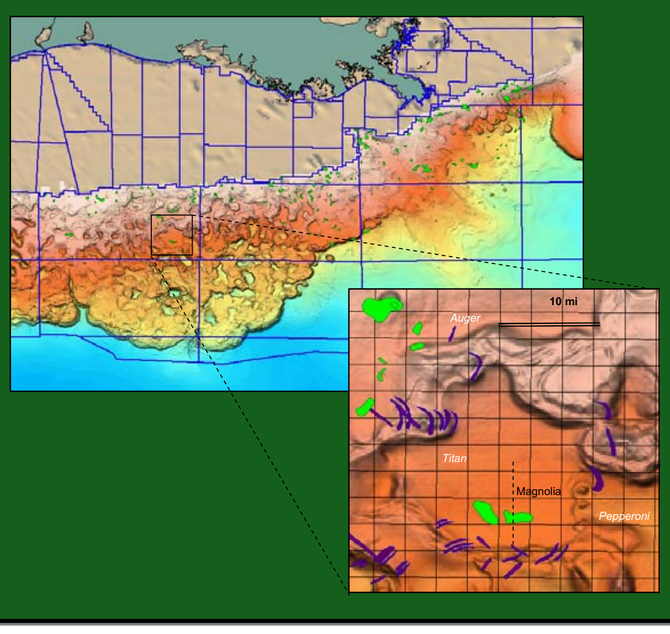
Case Study – Empirical Fluid Property Predictions

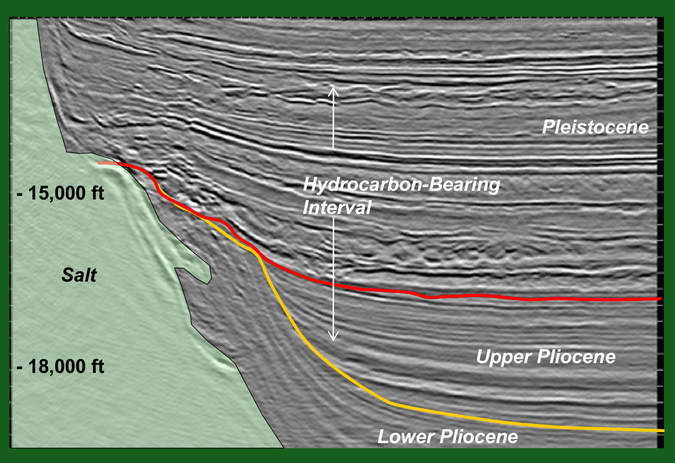
"Fluid properties, phase and compartmentalization: Magnolia Field case study, Deepwater Gulf of Mexico, USA" *

This study shows how field-specific empirical correlations were developed that allowed fluid properties to be predicted away from sample control. Using similar integrated approaches, OilTracers LLC can help you plan and interpret exploration, appraisal and development geochemical programs.

Magnolia Field setting

- Discovered 1999 by ConocoPhillips
- Pliocene & Pleistocene age
- Combination structural/stratigraphic
- Submarine channels & sheet sands
- Temperature 130 – 165°F
- Pressure 2200 – 5400 psi > hydrostatic
- Sedimentation rates ~3500 ft/Ma
- Unconsolidated fine-grained sand to silt

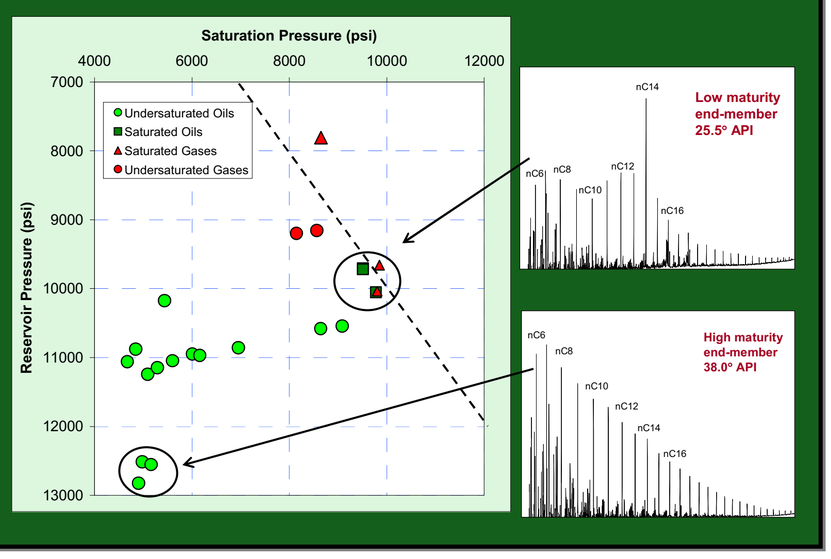




The problem: a perplexing variation of fluid properties

- Saturated oil, saturated gas & oils and gases of all degrees of undersaturation
- Gasoline range components, biomarkers & gas isotopes indicate charge by a common source rock at different levels of maturity

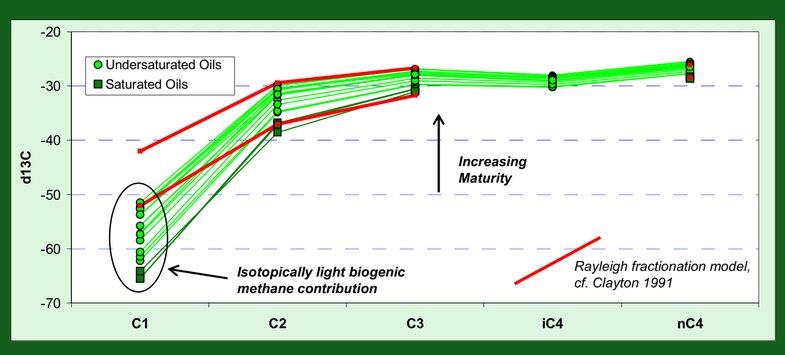
Psat versus Pres



Elements of a successful fluid property prediction program

- Fully characterize the molecular and physical attributes of petroleum samples obtained from exploration and appraisal wells
- Integrate these data with other geological and engineering data
- Include field-specific empirical approaches in their interpretation

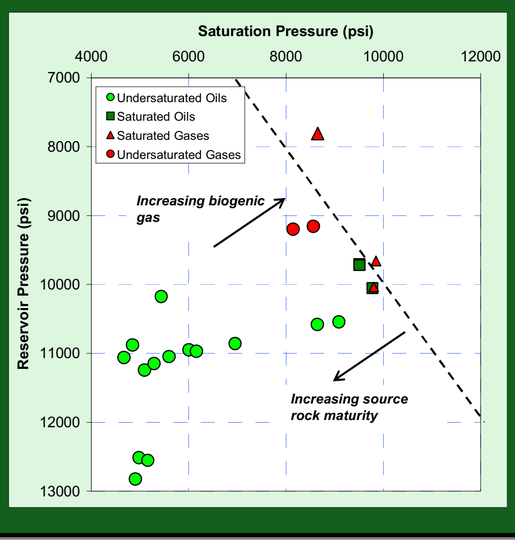
Associated gas isotope profiles of test oils



Controls of fluid properties

- However, source rock maturity alone does not account for the range of fluid properties observed
- Thermogenic fluids of varying maturity have mixed with biogenic gas
- Saturation state and fluid density controlled by source rock maturity + biogenic C_1

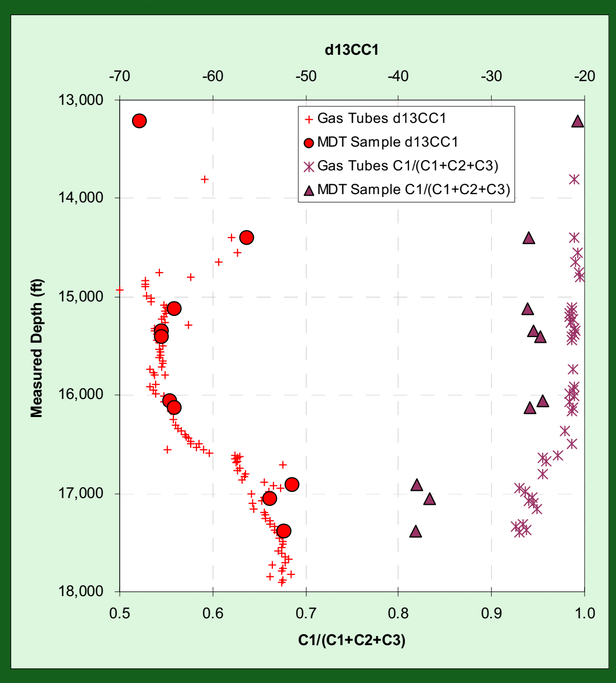
Psat versus Pres



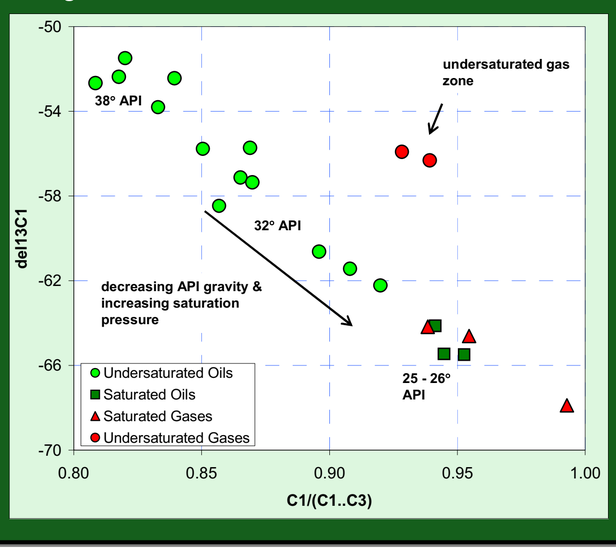
Predicting fluid properties in under-sampled zones

- This observation can be exploited and used to help predict fluid properties by integrating mud gas data
- At Magnolia, mud gas compositions are always drier than gas composition from corresponding MDT samples, however,
- Mud gas methane carbon isotopes perfectly match those of MDT samples, $R^2 = 0.98$
- Methane carbon isotopic composition and gas dryness of associated and free gases correlate with
  - Fluid maturity
  - Methane content
- These, in turn, correlate with
  - Phase properties
  - API, TAN, S, viscosity
- In zones of sparsely or ambiguously sampled fluids, mud gas composition and isotopic information can be used to predict the properties of reservoir fluids

Depth profiles showing gas composition and $\delta^{13}C_1$ from mud gas (IsoTube) samples against those of associated gases from MDT samples



Dryness versus $\delta^{13}C_1$ of Magnolia Field associated and free gas



* from Weissenburger, K.S. & T. Borbas, 2004, In: J.M. Cubitt, W.A. England & S. Larter (eds), Understanding Petroleum Reservoirs: Towards an Integrated Reservoir Engineering and Geochemical Approach. Geological Society, London, Special Publications, 237, 231-255.

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