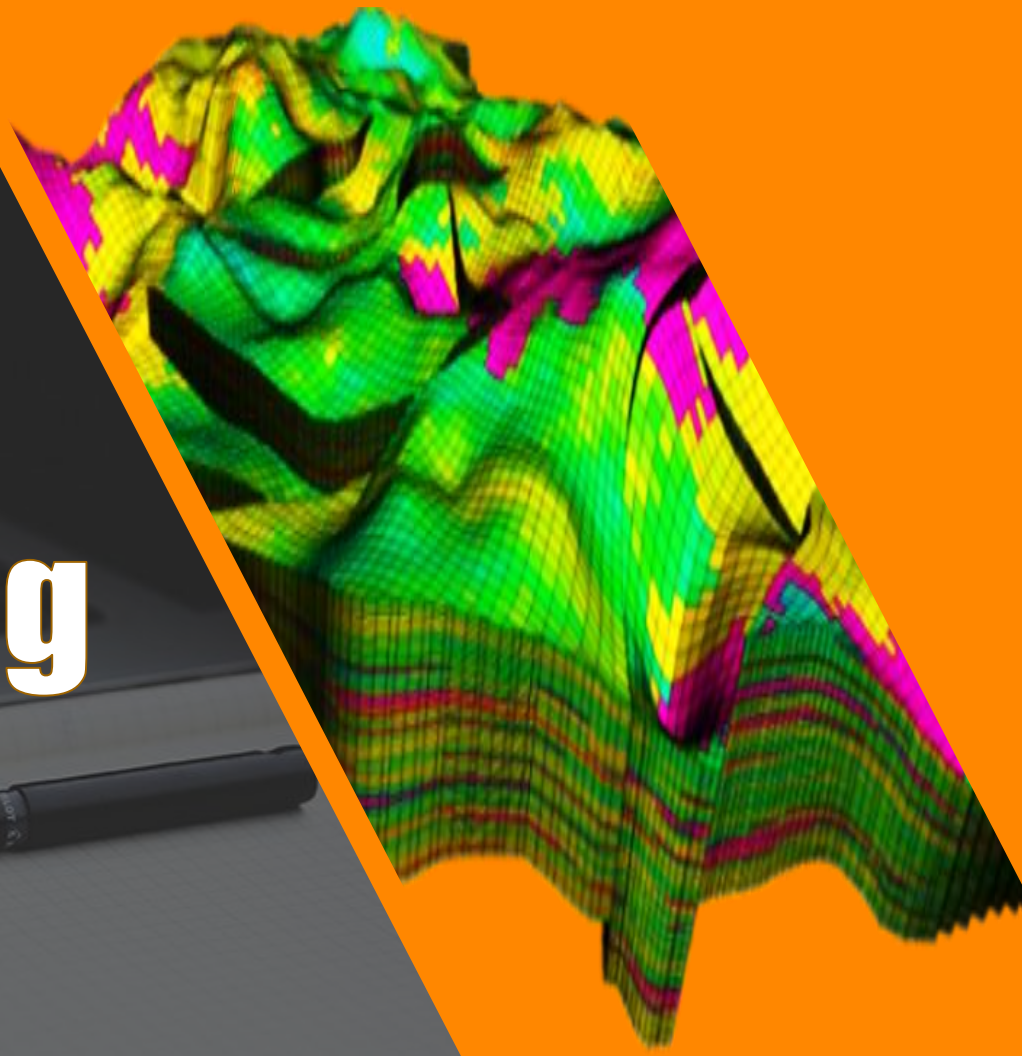
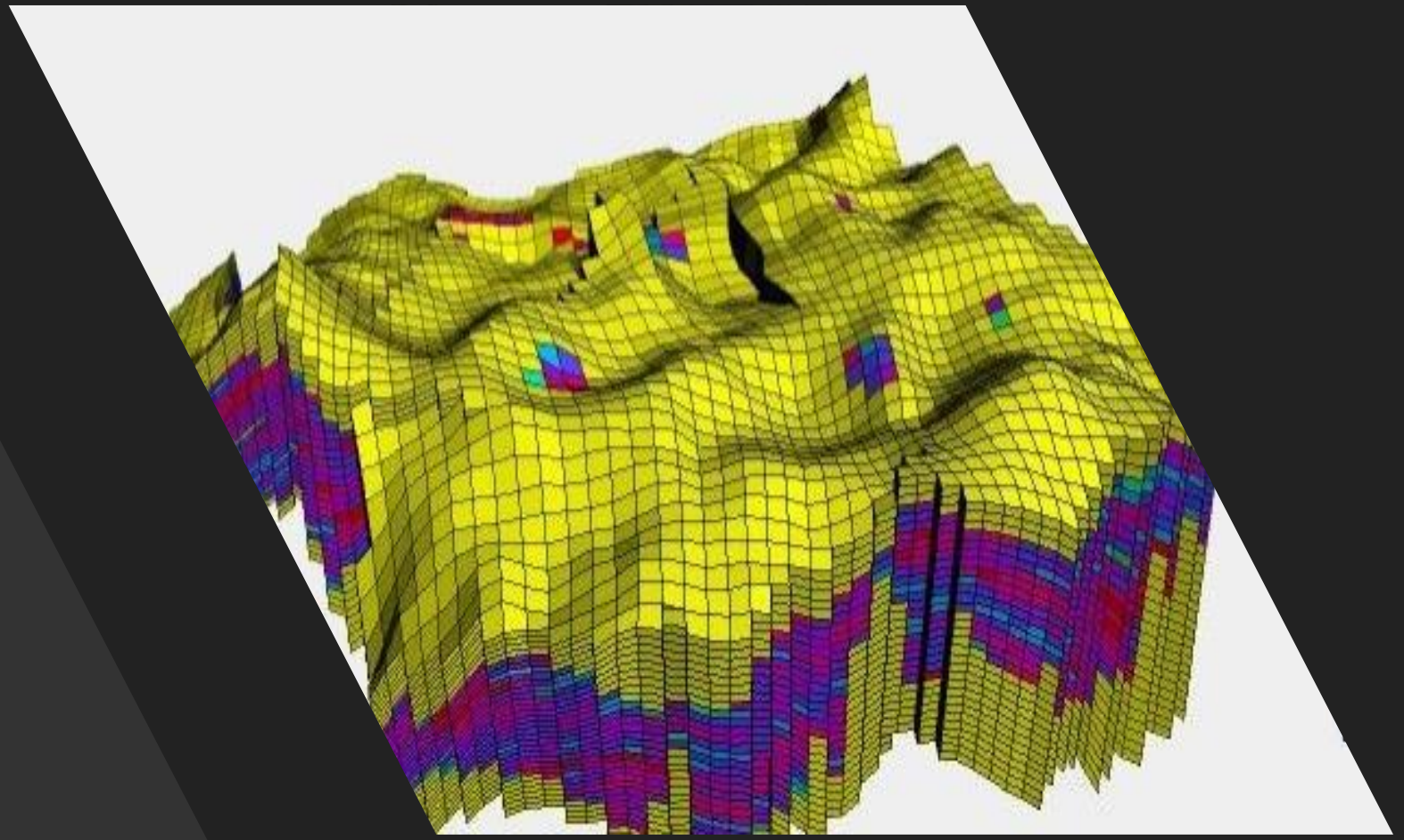
Reservoir Modelling



Petroleum & Mining Engineering Collage /Forth Year

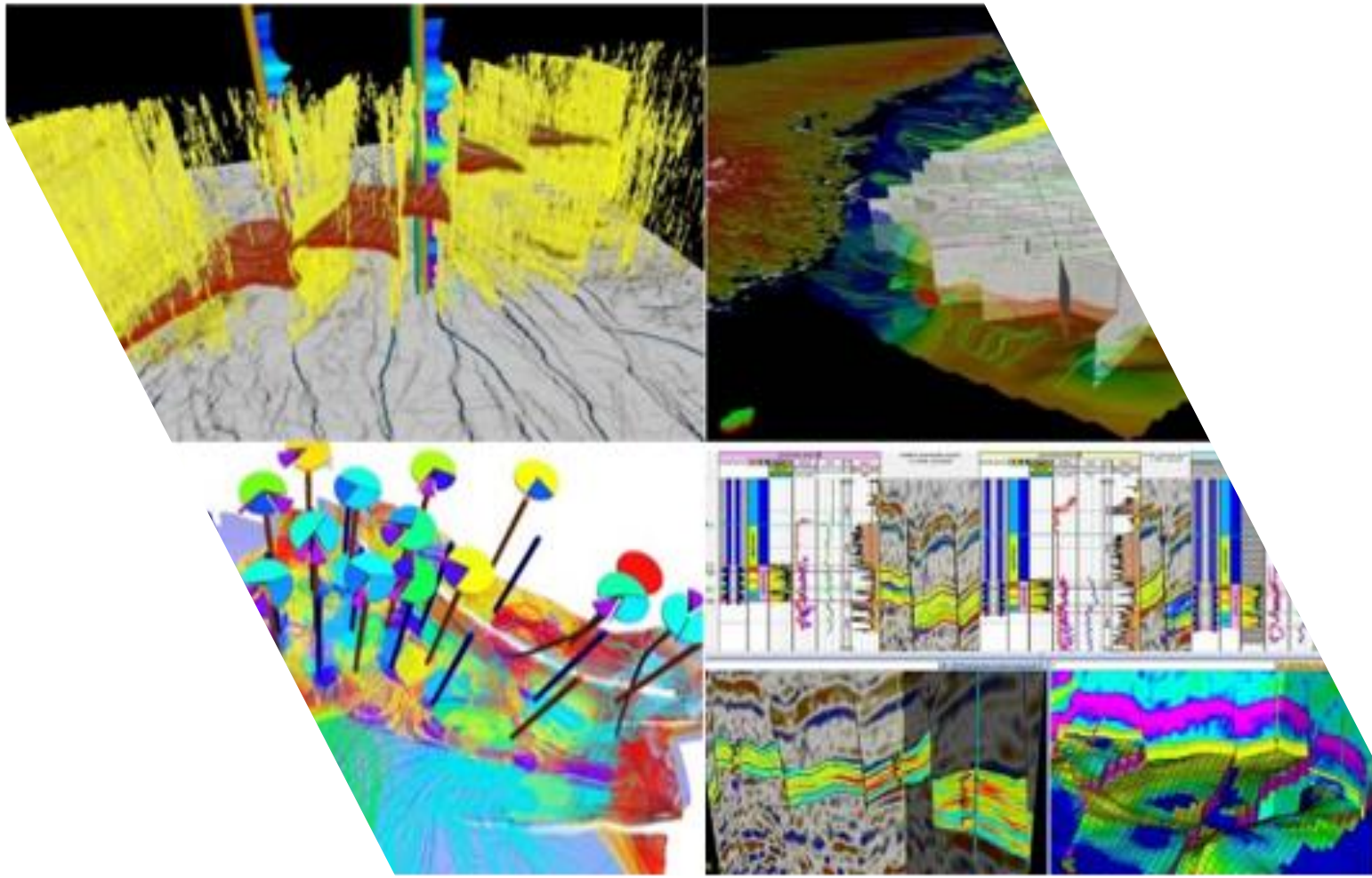
Dr. Maha Muneeb

Introduction



A Reservoir Model

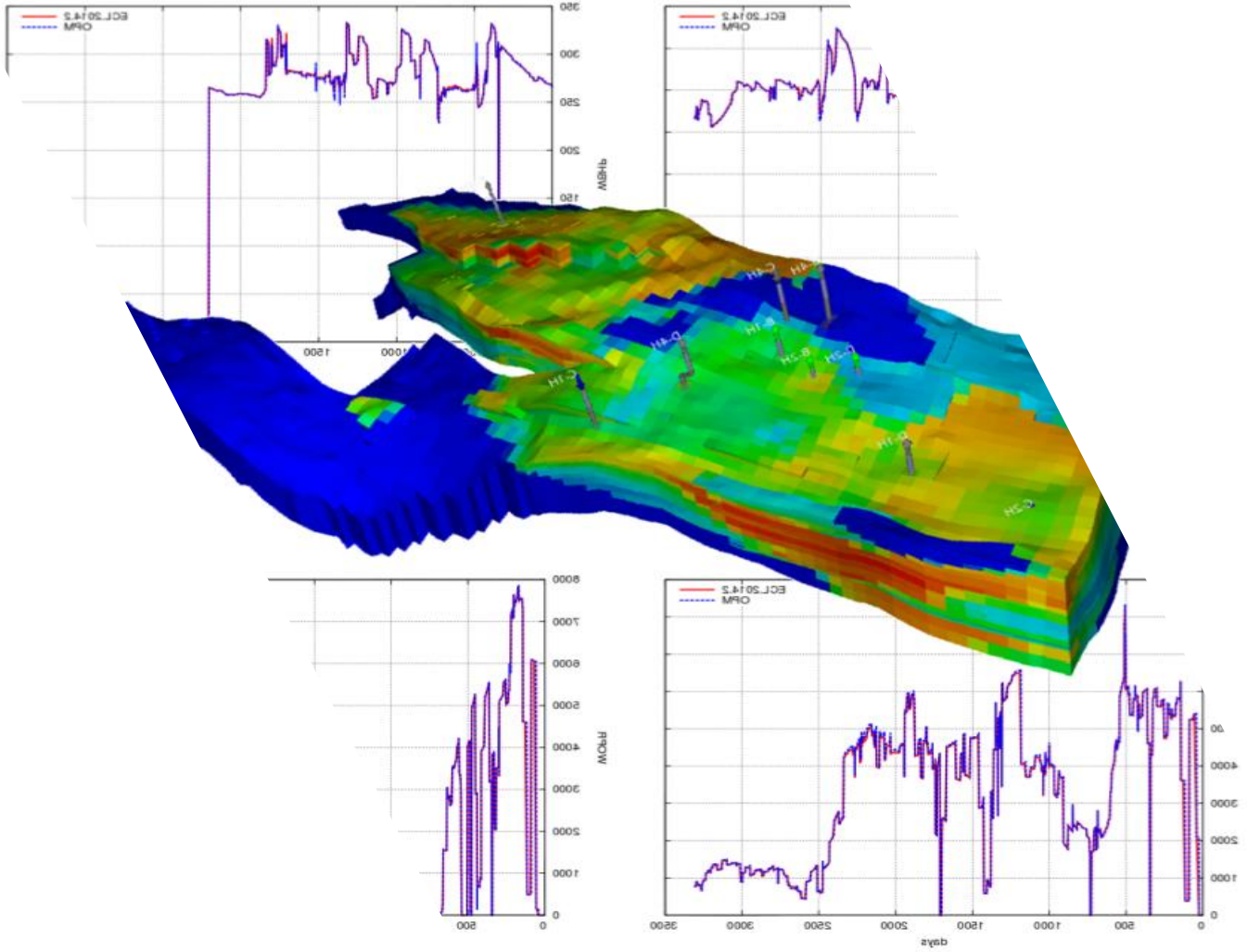
is a digital representation of the subsurface formations and its rock and petrophysical properties.



A Reservoir Simulation

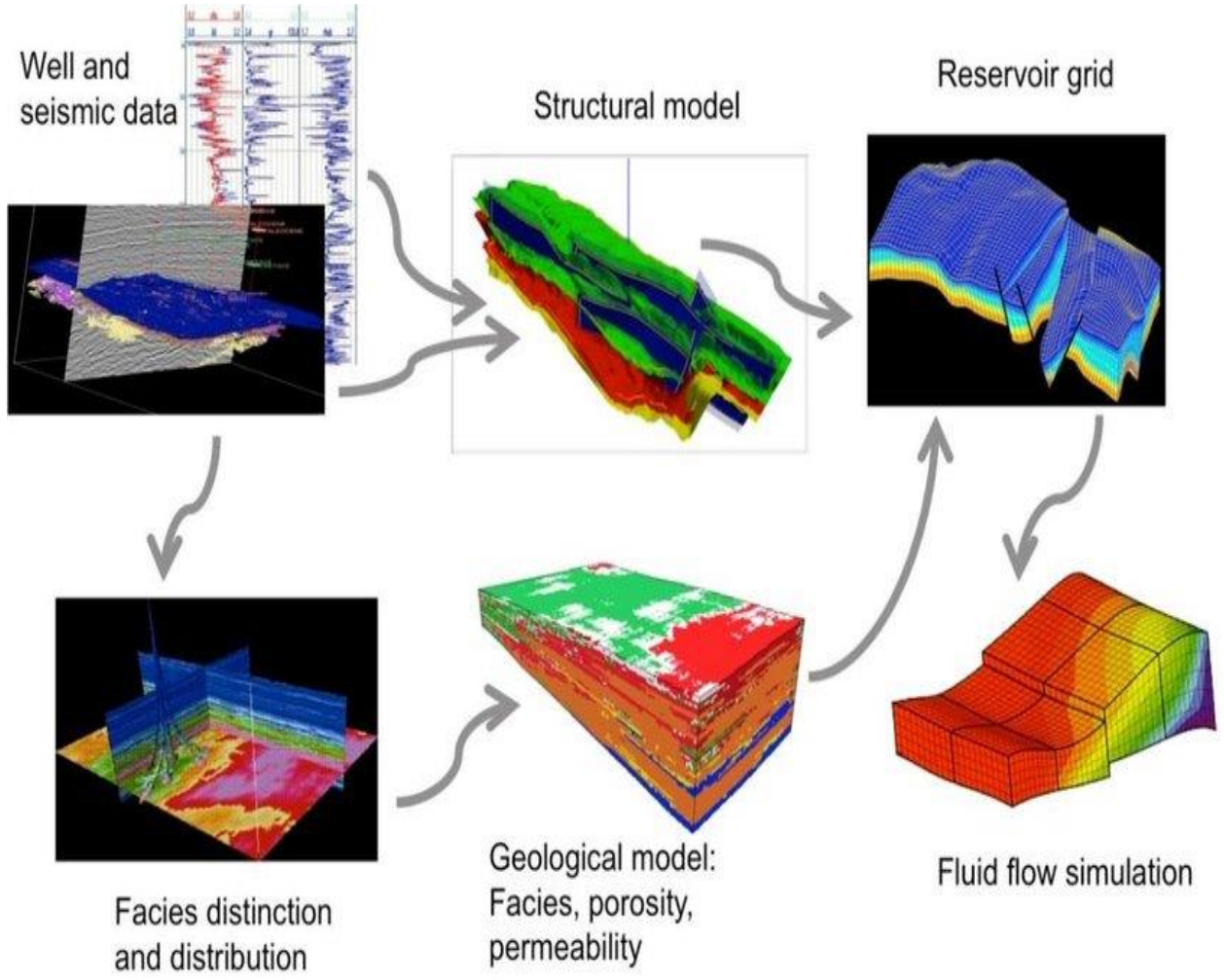
The process of running numerical models on these representations to predict fluid flow behavior within the reservoir.

Reservoir simulation is performed to **infer fluid flow behavior from a mathematical model.**



The integration of these two processes allows engineers to:

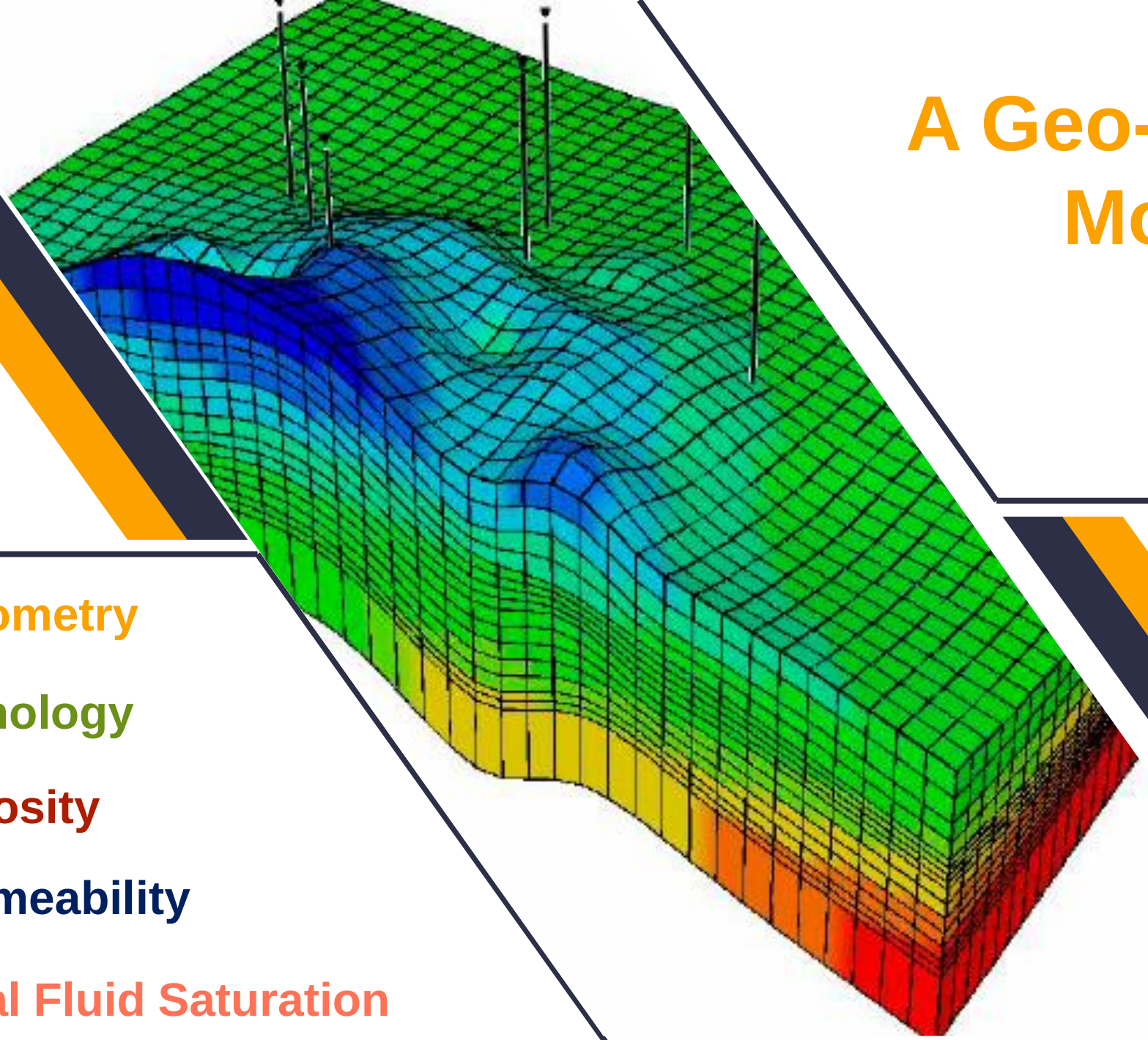
1. Optimize production strategies,
2. Estimate reserves accurately,
3. Make informed decisions regarding field development plans



The Goal of Reservoir Modeling and Fluid Simulation

is increased hydrocarbon production with an increased rate of return.

A Geo-Cellular Model



- Geometry
- Lithology
- Porosity
- Permeability
- Initial Fluid Saturation

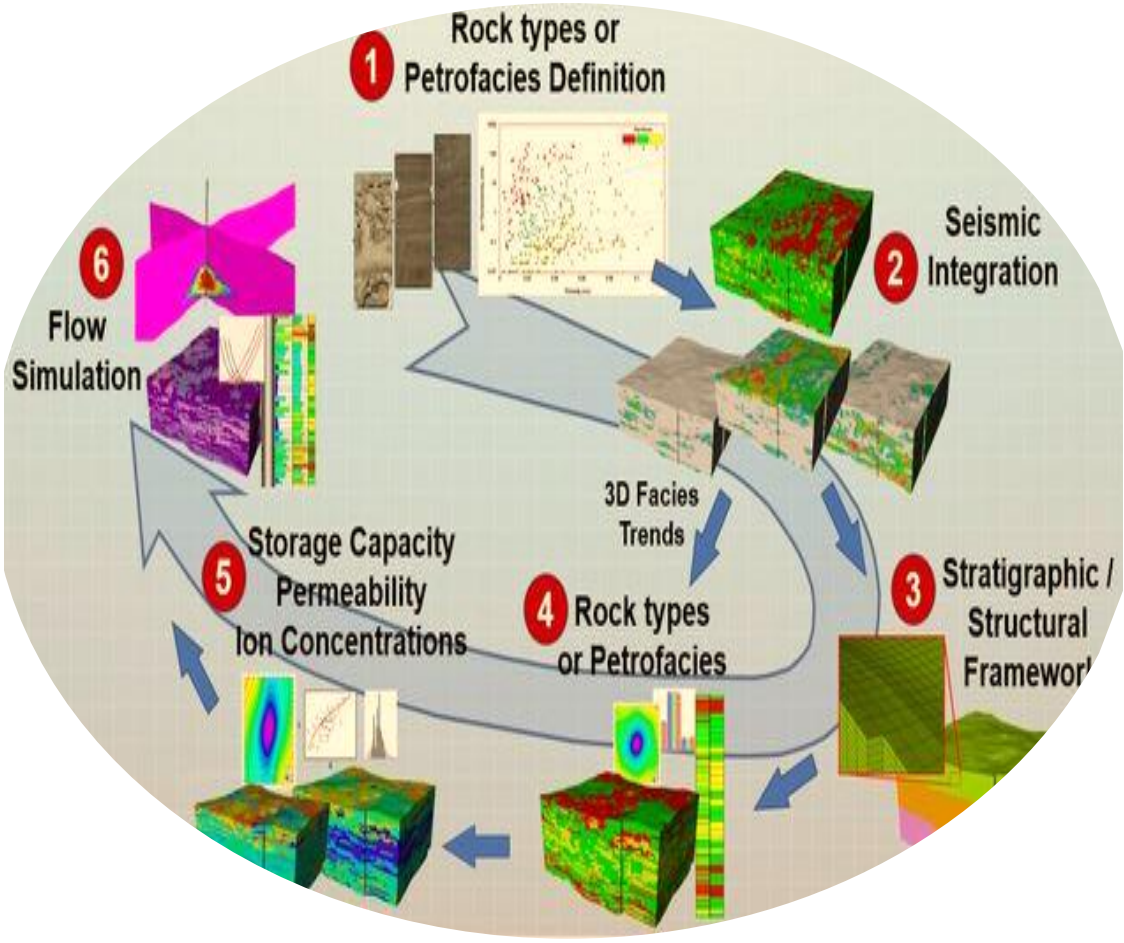
Data for Static Reservoir Model

01 Seismic Data

02 Cores

03 Well Logs

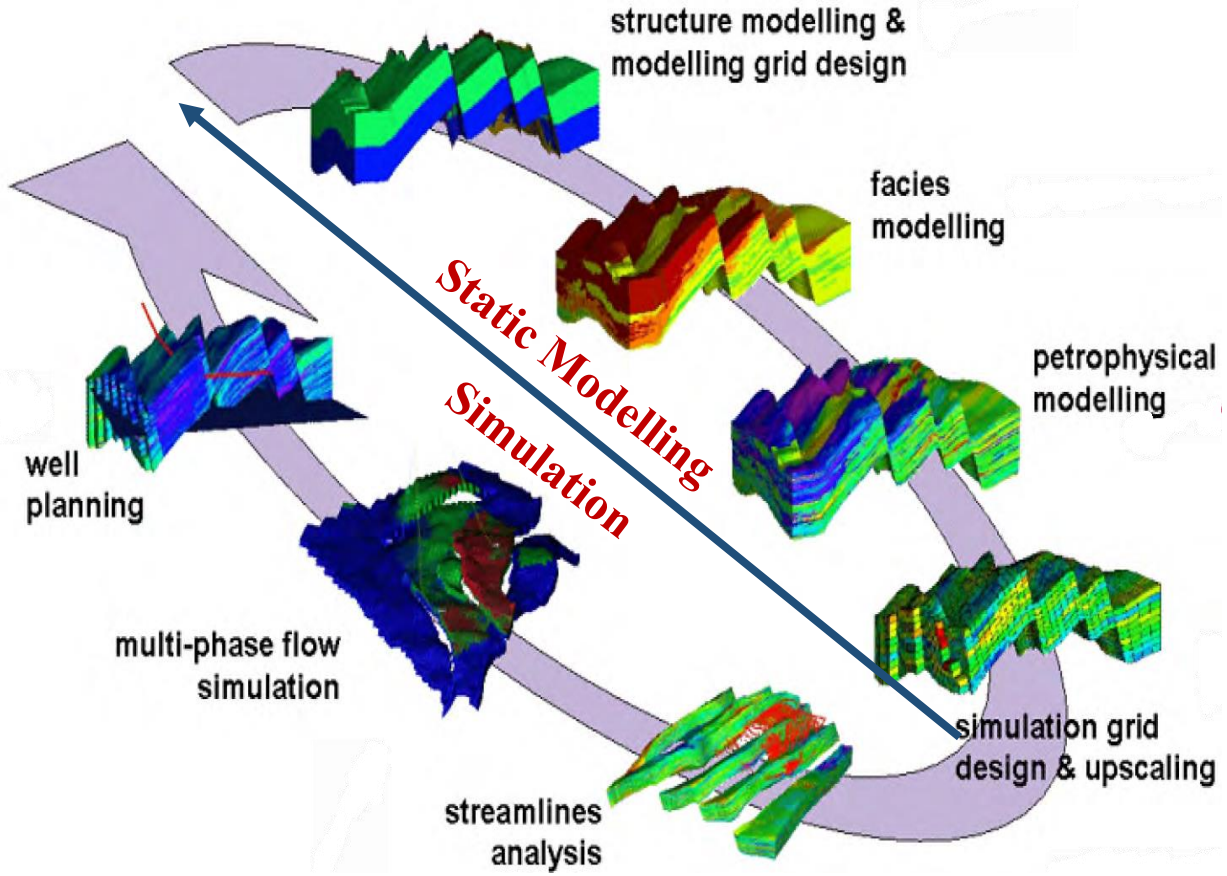
04 Outcrops



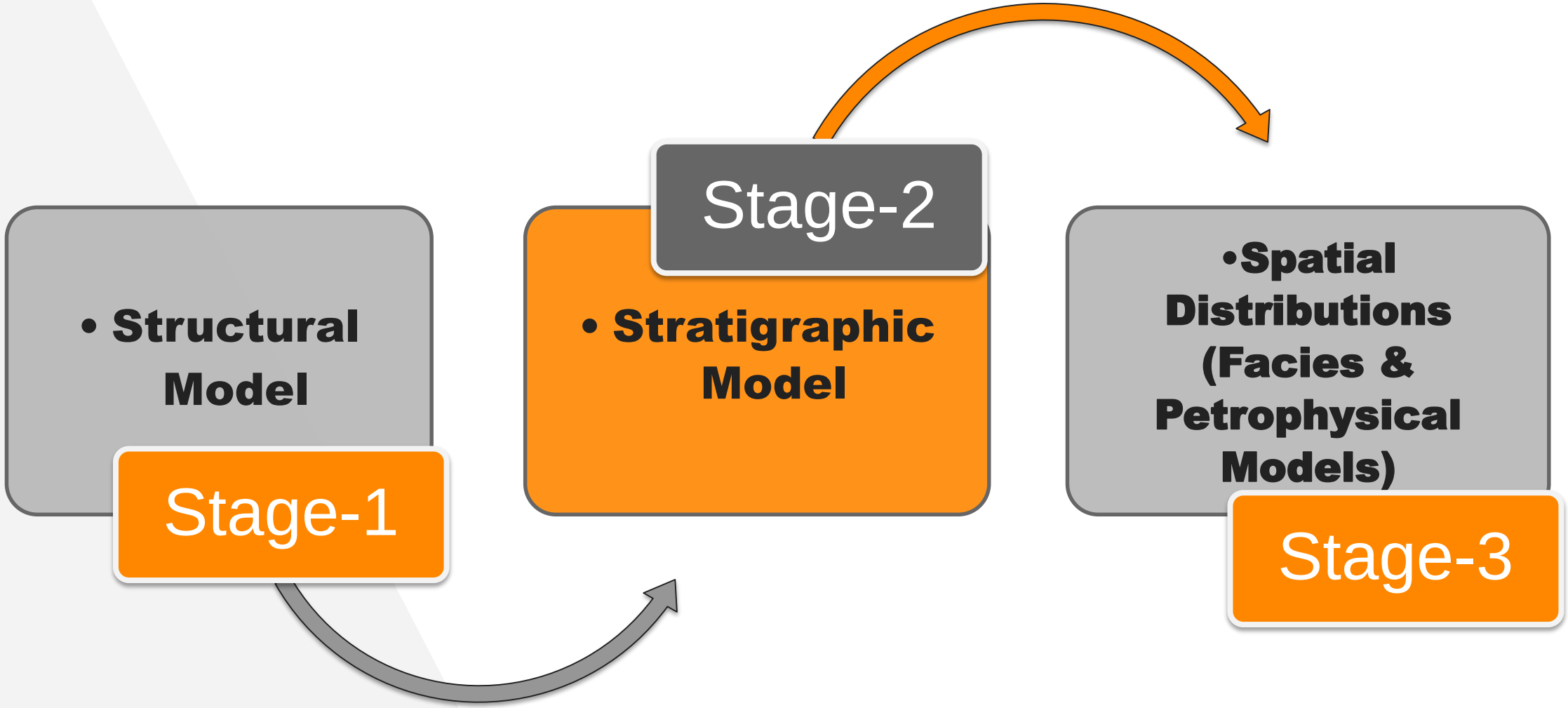
Differences Between Static and Dynamic Reservoir Model

Static Reservoir Model provides a representation of the structure, thickness, lithology, porosity, initial fluids in the reservoir.

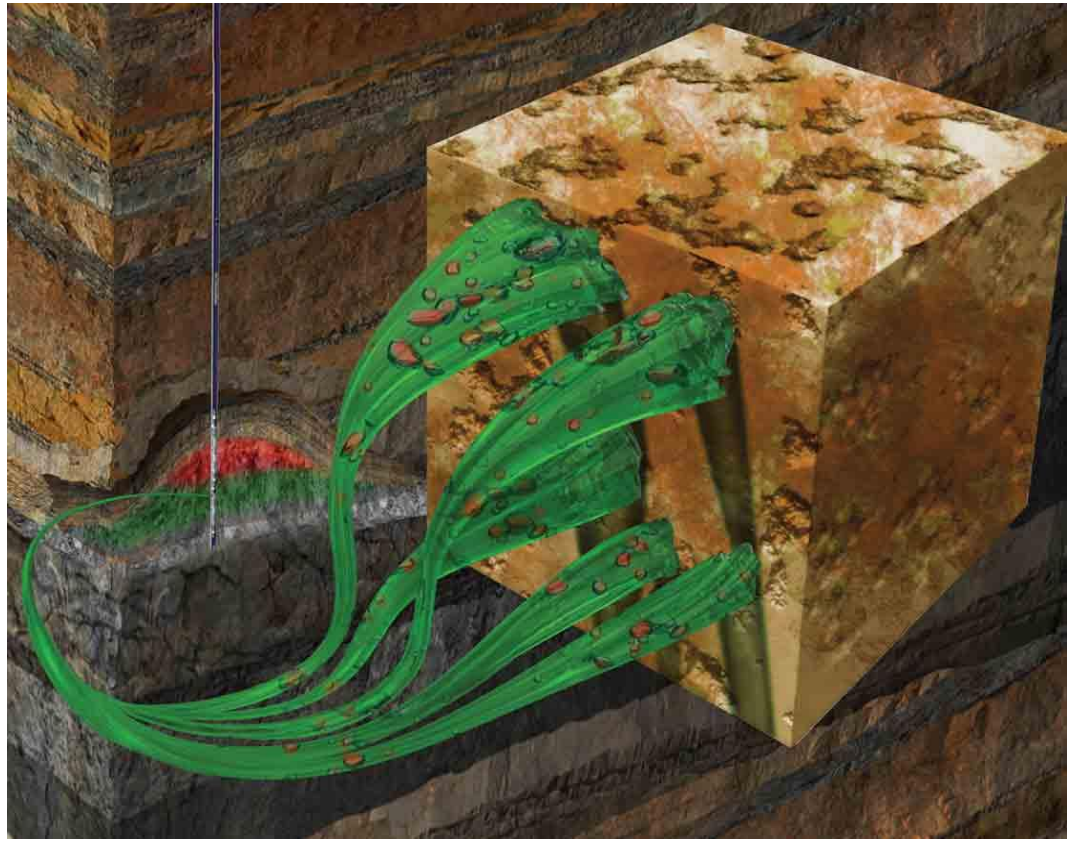
Dynamic Reservoir Model is a representation of the changes in fluid flow in the reservoir model that needs to be validated with reservoir performance data- pressure changes, production and injection rates.

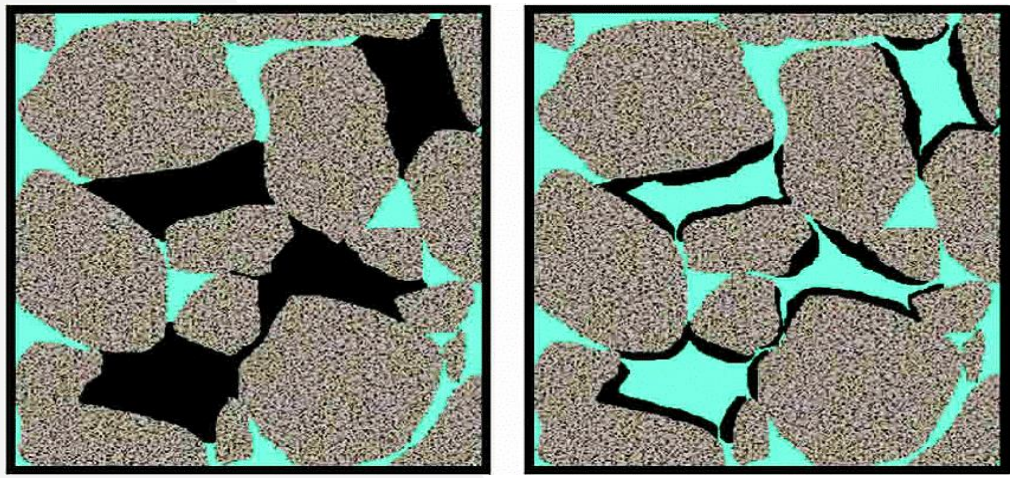


Building of Reservoir Model Include:



When we build models of oil and gas resources in the subsurface *we should never ignore the fact that the fluid resources are* ***contained within rock formations***.





Requires of Constructing a Good Reservoir Model

- Multi Specialties Analysis
- Integration of These Specialties.

Question

Why building a model of an oil and gas reservoir is complex?

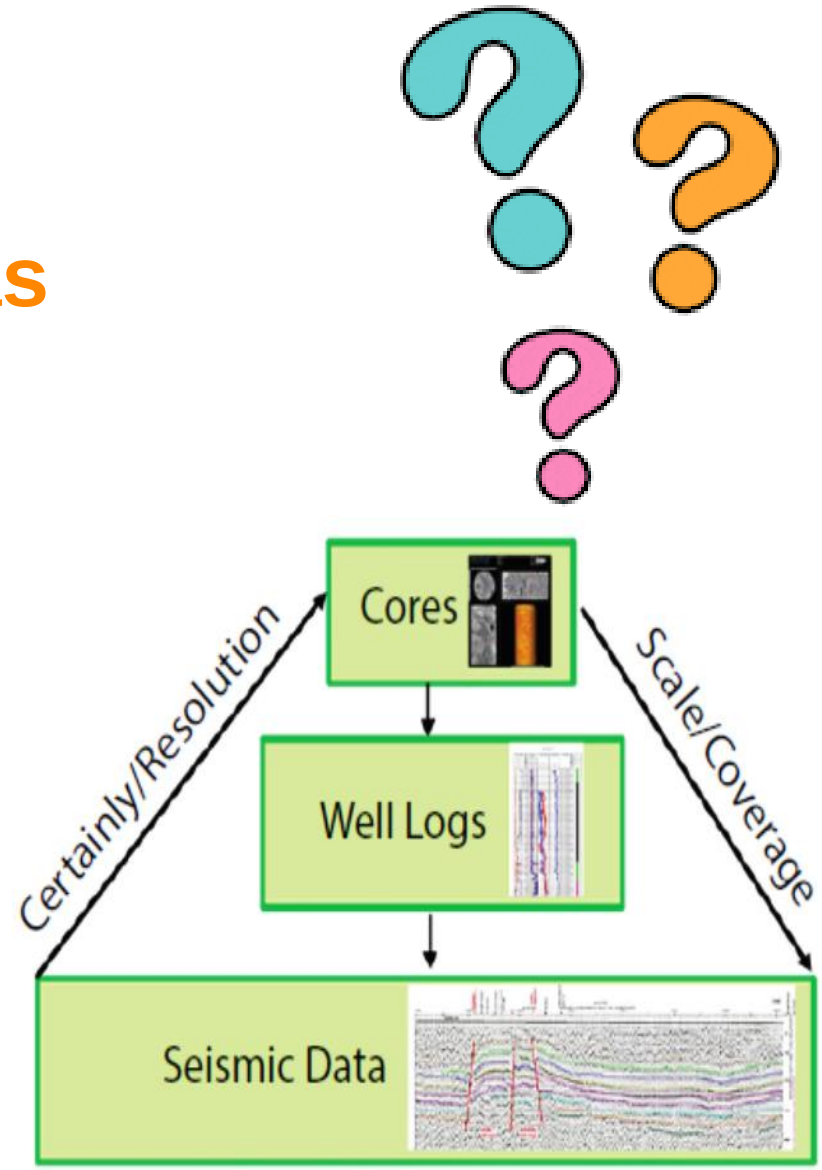
1 because of the variety of data types involved as the many different steps required.

Question

Why building a model of an oil and gas reservoir is complex?

2 to integrate measurements that are of different **Scale, Uncertainty, Resolution, and Environment** or the **SURE** Challenge

3 the complex fluids present in the reservoir.



Question

The Building of Reservoir Model include:

A - Structural Model

B- Stratigraphic Model

C- Structural and Stratigraphic Model

D- Facies Model

Evolution of Reservoir Modeling Techniques Over the Years

- **Early Reservoir Models:** The earliest reservoir models were basic and relied on simple geological data to estimate reservoir properties and fluid flow. They were limited in their accuracy and did not take into account complex geological features and heterogeneities. These models were mainly used for *exploration purposes and to estimate the size of the reservoir*.
- **2D Reservoir Models:** which allowed for a more accurate representation of geological features and heterogeneities. These models were able to simulate fluid flow in more complex reservoirs, such as those with faults and fractures. However, they still had limitations in their ability to capture the full complexity of the reservoir.

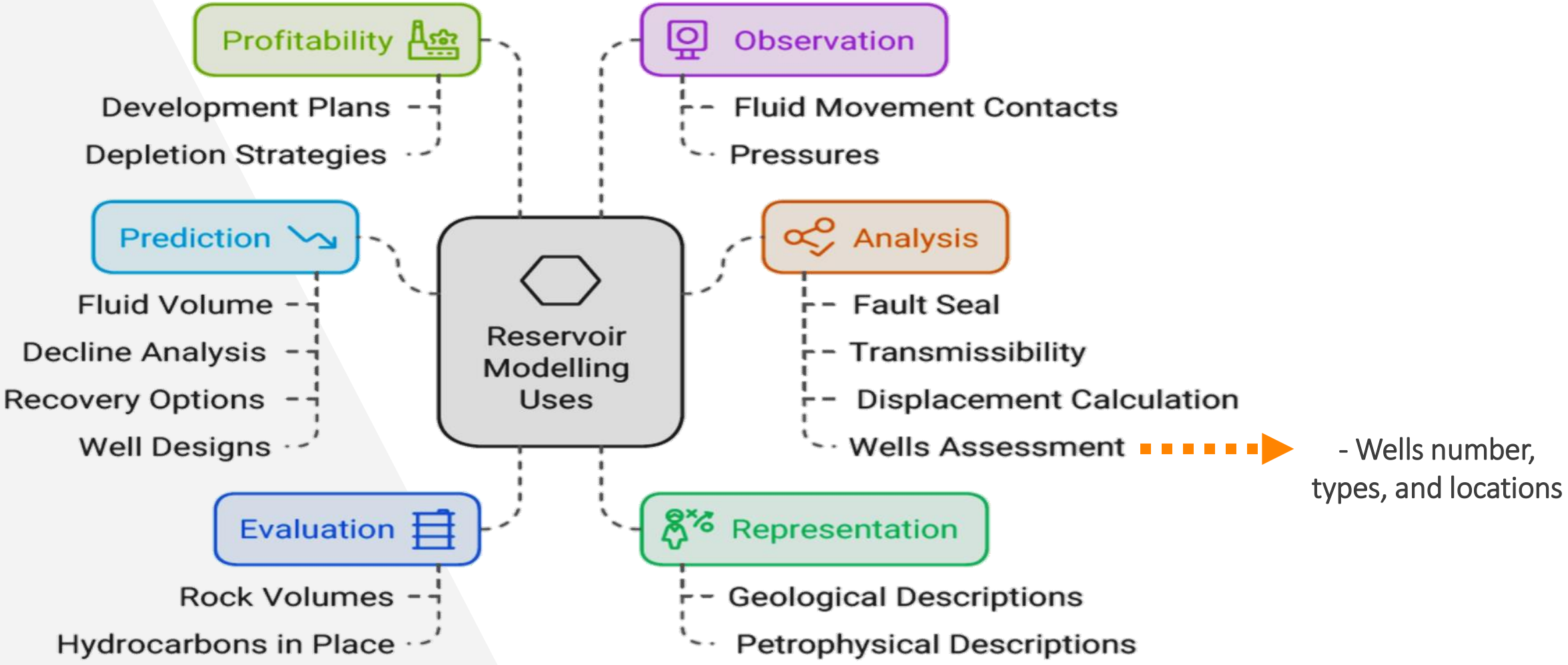
Evolution of Reservoir Modeling Techniques Over the Years

- **3D Reservoir Models:** more accurate representation of the reservoir and its properties, able to simulate fluid flow in complex reservoirs, used to optimize production strategies, provided a more detailed understanding of the reservoir's structure and properties, enabling operators to make better decisions about drilling and production.
- **Integrated Reservoir Models:** more comprehensive model (geological, geophysical, and engineering data) of the reservoir, allowed operators to simulate fluid flow and production in real-time, enabling them to adjust production strategies based on changing conditions, allowed for better prediction of future reservoir behavior and provided a more complete understanding of the reservoir.

Evolution of Reservoir Modeling Techniques Over the Years

- **Advanced Reservoir Models:** including **Machine Learning** and artificial intelligence-based models. These models are able to analyze large amounts of data and make predictions about future reservoir behavior. They can identify patterns and trends that may not be immediately apparent to human operators, allowing for more informed decisions about production strategies. These models are particularly useful in unconventional reservoirs, where traditional modeling techniques may not be sufficient.

The Uses of Reservoir Modelling



Reservoir Modeling According to the Stages the Reservoir Life Cycle:

Exploration (EXP)

- Enhance depositional environment and conceptual model understanding.
- Refine stratigraphic model.
- Assess fault partition.
- Identify new prospects.
- Use the model as a data/information store.

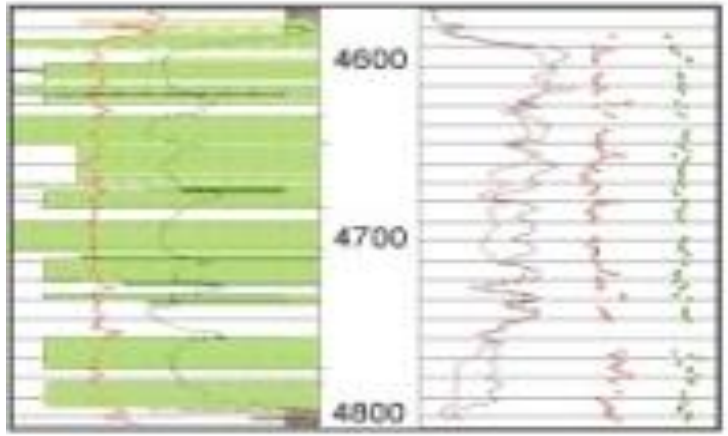
Development (DEV)

- Build more-detailed structural and stratigraphic model.
- Plan and design wells.
- Computing the production profiles (oil, gas, and water).
- Estimating the oil and gas technical reserves.
- Assess intermediate-scale reservoir heterogeneities and connectivity.

Production (PRD)

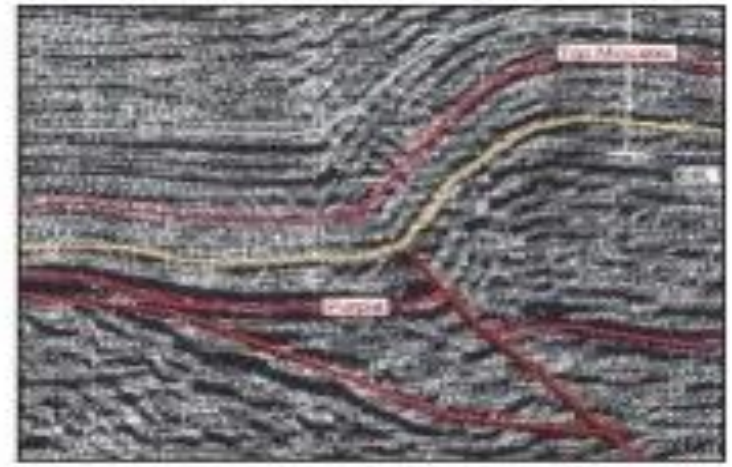
- Assess small-scale heterogeneities, including flow units modeling.
- Use for reservoir management.
- Matching of the past production history (fluid rates, GOR, WC, pressures, etc).
- Optimize production in the field.
- Perform enhanced oil recovery (EOR)

Tools for reservoir characterization



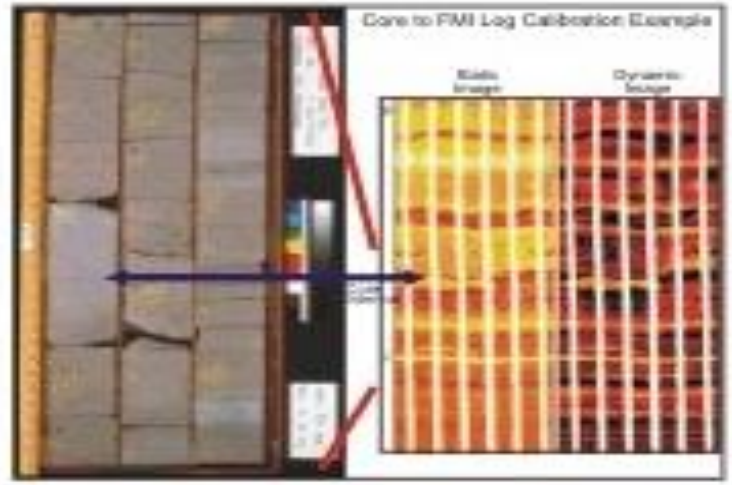
Conventional logs

Conceptual model

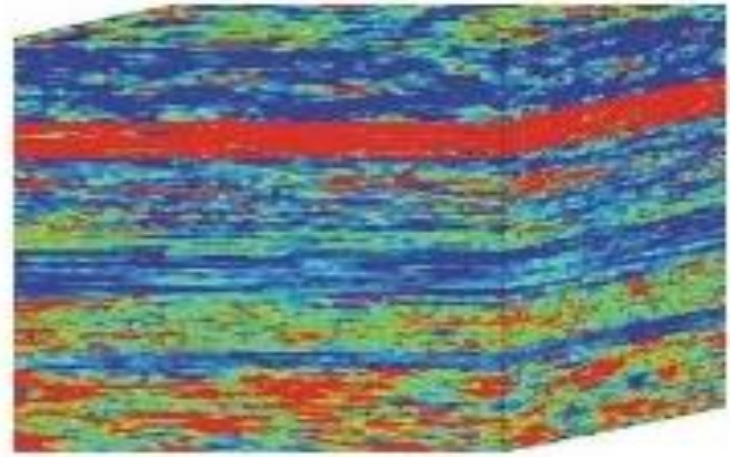


Seismic reflection

Outcrops



Cores & borehole image logs



Computer 3D geologic models