Happy Birthday Alain!

Well Testing
A Standard Geological Tool?

Patrick Corbett
How often have you seen Alain on the rocks?
Geological Data Uncertainty

How do we map between wells?
Geoengineering “certainty”

Well test diagnostic?
No Uncertainty

Deep water lateral facies variations
Geology and well testing

- Comparison of test and core perms
  - Geoskin
  - Geochoke
  - Geotype Curves
  - Geostorage ??
Comparison of test and core perms

Reality check

(ref. AAPG Dec 2000)
Comparison – North Sea case study

(from Zheng et al., 2000, AAPG Bulletin)
North Sea case study – Oseberg Field
Stratigraphic Uncertainty

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<th>CRET.</th>
<th>Rya</th>
<th>Vol</th>
<th>Kim</th>
<th>Oxf</th>
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- **Draupne Formation**
  - Sognefjord Formation
  - Fensfjord Formation
  - Krossfjord Fm.

- **Heather Formation**

- **Vatnaberg Fm.**
- **Ness Fm.**
- **Eilve Fm.**
- **Rannoch Fm.**
- **Broom/Oseberg Fms.**

- **Dunlin Group**

- **Statfjord Formation**

### Depth (m)

<table>
<thead>
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<th>Strat.</th>
<th>Gamma Ray</th>
<th>Core lithologies</th>
<th>Interpretation</th>
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<td>Deepwater splay floodplain</td>
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<td>Composite, multi-stranded fluvial channel sandstone</td>
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<td>Floodplain distributary channel (predominantly sandstone)</td>
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<td>Wave-dominated prograding shoreline</td>
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<td>Fan delta sandstones</td>
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Alain Gringarten’s 60th Birthday Seminar, London Sept, 2005
Ness cross section – Geobody uncertainty
Core data uncertainty

Well 30/6-19

Well B

Permeability (mD)

Depth (m)

13 points running average

Probe data available
Permeability measurement uncertainty
Core Uncertainties

- Depth matching
- Missing sections
- Representivity
- 1D profile
Well test uncertainty

Well B

Pressure
Derivatives

LOG(T) (hours)

MTR
ETR
LTR
Flowing interval uncertainty
Well test uncertainty

Well C

![Graph showing well test uncertainty with LOG(T) on the x-axis and LOG( DP/DT) (bar/Sm3/day) on the y-axis. The graph includes markers for Pressure and Derivatives with regions labeled MTR, LTR, ETR, 1DP, and 2DP.](image-url)
Flowing interval uncertainty
Well test uncertainty

![Graph showing well test uncertainty with pressure and derivatives plotted against LOG(T) (hours). The graph includes ETR, MTR, and LTR phases.]
Flowing interval uncertainty

Well A

Well 30/6-23, DST-3

- Data ordered
- Data not ordered

Fig. 8

30/6-23

Etive
Ness Formation variable well test response

- Expanding flow
  - Negative skin
- Contracting flow
  - Positive skin
- No flow boundary

Well A, Well B, Well C
Geo + engineering reduces uncertainty

Original well test interpretation versus core plug average

New test interpretation versus probe average

95% Confidence estimate

Uncertainty in well test estimate of permeability due to uncertainty in h

Core permeability (mD)
Geoskin

(Corbett et al., 1996, SPE 36882; Sagawa et al., 2000, JPSE)
Geochoke model

(Corbett et al., 2005, SPE 93992)
Geochoke pressure response

Log-Log Plot

Delta P / Delta Q (psi/STB/day)

Equivalent Time (hours)
Geotype curves

(Corbett et al., 2005, SPE 93992)
Geotype curves

Alain Gringarten’s 60th Birthday Seminar, London Sept, 2005
Geostorage?? - what is this response??

(Straub, 2005)
Future

• Well testing best practice
  – WT for Evaluation
  – WT for Description
  – WT for Reservoir Management

• Geotype curves
  – Geomodels for WT planning
  – A-priori WT interpretation
  – Scenario selection
  – Completion optimisation

• Geoengineering workflow
Conclusion

• Well testing geological and engineering tool
  – Nearwell/Interwell area imaging
• Reducing uncertainty
  – Cross validation
• Scenario selection
  – Numerical well test modelling
• Model Calibration
  – History Matching
• Forcing dialogue between geoscientists and engineers
  – Need for common language
Acknowledgements

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