AVOID THE IRRESISTIBLE

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London

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Spot the difference.

Outline

- Challenges to exploration performance and value creation
- Impact of CSEM in exploration uncertainty
- Performance of CSEM in prospect evaluation
- Challenges to the application of CSEM and value realization

Value of exploration

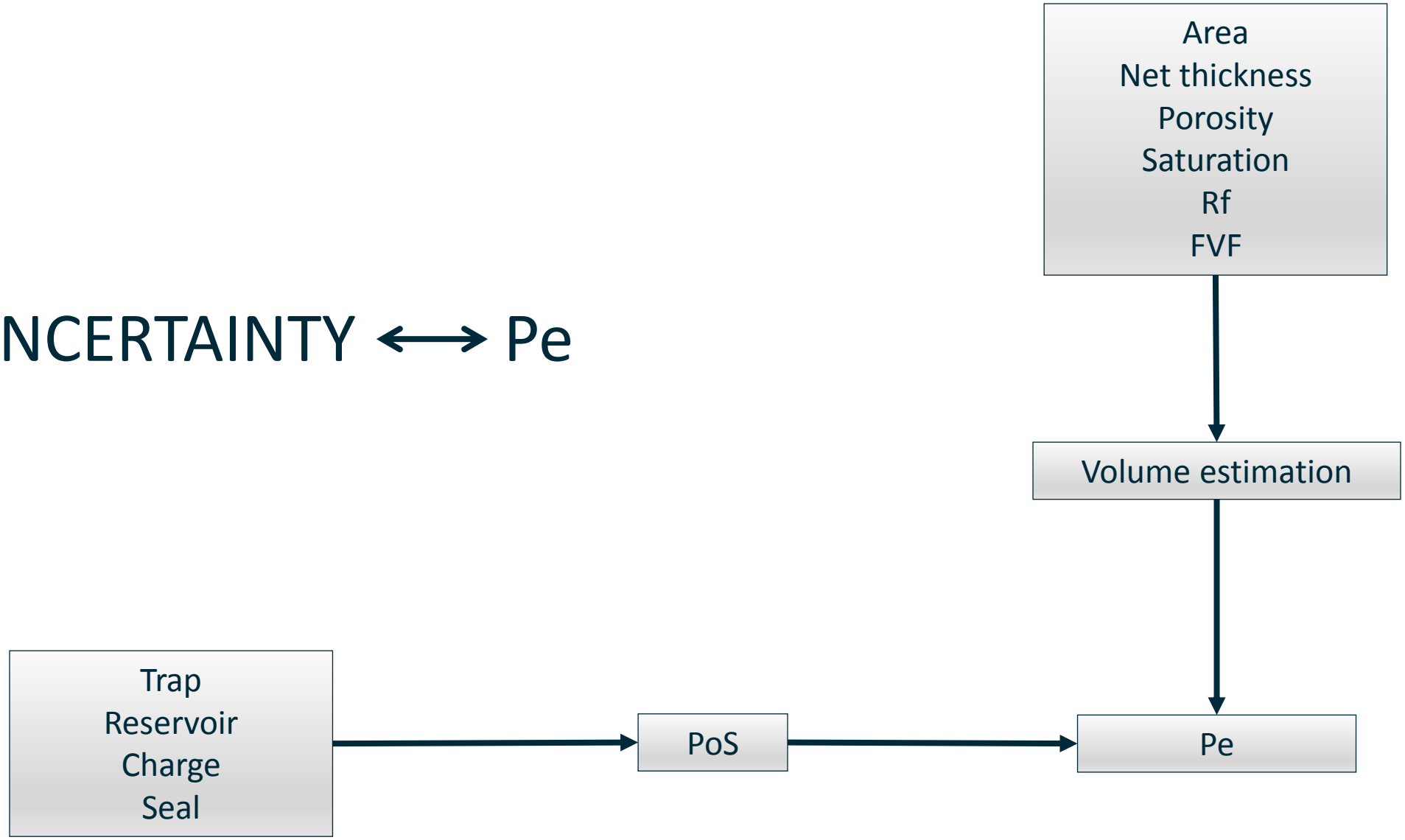
$$\mathbf{Vexp} = \underbrace{\mathbf{NPVe\ Pe}}_{\text{Gains term}} - \underbrace{(\mathbf{1} - \mathbf{Pe})\mathbf{Cexp}}_{\text{Losses term}}$$

Vexp is Value of Exploration
NPVe is the average Net Present Value of an economic success
Pe is the probability of an economic success
Cexp is the Cost of Exploration

- Pe is the main Value of Exploration driver

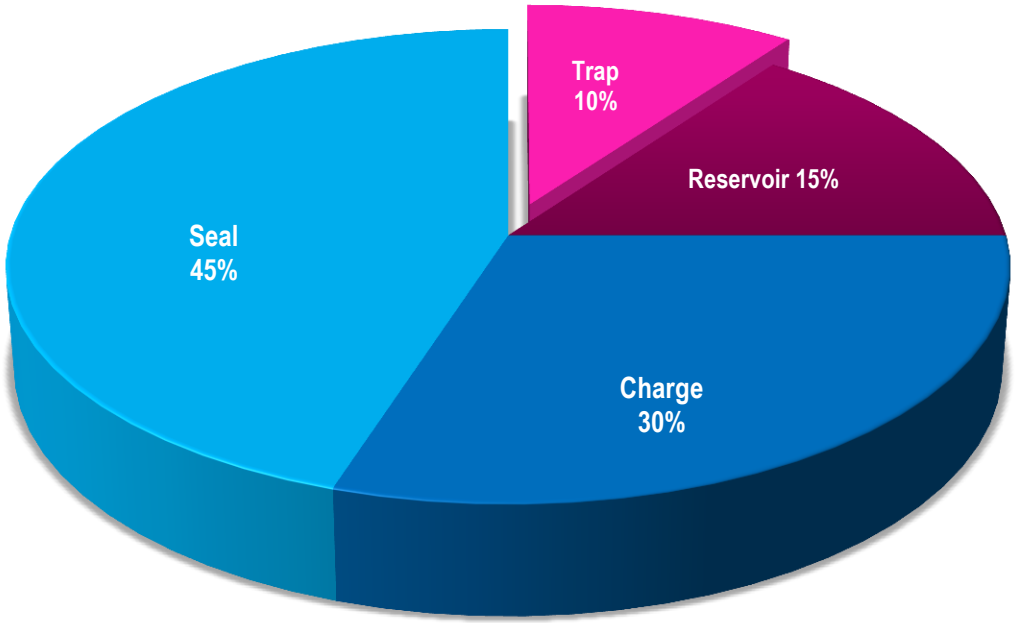
Evaluation workflow

UNCERTAINTY ⟷ Pe



A better exploration outcome

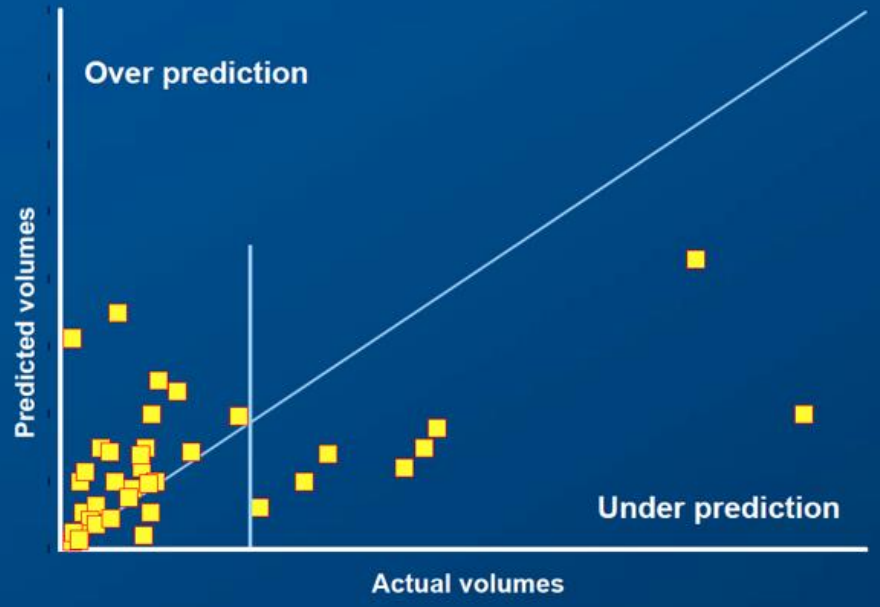
Typical exploration failures: most failures are due to the fluid component



PORTFOLIO VS PROSPECT

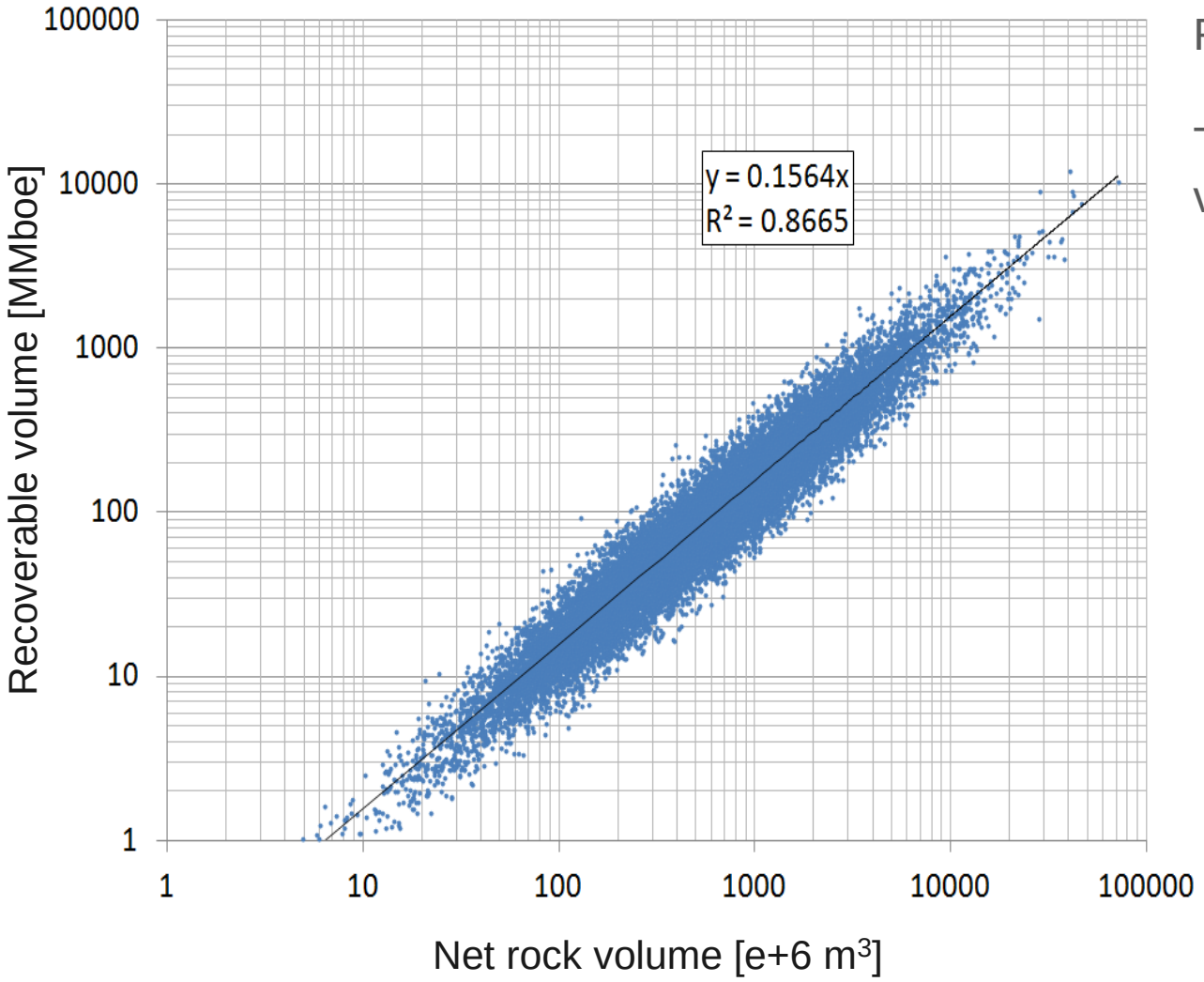
Prediction Performance

Gulf of Mexico, Amplitude Supported Plays



- Prediction capability limited on an individual prospect basis
- Large fields have been systematically under predicted (Mars Basin)
- Small fields have been systematically over predicted (creaming effect)

VOLUME ESTIMATION UNCERTAINTY



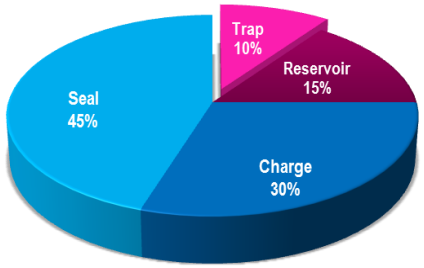
RV = NRV Φ Shc Rf / FVF

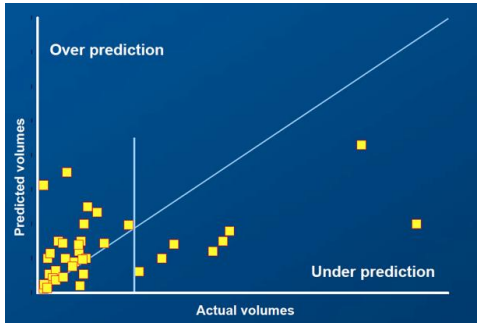
The net rock volume is the main source of recoverable volume uncertainty

Decision making under uncertainty

Pe ~ 5-50%

Can EM do something to improve this?





Area
Net thickness
Porosity
Saturation
Rf
FVF

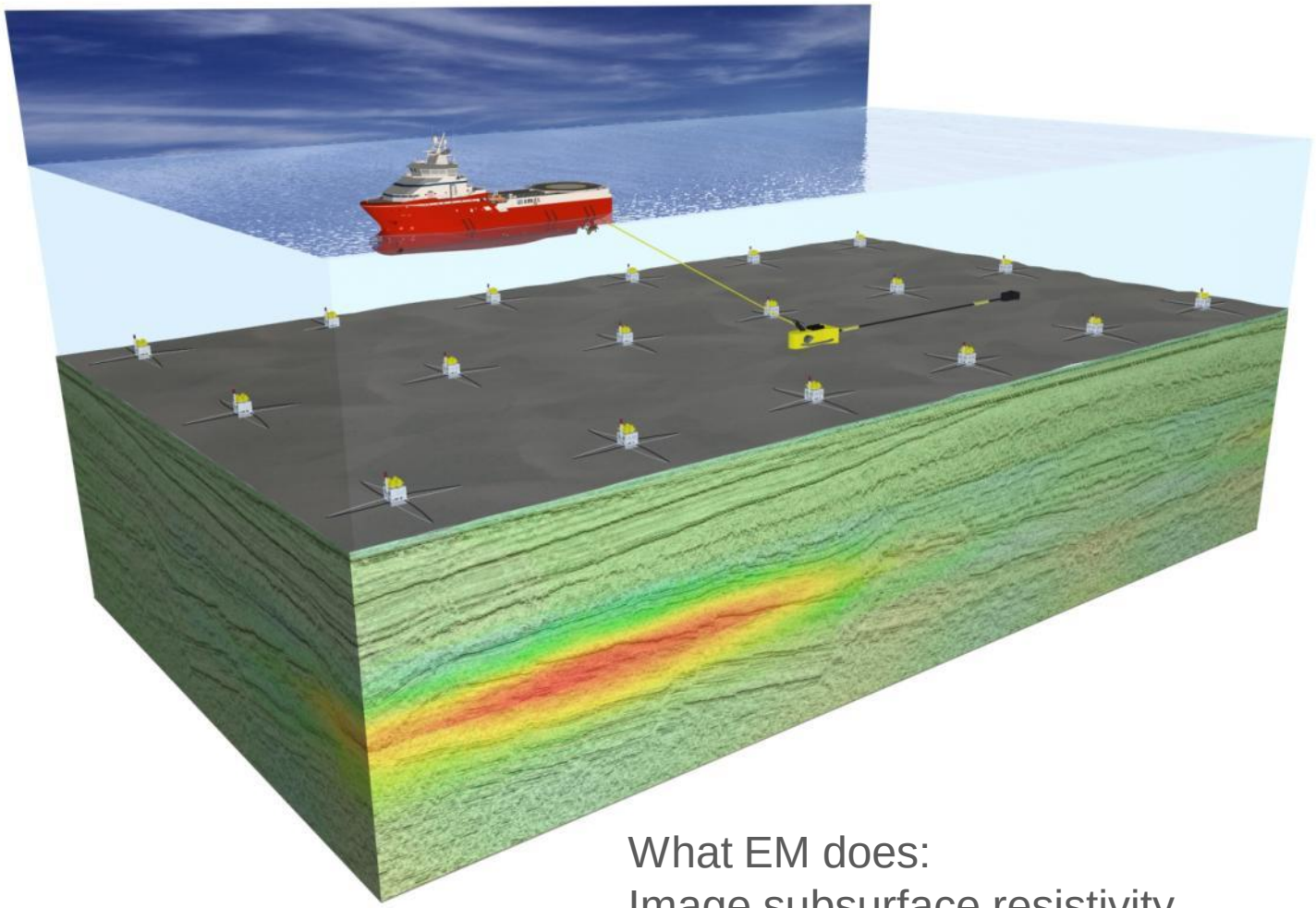
Volume estimation

Trap
Reservoir
Charge
Seal

PoS

Pe

3D EM TECHNOLOGY

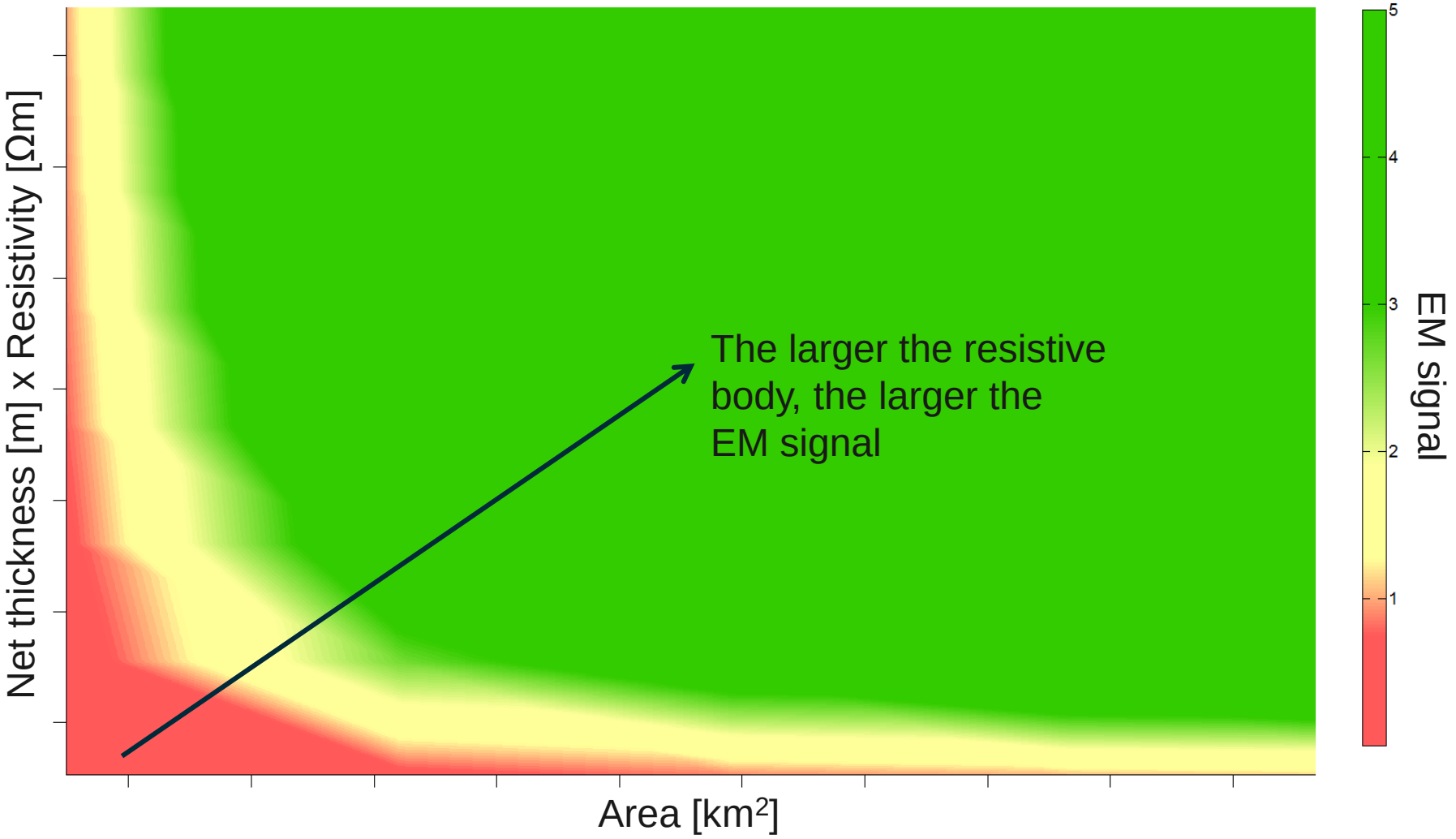


Acquisition
Water depth
20 – 3500m

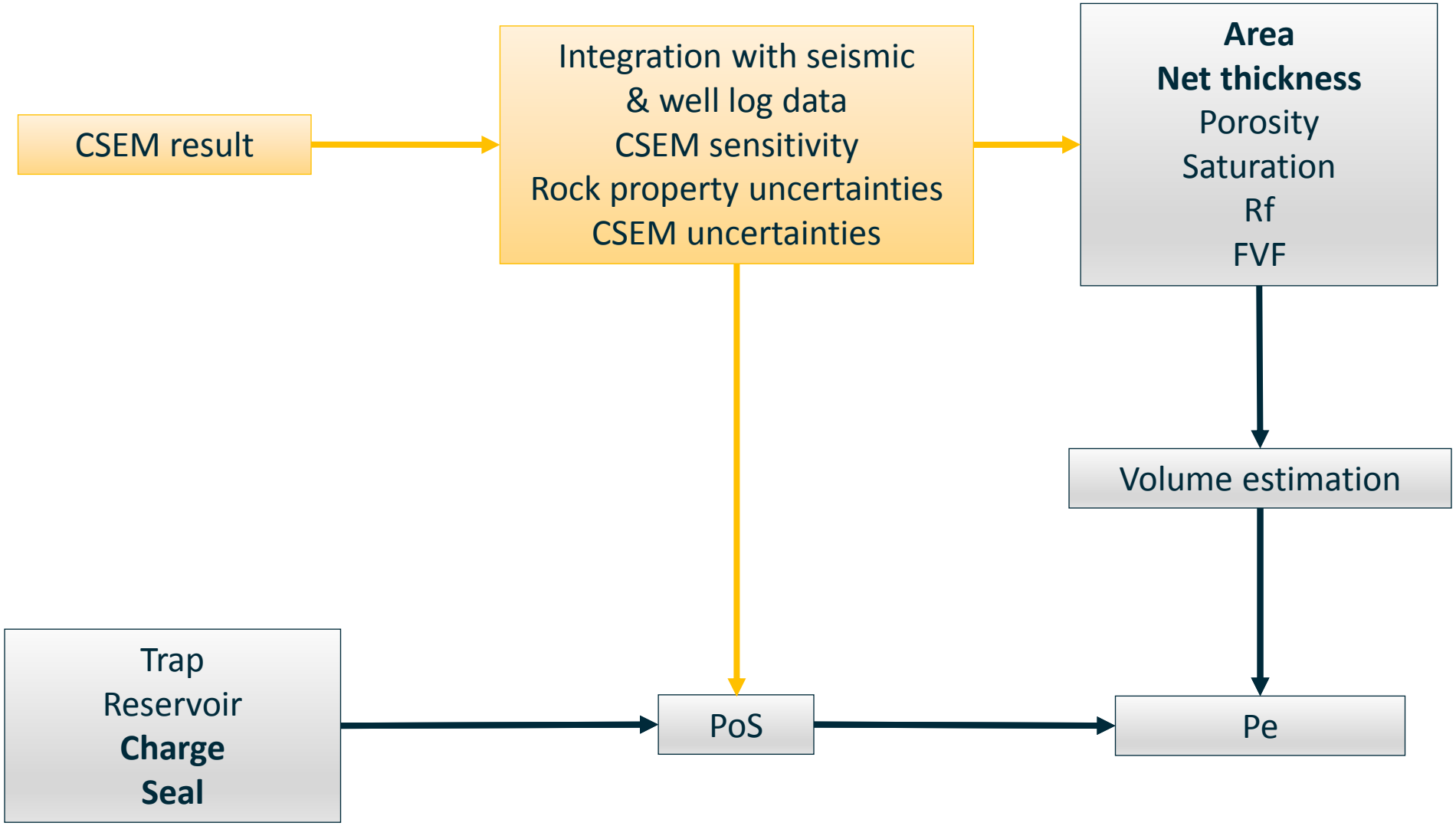
CSEM
Measurement
Sensitivity
0 – 3500m

What EM does:
Image subsurface resistivity

CSEM SENSITIVITY FOR A SPECIFIC TARGET

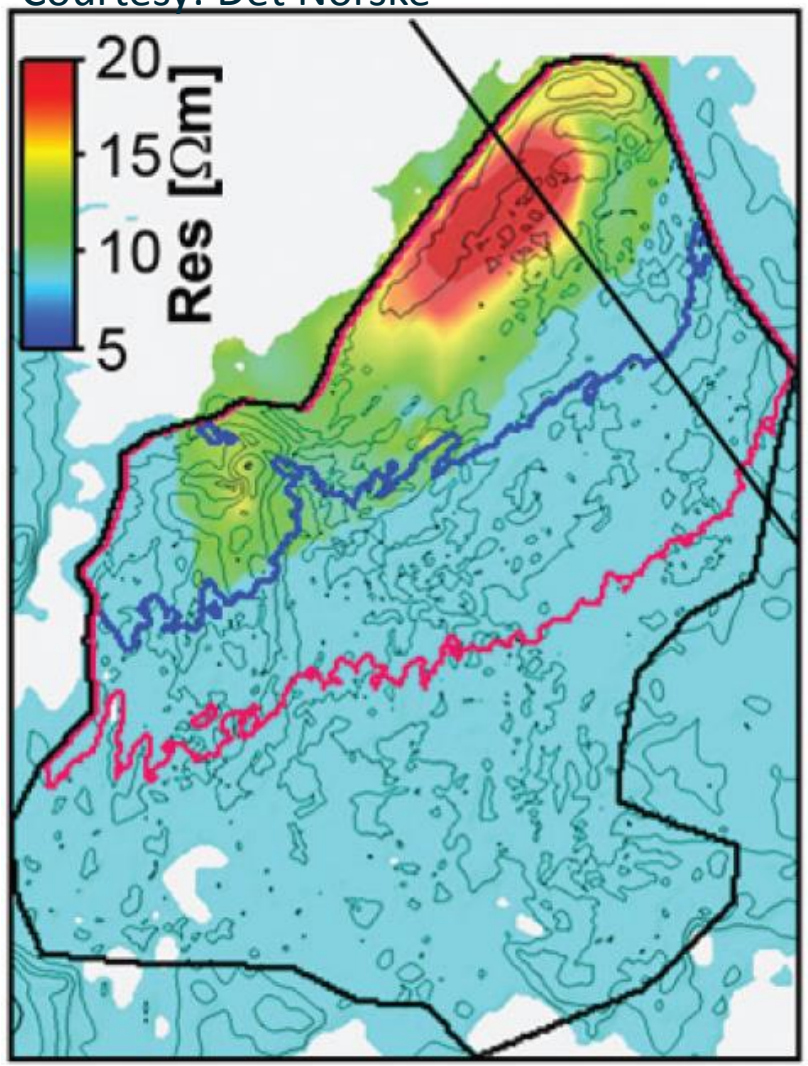


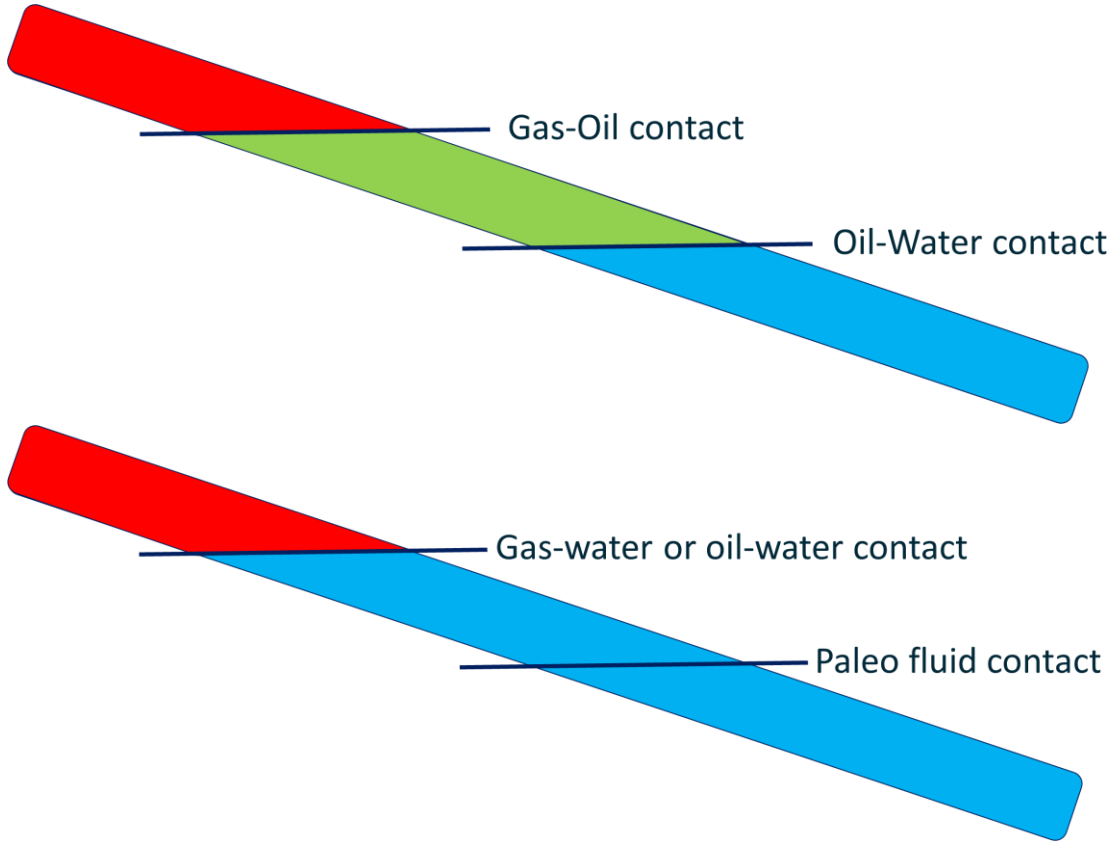
Decision making under uncertainty



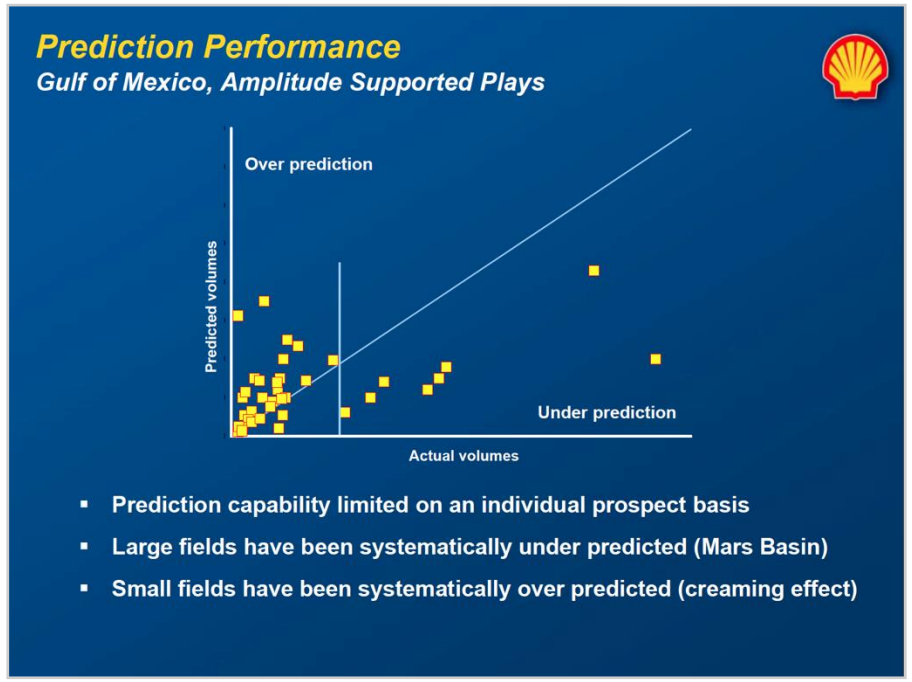
Barents Sea example

Courtesy: Det Norske

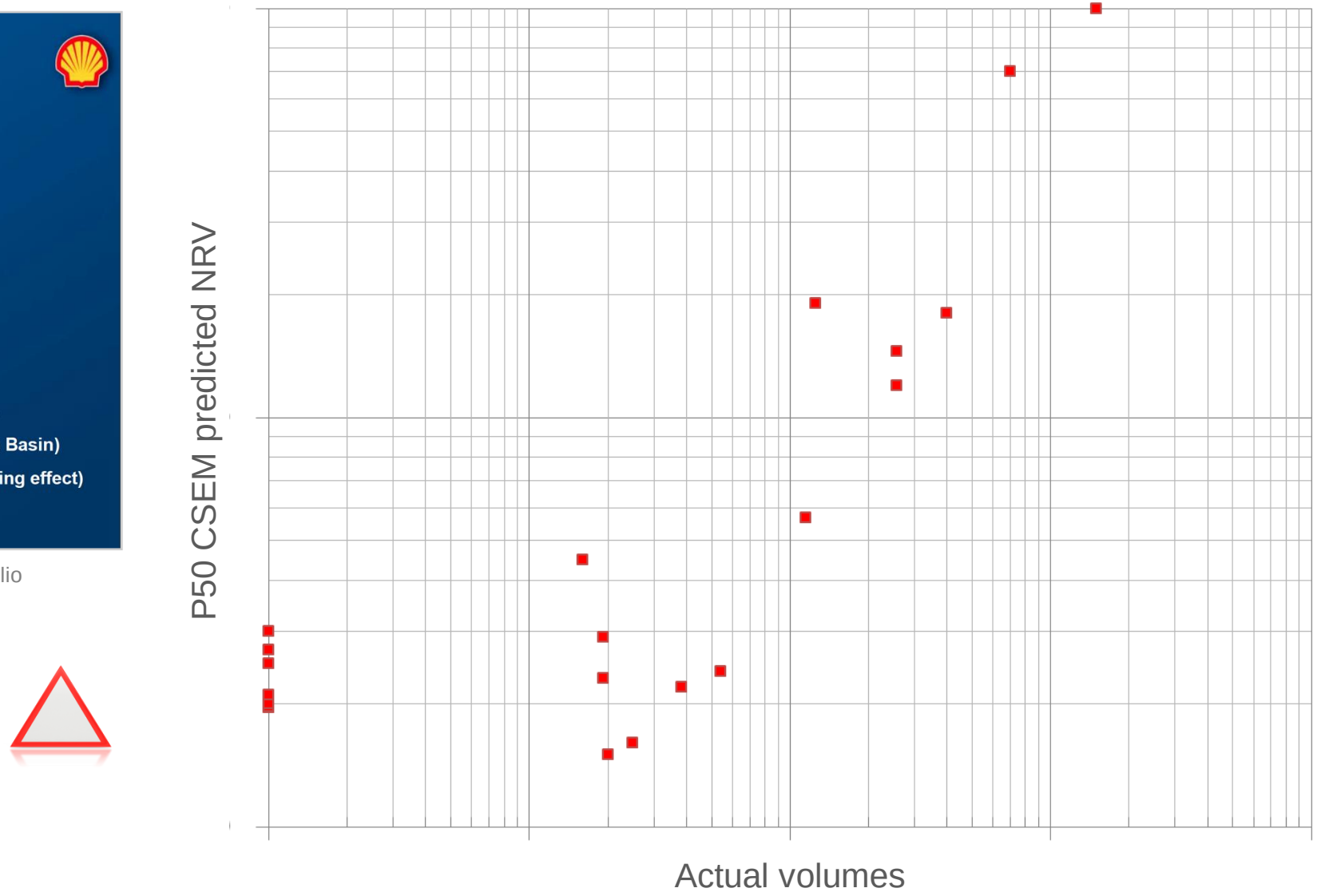




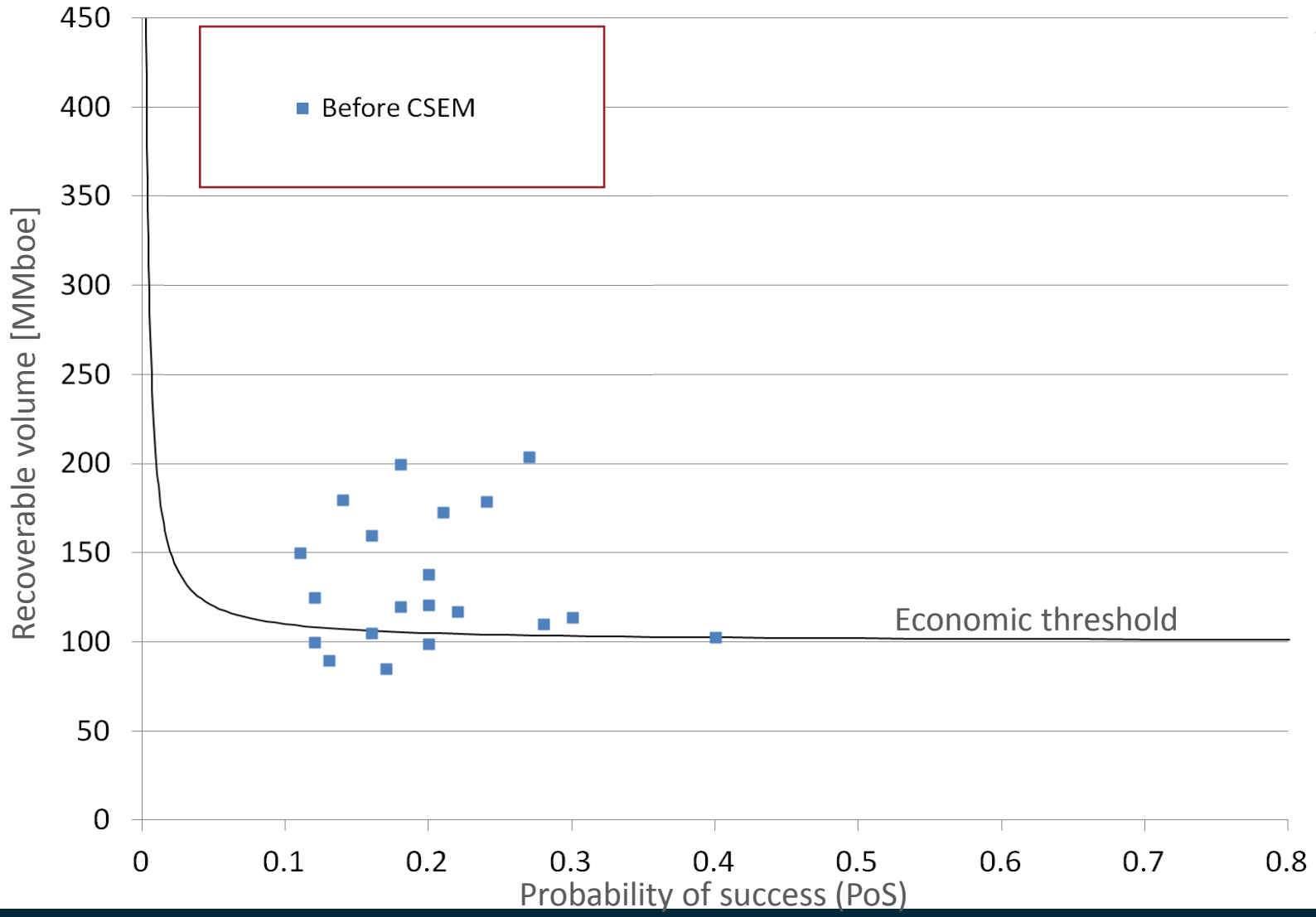
Volume prediction with CSEM



Do we need exploration to optimize EP portfolios? IQPC Portfolio Optimization in Oil and Gas, Houston, TX, February 2004.

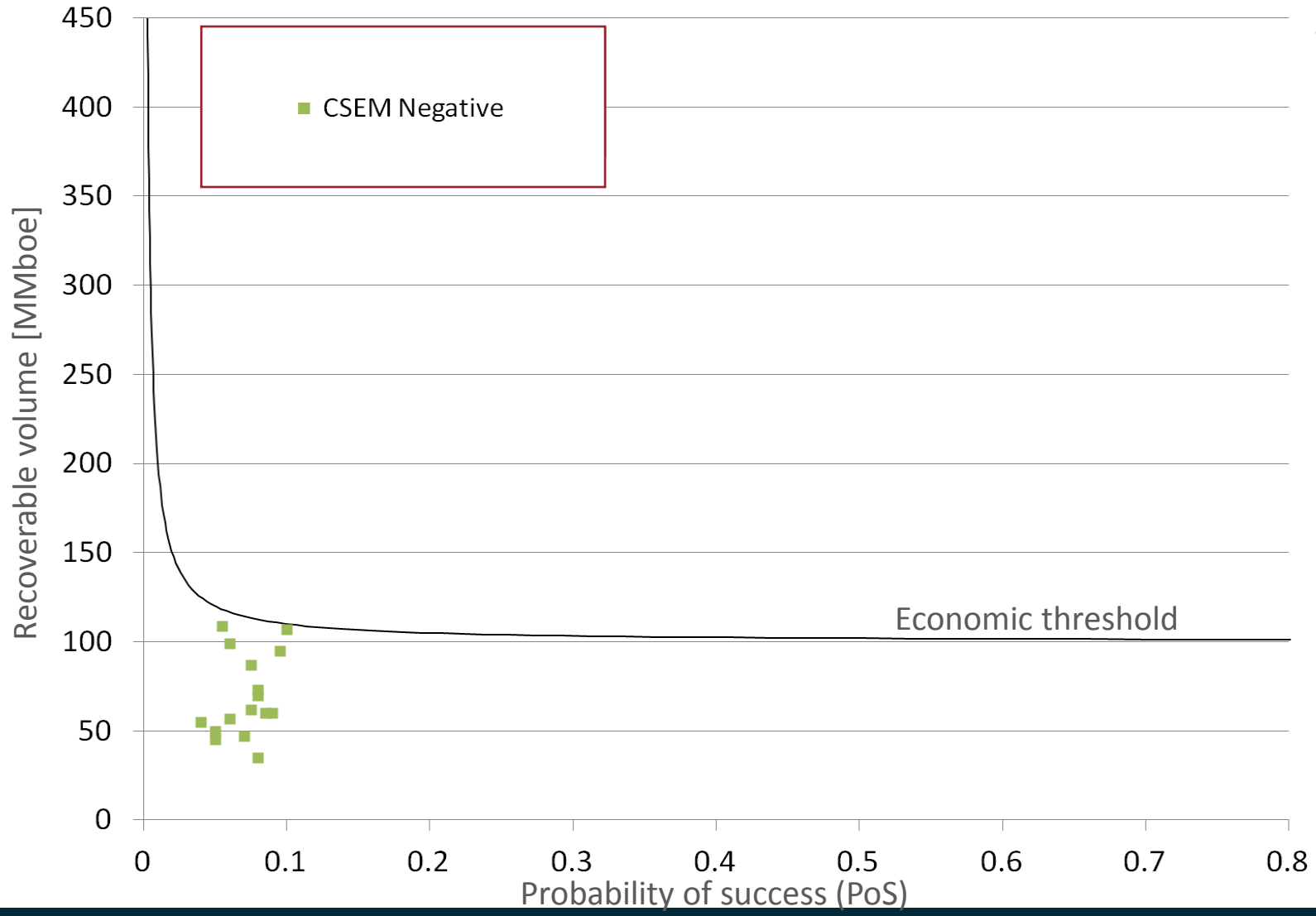


Exploration Portfolio before 3D CSEM



Note: only CSEM feasible prospects included in this portfolio

Exploration portfolio after 3D CSEM



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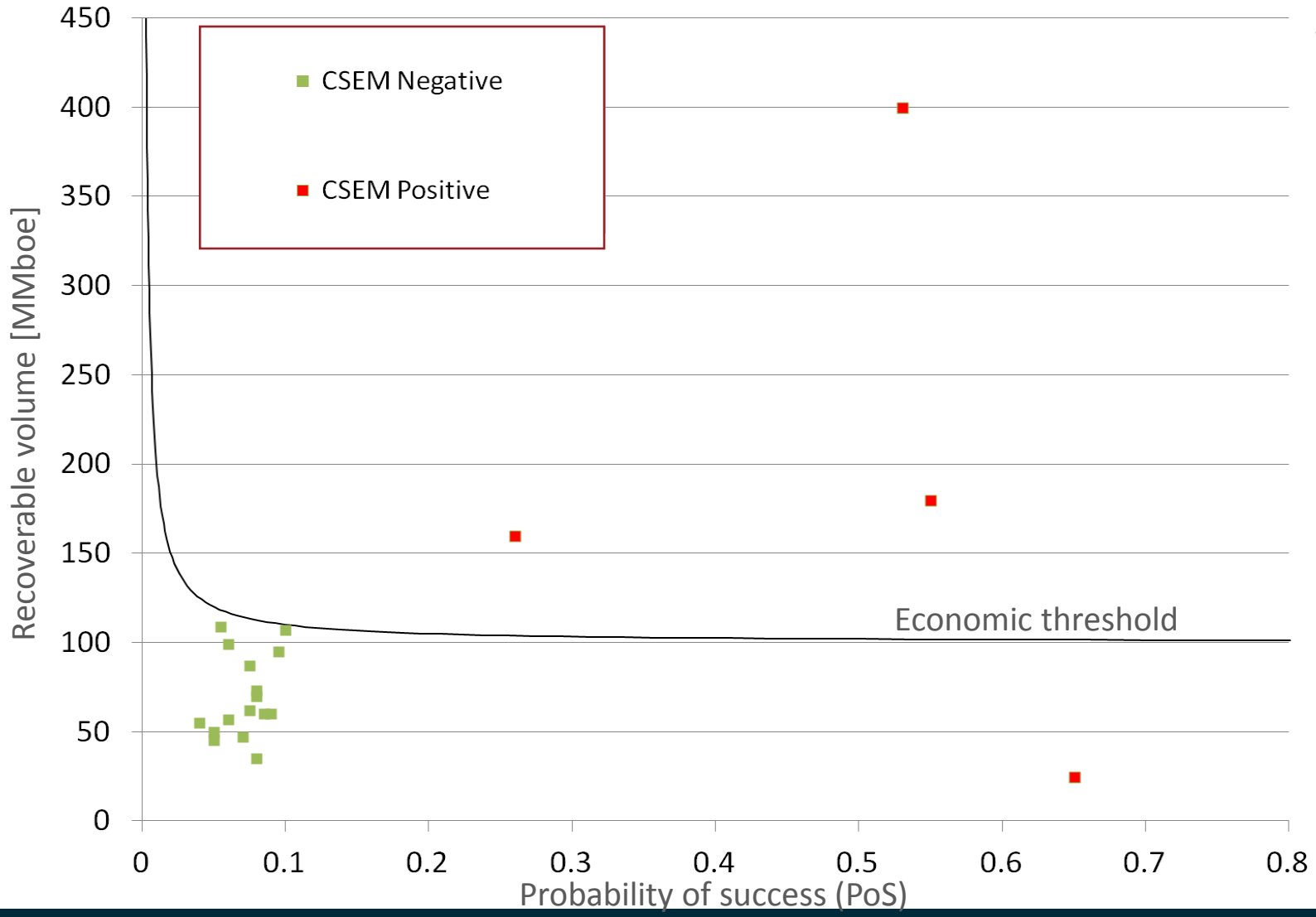

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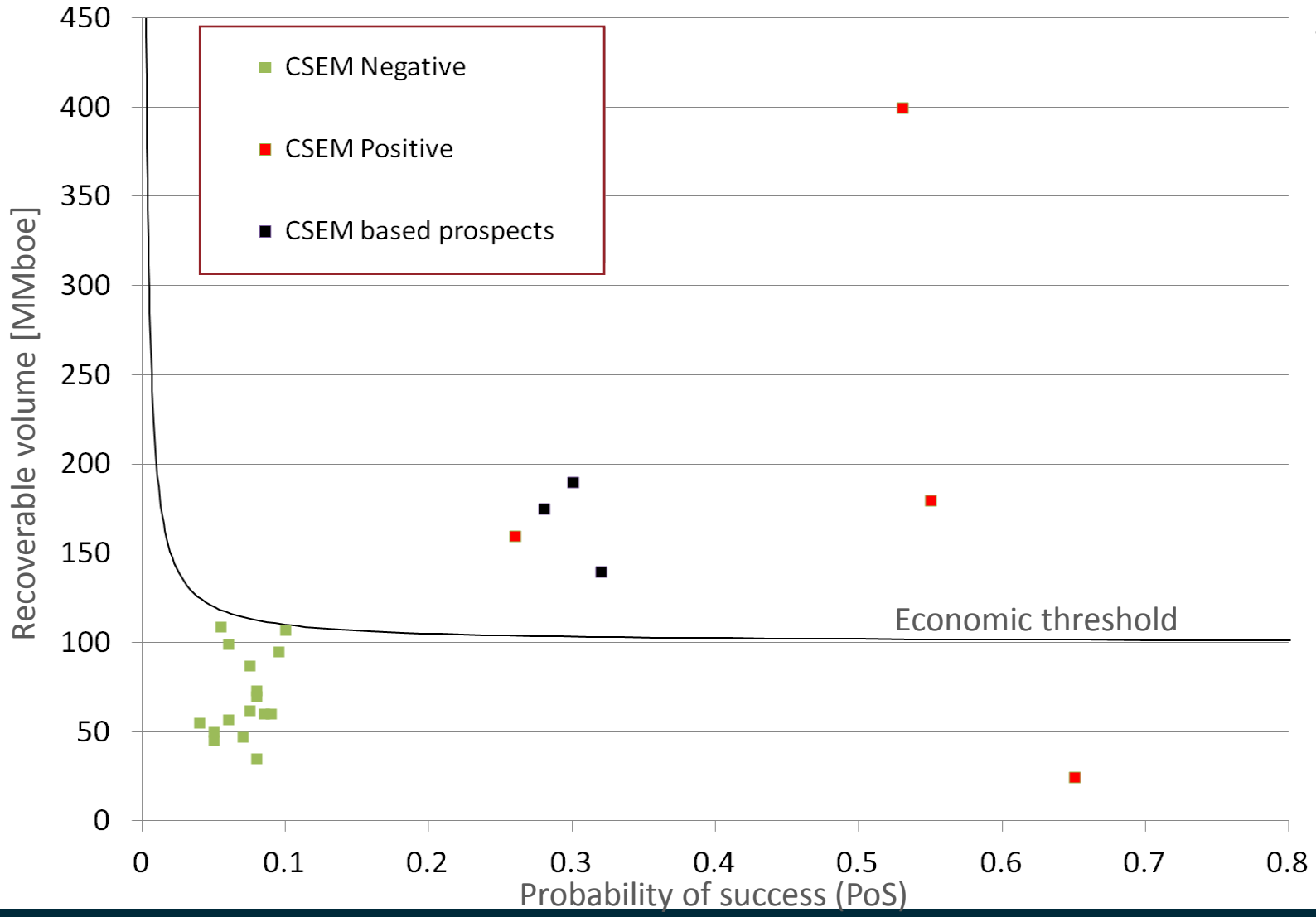

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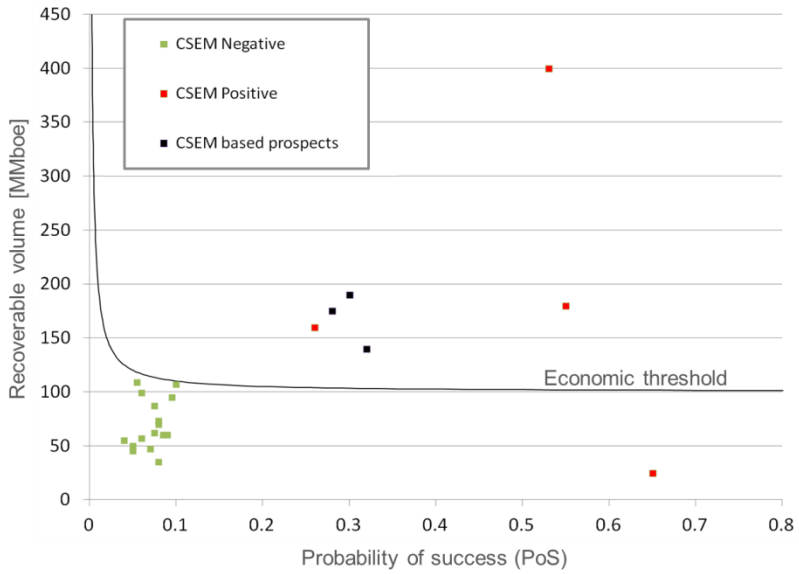
Portfolio before and after 3D EM

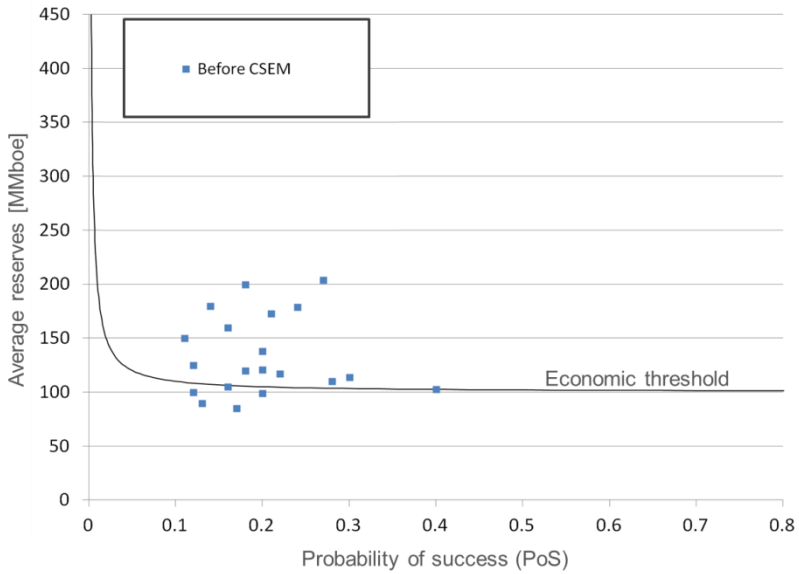


14 wells drilled

1 economic success
3 mid-sized discoveries

10 dry wells / technical success

Pe no EM = 7%
Pe with EM = 33 %

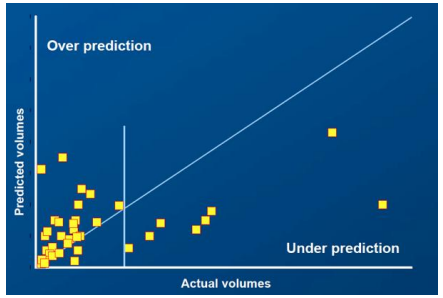


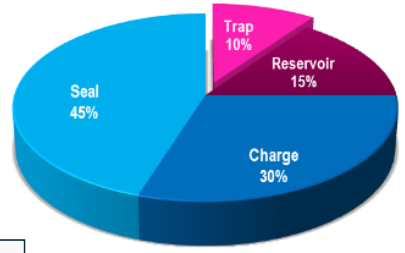
Decision making under uncertainty

Pe ~ 5-50%

Can EM do something to improve this?

Yes, evidence from Brazil, Mexico, and the Barents Sea prove this is the case.





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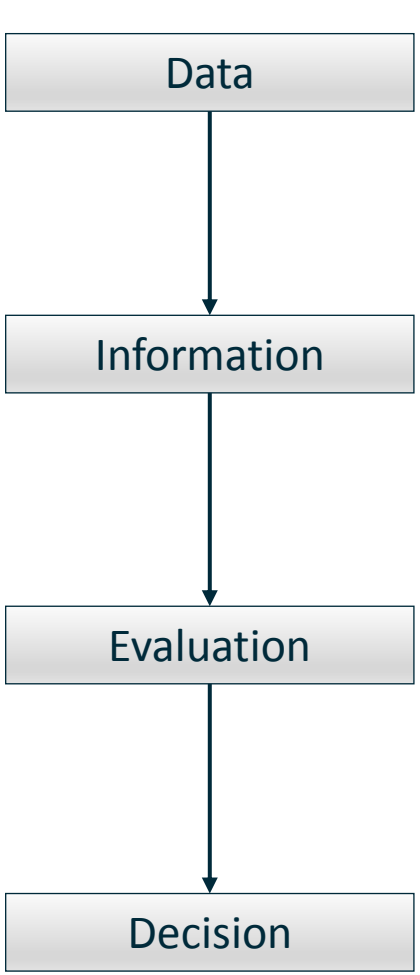
Challenges to CSEM adoption and application



Workflows
Interpreters

2002

2008

2012

Conclusion

- Pe is the main Value of Exploration driver
- Fluid presence and net rock volume evaluation uncertainties prevent Pe improvement
- Resistivity derived from CSEM allows for a significant reduction of the main uncertainties and increase of Pe
- Needs to be adopted systematically
    - Workflows must be adapted
    - Interpreters have to be trained
- The exploration workflow will need to change to adapt to the new tool
- EMGS offers an integral CSEM solution for hydrocarbon exploration

emgs

SPOT THE DIFFERENCE.

Thank you