Some Exploration problems that are worth solving......

My focus today will be on:

- Exploring effectively and efficiently onshore
 ✓ using satellite and UAVs
- Solving the "cloud of points" problem
 ✓ using multi-variate Analytics
- Improving sub-surface interpretation, especially but not only, with seismic
 × not yet utilising Machine Learning

Satellites and UAVs: Structure & Geomorphology



Satellites and UAVs: Micro-Seeps

Vertical Migration – Microseepage: Impacts oxygen levels in near surface

- > Rocks/soil: mineralization; colour changes
- Stresses vegetation

Four possible mechanisms:

1) Diffusion - gradient movement of dissolved gases

- 2) Aqueous transport movement in ascending water
- 3) Continuous gas phase flow
- Favoured mechanism:
- 4) Microbuoyancy transport in buoyant microbubbles

Klusman, R.W., and M.A. Saeed, 1996, Comparison of light hydrocarbon microseepage mechanisms, in D. Schumacher and M.A. Abrams, eds., Hydrocarbon migration and its near-surface expression: AAPG Memoir 66, pp. 157-168.

Brown, A., 2000, Evaluation of possible gas microseepage mechanisms, AAPG Bulletin, pp. 1775-1789.

"Vertical Migration Mechanisms"





Satellites and UAVs: Micro-Seeps



Sub-surface limits of pyrite mineralisation near Velma Field, Stephens County, Oklahoma. (from AAPG Memoir 66, D. Schumacher)

Satellites and UAVs: Gravity (especially FTG)





Ciezkowice sandstone IV

Petromall Ltd • lower istebna beds

permeability (md)

21/11/2016

Ciezkowice sandstone II

"Cloud of Points"

What's going on here?

Some options:

- The data is poor quality, poor logs, poor lab work etc?
- 2. There is a whole lot more going on than a straightforward correlation between porosity and permeability?

"Cloud of Points": Traditional Methods Need Improvement

Standard Existing Approach

1. Legacy tools unable to cope with modern, complex data

- 2. Conventional XY scatter plots reveal weak correlations
- 1. Trial & error strategies failing to maximize profitability
- 2. Slow well design workflows drive volatile uniform development _____ 1. Tailored, well-specific AFE preparation and evaluation
- 1. High risk of inflated/deflated asset valuations

Opportunity for OAG Upside

- 1. Extract over 50% more signal from noisy data
- 2. Machine learning enables correlations via dimensionality reduction
- 1. Data-driven insights drive value: ↑ 5% profit, ↓ \$400k per well
- 1. 20% more accurate asset valuations in hours not days





Obsolete techniques for today's complex data

OAG Analytics + Your Experts = Actionable Insights

"Cloud of Points": How it Works

Proprietary Algorithm

- 1. Enables 1000s of computers to work in parallel, approaching a Turing Complete analysis
- 2. Integrates multiple machine learning models to deliver unprecedented accuracy & dimensionality reduction
- 3. Optimizes RMSE for understanding production drivers in unconventional reservoirs



Purpose Built Workflow

- 1. Configurable modules ensures tailored approach to each client
- 2. Pre-loaded set of graphical tools create analysis transparency and enable experts to make decision
- Securely hosted off prem => up and running in hours with no capital outlay



Translates machine understanding to human understanding

Isolate the impact of each parameter on production

Sub-surface Interpretation: Rule-Driven!



Sub-surface Interpretation: Rule-Driven....sometimes!





This project is a collabortaion between Glasgow University and Midland Valley Exploration.

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Some progress, much to do; the "Big Prize" awaits...