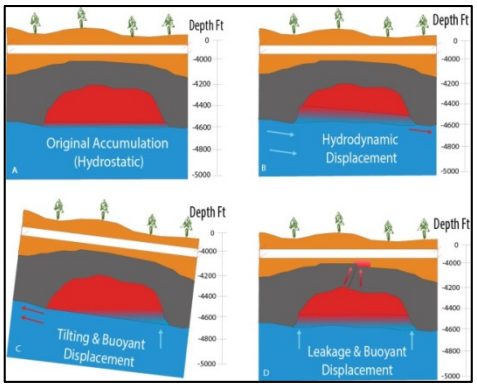
Unconventional EOR: Permian Basin ROZ Analysis

Project Description

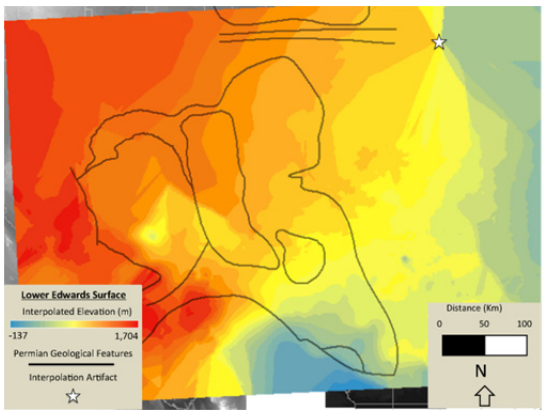
An independent analysis of the genesis and potential distribution of residual oil zones (ROZs) in the Permian Basin was performed to assess qualitatively the potential for a ROZ resource and determine implications for related CO_2 storage. The principal conclusion from the study is that there is widespread potential for ROZ presence and carbon capture use and storage (CCUS) opportunities in the Permian Basin.



Schematic of formation of a residual oil zone (ROZ)

Key Findings

- ROZs are defined as a volume of rock of significant scale into which oil accumulated and was later naturally displaced, leaving behind a low, largely immobile remaining oil saturation.
  - ROZs are predictable at the regional scale according to the principles of buoyancy and hydrodynamics.
  - Transition zones, waste zones, engineered waterfloods, migration pathways, source rocks, etc. are not ROZ.



Present-day elevations of proxy surfaces for pre-tilting sea level show differential regional uplift of ~1,800 m

- ROZs are known to be present in the Permian Basin. Anecdotal evidence used as a basis for the existing theory of ROZ formation via hydrodynamic forces resulting from regional tectonic uplift is largely supported by non-ROZ literature.
- The amount of regional uplift and subsequent hydrodynamic forces are consistent with the thickness of observed ROZs.

Uplift (Δz) & Tilting (Δz/Δx)	Value	Slope m/km
Total Uplift (Δz)	1800m	--
Permian Basin Tilt	0.128°	2.23
San Andres Regional Tilt	0.286°	4.99

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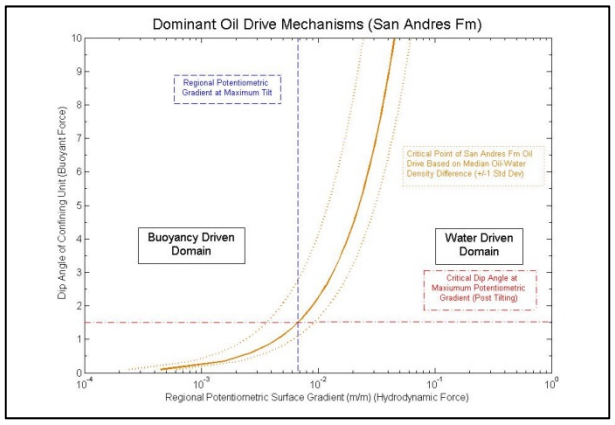
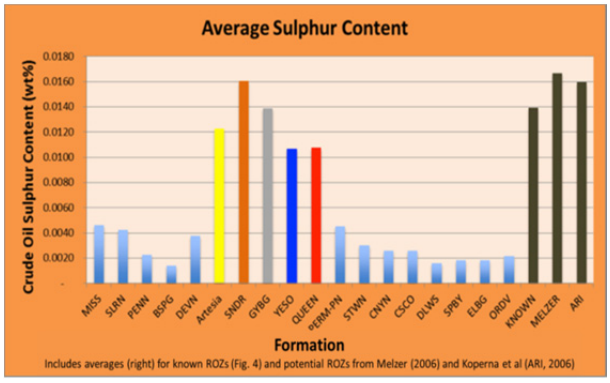
Key Findings (continued)

- Downdip hydrodynamic forces are generally more powerful drivers of oil displacement than are updip buoyant forces.
  - For San Andres structures dipping less than ~1.5°, hydrodynamic forces would be the dominant oil drive mechanism.
  - Most San Andres reservoirs located in shelf edge and shelf interior depositional environments dip <1.5°.



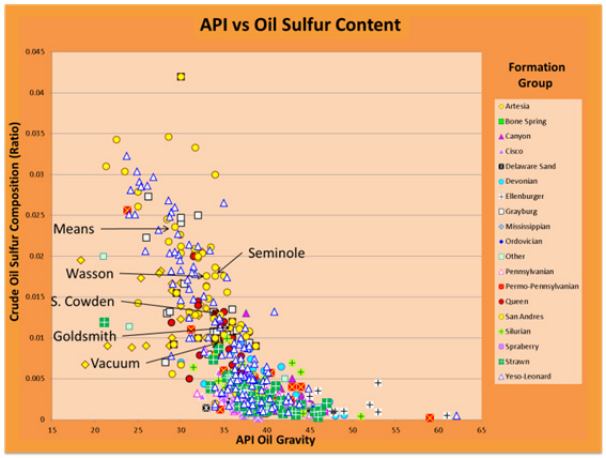
Hydrodynamics dominate buoyancy for oil displacement.

- Proxies indicate widespread potential ROZ presence, both spatially and stratigraphically, in several unexplored areas.

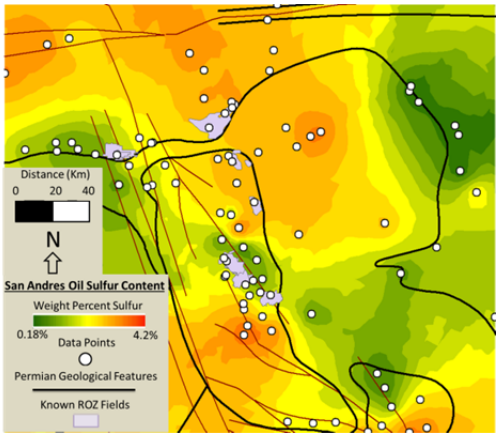


Sulphur content in a number of formations

- Crude oil sulfur content and API are related, viable proxies for potential ROZ presence that are widely available.
  - Crude sulfur and API increase and decrease, respectively, with increasing oil degradation.
  - Oils in ROZs and main reservoir zones of the Permian Basin are known to be biodegraded as a result of interaction with inflowing meteoric waters.



Relationship between API gravity and sulfur content



Distribution of sulfur in the Permian Basin.

- The ROZ resource in the Permian Basin may be larger than previously estimated.

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