

# **PS Assigning Volumes in Multiple-Lease Prospects**

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## **Abstract**

The large prospects under evaluation in regions such as the deep water Gulf of Mexico typically extend onto multiple lease blocks or concessions. The value of each lease is a function of the potential hydrocarbon volume within the lease boundary.

Calculating the hydrocarbon volume by lease for a field or a well defined discovery is straightforward using deterministic methods. However, the methods for calculating a representative hydrocarbon volume by lease for an undrilled prospect or a new discovery are not well established.

If a hydrocarbon accumulation extends onto multiple leases, the volumes cannot be apportioned to the leases based on the mapped area within each lease. An updip lease containing a given productive area may contain a greater hydrocarbon volume than a downdip lease containing the same productive area, due to the thinning of the accumulation as the reservoir top intersects the hydrocarbon-water contact.

Assessment of hydrocarbon volume by lease must consider not only the productive area on each lease, but lateral variations in reservoir thickness, the height of the hydrocarbon column on the lease, and lateral variations in the dip of the reservoir. Assessment of an undrilled prospect or new discovery must consider the uncertainty associated with these factors.

Contact uncertainty may significantly impact the proportion of the accumulation that is assigned to each lease. A deep contact may result in a large percentage of the accumulation being on a downdip lease, while a shallow contact may place little or no hydrocarbons on a downdip lease. A very shallow contact may in effect add risk to a downdip lease if the accumulation does not extend onto the lease.

Proper calculation of lease value must integrate contact uncertainty with a realistic representation of the potential container. Depth-dependent volume methods that vary structural area and reservoir thickness with depth can be used to construct appropriate container models for each lease. Monte Carlo simulations can then integrate contact uncertainty with uncertainty associated with the container model. The results will include the range of volumes and the associated probabilities for each lease. Relative value can then be assigned, based on the risk volumes.



# Assigning Volumes in Multiple-Lease Prospects

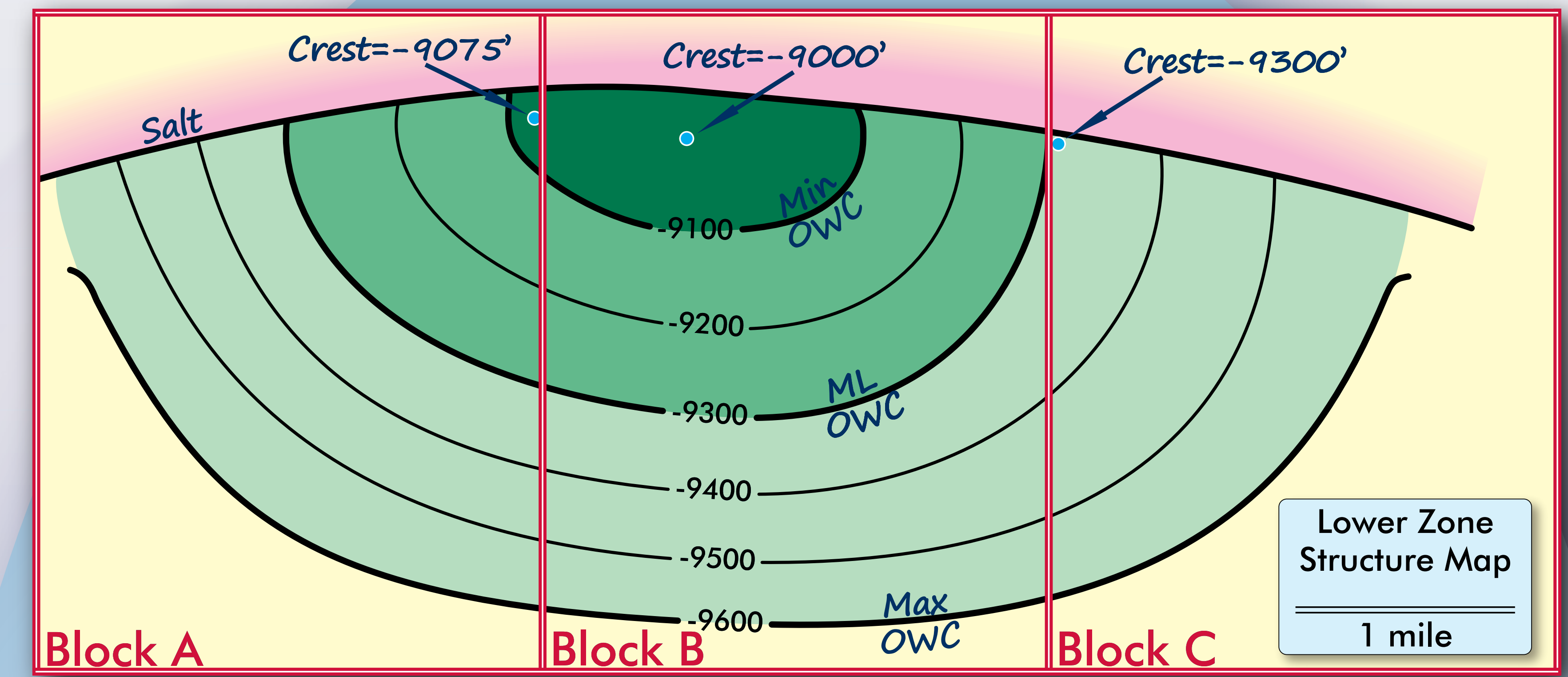
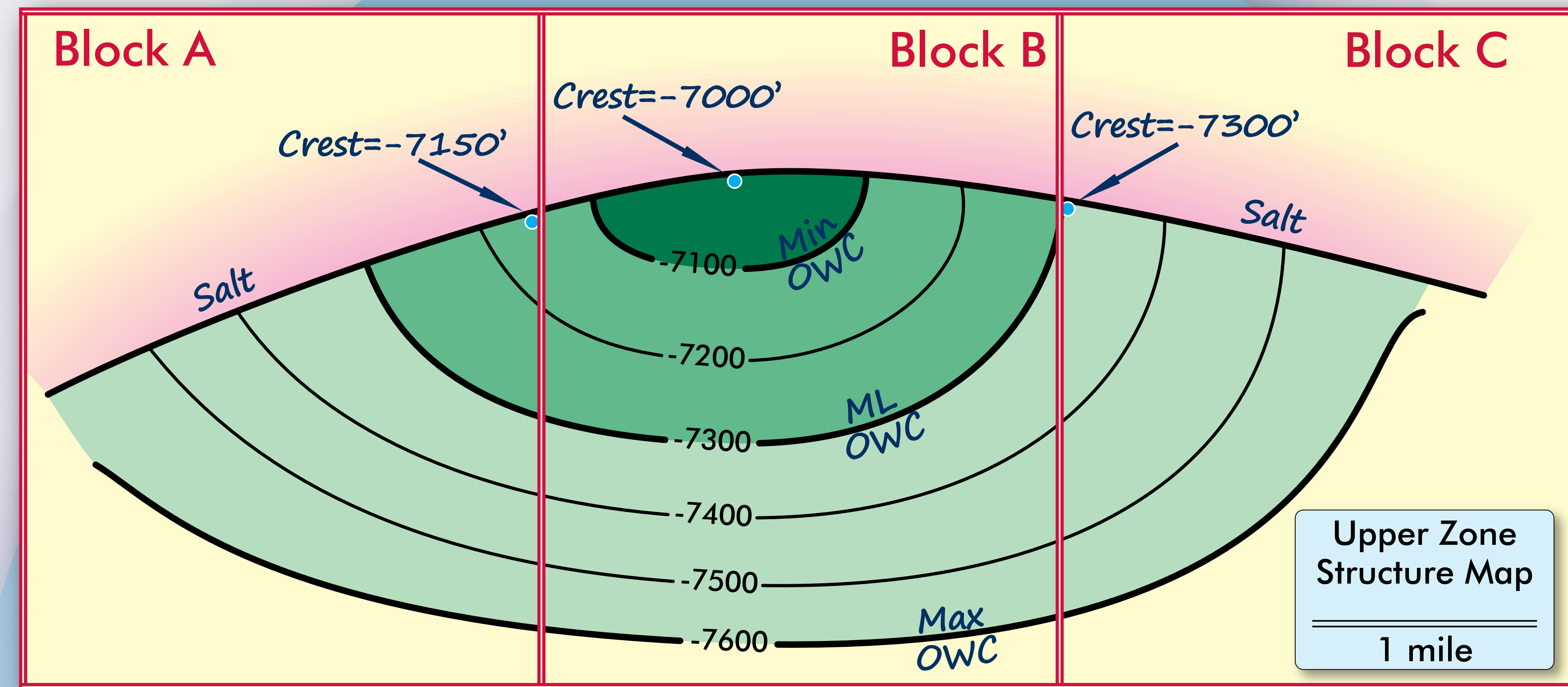
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## 1. Problem

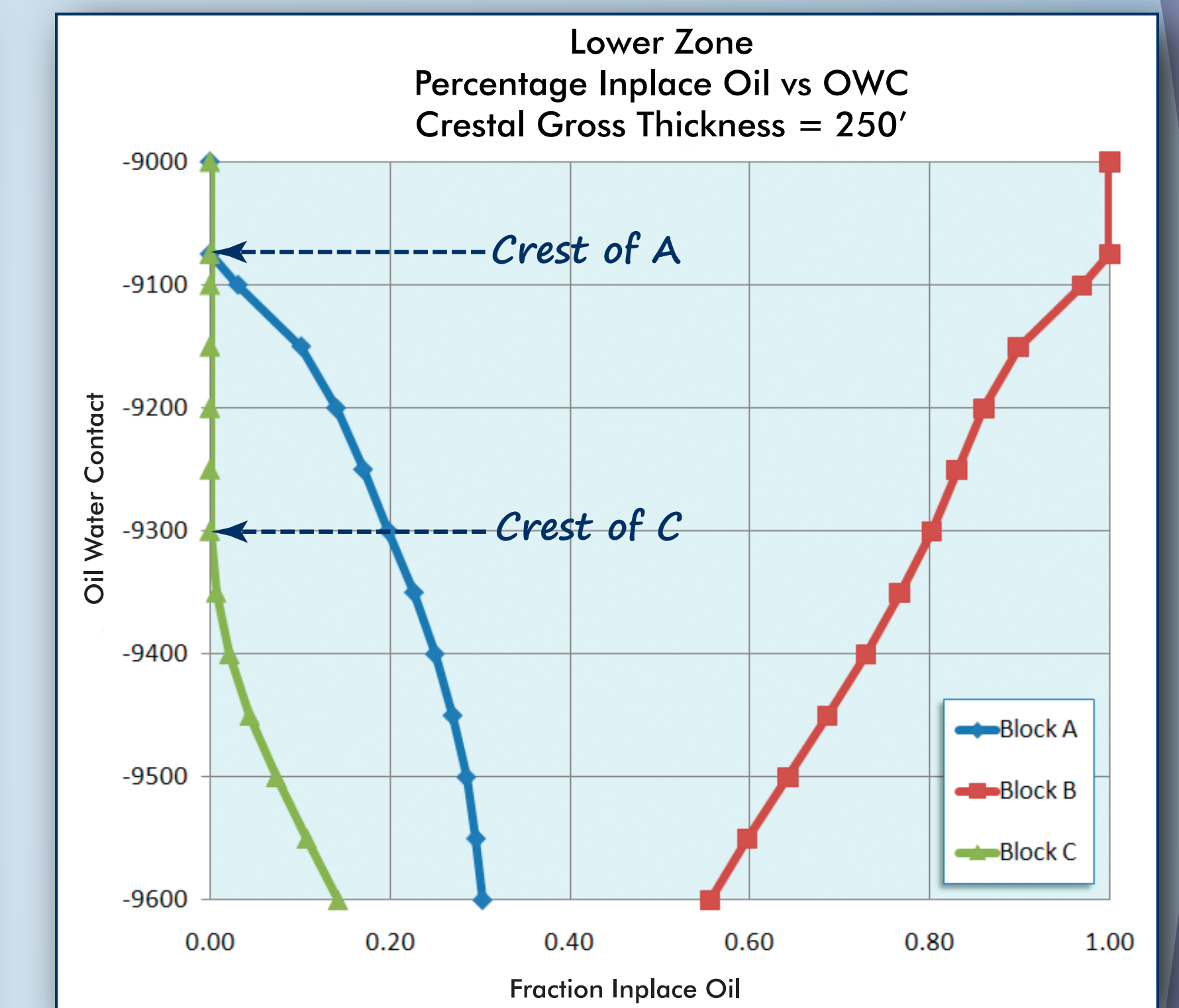
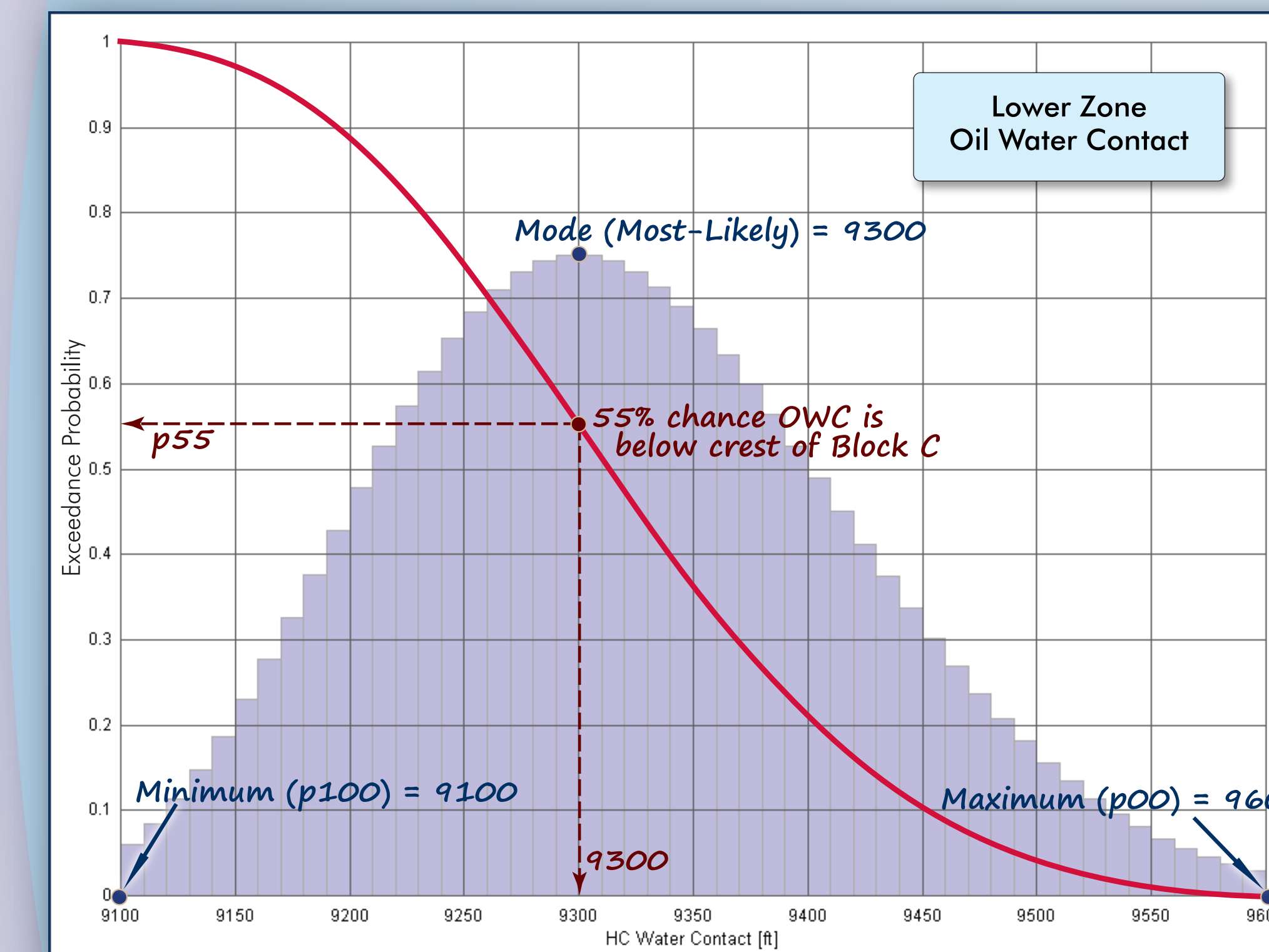
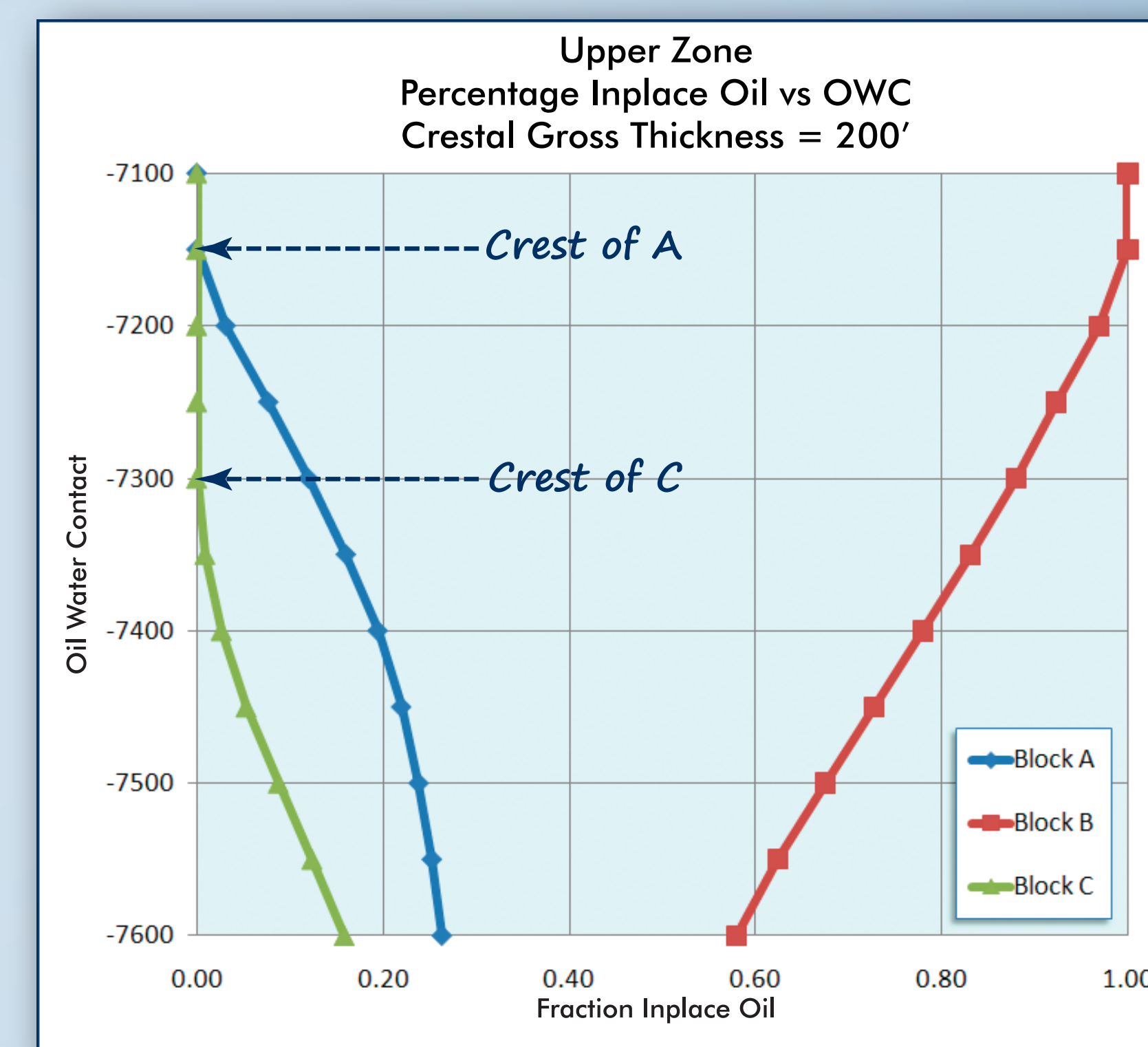
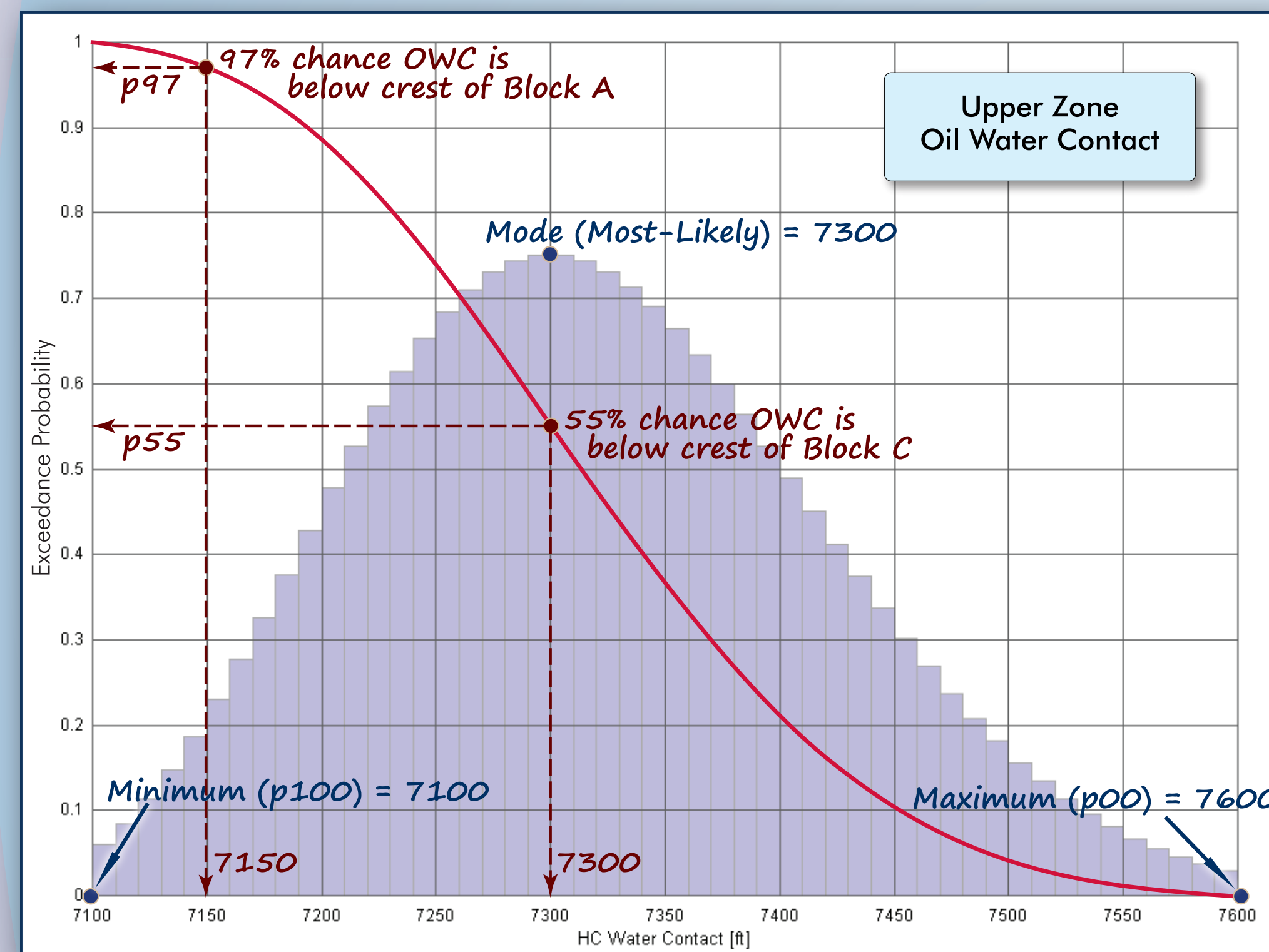
### Upper Zone

### Structure Maps & Lease Blocks

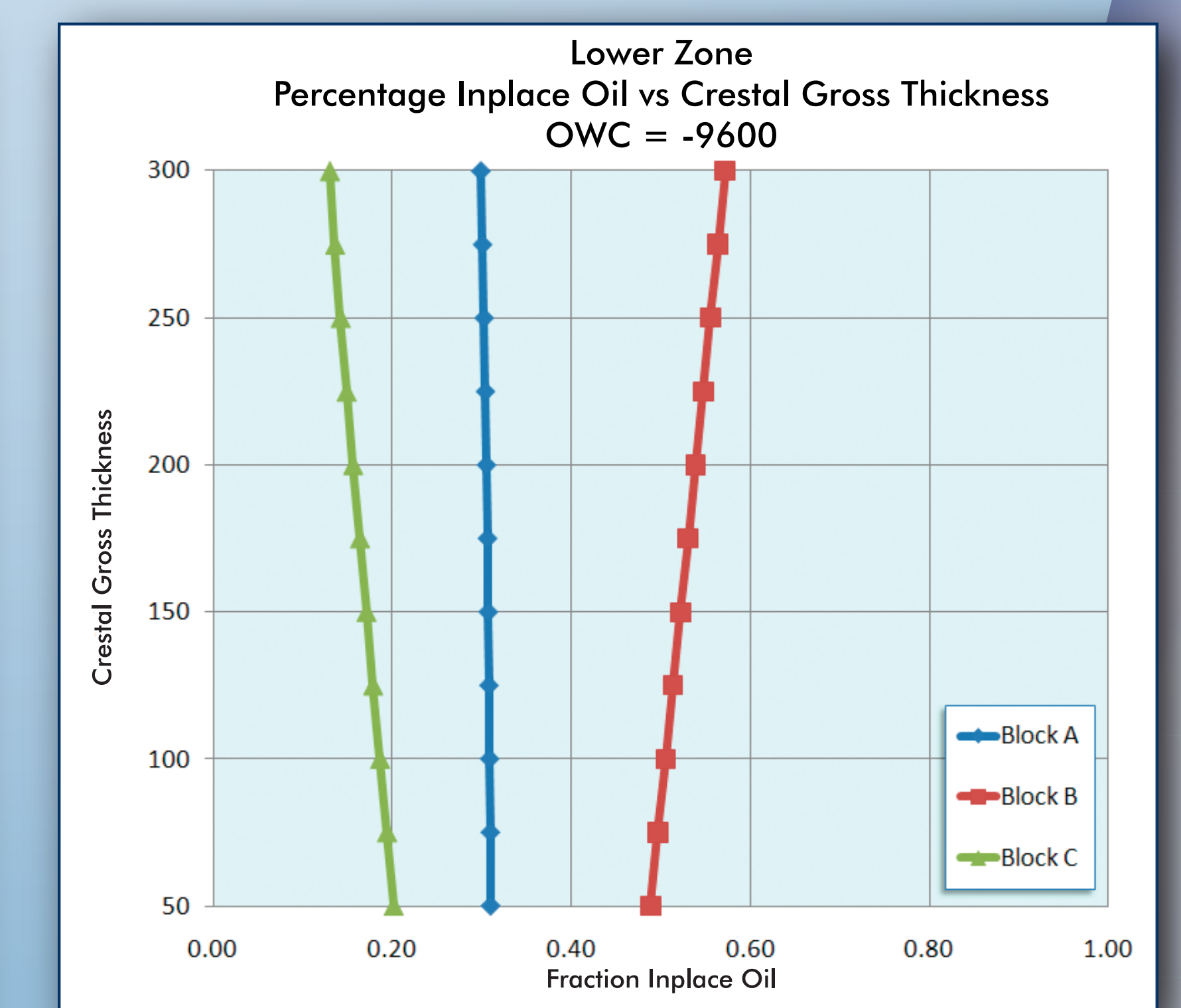
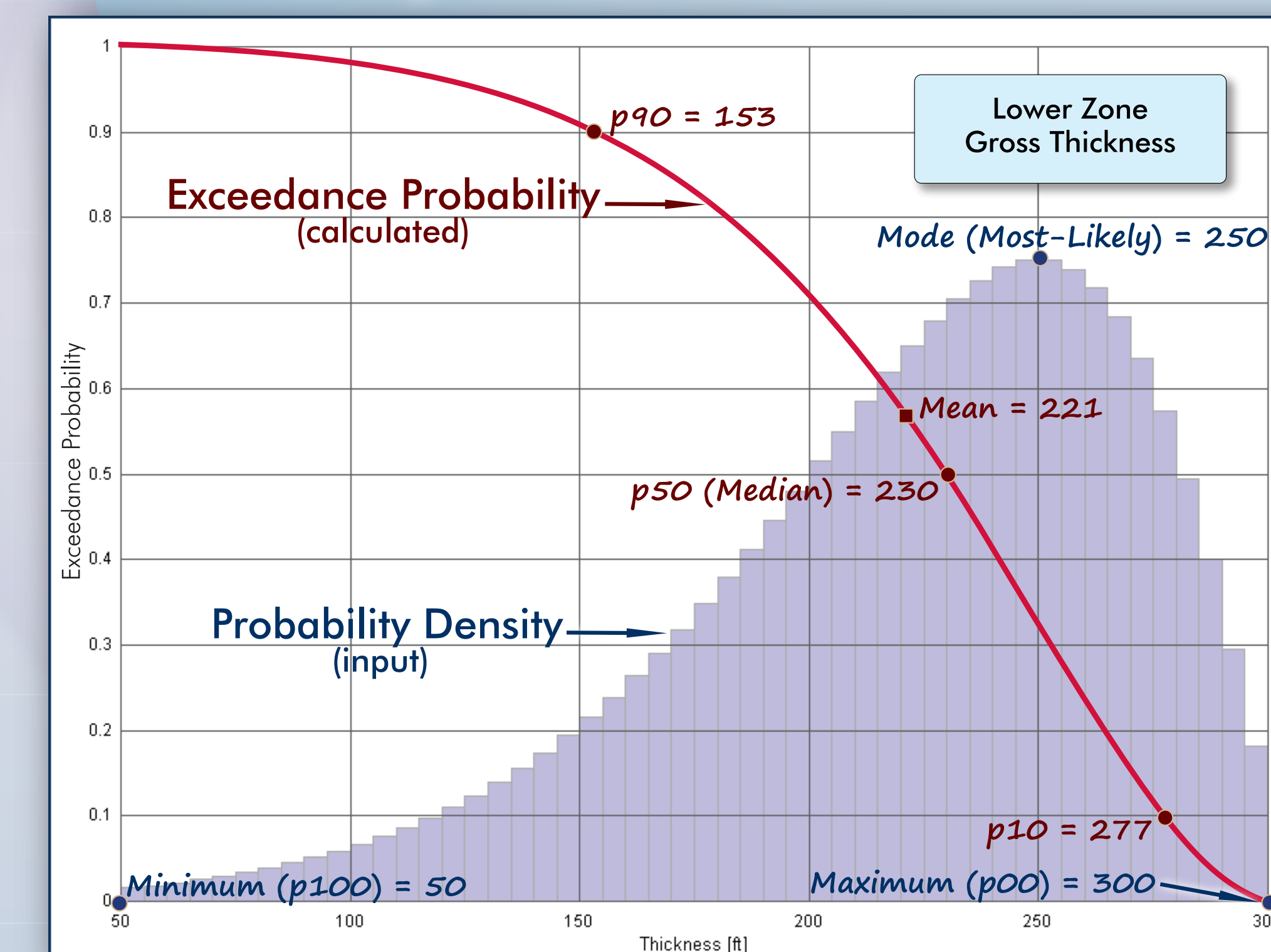
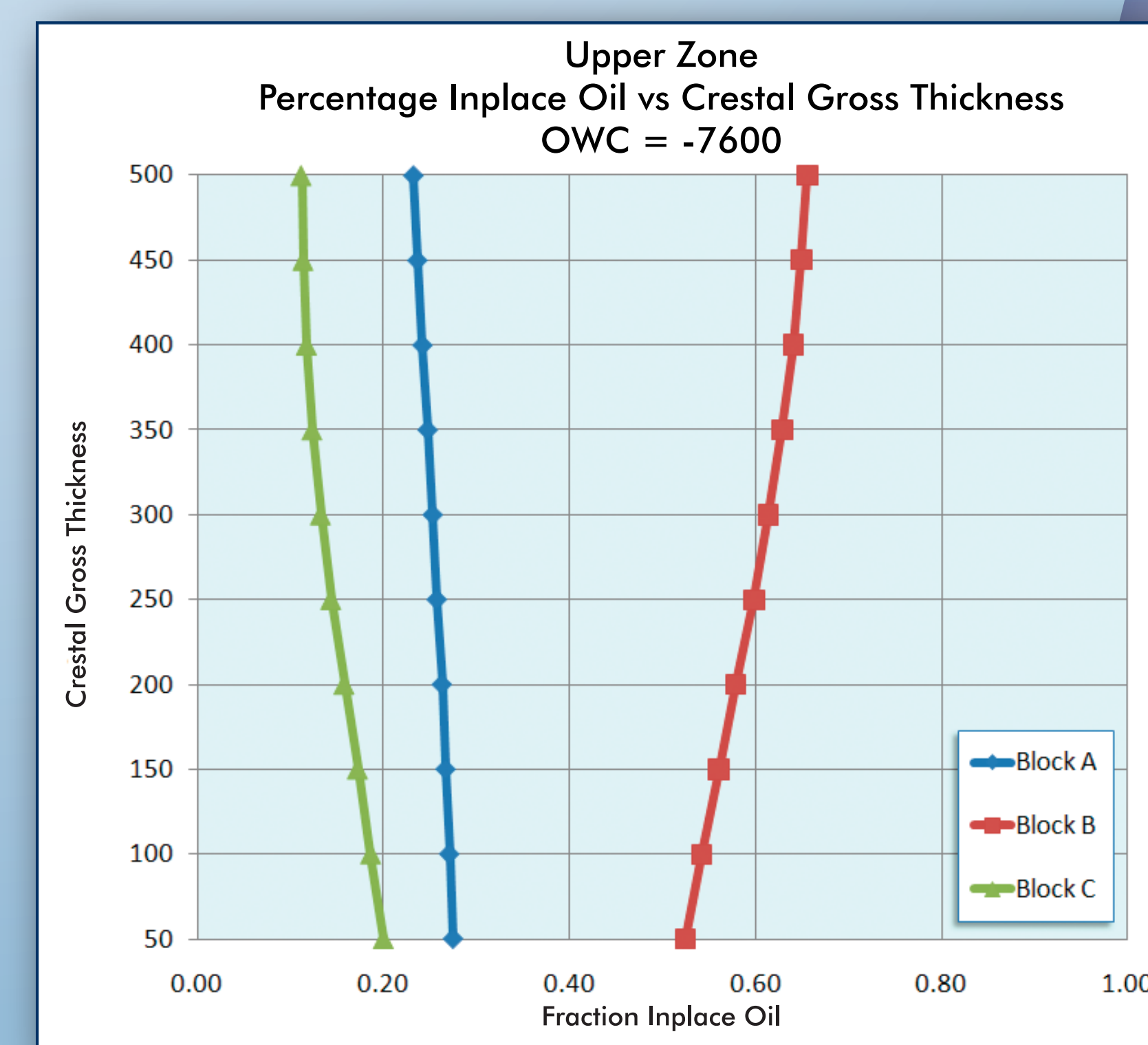
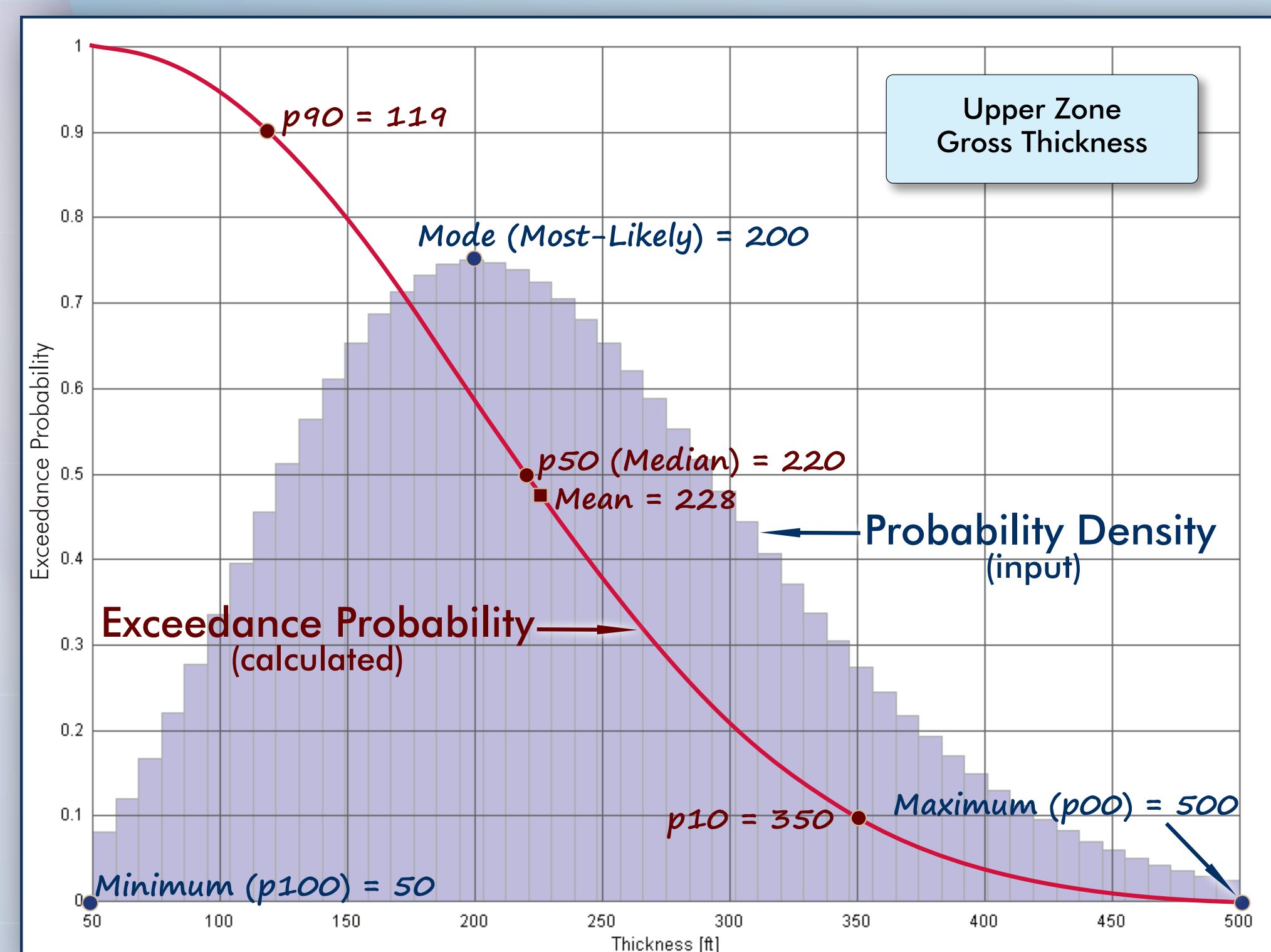
### Lower Zone



### Oil-Water Contact Uncertainty



### Thickness Uncertainty



### Problem:

- The prospect is within three lease blocks (A, B, and C).
- Prospect has two zones of interest (Upper and Lower).
- Percentage of resource volume in each block changes with contact depth.
- At deeper OWC's, percentage volume in each block is slightly impacted by thickness.
- **In the development cases, what volume should be assigned to each block?**

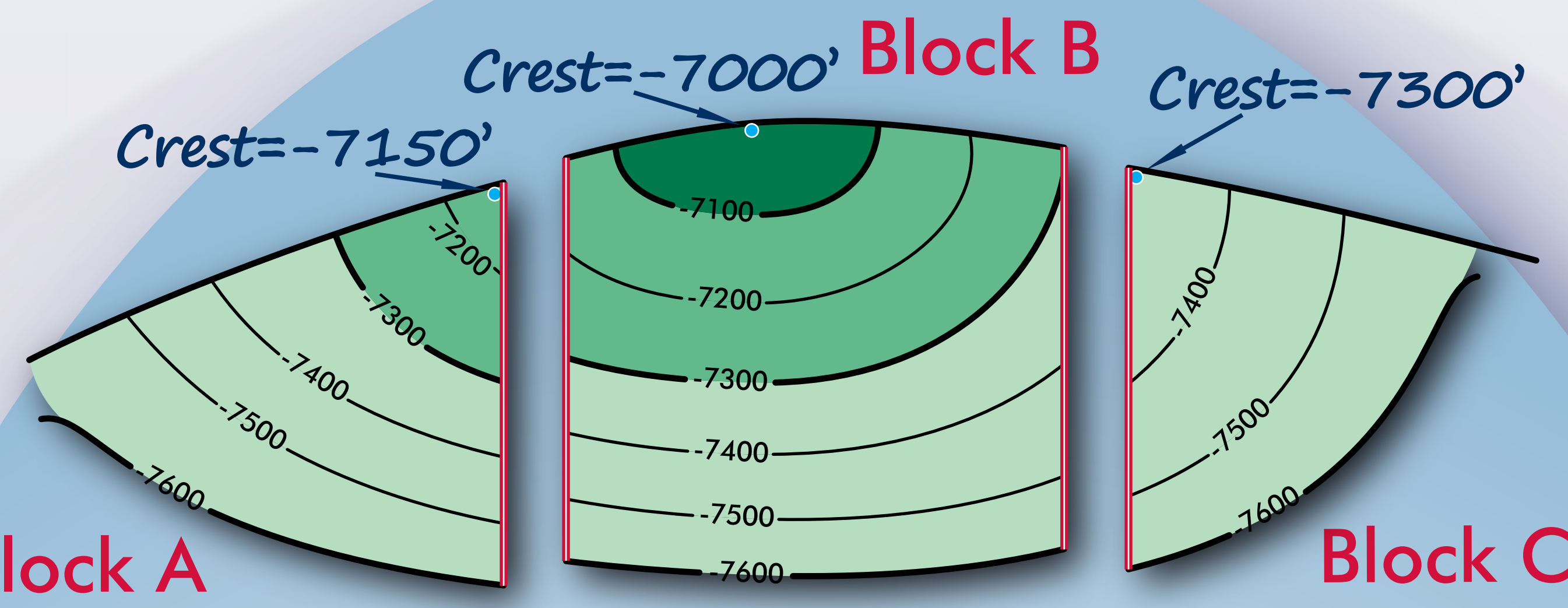


# Assigning Volumes in Multiple-Lease Prospects

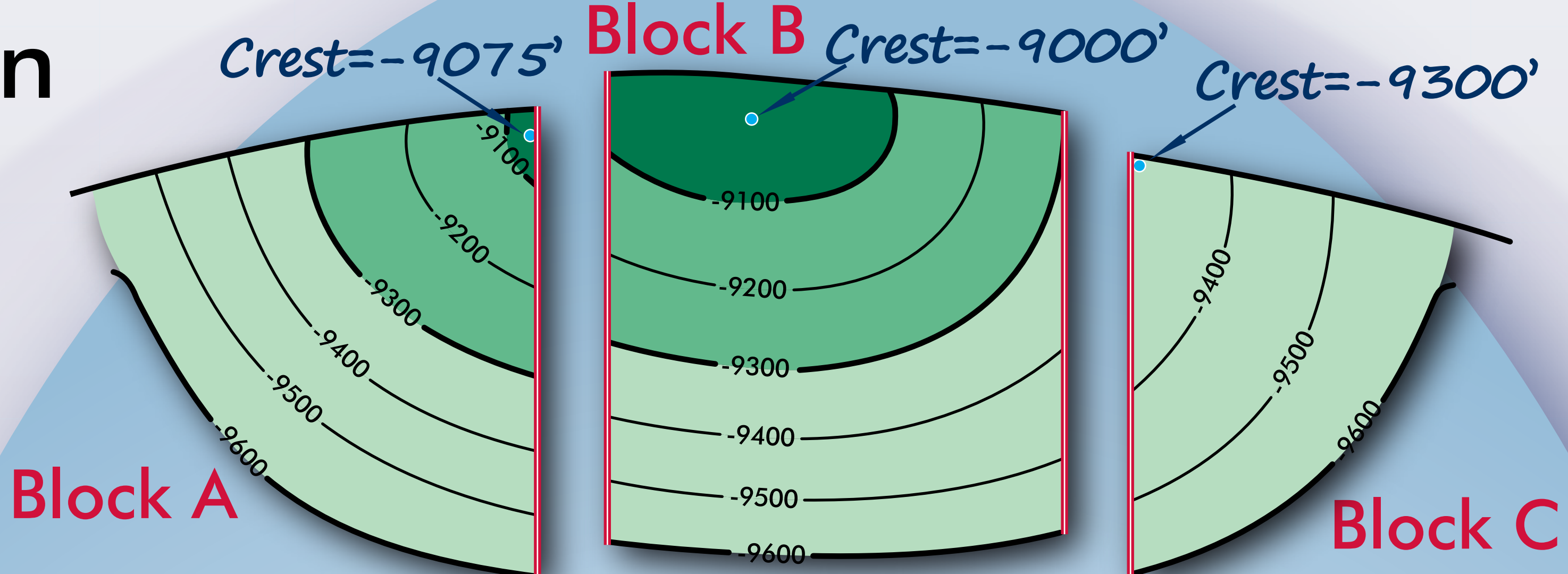
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## 2. Segment Models

### Upper Zone

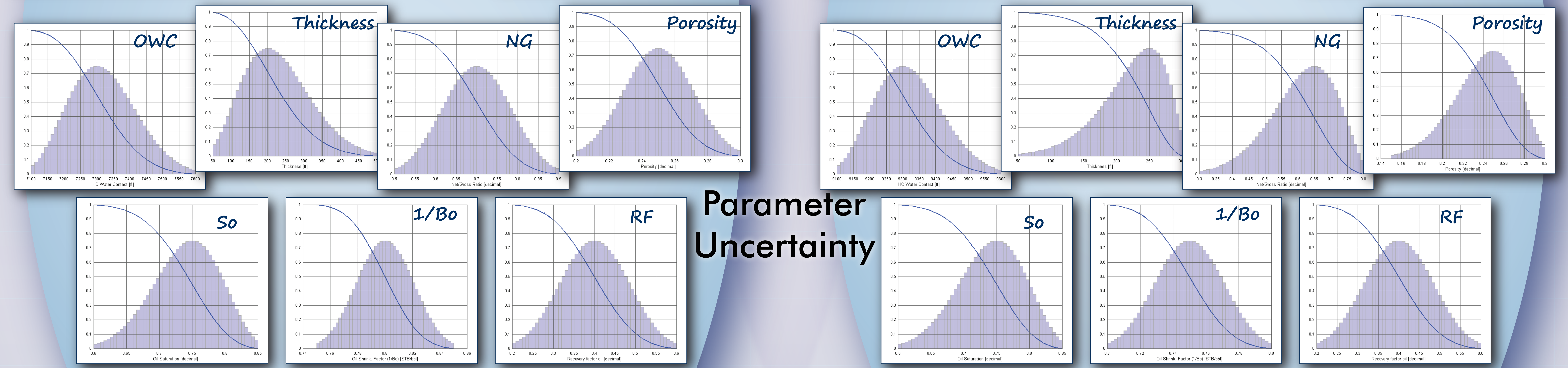
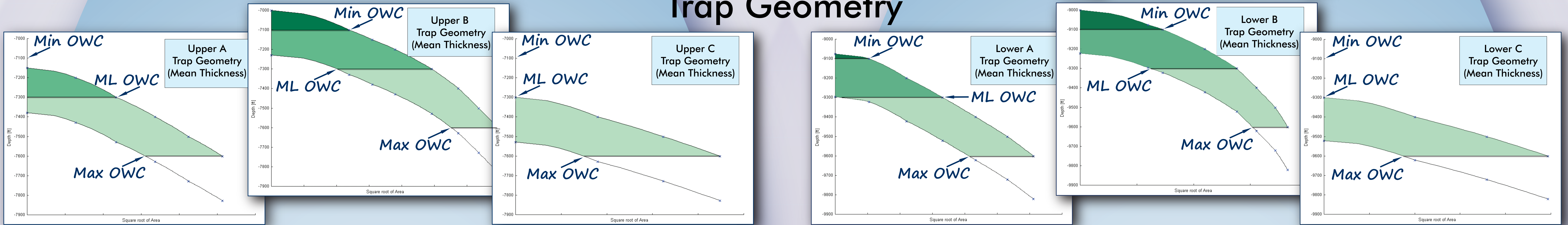


### Lower Zone



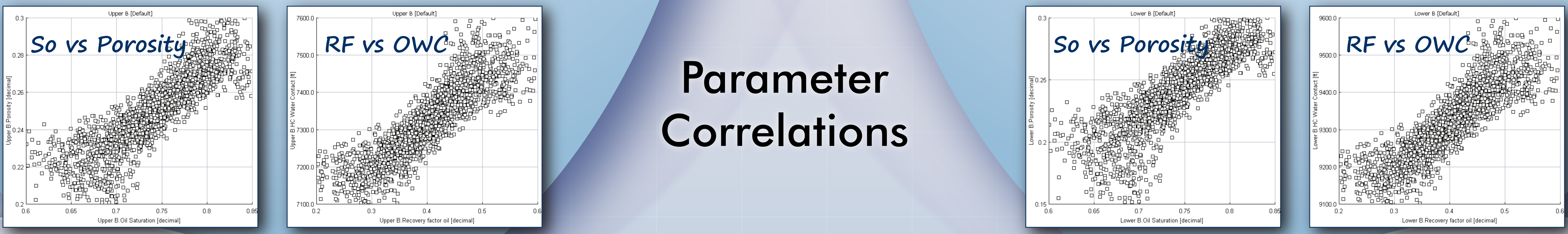
### Segment Definition

### Trap Geometry



### Parameter Uncertainty

### Parameter Correlations



Risk Factor	Probability
Trap	.70
Reservoir	.60
Source	1.00
Migration	1.00

### Zone Chance of Success

Risk Factor	Probability
Trap	.70
Reservoir	.50
Source	1.00
Migration	1.00

1. Define segments: portion of a zone on each block.
2. Input depths vs. areas for each segment.
3. Input parameter uncertainty for each segment.
4. Input parameter correlations within each segment.
5. Input chance of success for the zone.



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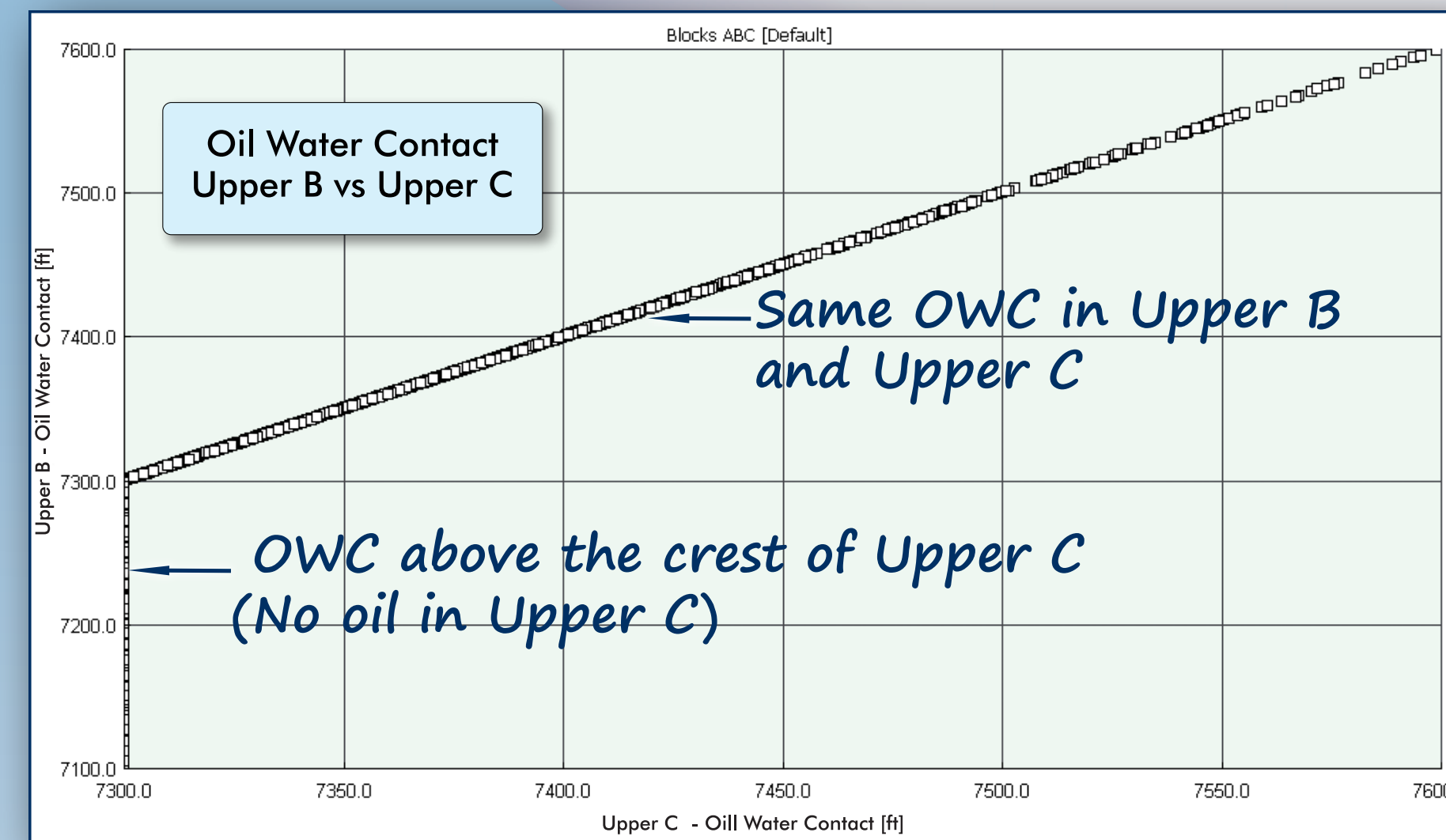
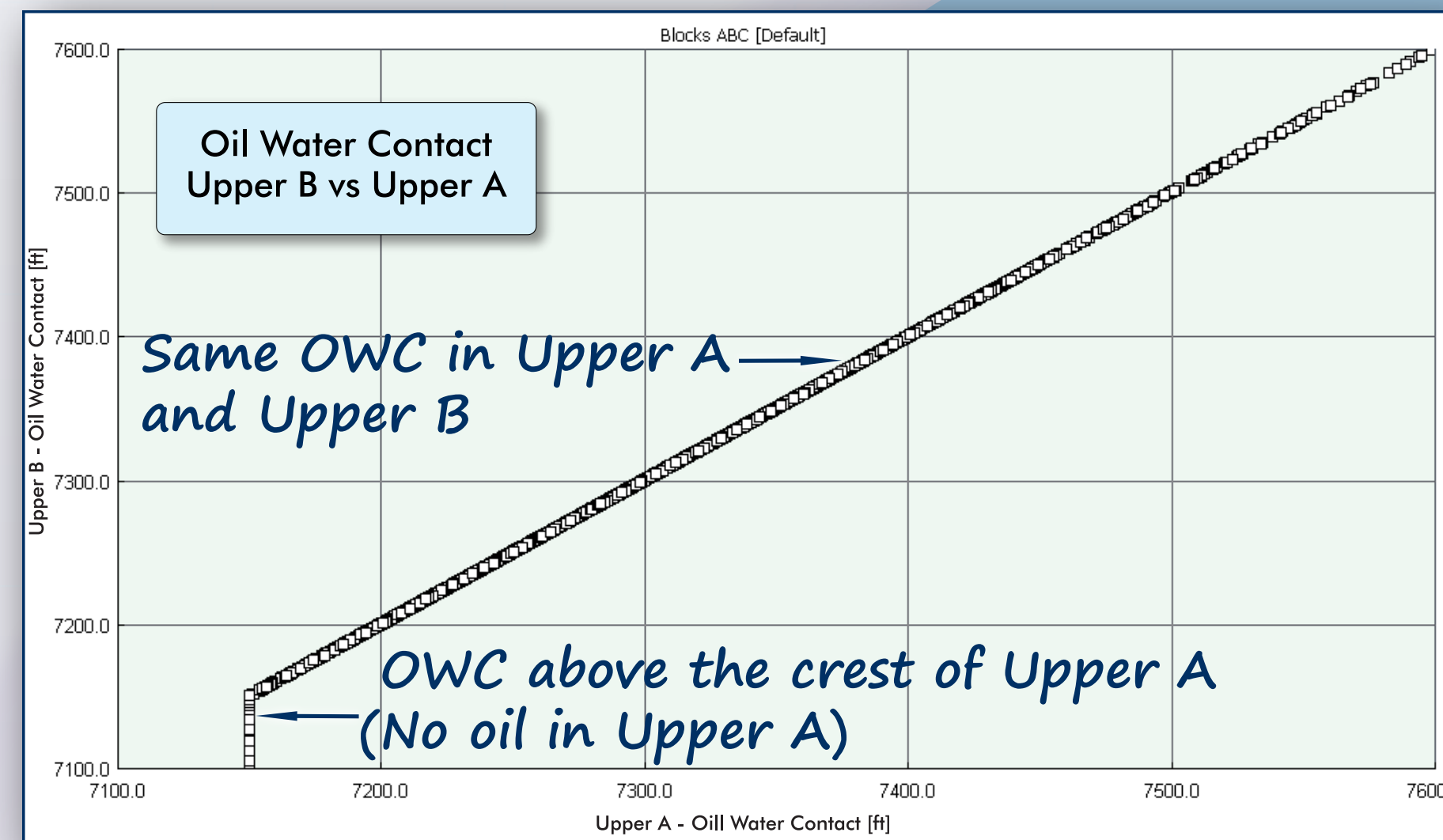
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## 3. Prospect Model

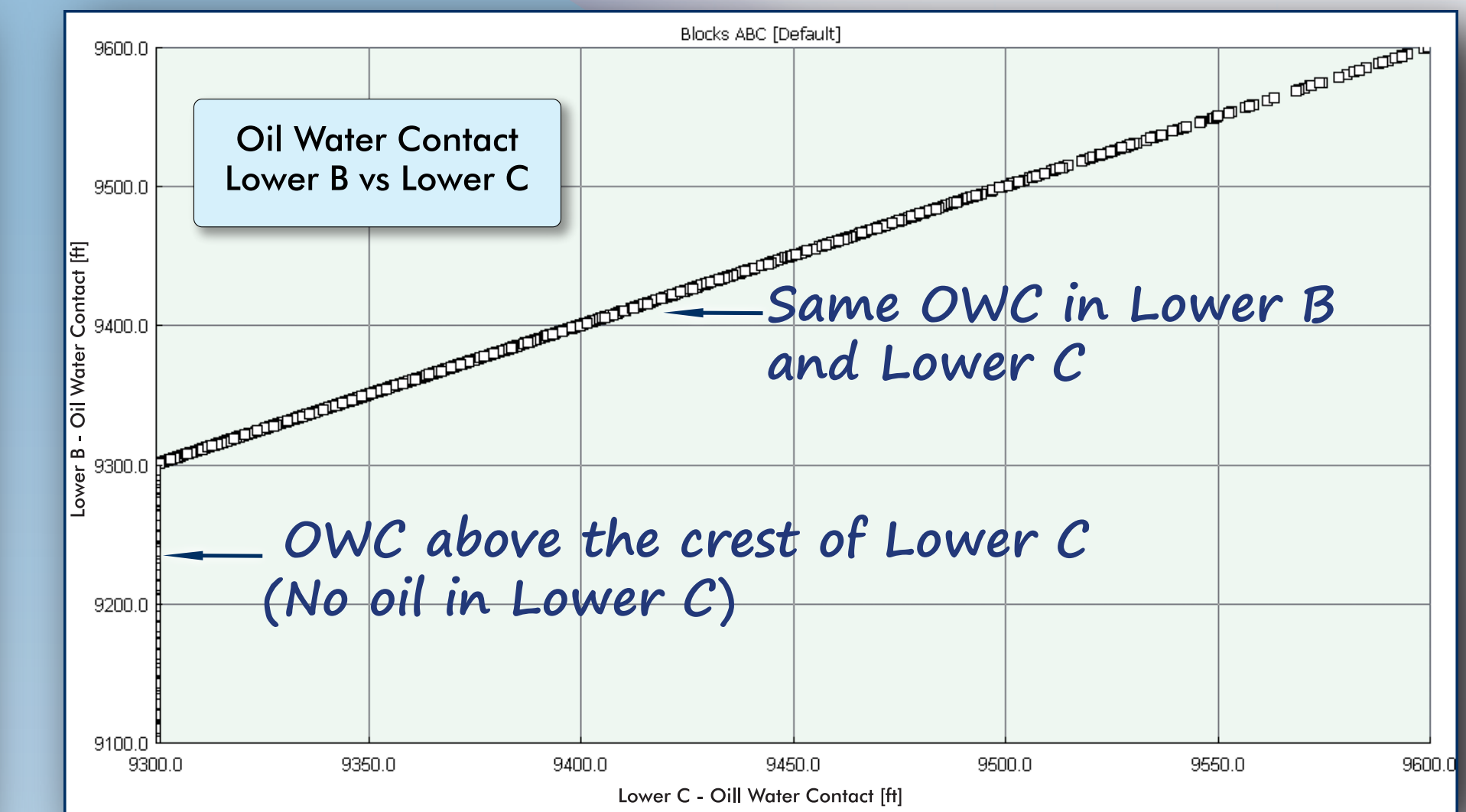
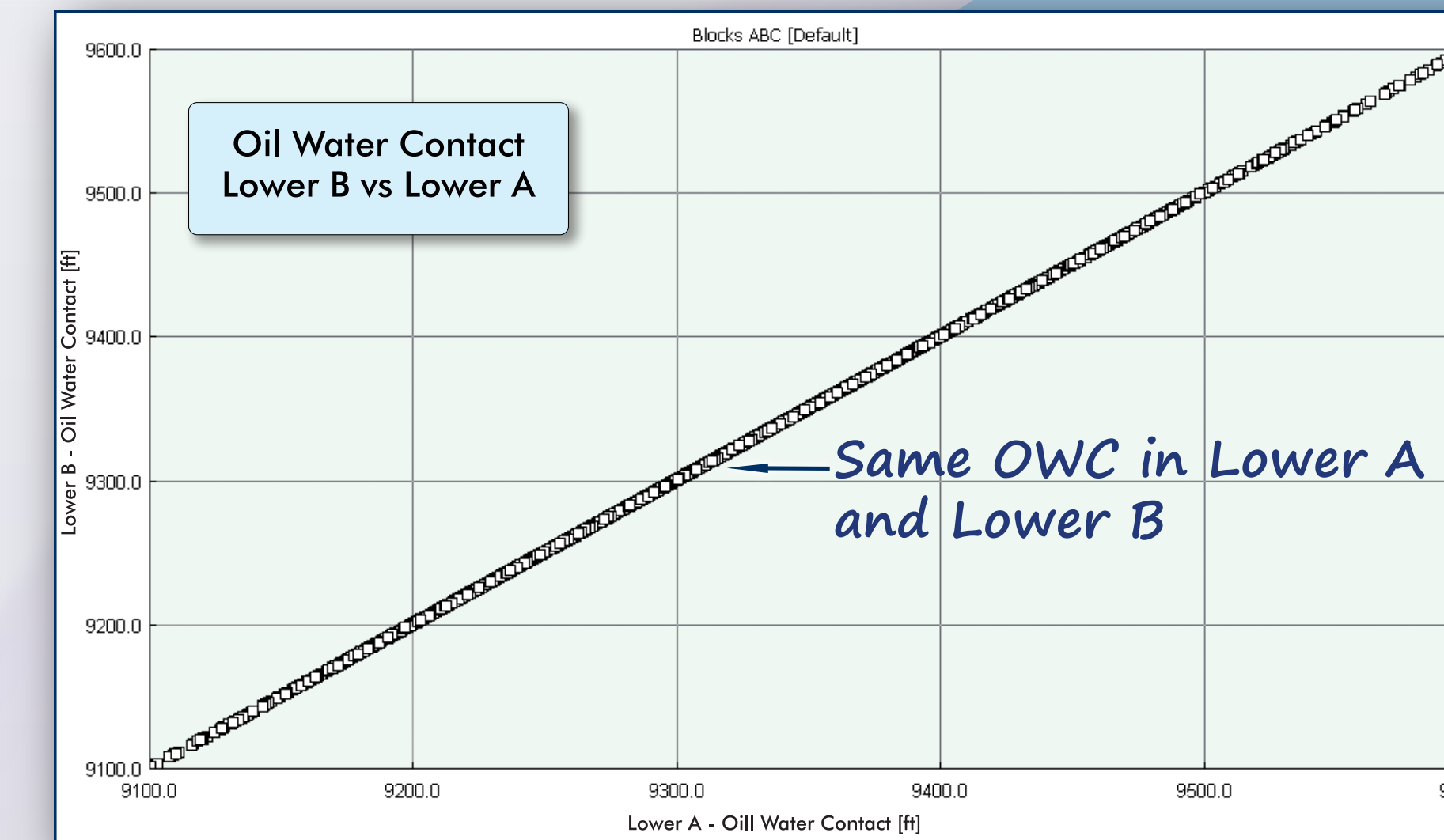
### Upper Zone

### Relationships Within Zones

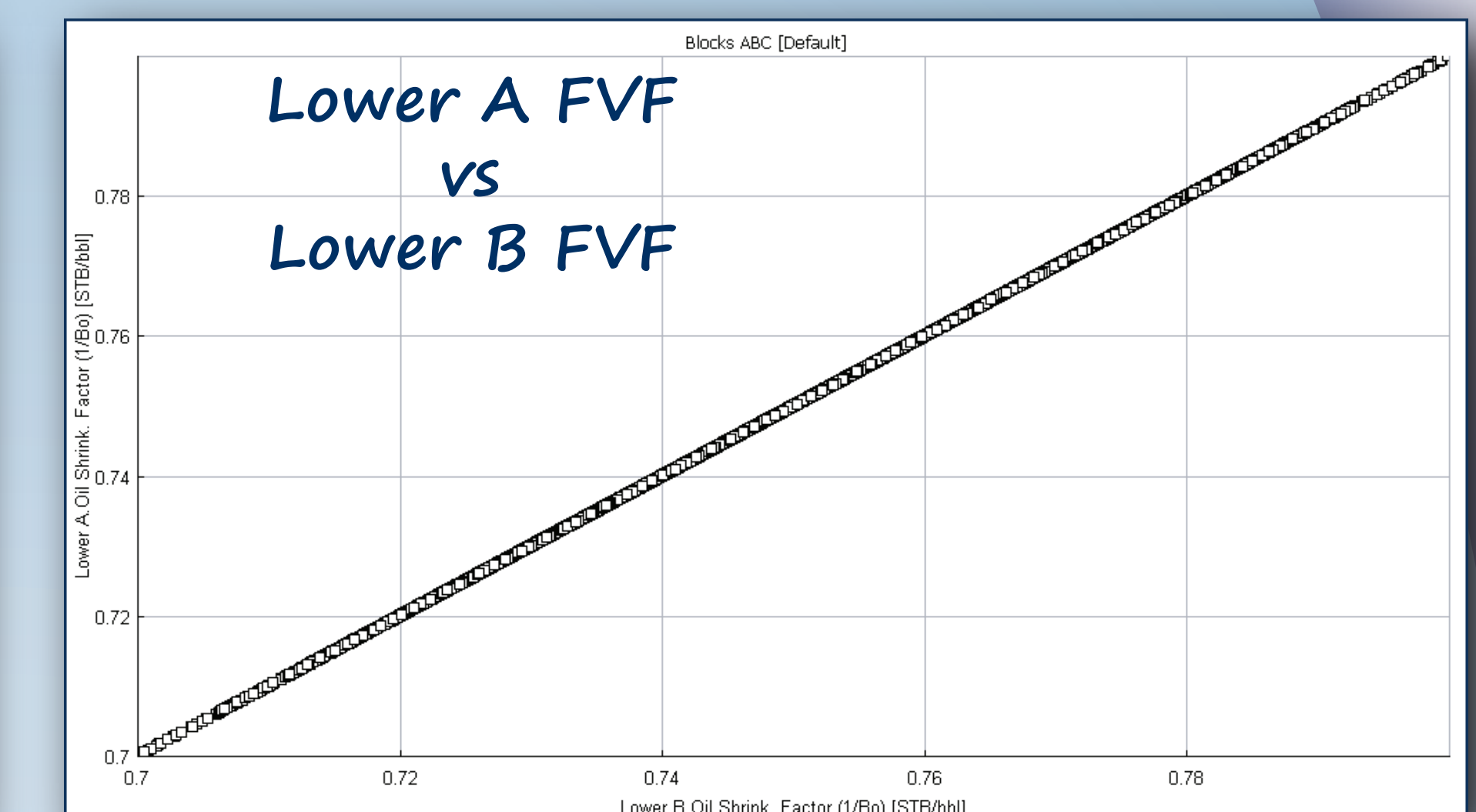
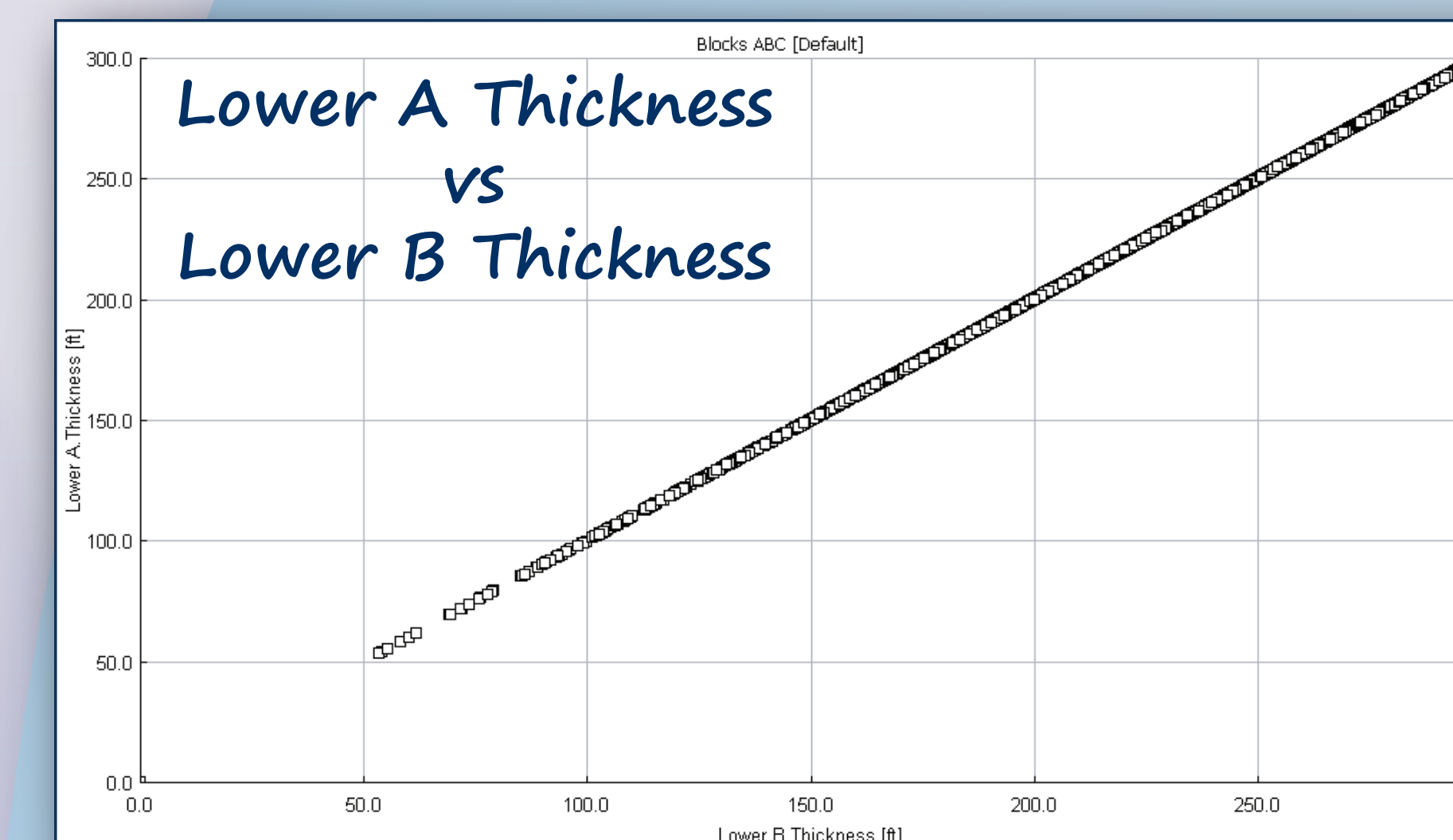
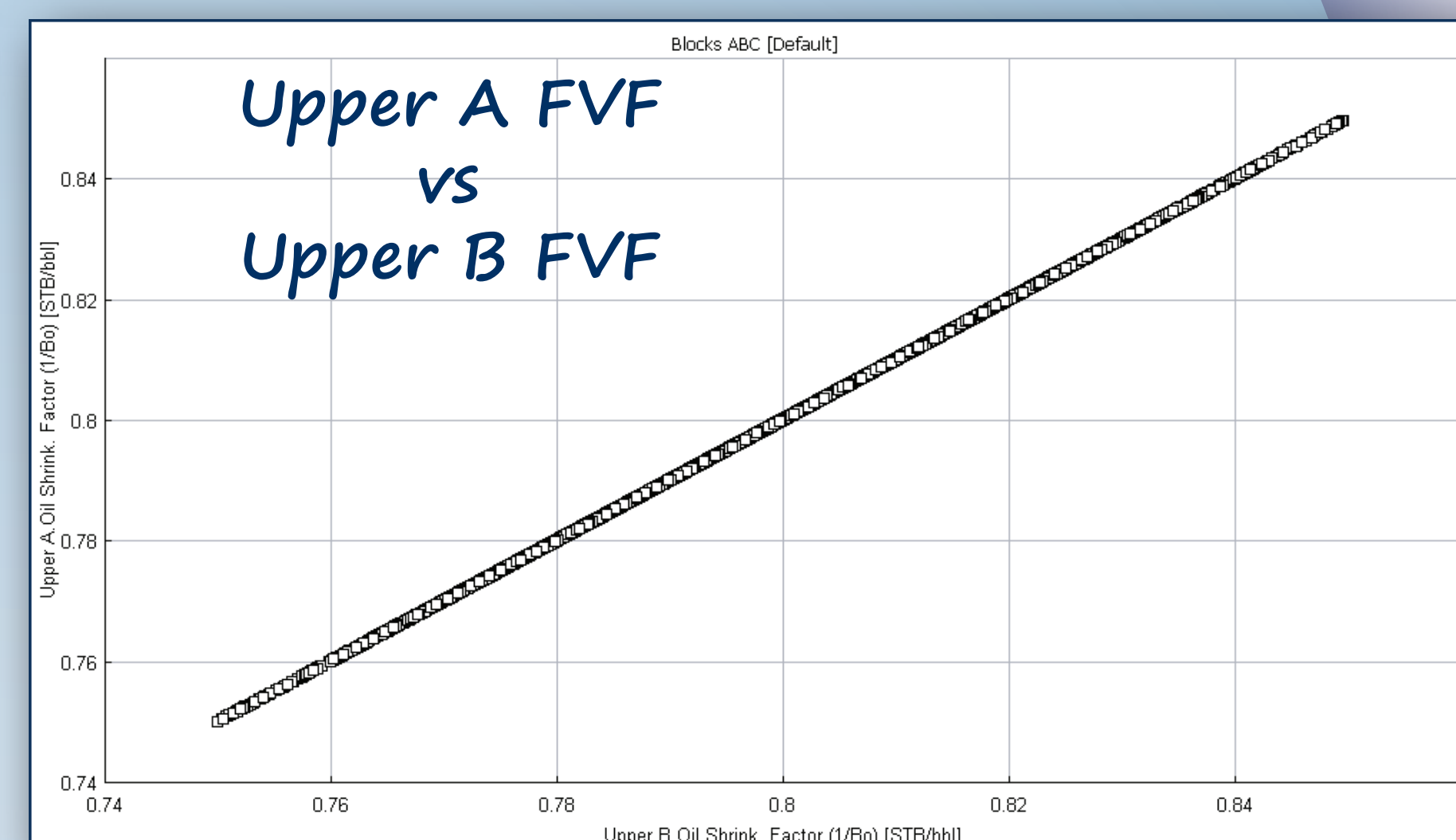
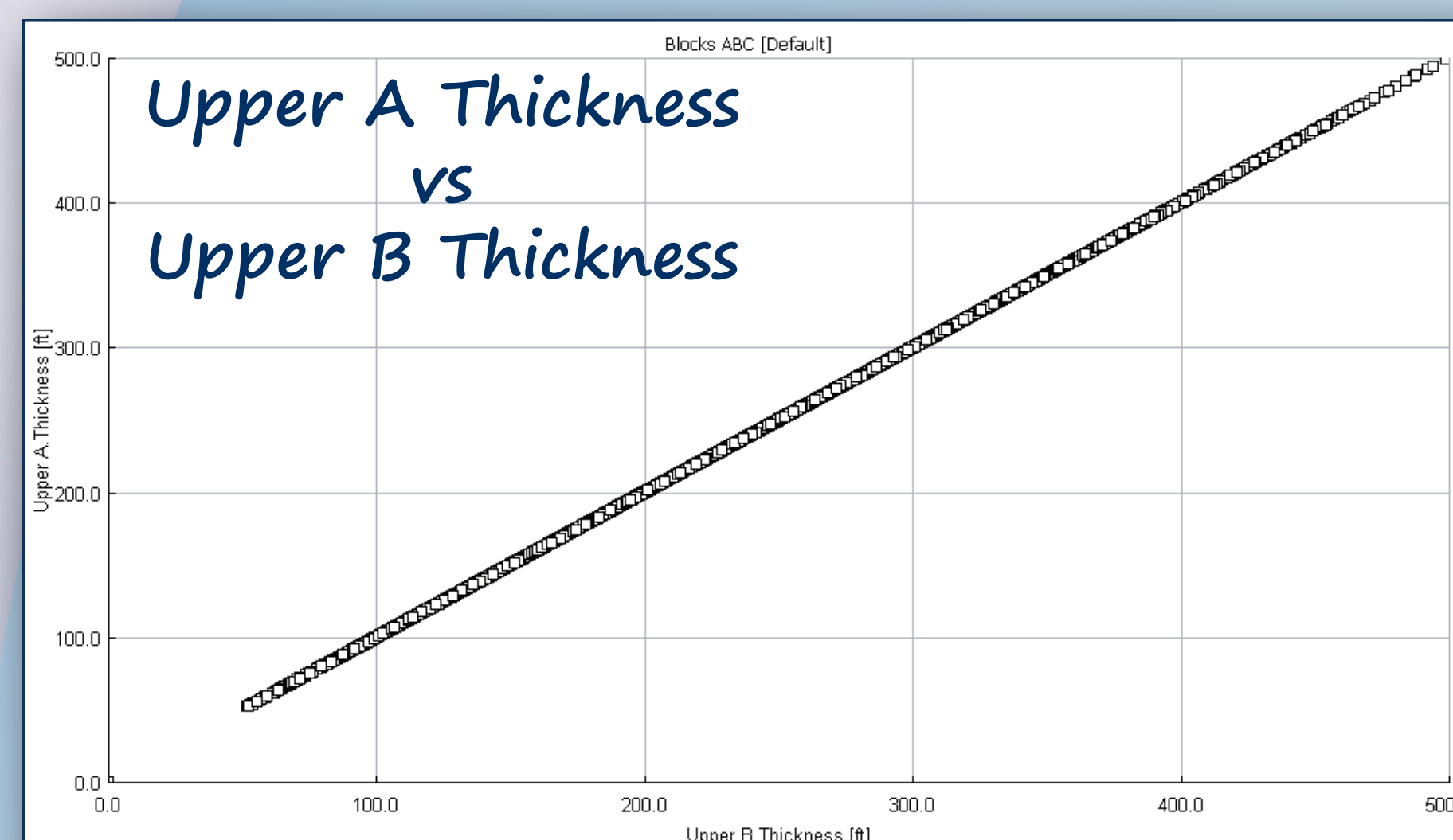
### Lower Zone



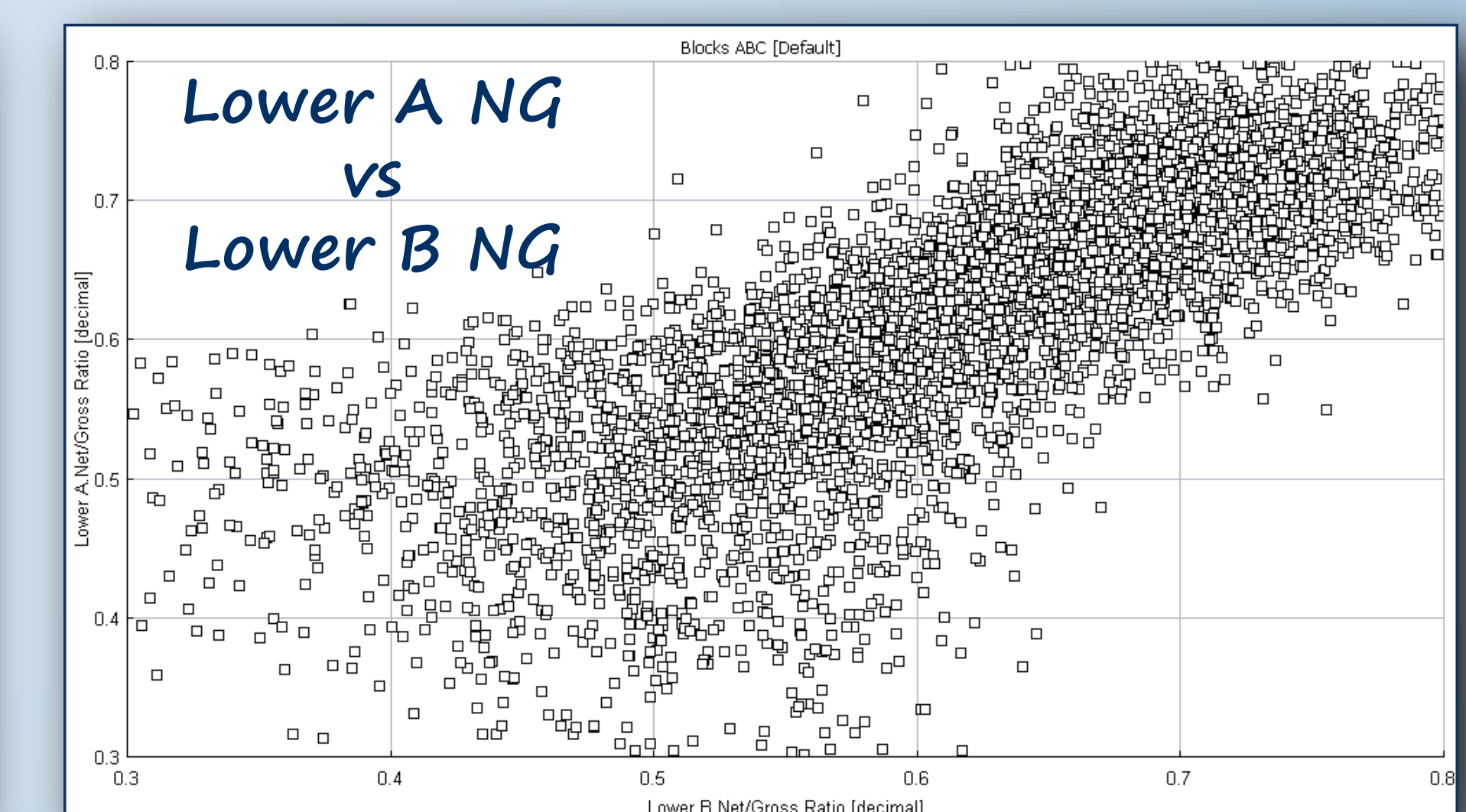
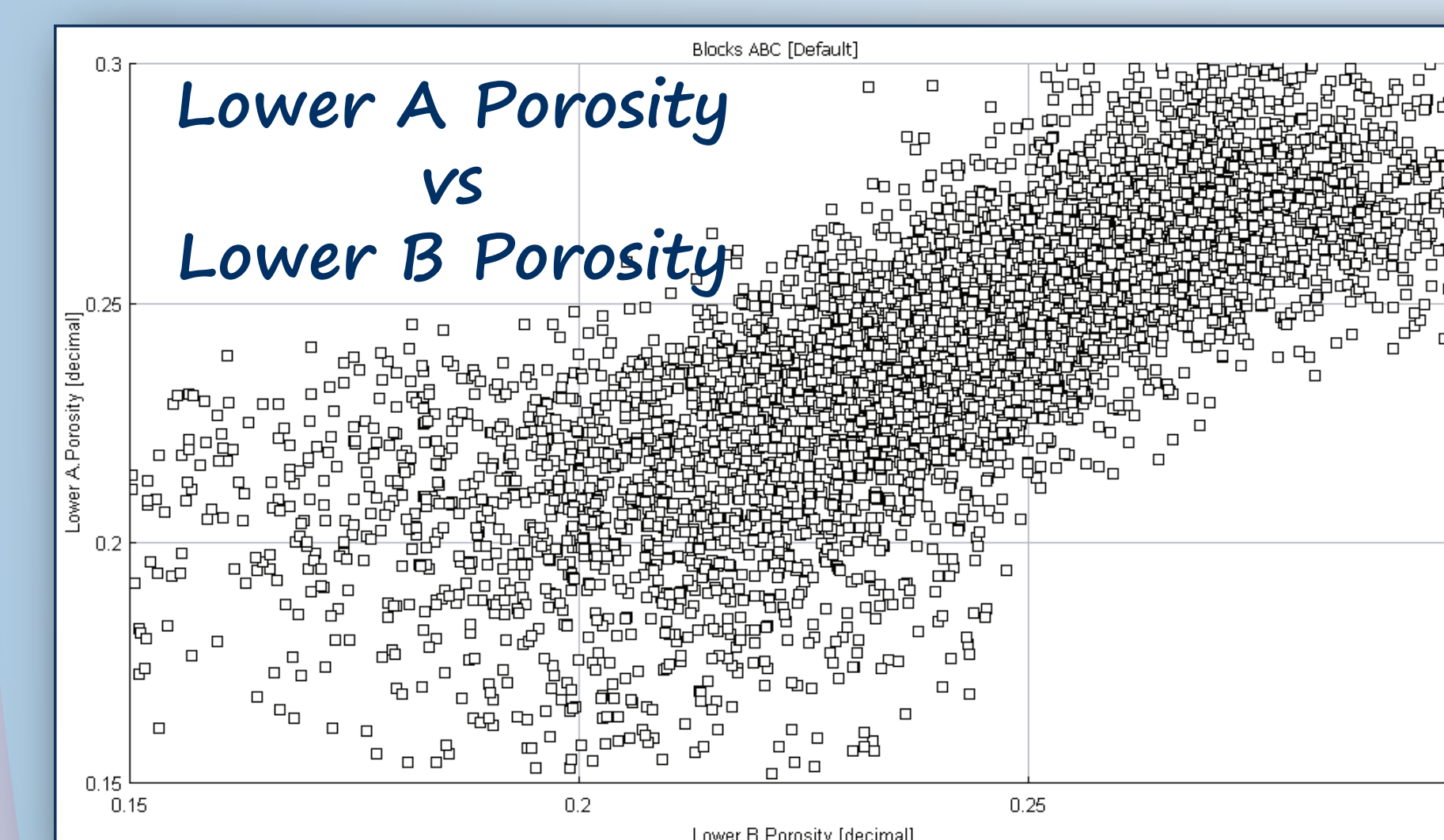
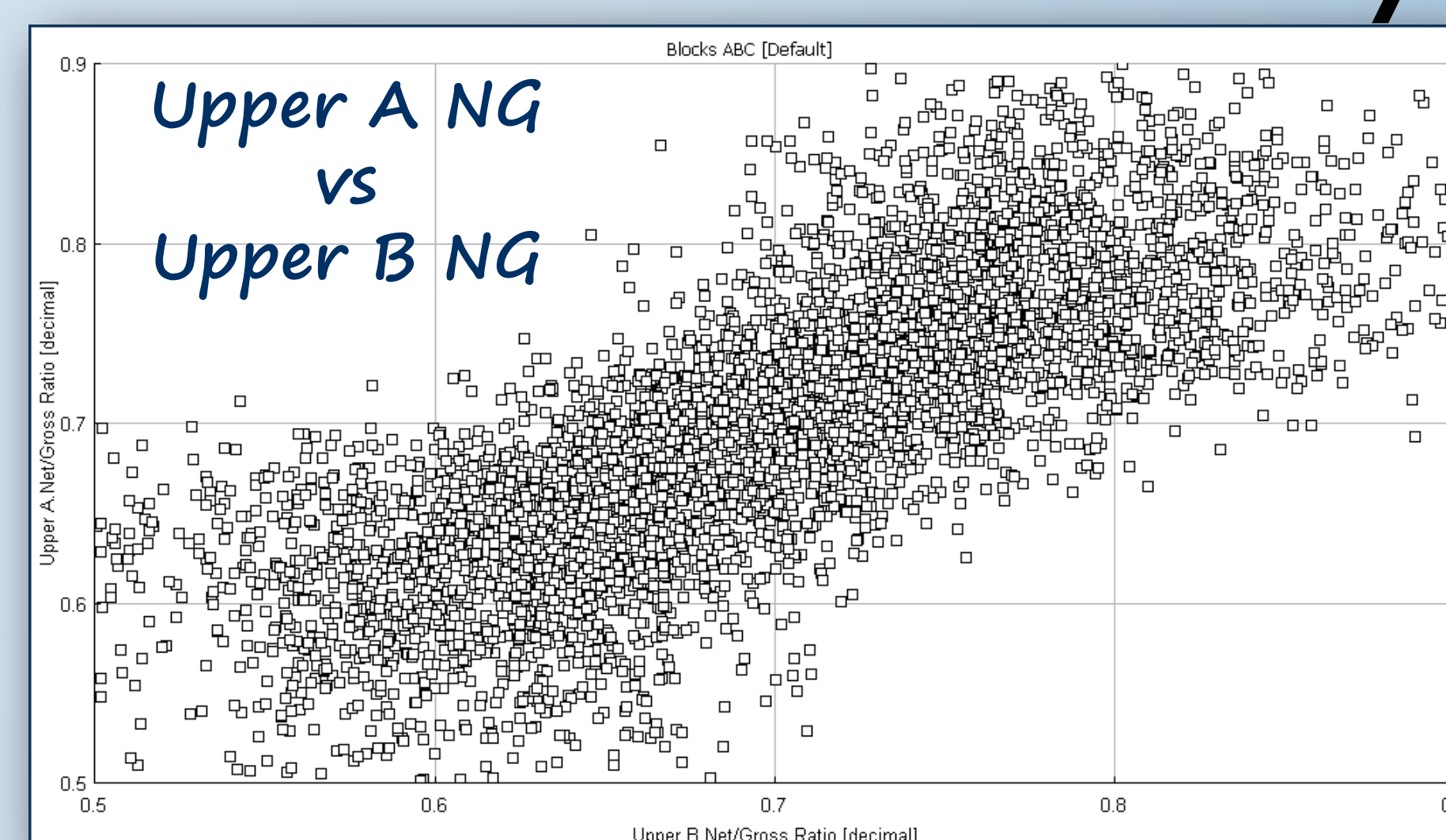
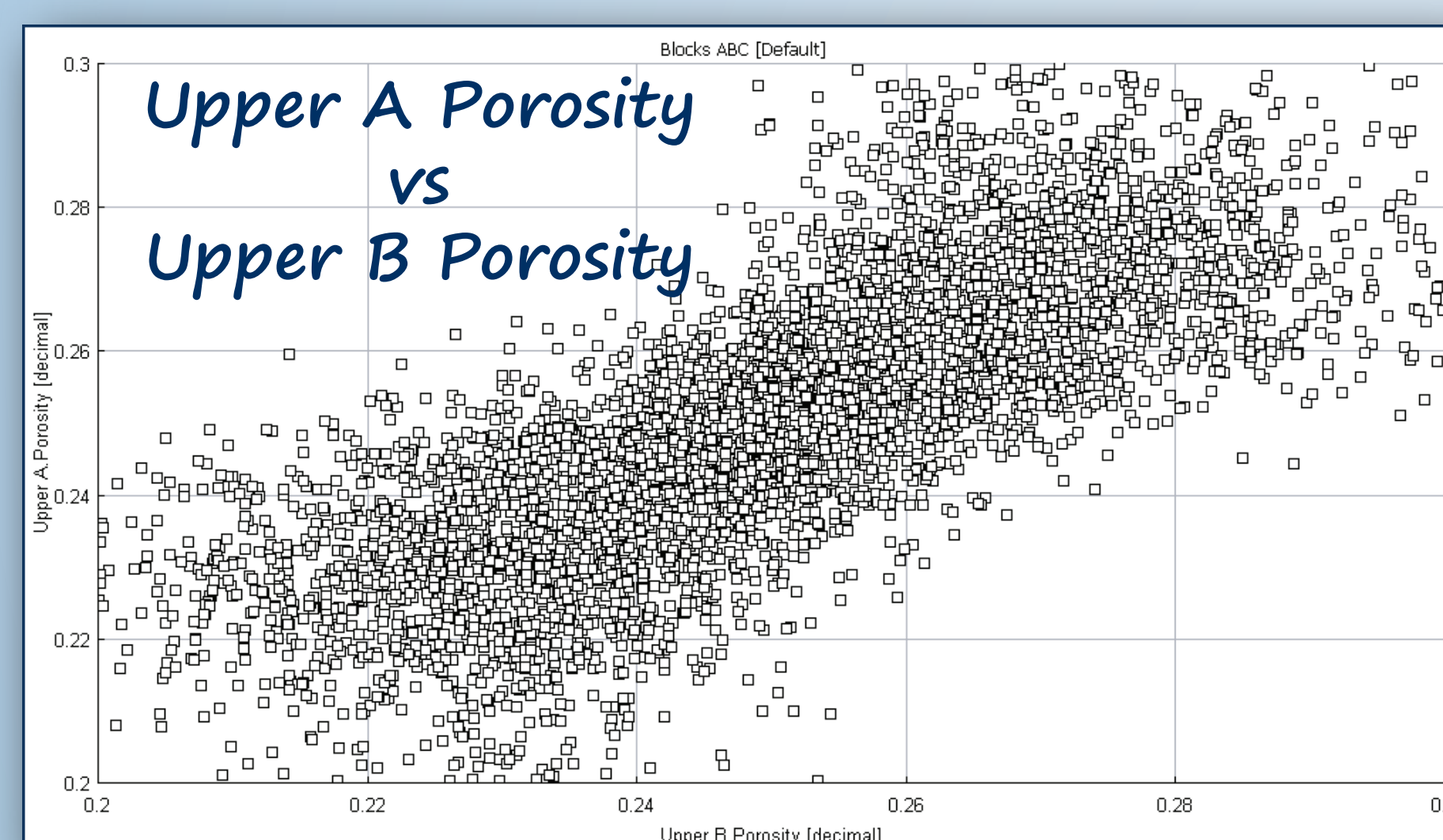
OWC



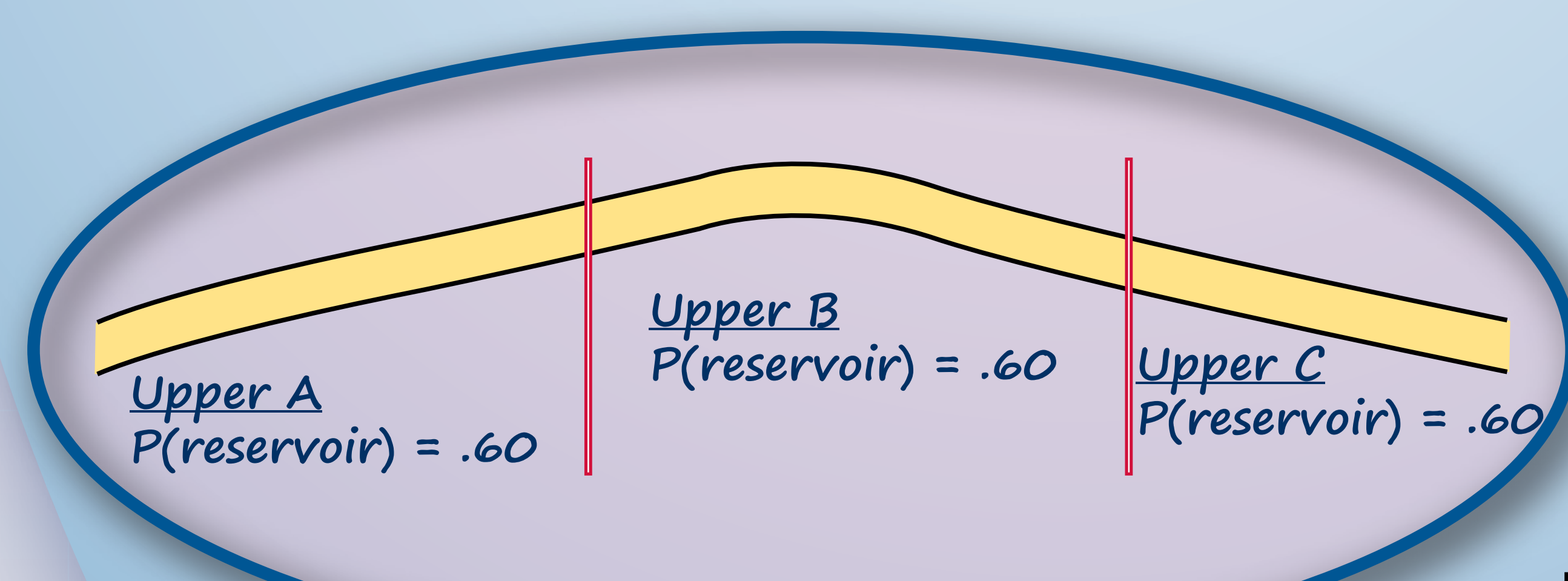
### Gross Thickness & FVF



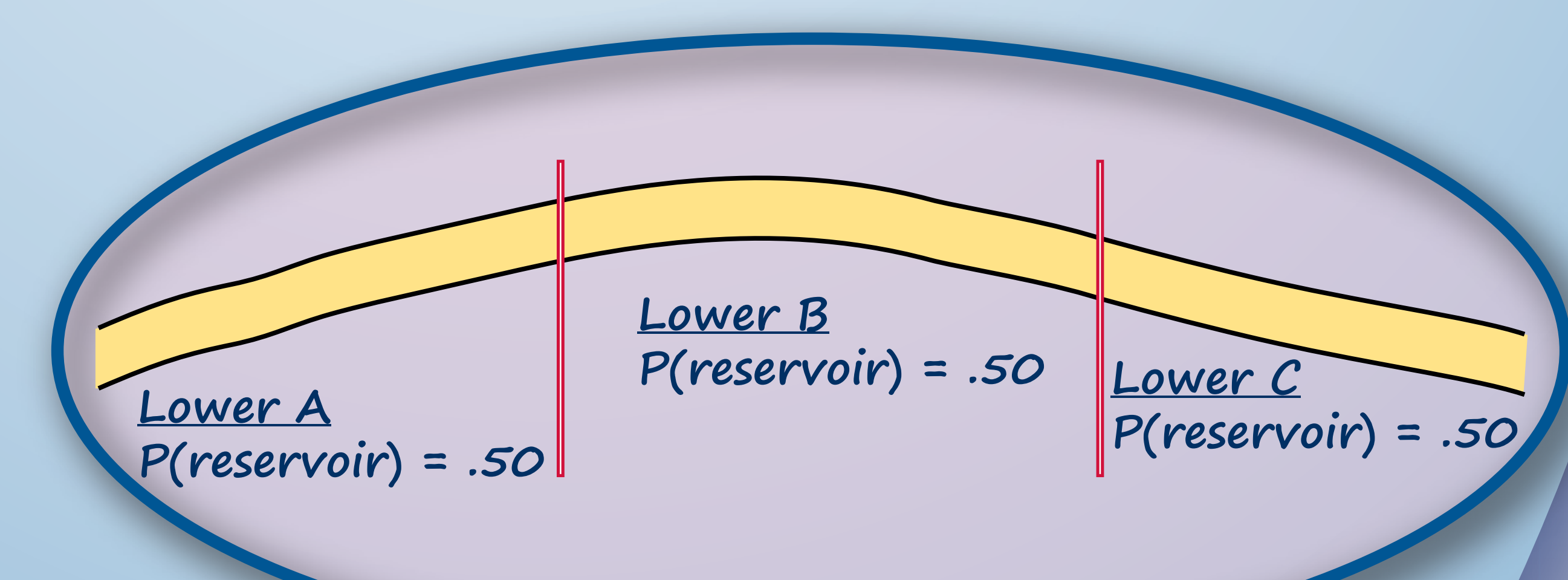
### Porosity & Net-to-Gross



### Reservoir Risk Dependency

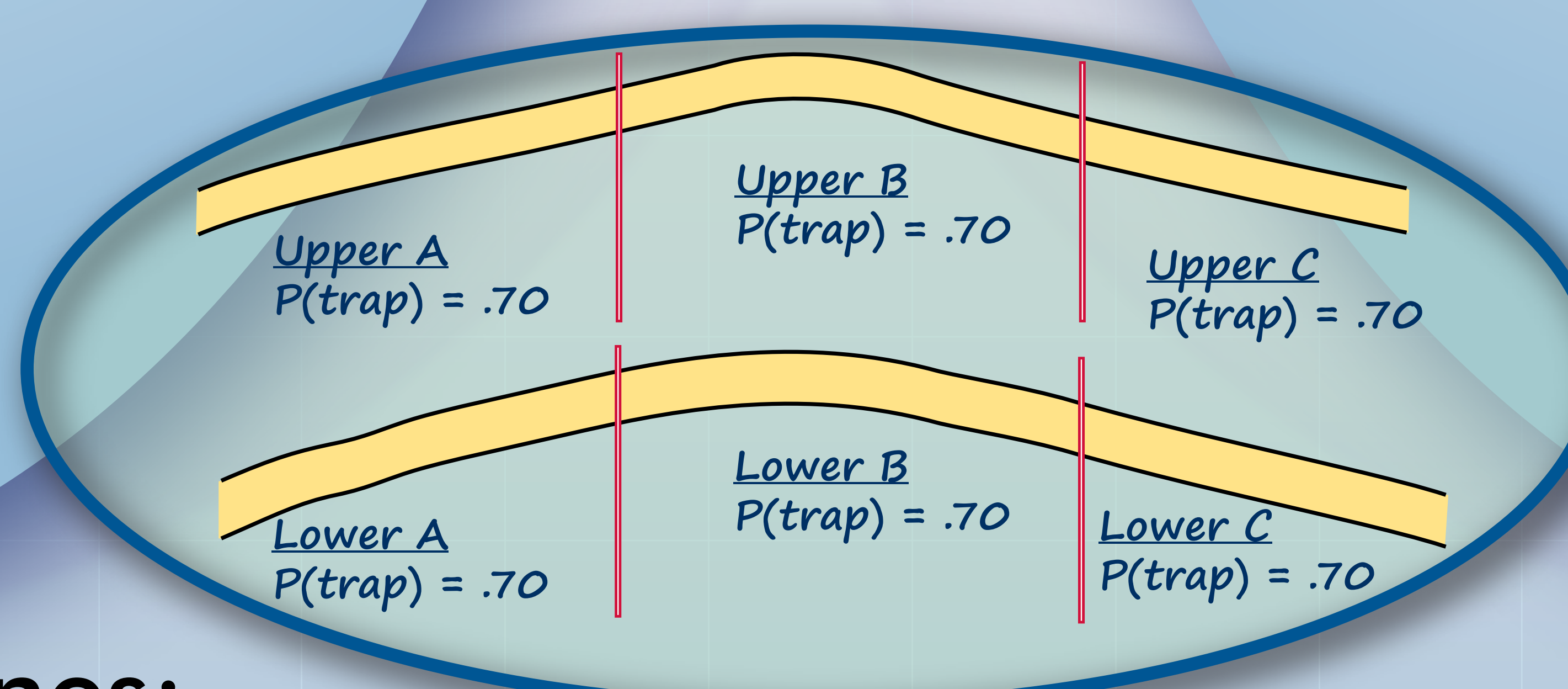


RESERVOIR RISK DEPENDENCY GROUP  
(upper segments)

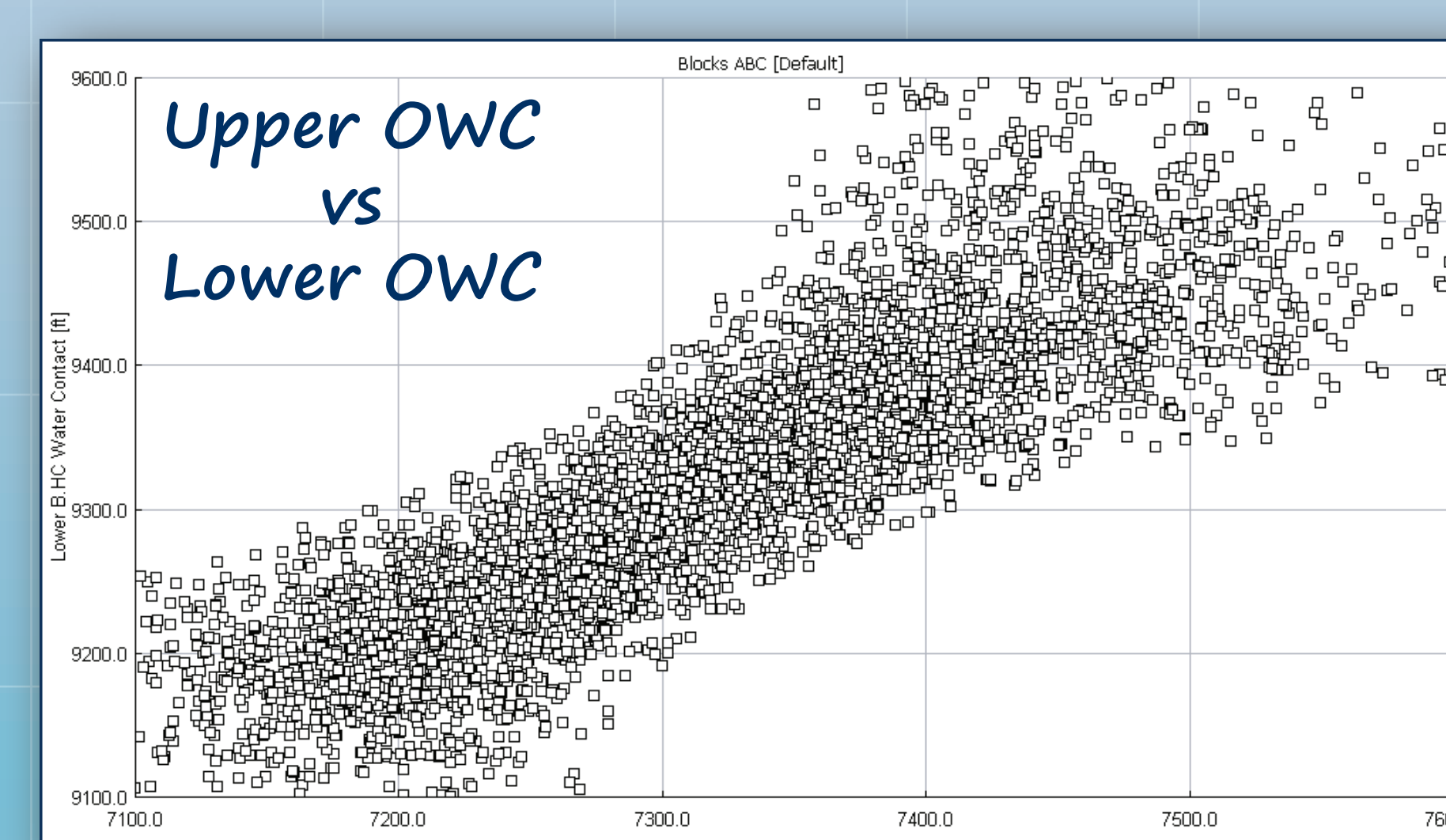


RESERVOIR RISK DEPENDENCY GROUP  
(lower segments)

### Relationships Between Zones



TRAP RISK DEPENDENCY GROUP  
(all segments)



1. Define relationships within zones:

- OWC, Thickness, and FVF are identical within a zone
- Porosity and net-to-gross are similar within a zone
- Segments within a zone share a common reservoir risk

2. Define relationships between zones:

- Zones share a common trap (closure height) risk
- Zones share a common closure height uncertainty (should have similar column heights)

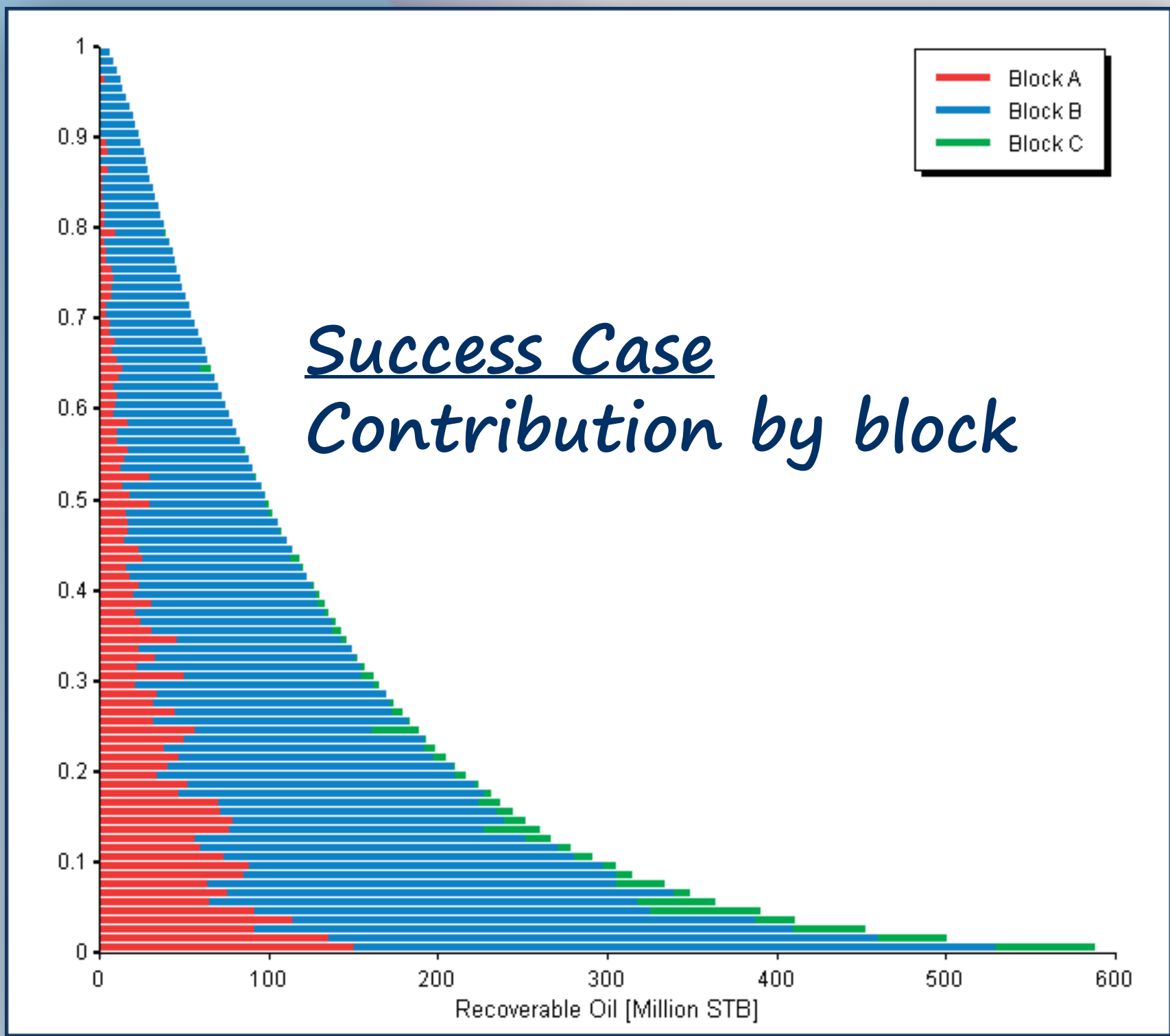
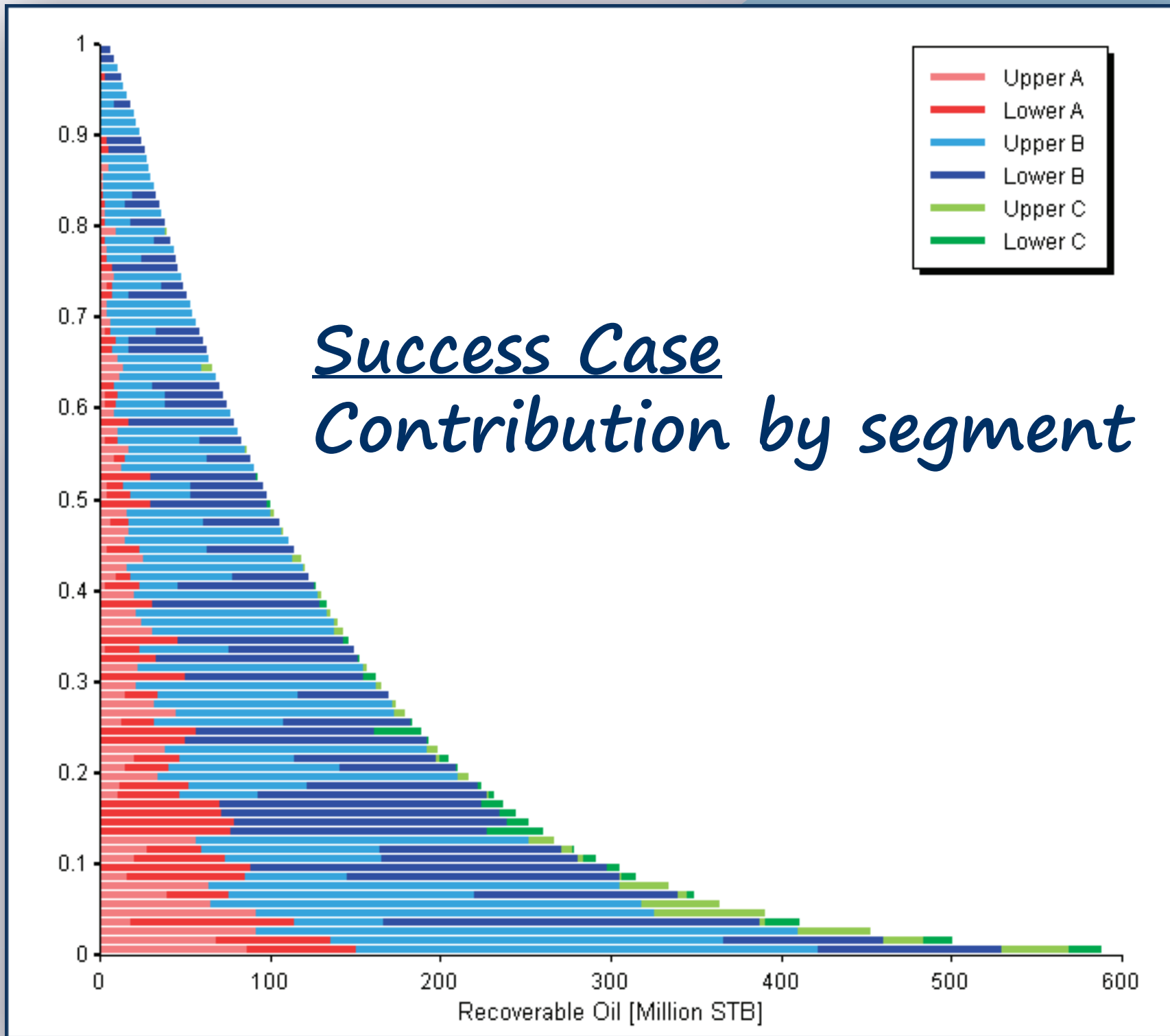
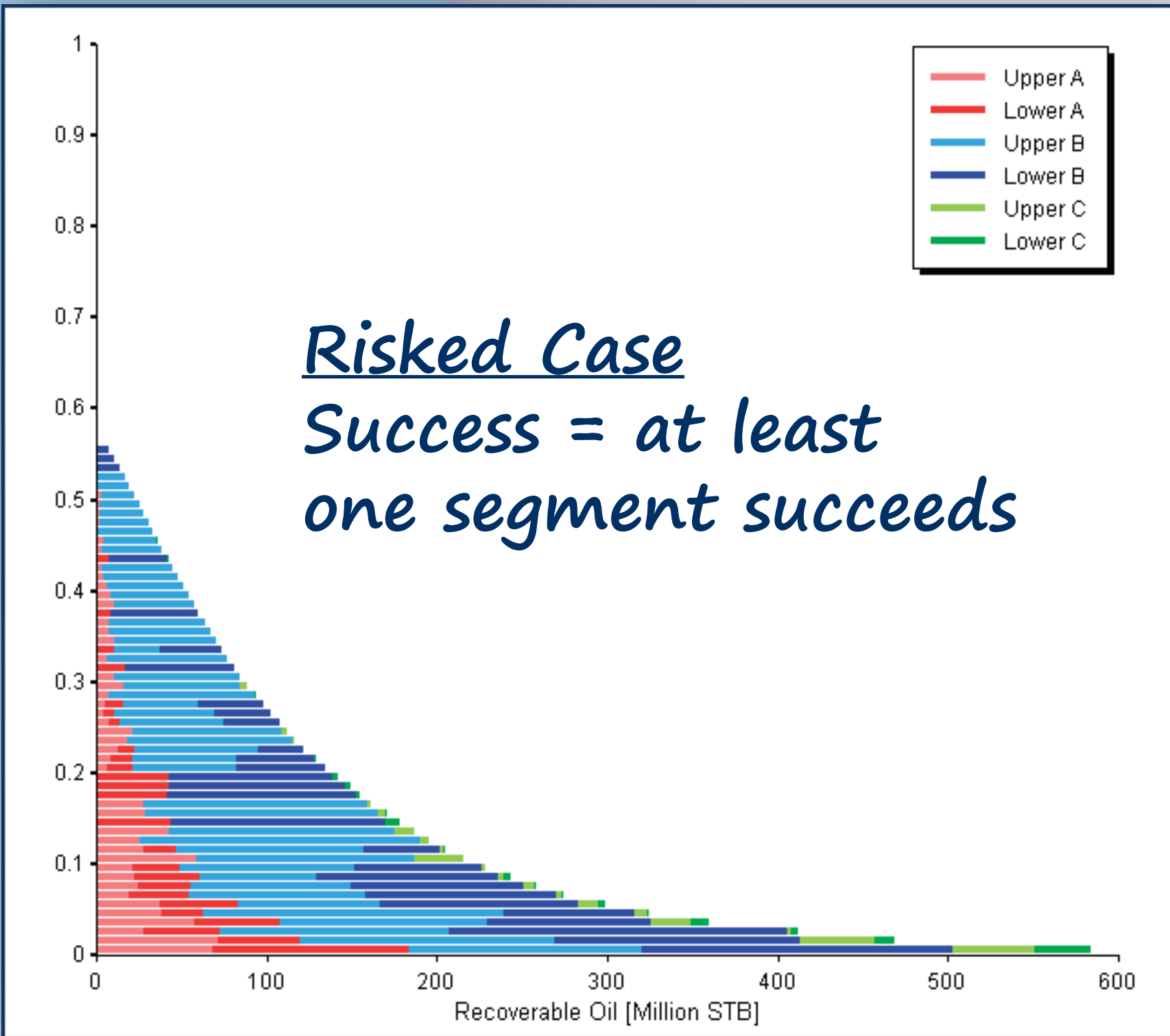
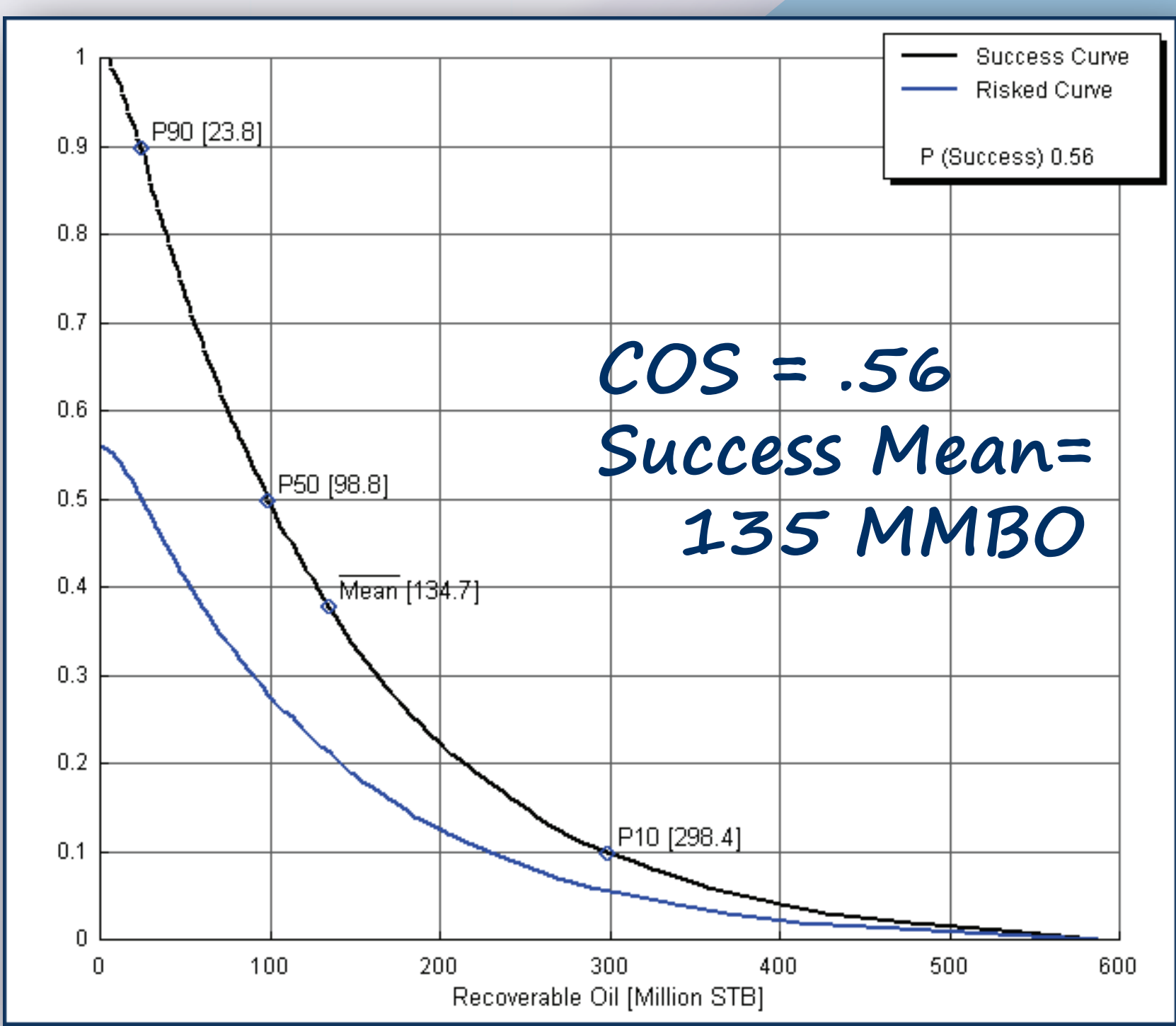


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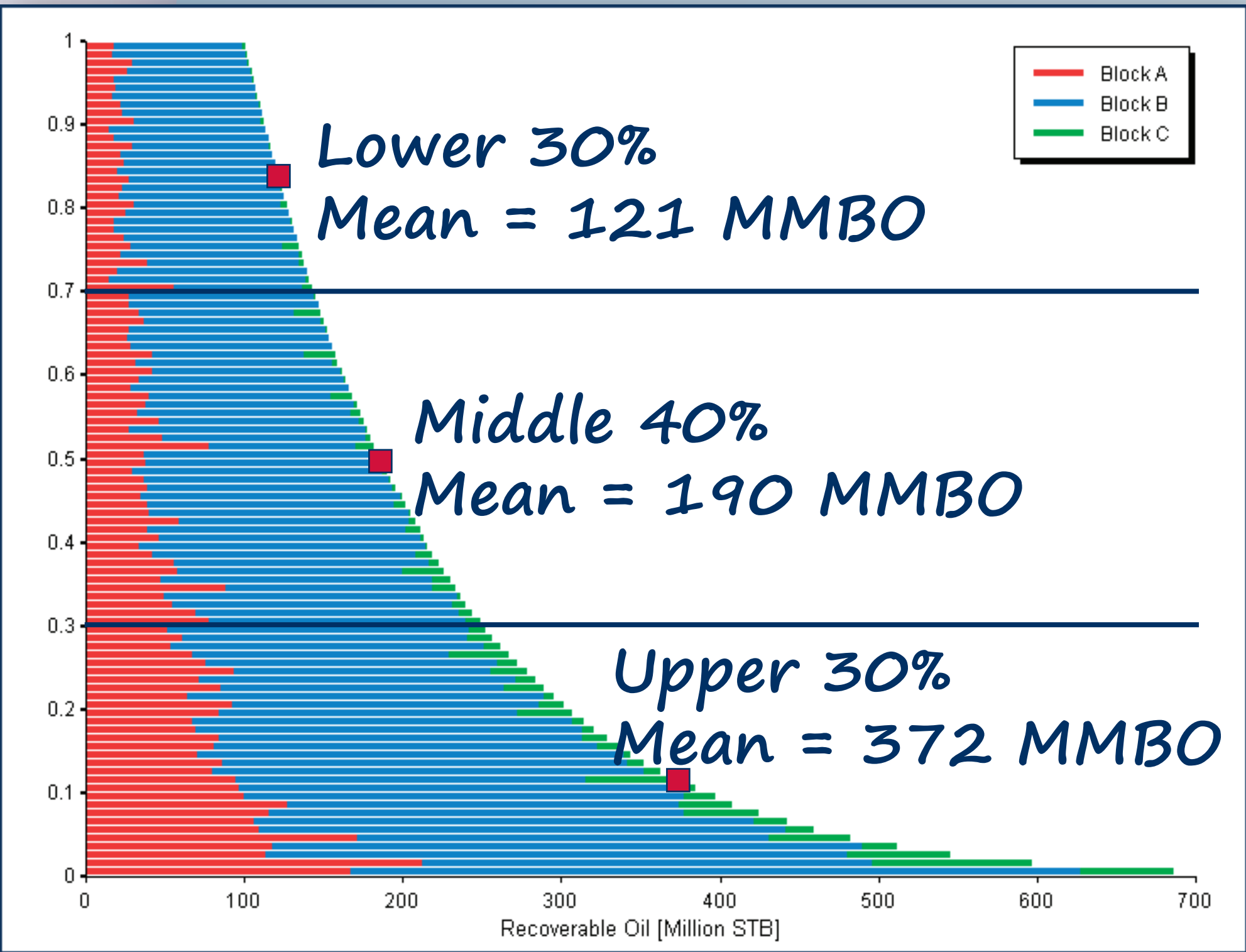
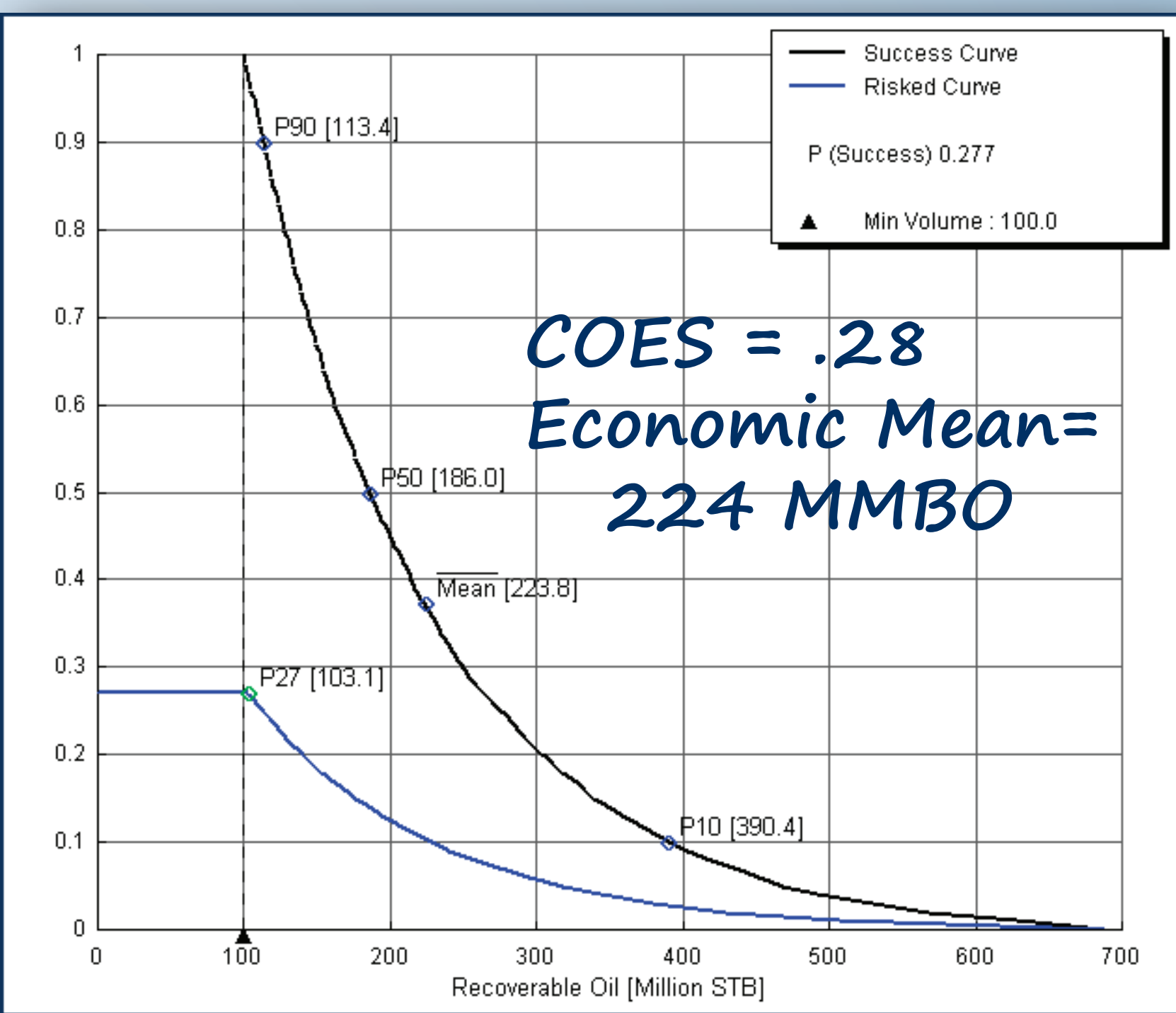
## 4. Results

### Prospect Results



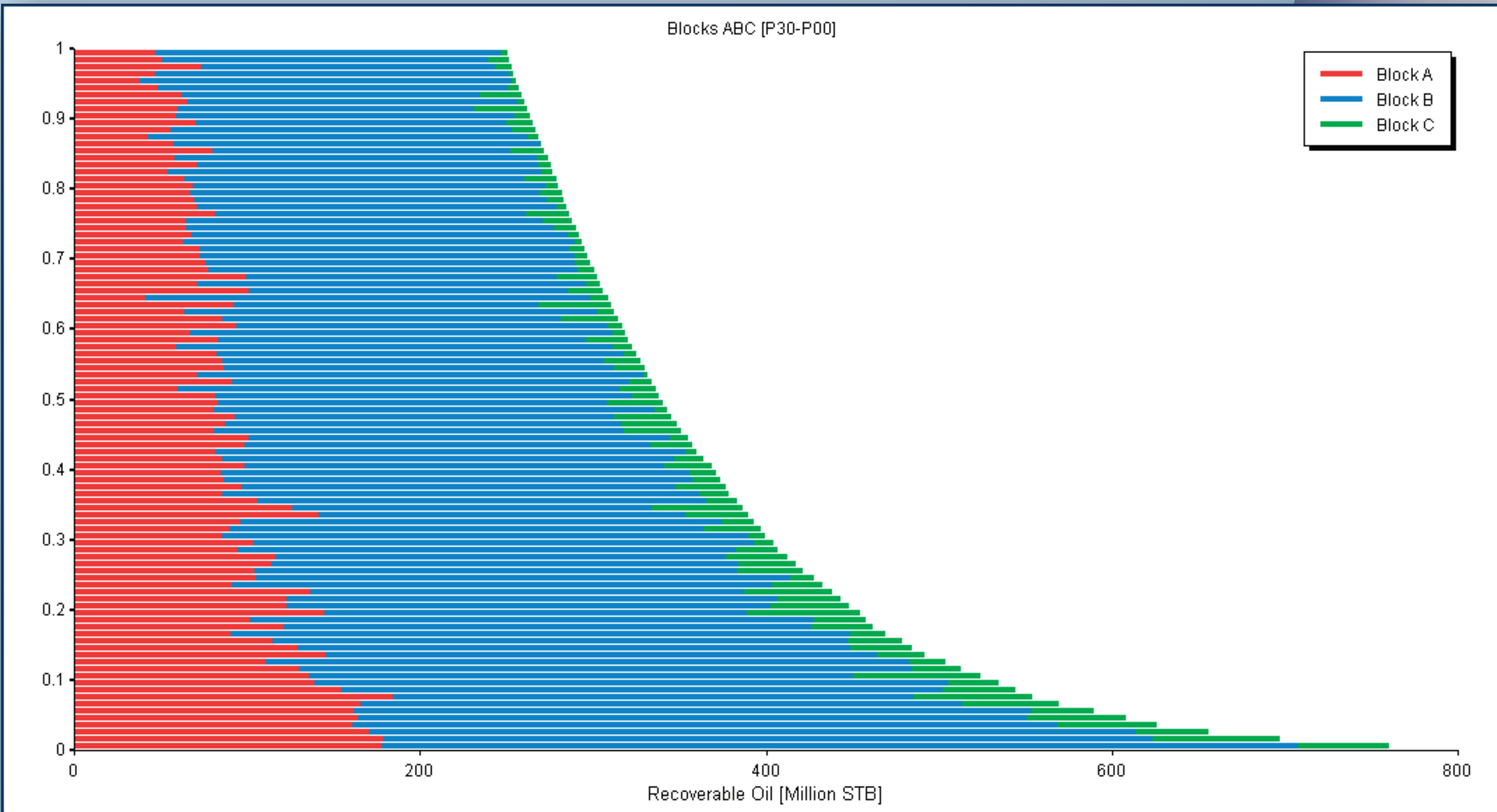
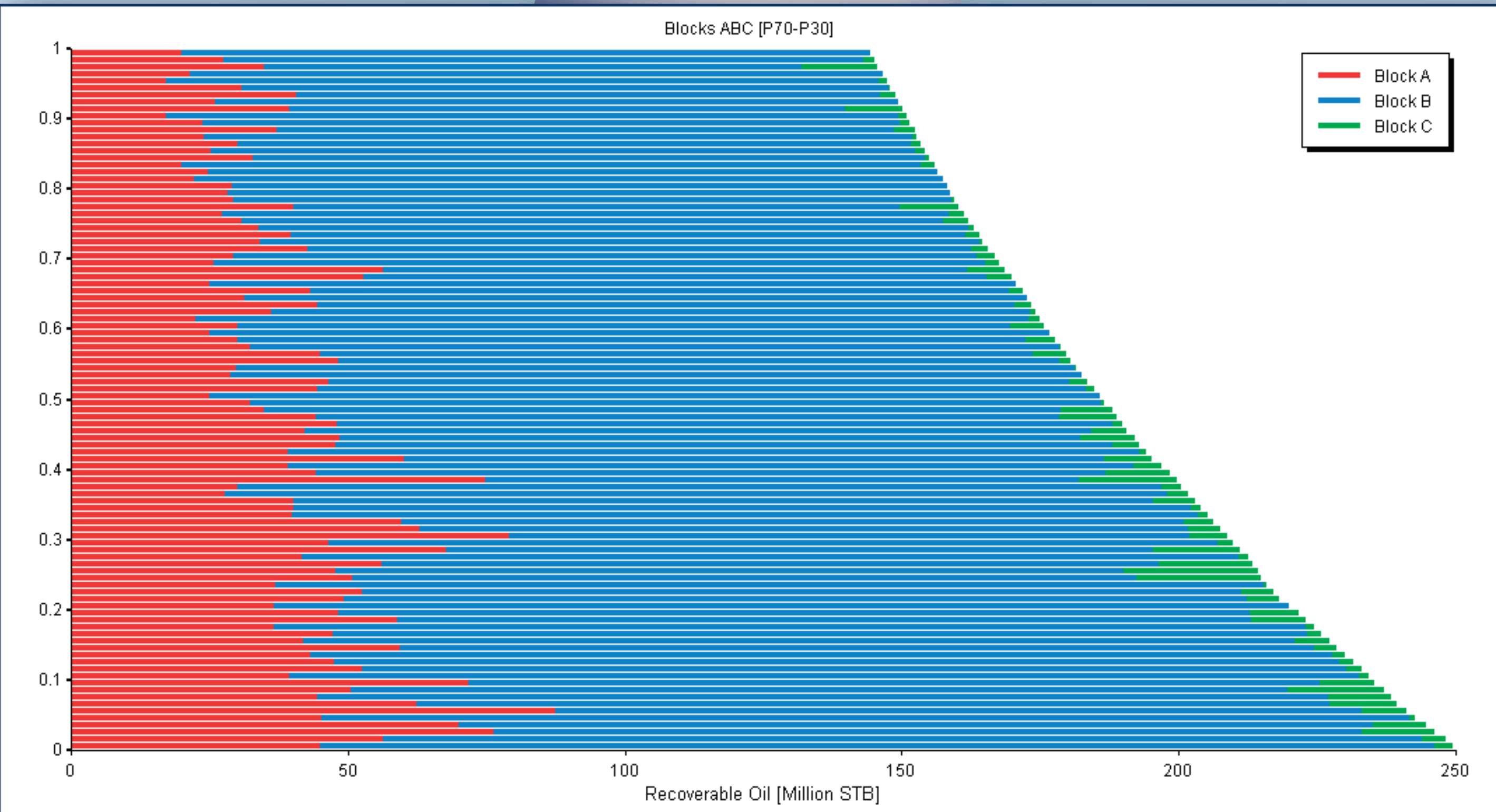
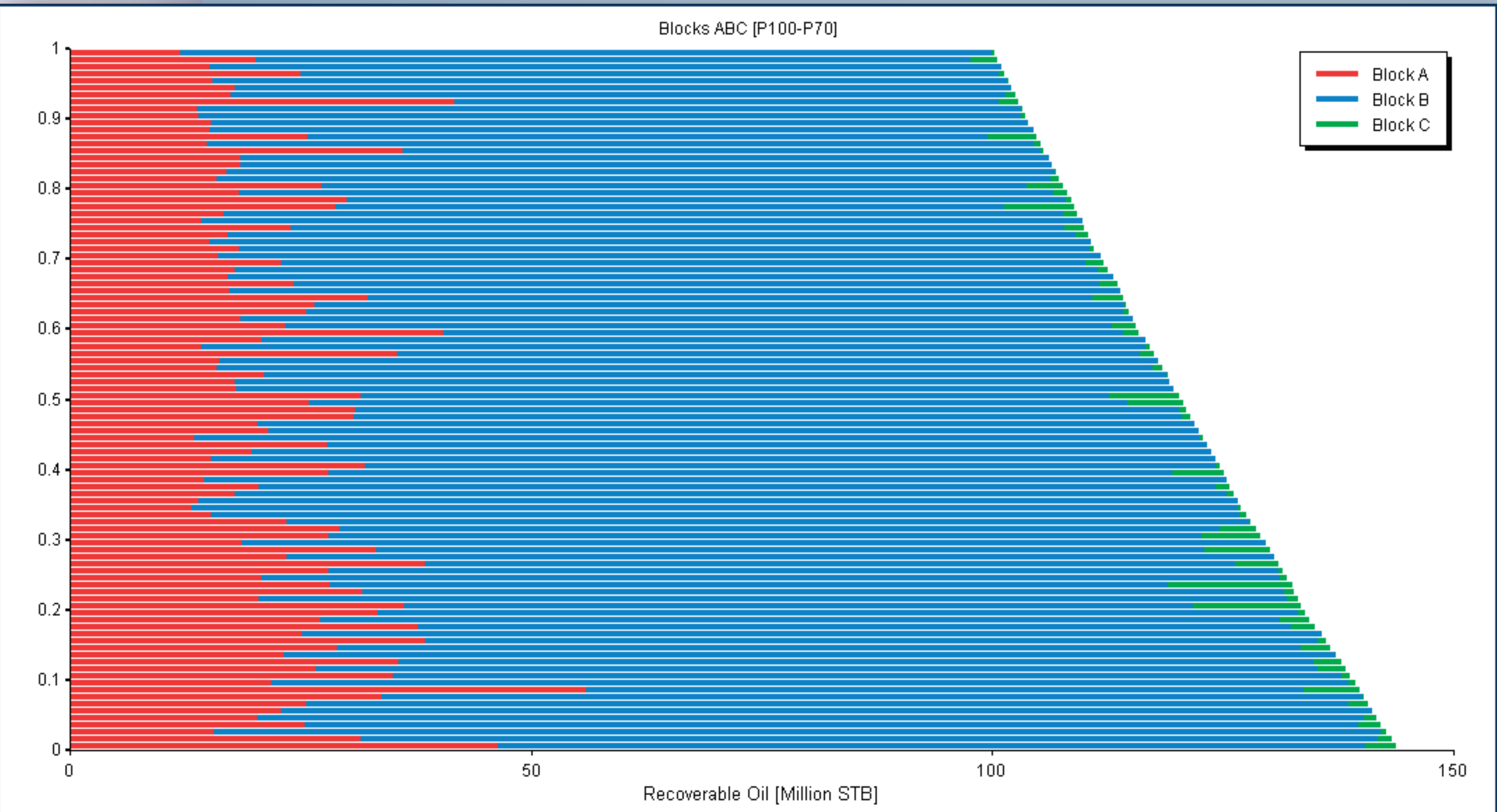
### Results Above Minimum Economic Field Size (100 MMBO)

1. Calculate segment volume in each trial
2. Combine segment volumes by block
3. Apply minimum economic field size (MEFS)



4. Sort trials above MEFS into groups
5. Calculate mean volume by block for each group
6. Create sub-groups if P(cond.) is low

### Development Cases



#### Lower 30%

Block	Mean	P(cond.)
A	23	1.00
B	96	1.00
C	2	0.82
Total	121 MMBO	

#### Middle 40%

Block	Mean	P(cond.)
A	41	1.00
B	144	1.00
C	5	0.98
Total	190 MMBO	

#### Upper 30%

Block	Mean	P(cond.)
A	92	1.00
B	258	1.00
C	22	1.00
Total	372 MMBO	