"Satisfying the Requirement for Establishing Reliable Technology. Does the argument meet the criteria?"

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What is Reliable Technology?

- SEC "Final Rule" (Dec 2008) defines...

  "(25) <u>Reliable technology.</u> Reliable technology is a grouping of one or more technologies (including computational methods) that has been field tested and has been demonstrated to provide reasonably certain results with consistency and repeatability in the formation being evaluated or in an analogous formation."

Where does the SEC mention R.T.?

SEC "Final Rule" notes R.T. can be used to:

- Define phase contacts (e.g., LKO, HKO) or other accumulation limits

  - Ref: Paragraphs 17 (Possible), 22 (Proved)

- Define Proved area away from well control

  - Ref: Paragraph 31 (Undeveloped reserves)

- Qualify Improved Recovery Techniques

  - Ref: Paragraphs 22 (Proved), 31 (Undeveloped reserves)

How to "demonstrate"?
What procedure to use?

What standard meets SEC criteria?*

- The technical community uses "the scientific method"

- The US legal community accepts this
  - US Federal Rules of Evidence (Rule 702) and subsequent US Supreme Court interpretation

* See SPEE Annual Meeting Presentation of 6 June 2011 on Reliable Technology; Also SPE papers # 129689 & 134237 by Rod Sidle and Dr. John Lee

Scientific Method: Steps

1. Define the question

2. Research the question and formulate a hypothesis (define the theoretical science behind your R.T.)

3. Perform experiments; collect and analyze the data (test your R.T.)

4. Interpret data; draw conclusions; document results

5. If necessary, revise hypothesis and repeat steps 3 and 4

Example 1 – 3 New PUD's

The Company is S.E.C. registered and files a yearly 20-F.

The Company is using a project definition process that has followed a method of utilizing many disciplines, data, and interpretation that has been successful multiple times.

The Company has defined, approved, scheduled, funded, and contracted 3 offshore well locations that will be drilled in 3rd and 4th quarters, 2018.

The Company believes that a Reliable Technology has been established and books 1P PUD reserves.
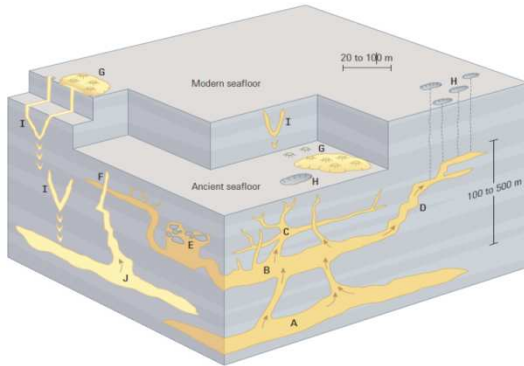
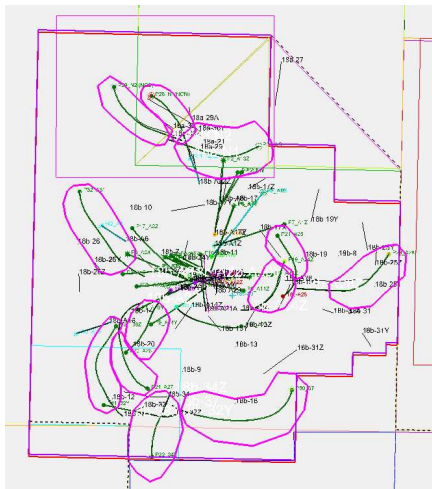Can the requirements for Proved Reserves be satisfied?

From 2014 SPEE Paper:
Reliable Technology for Reserves Estimation in Offshore Horizontal Development Wells, UK North Sea Turbidites
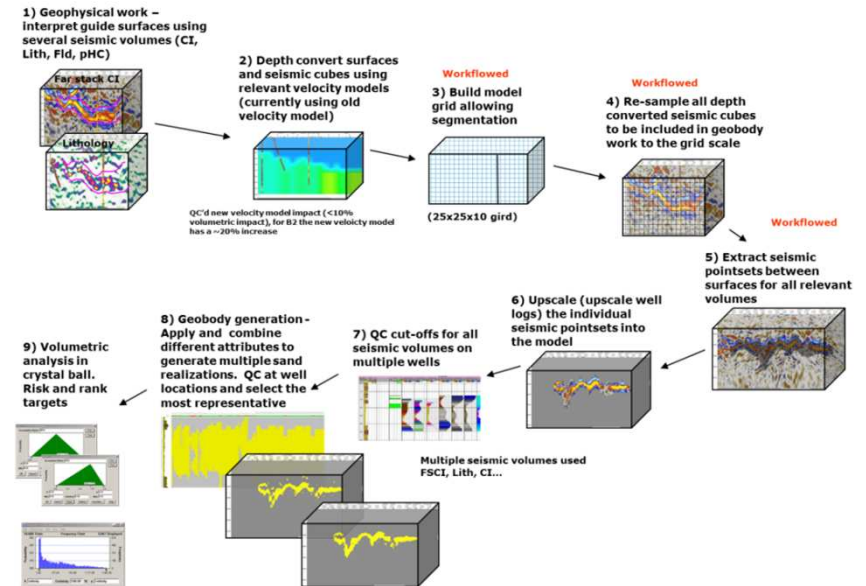
Work Flow to Define Project

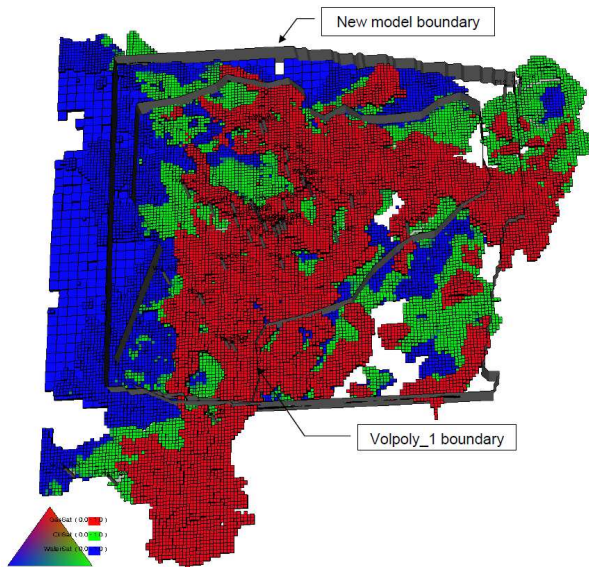## The Target
Injected Bodies above Main Sand

The Technology
Tried and True

The Outcome
Over Several Years

Observations

"reservoir" ➔ 'A subsurface rock formation containing an individual and separate natural accumulation of moveable petroleum that is confined by impermeable rocks/formations and is characterized by a single-pressure system.

Large Contiguous Area ✓
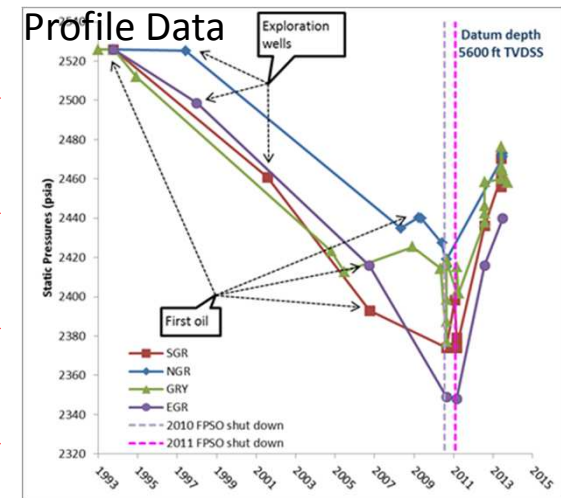
Areal Gas Cap ✓

Areal Aquifer ✓

Same PVT Regime ✓

Same Petrophysics ✓

4D Seismic contact surveillance ✓
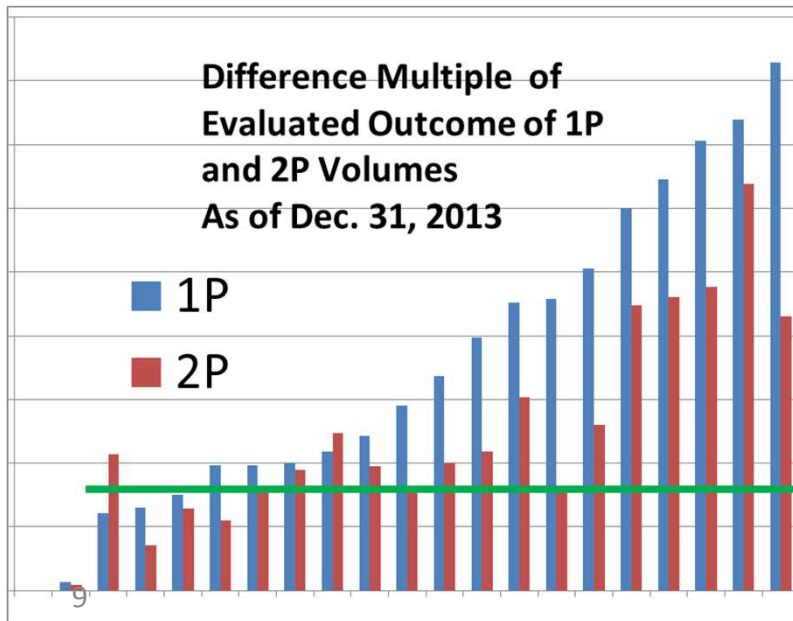
Areal Pressure Behavior ✓

Static Reservoir Pressure Profile Data

The Company Asserts

Discovered ✓

Recoverable ✓

Remaining ✓

Commercial ✓

The Statistics of Economic Success

=

20 of 23

Does 87% Success Suggest Reasonable Certainty?

Difference Multiple of Evaluated Outcome of 1P and 2P Volumes As of Dec. 31, 2013

■ 1P
■ 2P

Ratios of reserves @ 5-years + as compared to original estimate is significantly above 1.0
**Thus?**

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Reliable Technology – Can it do everything?

- Can one single RT satisfy all requirements for PUD reserves?.....including:
  - Discovery
  - Economically Producible
  - Volumetric Data (H, S_o, ϕ, Bo, A)
  - Recovery Factor
- Here we seem to be asking our RT to do all of this…….

The RT for "discovery" is drilling……

Recall the SEC requirement*:

"Reserves should not be assigned to adjacent reservoirs isolated by major, potentially sealing, faults until those reservoirs are penetrated and evaluated as economically producible. Reserves should not be assigned to areas that are clearly separated from a known accumulation by a non-productive reservoir (*i.e.*, absence of reservoir, structurally low reservoir, or negative test results). Such areas may contain prospective resources (*i.e.*, potentially recoverable resources from undiscovered accumulations)."
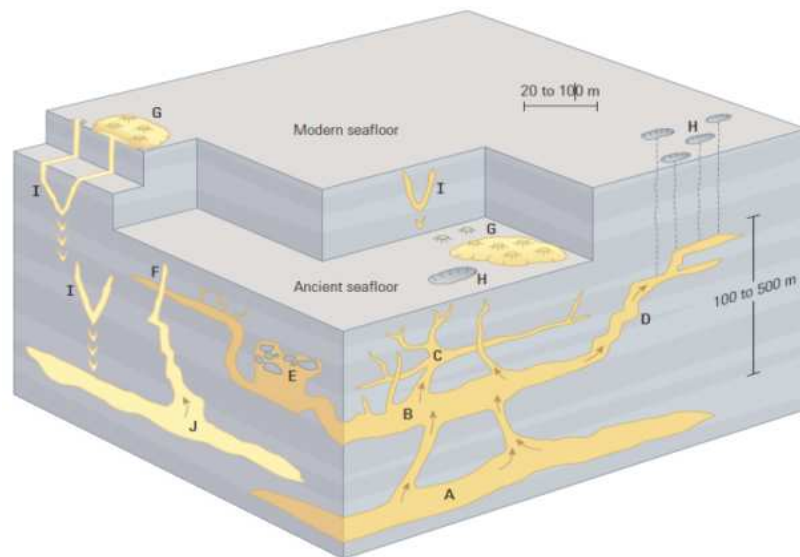
* SEC "Reserves" definition, note to paragraph a(26)

Example 2 – 6 New PUD's

Consider a SEC-registrant Company that…
- is developing an undrilled area of a heavily drilled area in the Bakken unconventional trend;

- has contracted a rig, has partner AFE approval, has received permits and plans to drill wells in the 2nd quarter of 2016.

Based on the Reliable Technology of combined geological modeling and statistical analysis (from surrounding analogue success), the Company books PUD reserves.

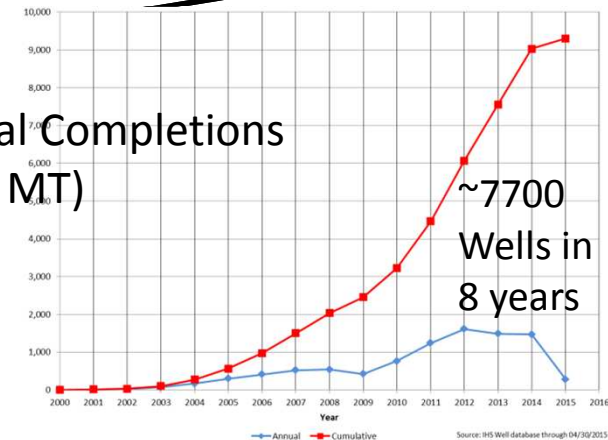❑ Have the requirements for Proved Reserves been satisfied?
      (Proved Area is greater than one DSU)

❑ Will the one spacing unit offset rule of the SEC overrule the RT argument?

The Project

**Six Years of History
Hundreds of Successful
Completions**

Area For Development

T147N-R95W   T147N-R94W

SYMBOL HIGHLIGHT
BAKKEN
THREE FORKS
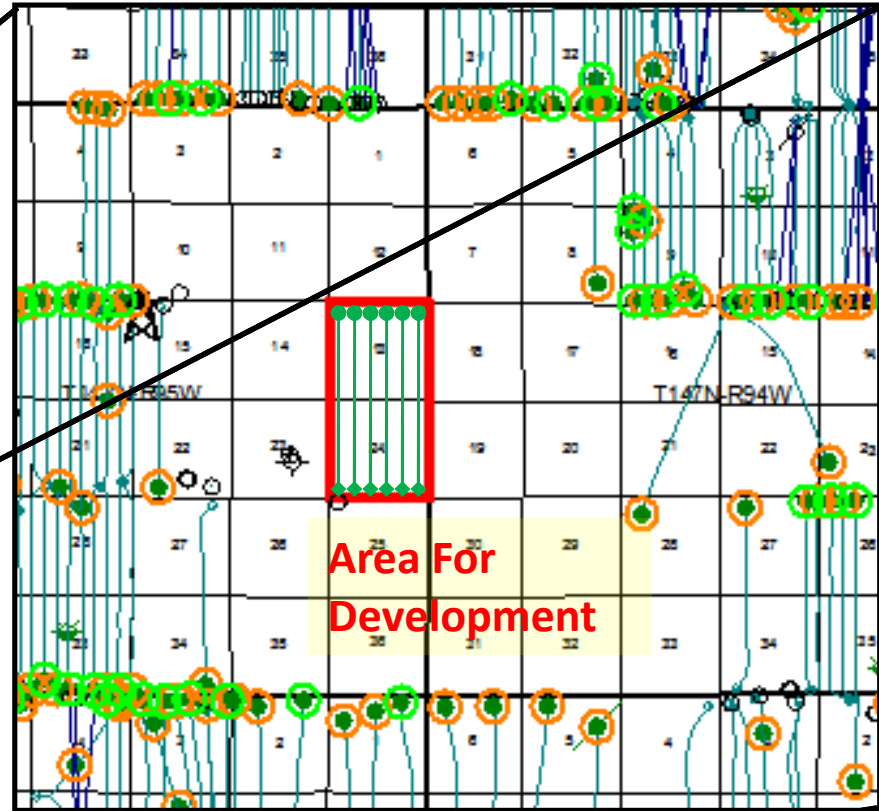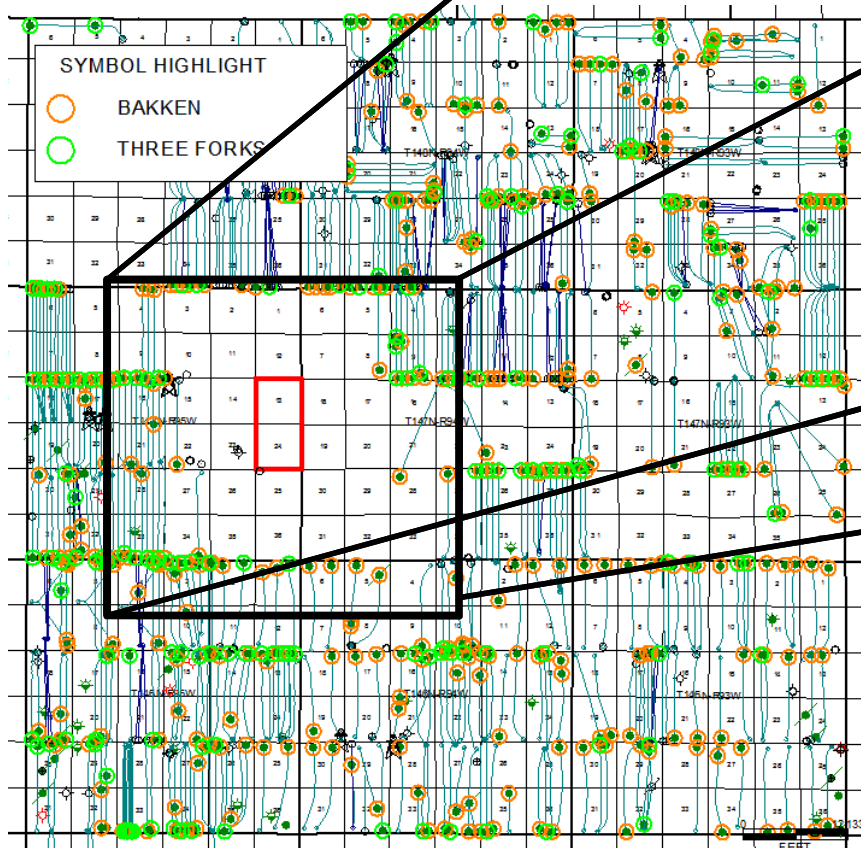
Bakken Horizontal Completions
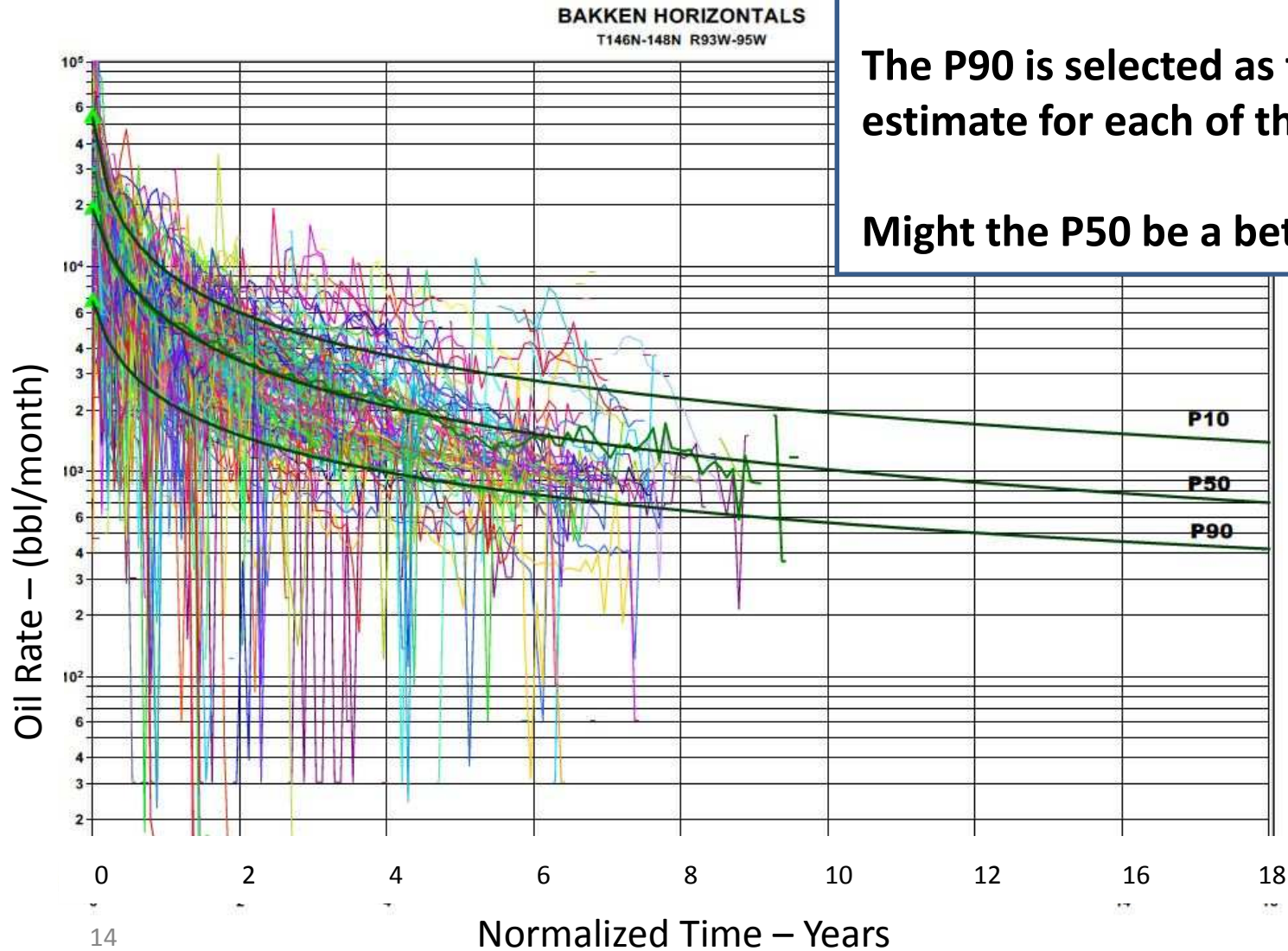(ND & MT)

~7700
Wells in
8 years

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The Observation And Expectation

500 wells used in development of type curve

The P90 is selected as the Proved estimate for each of the six wells

Might the P50 be a better estimate ?

BAKKEN HORIZONTALS
T146N-148N R93W-95W

Oil Rate – (bbl/month)

P10

P50

P90

Normalized Time – Years

The Company Asserts Historical Economic Success

Over 700 horizontal wells in this area

500 wells used in development of type curve

Demonstrated Repeatability

Drilling Spacing Unit Permitted

Discovered ✓

The reservoir is continuous

Recoverable ✓

Remaining ✓

Large Contiguous Area ✓

Commercial ✓

Same PVT Regime ✓

Same Petrophysics ✓

Statistics, Observations, Economics

Unconventional Pressure Regime ✓

Has the Company satisfied the RT requirement for Unconventional Reservoir Horizontal Well Development ?

Summary

Thoughtfully consider the challenges your proposed Reliable Technology must overcome to satisfy the requirements.

The key question is not "can I show how it could work", it is "can I show how it could fail and then show it does not fail".

A tough challenge but clearly doable!

Easier – simple, continuous geology and focus on one element of reserves estimation (e.g., Proved Area)

Harder – complex, discontinuous geology with intent to capture all reserves estimation data with one technology
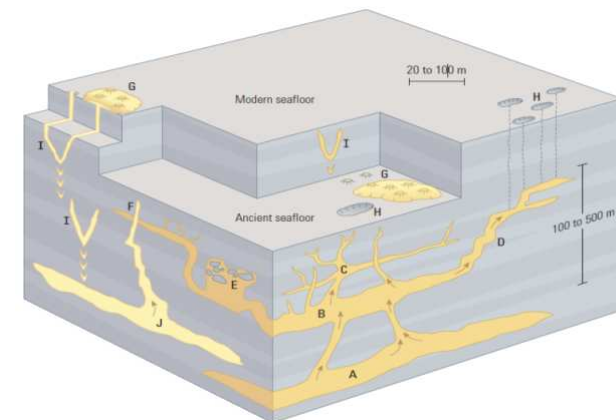
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Thank you,
Any Questions?

Leslie O'Conner, Rod Sidle, Richard Smith

Back-up Slide

Reliable Technology – Level of Complexity for Qualification

One example: a simple geologic model with typical static value and dynamic uncertainties

Consider SEC noted applications:
1. LKO (e.g., downdip saturation)
2. Proved Area (e.g., more than one offset away)
3. EOR Recovery Factor

Areal extent of measured values

Broad Area

Localized

Direct   Proximal   Remote

Where the measurement is made

Static

Dynamic

Timeframe of measured values

Least complex at the original; Increased complexity in any positive direction away from origin