Society of Petroleum Evaluation Engineers (SPEE)
Society of Petroleum Evaluation Engineers (SPEE)

- Formed in 1962 to bring together specialists in the evaluation of petroleum and natural gas properties
- Has over 500 members worldwide
- Strongly committed to providing education to its members and to the industry and to promote the profession of petroleum evaluation engineering
- Guided by by-laws that require the highest ethical standards while maintaining principals of acceptable evaluation engineering practice
SPEE – Continued

• The SPEE is a joint sponsor, along with the SPE, WPC and AAPG, of the Petroleum Resources Management System (PRMS)

• Membership – bachelor’s or higher degree in engineering or geology, 10 years experience in property evaluations

• Has local chapters in Houston, Austin, Central Texas, California, Dallas, Denver, Europe, Midland, Oklahoma City, Tulsa and Calgary
SPEE – Continued

• SPEE (Calgary) formed in 1995, currently has 50 active members and is a registered not-for-profit society

• SPEE (Calgary) is the copyright owner of the Canadian Oil and Gas Evaluation Handbook (COGEH) Volumes 1, 2 and 3

• Currently working on guidance for Resource evaluations

• Membership includes local evaluation consultants, IQREs from E & P Companies and representatives from the ASC
Considering The Full Production History Of Five Key Resource Plays

October 30, 2013
Calgary

Mike Morgan, P. Eng.
Major Concepts

• With over a decade of commercial deployment, multi-frac’d development is no longer new so why does most analysis still highlight initial rates?

• By analyzing the full production profile and decline behavior, simple diagnostics can help to identify the flow regime.

• If the petroleum industry is going to talk in terms of statistics (P10 reserves, average type wells, top tier acreage) it must talk in terms of geostatistics.

• These results can be used a starting point when trying to build analogs for emerging resource plays.

• Actual decline rates for old fields may be higher than you expected.
Peak Rate is, Mostly, a Good Proxy for EUR (Gas Wells in N. America)
...But This is a Broad Correlation
(Gas Wells in N. America with IP ≈ 500Mcf/d)

There can be an order of magnitude uncertainty if EUR is est. by Peak Rate
We Can Restrict Our Set of Wells (MR/MH Wells in Alberta and Saskatchewan)
...But This is Still a Broad Correlation
(MR/MH Wells with IP ≈ 200 Mcf/d)

There is still an order of magnitude uncertainty if EUR is estimated by Peak Rate.
MR/MH Gas EUR
(from existing wells)

Suffield... we'll see this later
MR/MH Gas Remaining
(from existing wells)

Suffield… we’ll see this next
Looking at one of Canada’s original resource plays, we can see that 25 years of technology have incrementally added EUR, but have not fundamentally changed the picture.
Decline Rates of MR/MH Gas Wells (after 1,2,3,5,10,20,30 years of production)

P50 decline at 10 years is \(\approx 10\%\)
Alberta Horseshoe Canyon CBM (Rate–Time Plot, by Well Cardinality)
Alberta Horseshoe Canyon CBM (Pseudo–Blasingame Plot)

Clear boundary dominated flow

Near wellbore perm improvement?

Only Rates Greater than 1 Mcf/d are Plotted
Alberta Horseshoe Canyon CBM
(Decline at 1,2,3,5,10 years of production)

P50 decline at 10 years is \(\approx 7\%\)
Horseshoe Canyon
EUR Method 1
Horseshoe Canyon
Variability in EUR Between Wells

The variability between wells can be large, which has prompted analysts to label these “statistical plays”, but we saw that average EUR per section was well-defined, at least on a regional scale.
Horseshoe Canyon Variograms

The variance is roughly 1.5 at a distance of 100 km.
Horseshoe Canyon
Computer Contours w/ Variance

EUR estimates can vary…

...and there are enough wells to be sure, even on the fringes.
Eagleford
EUR Method 2

Look, the Eagleford magically disappears in Mexico!
Eagleford
Variability in EUR Between Wells

EUR per well does vary, but we can quantify this variability.
The variance N/S is roughly 6.0 at a distance of 100 km.

EUR per well does vary more than in the HSC example, by about a factor of 2-4.

The variance E/W is roughly 3.0 at a distance of 100 km.
Eagleford
Computer Contours w/ Variance

Ordinary Kriging Prediction

Ordinary Kriging Variance
Montney Gas in NE British Columbia (Rate–Time Plot)

-1/2 Slope
Montney Gas in NE British Columbia
(Pseudo–Blasingame Plot)

If analytical rate/transient techniques are used for our “type-curves”, damage/skin/clean-up effects start to become apparent

Only Rates Greater than 100 Mcf/d are Plotted
Montney Wells in NE British Columbia
(Decline at 1, 2, 3, 5, 10 years of production)

P50 decline at 10 years is \( \approx 6\% \), but these are widely spaced verticals.
Montney
Variability in EUR Between Wells

- Multiple horizons
- High CGR
- Mixed vertical and horizontal development
- High CGR
Montney Variograms

These variograms don’t look like textbook examples… the play is still being delineated.
Decline Rates of N. American Gas Wells (after 1,2,3,5,10,20,30 years of production)

P50 decline at 20-30 years is ≈8%
Multifrac’d Cardium Oil in Alberta (Rate–Time Plot)

Early well performance is pulling-up the averages.
Multifrac’d Cardium Oil in Alberta (Pseudo–Blasingame Plot)

Maybe some wells are seeing boundary dominated flow, but most are not... suspect frac’s are interfering... wells are probably only interfering weakly... more work needed.

Only Rates Greater than 0.1 bbl/d are Plotted
Multifract’d Cardium Oil in Alberta 
(Decline at 1,2,3 years of production)

P50 decline at 3 years is steeper than both the Montney and overall N. American gas declines
Major Conclusions

• Many current plays are still in infinite acting flow and so it is difficult to verify DPIIP assumptions from production data.

• Good areas are developed first and will be drilled until there is enough interference, hopefully not too much!

• Smart operators will delineate the expected economic outcome, which may take over a decade… and make sure they don’t miss anything.

• Typical long term decline rates may be steeper than you expect: median decline rates for gas wells after 30 years of production are approximately 5–10%. A minority of wells have much shallower declines.

• Many important parameters, such as EUR and decline rates, can be neither normally nor log–normally distributed.
Contact Us

Keith Braaten
1–403–266–9515
kbraaten@gljpc.com

Mike Morgan
1–403–266–9437
mmorgan@gljpc.com

Jodi Anhorn
1–403–266–9479
janhorn@gljpc.com
Sample EUR Match 1

Production to Date = 3,292 MMcf

Exponential URR = 4,150 MMcf

Harmonic URR = 8,600 MMcf

Pseudo-Blasingame Plot

Radial Flow Identification

Linear Flow Identification

Only Rates Greater than 100 Mcf/d are Plotted
Sample EUR Match 2

Production to Date = 1,704 MMcf

- Calendar Day Gas Rate (Mcf/d)
- Date

Exponential URR = 2,000 MMcf

- Calendar Day Gas Rate (Mcf/d)
- Cumulative Gas Production (MMcf)
- D = 34.3%
- D = 34.3%

Harmonic URR = 3,150 MMcf

- Calendar Day Gas Rate (Mcf/d)
- Cumulative Gas Production (MMcf)
- D = 144.2%
- D = 18.7%

Peak COP = 4.0 (bbl/MMcf)

Pseudo-Blasingame Plot

- So
- I_{100} (days)

Only Rates Greater than 100 Mcf/d are Plotted

Radial Flow Identification

- I_{100}
- Time (hours)

Linear Flow Identification

- 1/(I_{100} Mcf/d)
- t (hours)
Sample EUR Match 3

Production to Date = 3,250 MMcf

Exponential URR = 12,750 MMcf
- \( D_1 = 6.0\% \)
- \( D_2 = 6.0\% \)

Harmonic URR = 18,000 MMcf
- \( D_1 = 15.0\% \)
- \( D_2 = 12.0\% \)

Pseudo-Blasingame Plot

Radial Flow Identification

Linear Flow Identification

Only Rates Greater than 100 Mcf/d are Plotted
In this example, both methods of calculating EUR show that the highest gas recoveries are in the middle of the play.
Horseshoe Canyon
EUR2–EUR1

The variability between EUR methods can be large, especially if there is not much production data.
MR/MH Gas Wells

Variograms

The variance N/S is roughly 2.5 at a distance of 100 km.

The variance E/W is roughly 1.5 at a distance of 100 km.
MR/MH Gas Wells
Computer Contours w/ Variance
Gas Wells in WCSB
Gas Wells in N. America

Well Locations Were Stored in a Different DB Table