Fekete NEWS

- Reservoir Evaluation
- Production Optimization
- Simulation
- Well Testing
- Engineering Software

Engineering and Business News From Fekete Associates Inc. *Summer 2003*

Announcing F.A.S.T. CBM™

F.A.S.T. CBM™ is Fekete's latest software. It is used for coalbed methane reservoirs to generate gas and water forecasts. Through forecasting, F.A.S.T. CBM™ helps the user determine optimum drilling spacing in new plays and estimate reserve recovery from existing coalbed methane wells.

F.A.S.T. CBM™ is used to optimize well spacing in both wet and dry coalbed methane reservoirs. The advantage of using F.A.S.T. CBM™ is the ability to forecast water production. In wet coalbed methane reservoirs, water is one of the primary concerns. If you don't drill enough wells, you may not be able to "de-water" the reservoir sufficiently to get economic gas rates, or it may take an unreasonable amount of time to recover the gas. Unlike conventional reservoirs, interference between wells in wet coalbed methane reservoirs is beneficial because it accelerates the depressuring of the reservoir below the desorption pressure. The de-watering phase is represented as a "negative decline" of gas production. During this time frame, the relative permeability to gas increases as water is being produced from the reservoir. Therefore gas rates increase during the initial stage of production. At the end of this stage, the gas rate will reach a peak and begin to decline. The more interference that is created between wells, the sooner you can de-water the wells and reach the maximum rate.

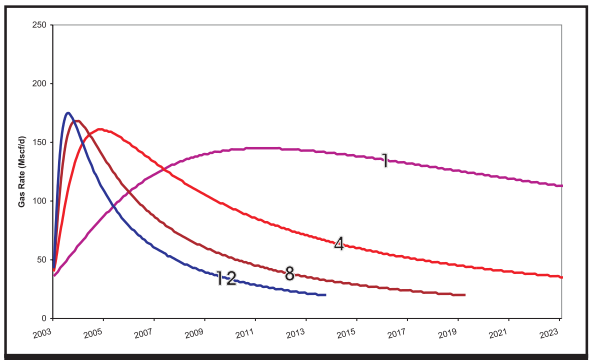


Fig 1. Gas Rates Per Well

Figure 1 shows gas rate forecasts for 1, 4, 8 and 12 wells in a section. This forecast represents the rates for one well. Figure 1 indicates that it takes over 100 years to deplete the reservoir with only 1 well, while it takes 11 years to deplete the entire section with 12 wells. After considering operating costs and the capital required for drilling, completion, tie-in, and compression it may not make economic sense to drill at a high density. In this particular case, the optimum drilling density may be 4 or 8 wells – depending on the marginal economics.

Fekete uses F.A.S.T. CBM™ in-house to determine reservoir parameters and drainage area. History matching provides reservoir parameters from which a future forecast is generated and the remaining recoverable gas reserves are determined. Figure 2 shows that if reserves were estimated using exponential decline analysis, the recoverable gas would have been underestimated. The hyperbolic profile of the gas production is due to the shape of the Langmuir isotherm for this particular coalbed reservoir.

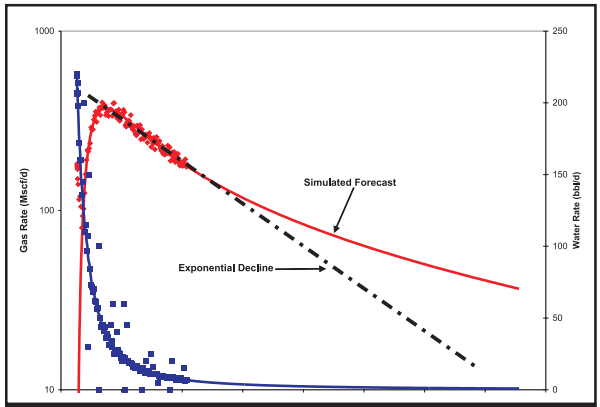


Fig 2. Simulated Forecast and Decline Analysis

Fast CBM™ COALBED METHANE

Fekete is holding an **Open House**, September 4, 2003, in Calgary, Alberta to introduce the latest upgrades in F.A.S.T. CBM™. Come have lunch and learn more about the benefits and features of F.A.S.T. CBM™. For more information, or to register, contact the course coordinator at courses@fekete.com.

INSIDE THIS ISSUE

Ed Mathison is a senior geologist with Fekete Associates Inc. He is part of a geological team that integrates geology with engineering. Fekete's geological services include petrophysical evaluation, reserves evaluation, sequence stratigraphy, bypass pay identification, 3D geological modeling, reservoir characterization, probabilistic resource assessment, and government applications.

Petroleum geologists, working with subsurface data, are faced with a difficult task; they must interpret three dimensional relationships of rock layers (stratigraphy) using largely one dimensional data sets (well logs and core). Seismic provides two and three dimensional data sets but even these require integration with well logs and core. To flesh out these point sources of information geologists must use well log correlations to bind it all together. Well log correlation is an interpretive process that is very much driven by the conceptual framework of the interpreter. Over the last few decades the conceptual framework with which subsurface stratigraphers undertake their task has undergone a revolution. Sequence stratigraphy, born out of seismic stratigraphy, has changed the way geologists look at the sedimentary record. Although sequence stratigraphy is merely a different way of looking at the same old rocks, this new packaging allows us to be far more precise in our subsurface predictions.

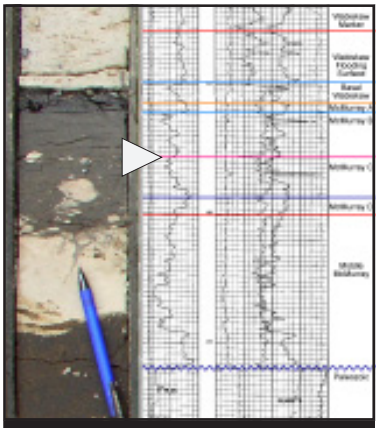


Fig 1. Upper McMurray in Well 14-22-80-11W4M

Sequence stratigraphy uses subaerial unconformities, sedimentary breaks formed by exposure at the earth's surface, as the primary bounding surfaces for depositional packages. Subaerial unconformities (SU) mark the end of one depositional phase and the beginning of another. In core, subaerial unconformities are expressed as soil horizons and/or erosional surfaces. For example, within the Upper McMurray (in well 14-22-80-11W4M) a soil horizon formed during subaerial exposure is directly overlain by a carbonaceous mudstone containing pebbles– eroded from the underlying sediment (Fig. 1). Sediments preserved below a subaerial unconformity record the final depositional episodes of a succession. Sediment above the surface represents the initial stages of the succeeding depositional cycle as sediments fill the new space created within a basin, either through subsidence or sea-level rise.

Not all subaerial unconformities are created equal. Only those boundaries where there has been a significant drop in sea-level are considered to be sequence boundaries. However the drop must be sufficient enough to result in valley incision on the resulting coastal plain. Significant valley incision, on a coastal plain, implies a drop in relative sea level as streams erode to a lower base level. Subaerial exposure surfaces, recognized in subsurface, must therefore be associated with paleo-valleys to qualify as sequence boundaries. Fluvial to

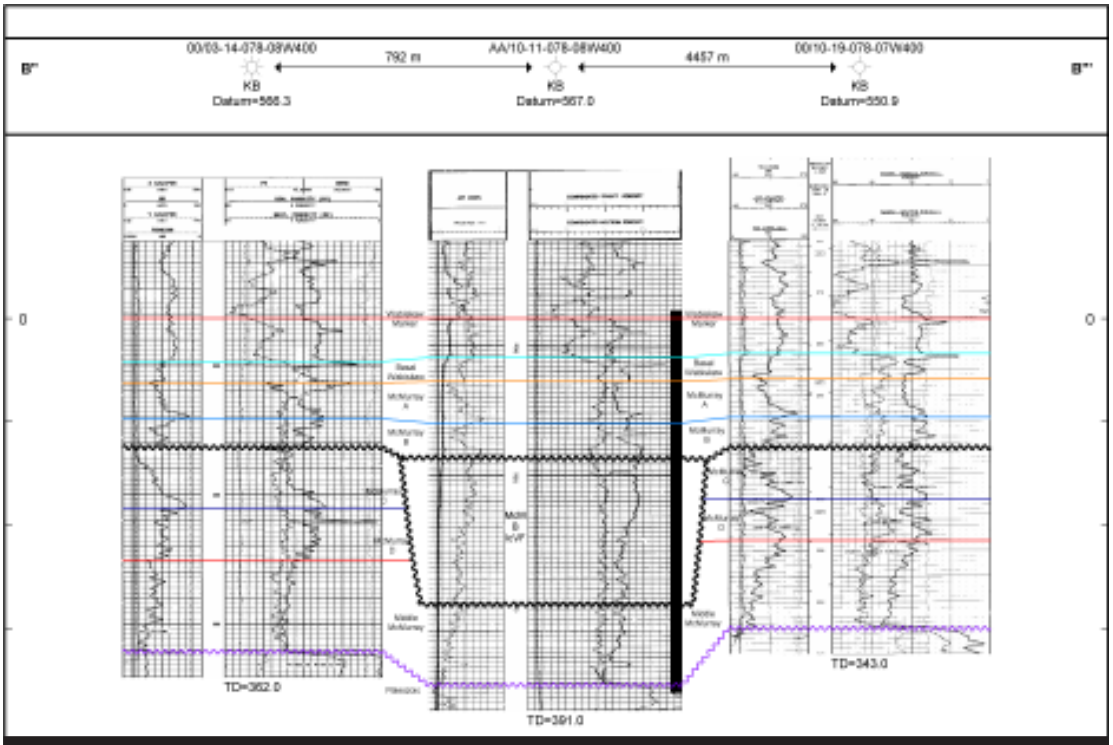


Fig 2. Upper McMurray Subaerial Unconformity

estuarine incised valley fills (IcVF) can be tied to the Upper McMurray subaerial unconformity (Fig. 2).

In addition to tracing sequence boundaries along subaerial unconformities, sequence stratigraphy uses a number of other surfaces to subdivide sequences: maximum flooding surfaces (MFS), regionally correlatable marine shales, and separate transgressive (TR) portions of sequences from regressive (R) portions. Ravinement surfaces (RS), located at the base of marine flooding surfaces, form by wave erosion as a shoreline passes through an area during transgression. Ravinement surfaces separate shoreface sediments deposited during transgression from overlying shallow marine deposits of the same sequence. Ravinement surfaces may also be sequence boundaries where there is significant shoreface erosion and all traces of the subaerial unconformity may have been removed from the preceding sequence.

The sequence stratigraphic architecture of a sedimentary succession provides a framework by which various depositional environments can be interpreted. By tracing these various surfaces, complex stratigraphic relationships can be unravelled and the various components of a stratigraphic succession delineated (Fig. 3). For example, fluvial-estuarine sediments fill incised valleys during the initial stages of transgressions. Shoreline sediments, however, can occur both

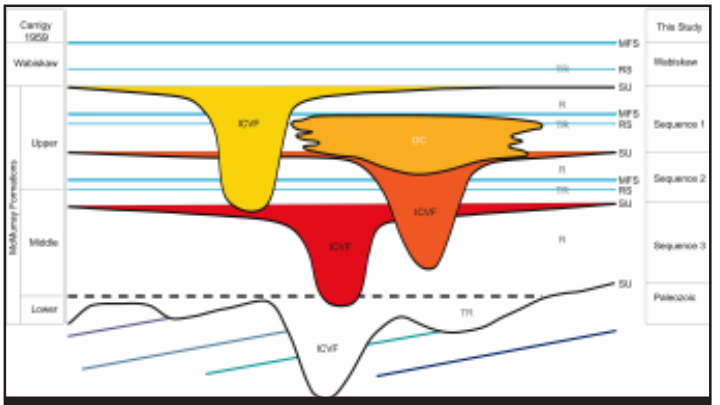


Fig 3. McMurray Formation Sequence Stratigraphic Framework

during transgressions (stratigraphically above estuarine/fluvial sediments but below maximum flooding surfaces) and regressions, as the shoreline extends outwards after maximum flooding.

The interplay between repeated fluctuations in relative sea-level, periodic subaerial erosion, and valley incision results in a wide variety of stratigraphic traps for hydrocarbons. Complex hydrocarbon trapping relationships, previously difficult to interpret, are frequently decipherable once the sediments have been critically analyzed from a sequence stratigraphic perspective (Fig. 4). In addition, detailed reservoir analysis is improved by mapping erosionally bounded

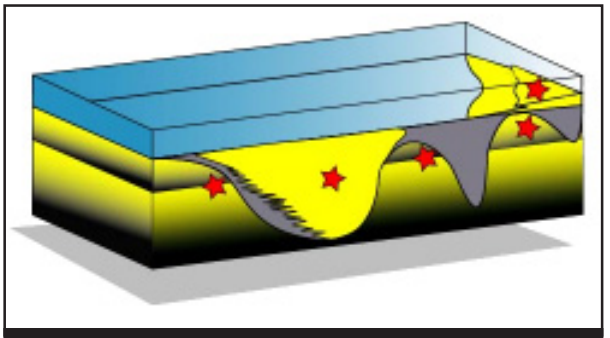


Fig 4. StratigraphicTraps (stars) at Sequence Boundary

depositional units. The depositional architecture of a reservoir can be interpreted by mapping the various scales of erosionally bounded depositional units that comprise it (e.g. various channel stories, Fig. 5). Heterogeneity within a reservoir is very much a function of the stratigraphic architecture of the unit. Understanding the heterogeneity of a reservoir is

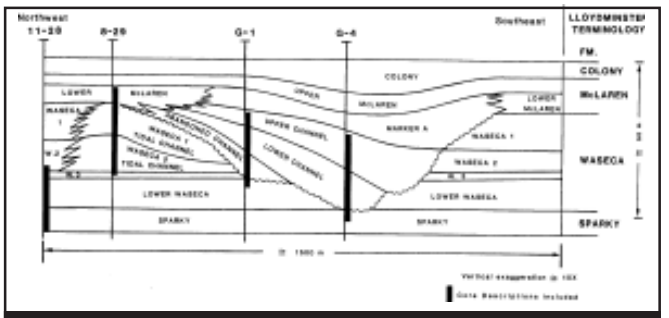


Fig 5. Example of Various Channel Stories in Cross Section

necessary for the reservoir engineer who is trying to understand primary recovery or to implement secondary or tertiary recovery schemes.

More information about Fekete's services and software is available on our new web site: http://www.fekete.com

Is there a technical issue you would like us to address in our newsletter?

Comments, requests or questions about the content of our newsletters can be directed to news@fekete.com

What's News @ Fekete...

Inactive Well Management

Fekete has partnered up with VECO Canada and Lionhead to provide a comprehensive solution for managing inactive wells. This joint venture allows the client to breathe new life into shut-in wells, ensure compliance with current EUB regulations and maximize their asset value while reducing liabilities and operating costs. Please contact Angelo Scarpino at VECO, (403) 231-6073, for more information.

UPGRADE

Fast RTA

Version 2.5

- Pseudo-Steady-State waterdrive (Fetkovich) model – geometry independent.
- Typecurve plot for history matching on Models page.
- Calculation of EUR using either recovery factor or abandonment pressure.
- Production forecasting at variable pressures, skins.
- P/Z versus Cumulative (classic material balance plot) integrated with Flowing Material Balance.
- Reservoir pressure displayed for each method
- New diagnostic plot: Wellhead Pressure vs. Cumulative.

Upcoming Courses

Courses are available for most of Fekete's software packages. For up to date schedule information, visit our webpage www.fekete.com. To register, contact courses@fekete.com or call our course coordinator at 403-213-4200 or 1-800-625-2488.

Distinguished Lecture Thanks

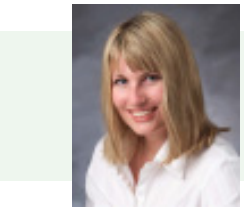
Louis Mattar has just completed his successful Distinguished Lecture Tour for the SPE. Louis travelled around the globe, presenting a practical look at the effects of wellbore dynamics in well test analysis. He had a lot of fun and would like to thank all of the participants who sat-in on his lectures. If you are interested in having Louis present his talk to engineers at your company, please contact us and arrange a time for this informative speech. A video of Louis' wellbore dynamics presentation will also be available on a CD scheduled for release in January 2004. For more information, please visit the About Us section of our web site.

UPGRADE

Fast MBA™

Full Serving or Lite?

There are now two versions of our gas material balance software. Some users require maximum flexibility, others just need to produce a P/Z plot. Fekete has a solution for each. **FAST MBA™** is a detailed version that requires production and pressure data on a well basis for user-defined pool groupings. It supports volumetric depletion, water-drive, connected, and over-pressured reservoir models. **FAST MBA™ Lite** is a volumetric depletion tool that allows users to plot a simple P/Z analysis.



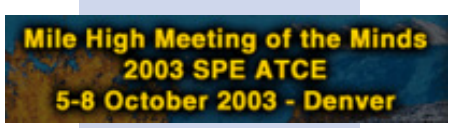
Welcome Aboard

Leanne Christie joins Fekete as an Account Manager for software and services. She provides clients with point of contact, updates and releases for software account enquiries. If you have any questions regarding your software account or training, please contact Leanne at (403) 213-4200 or email her at lchristie@fekete.com.

Fekete Family News

Our congratulations go out to Dave and Brandy Anderson who recently had a little addition to the family. Emma was born April 2003, and Dave promises to keep her away from integrals and derivatives for a least a few more years.

We also send our best wishes to Heather Campbell, database technician, and Leah Robbins, senior technologist, who both start maternity leave on August 1st.



Be sure to visit Fekete at **Booth #254** in Denver this year. We are teaching a variety of short courses concurrent with the conference. These courses will be held at the Westin Tabor Center. Our booth at the show will be setup as a teaching centre where our experts will be available to answer your questions, either in a group setting or one-on-one. More information on upcoming courses, software and services is available on our website at www.fekete.com or by contacting Kevin Dunn at 1-800-625-2488.

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