

Highlights

In November, we celebrated 141 years of service to the Oklahoma Geological Survey (OGS) by members of staff retiring in 2016 – Richard Andrews, Gene Kullman, Sue Palmer, Tommy Sanders, Michelle Summers, and Neil Suneson.

Oklahoma Geology Notes, last published in Winter 2014, returned with Neil Suneson's article (below) on the stratigraphy of the Ouachita Mountains.

The OGS recorded 321 earthquakes in November. Year-to-date total for all earthquakes = 4,008, for magnitude 2.5 and greater (M2.5+) = 2,019, for M3.0+ = 596, for M3.5+ = 169, for m4.0+ = 15, and for M5.0+ = 3.

OGS authors published in November include:

Boak J. and Kleinberg R., 2016, Shale- and Mudstone-Hosted Oil and Gas in *M. R. Riazi, ed., ASTM Manual 73: Exploration and Production of Petroleum and Natural Gas*, American Society for Testing Materials, p. 373-394

Crain, K. and G. R. Keller 3D Gravity Modeling of Osage County, Oklahoma, with 3D Geology Interpretation, Oklahoma Geological Survey Open File Report 5-2016. 1 Plate. 2016.

Gilbert, M.C., R.P. Philp, and **B.J. Cardott**, 2016, Petroleum migration through basement in southwest Oklahoma, U.S.A.: Oklahoma City Geological Society, *Shale Shaker*, v. 67, p. 232-249.

Suneson, N., 2016, Stratigraphic Nomenclature of the Ouachita Mountains in Oklahoma: Formal, Informal, Obsolete, and Incorrect, or The Good, the Bad, and the Ugly, *Oklahoma Geology Notes*, v 75, No. 1, p. 5-35.

Jeremy Boak, Director

During November, the Director attended meetings of the Secretary of Energy and Environment's Directors, the Governor's Coordinating Council on Seismicity, the Oklahoma Corporation Commission (OCC) and the Oklahoma Independent Petroleum Association (OIPA) working group on seismicity, along with various OGS team members. He also met with staff of the OGS at Sarkeys Energy Center and the Oklahoma Petroleum Information Center (OPIC), and met with the OGS Program Managers three times.

Boak worked on organizational issues, three Open Records requests, and on the final report for the Research Partnership to Secure Energy for America (RPSEA) Project on induced seismicity. He and David Brown met with Dean Stice regarding data collections and management, networking issues and a proposed Center for Induced Seismicity. Boak attended a meeting between OGS technical staff and Carlos Aiken of the University of Texas at Dallas (UTD) on imaging of rock-falls and other geologic features.

The Director participated in a meeting and two interviews of the Environmental Leadership Search Committee being conducted by Kelvin Droegemeier, Vice President for Research. He also participated in the Ph. D. examination for Tengfei Wu.

Dr. Boak reviewed final galley proofs of his chapter titled *Geochemistry of the Green River Formation, Piceance Creek Basin, Colorado* in an upcoming book on Rocky Mountain source rocks. *ASTM Manual 73: Exploration and Production of Petroleum and Natural Gas*, including the Chapter Shale- and Mudstone-Hosted Oil and Gas by Jeremy Boak and Robert Kleinberg, was published in November.

Dr. Boak made presentations on Oklahoma seismic activity to the Norman Lions Club, the University of Tulsa Geology Department, the Mewbourne College Board of Visitors, the Cleveland County Republican Women's Club, a Sam Noble Museum brownbag lunch group, and the Del City Kiwanis Club. He also handled two days of press phone calls and interviews regarding the November 6th M5.0 Cushing earthquake, as well as a variety of other press requests. He joined Ted Satterfield and Jim Anderson at the Oklahoma City Oklahoman's first Academic Excellence Luncheon thanking the Oklahoma Geological Survey (OGS) for preparing and sponsoring this year's Oklahoma Rocks insert to the Oklahoman.

Julie Chang, Geological Program Manager

Julie Chang spent much of November working with Stephen Holloway on improving our website. We have added new sections to the General Interest section on Meteorites/Impact Structures, Petrified Wood, and Rose Rocks. We have been working on a Hazard section under General Interest that will include Karst, Mass Wasting, Radon, and Abandoned Mines, in addition to linking to the Earthquake page. Other General Interest sections we have been working on include State Parks, Nature Conservancy Preserves, Dinosaurs/ Fossils, and the Tri-State Mining District (Picher/Tar Creek). Julie has been working to ensure new publications from OGS staff are posted onto our website in a timely manner, so the public can see what we have been doing. Input on other improvements to the website is sought.

Chang attended meetings with the Program Managers, the Oklahoma Dept. of Mines, Carlos Aiken of the University of Texas at Dallas, and the OGS Director's Staff meeting, as well as meetings with individual personnel. She answered inquiries on geologic and digital geologic mapping, and worked to organize OGS Brown Bag Discussions. She restarted work on the Helium project and plans to publish it as a Mineral Report in the future.

Jock Campbell

Tectonic map of Oklahoma: Current activity has been concerned with identifying and mapping faults that break basement in the Arkoma basin. Work remaining to be done in the eastern third of the state includes:

- Refining and revising mapping of surface (including near-surface) faults in the basin.
- Looking at Chevron seismic data acquired several years ago for the Ouachita uplift to determine position of a deep thrust fault that breaks basement.

- Moving mapping from a working map to compilation map for the eastern third of Oklahoma. This approach was driven by the complexity of the deep Arkoma basin, for which there are local spatial considerations relative to shallow structure.

Campbell provided references to three Masters theses that identify wells that cut reverse faults to Jacob Walter. He also discussed a review of the status and plans for the Tectonic map with the Director. Future activity on the Tectonic map would logically include contours on top of basement. Campbell has made such a map for the state where sufficient well data exist; however, in the deep Anadarko and Arkoma basins well data on basement are sparse to non-existent. There are other ways to map basement in the deep basins.

Brian Cardott - Coal Geologist and Organic Petrologist

Cardott's article, co-authored with colleagues from the OU School of Geology and Geophysics was published in November 2016:

Gilbert, M.C., R.P. Philp, and B.J. Cardott, 2016, Petroleum migration through basement in southwest Oklahoma, U.S.A.: Oklahoma City Geological Society, *Shale Shaker*, v. 67, p. 232-249.

The following article was submitted in November 2016 and accepted for publication in January 2017 in the *International Journal of Coal Geology*:

Pickel, W., J. Kus, D. Flores, S. Kalaitzidis, K. Christanis, B.J. Cardott, M. Misz-Kennan, S. Rodrigues, A. Hentschel, M. Hamor-Vidor, P. Crosdale, and N. Wagner, 2017, Classification of liptinite — ICCP System 1994: *International Journal of Coal Geology*, v. 169, p. 40-61.

Based on presentations in September and October, Brian is writing an article for the proceedings volume of the joint TSOP-ICCP-AASP meeting on *Classification and nanoporosity of macerals in coal by scanning electron microscopy* with Mark Curtis (OU School of Petroleum and Geological Engineering). As part of the USGS coal grant, Cardott added well records to the OGS Gas Shale Completions database. As chairman of the AAPG Energy Minerals Division Coalbed Methane Committee, Brian worked on the Mid-Year Leadership Meeting report set for December 7. As Vice Chair, Government of the AAPG EMD Shale Gas and Liquids Committee, he worked on the Oklahoma shale gas/tight oil section for the Mid-Year report.

Stacey Evans

This month Evans continued work on her play-based study of the Caney Shale. She compiled a spreadsheet of wells in the Ardmore Basin and Arkoma Basin that were completed in the Caney. This effort was complicated by differences in nomenclature and top picks; many wells identified as completed in the Caney turned out to be perforated in overlying or underlying strata. Other wells were identified only as completed in the Mississippian. Creating a comprehensive list of Caney wells required checking every well not already identified as being in the

Caney. Because IHSPetra does not usually contain full details of wells, such as Initial Production (IP) test results and completion details, it was necessary to look up 1002A forms submitted to the OCC. In December, Stacey will use the data collected to write the Production History section of the Caney study. A spreadsheet of the data will be available with the study. Stacey contacted the Caney geologist at XTO to inquire about getting cuttings/completion details on a Caney horizontal well recently completed in Love County.

For the Arbuckle/Basement project, Evans searched for additional cores or cuttings from the Arbuckle or basement, and began analysis of two samples of basement rock using X-Ray Computed Tomography (XRCT). This method permits the analyst to adjust the opacity of mineral grains of different densities in the sample, to characterize porosity and permeability in three dimensions throughout a sample. Stacey also collected samples from dolomite pipes located in the Arbuckle Group at Bally Mountain near the Slick Hills. In December, thin sections will be ordered from some of these samples. The magnetometer is finally working again, so the lab will begin doing pale magnetic analyses next year.

Stanley Krukowski – Industrial Minerals Geologist

Two major projects were begun in November: a spreadsheet of mining operations in Oklahoma and a synopsis of industrial minerals produced in the State for the OGS web page. Merging data from Oklahoma Department of Mines production and permitting spreadsheets consumed much of November. The first approach was to arrange the spreadsheet by mineral or commodity, but Stan later settled on a geographic approach, listing operations by county. A meeting with ODM on November 16 helped to clarify some issues. The first mineral described for the OGS web page is aggregate, which represent the largest contribution to mineral value of mined commodities outside the energy sector. The Oklahoma Aggregates Association (OKAA) and Dolese Bros supplied imagery. The second commodity will be iodine. IOCHEM, an Oklahoma iodine producer, granted permission to use images from its web site to enhance the OGS iodine piece.

A paper entitled *Geology and Industrial Minerals of Oklahoma*, coauthored with Dr. Kenneth S. Johnson was submitted to the Illinois State Geological Survey, publisher of the 52nd Annual Forum on the Geology of Industrial Minerals. As a board member of the Forum on the Geology of Industrial Minerals, Inc., Stan helped arrange its annual forum with the Society of Economic Geologists (SEG) in Colorado Springs for September 2017. The USGS invited Krukowski to contribute Oklahoma minerals activity to the *Minerals Yearbook* for the years 2014 and 2015. On November 11, Krukowski conducted a dry run for the OKAA annual meeting field trip to the Tishomingo area. The OGS has led OKAA field trips since 2004. Public service calls included queries about copper, metals production, and geologic maps. Dr. Bob Neman invited Krukowski to present a seminar-style presentation in December to junior high and high school students in Ada on careers in the mining industry.

Brittany Pritchett

In November Brittany worked on finishing up her Guide to OGS Guidebooks publication. She has been researching and picking out top Oklahoma outcrops and has begun taking photos of the outcrops for the publication. She is also going through older photos taken by OGS researchers for possible inclusion in the publication.

Early in November Brittany and Ella met with Carlos Aiken from UT Dallas in the Arbuckle Mountains. There, Carlos showed the work his group is doing with LIDAR and photogrammetry in Oklahoma. Brittany then set up a meeting between Carlos's team and some of the geology, database, and GIS experts here at the OGS. We are investigating the possibility of making their 3D LIDAR/photogrammetry data from the Arbuckle Mountains available to the public through the OGS and working on future projects together.

GIS day was held November 17th in the OU Memorial Union. Brittany volunteered at the OGS booth with David Brown, Jim Anderson, and Russell Standridge. David and Brittany also had a poster at the booth showcasing their 3D GIS work on OK earthquakes.

Along with co-authors Chip Legett, Megan Elwood Madden, Charity Phillips-Lander and Andrew Elwood Madden, Brittany submitted a manuscript entitled *Jarosite dissolution rates in perchlorate brine* to the journal *Icarus*. She is also working on updating and editing the Simpson Group Guidebook. Brittany has also taken over for Neil Suneson and is now collecting the monthly publications from various state rock and mineral clubs for the OU Geology library.

Tom Stanley – STATEMAP Program Coordinator

The first part of November, 2016 was spent putting the finishing touches on the most current issue of Oklahoma Rocks, a newsletter project published by the Daily Oklahoman as an educational supplement for kindergarten through twelfth grade pupils. The current issue deals specifically with Oklahoma fossils (types and collecting locations), and how to identify fossils the layperson may collect.

The latest STATEMAP proposal was completed and submitted well ahead of time. Funds in excess of \$100,000 were requested for two proposed mapping projects: 1) 1:24,000-scale mapping of the Miami NW quad, related to the Tar Creek Superfund site, and 2) 1:100,000-scale mapping of the Shawnee 1° sheet in central Oklahoma.

Much of the remaining month was spent writing a paper with Dr. Neil Suneson, dealing with the timing and duration of the various structural elements of the Ouachita-Wichita orogeny. Stanley's part of the paper deals mainly with field observations, with some literature review, in and around the Arbuckle Mountains, as they relate to the Arbuckle orogenic element. The paper will be published in either the Shale Shaker or in Oklahoma Geology Notes.

Tom also initiated a reevaluation and editing of former STATEMAP 1° geology, which includes compiling and edge matching with more recent mapping endeavors. The first goal is to put together a series of 2° geology maps, much like the Hydrologic Atlases (although with better base topography) that will eventually be incorporated into a new 1:500,000 scale map of the state of Oklahoma. Much of this work is dependent on available time for cartography to compile our 1° sheets.

Future Projects: Field work on the FY16 STATEMAP project should begin in early December, and continue into early spring, including reconnaissance mapping of thirty-two 7.5' quadrangles that comprise the Bristow 1° sheet. Stanley plans to begin a synthesis and compendium, using both field observations and available literature, on the Permian lithostratigraphy of western Oklahoma, based on observations made through mapping the lithologic characteristics of the different Permian-aged units in the state. This synthesis will include the nature of contacts, variations of internal lithologic character and textures, and a summary of contained fossil biota to aid in chronostratigraphy of the Permian. This will be published by the OGS and will adhere to the Code of Stratigraphic Code of Nomenclature as a standard for subsequent investigators into the Permian of Oklahoma.

Neil Suneson

Neil is continuing work on **Roadside Geology of Oklahoma** for Mountain Press Publishing Company, with a first draft anticipated in the second half of 2017. Suneson is working with Russell Standridge developing ~50 geologic maps for the book. Neil completed field work for road logs of US 64 between Tonkawa and Guymon, OK 325/US 412 between Kenton and I-35, and I-40 between Oklahoma City and the Arkansas state line. Suneson also continued work with Lynn Soreghan (Conoco-Phillips School of Geology and Geophysics – CPSGG) on quadrangles in Unaweep Canyon area, Colorado. These maps are the result of Tad Eccles' Masters thesis and will be submitted for publication by the Colorado Geological Survey. They are anticipated to be complete shortly.

Neil continues to work with Richie Tarver on collection and description of Oklahoma cherts to serve as reference material for archaeologists. First collection was from known sources of archaeological material in the Florence A and Wrenford limestones in northernmost Kay County. This project will continue with careful hand-specimen description, and appropriate chemical analyses that will enable archaeologists to determine sources (quarries) of lithic materials found at prehistoric sites.

A paper in preparation (*The Age of Oklahoma's Mountain Ranges*), co-authored with Tom Stanley, will review the age of deformation and uplift of the Ouachita, Arbuckle, and Wichita Mountains. It will be published in Oklahoma Geology Notes. Neil presented his talk on nuclear fracturing to the Oklahoma City Desk and Derrick Club lunch meeting. This talk has been presented at least a dozen times. Neil's paper on stratigraphic nomenclature of Ouachita Mountains and adjacent Arkoma Basin was published in Oklahoma Geology Notes.

Jacob Walter, Geophysical Program Manager & State Seismologist

In the last month, Jacob has spent considerable time understanding the capabilities and limitations of the current seismological monitoring efforts at OGS. The seismology team is hoping to revamp some of the monitoring software and he has coordinated many phone calls to ascertain some of the relevant details. In addition to this, he initiated collaborations with OU faculty and OGS researchers where we will pursue external funding in the coming months.

Walter attended and presented at the OIPA working group on induced seismicity, the Governor's Coordinating Council on Seismicity meeting, and engaged in several media interviews over the phone and in-person. He plans to co-organize the Seismological Society of America Eastern Section meeting in Norman or Oklahoma City in October 2017, and has begun planning that meeting, which will be a great opportunity to showcase OU/OGS induced seismicity research efforts. The OGS seismic team continues to respond to seismic events routinely and for larger events they analyze the events on an on-call basis – this included events during Friday after Thanksgiving and early morning weekend events.

Jefferson Chang – Seismology Network Manager

Chang is helping Jacob Walter get up to speed on the seismic team and their protocols. He has kept the seismic network and servers healthy. He also has helped Kevin Crain publish OGS work. Jefferson continues to Process seismic surveys across the Meers Fault. He has answered several external inquiries, including telephone and email. Chang has generated maps, as well as conducting interviews with media, interacting with other state agencies and research institutions. He has also acquired seismic reflection data from industry donors. He also acquired a Digital Object Identifier (DOI) for the Oklahoma Seismic Network ([doi:10.7914/SN/OK](https://doi.org/10.7914/SN/OK)) from the Federation of Digital Seismograph Networks (FDSN).

Significant accomplishments: Chang and the seismic team installed eight permanent GPS stations in the Pawnee area. They also installed seven temporary seismic stations in the South Central Oklahoma Oil Play (SCOOP), and relocated one permanent seismic station. Jefferson also aided in getting hydrologic measurements telemetered for the OIPA project. Jefferson prepared the Summary event fact sheet for the M5.0 Cushing event. He is the lead coordinator for a late-breaking session on the Pawnee M5.8 earthquake at the American Geophysical Union (AGU) annual meeting.

Issues: Keokuk real time acquisition software stopped working. Jefferson reconfigured data buffering parameters and disk usage, providing a temporary fix. The long-term solution is to get a new system with new software, details of which are still being discussed. The Wichita server was reportedly compromised, and was communicating with a known malware server, according to Mewbourne College Information Technology(IT) Security. After a week of working on this issue, it is believed to have been resolved. Security setting for

our seismic servers are tighter, and this seems to have lessened server down-time. 60+ cellular modems used in seismic telemetry were found to be compromised with hundreds of unauthorized users. There are still ~12 modems that need have their security settings updated. These remnant modems need to be accessed in-person to be fixed. Seismic data intermittently exhibit odd irregular biased spikey noise. We are working with PASSCAL and other institutions to troubleshoot the problem.

Kevin Crain

Kevin continued constructing a multi-parametric three dimensional (3D) geologic and petrophysical model of central Oklahoma. This effort includes:

1. Merging the Tulsa Geological Society SP-3 based layers to geologic volumes initially for gravity modeling.
2. Attempting to interest production companies in donating petrophysical data and two-dimensional (2D) seismic reflection data to improve the geologic and petrophysical knowledge the Oklahoma Geology Survey about Oklahoma.

Crain was the invited speaker at the 2016 November dinner meeting of the Geophysical Society of Houston, Potential Fields Interest Group. He prepared the talk, presented a dry run of the presentation to OGS personnel, revised the presentation, and traveled to Houston to present the material.

Crain is preparing for gravity data acquisitions in December and January to augment the undersampled public domain Panamerican Center Environmental Studies (PACES) gravity data. This effort includes equipment and map operations preparations, and training in the field and office operations of the Topcon survey systems. Kevin initiated interaction with The University of Oklahoma contracts department to advance the cooperative agreement documents between the United States Geological Survey (USGS) and the OGS to acquire high-resolution Airborne magnetic data in Oklahoma.

Field operations are planned during the months of December and January to acquire land gravity data in the region of the Woodward and Galena Township Fault earthquake clusters. In addition, Crain will continue refinement of the multi-parameter 3D sedimentary geologic model for gravity modeling and additional geological and geophysical interpretations.

OGS published Kevin's paper on Osage County as an Open File report:

Crain, K. and G. R. Keller 3D Gravity Modeling of Osage County, Oklahoma, with 3D Geology Interpretation, Oklahoma Geological Survey Open File Report 5-2016. 1 Plate. 2016.

Kyle Murray, Water Resources Program Manager

Research Program & Project Development: Kyle met with the OIPA seismic working group and presented a pressure monitoring project update. He discussed collaborative papers & proposals with Bridget Scanlon at the Texas Bu-

reau of Economic Geology (BEG). Murray also conducted field work, including fluid level measurements at prospective wells for the OIPA project. He discussed the industrial water supply well (Antlers Aquifer) project with the prospective Sponsor. He also met with the Central Oklahoma Master Conservancy District (COMCD) Board president regarding progress on the Lake Thunderbird project and scope addition, and with the Tank Vault collaborators regarding telemetry and access to a new well for the OIPA project. Murray also met with City of Bartlesville personnel to discuss a project proposal for a study of the Bartlesville water system

College, University, and External Collaboration and Coordination: He attended meetings of the Aquifer Storage and Recovery (ASR) Working Group at the Department of Environmental Quality (DEQ), the Coordinating Council on Seismicity, and the Water for 2060: Produced Water Working Group (PWWG) meeting at the Oklahoma Water Resources Board (OWRB). He also led a meeting with OU faculty researchers for Task 4 projects funded by Governor's Emergency Funds.

Issues: Concern about management and salary support for some research staff, and about oversaturation with talks and presentations, and the effect on research productivity.

Presentations:

- Oklahoma City, OK: Oklahoma Produced Water Panel Discussion hosted by Baker Hughes.
- Oklahoma City, OK: The Reality of Earthquakes – Municipal Infrastructure Workshop hosted by Freese and Nichols.
- Glenpool, OK: Natural Gas & Energy Association of Oklahoma
- Bartlesville, OK: Petroleum Environmental Research Forum (PERF)

Student Research Directions:

- Paula Perilla: fluid/brine compressibility as a function of depth/temp/ salinity
- Marlana McConville: compiling OCC volume reductions and 2016 SWD volumes
- Ashley Horton: coordinating with CEES faculty/students to streamline COMCD project analytical

Anticipated Events, Accomplishments:

- Presentation to the National Academies panel on induced seismicity
- Discussion of proposal for industrial water supply well in Antlers Aquifer
- Deployment of instrumentation in two more wells for OIPA project
- Attendance, presentation at, and co-convening of session at AGU
- Publication of Open-File Report on Arbuckle Core Characterization
- Publication of Open-File Report for Monthly SWD volumes through 2015

Jordan Williams

Jordan submitted a second draft of the Open-File Report of the regional characterization of the Arbuckle Group to Kyle Murray for final revisions prior to pub-

lication. Collaboration between Dr. Carl Sondergeld (CPSGG) and the Water Resources Group is in progress to examine petrophysical properties of the Arbuckle. The focus is to measure static and dynamic compressibility as a function of effective stress in the short term. The long-term goals are to measure effective stress, velocity as a function of pressure, rock type, mineralogy, porosity, and permeability, and to merge these data with the compressibility measurements previously completed. The lab analyzed values should validate existing field measurements. Jordan participated in the Governor's Emergency Funds Task 4 team meeting to discuss the progress of the Arbuckle and Basement characterization.

Williams prepared cross-sections of Bottom-Hole Instrumented Wells from the OIPA project for Kyle Murray's presentations at OIPA, Baker Hughes and the National Academies. The cross-sections accompany top Arbuckle and top Basement maps that Kyle created for the Earthquake Area of Interest (AOI). In December, she will help Kyle complete mapping the entire state using the methods he developed. Definition of the individual formations of the Arbuckle in the AOI is being completed for seismicity evaluation. The data are used in the Water Research Group, and shared with Xiaowei Chen (CPSGG), and her students for their project on poroelastic stress models.

Jordan is working with Kyle Murray and Brittany Pritchett on a compilation of all stratigraphic columns for the state of Oklahoma to develop a searchable database with age codes. At the end of November, the 1963 Cipriani Chart is searchable and cross-referencing with Dan Boyd's Chart (OGS Special Publication 2008-1) is in progress. Jordan has been working with Brandt Smith (Director of the Fabrication Lab, former Web Communications-CMS) on updates to the Water Resources page on the OGS website to highlight the ongoing projects, research, and publications. Jordan and Ella Walker began combining results from the OIPA project. They will meet with Dr. Zhang from the University of Kansas to discuss the Arbuckle Group on December 1, and. Next month's objectives are to publish an Open File Report, begin compressibility measurements, start work on top of formation maps, and further progress on searchable stratigraphic databases.

Ella Walker

In November, Walker spent most of her time working on the OIPA pressure monitoring project. Approximately half of that time was spent working on setting up the telemetry system for three wells so OGS can receive real-time data. One system was successfully installed at a well in Payne County, and equipment for the other two telemetry systems is being ordered. The other half of the OIPA project time was spent traveling to five abandoned injections wells that could potentially be added to our current network of nine wells. Ella attended meetings and conferences related to induced seismicity and produced water (OWRB PWWG, OCC, Baker Hughes, OIPA, Oka' Institute, Freese and Nichols). She also helped lead the Produced Water discussion at the Board of Visitors meeting for Mewbourne College.

Walker attended a meeting in Bartlesville with Kyle Murray to speak with the city managers regarding a *potential contaminants of emerging concern* project to facilitate the city's water re-use efforts. She and Brittany Pritchett also met with Dr. Carlos Aiken at the I-35 landslide site to discuss his LIDAR and photogrammetry research.

One major challenge encountered last month was trying to connect the OIPA project telemetry system to the home station. Jefferson Chang set up three Code Division Multiple Access (CDMA) lines through Verizon and taught Ella about CDMA networks and how to obtain static IP addresses. Connecting to the home station was difficult, due to firewalls and closed ports on the OU server. Chang's assistance was critical in sorting these problems out.

Next month, the objective is to install all three telemetry systems, and potentially to set up more. Walker also intends to finish processing the pressure monitoring data for the group and collaborators to analyze. Kyle and Ella plan to visit all the wells visited last month and deploy pressure transducers so the network can expand. Work should also start on the COMCD Lake Thunderbird project and Ella plans to add to the quarterly report that Curtis Smith started.

David Brown, Data & Collections Manager

OGS Database/Access Project: The OGS database/access project is entering the initial phase of developing a front-end web site for the new system. ITX, a development firm with expertise in creating web solutions for robust, multi-user needs, have been contracted to develop a prototype. Last month, Brown coordinated a two-day workshop where the OGS/OU-IT team outlined the project's plans for ITX, and collected valuable feedback from future users, who were selected from a cross section of petroleum and scientific backgrounds, and who volunteered their time to attend the session. The requirements gathered at the workshop are being used to design a wireframe for a web-based system. Starting this month, Brown and Richie Tarver attended daily conference calls with the ITX team, known as sprints, where they collaborate in real time as the wireframes are created. These wire frame prototypes will help the team as it presents the idea to others, to generate interest and funding opportunities. The first demo of the initial map-driven screens was a success, and the project is off to a good start.

GIS Projects: Brown has imported the first spatial layers into our new enterprise GIS database. Spatial Database Engine, or SDE, a key component of data management/GIS activities in the future, will give OGS researchers a single validated source of data for use in internal map making, spatial analysis, and the creation of web maps. A new dedicated server has been installed to run ESRI's ArcGIS for Server, which will work with SDE to manage mapping layers. Brown also started working with an Extract-Transform-and-Load software called FME. FME will be used to convert data formats, and then import them into our databases. It also has quality control capabilities, and can be used to automate tasks without the need to recreate them each time they are needed.

Outreach: Brown provided a tour of OPIC to a private school from Oklahoma City. He also spent time providing them with an overview of geology, and explained to them why it's important, both scientifically and economically, to preserve core and samples from wells drilled in our state. He also attended a GIS-Day-at-OU event at the Oklahoma Memorial Union. OGS staff spent the day showing some recent mapping products, as well as promoting other OGS resources. Brown exhibited a computerized 3D display showing recent earthquake events across the state. David also displayed a poster that he and Brittany Pritchett made that presented and described the 3D analysis concept.

OPIC: The new organizational realignment made at OPIC in September appears to be improving effectiveness for our customers, and overall productivity of the team. The Amoco collection has been somewhat neglected for several years, but our new collaborative approach is accelerating the inventorying and integrating of these cores into our viewing collection, and transferring the non-Oklahoma assets to their respective states. Scott Bryant, who is now in charge of our warehouse, reports that progress is being made not only with the collections inventory, but also with the movement of rocks in general. The number of boxes moved this month is the highest in several years, reflecting a steady flow of customers through our viewing area and requests to have plugs drilled from the core for selected testing. OPIC received a positive letter from a major industry user stating they were "impressed...with the collaborative spirit" provided by members of our OPIC team.

Building maintenance at OPIC got a major boost this month as OPIC accepted shipments of new steel racking for warehouse #4, described in Scott Bryant's report below. This replacement to our infrastructure was sorely needed, and OGS appreciates the financial support provided by our industry partner.

Brown attended discussions regarding a proposed project to investigate subsurface faults near or at recent major seismic events. His involvement relates to the use of OPIC to store and study samples recovered from the study. He met with a team from UTD to discuss opportunities for incorporating their work with LIDAR and photogrammetry to create high-resolution images of geologic outcrops, particularly along I-35 in the Arbuckle Mountains. OGS is considering using their imagery with some of our work in the area, e.g. an article submitted for a future OGS Oklahoma Geology Notes publication that describes the 2015 rockfall along I-35. David also assisted a team from Canada with investigating oil and gas well data in Oklahoma. They were specifically interested in our Natural Resources Information System (NRIS) database. NRIS contains some older well records that are difficult to find in other data collections.

Jim Anderson

Jim's recurring duties include:

- Conferring with Survey and outside staff on mapping and publication issues.
- Assisting staff with set up for meetings, conferences and other gatherings.
- Planning and creating maps, illustrations, presentations, photos and page layout for publications.

- Maintaining the archive room

In November, Anderson assisted Neil Suneson's efforts on **Roadside Geology of Oklahoma**. He also finalized the activities section of Newspapers in Education's (NIE) Fossil Edition of Oklahoma Rocks. He worked with Kyle Murray to prepare a poster of *Municipal Water Reuse* for the Governor's Water Conference. Jim also prepared graphic files for the OGS website in support of Stephenn Hol-loway, earthquake maps for 2015 and 2016 for the Director, and contours for the Woodford Structure Map for Brian Cardott and David Brown. He updated two Woodford Gas Shale maps for page illustrations and a website for Cardott. Jim answered several public inquiries and provided map files, and prepared material for display at, and attended OU GIS Day. Upcoming new maps for the StateMap Project will include the Bristow, 30'x60' and LeFlore, 7.5' quadrangles

Paul Bowen

During the month of November approximately 360 plugs/samples were taken from OPIC core. Plugs and cut blanks were taken for sampling. This total includes work done for general OPIC customers and Devon Energy. Thirteen bags of cuttings were sampled. One rock was cut for Jock Campbell. No gamma scans were done. No cores were oriented or slabbed. The motor on one of the polishing wheels burned out and will need to be replaced. All other equipment remains in functional order despite increased amounts of wear and tear. The large slabbing saw is reaching the end of its functional lifespan and will need to be replaced soon. Revisions of the forms for requesting core sampling were completed and have replaced the old forms.

Tim Brown

Tim coordinated the delivery of new storage racks for core in the Devon area, and worked with Scott, and Travis, on staging them. They are currently being installed. For safety reasons, Devon has been advised to limit access to their OPIC warehouse. Attendance was 10 visitors for the month. Activity for last month included requests for 7 wells, and 168 boxes. Tim prepared, and worked with Devon on moving two wells to their layout space in downtown Oklahoma City.

Scott Bryant

In the past 2 months since taking over the responsibilities of running the warehouse Scott have accomplished a lot. With help from Justin Allen, Scott and his team defined and started to implement a plan of attack for cataloguing the Amoco collection. They have also focused efforts on donated core that OPIC has received over the last six months to ensure that it gets cataloged in the data base and assigned a spot on the shelf. This effort will be complete by the Christmas break. The team has also focused on giving the viewing room a friendlier atmosphere, and this has paid off - OPIC has received positive phone

call and emails from customers. The team has also pulled more than 4,600 boxes since October and more than 13,500 boxes in 2016, the best year for the viewing room since 2013.

Scott and his team have also unloaded three semi-truck loads of racking for the Devon area. This racking is to replace that old racks in their area. Steel from the old racks was sold to a recycle center resulting in \$500 of income, which will be applied to purchasing new equipment for the machine shop. Bryant was able to repair an air conditioning unit that was leaking water from the roof and damaging the ceiling tiles and carpet by removing and unclogging the drain tube for condensation water. He is also replacing burned out light bulbs throughout the building, especially in the front offices, to make the area brighter and more appealing to employees and customers. The team also worked side by side with the Sam Noble Museum staff in finding a better place for their collection in one of the other warehouses at OPIC. The team helped Stan Krukowski move to Sarkeys Energy Center, and moved material he left at OPIC to the warehouse to free up office space. Bryant moved the rock collection, consisting of 20 filing cabinets, from the Devon warehouse to a more permanent place in another warehouse. The team has also focused attention on improving interactions between Devon and OPIC.

Jeffrey Dillon

Jeff has been active on photography of core requested by clients, scheduling core facility time for clients and handling any troubleshooting with data requests. He has also been helping students prepare their requests and find what they need. As a consequence, he is more familiar with current clients and what customers are looking for, with core and geologic formations, and is better able to help students complete their projects. The recent changes implemented by David Brown have been an improvement, customers are satisfied and have personally spoken of their satisfaction to Jeff.

Stephenn Holloway

Fault Database: Stephenn cleaned up duplicate and erroneous data and is attempting to enter missing metadata where it exists. He has checked on student Stephen Marsh's progress on adding faults and expanding review to other types of publications like theses. He met with Xiaowei Chen (CPSGG) to start incorporating the seismogenic faults that she and her students have identified, and with Brad Wallet (CPSGG) to start the same process with Kurt Marfurt's students and seismic reflection identified faults. Holloway also started defining fault zones based on areas with multiple traces.

OGS Website: Stephenn posted new calendar events and content, carried out general troubleshooting and maintenance of the OGS website, and helped users with software suggestions to download documents, maps, and GIS files. He had contact with users from Bermuda, Ontario, and France. He integrated new content in the General Interest section on rose rocks (from David London), pet-

rified wood (from Neil Suneson), impact structures, karst, radon, and state parks, as well as listing relevant new OGS publications (courtesy of Julie).

Quake Catcher Network: In late October Stephenn took over the Quake Catcher Network and started by contacting all users to troubleshoot immediate problems. He made site visits to the Tulsa Children's Museum to help move their existing installation to a new location with new computer, the Tulsa Geoscience Center to confirm their installation was working, and the Oklahoma Science Museum to help them use the software. He also spent time helping a user in Poteau troubleshoot a broken software installation. Following a meeting in late October with G&G, he started working with the Geology Club outreach coordinator to plan a teacher workshop next year.

Stephenn explored options for data management for the OIPA injection well monitoring program, including running our own File Transfer Protocol (FTP) server, using Microsoft OneDrive, using paid Shared Services, and purchasing a dedicated file server. OU IT was reluctant to provide timely helpful responses. Jefferson Chang used an IT contact and we are now set up to receive data transfers from outside the university if One Drive does not meet those needs.

Stephenn helped Jefferson Chang and Isaac Woelfel start construction on a seismic station, and tended the OGS booth and networked with other GIS users at OU GIS Day. He attended a meeting with Carlos Aiken and Lionel White from UTD on working with and eventually hosting their Lidar data collection of I-35 road cuts for use with field trips, possible publications, and education. Holloway joined a videoconference meeting with ITX regarding continued development of an OGS data portal. Stephen is working with a librarian at Lehigh University who has copies of early OGS publications and maps that we currently do not have. They are working on scanning them and will ship us the books and maps. Stephen has met with Michael Behm (CPSGG), on future collaboration and potential proposals for gravity, magnetic, and seismic field projects. Holloway trained Kevin Crain and Isaac Woelfel on the differential Global Positioning System (GPS) equipment.

Future Work: Holloway will add website content on dinosaurs, abandoned mines, and an expanded summary on natural hazards, and add OGS staff publications from the Shale Shaker. He will continue effort on the fault database and expand efforts on Quake Catcher Network to identify new installation sites and to fix the troublesome Poteau site. STATEMAP fault specific shapefiles will be added to the website with a searchable index map.

Vyetta Jordan

Currently Vy Jordan is working on a backlog of received data, digital missing files and folders. These include photographs, gamma scans, digital reports and digital test results etc. The goal is to complete this phase as quickly as possible and then go back through all the data and make sure there are no duplicates; all folders and files will have data converted to an on-line format such as PDF. Multi-well data reports need to be contained in each individual well folder. Amoco Oklahoma reports that now have OGS file numbers are being added to

that data set. Working with data sets gives a much better picture of what the analysis and reports contain and will help OPIC to offer better service to customers. Sample shipments are being sent to labs as they are ready from the machine shop. Record keeping is still done with hard copy files and folders as well as digital copies.

There are a small number of returned material samples to work through. These need to be entered into a spreadsheet and the samples boxed up to be added to their collection. January is the target month for tracking down all clients and labs who received samples. E mails to clients and labs are sent after checking the files to make sure that all data and samples are returned (excluding samples that are destructively tested or chemically contaminated).

Russell Standridge

Russell spent most of November working on Neil Suneson's **Roadside Geology of Oklahoma**. The work consisted of constructing 49 rectangle areas that represent the maps or stops to be used in the book. He compiled the three geologic map source materials (OGQ, HA, Bulletin and Circular county maps) chosen to be used for each area. The Bulletin and Circular county maps haven't been digitized or georeferenced; therefore he georeferenced selected ones for the compilation. Standridge also worked on a state-wide base map that will be used for the maps. Other small projects included coordinate conversions for Lynn Soreghan of CPSGG, edits to Brian's Woodford structure map, and two earthquake maps for the Director. He also attended OU GIS Day.

For December, he will continue to work on Neil's project, and anticipates finishing the base map and progressing on geologic map compilation with a clear plan on a state-wide map for the project.

Richie Tarver

OPIC Data Library Snapshot: In addition to helping customers and students with data requests, OPIC staff are making progress on completing inventories and digital imaging of all OGS-OPIC collections. The current focus is on completing inventories of electric logs and aerial photographs - the two most used collections within the OPIC Data Library, according to user statistics. The public access portion of the aerial photo collection has been scanned, and metadata records for some 60,000 photos have been created to refine our extant, incipient inventory. We have also created inventory records for ~200,000 well logs; we input on average ~ 5,000 records per month. Additionally, we are processing new donations that have been trickling in steadily throughout the past month. We are also working on staging materials for the AAPG pipeline program where we will be 'regifting' donated geological texts and professional journals to developing countries.

Database Project: We have made significant strides in developing our strategy to implement a comprehensive database to make all OGS data accessible to

the public. Initial planning phases have included meetings with the Kansas Geological Survey and various Oklahoma state agencies, such as the Oklahoma Corporation Commission (OCC) and the Oklahoma Energy Resources Board (OERB). The OPIC data is forging collaborative partnerships with these entities to derive funding and seek out opportunities for data synthesis. We have received a well list from the OCC, and are in the process of receiving the National Resource Information System (NRIS) dataset housed at OU, which together, will be used to make a master composite.

OGS and OPIC have also been successful getting funding. We have recently received a funding commitment from the OERB Sustaining Oklahoma's Energy Resources group to fund a significant portion of the project, with the promise of matching funding from the Dean of the Mewbourne College of Earth and Energy (MCEE) to maintain subsequent development phases of the project. This past month, the team entered the initial design phase with front end developer, ITX. As product owner, Tarver is working with ITX every day to refine the design of the product. We are hoping to view initial wire frames for our web portal by end of the year.

Grant Project: Tarver is in the process of closing out a grant he was awarded via the USGS's National Geological and Geophysical Data Preservation Program (NGGDPP). The project will deliver metadata describing some 60,000 aerial photographs which will be uploaded to the National Digital Catalog for posterity.

Special Research Project: A project to establish unique geochemical/ petrographic profiles for archaeological quarry sites in Oklahoma was initiated by David Brown, Neil Suneson, and Richie Tarver this summer. We have gathered samples of Florence-A and Wreford chert from Kay county quarry sites, and are currently evaluating analytic methods such as neutron activation, XRD, and XRF to establish a proof of concept for sourcing tool industry. As the anthropologist on this project, Tarver is acting as the point of contact between the Oklahoma Archaeological Survey and Anthropology Department housed at OU. Any suggestions on in-house analytic methods would be appreciated.

Moving Forward: Next month Richie plans to be further into the database front end design, to sample more quarries, and to identify funding opportunities for data preservation of OPIC data collections.

Ted Satterfield

In November, Ted designed promotional images for online distribution of the Fall 2016 issue of the Oklahoma Geology Notes, which was completed at the end of October. Toward the efforts of print distribution, he designed a subscription form and wrote a letter to subscribers explaining the new format for the Notes and options for subscribing. He began work laying out the Winter 2017 issue of the Geology Notes by completing the cover layout, processing photos shot in previous months, and gathering materials from Google Earth to show cracking occurring before the rock fall on I-35 that will be the lead story. Ted also paginated the overall article and line-edited it. Also for this issue he began initial steps to compile a list of Oklahoma earth science theses from 2016.

He compiled press release and media contact information before leaving on a vacation, which ended up being timely, as the Cushing earthquake happened the Sunday before his vacation. Ted helped plan — and processed a variety of photos for — Fossil Fridays and Mineral Mondays for use on social media. At the beginning of the month he assisted student workers in the completion of the November newsletter, which was the first released with a new format. At the end of the month he assisted with, and shot photos for, the upcoming December newsletter.

In the month of December, Satterfield will make necessary changes to the Rock Fall story layout and finish compiling the Oklahoma theses, after which he will prepare the Winter 2017 issue for distribution. He also plans to complete a brochures for OPIC and seismic monitoring.

Joyce Stiehler

Logistics: During October & November, Ted Satterfield has been moved from R-128 to E-134. Ella Walker has been moved from E-218 to R-128. The flume hood in Brian Cardott's lab appears to have been fixed. His move from the 14th floor is still pending. A work order is pending to have the door replaced for the new lab that Stacey and Neil will be sharing.

Conferences: October 25, 26, & 27 was the date for OGS's Simpson Play Workshop & Field Trip. Stiehler assisted Michelle Summers with the logistics for both the Workshop & Field Trip and was responsible for registration for both. There were 117 registered attendees for the Workshop and 26 attendees for the Field Trip. Both the workshop and field trip were a success due to the hard work of all OGS staff involved, most especially Michelle. OGS has already submitted the necessary paperwork and fees to be a bronze sponsor for the Oklahoma Ground Water Association meeting January 10th & 11th at the Embassy Suites in Norman.

Income: Survey Sales & Conference/Copy Shop income reports for October 2016 were transmitted separately. Joyce will be working on November data as soon as the PeopleSoft reports are available.

Travel: Travel expense report are almost caught up. There are still some outstanding ones for Jefferson Chang that we are working. The plan is to have these taken care of by the 15th of December.

In December Joyce will be updating the phone list, creating a computer database, and finishing travel expenses for Jefferson. Recent discussion have considered turning the refrigerator room into a storage area for Conferences, Seismicity, Water Resources, and Geological Programs, with work potentially planned for January. In addition, Joyce will be training Michael and Chrishelle on some of the job duties that Sue Palmer currently does.