

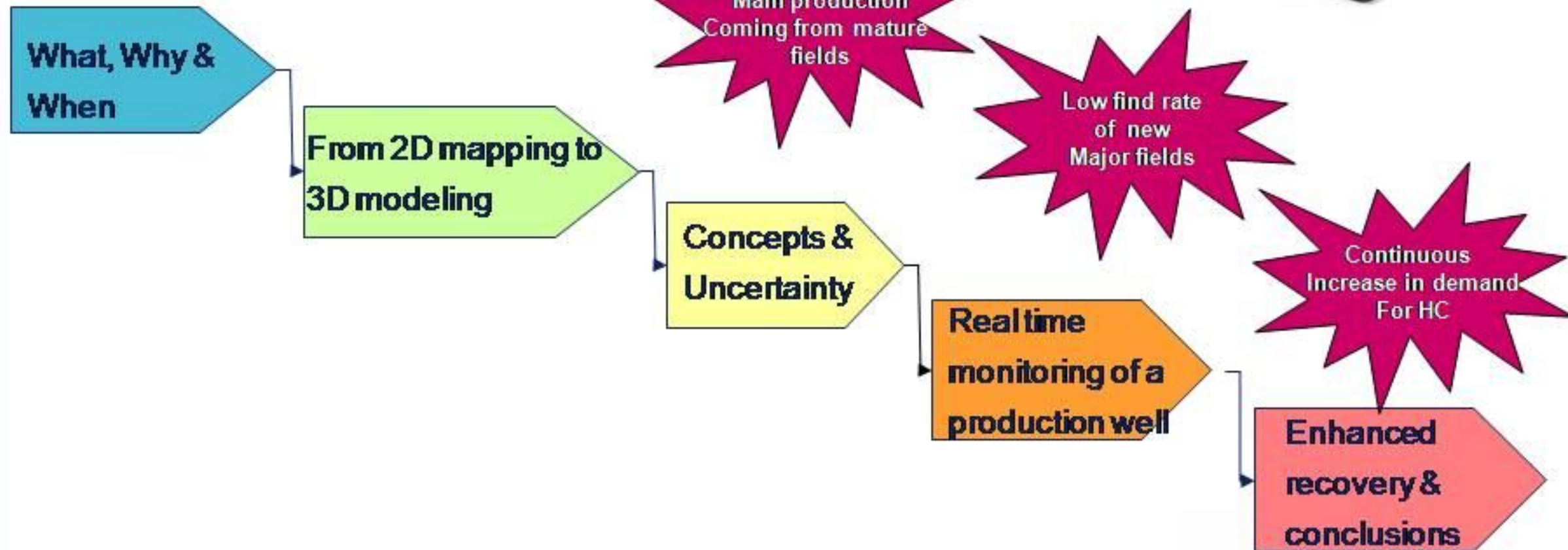
Reservoir modeling for enhanced Hydro Carbon Recovery

IDEC 2010,
May 21st. 2010,

By
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Roxar Software Solutions

Key messages: Presentation Outline

The challenge – balance the demand & supply:
How can reservoir modeling help?



What is a Reservoir Model?

A numerical prediction of how the reservoir may look like based on:

- Hard input data such as
 - Seismic
 - Well log data
- Combined with soft data such as
 - Geological knowledge
 - Out crop data from field studies
 - Geo statistics
 - Reservoir engineering knowledge

Why do Reservoir Modeling?

- Predict Hydro Carbon volumes
- Provide input to reservoir simulation -> estimates production forecasts
- Support the planning of the next well
- Mitigating risk – capturing the Uncertainty
- Utilize expensive achieved data in a best possible manner

A decision support tool for G&G professionals, reservoir engineers and management. which mitigates risk and improve HC-recovery!

When do Reservoir Modeling?

What, Why &
When

- **Constantly**
 - From the early exploration phase through the appraisal phase and the entire production phases
 - **New data are constantly available**
 - Well data
 - New (4D) or re-processed Seismic
 - Production data -> History match

From 2D Maps to 3D Models, Structure

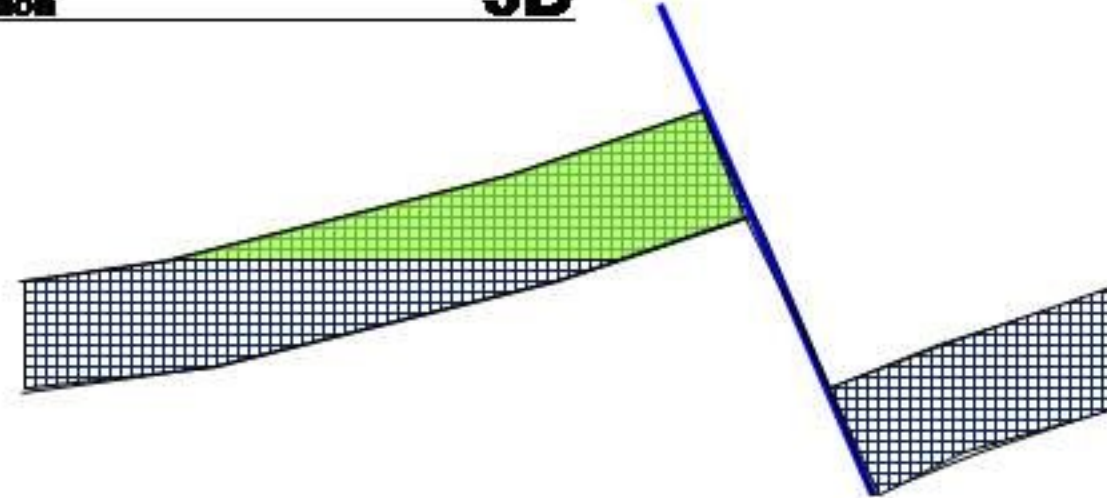
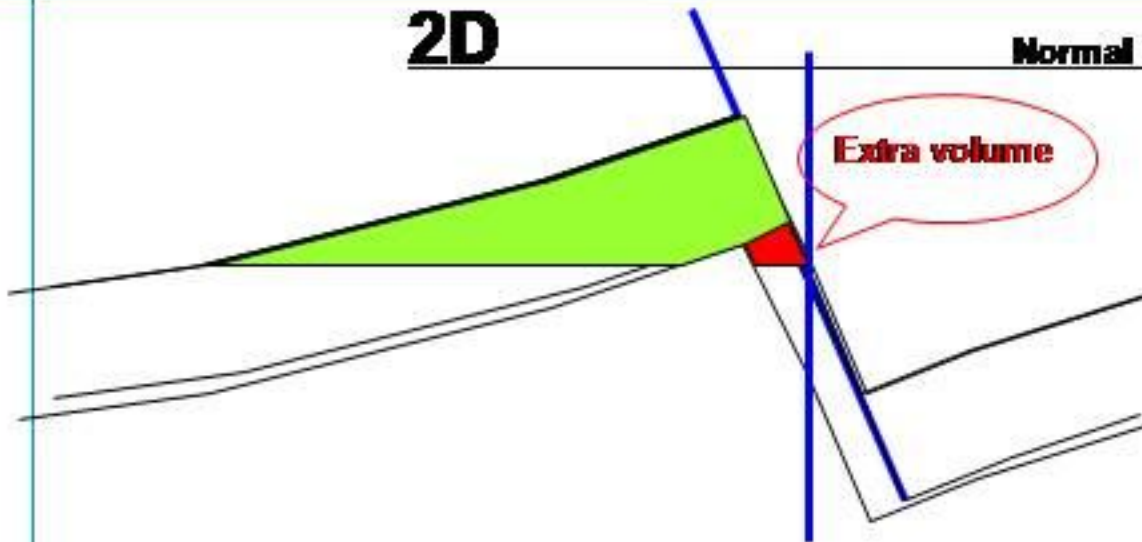
From 2D mapping to 3D modeling

2D

Normal Fault situation

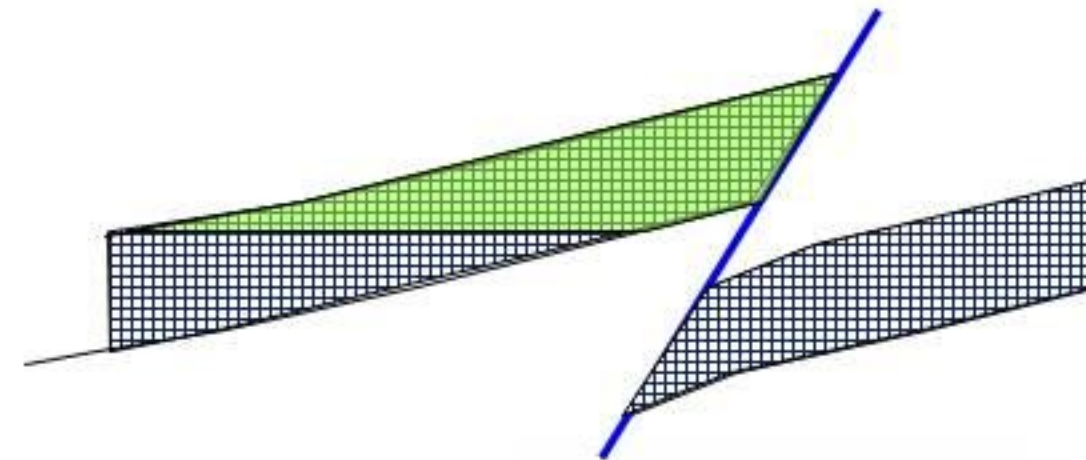
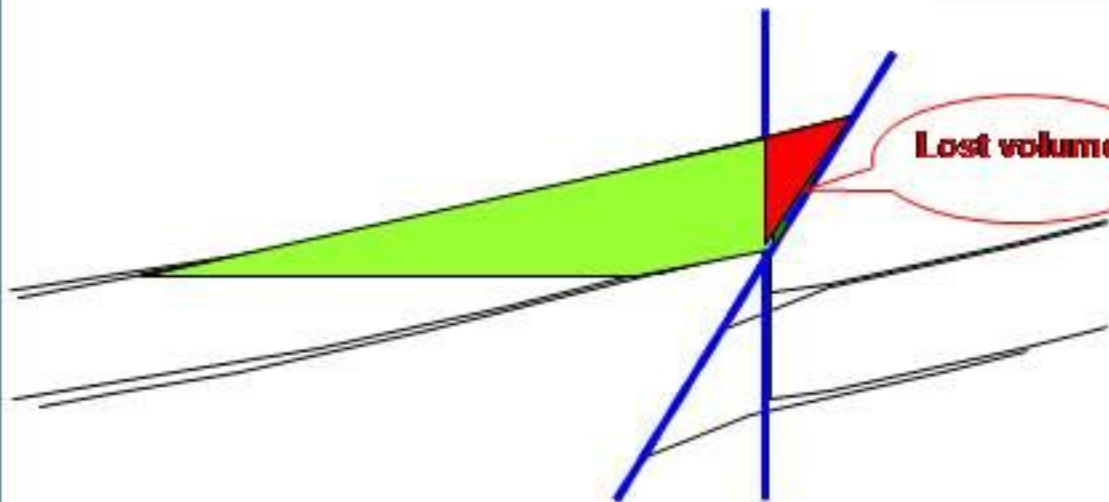
3D

Extra volume



Reverse Fault situation

Lost volume



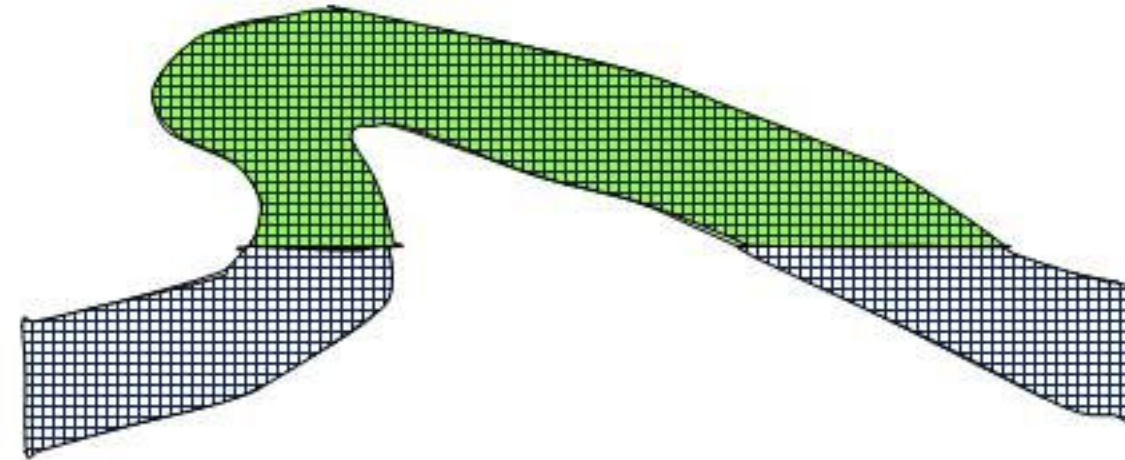
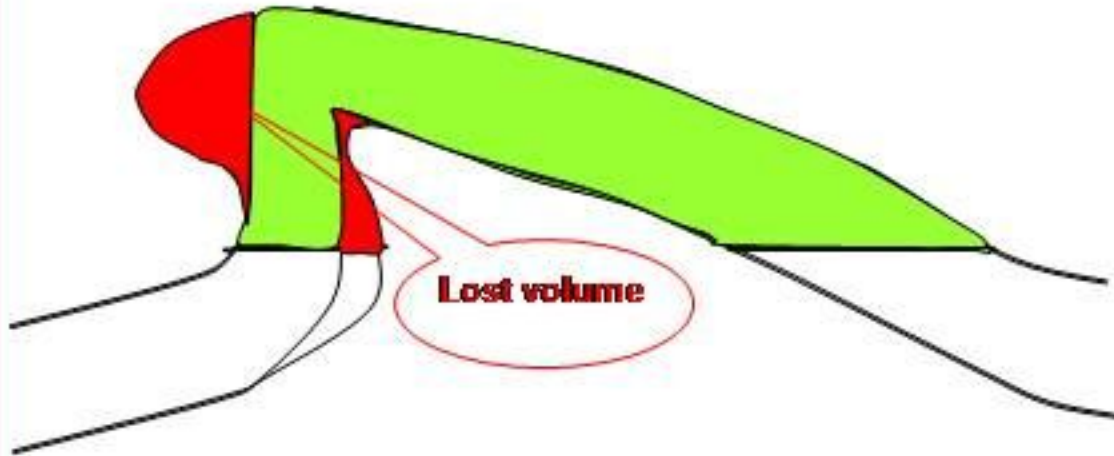
From 2D Maps to 3D Models, Structure (2)

From 2D mapping to 3D modeling

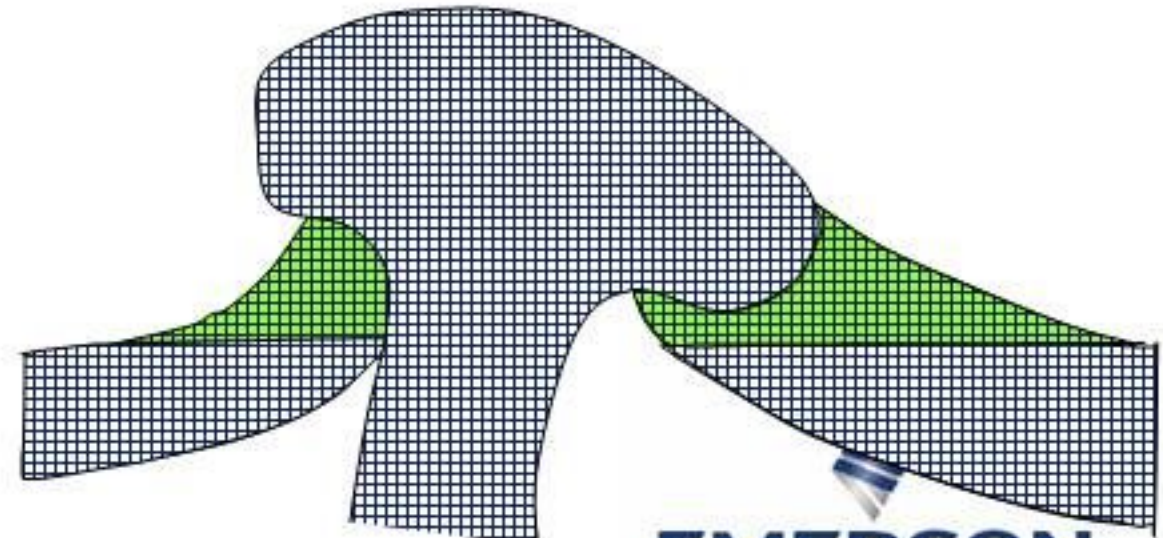
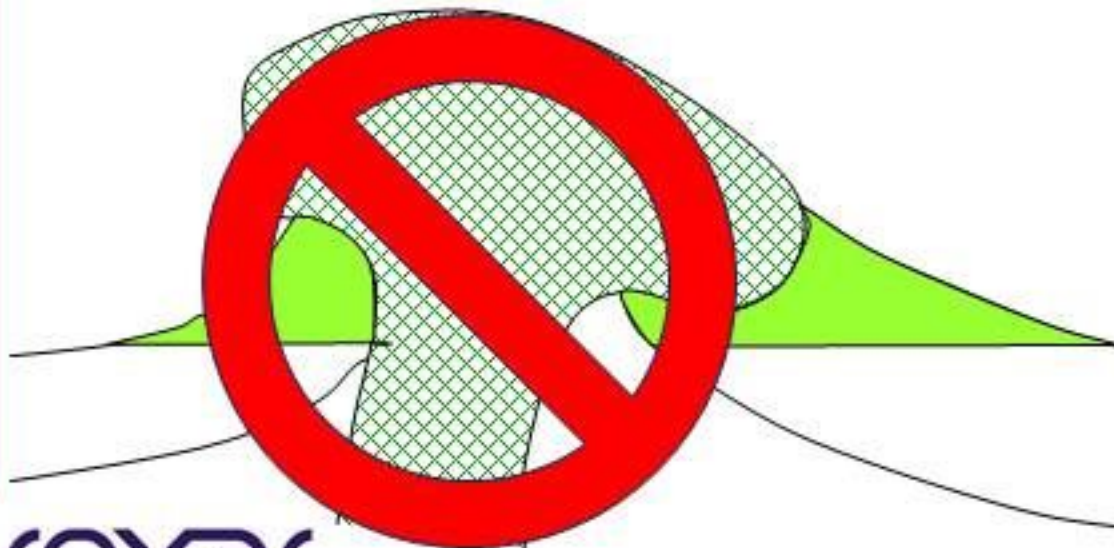
2D

Trust Folding situation

3D



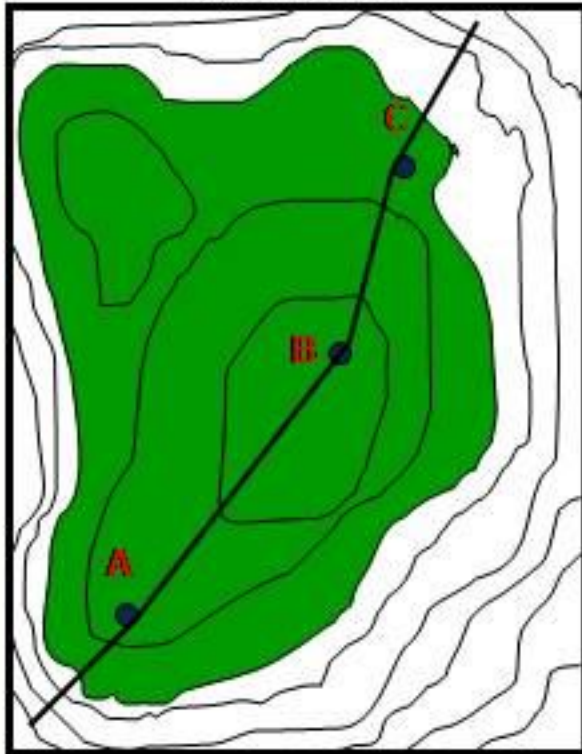
Salt Domes



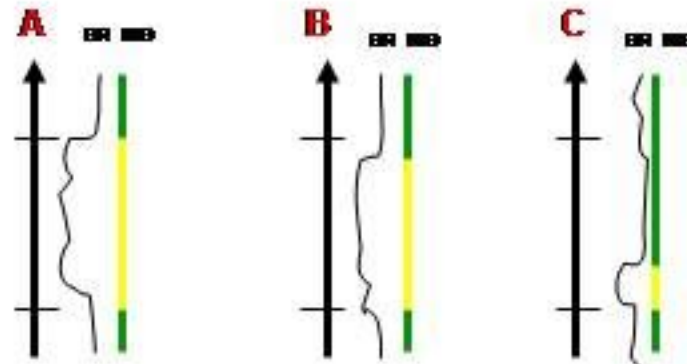
From 2D Maps to 3D Models, Properties & geological concepts

From 2D mapping to 3D modeling

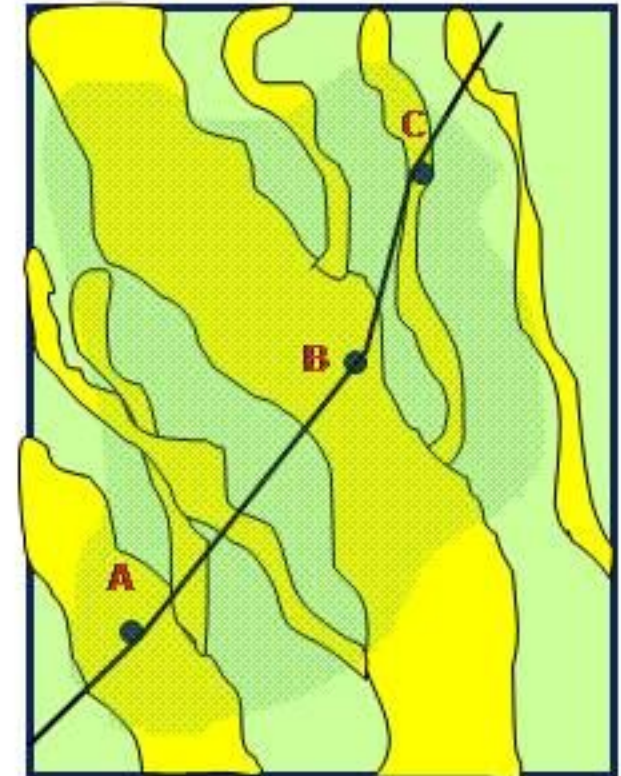
Structure Map of Top Reservoir



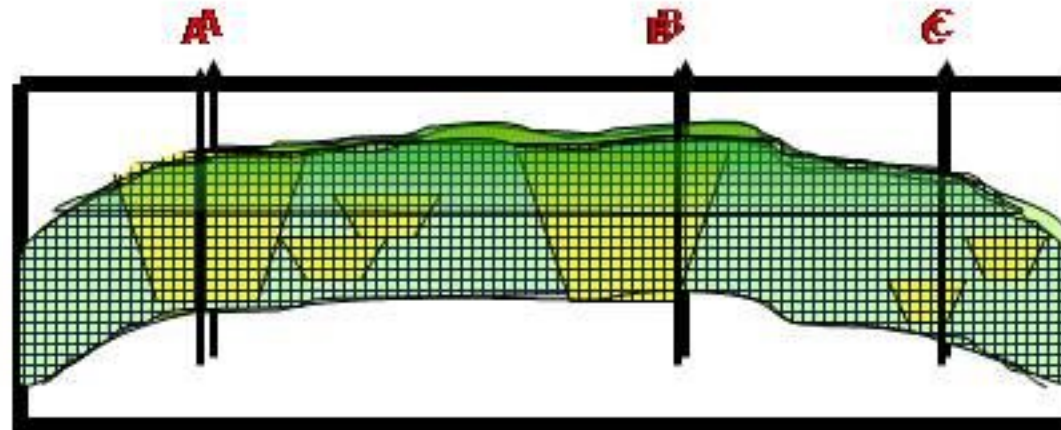
3 Expl. Wells with GR & N/G logs



3D Geological Model



Cross section



Benefits of 3D vs. 2D

From 2D mapping to
3D modeling

- Models variability in all dimensions
- Allows modeling of geological heterogeneities & concepts in a realistic manner
- Property (porosity, permeability etc.) modeling conditioned to geological model

LEADS TO:

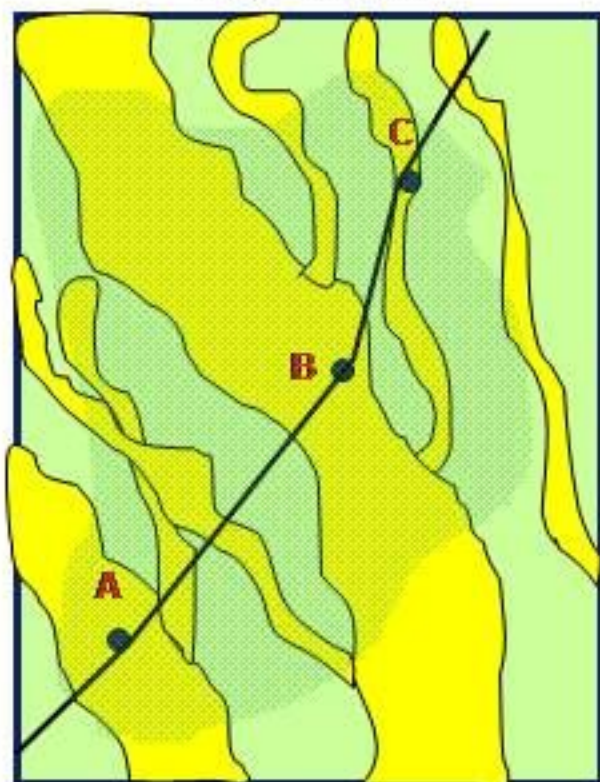
- More precise models for volumetrics
- Much more realistic input for reservoir simulators, hence more reliable production forecasts
- More reliable decision support for planning the next well

→ Mitigates RISK in Managements decisions!

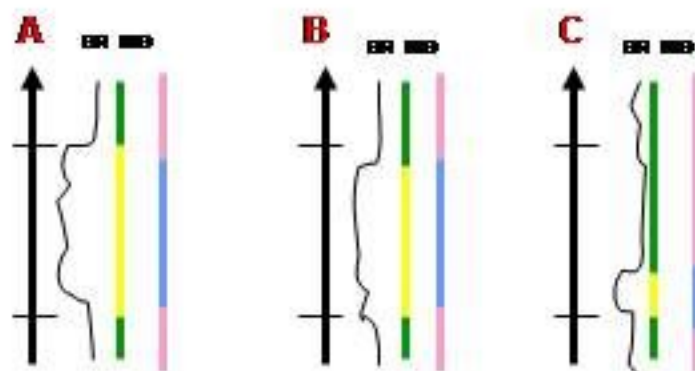
3D Modeling capture different geological concepts

Concepts & Uncertainty

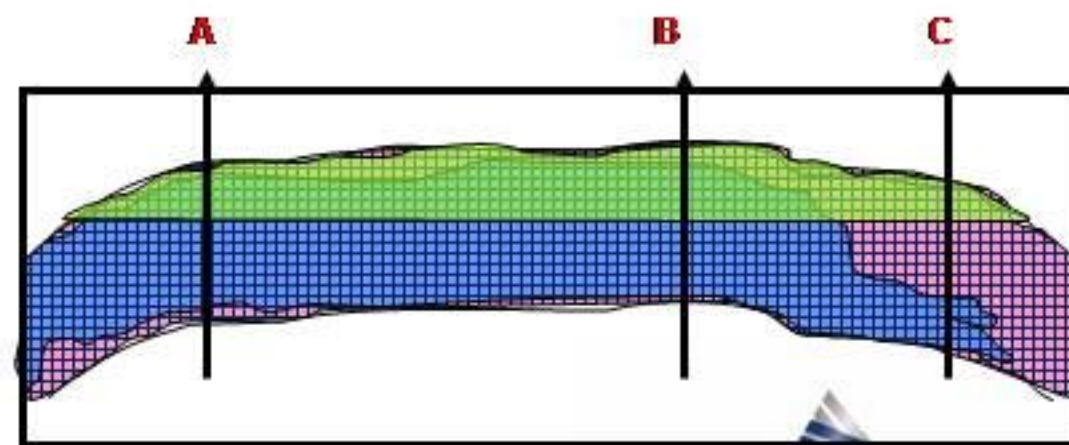
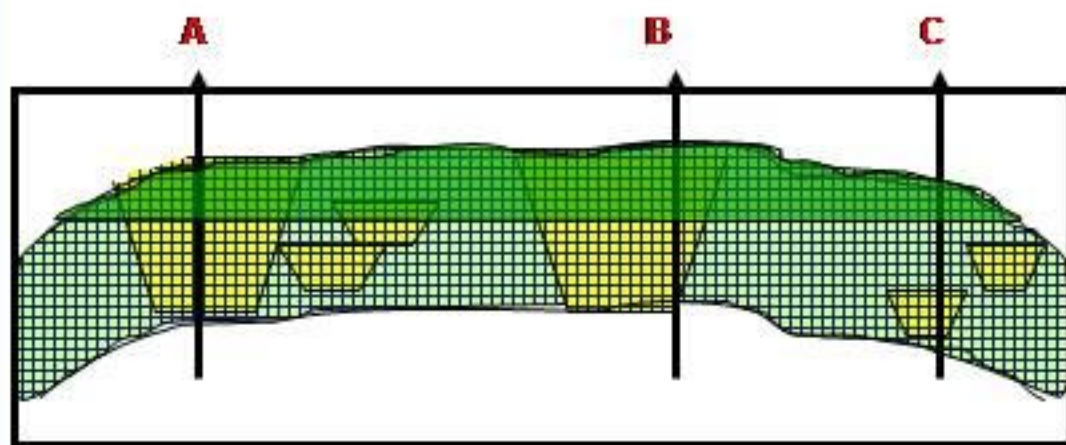
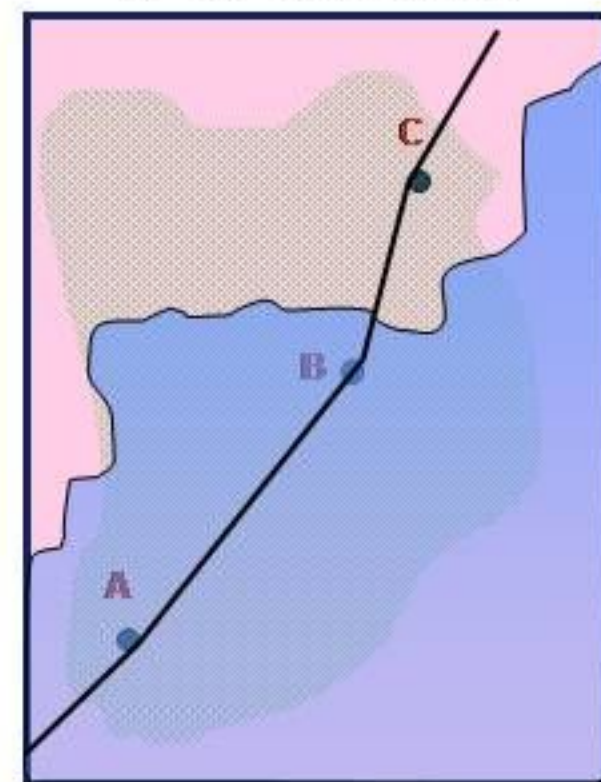
Fluvial Model



3 Expl. Wells with GR & N/G logs

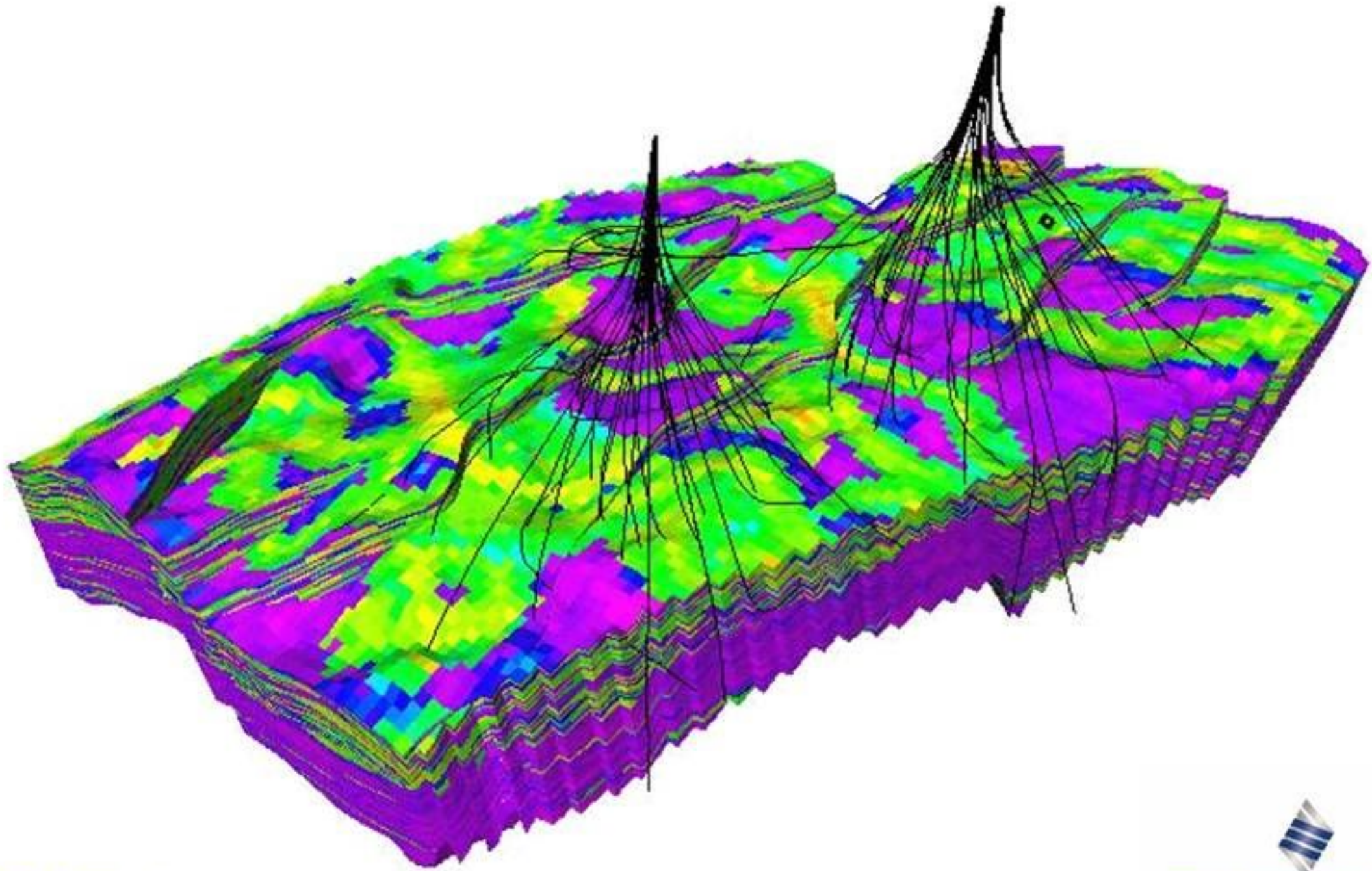


Carbonate Reef Model



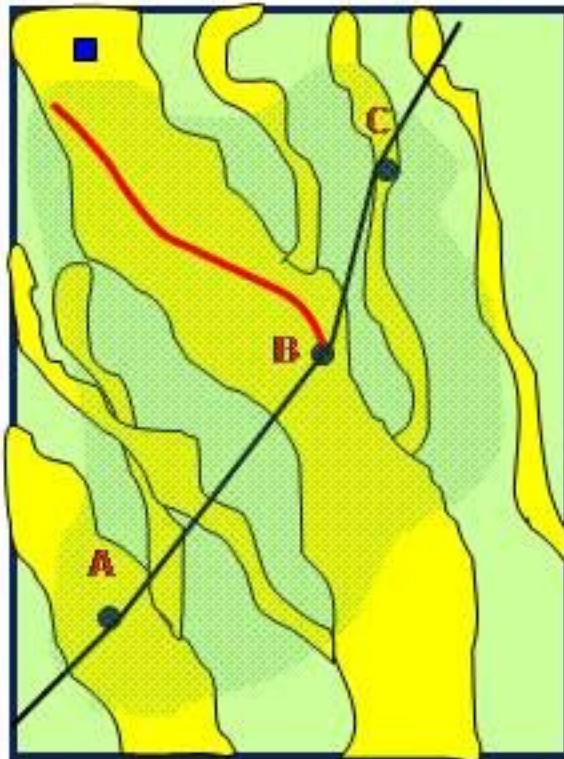
Petrophysical parameters conditioned to a conceptual geological model

Concepts &
Uncertainty

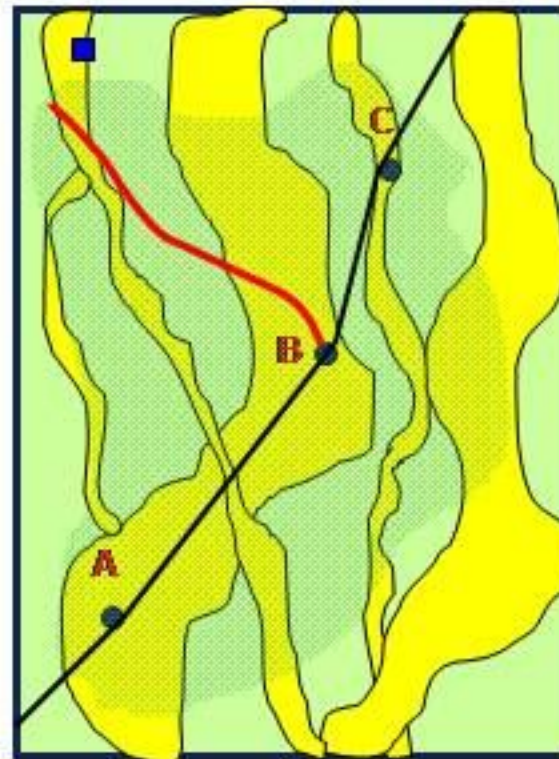


The stochastic element, realizations & uncertainty

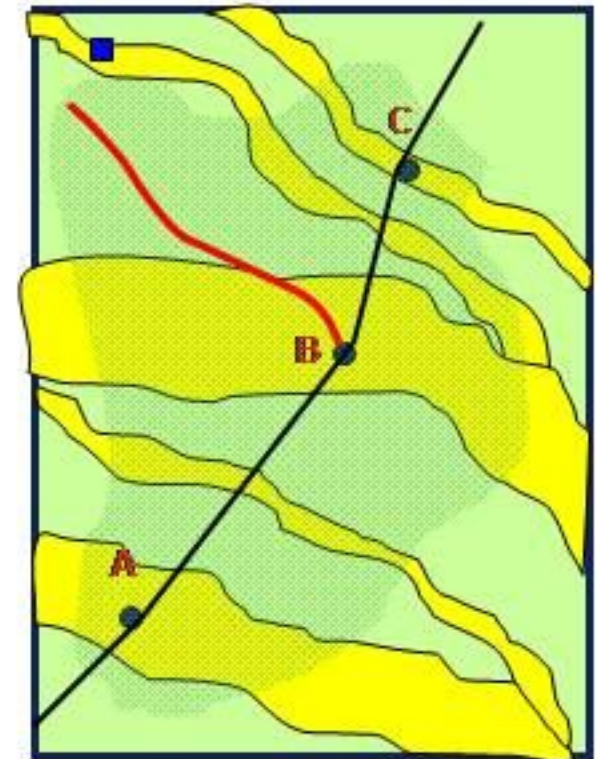
Model 1



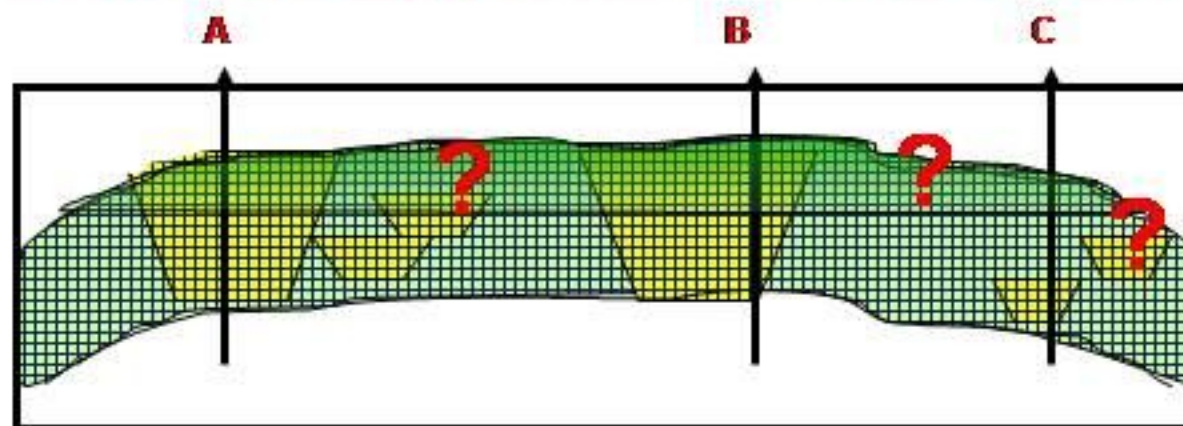
Model 2



Model 3

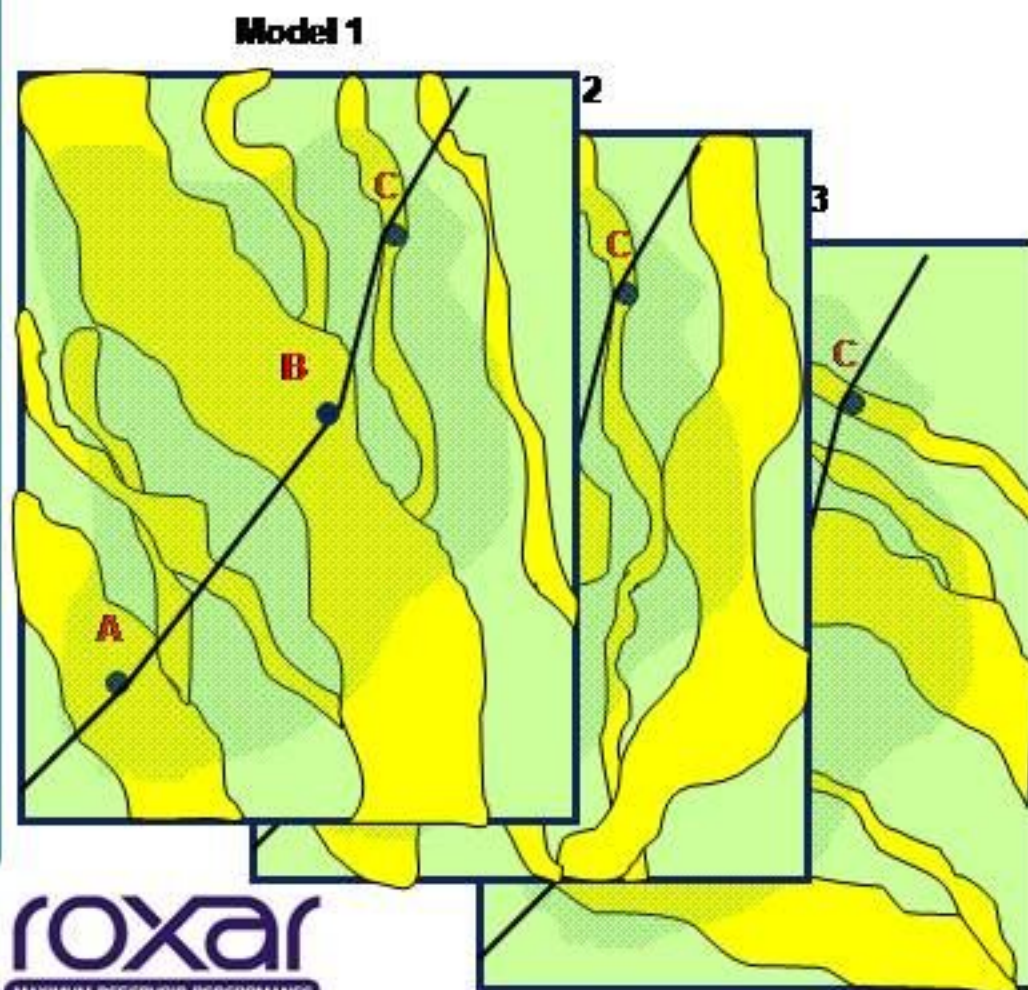


**But how does the geology look like outside the wells?
Even very high quality seismic will not reveal everything!**

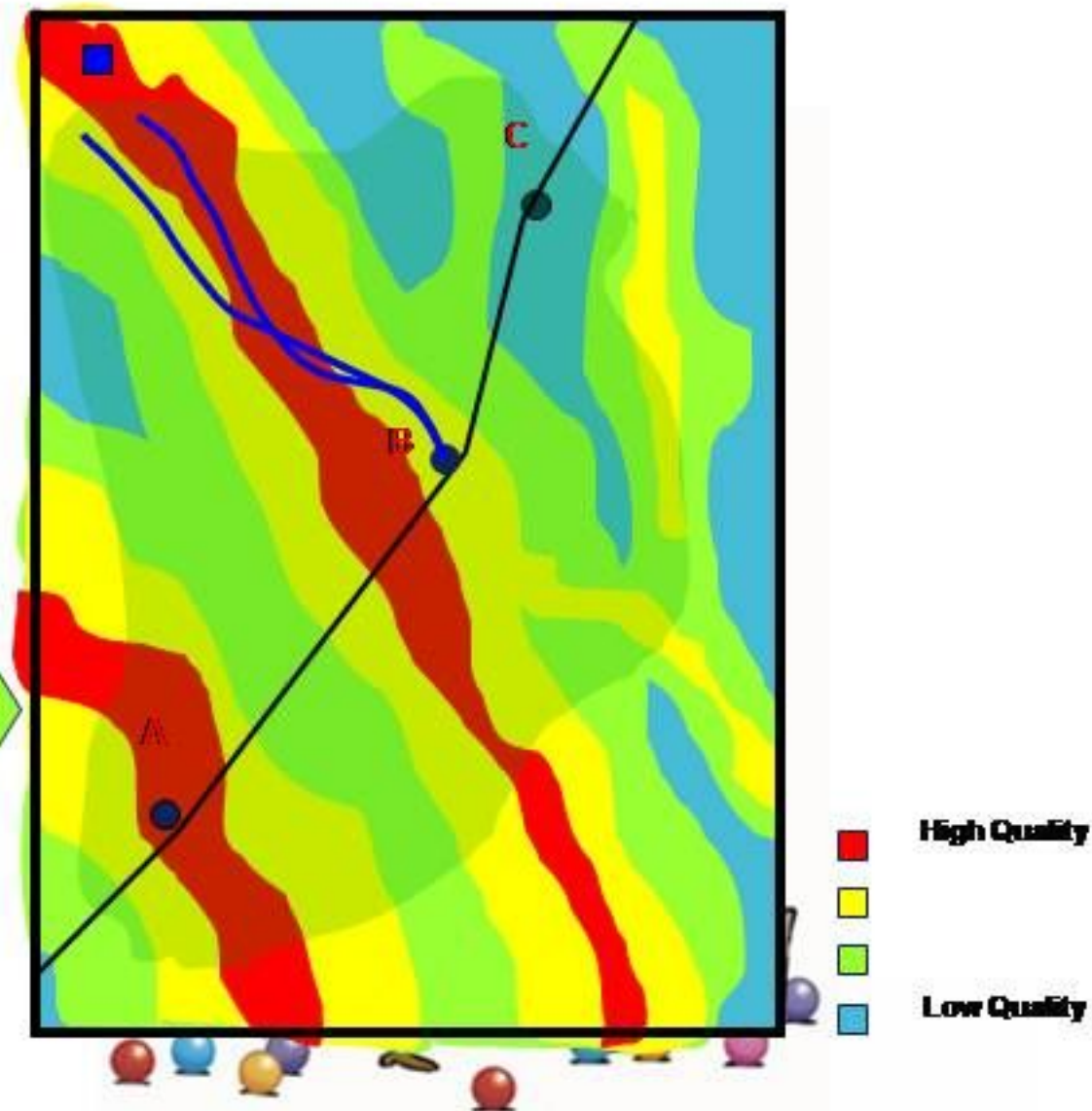


How to rank my realizations?

- Working with many realizations is difficult and time consuming
- What is a proper base case?



Probability Model



Benefits of several realizations

Provides the possibility to investigate uncertainty

- On all input parameters, and reveal which are more sensitive than others
- On volumetrics

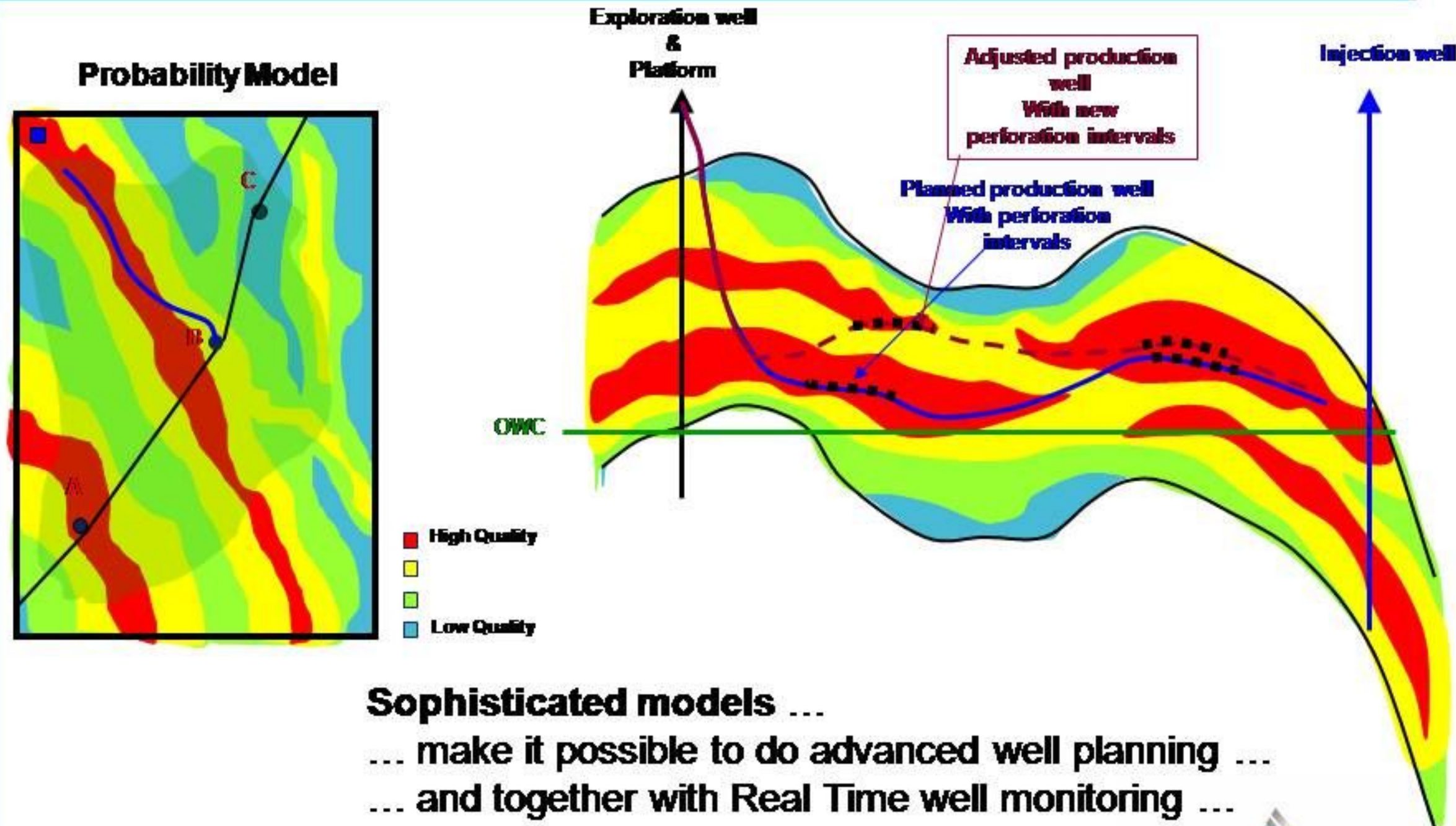
LEADS TO:

- Volume probability curves
- Provides several realistic input models for reservoir simulation, easier to find a model that fits production history

→ Mitigates RISK in Managements decisions!

Plan the next well - GeoSteering

Real time monitoring of a production well



Sophisticated models ...

... make it possible to do advanced well planning ...

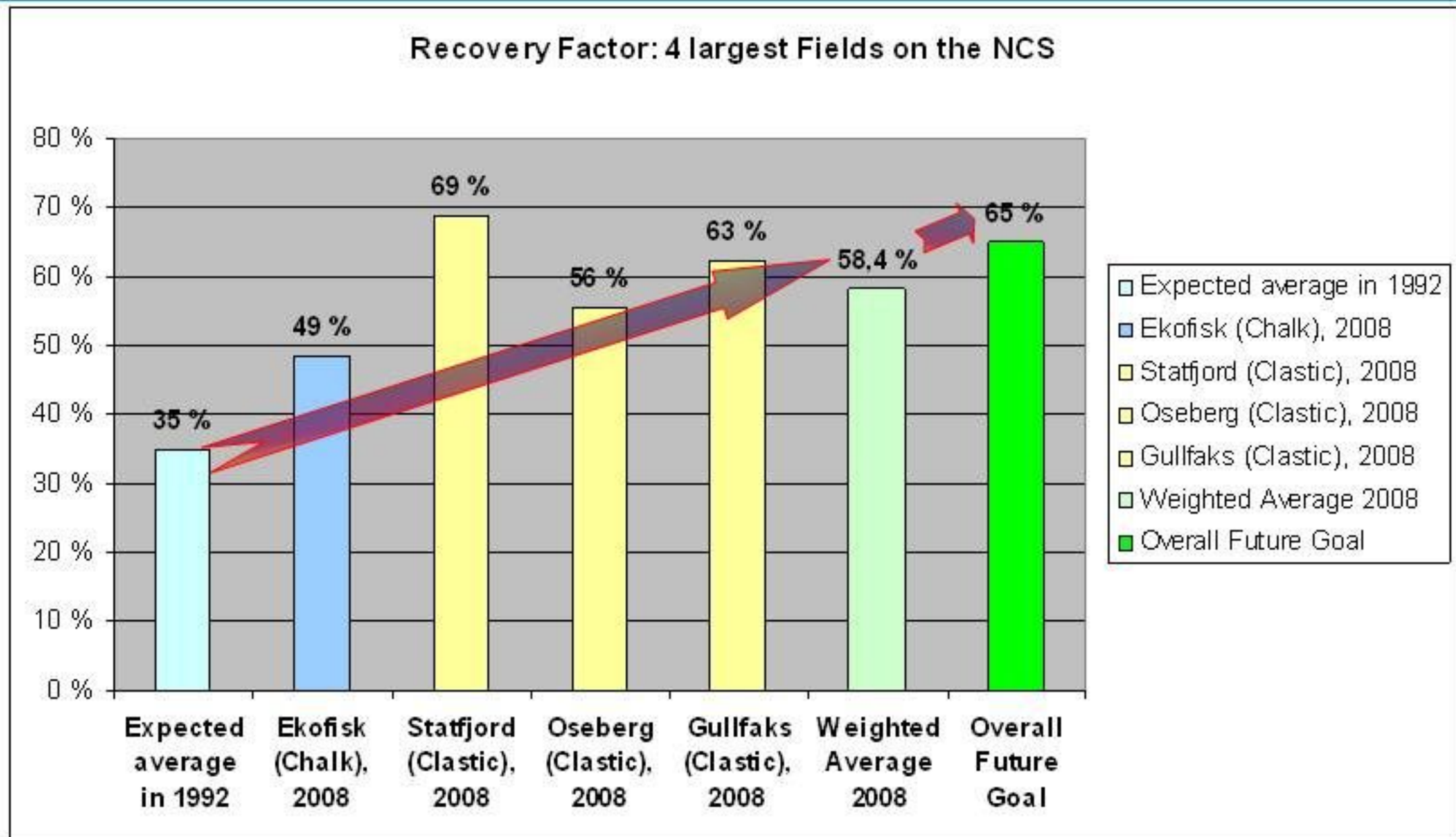
... and together with Real Time well monitoring ...

... it will results in

→ Enhanced Recovery!

The Increased Recovery on the NCS

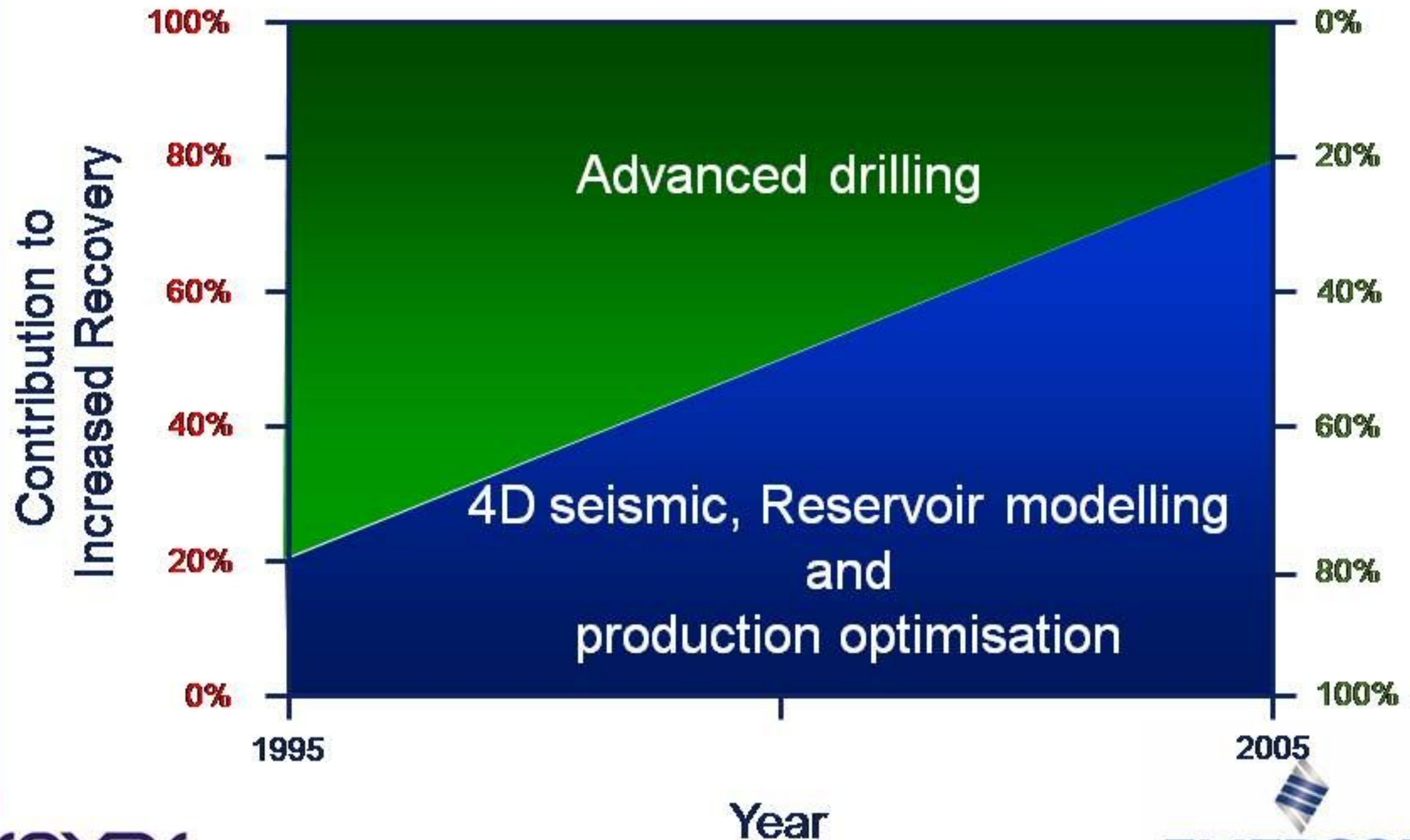
Enhanced
recovery &
conclusions



Saudi Aramco is talking about future Recovery on 65 – 70%!

Contributory factors to Increased Recovery

Enhanced recovery & conclusions



Closing conclusions

Enhanced
recovery &
conclusions

Thorough reservoir description with advanced reservoir modeling tools have caused:

- More precise Hydro Carbon Volume estimates
- More realistic production forecasts
- More frequent hits in high quality reservoir zones when drilling new (horizontal) production wells
- Better understanding of the Reservoir Uncertainty
- Less RISK in decision making

➔ INCREASED HYDRO CARBON RECOVERY!

