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(5/09)
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ATTACHMENT 3
U.S. Department of Energy
FEDERAL ASSISTANCE REPORTING CHECKLIST
AND INSTRUCTIONS

1. Identification Number: **DE-FE0002056**	2. Program/Project Title: **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	Q	Electronic Version to NETL>	FITS@NETL.DOE.GOV
☒ Special Status Report	A		
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	FG	Electronic Version to E-link>	http://www.osti.gov/elink-2413
☒ Conference papers/proceedings/etc.* — DOE F 241.3	A		http://www.osti.gov/elink-2413
☐ Software/Manual — DOE F 241.4			http://www.osti.gov/estsc/241-4pre.jsp
☒ Other (see special instructions)			
Topical — DOE F 241.3	A		
** Scientific/technical conferences only*			
C. FINANCIAL REPORTING			
☒ SF-425, Federal Financial Report	Q, FG	Electronic Version To NETL>	FITS@NETL.DOE.GOV
D. CLOSEOUT REPORTING			
☐ Patent Certification	FC	Electronic Version To NETL>	FITS@NETL.DOE.GOV
☐ Property Certificate	FC		
☐ Other			
E. OTHER REPORTING			
☒ Annual Indirect Cost Proposal	A	Electronic Version To NETL>	FITS@NETL.DOE.GOV
☒ Annual Inventory Report of Federally Owned Property, if any	A		
☐ Other			
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

Second Quarter Progress Report

Date of Report: 4/28/2010

Period Covered by the Report: December 31, 2010 through March 31, 2010

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 are 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.

Milestone 1.1 to hire geology consultants for OPAS modeling was accomplished in the second quarter ending March 31st. The consultants hired are part of the Bittersweet Energy subcontract and are working on the regional portion of the study. Consultants that comprise this team are experts in their disciplines that span subsurface geology, Class I waste injection and well design, hydrologic modeling, risk assessment, and structural geology. The team has responded to the tasks quickly and began to identify initial type wells in the regional study under Subtask 2.2. They have assessed wells the 20,000 square mile area and have screened over 95,000 wells to identify 292 Precambrian tests and 14,105 Arbuckle tests. Of these, 1,417 Type Wells have been identified that penetrate over 200 ft into the Arbuckle and 90 Super Type Wells that penetrate over 400 ft in the Arbuckle and were drilled after 1980. Four students were hired by Bittersweet to gather and scan well data that is available at the KGS. These well data are being uploaded to the server. The Super Type logs have been organized and half have been sent and returned by the digitizing service, LogDigi. The resulting LAS (Log ASCII Standard) were returned, passed our quality control inspection, and are ready for use. A total of 1324 wells were loaded into PC-based Geographix mapping software and depth-registered for use in making cross sections and correlating the stratigraphy.

Initial correlations are being made with raster log data, but new ways are being examined to facilitate refining these correlations through digital well log analysis and imaging. Depth registered raster data includes sample logs and published sections such as insoluble residues. The latter were used extensively by early workers to correlate within the Arbuckle. Their meticulous correlations from samples are an important starting point for correlation. Besides sample descriptions, lithology can also be derived from modern well log suites. We are working to

convert the digital log data to color imaged lithology that can be compared and validated with samples. Together with traditional well log analysis to derive porosity, secondary porosity, water resistivity/salinity, apparent cementation exponent to estimate pore size and type, we are developing and testing Java web tool under Subtask 2.3 to assist in establishing detailed stratigraphic correlations, flow unit designation, and rock properties associated with the flow units that are necessary for quantitative geomodel development. Much progress has been made in the second quarter to develop a "smart" analysis whereby the software does most of the setup so that the user spends their time interpreting rather than creating the well profile. The goal is to be able to efficiently interrogate what will become a large database and revisit the results of the well log analysis and its integration with the supporting sample/rock data with minimal effort. This will allow rapid negotiation of a spatially extensive and large digital well log database. The goal is transparency of interpretations so that stakeholders can interrogate origin of results and to investigate at greater technical detail prospective sites to be selected for carbon sequestration. The Java code that is being modified and adapted to this project has been tested in various phases of development for 10 years and simpler versions are available to display digital log files served on the internet by the KGS.

The original compiled well data and interpretations used in the well profiles are being saved in LAS 3.0 format. This standard dataset can be downloaded as one file, facilitate utilization in other applications, and does not require any form of data compilation. The same data structure will be eventually be used to loaded compiled well data and analyses into the Petrel 3D geomodel.

The regional team will collaborate with the U.S. Geological Survey in their project on the National Oil and Gas Assessment for the Anadarko Basin. The USGS is compiling subsurface data that include our our entire area as well as the surrounding area of Oklahoma, Texas Panhandle, and southeastern Colorado. Our depth of investigation of the aquifer system is more detailed and we will be modeling for CO_2 sequestration rather than petroleum systems. However, the sharing of data, ideas, and results will provide a means to constrain and validate our interpretations of structural development and fluid flow in the context of their very large regional study.

At Wellington Field, an 11 mi^2 3D seismic survey has been obtained. The seismic from nearby Anson-Bates fields donated by Noble Energy Corporation has been uploaded for analysis and was used in the design of the Wellington survey. Data quality of the new seismic appears to be very good. Well data are being scanned and digitized so that a geomodel can be built early in the third quarter and integrated with the seismic volume. High resolution gravity data has been obtained from Wellington field. Strategies and protocol are being developed for the geochemical analyses.

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

Subtask 2.1 -- Choose Subcontractor- OPAS Data Acquisition

Milestone 1.1 to hire geology consultants for OPAS modeling under ***Subtask 2.1*** was accomplished in mid December 2009. Tom Hansen, principal of Bittersweet Energy Inc. became subcontractor and manager for the regional portion of the study to characterize the OPAS. Two consultants, Larry Nicholson and Paul Gerlach were hired for two-year full-time appointments by Tom Hansen. Both consultants have several decades of experience in Kansas and are successful geoscientists/consultants with extensive knowledge of the Kansas subsurface and its natural resources. Moreover, they have considerable skills in computer-assisted data management, mapping, and interpretation. The subcontract was finalized in December so the team could begin work.

Bittersweet Energy also went on to contract for part-time work for four students located at the Kansas Geological Survey (KGS) to expedite inventory and scanning of well logs, georeports (geologist's descriptions of samples presented in depth format), and drillers logs from the paper records and place this information on the website to make them available for additional tasks.

Other Hiring Activity

Two students have also been hired for work on microbiological studies (**Subtask 4.12**) and a student selected to begin work in fall on the diagenetic history of fracture fill (**Subtask 4.14**).

Subtask 2.2 -- Data Collection in Regional Study Area

Measureable progress has been made by the Bittersweet Energy team to assemble well data to use for regional characterization of the Arbuckle Saline Aquifer System over a 17+ county, 20,000 square mile study area as part of **Task 2**. The study area is outlined in **Figure 1**. All oil, gas, stratigraphic tests, and water wells in Kansas are inventoried on the KGS electronic database and include associated geographic coordinates and API accession numbers for ease in access and recognition. Well status information such as completion and plugging, new operators, reworking, reopening, and drilled depths and formations penetrated are kept up in the KGS database and are easily accessible as public information. This basic well information was downloaded into Geographix software for further analysis and screening to aid in well selection.

Selected key wells were defined for initial regional assessment of the aquifer system. Since many wells are shallow and do not penetrate the Arbuckle or only are drilled into the top of the Arbuckle, many wells were initially eliminated from this round of data gathering. Over 95,000 wells were identified in the 20,000 square mile study area on southern Kansas (**Figures 1 and 2**). A total of 292 wells were Precambrian basement were identified from the KGS database and are automatically key wells regardless of age. The basement tests often helps identify the basement rock type that is important for modeling as well as understanding geologic processes that have influenced the basement.

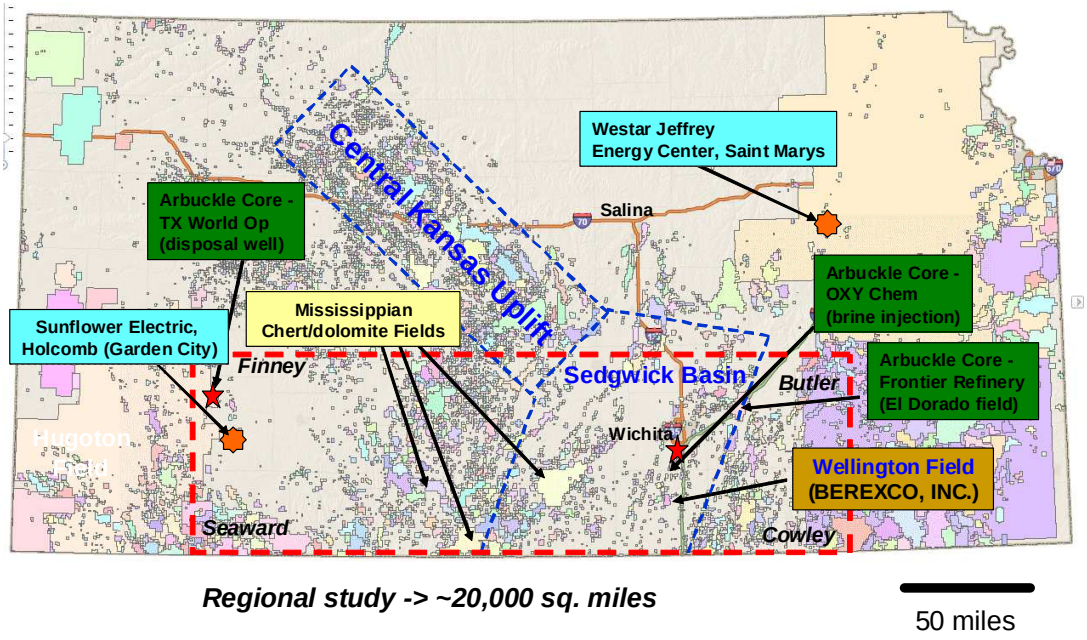

Figure 1. Kansas map showing study area in red dashed outline. Site of local study in Wellington Field is also shown along with colored regions depicting other oil, gas, and coal-bed methane producing areas.

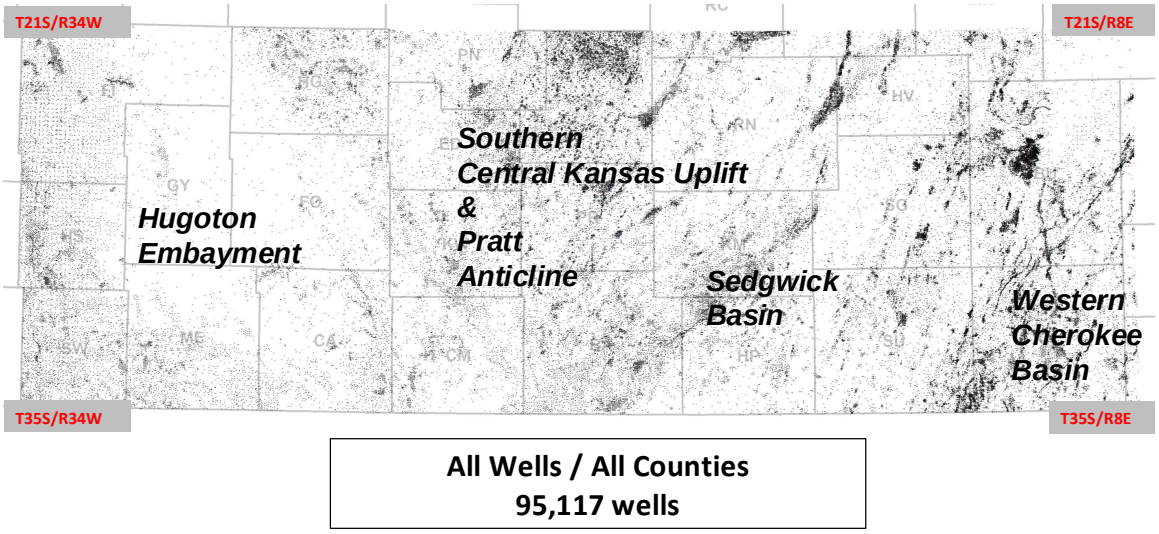

Figure 2. Regional study area in southern Kansas showing location of all wells (small gray dots and black patches of high density drilling). Geologic provinces encompassed by the regional study are labeled. County boundaries are shown as gray lines. Index for mapped area is found in Figure 1.

The Precambrian wells (292) and Arbuckle tests (14,105), and what are referred to as Type Wells (1,417) and Super Type Wells (91) are identified in **Figure 3**. The Type Wells numbering 1417 at present penetrate over 200 feet into the Arbuckle while the Super Type Logs have been drilled to over 400 ft in the Arbuckle and were drilled after 1980. Wells without formation tops were identified by comparing the total depths of the well with projected depths of the top of Arbuckle based on nearby wells. This comparison was done using Geographix software.

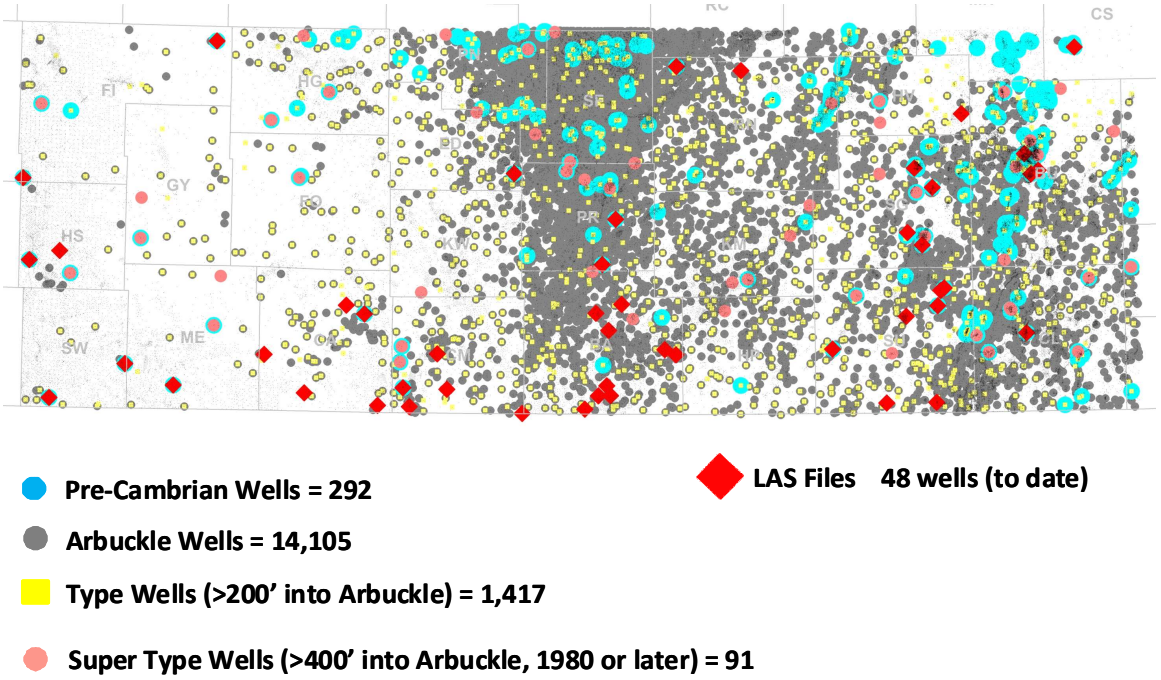

Figure 3. Distribution of wells to be used in the study in regional study area in southern Kansas. Index for mapped area is found in Figure 1.

A total of 1324 wells have thus far been loaded into PC-based Geographix software and depth-registered. Geographix will be used by the Bittersweet team to make an extended set of cross sections and maps including structure, thickness, and stratigraphic variations of the aquifer system. Depth registration is the process of digitally tagging a raster image of the well log with depth and log scale identification by creating an accompanying DRI file. The log raster images can then be scaled, essentially stretched and compressed, to fit cross sections as depth scales are changed. Once key well logs are digitized, curves will be plotted to scale for greater accuracy.

Other depth-based well data is being scanned for key wells including georeports that provide basic lithology, porosity, and rock texture or published descriptions on wells such as insoluble residues that have been used in the early years to correlate the thick Arbuckle aquifer (**Figure 4**) (Kroher and Kirby, 1948).

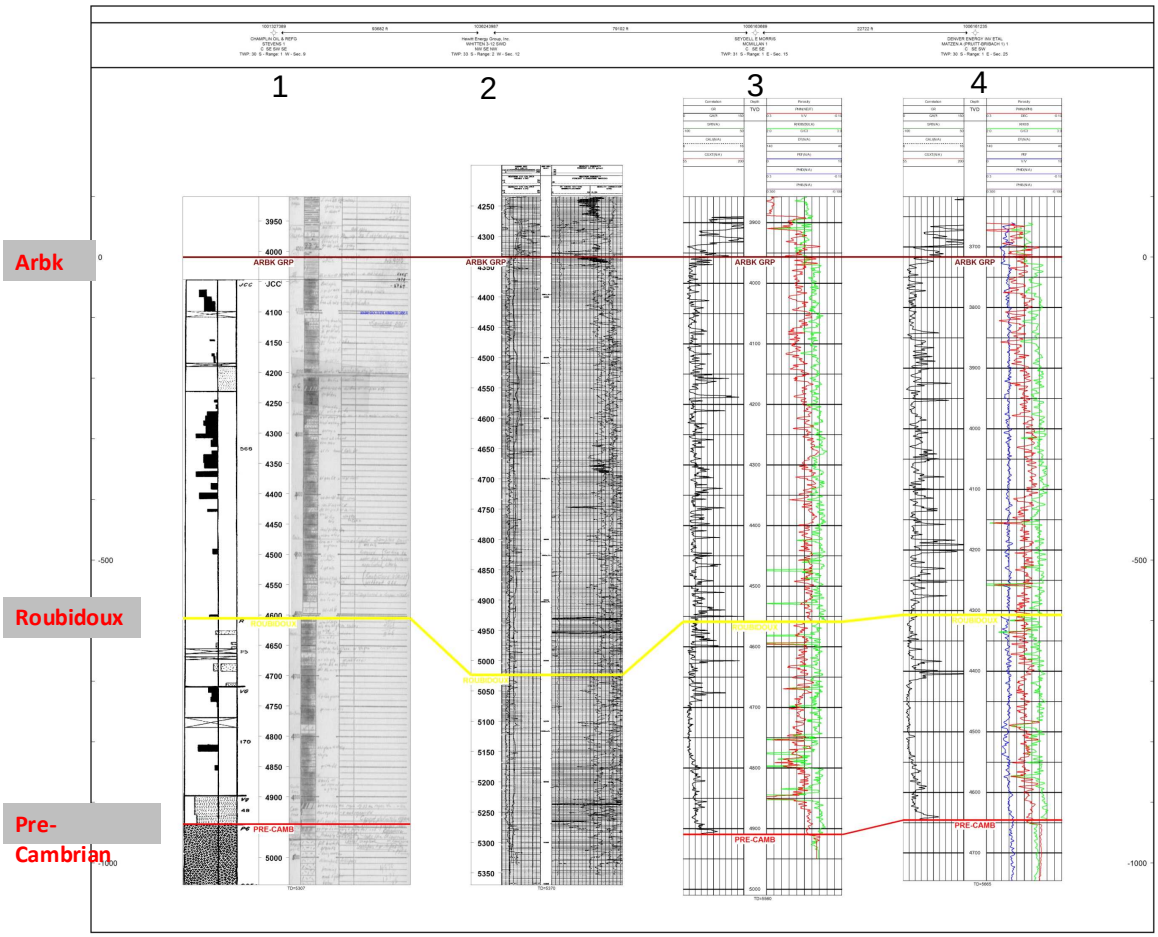

Figure 4. Example of a working stratigraphic well cross section from Geographix being used to examine possible correlations for the Roubidoux stratigraphic horizon within the Arbuckle aquifer. Well #1 is represented by depth-registered insoluble residue log and sample log description from which the lithologic correlation was based. Well #2 includes a depth-registered log raster while wells #3 and #4 utilize digital (LAS) log files.

Geographix will be used to develop primary stratigraphic correlations within the aquifer system. Detailed flow unit classification and correlations will be a joint effort between the Bittersweet team and KGS staff incorporating web-based log analysis and imaging of lithology and other rock properties obtained from the digital logs (LAS) and sample descriptions (ASCII based).

Subtask 2.3 – Develop regional correlation framework and integrated geomodel

Web-based Log Analysis -- Flow units will be defined by an integrated interpretation of multiple well data types including digital logs analyzed for lithology (if neutron, density, and gamma ray +- photoelectric curve), porosity, secondary porosity (if sonic log), water resistivity

(salinity/total dissolved solids), and apparent cementation exponent from Archie equation (estimate of pore size and type). Work continued this quarter to refine the web-based (Java) Well Profile to display a single LAS file that is accompanied by stratigraphic nomenclature obtained from the server or added interactively. The color imaging provides more visual cues for correlation (**Figure 5**). Moreover, with imaging of lithology and additional results from log analysis, the geologist will be able to more easily correlate stratigraphic markers and eventually flow units.

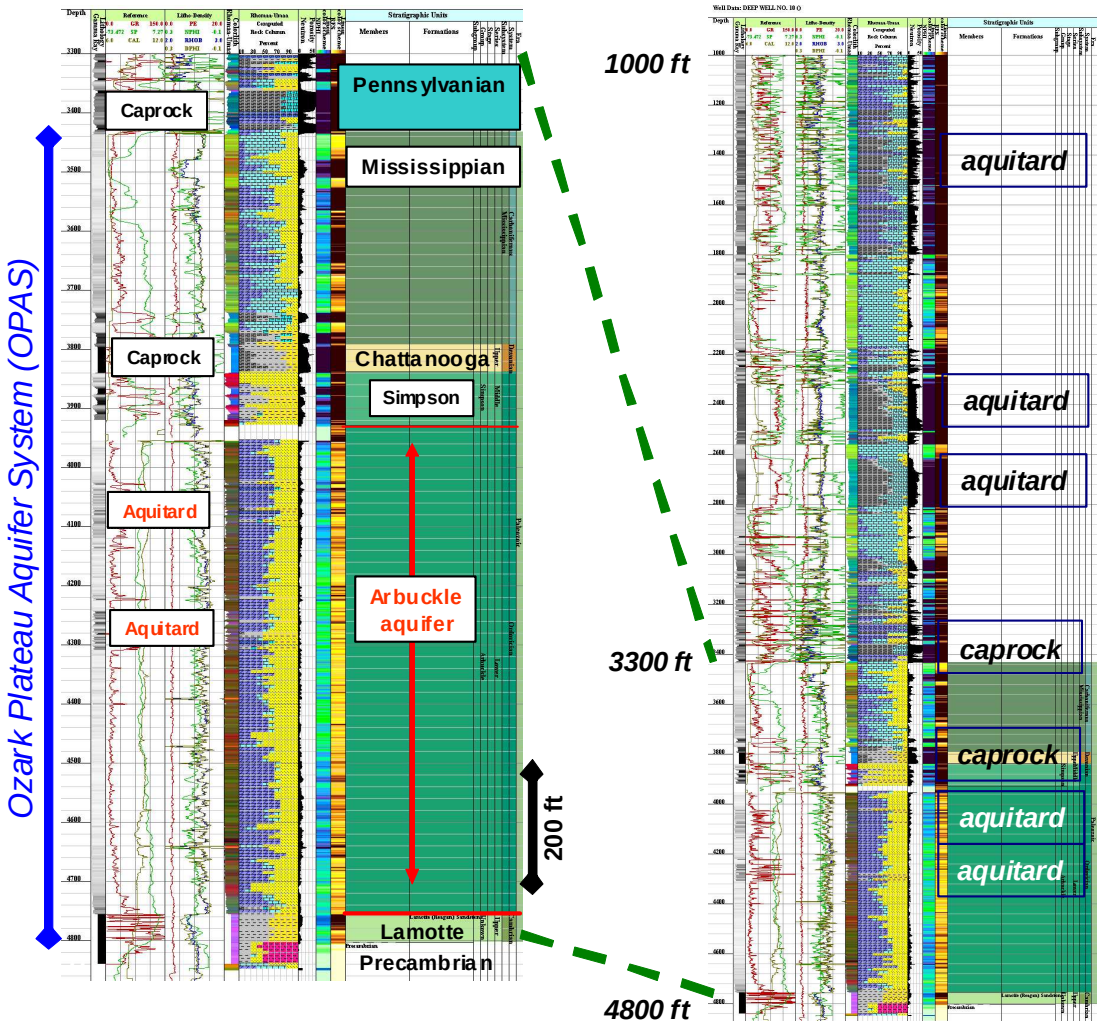

Figure 5. Current version of web-based Well Profile being modified this quarter to obtain additional log analysis suited for establishing flow units. Illustration of a Class I waste injection well in the Arbuckle near Wichita, Kansas.

The *Well & Outcrop Data Collection Profile Plot Applet* is being modified to assist in the Log Analysis (for Subtasks 2.2 and 4.6). The Profile Plot Applet not only plots the Log Data, but the

log data is processed to create color image tracks (**Figure 6**). There are two changes that have been introduced to the existing Applet for this project

1. The well analysis from the Profile Web Applet is being saved as Log ASCII Standard (LAS) Version 3.0 developed by the Canadian Well Logging Society (CWLS), http://www.cwls.org/las_info.php. The Applet also reads the LAS 3.0 File format. The Log ASCII Standard Version 2.0 has been around for many years and holds only the Measured Log Data. This new version allows the user to collect all well data in one file, i.e. Log Data, Formation Tops, Measured Core Data, etc. The Profile Applet was originally designed to collect and save the Well Data as XML, Extensible Markup Language. The Profile Applet generates up to 14 XML Data files as output, which requires a data management system, but the LAS 3.0 simplifies the read/write process for the well data and does not require a complicated data management system. The user can save the file anywhere on their PC. The LAS 3.0 Read Java Class will also read the LAS Version 2.0 Format.
2. The original version of the Profile Plot selected the curves automatically by using a KGS Standard Tool list, which does not account for all possible tool mnemonics. The Profile Plot still tries to map the tool mnemonic to the KGS Standard Tool list, but a dialog was provided that allows the user to manually map the curves to the KGS Standard Tool list so the curves would display on the Profile Plot.
3. PfEFFER (**P**etrofacies **E**valuation of **F**ormations for **E**ngineering **R**eservoirs) in the GEMINI Project (DE-FC26-00BC15310) is being modified and included in the Profile Web Applet to help in the Log Analysis of the Log Data. The PfEFFER Module is focused on interpreting and analyzing reservoir *pore type*. PfEFFER provides procedures for optimal estimation of bulk volume water and water saturation (including irreducible values) to better evaluate potential production, reservoir quality, and heterogeneity.

The Profile Applet Web Site was recently released with the above changes to http://www.kgs.ku.edu/PRS/Ozark/PROFILE. This release 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 Profile plot also reads parses and plots Measured Sections Reports (precise measurements and descriptions of a cross section of an outcrop or road-cuts) that are stored in the KGS Database, this data can not be saved at this time.

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 Profile Web Site is in a hidden URL http://www.kgs.ku.edu/PRS/Ozark/PROFILE while the Applet is being tested.

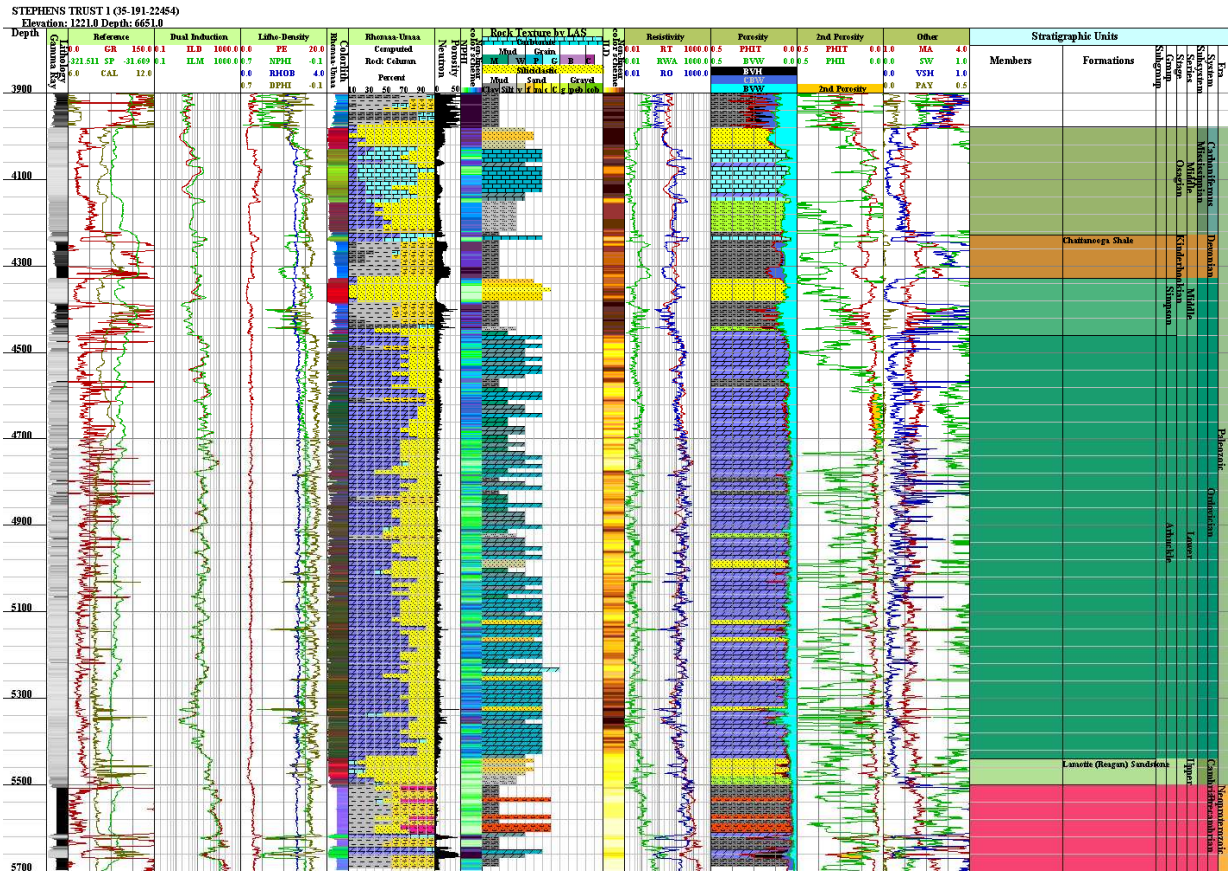

Figure 6. Sample output of the STEPHENS TRUST 1 (API 15-191-22454) Well Log. This analysis displays the log curves as well as the stratigraphic units, color image tracks and general PfEFFER (well log) analysis, i.e. rock composition, rock texture, single FMI-type conductivity and porosity color track as well as the colorlith (color imaging of lithology) track (colorlith assigns three log curves to a red, green and blue color to provide a visual lithology interpretation)

Subtask 2.3 (continued) -- Develop regional correlation framework and integrated geomodel

The Bittersweet team has integrated existing Arbuckle insoluble residue correlations into well data, and created a west to east cross-section through Arbuckle formation, correlating major zones.

Initial maps have also been examined including top of Mississippian, Arbuckle map, and Pre-Cambrian maps and isopachous maps between above horizons. An example of the quality of the stratigraphic tops in the existing database (14,105 wells) for the top of the Arbuckle Group in the regional study area in southern Kansas is shown in **Figure 7**.

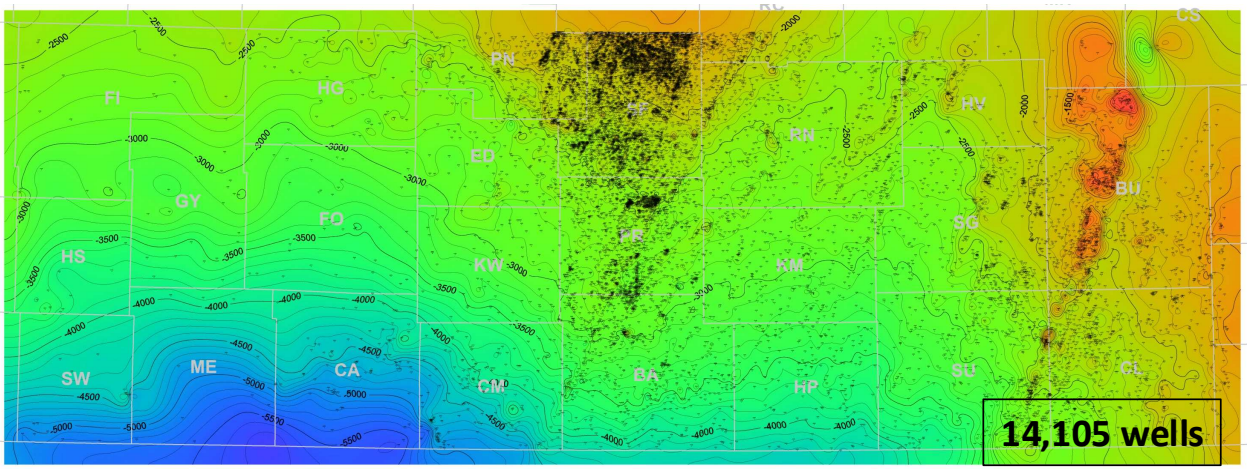

Figure 7. Structure contour map of the top of Arbuckle Group in the regional study area of southern Kansas

Subtask 2.4. Subsurface fluid chemistry and flow regime analysis

Bittersweet team is compiling applicable literature available regarding Arbuckle geochemistry**.** Protocol for determination of regional flow system is being developed. KGS and Bittersweet personnel are collaborating with the USGS Project on the National Oil and Gas Assessment for the Anadarko Basin being conducted by Energy Resources Center in Denver. We have agreed to share data from our projects to help validate interpretations. The USGS study encompasses the entire regional study area of the KGS DOE-CO2 project and adjoining areas of Oklahoma, Texas Panhandle, and southeastern Colorado (**Figure 8**). In addition to evaluating resources by the USGS, they are mapping key stratal units and obtaining property information on rocks and fluids including pressure and salinity that are important in our DOE study. Consistency in flow regimes and understanding structural development from this regional basin perspective will help constrain our interpretations of structural and fluid flow more robust and assist in obtaining more accurate simulation models of carbon sequestration.

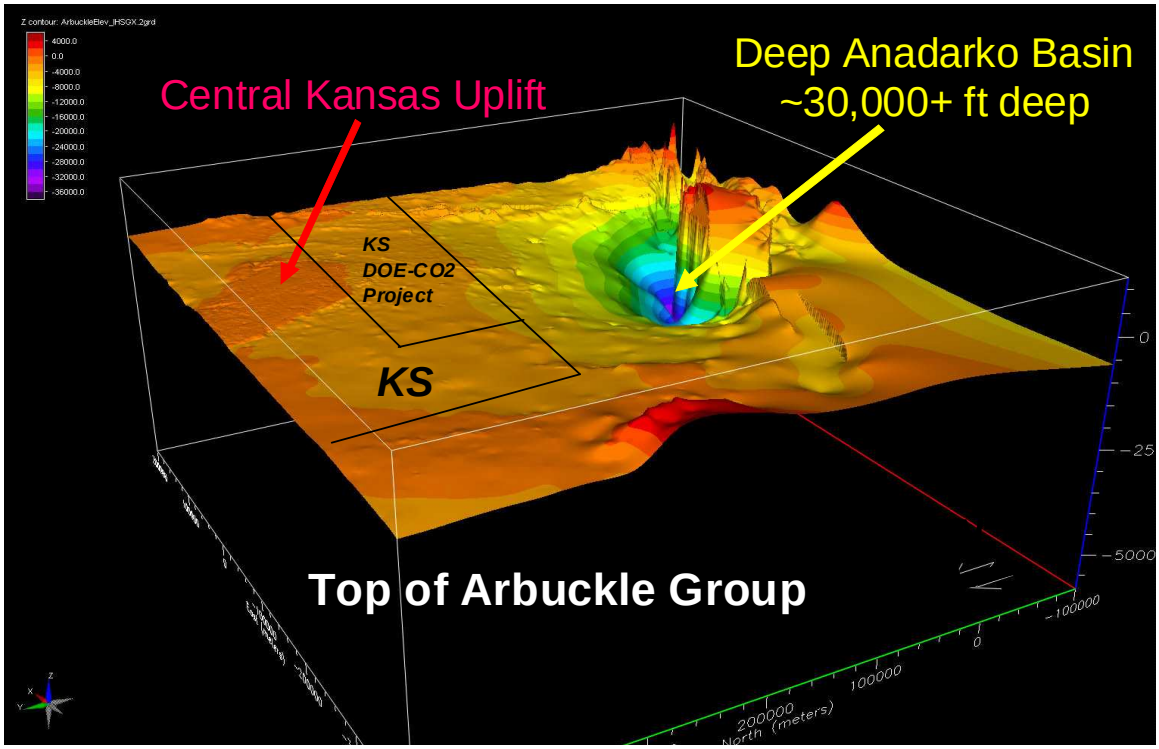

Figure 8. Preliminary 3D structure surface of the top of the Arbuckle Group in the greater Anadarko Basin study area generated by USGS being developed for the National Oil and Gas Assessment Project. Provided with permission of D. Higley. Kansas' DOE-CO2 project is outlined on northern shelf of the Andarko Basin. Collaboration between USGS and KGS will help to constrain interpretations and improve models.

Subtask 2.6. Remote Sensing Analysis for Lineaments

Koger Remote Sensing Analysis began to select optimum ETM scenes (6 total), ordered and downloaded same; mosaic the data with regional and local topographic map to assist with analysis and final output. Existing regional gravity and magnetic data were also obtained from the KGS.

Subtask 3. Geomodel of Mississippian Chat & Arbuckle Group - Wellington field

Second quarter activities at Wellington Field including initiation of the collection of geologic and engineering data (Subtask 3.1), collection of 3D seismic data (Subtask 3.2), collection of high resolution gravity and magnetic data (Subtask 3.4), and initial interpretation of seismic, gravity, and magnetic data.

Subtask 3.1. Collect geologic and engineering data at Wellington Field

The KGS has worked closely with BEREXCO, the operators of Wellington Field and project subcontractor, to identify well data and scan well logs for digitizing into LAS format. About half of the wells have been digitized thus far. Digitizing logs and entering other well data will be completed early in the second quarter so a well based geomodel can be developed and integrated with the new seismic data. In addition. well logs from Anson and Bates fields to the north have been scanned in the area of the 3D seismic survey donated by Noble Energy Corporation (**Figure 10**). Initial mapping of Wellington Field confirms known the shallow structural closure and updip truncation of the Mississippian reservoir that defines the field. Anson and Bates fields to the north lie on a separate shallow structural closure. Well distribution at Anson-Bates is less regular suggesting greater heterogeneity. Seismic 3D survey donated by Noble Energy from Anson-Bates indicates clearly defined northeast trending graben and horst fault blocks, which may explain the irregularities in well-based mapped structure and distribution of producing wells. This is in contrast to Wellington and differences will be investigated in this study.

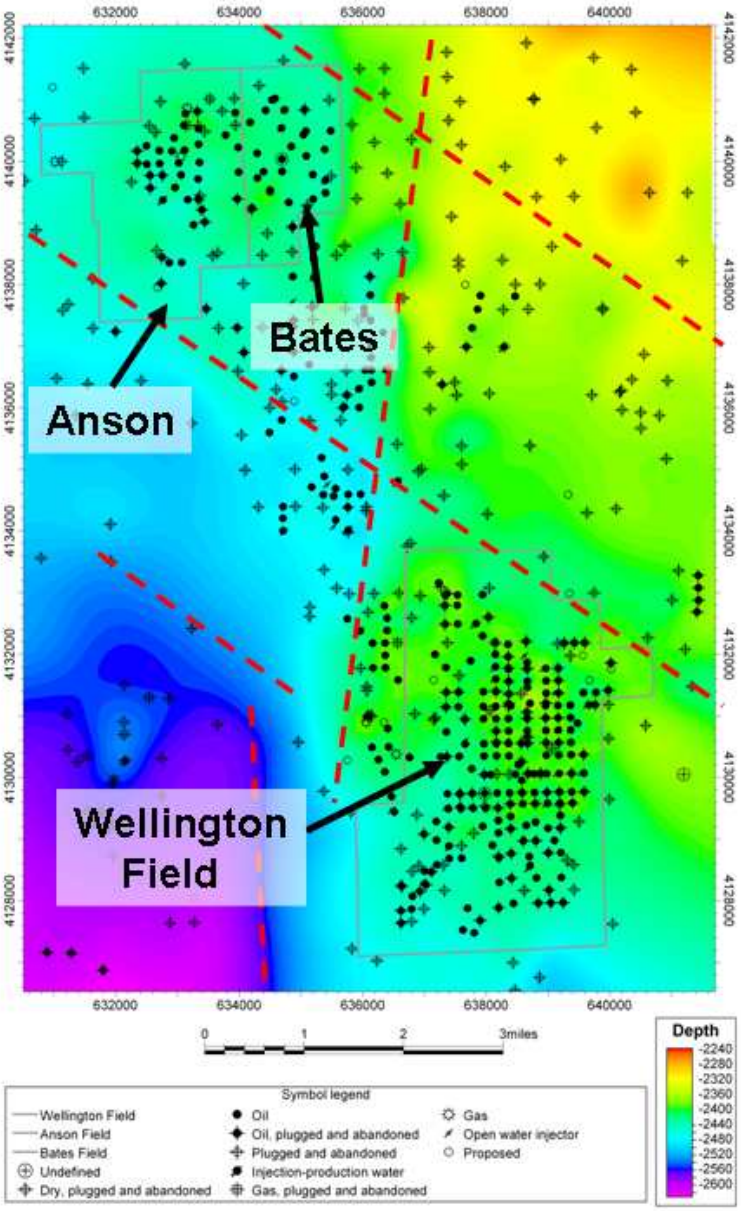

Figure 10. Structure map on the top of the Mississippian chert/dolomite petroleum reservoir in Wellington Field and Anson-Bates fields to the north. Red dashed lines are possible structural lineaments.

Subtask 3.2. Collection of seismic data – Paragon Geophysical Services, Inc. began seismic data collection on March 4th and finished after some weather delays on April 4th. The outlines of the donated 3D seismic survey at Anson Bates and the newly acquired Wellington Unit 3D are shown in **Figure 11**. The total coverage of the 3D surveys is about 20 square miles. Adjustments were made to the Wellington 3D to ensure overlap and extension to northeast to have fold over the possible structural trap of the field and the structural lineament shown in **Figure 10**.

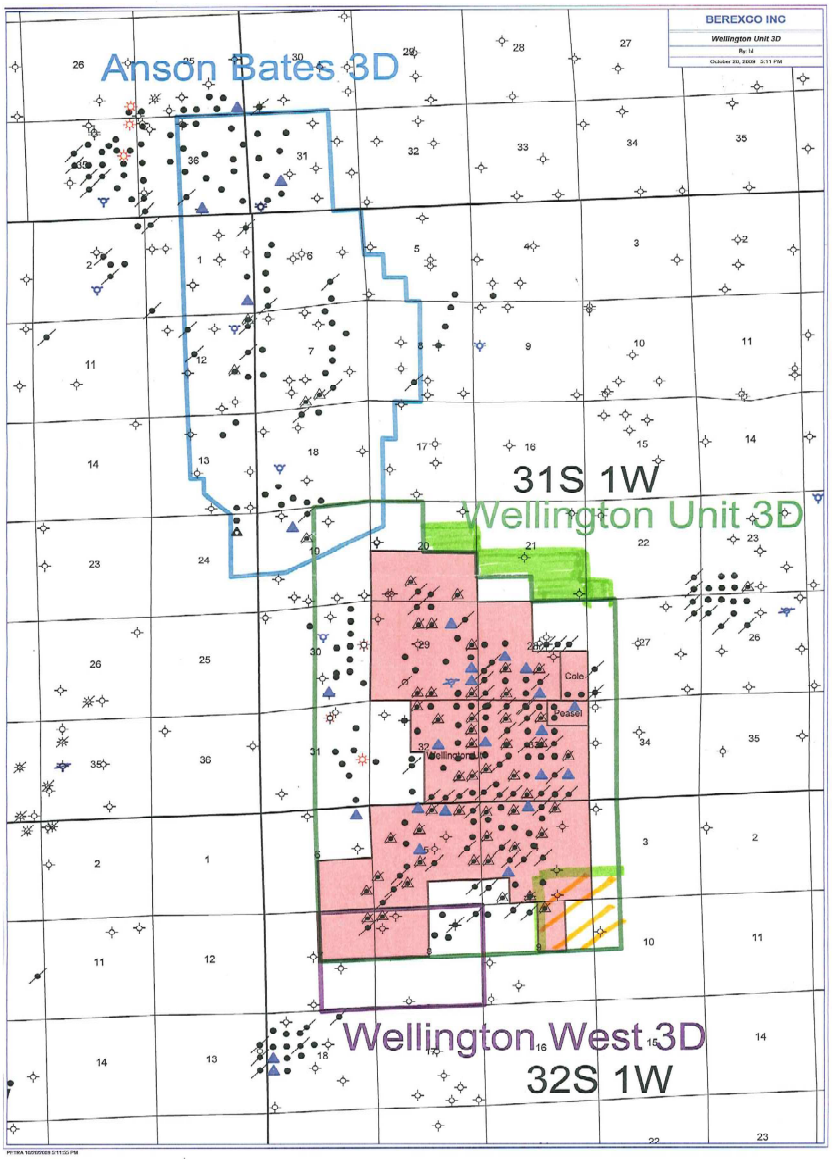

Figure 11. Outlines of 3D seismic surveys (blue line = Anson-Bates; green line = Wellington) with late adjustments to Wellington 3D in green and yellow filled areas to cover field's structural/stratigraphic trap.

The acquisition pattern of the Wellington 3D seismic survey is shown in **Figure 12**. The staggered brick pattern of shot points is commonly used in the petroleum industry. The fold at 5000 ft in the inner portion of the shoot is around 60. The high fold is also used to aid making static corrections due to irregularities of the shallow near surface velocities. The geophones used are sophisticated solid state three-component oriented receivers used to collect both p-wave and converted shear wave information. A long 40 second sweep at each "shot point" of the vibroseis vehicle also spanned a large frequency range, from 6 to 150 hertz/cycles per second. The data quality has been deemed excellent.

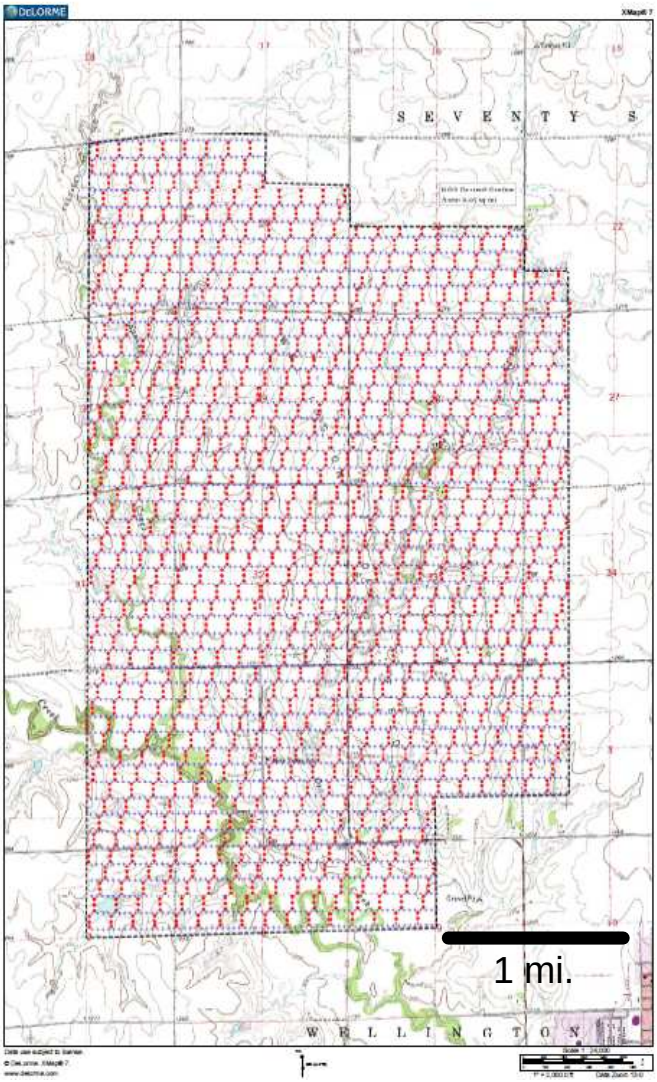

Figure 12. Acquisition pattern of 3D seismic at Wellington Field with "shot points" in red overlain on a topographic map. Ground conditions were excellent for acquisition and data quality has been deemed to be excellent.

Subtask 3.4. Collect Gravity and Magnetic Data
High resolution gravity data was collected at seismic shot points before the Wellington 3D acquisition. High resolution magnetic data acquisition was to immediately follow the gravity data gathering, but due to the failure of both a survey magnetometer and a base instrument, the magnetic acquisition is postponed until probably until early June.

Subtask 4.11. Geochemical analysis of water samples
Kansas State University has a subcontract for geochemical analysis. CoPI , Dr Datta is currently in the phase of establishing his water-modelling laboratory and assessing the experiments that will be run in October 2010 on the water samples procured during drilling. Dr Datta has already installed, from funds available elsewhere (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 summer for detailed chemical analysis (whenever dilution will be required). Dr Datta is also in the process of hiring a student (Masters Student to work for this project) and on his final agreement phase. Dr Datta anticipates full blown lab with equipments over the summer and early Fall, to be able to conduct these experiments and later geochemical modeling. Dr Datta has also visited the field site in Wellington with PIs Watney and Bhattacharyya in April 2010.

Task 9. Characterize leakage pathways - Risk assessment area (with KGS)
The Bittersweet Energy team is involved in Subtask 9.1 to collect reservoir characterization data from external resources. This work began with identification of 90 Super Type Wells with modern day log suites. Thirty three well will be purchased from the Kansas Geological Society to complete the current version of the Super Type Well dataset.

Subtask 9.2. Map fracture-fault network
Bittersweet Energy is in the early stages of structural mapping and has been experimenting with 3rd order structural residual maps as a method to identify possible compartments created by faults.

Subtask 9.3. Verify seal continuity and integrity
Bittersweet Energy has begun compiling available literature data and historic regulations regarding standard practices. They are also assembling and reviewing literature data regarding well integrity.

Subtask 9.4. Inventory well status
Bittersweet Energy is making plans to develop a well status database and create a review protocol.

Subtask 9.5. Gather expert advice on well integrity
Bittersweet Energy is compiling list of applicable literature regarding well integrity. They also have extensive experience in design of Class I injection wells that will be extremely useful in establishing best means to evaluate well integrity.

Task 13. Regional Source-sink relationship
Bittersweet Energy is compiling a list of major CO2 point sources in Kansas as part of Subtask 13.1.

Task 14. Technology Transfer
The provisional project website has been established -- www.kgs.ku.edu/PRS/Ozark. The site will carry data, interpretations, and updates as the project progresses. The PIs made an invited presentation to the Kansas House Energy and Utilities Committee in January, presented at the DOE Kickoff Meeting in Pittsburg in February, and ran a field trip to Wellington Field to observe the seismic acquisition.

Major Finding and Conclusions

Project is just underway and major findings and conclusions will be forthcoming.

Key Outcomes and Other Achievements

Milestone 1.1 to hire consultants for the OPAS modeling was accomplished early in the second quarter. The 20,000 square mile regional dataset includes a large 95,000 well inventory. This dataset has been pared down to 14,105 Arbuckle tests and 1,417 Type Logs that will be the initial focus of the regional study.

There is a considerable amount of old sample descriptions in the KGS archives including insoluble residues. Images of this vital information are being depth-registered and used with modern mapping and cross section software.

Progress is being made to enhance a Java well profile tool to expedite analysis and imaging of well logs interactively via a web interface. Moreover, programming is being thought out to integrate these analyses with digital versions of the sample descriptions to refine stratigraphic correlations and define and quantify flow units, which is the foundation of quantitative Geomodeling and vital to the success of the project.

The 11 square mile 3D multicomponent seismic survey has been acquired at Wellington Field and the geomodel development will begin shortly as soon as the well logs have been digitized.

COST STATUS

Cost Plan/Status

Costs were incurred in Tasks 2 and 3. While KGS spent more than planned in Task 1 (+2,746.83) due to faster start on subtasks. Spending was under projections (-$245,667.44) in Subtask 3.2 due to delays in collection of 3D seismic because of extended weather delays not suitable for good quality seismic acquisition such as high winds or potential to damage ground due to heavy snow and rain. Seismic acquisition was completed on April 10, two weeks into 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		
Non-Federal Shale				
Total Planned (Federal and Non-Federal)	$1,273.10	$330,271.41		
Cumulative Baseline Cost	$1,273.10	$330,271.41		
Actual Incurred Costs				
Federal Share	$4,019.93	$84,603.97		
Non-Federal Share				
Total Incurred Costs-Quarterly (Federal and Non-Federal)	$4,019.93	$84,603.97		
Cumulative Incurred Costs	$4,019.93	$84,603.97		
Variance				
Federal Share	$2,746.83	-$245,667.44		
Non-Federal Shale				
Total Variance-Quarterly Federal and Non-Federal)	$2,746.83	-$245,667.44		
Cumulative Variance	**$2,746.83**	**-$245,667.44**		

SCHEDULE/MILESTONE STATUS

Project is on schedule with the exception of a two-week delay in the completion of seismic acquisition due to several extended weather delays. We are considering moving forward Subtask 4.15 to collect 2D shear wave seismic survey schedule to begin in August to approximately June 1st if initial geomodel can be developed and interpreted (Subtask 3.6) in May, a month ahead of schedule to select approximate drilling locations. The two 2D shear wave surveys will be placed along the proposed well locations before Well #1 is drilled (Subtask 4.3), currently scheduled to begin in July. Processed data from these 2D shear lines (Subtask 4.16), currently scheduled for completion in November 2010, would be completed in October or sooner. This processed data from the 2D lines will be used to re-process the 3D multicomponent seismic volume so that the shear wave information can be maximized and interpreted correctly. All of this information will be factored in to refining the locations of the wells to be drilled. If this is approved by our program manager, Well #1 would not be drilled until approximately October compared to currently planned start in June. The 2D shear survey would then move up from a currently planned September start to June.

MILESTONE STATUS REPORT

			Project Duration -- Starts: 10/1/09 Ends: 9/30/12					Planned	Planned	Actual	Actual	
	Project Milestone Description		Project Year (PY) 1					Start	End	Start	End	Comments
Task/Subtask	Title	Name	Q1	Q2	Q3	Q4		Date:	Date:	Date:	Date:	
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			