Geologic Structure and Seismic Analysis

Kentucky Geological Survey
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Trenton–Black River Research Consortium
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Structure and Seismic Analysis

Structure and isopach maps
- Base of Devonian Shale
- Ordovician (top)
- Kope Fm
- Utica Shale
- Trenton Fm
- Black River Ls
- Knox Unconformity
- Basal Sandstones
  (needed as hydrothermal fluid conduit for dolomitization?)
- Top of Precambrian Basement
- Major structural features (esp. those affecting dolomitization)

Assist in evaluating zones of potential hydrothermal dolomite development
Outline of Tasks

Data Acquisition

– Seismic, well logs, and stratigraphic well tops

Load Seismic data

– Digital SEGY files into Kingdom Suite
– Raster images into PetraSeis

Load Well Data

– Digital LAS files into Kingdom Suite & Petra
– Raster images into Petra

Load Preliminary (i.e. any available) Well Tops
Outline, con’t.

- Use sonic logs for synthetic seismogram creation and creation of velocity model
- Correlate log tops to reflecting seismic horizons
- Interpret stratigraphy and structure from seismic
- Use velocity model to transform depths in time to depths in feet subsea
- Create 3D surfaces from seismic horizon and well based stratigraphic tops elevations
- Merge products with those of the other members of TBRRC
Newly Acquired Seismic Data

Two new analog (paper copies) and three new digital (SEGY) Ohio seismic lines have been received and loaded.

Three new digital (SEG-Y) field scale seismic lines from eastern Kentucky have been received (from ABARTA) and loaded into Kingdom Suite™ software.

Two new digital (SEG-Y) regional seismic lines from central Ohio have been loaded into Kingdom Suite™ software (reprocessed COCORP lines).
Current Seismic Data Loaded
Well Data Loaded

- Total of 402 digital well log files loaded into Petra and Kingdom Suite software projects
  - Includes sonic logs for 114 wells

- Preliminary set of tops loaded:
  - 831 KY wells
  - 103 OH wells
  - 644 NY wells
  - 101 PA wells
  - 22 WV wells
Well Tops Picked or Loaded

Current set of tops being picked for project:

- Ohio Shale
- Top of Ordovician
- Kope Sh
- Point Pleasant Fm
- Trenton Fm
- Black River Gp
- Deike and Millbrig Bentonites
- Wells Creek Dolomite
Well Tops Picked or Loaded, con’t.

Current set of tops being picked for project:

– St. Peter Sandstone
– Knox Unconformity
– Rose Run Sandstone
– Conasauga Gp
– Rome Fm
– Basal & Mt. Simon Ss
– Precambrian Unconformity
Wells used for preliminary correlations
Southern App. Velocity Model

- Continuing to assist in time-to-depth calculations of seismic horizons, and aiding in stratigraphic correlation in areas of low resolution data.
- A sixteen layer regional velocity model for the Southern Appalachian area, with an average error < 5%, based on well data.
- Quality checking horizon tops based on time calculations ongoing.
New Northern Region Velocity Model

Created to help determine the time-to-depth of seismic horizons, and to aid in stratigraphic correlation in areas of low resolution data.

Formation tops from 745 wells, and sonic logs from 53 LAS files were used from the deep wells in PA and NY.

Sonic log data averaged with petrophysical software (Petra®) within groups of strata resulted in precise interval velocities.
Interval velocities of sixteen layers (groups of strata) corresponding to possible seismic horizons were gridded over PA & NY project area, and edited for known fault trends.

In wells without sonic logs, internal velocities were calculated by creating sonic log grids. These grids then were used to calculate the depth of formation tops in time.
Interpretation of Current Data

- Initial framework of 648 deep well’s tops in KY complete
- Infilling with shallower wells, and addition of additional related members beginning
- Initial interpretation of NY, PA, and WV seismic horizons complete, OH and KY nearing completion
- QC and “fine tuning” of horizon picks ongoing
WV Wrench Fault with Trenton Sag

Trenton
Knox
Conasauga
Rome
PC Basement
Preliminary Tully Two Way Time Structure
Gridding horizons across adjacent seismic lines
PC map combining wells & seismic
Ordovician seismic response

- Regional differences in seismic character of the Trenton-Black River interval

- How does local stratigraphy affect the seismic image?
Trenton Isopach

Schuyler Co, NY
Trenton shelf edge
Trenton Isopach

Sandusky Co, OH
Trenton, off
Galena Platform
shelf

Trenton

PC Basement
Trenton Isopach

Delaware Co, OH
Trenton, Sebree sub-basin
Harrison Co, OH near eastern Trenton shelf
Trenton Isopach

Clay Co, WV above Rome Trough
Trenton Isopach

Leslie Co, KY above Rome Trough
What’s Next?

- Create regional fault trend maps
- Interpret magnitude and age of movement along fault trends
- Assist with interpretation of possible fairways of high reservoir potential
Tectonic Dolomitization, Rough Creek Fault Zone
Ohio and Grayson Counties, Ky.

D. C. Harris, 2004
Note tight dolomite in Black River interval in center 4 wells. Conoco wells on ends are undolomitized.
Central Southern New York
South-Southeast New York
East Central Ohio
Southeastern KY

Central WV