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Geologic Framework Model for the Deep Borehole Field Test

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Overview of Geologic Framework Model (GFM)

- **Emphasis on Capability for Documentation**, **Data Management** and **Visualization** of DBFT site, borehole and test data
- Model utilizes GFM software (RockWorks 17, Rockware) supported by GIS software (ArcGIS 10, ESRI)
- First Step - Document existing geologic data for deep borehole site and surrounding region
- Document and provide data management and visualization of data collected as part of deep borehole drilling and testing:
  - Stratigraphy
  - Lithologic variations in crystalline rock
  - Fracture data
  - Data from well logging
  - Data from scientific tests
- Provide a framework to aid in test decisions

Examples of Data Included in GFM

- **RockWorks is designed around the concept of a borehole database**
  - Formation and lithologic data
  - Fractures/Faults
  - P-T conditions
  - Geophysical data
  - Geochemical data
  - Aquifer data
  - Standard well log data
  - DBFT scientific test data
  - Well construction data
- **Data is organized into three general types**
  - Borehole point data (specific depth)
  - Borehole interval data (specific depth interval)
  - Borehole time-interval data (time-series)

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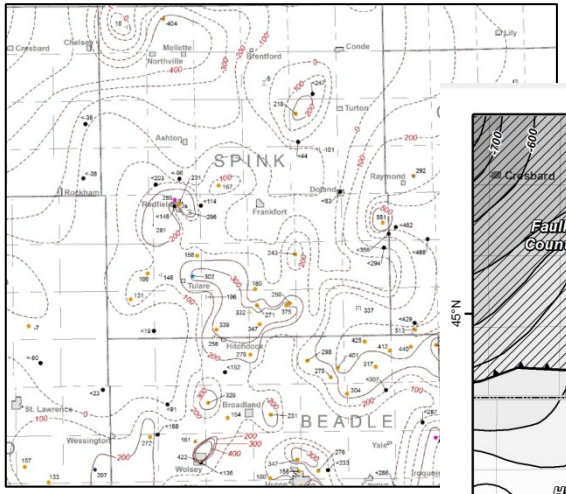
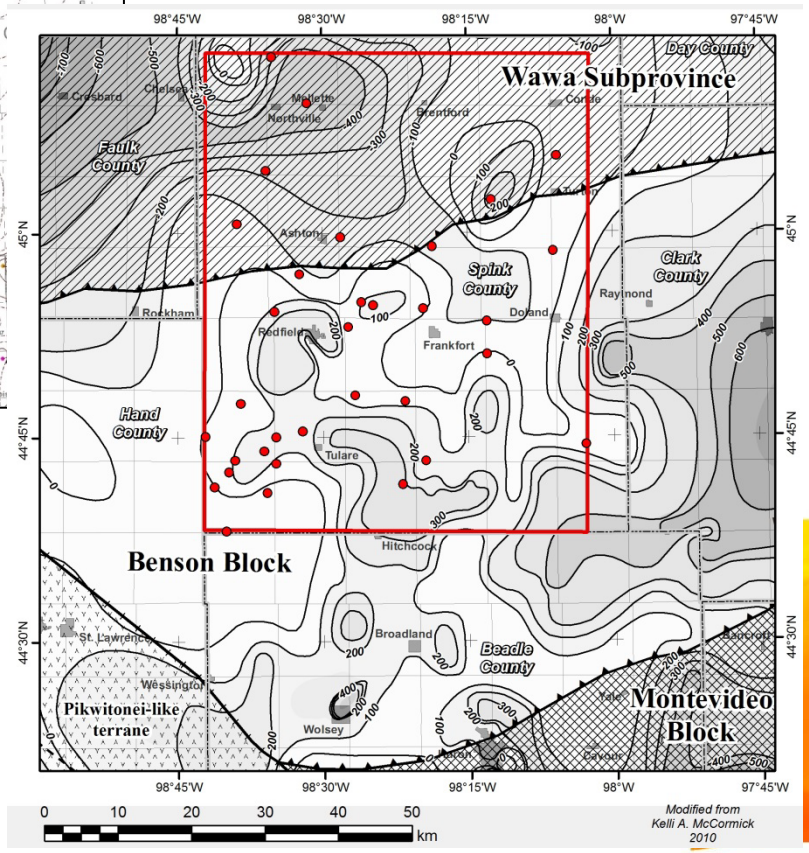
Flexible Incorporation of Data



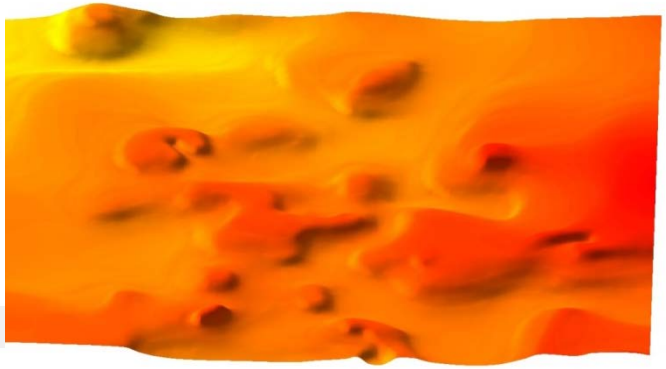
1. Original published map (McCormick 2010)

Borehole Domain
- boreholes that intersect Dakota SS



2. Define project domain and create xyz PC surface grid in **ArcGIS**

- Existing publications and maps
- Existing geologic or geophysical data in digital format
- Borehole data from state well databases (water, oil and gas)
- Newly acquired data from DBFT



3. Import grid into **RockWorks** for 3D visualization and incorporation in GFM

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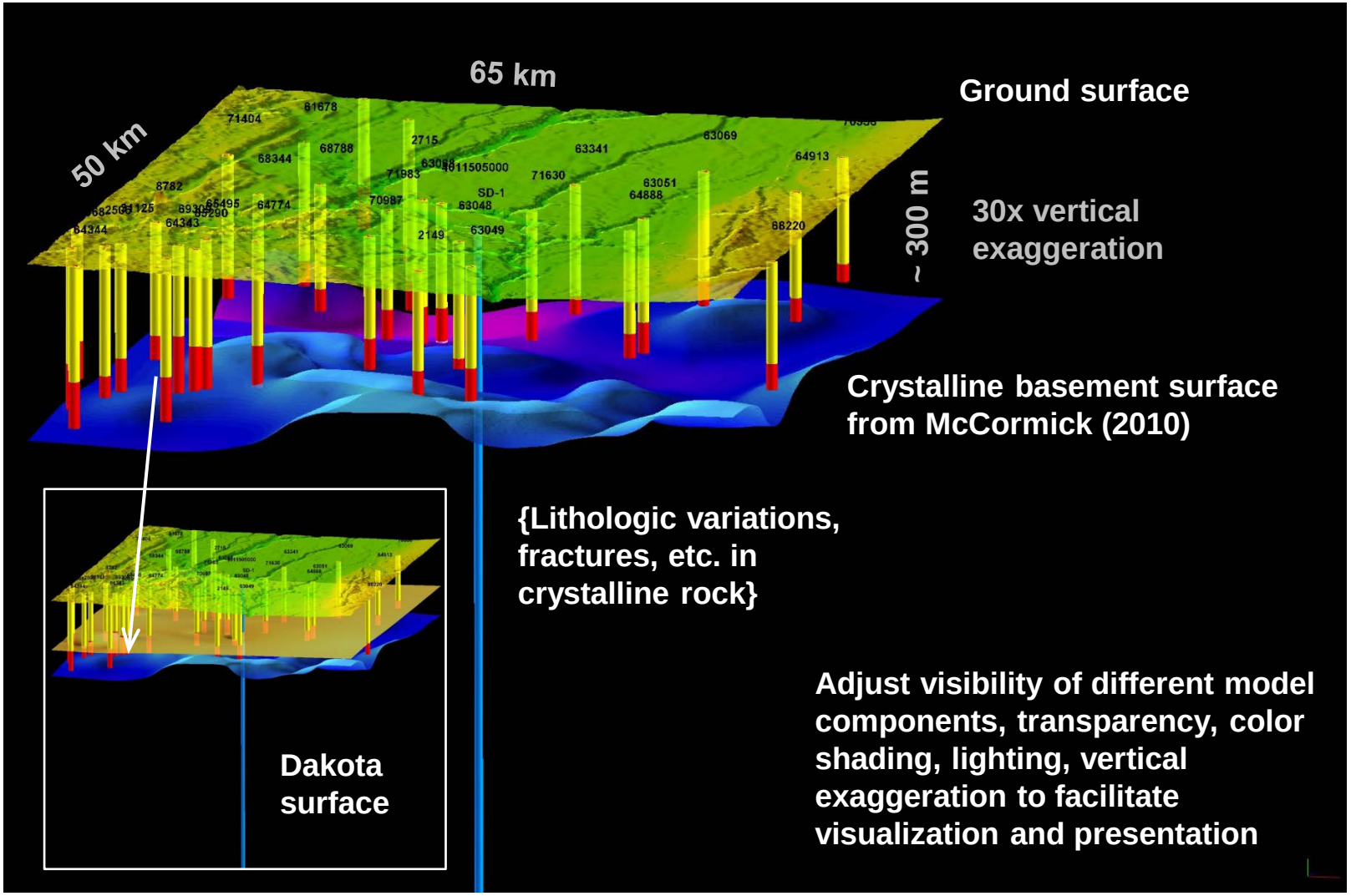
Visualization of Regional Borehole Stratigraphy and Geologic Surfaces



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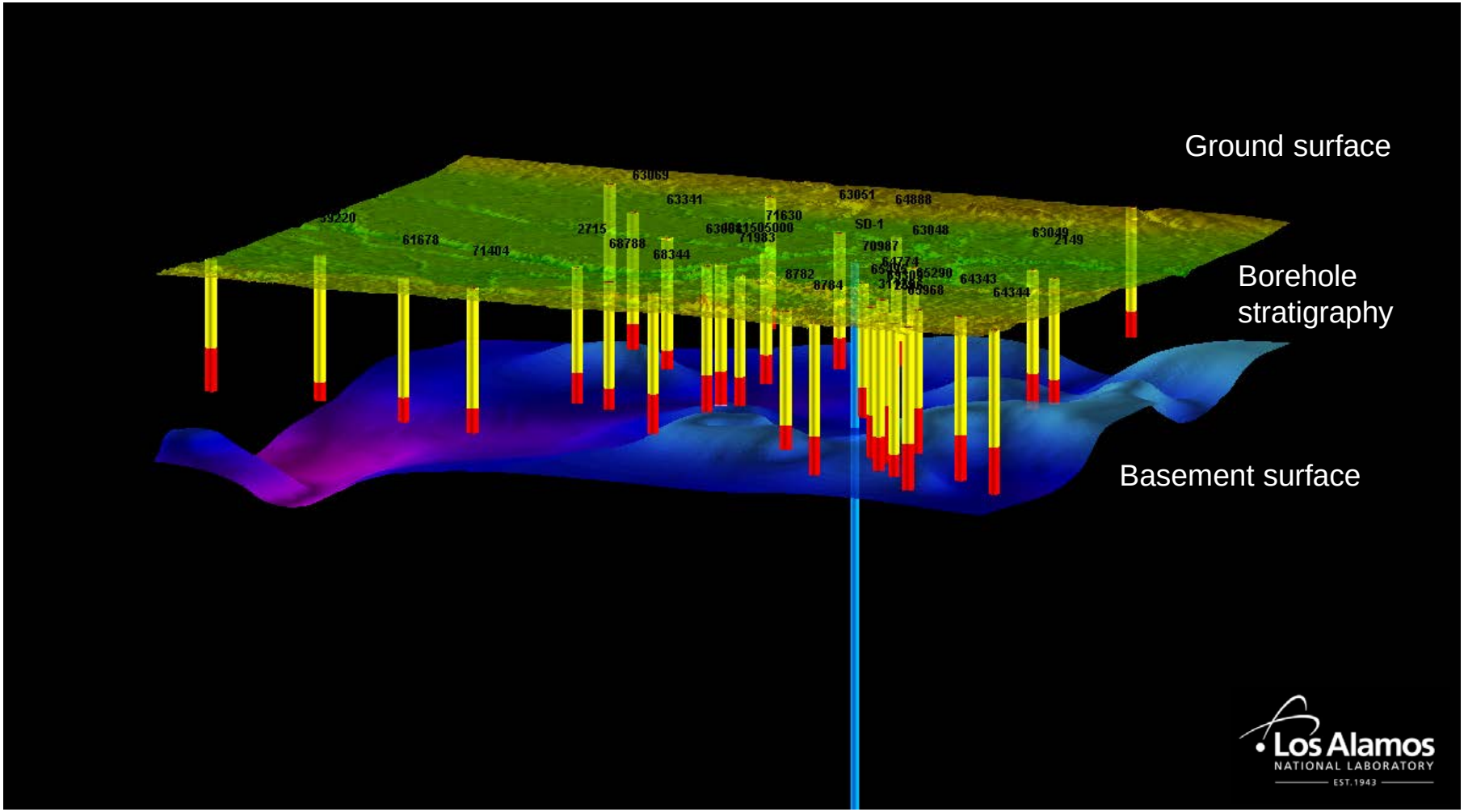
GFM Visualization of Geologic Surfaces and Borehole Locations/Stratigraphy



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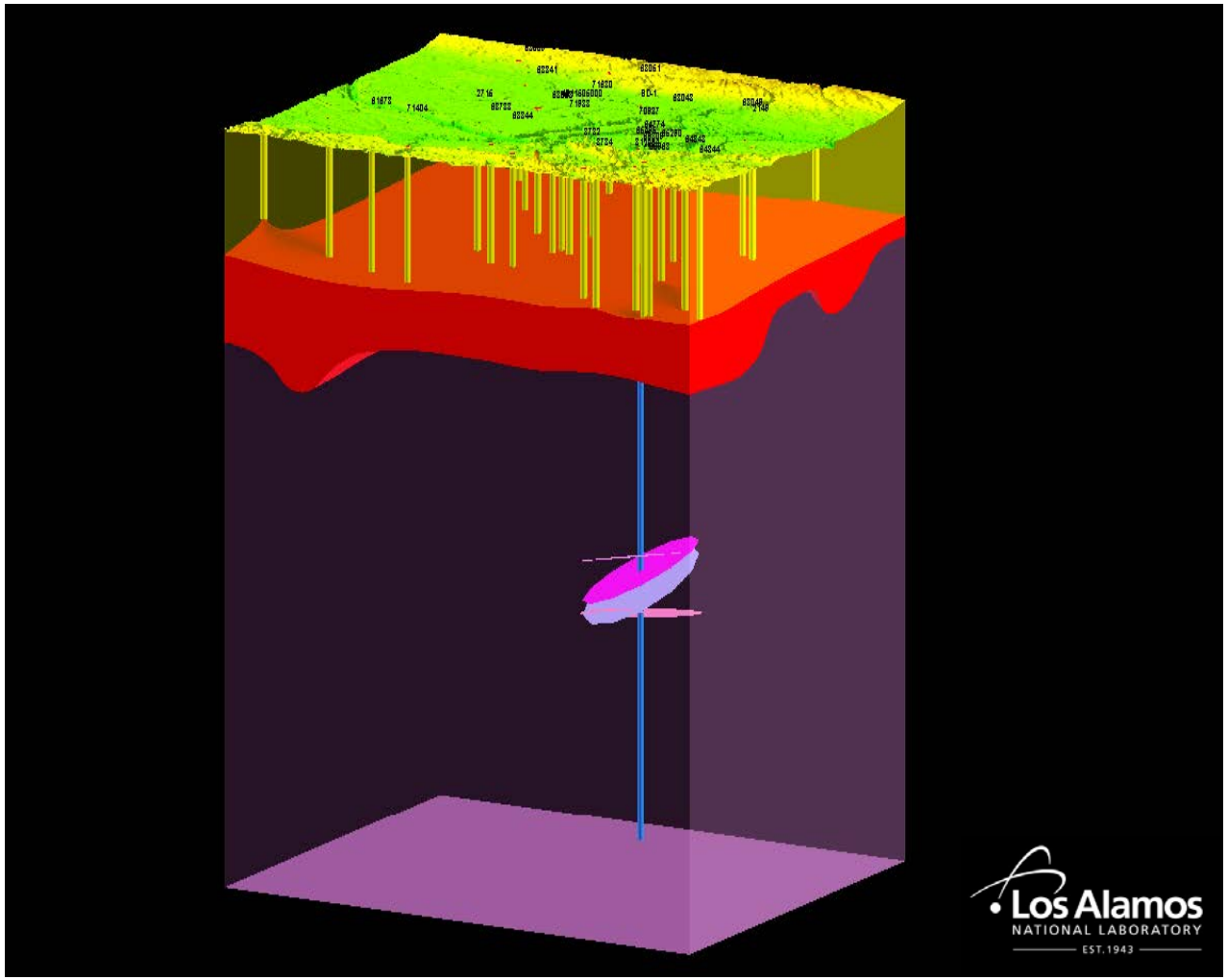
GFM Visualization of Regional Stratigraphy as Block Model

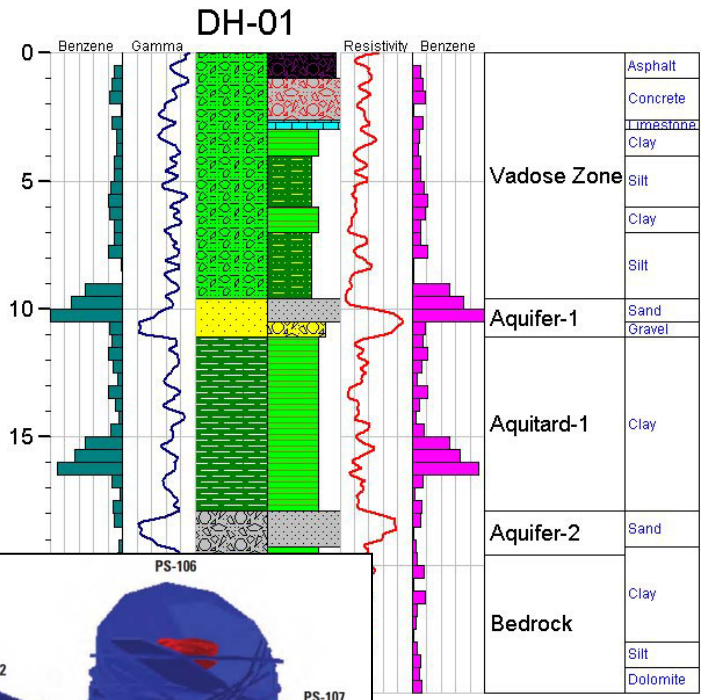


Blocks have adjustable transparency to allow visualization of different features

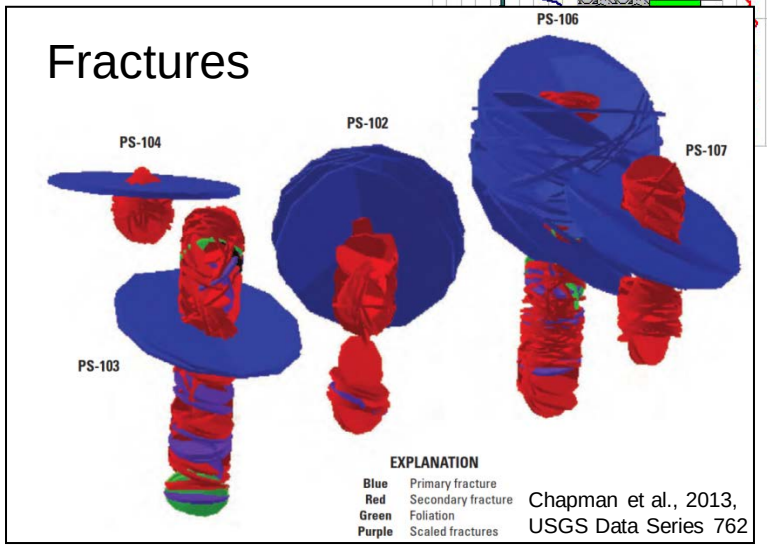
- Borehole locations and penetration into the Dakota Sandstone
- Thickness variations of Dakota Sandstone
- Fracture systems

Additional GFM Capabilities

- Model slices and cross-sections
- Well log plots
- Representation of borehole fractures
- Borehole data management (relational database)
- Statistical analysis
- Import numeric data in multiple formats from well log or test results
- Export data and GFM geometry to support flow and transport modeling efforts



Well log



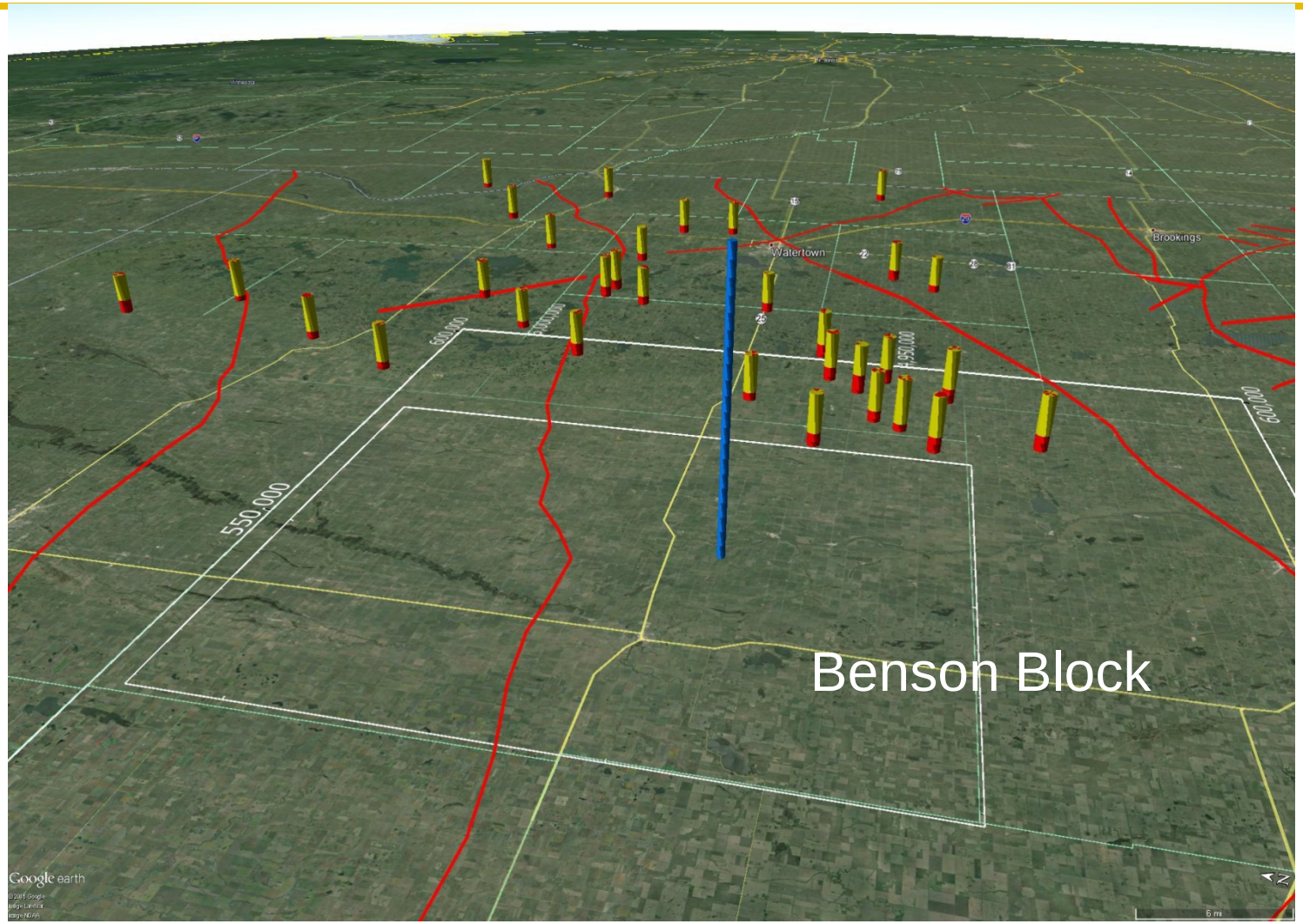
Chapman et al., 2013, USGS Data Series 762

Summary of the GFM Capability

- **Documentation**, **Data Management** and **Visualization** of DBFT site, borehole and test data
- Document model of site geology and provide visualization of the geologic context of a deep borehole field test
- Provide a DBFT borehole database to document and visualize borehole and test data
- Visualize borehole geology and DBFT testing framework for project participants and stakeholders
- The Regional Geology GIS database and the GFM are complementary capabilities that can be applied to any future technical site evaluation or disposal site activities

Backup

GFM components can be displayed in Google Earth



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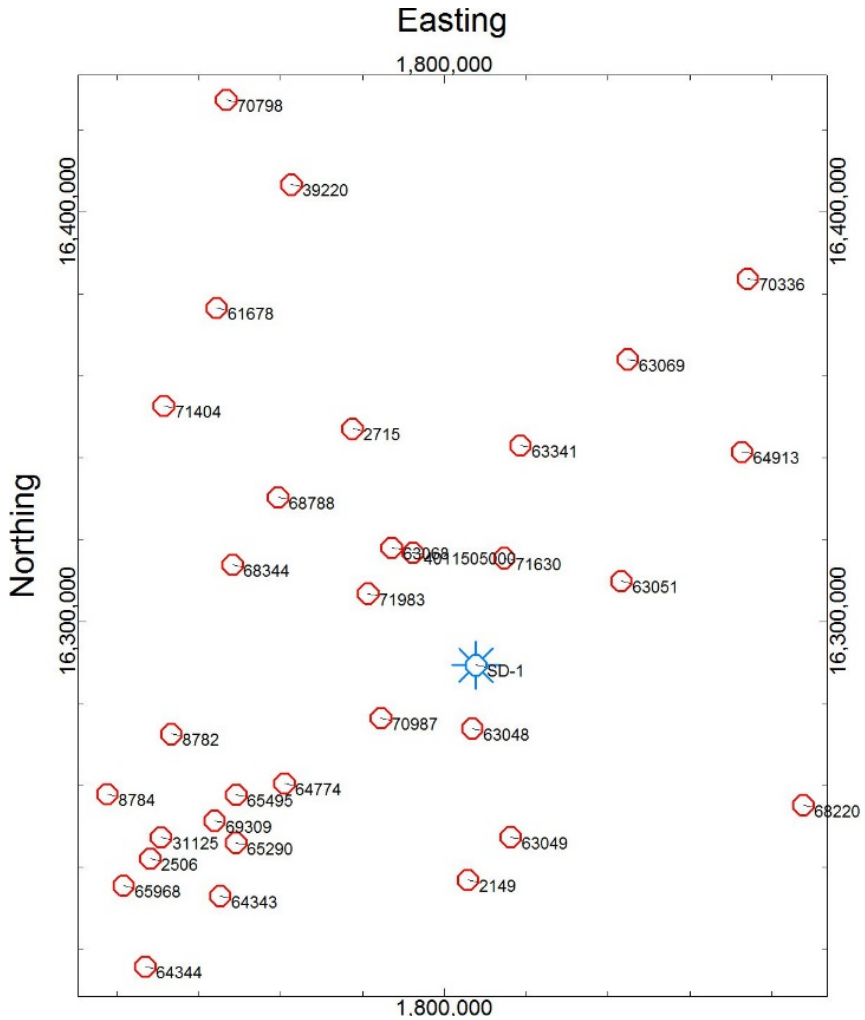
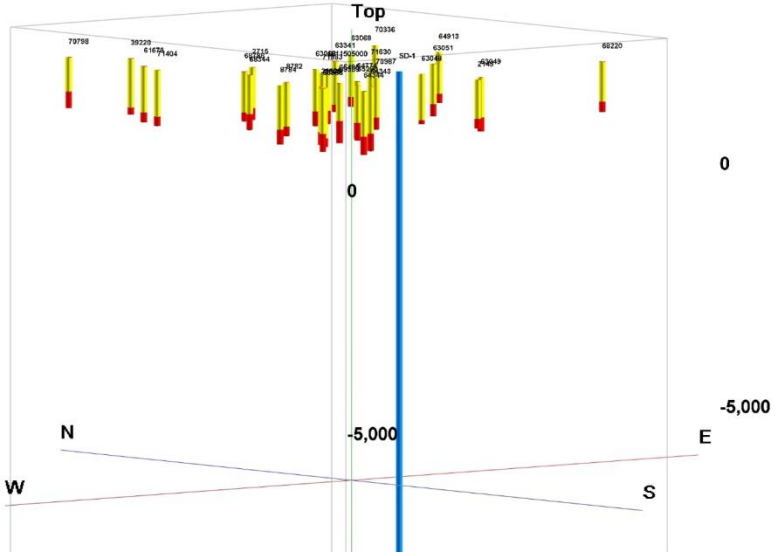
Data from nearby boreholes are the usual starting point for a GFM



Borehole data from state databases (water, oil and gas) are used to understand the details of site stratigraphy



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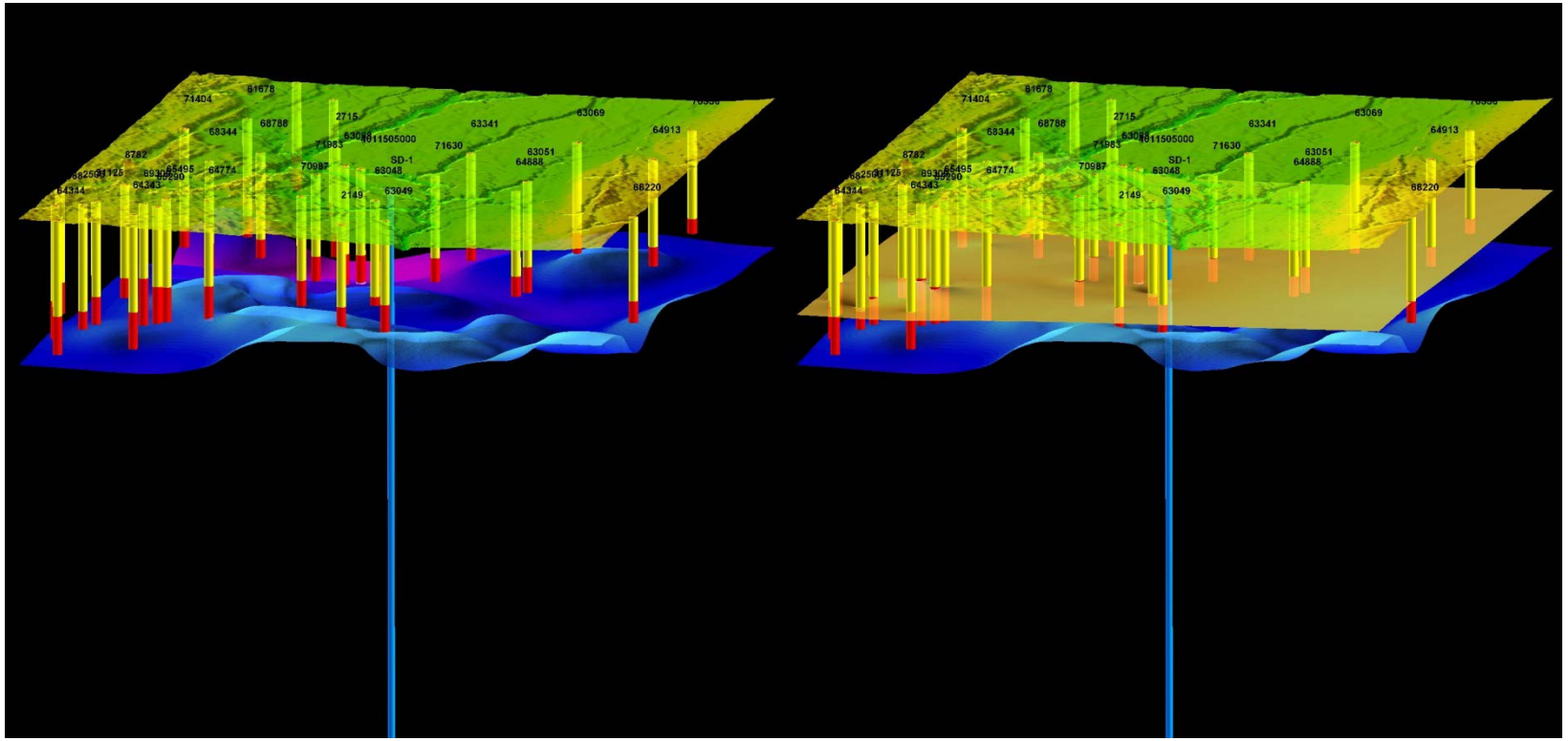
GFM with Boreholes and Site Stratigraphy as Geologic Surfaces