Arc-Objects: extending GIS functionality for the Petroleum Upstream

Power Tools to automate Data Transfer,
Gridding & Contouring, Risk Analysis,
and lots more Cool Stuff

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PRIEMERE L.L.C. GeoTechnology

ESRI Petroleum Users Group Conference (PUG)
26-February 2008 (Tuesday) 11:00 – 11:30 am

Outline

Why: What is the Motivation

Where: are the Opportunities

How: Arc Objects & Visual Basic

What: Power Tools for ArcGIS

Who: Consortium of Clients

Q&A: Questions & Discussion

DISCLAIMER: presentation solicited just 3 days ago
Apologize: short on visual examples

Why: what is the motivation?

- ArcGIS is a large & diverse product
  - Depth & breadth of robust functionality to leverage
- Petroleum is a minor vertical niche to ESRI
  - But rapidly growing, as evidence by this conference!
  - and represented by some of the largest & most profitable companies in the world!
- With some specific needs in the Upstream Sector
  - Not well understood, appreciated, or adressed by ESRI
- Already serviced by a few mature Vendors
  - that might be too large & lethargic to respond to the emerging GIS market
- Creating an Opportunity for new Innovations
  - By experienced, but agile Business Partners

Untapped GIS Potential

- 1. Access GIS Data
  - Exchange with the many other E&P applications
- 2. Process GIS Data
  - Risk Analysis, Gridding & Contouring, Fluid Flow
- 3. Modify GIS Data
  - Attributes, Metadata, Projections
- 4. View GIS Data
  - Map panels, 3D, Cross-sections
- 5. Present GIS Data
  - Hardcopy, Slides, Interactive
- 6. Manage GIS Data
  - Organize, Publish, Inventory, Repair

1. Access GIS Data

- Exchange with the other E&P applications
  - SeisWorks, OpenWorks, Zmap, GeoProbe
  - GeoQuest, CPS3, EarthVision, RMS, GoCad
  - Ukooa, Excel, Generic ascii columns, etc.
- Efficiency
  - Batch capabilities: multi-select, drag & drop
  - Auto-detect formats
- Dumbing Down (export)
  - Complex Polygons (donuts)
  - Annotations from Labels

2. Process GIS Data

- Risk Analysis
  - Evaluate the spatial component (map optimization)
    - Convolve risk elements from any number of input GIS layers
  - Exploration play fairways
  - Prospect drill site selection
  - Reservoir development (infill drilling)
- Gridding & Contouring
  - Batch processing, clipping, faults/barriers
  - Topo Maps: fine & bold contours, labels, outline
  - Thickness (TST), reconstructions
  - Trends, residuals, smoothing, blanking
- Fluid Flow Analysis
  - Trap & source locations (fill & spill)
  - Area, volume, column heights

3. Modify GIS Data

- Attributes added to Features
  - Generate from any number of other GIS layers
- Metadata enhancements
  - Simplify viewing or editing any Map layer
  - View complete data Lineage
    - Every processing step → back to raw input!
- Projection issues
  - Correct or modify spatial reference (batch)

4. View GIS Data

- Map panels
  - Systematically pan/zoom/scroll data extent
  - Or features, sorted by attribute
- 3D
  - Drape features & attributes on DEM
- Cross-section
  - Unlimited number of layers: raster or feature
  - Dynamically update: drag transect on map
  - Mouse-over information

5. Present GIS Data

- PowerPoint Slides
  - Batch export options, concistent matrix layout
    - Preserve metadata in notes
  - Dynamically update map surrounds
    - Date, name, labels, spatial reference, paths, etc.
- Interactive Sessions
  - Symbology modified in batch
    - Consistent rendering for a group of layers
  - Bookmarks: import, modify, rename, reorder

6. Manage GIS Data

- Inventory
  - Scan document(s) or catalog tree
- Repair
  - Broken links: relative, UNC, MND, dos8.3
  - Spatial Reference: wrong or missing
- Publish
  - Bundle of layers sent to a new location
- Organize
  - Batch renaming

Vision of Efficiency

- Import Interpretation
  - a stack of a dozen horizons from a 2d/3d SeisWorks project
- Mixed Projections
  - Repeat for a corresponding stack from another project in a different projection
- Grid and Merge
  - Mosaic across mixed projections
  - Create a set of Isochore (true stratigraphic thickness) grids for each interval
- Make contour maps of all these surfaces
  - Create a montage of Depth and Thickness and send to the plotter
- Identify leads as traps on target horizons
  - Similarly, identify source migration points from Kitchen horizon
- Evaluate the Exploration Risk
  - Adequate trap column from stacked pay zones
  - Filled by significantly mature source volume near the crest of a reconstructed carrier bed
- Dump everything to Powerpoint for presentation to Management
  - Convince them we pulled all-nighters over the Weekend to get all this work done
- But, we do this stuff repeatedly
  - Want it to be faster & easier!

How: Arc Objects

- "Dev Kit" for ArcGIS
  - Oops: Object Oriented Programming
  - Robust library of Interfaces, Methods, and Properties
  - Access to data structures, tools, functions, models, etc.
- Development Resources
  - ESRI Developers Network & Web Forums
- Architecture: Microsoft "COM" compliant
  - Broad base of Software Developers
  - Compilers: C++, VB, .Net, Python, etc.
- Visual Basic
  - VBA (prototype): visual basic for applications
  - VB6 (package): compile into DLL extensions

Pros & Cons

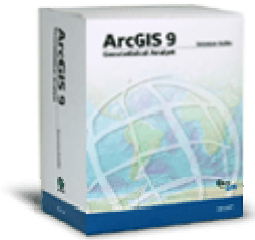
- Advantages of Arc Objects
  - Truly “Open” development environment
    - Integrate across applications (ie, Office)
  - Comes free with the ArcGIS software
  - Clearly documented on the Web
    - Many sources of code samples
- Disadvantages of Arc Objects
  - Complex object model, with some quirks
  - Learning Curve is steep, hard to get Help
  - Web Resources: usually get what you pay for
  - Lots of Hackers, far less Experts

Necessity . . .

- . . . is the Mother of Invention . . .
  - Clients have lots of Problems to Solve
  - Many things not working efficiently
  - Many of them are frequently recurring
- Lazy, Lazy, Lazy, Me
  - Low tolerance for tedious, menial, manual work
- Leverage skills & resources (work smart)
  - Rather than spending an hour of monotony . .
  - Spend a few hours writing a script (rapid prototyping)
  - Then refine and reuse over & over (payback)
- Commercialize
  - Package and Distribute for Customers to use
  - Which inevitably leads to more Business

What: Priemere Power Tools

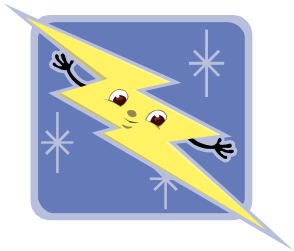
- A suite of tools to extend the generic functionality of ArcGIS Desktop
  - ArcMap, Catalog, Scene, and Globe

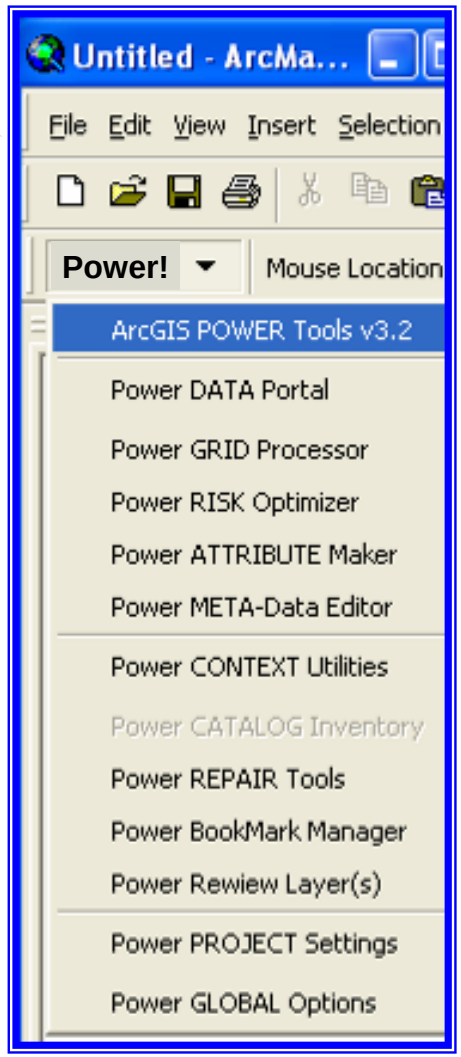


- Designed around the unique requirements of the Petroleum E&P environment
  - defined by the needs of our Customers
- With focus on Automation & Efficiency
  - to facilitate access, analysis, presentation, and management of large amounts of Data
- Field Tested in our Client Offices
  - Used to deliver our Consulting Service Projects

Putting in the **Power!**

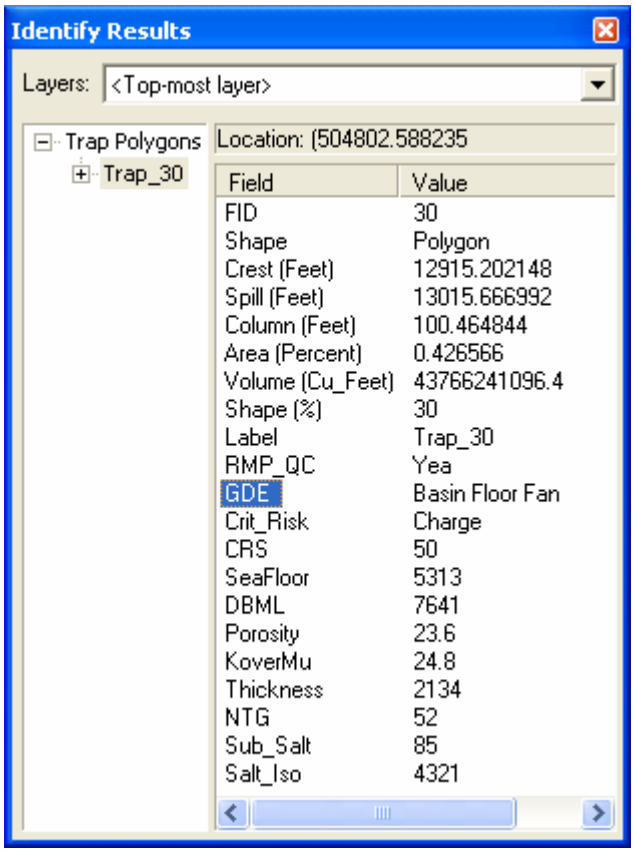
- Floating Toolbar
  - Custom add-in extension
  - ArcMap, Catalog, Scene, Globe
- Menu of Tools
  - Address requirements stated earlier
- Focus on Automation
  - Fast and efficient work processes
- Batch Processing
  - Operate on Groups of Data
- Intelligent Defaults
  - Minimize key strokes for parameter selection
- Priemere Algorithms
  - Designed for E&P customer requirements

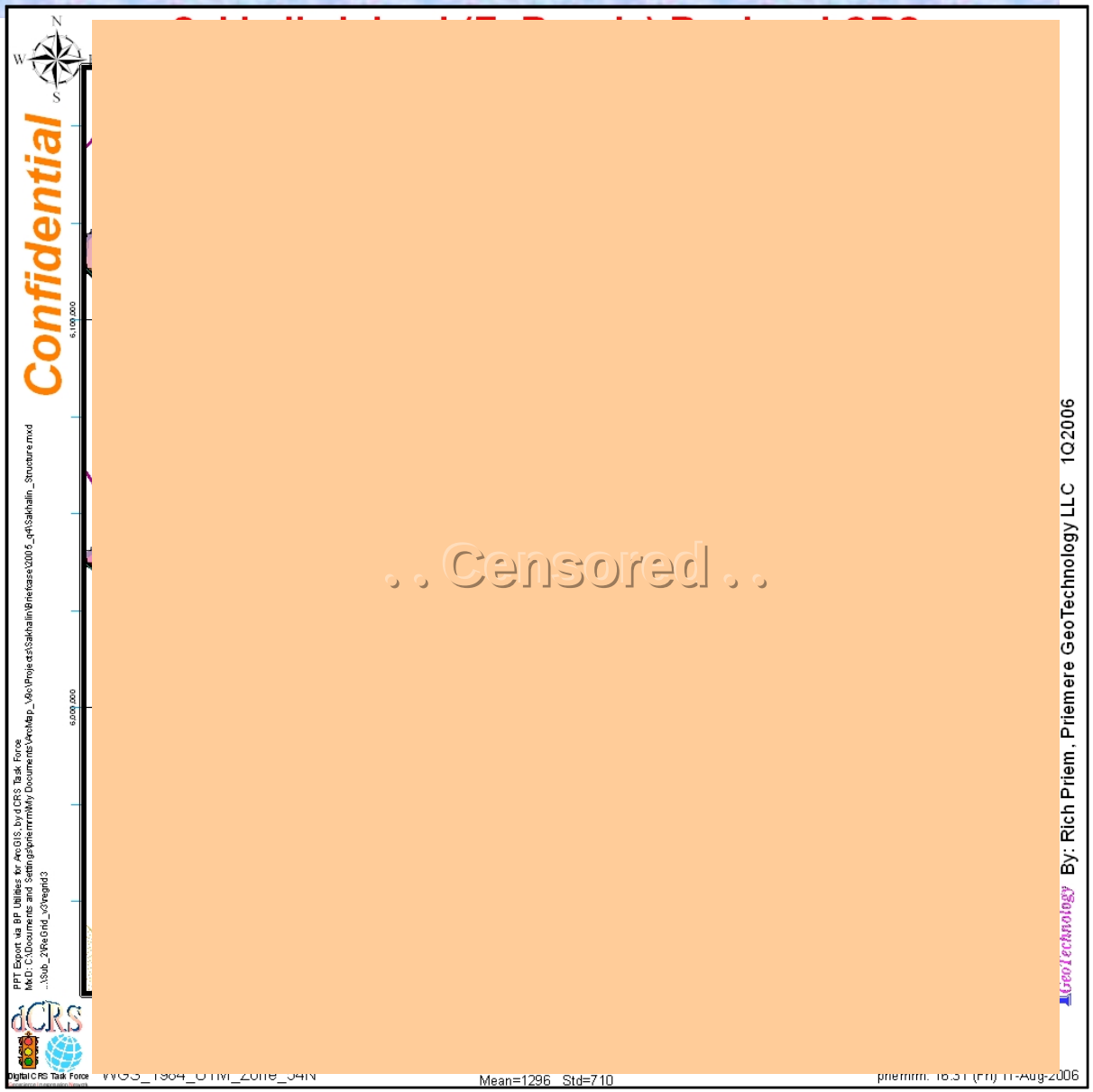




Example: Topo with Traps

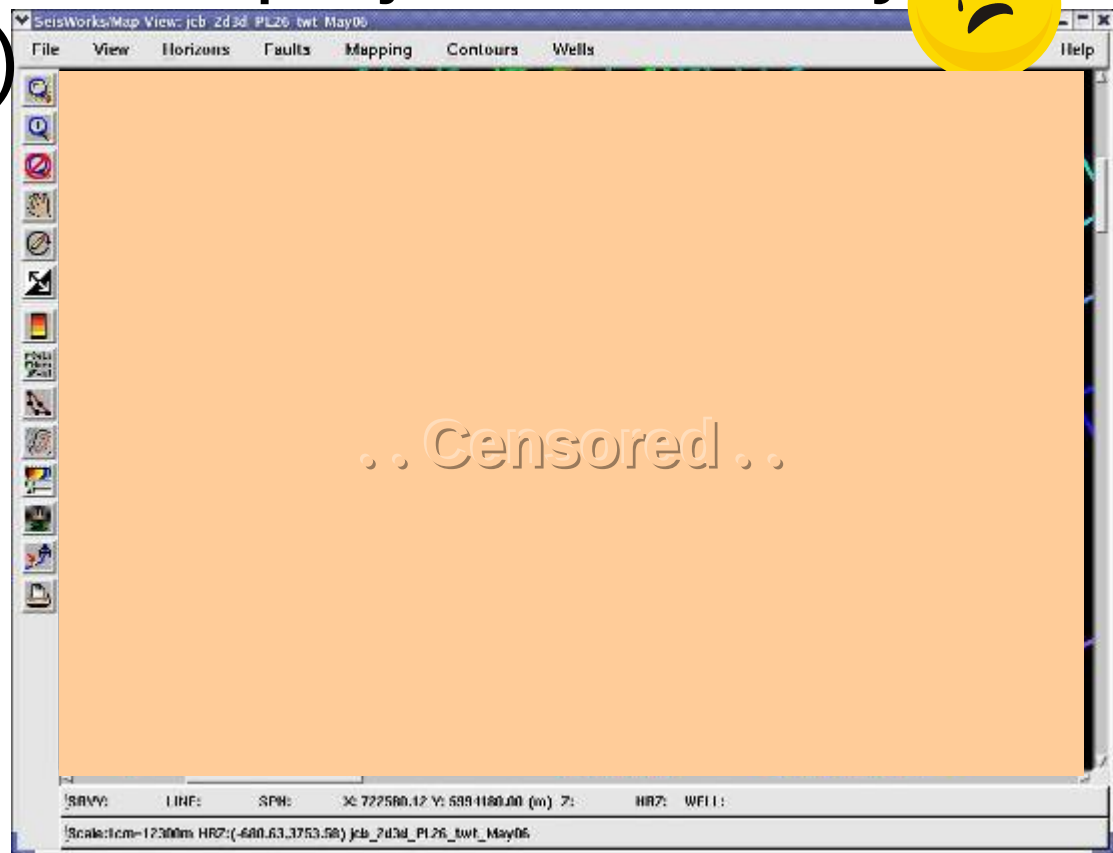
- Contours: fine & bold
- Perimeter outline (edge)
- Quantile classification
- Custom map surrounds
- Traps w. attributes



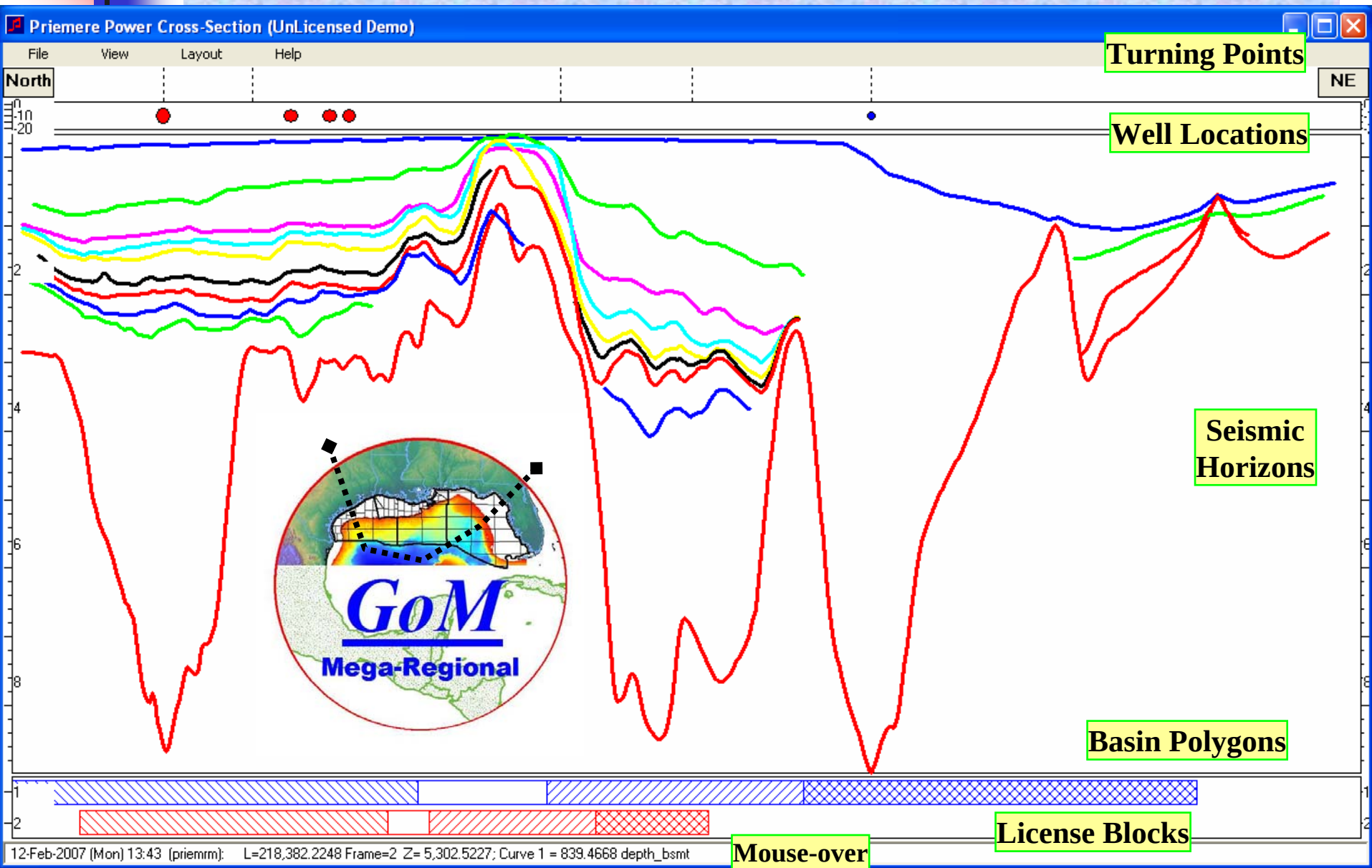


Beauty from the Beast

- SeisWorks Horizons: 2d/3d merged projects
- ToC: unlimited culture, grids, overlays, etc.
- Mix coordinate systems: project-on-the-fly
- True Color (32 bit)
- Transparency
- Easy Cut/Paste
- Identify Attributes
- Hyperlinks
- Etc, etc, etc...

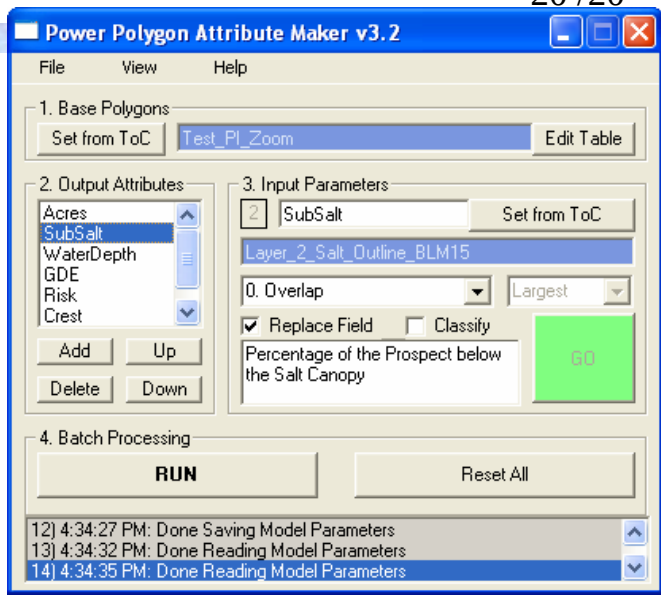


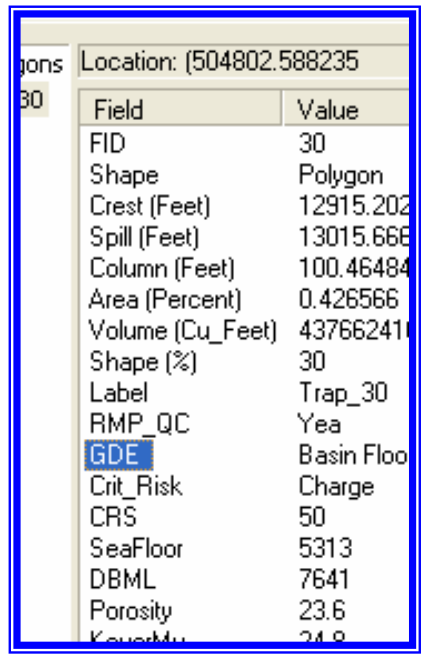
Example: Cross-Section



Example: Attribute Maker

- GUI Interface
  - Define base layer (inventory of leads)
  - Scrolling List Attribute
    - Input laye, parameters, and notes
  - Process individually or in batch
  - Parameter file to save & reuse
- Extract Values from Other GIS Layers
  - Raster (grid) statistics: mean, min, max, etc.
    - Structure: Depth, Thickness, Bathymetry, DBML
    - Measures: NTG, Porosity, Amplitude, Risk
  - Feature layers: attributes or statistics
    - Lease Block, nearest Well
    - distance from Pipeline
- Result: Attribute Table
  - View in Excel, Access, etc.
  - Metadata recording processing history





Who: if, when, how?

- Just throwing out Ideas . . .
  - Many companies have dabbled in Development
  - PUG list has many lingering requests
- Consortium Opportunities
  - Pool support from interested customers
  - Prioritize commercialization of Products
  - Shared Funding of new Innovations

Conclusion

- Questions → Answers
  - Comments
  - Feedback

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Bio: Rich Priem

- Rich is a GeoScience Consultant doing business as the Priemere Consulting Group for more than two decades. His degrees are in Engineering, Mathematics, and Computer Science.
- Rich has been programming & using software applications for 35 years, with 28 years in the Petroleum Industry, mostly on the Exploration side.
- This is his 6th PUG, and he has been heavily using ArcGIS Desktop for Mapping & Modeling - as well as ArcObjects for developing custom extensions to address specific needs of his clients.

Abstract

- Never Written . . .