Prospect Evaluation

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The Bridge Group AS
Purpose of Prospect Evaluation

• Government
  – Integral part of resource assessment
  – Basis for nomination of contract areas
  – Basis for contractor’s work commitment
  – Basis for evaluation of applications

• Oil company
  – Integral part of resource assessment
  – Basis for investment decision
Methodology

• Volumetric Evaluation
  – Seismic Interpretation
  – Mapping
  – Gross rock volume determination
  – Volume of liquid/gas at surface

• Economic Evaluation
  – Discounted cash flow analysis
The volumetric equation

\[
\text{STOIIP} = \text{GRV} \times \frac{\text{Net/Gross Ratio}}{} \times \text{Porosity} \times \text{oil saturation} \times (1/\text{Bo})
\]

\[
\text{GIIP} = \text{GRV} \times \frac{\text{Net/Gross Ratio}}{} \times \text{Porosity} \times \text{gas saturation} \times (1/\text{Bg})
\]

Recoverable oil = STOIIP \times \text{Recovery Factor for oil}
Recoverable gas = GIIP \times \text{Recovery Factor for gas}
HCPV

• Hydrocarbon Pore Volume

HCPV = GRV * Net/Gross Ratio * Porosity * HC saturation
Finding the Volume

- Interpretation and mapping
  - Seismic
  - Digitizing and mapping
  - Depth Conversion
- Geometric description
  - Vertical closure
  - Spillpoint realtions
  - Trap fill
  - Uncertainties
The Trap

CROSS SECTION OF DIFFERENT TRAP CRITERIA
The trap

Rock Volume

vertical closure

HC-contact

top surface

spill point

bottom surface
The maps

A bottom surface map is not required, when:
- the reservoir thickness > vertical closure
- the reservoir thickness is constant
Volume vs. Depth

Depth vs. Volume graph with top and bottom maps, and HC water contact.
Area/depth graph

-2700
-2500
-2200
-1900

Depth

Gross Rock Volume
= Area under Graph

Structural contours

Culmination

Spill Point

Gross Rock Volume
= Area under Graph

Modified from Geoknowledge a.s.
Anticline Geometry Corrections
(assume no internal seals)

Reservoir thickness (a,b,c)

OWC/GWC

Spill point closure

Closure height (h)

a/h \ll 1 \quad \text{Large geometric multiplier}

b/h = 1 \quad \text{Small geometric multiplier}

c/h > 1 \quad \text{Small geometric multiplier}

PhilPRA/Akj
The trap geometry multiplier reduces closure height or reservoir thickness to the effective average for the whole closure area, allowing for oil/gas column thinning at the trap edge. Restore the missing half to determine length/width ratio of faulted structure.

From White, 1987

<table>
<thead>
<tr>
<th>Reservoir Thickness / Height of Closure</th>
<th>Dome, Cone, Pyramid</th>
<th>Anticline, Prism, Cylinder</th>
<th>Flat-Topped Dome</th>
<th>Flat-Topped Anticline</th>
<th>Block, Vertical Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.34</td>
<td>0.42</td>
<td>0.49</td>
<td>0.59</td>
<td>0.68</td>
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<td>1.0</td>
<td>1.0</td>
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</tbody>
</table>
Reservoir Parameters 1

- Gross thickness (from mapping)
- Net pay
- Porosity
- Permeability
- HC saturation
Reservoir Parameters 2

- Formation volume factor oil (Bo)
- Formation volume factor gas (Bg)
- Gas deviation factor (Z)
Recovery Factor

- **Oil**
  - Dependant on depletion mechanism
    - Natural depletion
      - 5-15%
    - Effective water drive
      - 15-30%
    - Pressure maintenance methods
      - Up to 65%

- **Gas**
  - Up to 80-85%
Exercise
Volume calculations

<table>
<thead>
<tr>
<th>Length</th>
<th>10000 m</th>
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<tbody>
<tr>
<td>With</td>
<td>2000 m</td>
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<tr>
<td>Hight</td>
<td>100 m</td>
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Geometric Factor

<table>
<thead>
<tr>
<th>Porosity</th>
<th>20%</th>
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<tbody>
<tr>
<td>So</td>
<td>70%</td>
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<tr>
<td>N/G</td>
<td>50%</td>
</tr>
<tr>
<td>RF</td>
<td>30%</td>
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Bo 1.3

1m³ = 6.29 barrels

10km 100m 2km
# Volume calculation - Solution

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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<td>Length</td>
<td>10000 m</td>
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<tr>
<td>With</td>
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<td>Height</td>
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<tr>
<td>Geometric Factor</td>
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<tr>
<td>GRV</td>
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<tr>
<td></td>
<td>5661 MMbbl</td>
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<tr>
<td>N/G</td>
<td>50%</td>
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<tr>
<td>NRV</td>
<td>450000000 m³</td>
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<td>2831 MMbbl</td>
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<tr>
<td>Porosity</td>
<td>20%</td>
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<tr>
<td>So</td>
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<tr>
<td>HCPV</td>
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<tr>
<td>Bo</td>
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<td>STOIIP</td>
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<tr>
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<td>304.8 MMbbl</td>
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<tr>
<td>RF</td>
<td>30%</td>
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<tr>
<td>Recoverable resources</td>
<td>14538462 m³</td>
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<tr>
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<td>91.4 MMbbl</td>
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1 m³ = 6.29/1000000 MMbbl