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ATTACHMENT 3
U.S. Department of Energy
FEDERAL ASSISTANCE REPORTING CHECKLIST AND INSTRUCTIONS

1. Identification Number:	2. Program/Project Title:
DE-FE0002056	**Modeling CO2 Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO2 Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas**

3. Recipient:
University of Kansas Center for Research

4. Reporting Requirements:	Frequency	No. of Copies	Addresses
A. MANAGEMENT REPORTING			
☒ Progress Report ☒ Special Status Report	Q A	Electronic Version to NETL>	FITS@NETL.DOE.GOV
B. SCIENTIFIC/TECHNICAL REPORTING * (Reports/Products must be submitted with appropriate DOE F 241. The 241 forms are available at https://www.osti.gov/elink)			
Report/Product — Form			
☒ Final Scientific/Technical Report — DOE F 241.3 ☒ Conference papers/proceedings/etc.* — DOE F 241.3 ☐ Software/Manual — DOE F 241.4 ☒ Other (see special instructions) Topical — DOE F 241.3 ** Scientific/technical conferences only*	FG A A	Electronic Version to E-link>	http://www.osti.gov/elink-2413 http://www.osti.gov/elink-2413 http://www.osti.gov/estsc/241-4pre.jsp
C. FINANCIAL REPORTING			
☒ SF-425, Federal Financial Report	Q, FG	Electronic Version To NETL>	FITS@NETL.DOE.GOV
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E. OTHER REPORTING			
☒ Annual Indirect Cost Proposal ☒ Annual Inventory Report of Federally Owned Property, if any ☐ Other	A A	Electronic Version To NETL>	FITS@NETL.DOE.GOV
F. AMERICAN RECOVERY AND REINVESTMENT ACT REPORTING			
☐ Reporting and Registration Requirements			http://www.federalreporting.gov

FREQUENCY CODES AND DUE DATES:

A - As required; see attached text for applicability.
FG - Final; within ninety (90) calendar days after the project period ends.
FC - Final - End of Effort.
Q - Quarterly; within thirty (30) calendar days after end of the calendar quarter or portion thereof.
S - Semiannually; within thirty (30) calendar days after end of project year and project half-year.
YF - Yearly; 90 calendar days after the end of project year.
YP - Yearly Property - due 15 days after period ending 9/30.

QUARTERY PROGRESS REPORT

Award Number: DE-FE0002056

Recipient: University of Kansas Center for Research &
Kansas Geological Survey
1930 Constant Avenue
Lawrence, KS 66047

"Modeling CO2 Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO2 Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas"

Project Director/Principal Investigator: W. Lynn Watney
Principal Investigator: Saibal Bhattacharya

Third Quarter Progress Report

Date of Report: 7/30/2010

Period Covered by the Report: April 1, 2010 through June 30, 2010

Contributors to this Report: Saibal Bhattacharya, Ken Cooper, Saugata Datta, John Doveton, Paul Gerlach, Tom Hansen, Dennis Hedke, Robert Hefner, Mike Killian, Dave Koger, Randy Koudele, Abdelmoneam Raef, Jason Rush, John Victorine, Lynn Watney, Dana Wreath

EXECUTIVE SUMMARY

The project “Modeling CO2 Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO2 Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas” is focused on the Paleozoic-age Ozark Plateau Aquifer System (OPAS) in south-central Kansas. OPAS is comprised of the thick and deeply buried Arbuckle Group saline aquifer and the overlying Mississippian carbonates that contain large oil and gas reservoirs. The study is a collaboration between the KGS, Geology Departments at Kansas State University and The University of Kansas, BEREXCO, INC., Bittersweet Energy, Inc. (Wichita, KS). The project has two areas of focus, 1) a field-scale study at Wellington Field, Sumner County, Kansas and 2) 20,000 square mile regional study of a 17+ county area in southern Kansas. Activities at Wellington Field are carried out through BEREXCO, a subcontractor on the project who is assisting in acquiring seismic, geologic, and engineering data for analysis. Evaluation of Wellington Field by the team will assess miscible CO_2-EOR and tertiary oil recovery potential in the Mississippian chat reservoir and CO_2 sequestration potential in the underlying Arbuckle Group saline aquifer. Activities in the regional study are carried out through Bittersweet Energy another subcontractor. They are characterizing the Arbuckle Group (saline) aquifer in southern Kansas to estimate regional CO_2 sequestration capacity. The key scientific theme is to understand the geologic fundamentals behind the internal stratal architecture, structural deformation, and diagenesis and to evaluate their role on flow units, caprock integrity, aquifer storage, and identification of reservoir compartments and barriers to flow.

Project Status: Subtasks completed to date include: 1) collection of 3D seismic survey at Wellington field (Sumner County, KS), 2) collection of gravity survey data at Wellington field, 3) initial processing of 3D seismic data, 4) identification of type and super-type wells with significant log data from Arbuckle saline aquifer in 17+ county study area, 5) digitizing of log data from super-type wells in Arbuckle saline aquifer, and 6) digitizing of wireline logs from Wellington field wells. Other ongoing tasks include identification and collection of well level information at Wellington field including oil and water production, water injection, and well completion/plugging history and details.

ACCOMPLISHMENTS

Methods/Approach

The project will characterize the Ozark Plateau Aquifer System (OPAS), which includes the Mississippian chert/dolomite (chat) reservoirs, and the underlying Arbuckle Saline Aquifer System, in an area covering approximately 17 counties in south-central Kansas in order to estimate its potential for CO_2 sequestration. The major objectives of this project include a) estimation of the CO_2 sequestration potential (tonnage) in the deep saline Arbuckle Saline Aquifer System underlying a 17+ county area in south-central Kansas using an integrated geomodel and reservoir simulation studies, b) estimation of the CO_2 sequestration potential and incremental oil production through implementation of CO_2-EOR in the depleted Wellington oil field in Sumner County, Kansas, c) risk analysis by modeling the development, migration, containment, and long-term fate of free-phase CO_2 plume using flow-unit specific petrophysical and geochemistry data, and d) technology transfer of acquired knowledge.

Phase 1 (Year 1) of the project consists of data collection and geomodel development to build a regional geomodel for the Arbuckle Saline Aquifer System over a 17+ county area and a local geomodel for the Wellington field. Well data will be electronically "mined" and digitized to build a regional Arbuckle Aquifer geomodel that will be in part validated by comparing and integrating it within a larger geomodel being developed to evaluate a Midcontinent-scale petroleum system as part of the USGS's Anadarko Basin Resource Assessment Project. Structural, isopachous, rock properties and their derivative information will be mapped and analyzed in the context of reprocessed regional gravity and magnetic data to characterize stratigraphy and lithofacies of the Paleozoic strata, in particular the Pre-Pennsylvanian. Recent high resolution satellite imagery will be compiled and interpreted to identify and substantiate major structural features and compared with subsurface data including attributes of the Arbuckle Saline Aquifer System to help establish and corroborate compartments. Significant compartments will be identified for more detailed characterization and modeling.

At the Wellington field, surveys including high-resolution gravity/magnetic, a ~11 mi^2 3D multicomponent seismic, and two 4 mi long 2D shear wave seismic surveys will be collected, two new wells will be drilled and logged, including one cored from the Pennsylvanian caprock to the basement, and selected flow-units will be tested for pressure and fluid samples in both of the newly drilled wells. Geochemical analysis will be carried out on flow unit specific water samples along with studies of diagenetic history of fracture fill to determine cap rock integrity and fluid migration through aquifer in general. The newly collected data will be integrated with existing data from the regional study area to build a database of flow-unit specific petrophysical properties and water geo-chemistry. Also, a local geomodel for the Wellington Mississippian depleted oil field and the underlying Arbuckle Saline Aquifer System will be developed.

Major Activities

ONGOING ACTIVITIES concerning 17+ county (regional, ~20,000 mi^2) study area:

Subtask 2.2. Acquire geologic, seismic, and engineering data.
Most of the wireline logs from the super type wells (post 1980, Arbuckle penetrations greater than 400 ft) have been digitized. Well tally is as follows:

Collected well and formation top data

Total Wells	95,120 wells
Pre-Cambrian Tests	293 wells
Type Wells	1417 wells
Super Type Wells	91 wells
Download & depth register e-log images	1337 wells
Import LAS files for Super Type wells	124 wells
Convert wells with las to Profile Plot	15 wells

Maps of the Mississippian and Arbuckle formation tops and 3rd order trend surface residuals of these maps have been generated. Student described below working on data gather in and nearby vicinity of Wellington Field is also working to complete data gathering for super type and type well information for the regional study.

Subtask 2.3. Develop regional correlation framework and geomodel.
Bittersweet team lead by Tom Hansen with Paul Gerlach and Larry Nicholson continues to integrate existing Arbuckle insoluble residue correlations into well data to aid in understanding concepts of stratigraphic correlation that extend to type sections in surface localities mainly in Missouri. Sample logs have been classified as to type and quality. Lithologic and porosity information has begun to be extracted from this information to aid in correlation and establishing properties of flow units, aquitards, aquicludes, and caprock. Written sample descriptions are being typed into ASCII files to be used as input into web-based generated well profiles containing depth-based presentations of wireline log data, log analysis results, core analysis, stratigraphic correlations, flow units, and scaleable graphics of lithology and porosity type using the ASCII sample data. Well data will be accessed via interactive web-based map.

Cross sections are being created focused on the Arbuckle Group to establish correlations of major stratigraphic intervals so that all Super Type wells are correlated consistently. Detailed mapping of the interval between the top of Mississippian through the top of Precambrian is underway. Eight (8) areas of been initially selected in the regional 20,000 mi^2 study area for additional investigation based on cross sections and mapping to date as potential targets for saline aquifer sequestration. In each area more detailed stratigraphic correlations will be made and the pre Pennsylvanian interval will be identified into flow units and barriers to fluid movement and seals. The new student geological assistant is acquiring super type well logs, drill stem information, and completion information.

Subtask 2.5. Gather and interpret KGS's gravity and magnetic data.
Recoding of the potential-field data processing software by has been completed for its use on a PC. Programming continues on the tilt-depth algorithm (Miller and Singh, 1994, Potential field tilt - a new concept for location of potential field sources: Applied Geophysics, 32, 213-217) that has been shown to work quite reliably on vertical-sided prisms in ambient magnetic fields. This method estimates the depths to the tops of source bodies and edges and will be very useful in interpreting the origin and significant of potential field anomalies.

Subtask 2.4. Subsurface fluid chemistry and flow regime analysis.
Literature is being compiled on Arbuckle geochemistry. Resistivity and salinity data on Arbuckle are also being assembled. A preliminary protocol was determined for determination of the regional flow system.

Watney and Ken Cooper (member of Bittersweet team from Littleton) met in Denver with members of the USGS' Anadarko Basin Modeling and Resource Assessment Team on May 6-7th led by Debra Higley to discuss areas of cooperation and to hear and discuss results of their regional geologic assessment. USGS will use their geological analysis to aid in their resource assessment for the Anadarko Basin. Of particular interest and pertinence to this project is the analysis of drillstem test data in the 4-state region by the USGS to understand pressure and flow patterns in the Paleozoic aquifer systems. In particular, the depth of estimated water levels (potentiometric surface) relative to the land surface demonstrates significant lateral continuity of aquifers throughout most of the region and communication of the shallow edges of these aquifers with meteoric water. This open system is important when considering the potential for local pressure buildup with injection of CO2, whereas this connectivity suggests the potential to model this reservoir as an infinite aquifer.

Another key finding of the USGS study is that the evaporite interval of the Permian-age strata provides effective hydraulic isolation of the underlying lower Permian, Pennsylvanian, and older strata from the land surface including the deep saline aquifer system of the Arbuckle. Third, based on a series of potentiometric maps, the hydraulic reference (connection to atmospheric pressure) appears to be in eastern Kansas and beyond into Missouri in the case of the Ozark Plateau Aquifer System (OPAS) where sealing Permian evaporites have been removed by erosion and aquifers outcrop. The Ozark Plateau in Missouri is the source of freshwater that is found in the OPAS in southeastern Kansas some 80 miles east to the eastern edge of the regional study area of this project. The map below in **Figure 1** shows the distribution of fresh (light blue) vs. saline (yellow) waters that resides within the Arbuckle in southeastern Kansas, east of the area of investigation.

Fourth, the potentiometric surface in the lower Paleozoic strata for the entire regional area of investigation in southern Kansas suggests a very low flow gradient. Elevations rang on the east between 500-750 feet above sea level to 1000 to 1250 feet above sea level in the extreme western region of our study area (maps shared by Phil Nelson, May 2010). Additional work in our current investigation will use this framework to map pressure, salinities, and fluid flow as parameters for simulation modeling and assessing the fate of a CO2 plume under supercritical injection.

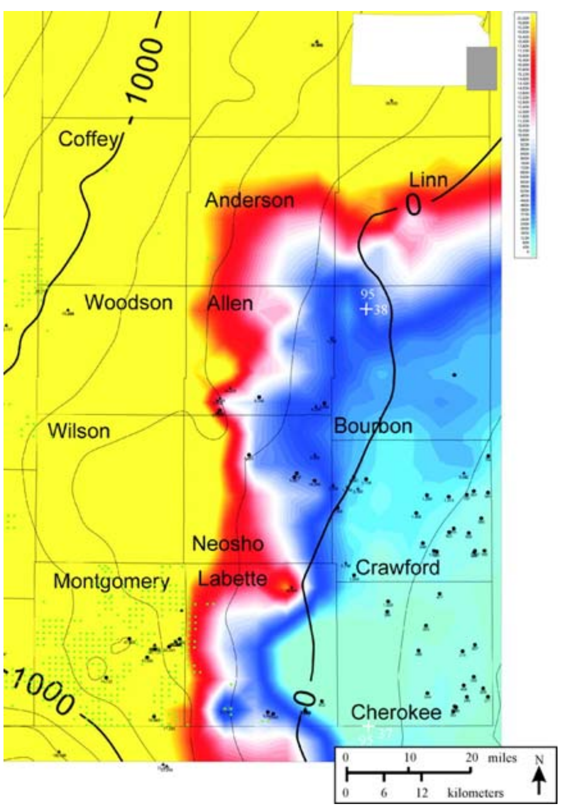


Figure 1. Map of southeastern Kansas showing TDS concentration (CI = 400 ppm) in ground waters of the Arbuckle Group with overlay of structure on top of the Arbuckle (CI = 250 ft; 76 m). Sample points are shown. The white band is the TDS of 10,000 ppm, marking the boundary between higher TDS concentrations on the west and the lower TDS concentrations on the east in the Ozark Plateau Aquifer System (OPAS). Green squares show leases producing oil from the Arbuckle Group located in the saline portion of the aquifer. Insert shows the area of southeastern Kansas covered by the map. From Carr et al. (Carr, Merriam, Bartley, 2005, AAPG Bulletin; December 2005; v. 89; no. 12; p. 1607-1627)

Subtask 2.6. Remote sensing analysis for lineaments.

Landsat lineaments have been mapped by Koger Remote Sensing for the regional portion of the study at a scale of 1:250,000. Information is being transferred to topographic maps. A draft of the eastern half of the mapped area is included in **Figure 2**. Lineaments will then be digitized and submitted in electronic format for georeferencing and integration with the web-based project mapper.

Lineaments are being mapped subjectively based on the observed alignment of individual elements or natural features such as geologic structure, outcropping strata, stream segments, straight coastlines or lakes, aligned depressions or ponds, erosional scarps and natural offsets in these features. Line thickness and weight correspond to the interpreted "confidence" of the actual presence of the feature - broad, heavy continuous lines are high confidence and are easily observed and lighter, discontinuous to dotted lines are less certain and more interpretative. Often lineaments are projected across lakes or alluvium or vegetated regions where no surface evidence exists. Correlations of basement structure with surface lineaments will be established using subsurface control including seismic and well data, and aeromagnetic and gravity surveys.

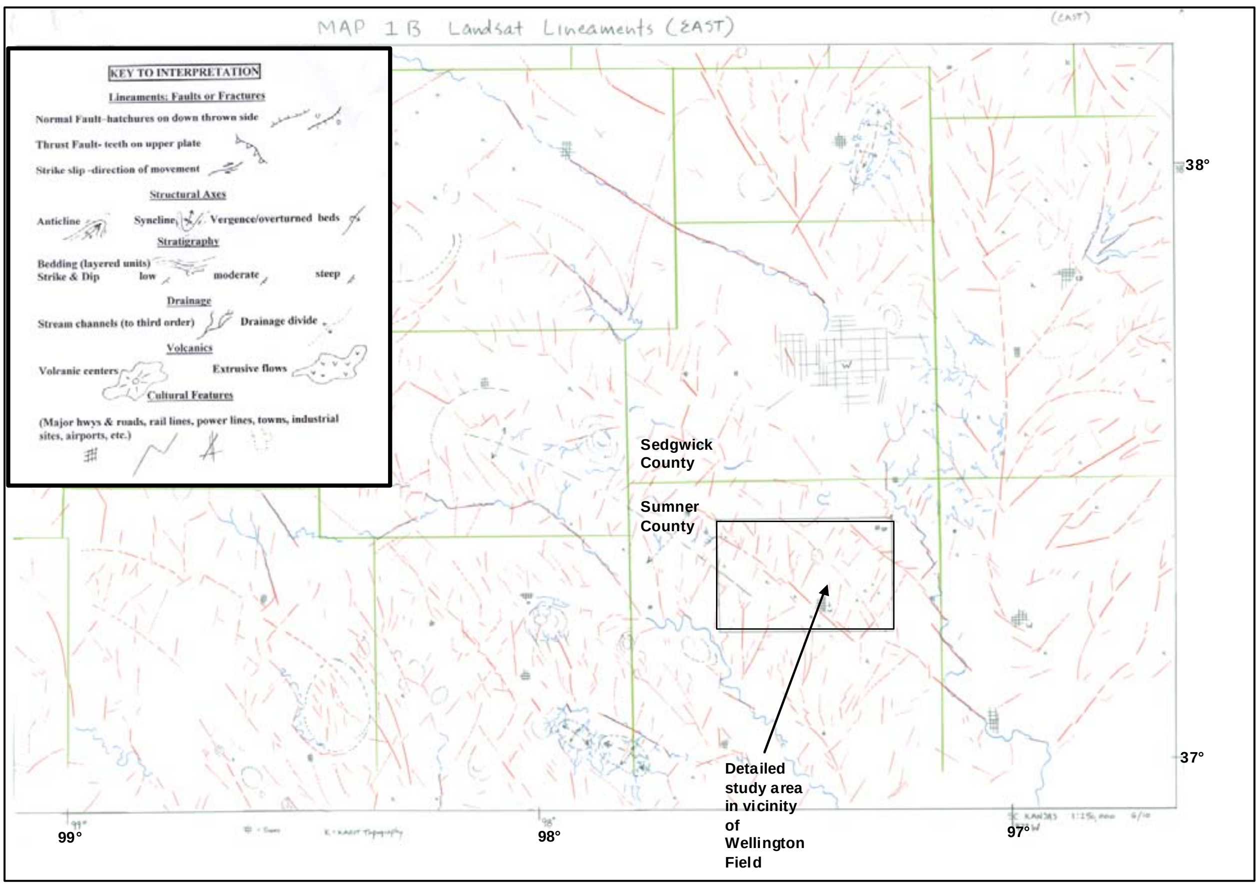


Figure 2. Draft of a map of lineaments derived from Landsat satellite imagery for the eastern half of the regional study area including vicinity of the Sedgwick and Sumner counties.

Interpretations of the remote sensing are focused on the following physiographic features:

- Abrupt lineament bends: intersections or "corners" of the lineaments may suggest structuring—structural noses or fault offset traps at depth. Intersections or high concentrations of surface lineaments may indicate local deformation, an overprint of unrelated tectonic events or ongoing tectonic activity.
- Drainage anomalies: Streams deviating from their expected down-gradient trend may reflect the influence of subtle topographic highs related to geologic structure or an isolated erosional remnant.
- Tonal anomalies enhanced by image processing techniques which indicate an unusual "anomaly" possibly resulting from the influence of local oil or gas deposits.
- Soils and barren (unvegetated) areas which appear dark (low reflectance) in the enhanced imagery may be rich in organic matter, suggesting higher TOC content and an increased potential for migrated petroleum.

Interpretations from the remote sensing will be extended through integration with subsurface data including well logs and samples, seismic, aeromagnetic, and gravity.

Subtask: 4.11: Geochemical analyses of water samples

For the DOE part of the project on KSU Geochemistry side, CoPI Dr. Datta is currently in the phase of extending his water-modelling laboratory and geochemical samples processing (one representative water sample from Wellington Field site has been collected by PI Bhattacharyya and delivered) in assessing the experiments that will be run in October 2010 on the water samples procured during drilling. Dr. Datta has already acquired a state-of-the-art Hydrolab MiniSonde MS5 ® (from external funding) to monitor on the water quality parameters on-site (that includes-pH, Conductivity, Oxidative Reductive Potential, Dissolved Oxygen, Total Dissolved Solids, Temp, Salinity and Turbidity). Dr. Datta has already installed (from external funds), a state-of the art Water Purification System-Elix Advantage 3/5/10/15 and Milli-Q Element Millipore combination) that will produce nanopure grade water which will be used for standard preparation for Ion Chromatograph and ICP-MS analyses and for digesting well waters that will be collected over the next few months for detailed chemical analysis (whenever dilution will be required). The Geochemistry Lab now has cabinetry installed too, to pursue setting up of the experimental platform (flow through columns and batch experiments). Dr. Datta also has organized where the water (proportionately mixed with oil) samples will be centrifuged before analysis. Dr. Datta has also hired a student (Masters Student to work for this project) who is joining him on Aug 17/2010. Dr Datta anticipates full scale lab with equipments over the early Fall, to be able to conduct these experiments and later undergoing to process data via geochemical modeling. Dr Datta has also visited the field site in Wellington with PIs Watney and Bhattacharyya in April 2010.

Subtask 9.1. Collect reservoir characterization data – external sources.

Ninety super type wells with modern elog suites were identified. Thirty-six tiff images were uploaded to the vendor LOGIDIGI for LAS creation. These files now been uploaded unto the website and wells are highlighted on the interactive project map described later in this report. The digital logs are also being used for log analysis, a topic also described later in the report. The remaining super type wells are being submitted for digitizing.

Subtask 9.2. Map Fracture Fault Network.

Known faults have been inventoried from the published literature and are summarized on the following map (**Figure 3**) in addition to new faults Baars and Watney (1991). Published fault maps were converted to tiff, geo-referenced, and imported into the project. Published (documented) faults will be added to structure and isopach maps. Additional documented faults will be added as information is analyzed.

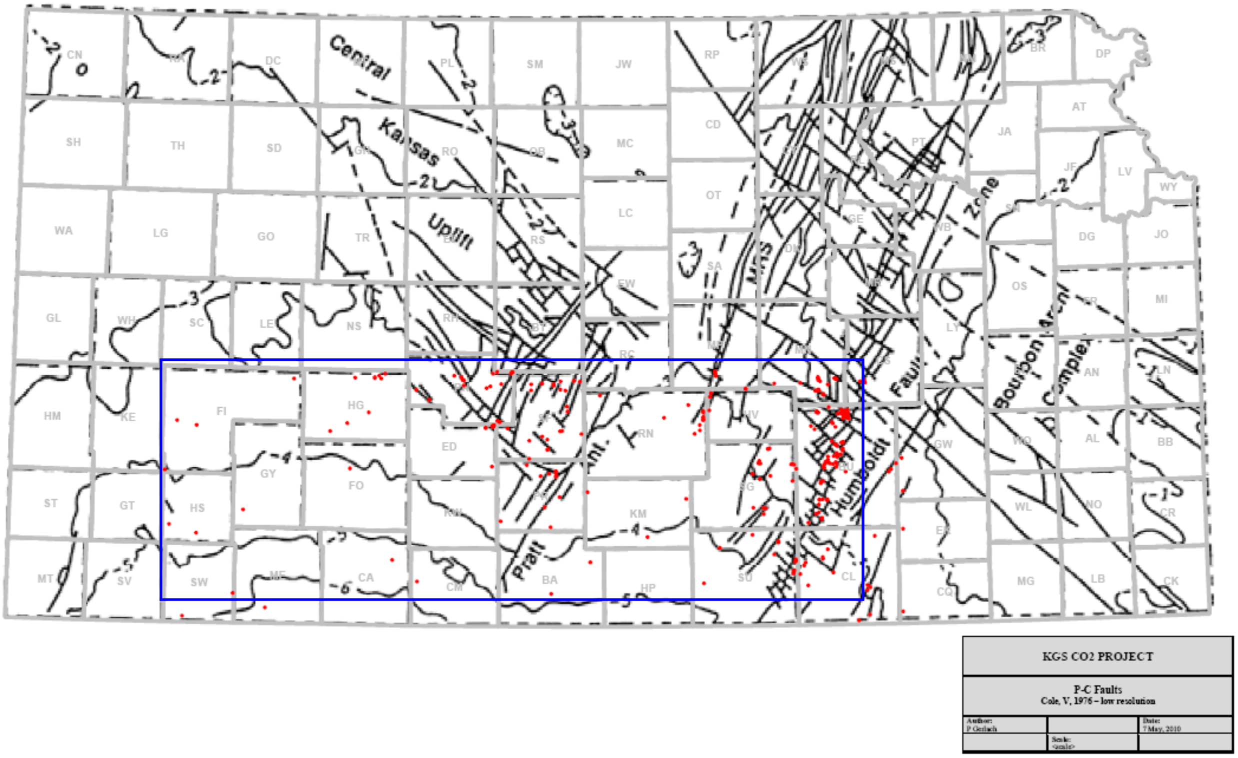


Figure 3. Precambrian map showing recognized and published basement faults on a generalized structure map on the top of the Precambrian. Precambrian wells are shown along with an outline (in blue) of the regional study area in southern Kansas. Most of these basement faults do not extend to the surface. Base map from Baars, D.L., and Watney, W.L., 1991, Paleotectonic control of reservoir facies: in Sedimentary Modeling: Computer Simulations and Methods for Improved Parameter Definition, Kansas Geological Survey Bulletin 233, p. 253-262.

Subtask 9.4. Inventory of Well Status – for characterization of potential leakage pathways.

Literature on well completions and historic regulations is being reviewed. Standard practices in well completion and well integrity and well plugged are being compiled.

An inventory of well status has begun to be used to assess potential leakage pathways. An important consideration is leakage of fluid through unplugged or poorly plugged abandoned wells. Database of well completion and plugged was developed for area within a ~10 mile radius around Wellington Field. Well data was obtained from the well files of the Kansas Geological Survey, Kansas Geological Society Library, and Kansas Corporation Commission- Conservation Division. Work was led by the Bittersweet team and the new student geological assistant. Wells are grouped into separate categories by date of plugging that is important in the assessment of the quality of the plugging --

- Master list of wells
- 1933-1955 (but there are many wells with completion/plug dates earlier than 1933)
- 1956-1988
- 1989-2010

In an attempt to fill in missing information in the plugging spreadsheet, all wells that did not have a plug date and were listed as D&A were given the same plug date as their completion or spud date. Similarly, in the completion spreadsheet, all wells that did not have a completion date were given the same completion date as their spud date. Some wells have no completion date or spud date and are listed as such. Information sought in the well inventory includes -- PERMIT_DATE, SPUD_DATE, COMPLETION_DATE, PLUG_DATE, WELL_TYPE, STATUS, TOTAL_DEPTH, ELEVATION, ELEVATION_REFERENCE, FORMATION_AT_TOTAL_DEPTH, PRODUCING_FORMATION, INITIAL_PROD_OIL, INITIAL_PROD_WATER, INITIAL_PROD_GAS.

Subtask 9.5. Gather Expert Advice on Well Integrity.
An initial work flow is being developed with Bittersweet team to evaluate risk. The team has considerable geological and engineering experience in the local area and with the Arbuckle well completions. Team will continue to compile list of applicable literature regarding well integrity.

Subtask 12.1. Map Arbuckle reservoir compartments.
Preliminary maps (top Mississippian and Arbuckle structure), well log cross sections, and samples have been used to begin a dialog on possible candidate areas for sequestration in the regional study area (**Figure 4**). Based on the regional mapping Paul Gerlach of the Bittersweet team initiated a list of criteria to consider as constraints for locating sequestration sites to aid ongoing discussion. The current criteria for possible sequestration candidates include:

- Areas have at least one well test to the Precambrian with a log suite containing 3 porosity tools (density, neutron, and sonic).
- Multiple wells penetrate the Arbuckle with good wireline log combinations.
- Top of the Arbuckle should have a synclinal or monoclinal structural attitude (not anticlinal closure).
- Areas with continuity of strata and related lithofacies and stratigraphy. Stratigraphic truncations, faulting, or fracture systems not significant to disrupt the distribution of flow units, aquitards, aquicludes, and caprock.
- Sufficient size of the area to accommodate commercial quantities of CO2.

Initial considerations in simulation modeling in the next quarter will further aid to strategies to evaluate the CO_2 sequestration capacity of the Ozark Plateau Aquifer System. Accordingly, it was decided to select a pilot area to build a simple pilot test for the petrophysical modeling and simulation. Results will be shared in the next quarter. The selected site is in southern Sedgwick County centered on the Oxy-Chem Bring Disposal Well #10 (**Figure 4**). A simple layered geomodel of the Arbuckle Group will be run in order to establish a workflow and to obtain a better understanding of how CO_2 injection and plume development behaves in this rock/fluid system. Disposal Well #10 is part of a well field that has a long history of brine injection, cores have been taken and analyses of the core have been shared with the project and are publically available through the Kansas Geological Survey website. In addition, the site is nearby the Wellington Field site, the focus of the CO_2-IOR and saline sequestration modeling so what is learned in the pilot can be quite easily applied to the oil field area. Pilot is further characterized in later sections addressing petrophysical modeling.

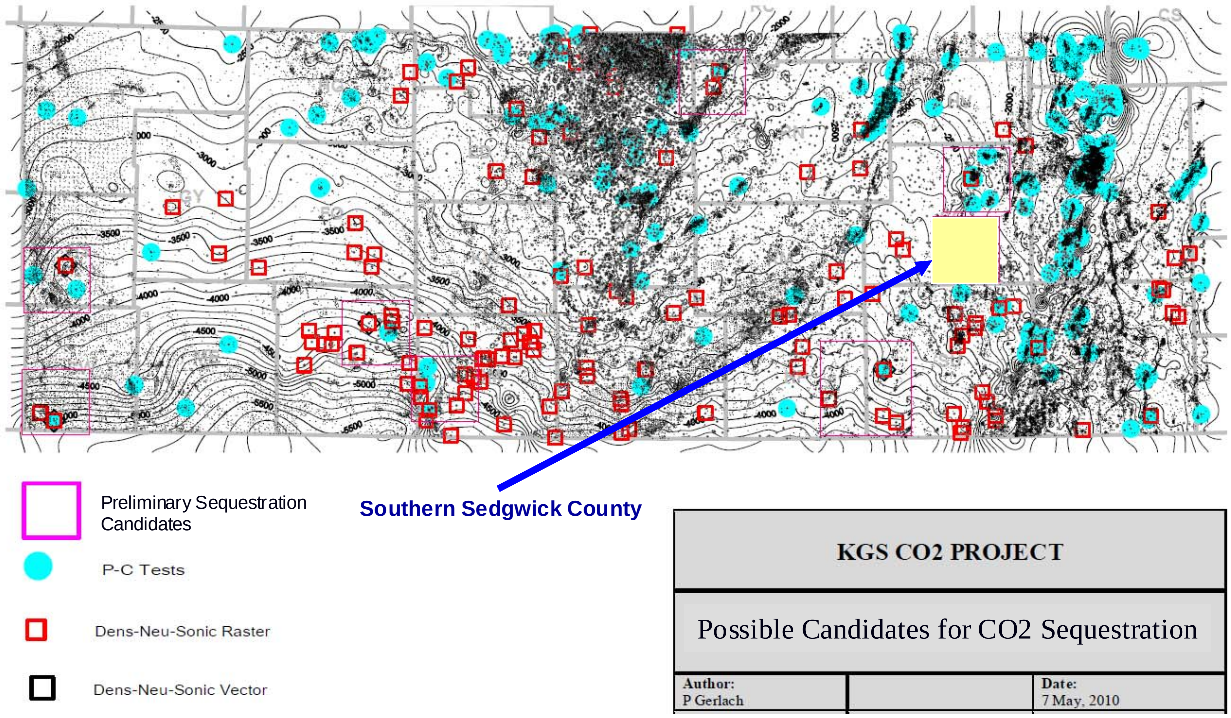


Figure 4. Structure map of top of Arbuckle Group in southern Kansas within the 20,000 mi^2 study area locating eight possible candidates for sequestration (light pink rectangles) and well symbols denoting Precambrian well tests, wells with modern wireline log suite that penetrate significantly into the Arbuckle.

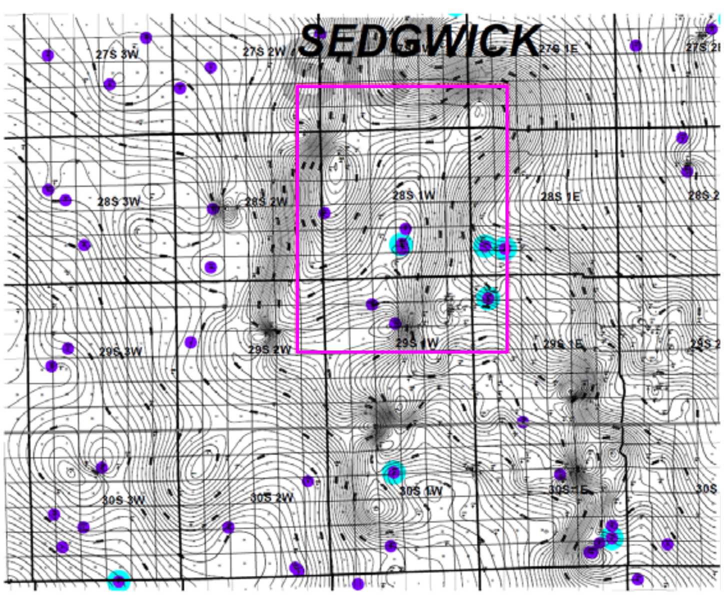


Figure 5. Structure map at top of Arbuckle in southern Sedgwick County showing outline of candidate CO2 sequestration site in pink rectangle. At this stage the site is for testing petrophysical and simulation software in area with good subsurface control. Wells are highlighted in purple that have wireline logs. Cyan circles highlight wells that are Precambrian penetration.

Subtask 14.1 **(Build and maintain project website)**

A prototype of the interactive web-based project map viewer is available. It allows display and access to spatial information including well data and interpretations, maps, cross sections, and simulations as available. The example shown in **Figure 6** displays an area near Wellington Field in south-central Kansas in which a filter has been applied to show only wells that are part of the type wells identified to date. The dropdown dialogs over the mapped area show the current list of well filters and also a new cross section tool that will be used to build and display cross sections for wells that have integrated digital well profiles. The well profiles include wireline logs, petrophysical interpretations, sample log profiles or core analysis, and stratigraphic and flow units as available.

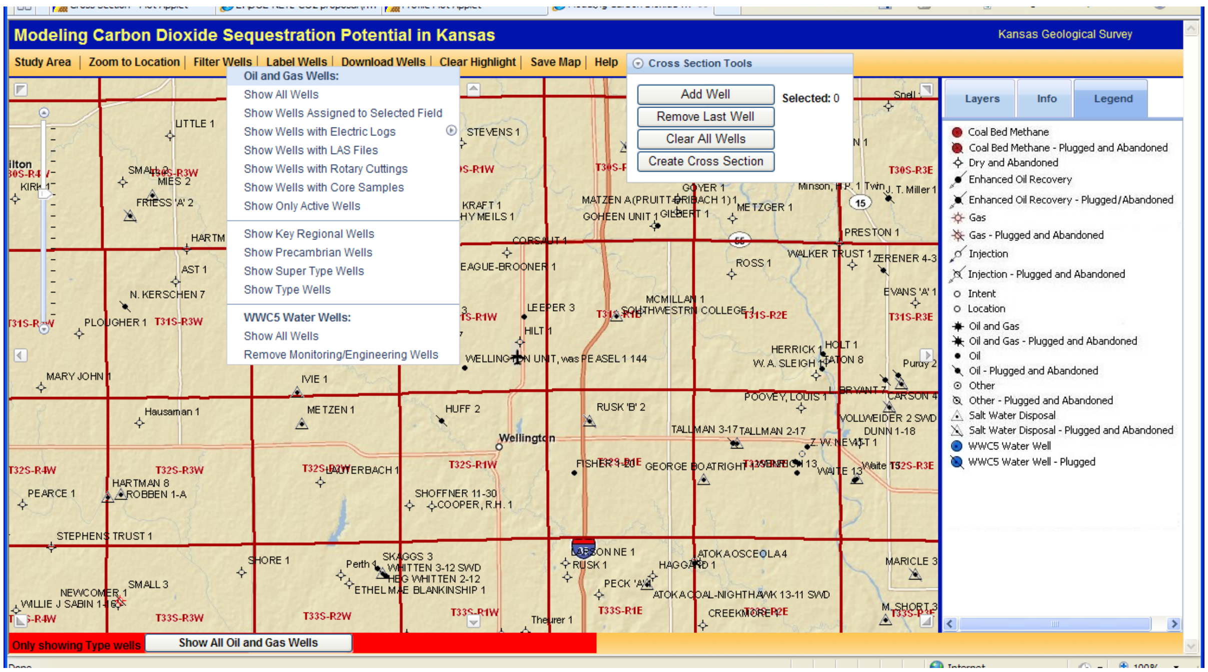


Figure 6. The prototype of the interactive project map viewer developed by Mike Killian. Legend to well symbols is on the right side of the figure. Dimension of the squares 6 miles on a side.

An existing Java web-based log analysis tool has been augmented to establish and quantitatively characterize stratigraphic flow units. The web-based tools are used to analyze wireline logs, establish flow units, and integrate various data types such as sample descriptions, core analysis, stratigraphic tops. Original well information and computed results can together be saved as LAS 3.0 files. The focus of this quarter's activities has been to develop the cross section plot applet as described below, followed by examples.

Cross Section Plot Applet

The Cross Section Plot Applets are being modified to assist in the Log Analysis (including Subtask 4.6 among others). The Cross Section combines the Profile Plots for multiple wells on one plot. The program presents multiple profile plots drawn by depth to better understand the subsurface or surface geology (through measured sections). The Profile Plots combine digital Log ASCII Standard (LAS) data with measured rock, observational descriptions of rock outcrops and horizons on one plot. The program also tries to interpret the lithology, texture, fossils, colors, etc. and presents the interpretation as image tracks. The developer has a growing list of common terms and abbreviations and uses these to assign symbols that are recognizable by the geologist. The Cross Section Project is a series of ASCII files comprising a Control XML (Extensible Markup Language) File that holds the Cross Section Plot presentation as well as the well XYZ positions and LAS version 3.0 files of each individual well data set being displayed on the cross section plot. The LAS version 3.0 files saved in the Cross Section Applets follows the Log ASCII Standard (LAS) Version 3.0 standards developed by the Canadian Well Logging Society (CWLS), http://www.cwls.org/las_info.php. In order to maximize the capability for the Cross Section, it has been divided into two applets,

1. **Build Cross Section:** The build applet allows the user to use a Profile Plot to select plot tracks, i.e. LAS curves, rock composition, colorlith plot track combinations and to set the depth range of the data to plot. The user can also load measured sections and geo-reports, but are not allowed to alter the data in the plot, the Profile Plot Applet is provided for this purpose. Only the formation tops and the PfEFFER flow units may be modified. PfEFFER originally was written in Visual Basic for use with Excel (http://www.kgs.ku.edu/PRS/software/pfeffer1.html; Petrofacies Evaluation of Formations for Engineering Reservoirs developed by Bohling, Doveton, Guy, Watney, and Bhattacharya with support from U.S. Department of Energy, BDM-Oklahoma, Inc., and Kansas Technology Enterprise Corporation), but was re-written by Geoff Bohling at the Kansas Geological Survey into Java, which is being adapted here and enhanced.
2. **Plot Cross Section:** The plot applet opens the LAS files and plots the data on one plot using the control XML file to determine the order of the wells and the order of the plot tracks of each well. If the Elevation is present then the data is displayed with respect to the elevation or to a horizon. Like the Build Cross Section the user is allowed to modify the formation tops and the PfEFFER flow units.

NOTE: In order to plot multiple wells the user must either reduce the number of wells that are presented at one time if the data is over a long depth range or to reduce the depth range of each well. A memory usage dialog is presented in both applets so the user can see how much memory the program is using on their PC.

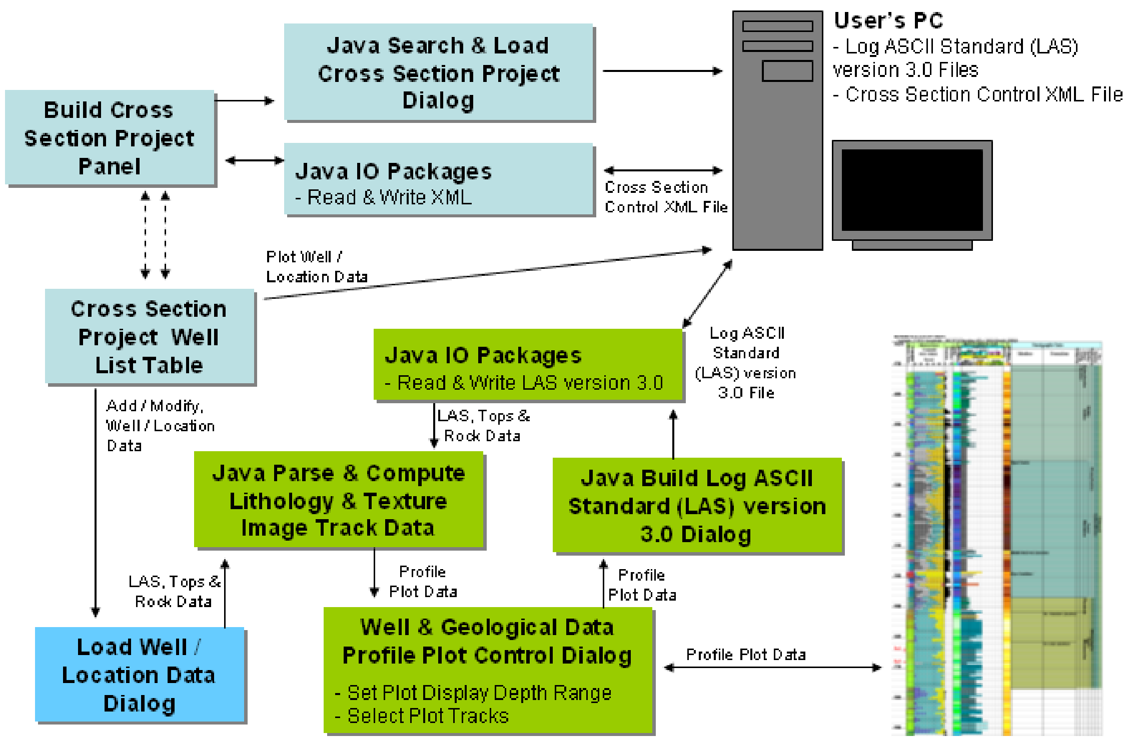


Figure 7. Flow Chart for the Cross Section Build Web Applet.

The Cross Section Project can be saved anywhere on the user's PC and the cross section control file can be any name, but the filename that is provided must be a proper filename string, i.e. no spaces between words or peculiar characters. The cross section maintains the well list and the data that is generated from this program in the same directory the Cross Section Control XML file were saved. The Cross Section Control File maintains the location and filename of the data. Each well will be assigned a unique id generated from the date and time. The unique id becomes the prefix to all the data for each well. This way the program maintains the data within the program. The LAS version 3.0 Files are used to build the cross section only, but not used in any archival mode.

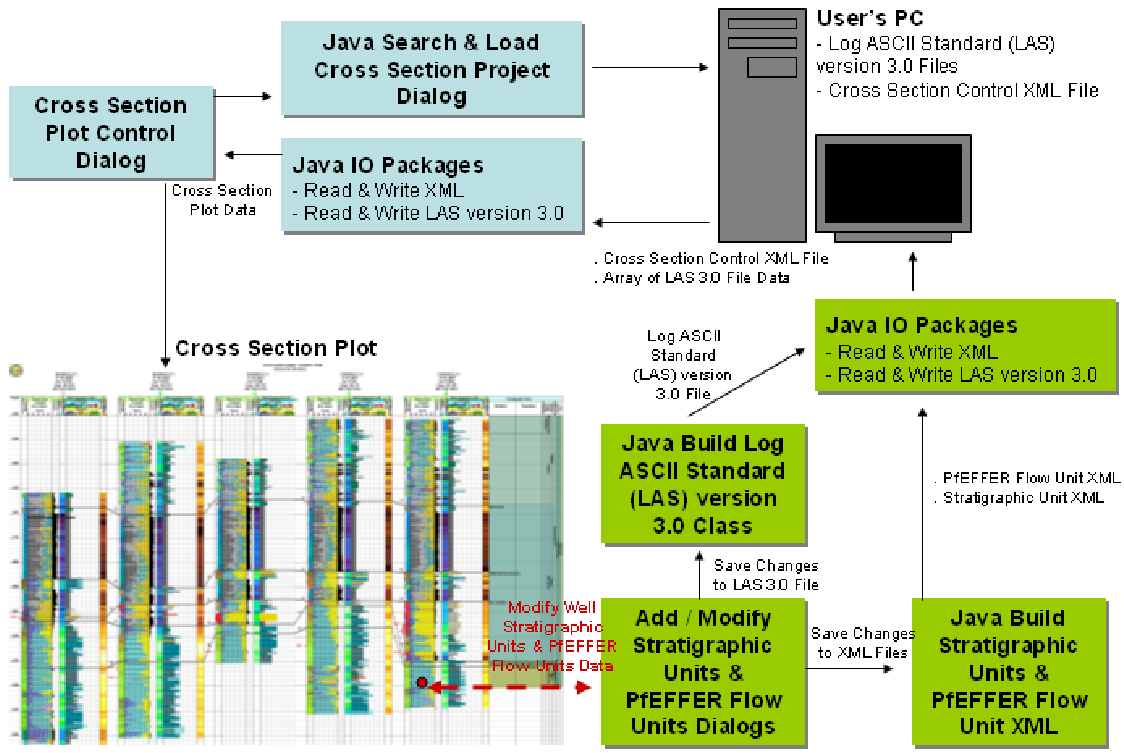


Figure 8. Flow Chart for the Cross Section Plot Web Applet.

The Cross Section Applet Web Site was recently released http://www.kgs.ku.edu/PRS/Ozark/CROSS_SECTION/. This Cross Section Build Web Application can access all the Well Data that is stored on the Kansas Geological Survey (KGS) Database and Server, i.e. LAS 2.0 Files, Formation Tops, Measured Core Data, Core Images and Perforations, which can be displayed on the Profile Plot and saved as a LAS 3.0 File. The User is allowed to modify the Formation Tops and the PfEFFER Flow Units, but not the other data types in the Cross Section Applets. The project Users will be able to select wells from an interactive ESRI Map which will send the list of wells to the Cross Section Build and create a new project. The general user will select an existing cross section from the ESRI Map that will open the Cross Section XML file dynamically (shown in **Figure 15**) and read the LAS 3.0 Files to build the cross section. The user will be able to change the scale (feet / inch) and depth range as well as setting the datum.

The South-central Kansas CO_2 Project web site is at http://www.kgs.ku.edu/PRS/Ozark (Subtask 14.1. Build and maintain project website). The Cross Section Web Site is in a hidden URL http://www.kgs.ku.edu/PRS/Ozark/CROSS_SECTION/ while the Applet is being tested.

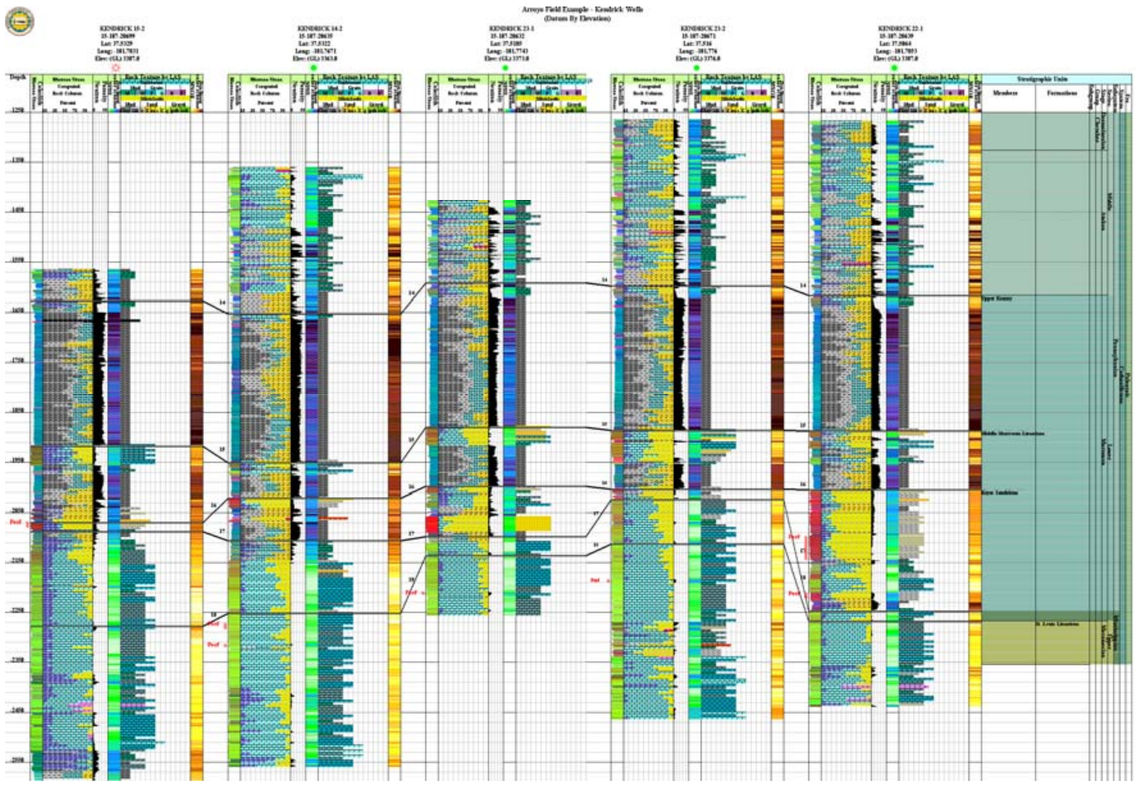


Figure 10. Example output for the Cross Section Plot Applet – Arroyo Field Wells in Stanton County, Kansas.

The text version of the well sample description is usually part of a scaled graphic strip log (**Figure 11**). The description often contains vital information about lithology and porosity amount and type. The text of these sample strip logs is being typed to create an ASCII file that are in turn imported to the Well Profile Java application to generate a scalable graphic column (**Figures 12 and 13**). The column can be used in a well profile combined with wireline log data or use in a cross section. The new Sample Well Profile can be saved in an LAS 3.0 file format like the digital well logs where this file can be retrieved to regenerate the profile or include in a cross section (**Figure 14**).

One area of focus to test this new tool has been in the Sedgwick and Sumner county area since this is a site of excellent data derived from brine injection into the Arbuckle Group at the Oxy-Chem facility south of Wichita in Sedgwick County and the location of Wellington Field in Sumner County. The Frontier Disposal Well #1 and the Oxy-Chem disposal well #10 are adjacent to each other and can serve as a comparison of the lithologic profile from the sample data in Disposal Well #1 with petrophysical log interpretation from the Oxy-Chem well.

This graphic lithology description is scalable and is shown in attached as a single profile with details of the written description (**Figure 12**) and as a cross section alongside the Oxy-Chem #10 well with our flow units chosen in this modeling run/test (**Figure 14**). This application will allow future users to look at details of individual well data and also examine wells in cross section. Integration of data sources to define the lithology and pore type is critical to create better constrained and reliable geomodels and simulations to access the fate of CO_2.

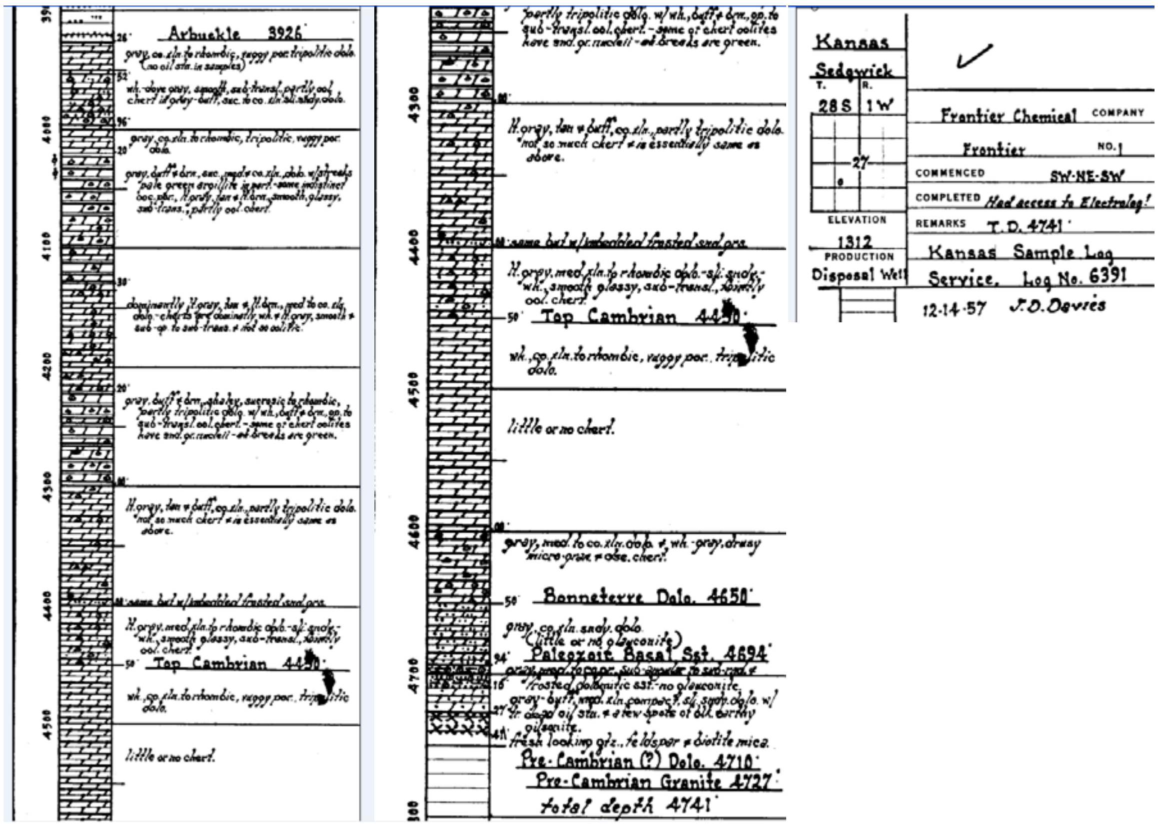


Figure 11. Original sample log called a Davies Log. Several hundred of these types of logs are available in the regional study area.

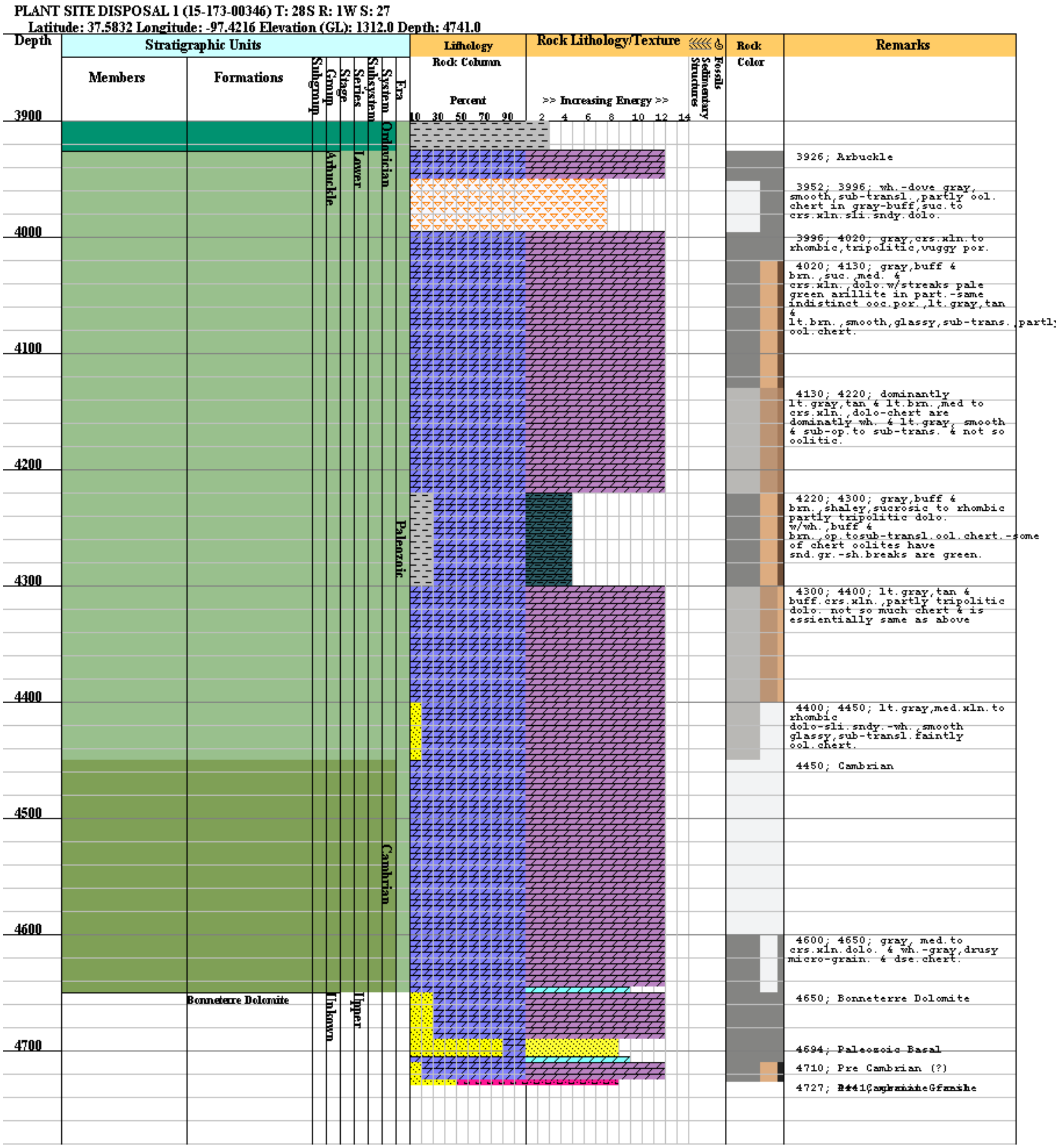
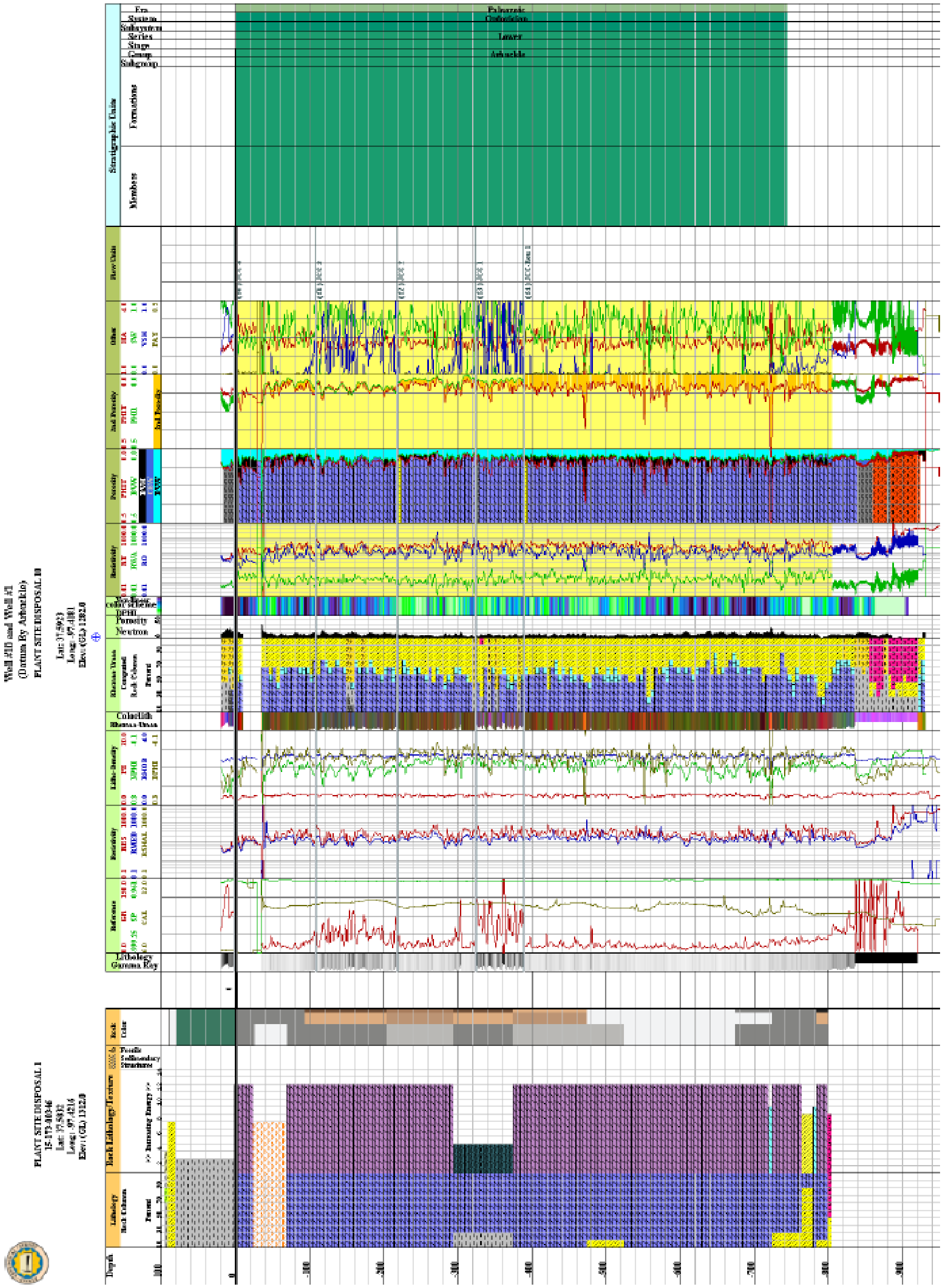


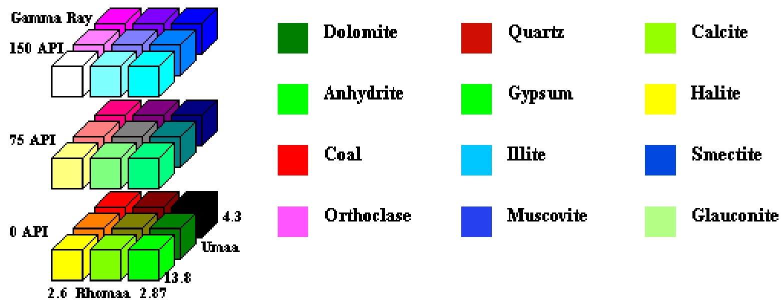
Figure 12. Graphic column generated from parsing of text shown in right margin and matched to graphic symbols and colors. Text was typed in and parsed into the new Java-based well profile. Graphic column is scalable and can be integrated with petrophysical logs and stratigraphic information.

Figure 13. Key to textures and lithologies used in scaleable graphic sample description illustrated in Figure 12.


Well #II and Well #1
(Datum By Arbuckle)
PLANT SITE DISPOSAL II
PLANT SITE DISPOSAL 1
Stratigraphic Units
Paleozoic
Ordovician
Lower
Arbuckle
Depth

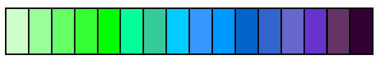
Colorlith Image Tracks

Rhomaa-Umaa Colorlith



Porosity Color Image Track

Increasing Porosity >>

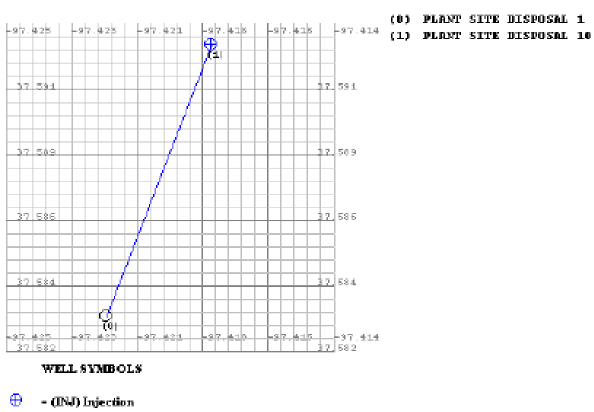


Linear Method: The number of data points are distributed by magnitude into equal bins.

Non-linear Method: The number of data points over the given depth range is subdivided equally into each color bin.

Cross Section Plot Track Legend (Jul 28, 2010)

Created: Jul 28, 2010 Title: Well #10 and Well #1



W100728242917: PLANT SITE DISPOSAL 1 (15-173-00346)
Section: 27 Township: 28S Range: 1W
Operator: FRONTIER CHEMICAL Field: ROBBINS
SEDGWICK County, Kansas
Latitude: 37.5832 Longitude: -97.4216
Total Depth: 4741.0 Ground Level: 1312.0 Kelly Bushing: 1312.0

W100728243202: PLANT SITE DISPOSAL 10
Section: 27 Township: 28S Range: 1W
Operator: VULCAN CHEMICALS Field: UNKNOWN
SEDGWICK County, Kansas
Latitude: 37.5923 Longitude: -97.4181
Total Depth: 4866.0 Ground Level: 1282.0 Kelly Bushing: 1297.0

Figure 14 (*including previous page*). Key to color defined lithologies (Colorlith) and index map for cross section shown on previous page consisting of sample log for Disposal Well #1 in southern Sedgwick County (also shown separately in Figure 12) and the adjacent well Disposal Well #10, a key well with core and modern log suites.

```
<?xml version="1.0" ?>
<!DOCTYPE control (View Source for full doctype...)>
- <control>
  <plot project="Well #10 and Well #1" created="Jul 28, 2010" start="0.0" end="0.0" />
- <data records="2">
- <profile>
- <well>
  <info key="W100728242917" type="WELL" api="15-173-00346" name="PLANT SITE DISPOSAL 1" status="D
     & A" />
  <other operator="FRONTIER CHEMICAL" oper_kid="0" field="ROBBINS" field_kid="0" />
  <loc state="Kansas" county="SEDGWICK" loc="S27-T28S-R1W" town="28" town_dir="S" range="1"
     range_dir="W" section="27" />
  <xy latitude="37.5832" longitude="-97.4216" zone="14.0" utm_x="639362.06" utm_y="4160527.0" />
  <z depth="4741.0" gl="1312.0" kb="1312.0" df="0.0" />
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  <cnt las="1" tops="7" core="0" images="0" perf="0" geo="84" />
  </well>
  <o_track start="2300.0" end="4750.0" />
- <tracks records="7" order="DEFAULT">
  <track group="TOPS" source="TOPS" type="STRAT" desc="Horizons - Stratigraphic Units" />
  <track group="OBS" source="ROCK" type="ROCK" desc="Lithology - Rock Column" />
  <track group="OBS" source="ROCK" type="GRAIN" desc="Texture - by User Input" />
  <track group="OBS" source="ROCK" type="ICON" desc="Sedimentary Structures" />
  <track group="OBS" source="ROCK" type="ICON" desc="Fossils" />
  <track group="OBS" source="ROCK" type="COLOR" desc="Color - Rock RGB Values" />
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  </tracks>
  </profile>
- <profile>
- <well>
  <info key="W100728243202" type="WELL" name="PLANT SITE DISPOSAL 10" status="INJ" />
  <other operator="VULCAN CHEMICALS" oper_kid="0" field="UNKNOWN" field_kid="0" />
  <loc state="Kansas" county="SEDGWICK" town="28" town_dir="S" range="1" range_dir="W" section="27" />
  <xy latitude="37.5923" longitude="-97.4181" />
  <z depth="4866.0" gl="1282.0" kb="1297.0" df="0.0" />
  <misc access="0" source="" date="02/12/2008" />
  <cnt las="1" tops="1" core="0" images="0" perf="0" geo="0" />
  </well>
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     start="3900.0" end="4870.0" />
- <tracks records="14" order="DEFAULT">
  <track group="CL" source="LAS" type="LITH" desc="Lithology - Gamma Ray" />
  <track group="LAS" source="LAS" type="LAS" desc="LAS - Reference - GR,SP,CAL Logs" />
  <track group="LAS" source="LAS" type="LAS" desc="LAS - Resistivity Logs" />
  <track group="LAS" source="LAS" type="LAS" desc="LAS - Litho-Density - NPHI,RHOB,PE Logs" />
  <track group="CL" source="LAS" type="LITH" desc="Colorlith - Rhomaa-Umaa Track" />
  <track group="CL" source="LAS" type="ROCK" desc="Lithology - Rhomaa-Umaa Track" />
  <track group="CL" source="LAS" type="PHI" desc="Thin Porosity Track" />
  <track group="CL" source="LAS" type="LITH" desc="Colorlith - Porosity Imager Nonlinear" />
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  <track group="PfEFFER" source="PfEFFER" type="LAS" desc="PfEFFER - Porosity" />
  <track group="PfEFFER" source="PfEFFER" type="LAS" desc="PfEFFER - 2nd Porosity" />
  <track group="PfEFFER" source="PfEFFER" type="LAS" desc="PfEFFER - Other" />
  <track group="PfEFFER" source="PfEFFER" type="FLOW" desc="PfEFFER - Flow Units" />
  <track group="TOPS" source="TOPS" type="STRAT" desc="Horizons - Stratigraphic Units" />
  </tracks>
  </profile>
  </data>
  </control>
```


Figure 15. XML file that is used to read an LAS 3.O file of the two wells, Disposal Well #1 and Disposal Well #10 used in creating the cross section shown in Figure 14. This file acts as a control

to rebuild the cross section, which once built in the Java applet can be manipulated in vertical scale and by datums common to wells that are part of the cross section.

Task 14. Technology Transfer.
PI's Watney and Bhattacharya made presentations about CO2 sequestration in saline aquifers and by CO_2-EOR and project activities to industry professionals, public, legislators, and regulators at 5 different industry meetings. Presentations include two seminars at mid-year meeting of Kansas Independent Oil and Gas Association and presentations at annual meeting of Southwest Kansas Landowners Association, Kansas Water Authority, and Spring Underground Injection Control State Representatives Meeting hosted by Region 7 Environmental Protection Agency.

ONGOING & COMPLETED ACTIVITIES concerning Wellington field, Sumner County, KS:

Subtask 3.1. Collect geologic and engineering data.
40% complete, student hired to acquire well records in Wichita for key wells including wireline logs, sample descriptions, completion history (example), DST, and LAS (Log ASCII digital files).

Well and seismic data are being loaded into Petrel by J. Rush, but this process is incomplete due to software and data format issues. Problems are quickly being resolved and an integrated geomodel for Wellington Field is anticipated in the next quarter. Additional modeling focused on seismic interpretation is being done by the Robert Hefner with the operating company BEREXCO; Dennis Hedke of Hedke-Saenger Geoscience, Ltd., who has overseen the design and now the interpretation of the 3D seismic; Abdelmoneam Raef, Assoc. Prof. at KSU, who along with an M.S. student, will examine seismic attributes using unconventional means such as wavelet based spectral analysis to create enhanced structural and stratigraphic attributes. Susan Nissan, consultant, will also explore heterogeneity through the use of the volumetric curvature attribute.

Subtask 3.2. Collect 3D seismic data.
Seismic data acquisition via Paragon Geophysical Corporation commenced on about March 5, 2010, with field testing to determine optimum vibroseis sweep parameters. These tests yielded a decision to record data with a pilot frequency of 6-150Hz, 3db/oct, 0.3 sec tapers, with 2 vibrators each applying 2-40 second sweeps, with a 3 second listening time.

Seismic data acquisition was completed late April, 2010, and data processing commenced soon thereafter. P-wave processing was accomplished by both Echo Geophysical and Fairfield Nodal of Denver, Colorado, while multi-component processing was assigned exclusively to Fairfield. Both P-wave and converted wave processing is ongoing.

In addition to the Wellington CO_2 database, Noble Energy, Houston, Texas, agreed to contribute an already acquired 3D P-wave seismic database covering the Anson-Bates Field northwest of the Berexco Wellington Unit.

Subtask 3.3. Process 3D seismic data.

Seismic data acquisition via Paragon Geophysical Corporation commenced on about March 5, 2010, with field testing to determine optimum vibroseis sweep parameters. These tests yielded a decision to record data with a pilot frequency of 6-150Hz, 3db/oct, 0.3 sec tapers, with 2 vibrators each applying 2-40 second sweeps, with a 3 second listening time.

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In addition to the Wellington CO_2 database, Noble Energy, Houston, Texas, agreed to contribute an already acquired 3D P-wave seismic database covering the Anson-Bates Field northwest of the Berexco Wellington Unit.

Both Fairfield and Echo will be providing a merged 3D volume that will incorporate P-wave data only, through Pre-stack Time Migration (PSTM). Iterative processing is ongoing in both of these processing centers, and preliminary analysis has begun.

Correlations to the processed 3D volumes have been made via sonic and density log control at a key location within Wellington, the former Terra Resources, now Berexco – Wellington Unit Peasel 1-144, located approximately NE NE NW NE Section 33 – Twp 31 S – Rge 1 W. A zero-phase correlation with appropriately adjusted synthetic seismogram is included below, **Figure 16 (a & b)**.

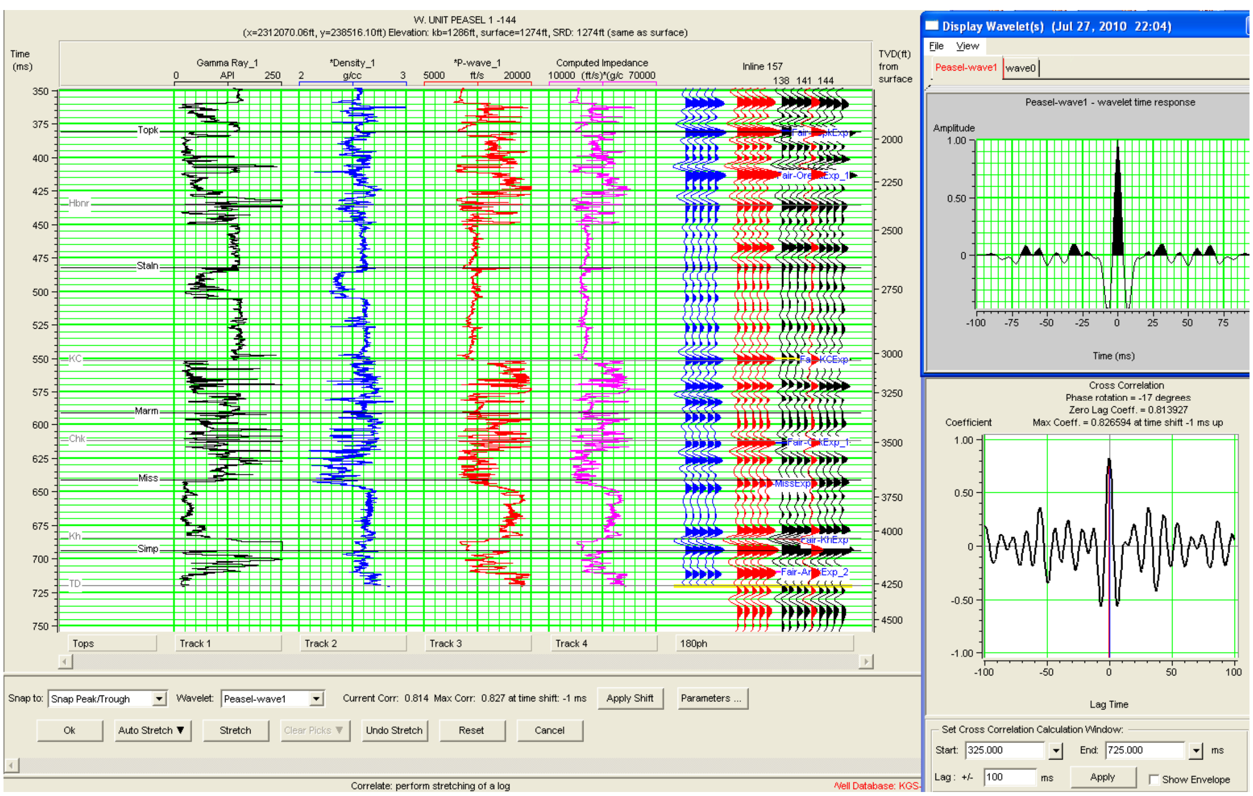

Figure 16 (a) (*previous page*). A wavelet was extracted Berexco - Wellington Unit Peasel 144-1 with a 36-trace search, with the Peasel located in the center of the search window. Lower portion shows log correlations with gamma ray, density, sonic and acoustic impedance. Correlation coefficient on lower image is 82.67% over the time interval 350-725 ms.

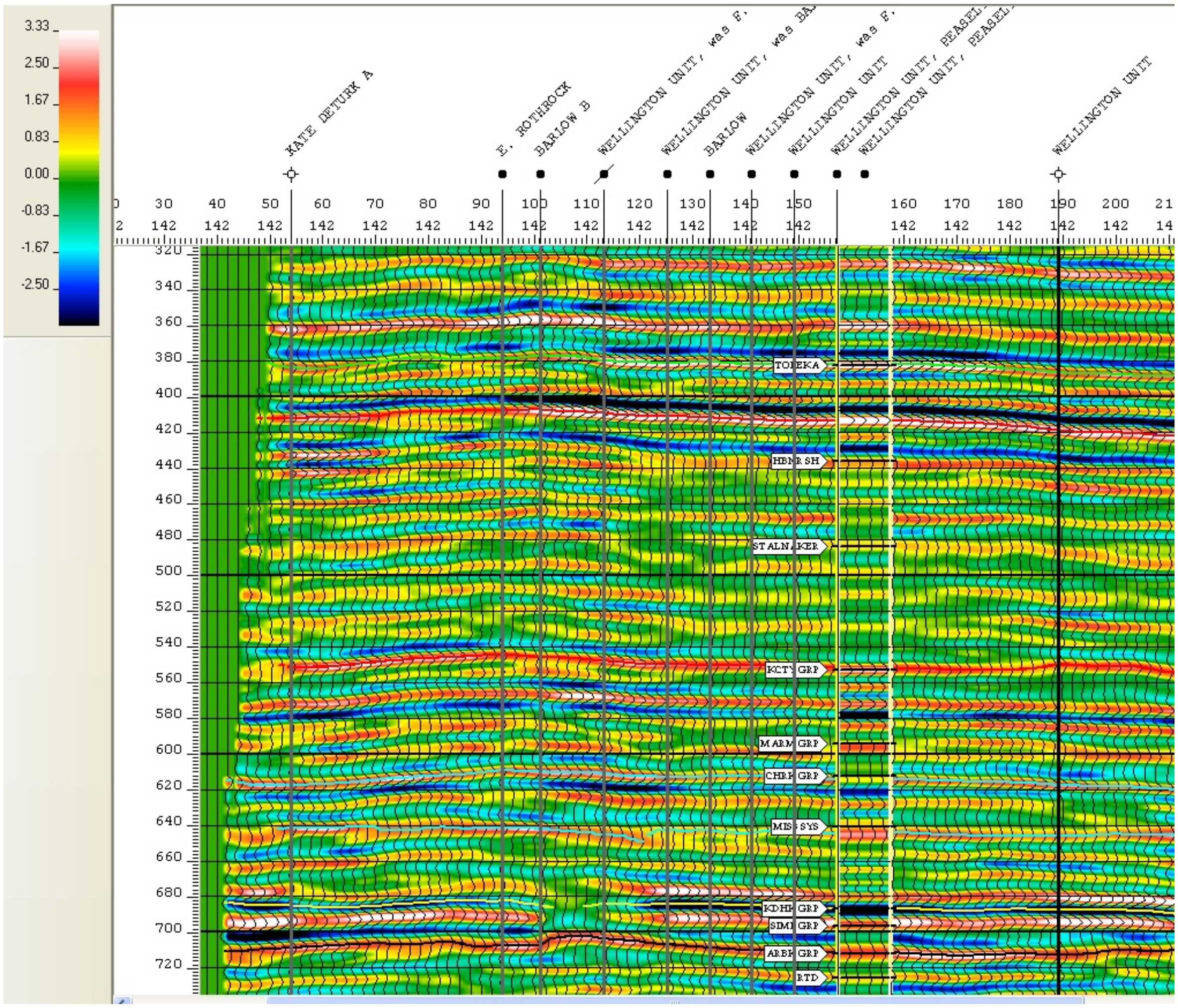

Figure 16 (b). Synthetic Seismogram tied at Berexco - Wellington Unit Peasel 144-1, Crossline 142, at Inline 157, Fairfield post-stack migration, original input rotated 180 degrees to match zero phase 10-15-110-120 Hz wavelet. Crossline shows major stratigraphic intervals ranging from the Upper Pennsylvanian Topeka Limestone to the Cambro-Ordovician Arbuckle Group.

Time structure mapping at a robust seismic event correlated to the Kansas City Group (appx 550 ms on Crossline 142) illustrates the differences that can arise via different processing analysts, as is illustrated below in **Figure 17**.

Time Structure Comparisons

Fairfield Echo

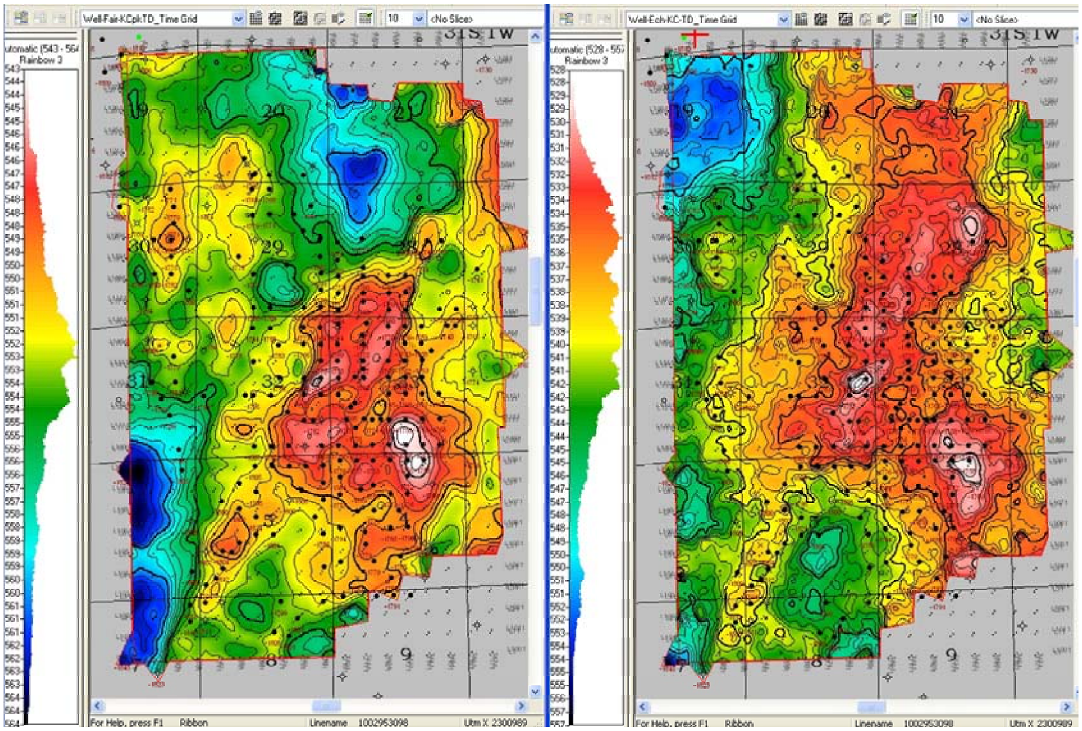

Figure 17: Time Structure Comparison – Time 'highs' warm, time 'lows' cool colors

Both solutions as presented above were derived from refraction statics volumes. There is fairly considerable variance between the two time solutions, which is due to individual preferences in refraction statics analysis, as well as individual preferences in the concomitant iterative velocity analyses. The well-control only gridded outcome is presented below for comparison in **Figure 18**, where depth highs are warm, lows cool.

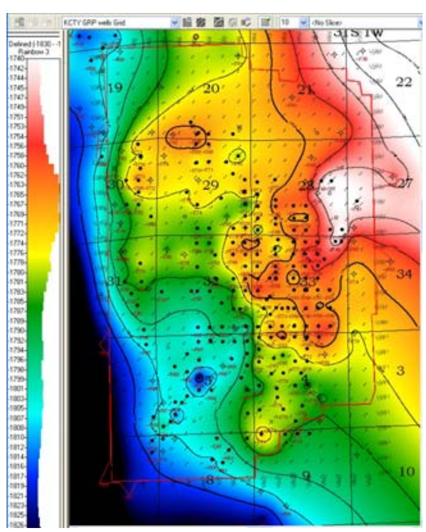

Figure 18: Well-control Depth Structure

Given the significant amount of well control, a depth converted solution was constructed, based on each time solution, as illustrated below in **Figure 19**.

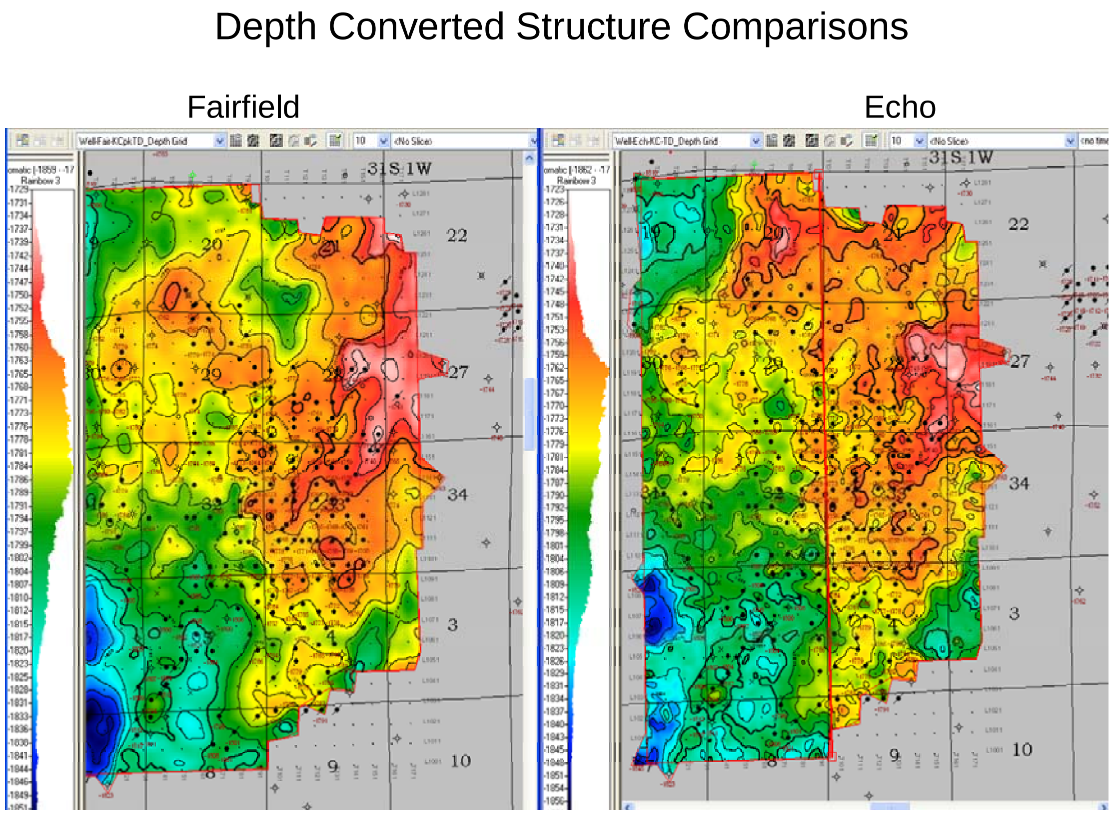

Figure 19: Comparison of Depth Conversion solutions.

A converted-depth difference map was calculated, and is presented below in **Figure 20**, illustrating a region in the northern portion of the survey wherein the maximum deviation between solutions amounted to approximately 50 feet, or approximately 25 feet above or below an average.

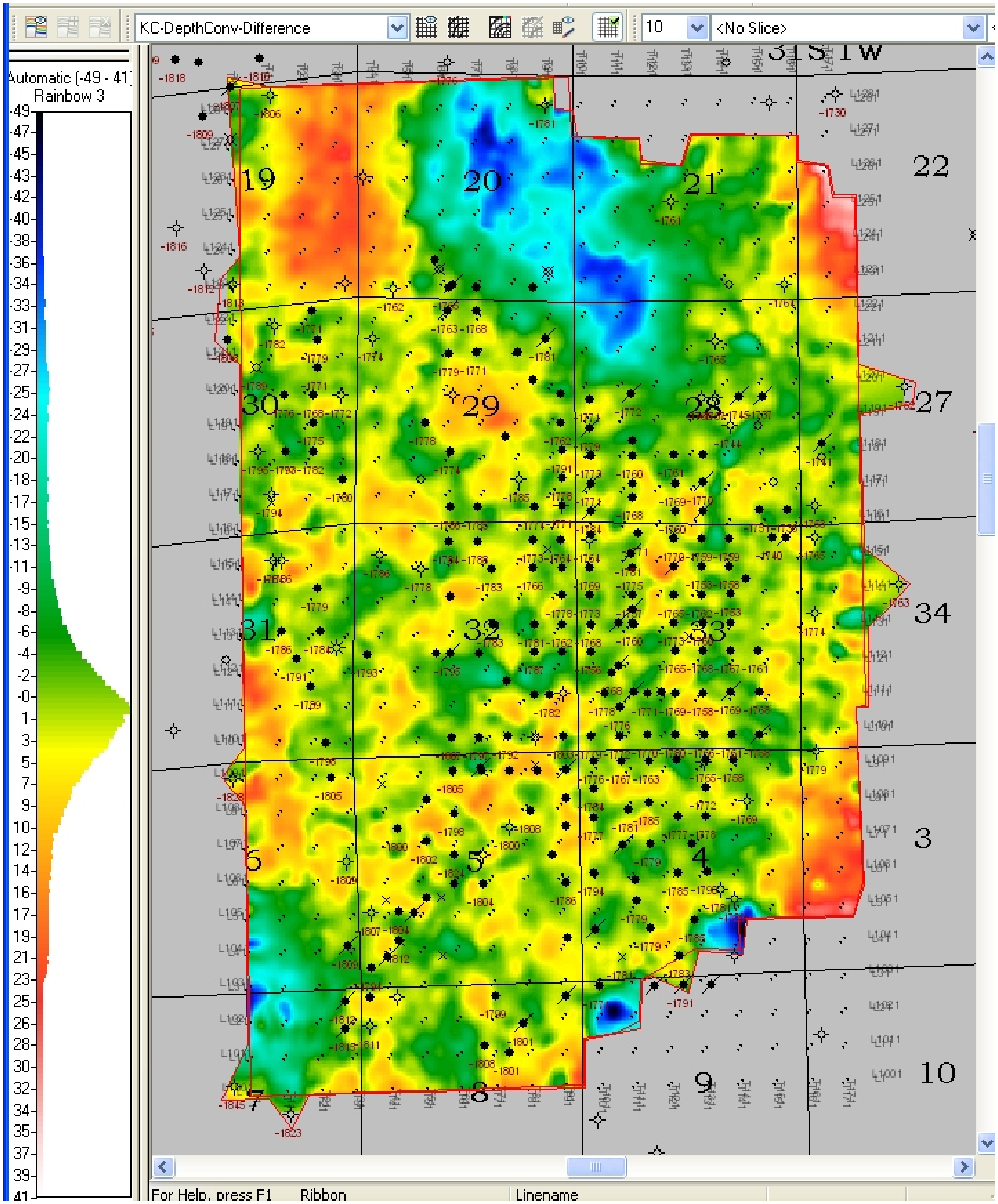

Figure 20: Converted Depth Difference Map. Maximum negative deviation in sections 20, 21; maximum positive deviation in section 19.

The deviation was analyzed by summing the two surfaces and then averaging to determine the departure from the Average Depth Converted Solution. This comparison indicated that the Fairfield solution yielded a generally closer fit to the average, and might, therefore, be considered as a statistically more accurate solution. The Fairfield Depth (left) vs Average Depth (right) is shown below in **Figure 21**.

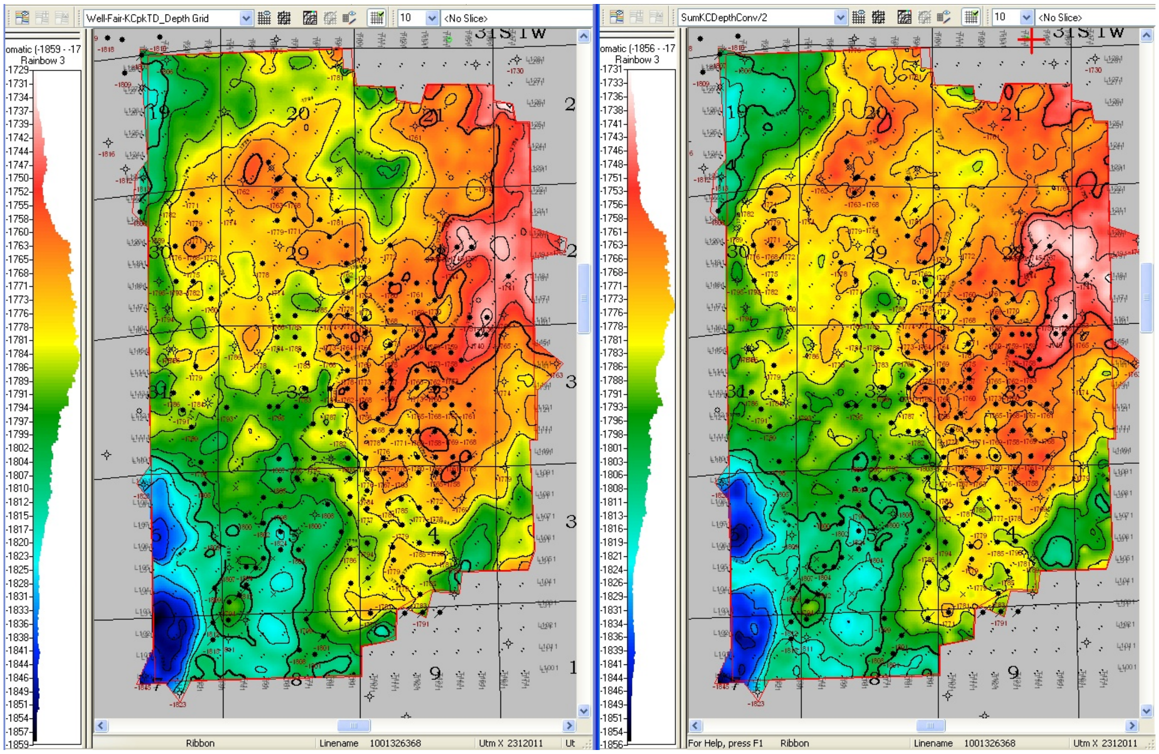

Figure 21: Fairfield Depth (left), vs Average Depth (right)

The Echo Depth Solution vs Average is shown below in **Figure 22**.

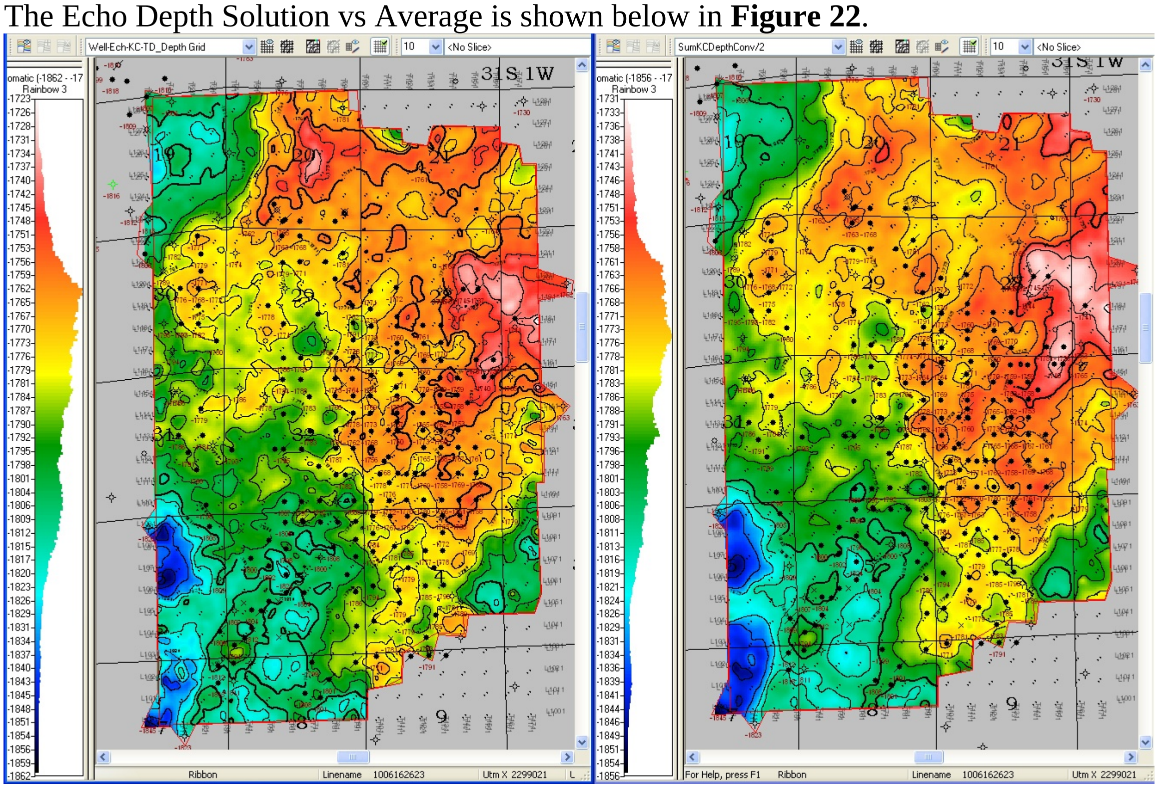

Figure 22: Echo Depth (left) vs Average Depth (right)

It is anticipated that Fairfield processing will yield a PSTM solution for the merged volume in the near future, at which time a comprehensive interpretation of P-wave data can be accomplished.

Fairfield is also advancing on a Converted wave solution for just the Wellington survey. Considering that no shear wave logging has yet been accomplished in the survey volume, modeling of the existing P-wave data will be accomplished to generate a shear wave velocity curve, from which additional derivatives, such as Vp/Vs ratio will be calculated and used for shear wave domain modeling.

Gravity statics (Grav-Stat) data has been acquired by Lockhart Geophysical, processed and delivered to both Echo Geophysical and Fairfield Nodal. Echo has completed their inclusion of this data into their P-wave processing flow, with evidence of improvement in the datum statics. It would appear, however, that the refraction statics solution via Echo is far superior to the datum statics with Grav-Stat. Figures demonstrate the differences in these statics applications. Fairfield has yet to complete the introduction of Grav-Stat data into their statics analysis.

Discussions have been initiated with Survey log analyst John Doveton to explore the transformation of gamma ray curve data into sonic data. If the application can be worked out satisfactorily, we will be able to materially improve modeling in support of acoustic impedance inversion, a process we intend to apply in the future.

In addition to acoustic impedance inversion, we should be able to accomplish various modeling and processing runs related to AVO characteristics, yielding independent elastic inversion products, such as Vp/Vs ratio and other potentially valuable parameters in the study of anisotropic effects within the data volume.

Additional considerations for interpreting seismic including attribute computation -- The availability of two post-stack 3D seismic reflection datasets processed by two seismic data contractors, offers an excellent opportunity to examine effects of differences in data processing flows on data quality and interpretability. Upon initial inspection Dr. Raef observed that one of the main differences between the processing is amplitude. These datasets will provide options to optimize the quality of the final structural or property prediction product. Evaluating these seismic models and interpretations will be based on a comparison with production and drilling information.

An initial result from Dr. Raef using a structural attribute called coherency reveals structural or stratigraphic anomalies. Improvement and parameter testing of these and other attributes is underway (**Figure 22 and 23**). A M.S. student in geophysics has been hired at Kansas State University to assist Dr. Raef in this effort. A 3D continuity/discontinuity volume will ultimately be developed to assist in designing the geomodel for fluid flow simulation.

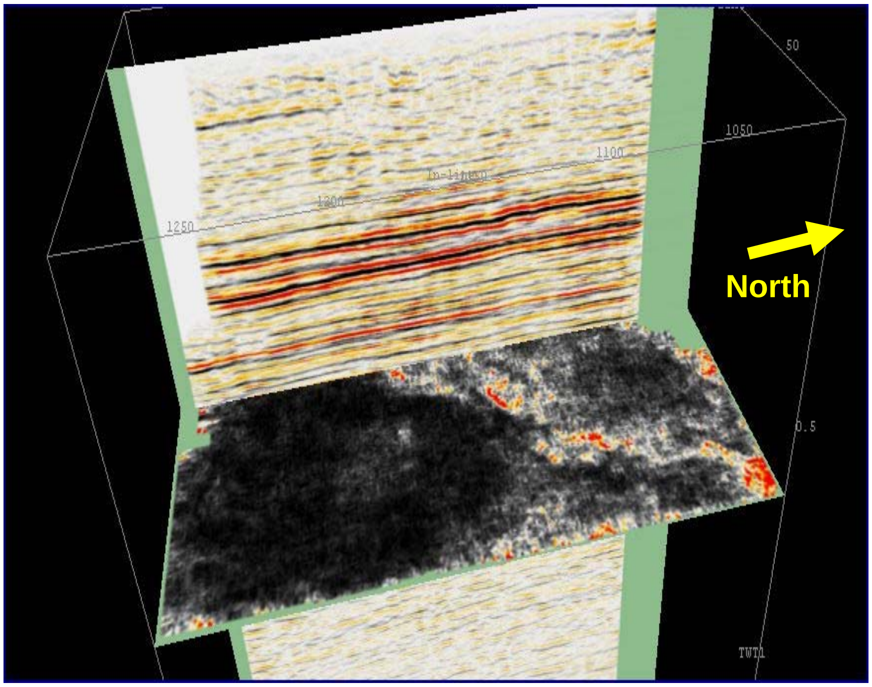

Figure 22. Initial realization of a coherency time slice of the Wellington 3D seismic survey showing time slice. A clearly defined structural or stratigraphic anomaly is indicated separating the time slice into northwest and southeast sectors.

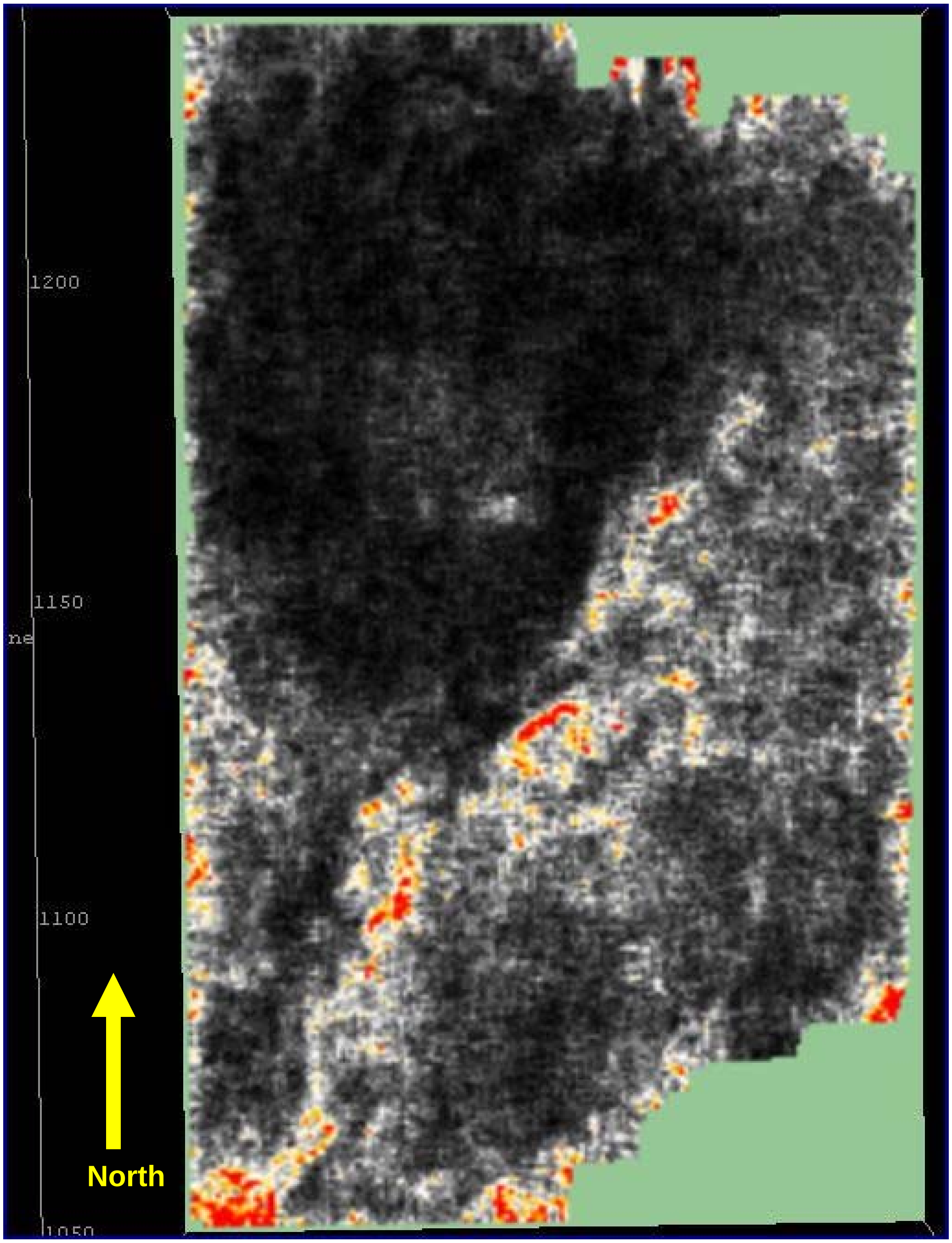

Figure 23. More detailed view of the coherency attribute time slice showing structural/stratigraphic anomaly cutting NE-SW, diagonally through the time slice.

***Subtask 3.4*. Collection of gravity data.**
High-resolution gravity data has been collected, processed, and shared with seismic processors to aid in statics correction. Analysis of the Bouger gravity map in conjunction with the seismic and well log based mapping will be accomplished in during the next quarter.

***Subtask 3.5*. Interpret seismic, gravimetric, and magnetic data – ongoing.**
A preliminary field geomodel has been developed (3rd quarter milestone 1.2) as shared in previous quarterly report, but now that well logs have been digitized and seismic interpretations now forthcoming, much more process will be seen through the next quarter.

Major Finding and Conclusions

While major findings and conclusions are still forthcoming, much is being learned about the internal stratigraphy of the Arbuckle Group that is the primary target for saline aquifer CO_2 sequestration. Incorporating details of vertical and lateral variations in this stratigraphy should prove to be very important to improve estimates of sequestration capacity in this major saline aquifer system. An integrated interpretation of the growing petrophysical, sample and core data, geophysical, and remote sensing information coupled with an assessment of potential avenues for leakage will also greatly improve the evaluation of risk and the feasibility for sequestering commercial quantities of CO_2.

Key Outcomes and Other Achievements

With new additions of well logs around Wellington Field and additions to wells from the regional study, we are approaching the digitization of 300 wells. We have estimated nearly 1200 key wells logs will be digitized during this project. As we correlate and map and select areas of interest regionally, additional logs will be digitized. In addition, sample logs from key wells are being typed to create ASCII files of lithologic and porosity descriptions. KGS staff and students have contributed to this effort led by the Bittersweet team. Log digitizing by LOGDIGI has been timely and of good quality.

Petrophysical web-based computing and display tools developed by John Victorine are being tested and are ready to be used in a mass-production mode to analyze the new digital log data to develop flow unit-based stratigraphy and to determine their properties, both essential ingredients to quantitative assessments of CO2 sequestration capacity via compositional fluid-flow simulation.

Much is being learned from the collaboration with the USGS in their Anadarko Basin Resource Assessment Program. Visits with staff and the program manager, Debra Higley, and a review of results on potentiometric mapping of Paleozoic aquifers by Phil Nelson provide a significant framework to base our understanding of the aquifer system. Their knowledge and approach should prove immensely useful for comparison with our efforts to characterize the pressure regime and salinity variation within the flow units comprising the Ozark Plateau Aquifer System.

Draft maps of the remote sensing analyses provided by Dave Koger show consistent patterns and trends that will be very important to compare with the subsurface information in order to evaluate relationships and any coincidences with confirmed fractures and faults.

Staff and facilities are proving ready for the challenges of the project. Geochemical facilities and staffing by Dr. Datta and his student at KSU are now ready to provide analyses of water and rock samples and provide essential parameters on kinetics for reactions that are input into the compositional simulator. The Bittersweet team continues to perform with high efficiency to identify key wells, collect well data, and perform vital stratigraphic correlations and initial evaluations. Eight areas of interest for possible sequestration site in the regional study area beyond that of Wellington Field in Sumner County have been identified and addressed with structural and isopach mapping and cross sections. The widespread distribution of the sites will allow us to compare and contrast and provide constraints on simulation modeling since areas that are modeled have to be restricted based on computing intensive nature of the compositional simulator.

BEREXCO staff has contributed significantly toward compiling data on Wellington Field. Geophysical members of the project team have performed timely services and shared results that have kept up with the project schedule including Paragon and Lockhart with geophysical data acquisition; Echo and Fairfield with seismic processing; Dennis Hedke, Robert Hefner, and Abdelmoneam Raef for seismic interpretation; and Jianghai Xia for work on tailored software for re-processing potential fields data.

Dana Heljeson at the KGS has been handling important tasks in creating and maintaining the website while Mike Killion at the KGS is making timely progress in adapting the interactive web-based map viewer for our project.

A useful open dialog is occurring within the project team and the stakeholders in the region who are interested in carbon sequestration. Presentations to stakeholders have been steady since the project began. Discussions resulting from this interaction have been a learning experience leading to a much better understanding of their concerns, issues, and constraints and opportunities facing sequestration. Stakeholders thus far who have entered with us in an ongoing dialog include Kansas Water Authority, Kansas Oil and Gas Association, Kansas Department of Health and Environment, Kansas Corporation Commission, Kansas Department of Commerce, Kansas Legislature, Southwest Kansas Royalty Owners Association, and the U.S. EPA.

COST STATUS

Cost Plan/Status

Costs in the 3rd quarter were incurred in Tasks 2, 3, 9, 13, and 14. Spending was $164,156.96 over projections in the 3rd quarter with overage coming from Subtask 3.2 in collection of 3D seismic data. Weather delays in 2nd quarter led to completion of the survey on April 10, two weeks into the 3rd quarter. Invoice and payment of these services was all done in the 3rd quarter.

	COST PLAN/STATUS			
	Year 1 Starts: 10/1/09		**Ends: 9/30/10**	
Baseline Reporting Quarter	**Q1**	**Q2**	**Q3**	**Q4**
Baseline Cost Plan (from SF-424A)	(from 424A, Sec. D)			
Federal Share	$1,273.10	$330,271.41	$330,271.41	
Non-Federal Share				
Total Planned (Federal and Non-Federal)	$1,273.10	$330,271.41	$330,271.41	
Cumulative Baseline Cost	$1,273.10	$330,271.41	$330,271.41	
Actual Incurred Costs				
Federal Share	$4,019.93	$84,603.97	$494,428.37	
Non-Federal Share				
Total Incurred Costs-Quarterly (Federal and Non-Federal)	$4,019.93	$84,603.97	$494,428.37	
Cumulative Incurred Costs	$4,019.93	$84,603.97	$494,428.37	
Variance				
Federal Share	$2,746.83	-$245,667.44	$164,156.96	
Non-Federal Share				
Total Variance-Quarterly Federal and Non-Federal)	$2,746.83	-$245,667.44	$164,156.96	
Cumulative Variance	**$2,746.83**	**-$245,667.44**	**$164,156.96**	

SCHEDULE/MILESTONE STATUS

Milestone 1.2, Acquire/analyze seismic, geologic and engineering data - Wellington field, was due to be completed during the 3rd quarter. However, acquisition of lease production and well completion information for Wellington Field is 70% complete as of the end of the 3rd quarter. Processing of the 3D seisimic data was completed, but analysis continues due to lateness in completing the seismic survey. Initial interpretation of the seismic and integration with the Wellington field logs is underway. Also, 3D seismic data from adjacent Anson-Bates Field is being merged with the Wellington 3D survey to provide a full 20 mi^2 perspective. Acquisition of geologic data is well underway with all available Wellington field wireline logs have been gathered, scanned, digitized, verified, and uploaded on the KGS website for use by the team and public. Currently, the digital log data are being uploaded into Petra and Petrel geomodels. Petrel will also be used to integrate the 3D seismic volume and interpreted log data to create the 3D geocellular model for use by the compositional simulator. Acquisition of engineering data in Wellington field and establishing a complete as possible production history is in progress. The early discovery date of the field (1929) and the changes in ownership have resulted in an incomplete lease production history. In order to be able to do adequate history matching and calibration during reservoir simulation, efforts continue to locate production, well completion, and plugging files so that allocation of oil production by lease through time can be realized. Inventory of well completion data is also in progress. Archived company data and paper copy submitted to the state are being discovered and assimilated.

In terms of future activities, Subtask 4.15 to collect 2D shear wave seismic survey is next in the critical path to be able to process the 3D seismic volume at Wellington Field for converted shear wave information. The two 2D shear wave surveys will be placed along the proposed locations of Well #1 and #2 based on the geomodel and current P-wave seismic processed data. The current seismic interpretation and geomodel development will continue into the 4th quarter before well locations are determined. Processed information from the 2D shear wave seismic lines (Subtask 4.16) will be used to re-process the 3D multicomponent seismic volume to maximize shear wave content and optimize interpretations. All of this information will be factored in to refining the locations of the wells, Well #1 to be drilled by 12/30/10 with approved from our program manager.

Budget Period 1				
Title	Description	Related Task/Subtask	Completion date	Validation Technique and Milestone Progress
Milestone 1.1	Hire geology consultants for OPAS modeling	Subtask 2.1	3/31/2010	*Completed*
Milestone 1.2	Acquire/analyze seismic, geologic and engineering data - Wellington field	Subtasks 3.2 to 3.5	6/30/2010	*70% Completed **
Milestone 1.3	Develop initial geomodel for Wellington field	Subtasks 3.1 & 3.6	9/30/2010	
Milestone 1.4	Locate and initiate drilling of Well #1 at Wellington field	Subtasks 4.1 & 4.2	12/31/2010	

MILESTONE STATUS REPORT

			Project Duration -- Starts: 10/1/09 Ends: 9/30/12					Planned Start Date:	Planned End Date:	Actual Start Date:	Actual End Date:	Comments
	Project Milestone Description		Project Year (PY) 1									
Task/Subtask	Title	Name	Q1	Q2	Q3	Q4						
Subtask 2.1	Milestone 1.1	Hire geology consultants for OPAS modeling						12/1/2009	3/31/2010	12/1/2009	12/30/2010	Completed
Subtasks 3.2 to 3.5	Milestone 1.2	Acquire/analyze seismic, geologic and engineering data - Wellington field						12/1/2009	6/30/2010	12/15/2009		Seismic delays
Subtasks 3.1 & 3.6	Milestone 1.3	Develop initial geomodel for Wellington field						12/1/2009	9/30/2010	12/1/2009		
Subtasks 4.1 & 4.2	Milestone 1.4	Locate and initiate drilling of Well #1 at Wellington field						5/1/2010	2/31/2010			