zones are not always obvious from core (Figure 2b). Bulk log properties or multiple attributes from seismic are often required for mapping these fine-scale differences in carbonate content, grain size, TOC, clastic content, etc.

Both the LWCA/WCC in Midland county and Lower Spraberry in Martin county manifest themselves as “transitional” units in log space but have significantly different geomechanical and reservoir properties. A depositional framework from core can help bring clarity to successfully interpreting log properties.