### **OKLAHOMA**

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**Mission:** The Oklahoma Geological Survey is a state agency for research and public service located on the Norman Campus of the University of Oklahoma and affiliated with the Mewbourne College of Earth and Energy. The Survey is chartered in the Oklahoma Constitution and is charged with investigating the state's land, water, mineral, and energy resources and disseminating the results of those investigations to promote wise use and sound environmental practices. The OGS has no regulatory duties.

The OGS presently has 10 geologists, 10 professional staff, 11 hourly staff, and 15 students, for a total of 46.

The OGS operates the Oklahoma Petroleum Information Center in Norman, Oklahoma, which serves as a repository for cores and samples, well logs, and other geological material and information. Also part of the Survey is the Leonard Geophysical Observatory, located near Tulsa, Oklahoma, which monitors and records earthquake data; and a network of remote seismic stations around the state.

## Dr. Charles J. "Charlie" Mankin January 15, 1932 to November 13, 2012 OGS Director 1967–2007 resume: http://ogs.ou.edu/pdf/MankinResume.pdf

Charlie was a west-Texas ranch kid who had three degrees in geology from the University of Texas, and post-doc work at Cal Tech (where he worked for Linus Pauling).

He crossed the Red River in 1959 to become an Assistant Professor of Geology at the University of Oklahoma; became Acting Director of the School in 1963; Director of the School of Geology from 1964 to 1977; then Director of the OGS in 1967—serving a dual role at the OGS and at the School for 10 years. While at the Survey, he also was at times Director of the Energy Resources Institute, Geological Information Systems, and Sarkeys Energy Center.

Dr. Mankin was a nationally prominent geologist and a stalwart defender of the profession, the Survey and his adopted state. Uppermost in his mind was service—to the public always, as well as to the University, State and Nation. But he never forgot the public, and he never took that part of his job for granted; no matter how many trips to Capitol Hill he made or how many times he testified before Congress on important energy or geological issues. To him, everyone he met had equal stature, and everyone had a right to be heard and to have their inquiries respected at the Survey.

Charlie's loss is felt deeply as an important member of AASG, and as a colleague, a mentor, the teller of a great story, and certainly as a friend to many.

#### Energy

Petroleum: The OGS spent a good amount of time and staff energy during this fiscal year fielding questions about the controversial issue of drilling, injection wells and induced seismicity. The end of June, 2013, found seismologist Austin Holland, Randy Keller and others at the OGS completing plans for a working session in mid-July to bring state and federal officials, members of the petroleum industry and others together to exchange thoughts on a draft proposal from the Survey outlining a set of potential best practices for the industry relating to injection wells and induced seismicity. More than 50 people were expected to attend the sessions to hear three speakers and then participate in breakout groups to review the draft document presented.

Many public service requests are fielded each year by the OGS, from in-state and out. A sampling of petroleum-related requests would include drilling activity, hydrocarbon potential and production, nomenclature, and general geologic information. Sometimes the requests can be answered by e-mail or phone call, but some require limited data transfers, personal consultations or mail. Most of these are handled by geologist Richard Andrews.

Work is nearing completion on a Simpson Field Trip and guidebook, with an accompanying playbased study to be published as well.

Continuing the Survey's series of very popular workshops on petroleum issues, the OGS sponsored or participated in: *Real Deal Mid-Continent Prospect Expo* (212 attending), in Oklahoma City September 20, 2012; OGS *Mississippian Play Workshop* (256 attending), October 31, 2012, in Norman; 11<sup>th</sup> Annual Osage Minerals Council Oil & Gas Summit & Lease Sale (316 attending), in Tulsa, November 7–8, 2012; 37<sup>th;</sup> Annual Western Interior Coal Forum Meeting (21 attending), in Poteau, OK, June 3–5, 2013.

*Coal, Coalbed Methane, Gas Shales:* Coal-related work continues in vitrinite reflectance analysis, subsurface coal rank, Oklahoma coal database, scanning electron microscopy of organic matter, and other organic petrology projects.

The increase in drilling for gas shales in Oklahoma has made Brian Cardott's studies an even more

valuable and sought after source of information for exploration and production. This is one of the most used features of the website. He provides CBM completion tables (currently with 6,000 records) and maps, bibliographies, reports, coal rank maps, and presentations and data bases on coal, hydrocarbon source rocks and gas shales.

The website also contains the Hartshorne coal rank map, and a number of other related maps and tables. The gas shale completions table alone has some 2,500 records and is increasing rapidly (277 additions in 6 months). This is one of the most visited areas of the OGS website.

*Coal, coalbed methane*: <u>http://ogs.ou.edu/level3-</u> <u>coal.php</u>

*Hydrocarbon Source Rocks and Gas Shales:* <u>http://ogs.ou.edu/level3-oilgas.php</u>

#### **Oklahoma Petroleum Information Center**

(**OPIC**): OPIC is a 200,000 sq. ft. facility used by many individuals and groups other than energy industry workers. Labs are held there for OU geology students and groups of teachers come for tours and special teaching sessions. Individuals and many associated with state and federal agencies also make use of the massive core and sample collections, paper data records, and aerial photos housed here.

Core usage increased by about 200 boxes over the last two years, and pulls are coming from a wider variety of plays, which is good news for the state. Patrons come not only from Oklahoma but come from around the U.S. and even from foreign countries. The Survey also gets a good number of data requests from people and companies in other countries.

Cores from more than 700 wells were added to the holdings,

The facility received some 50,000 scanned images of aerial photographs from the Oklahoma Corporation Commission, bringing aerial digital images sorted by county, township and range to a total of 60,000. There are core gamma ray logs from 65 wells, 164 wells in the core photography database, and 3,502 mud logs in the collection.

In addition, the Survey is making great progress in adding to and extending its range of databases. *Databases:* <u>http://ogs.ou.edu/level3-</u> <u>databases.php</u>

Thanks to the generosity of Devon Energy and support from the university, a great many physical improvements to the facility have been made in recent months.

# See all OPIC information at: <u>http://ogs.ou.edu/level2-OPIC.php</u>

Earthquakes: Since the late 1960s the OGS has been involved in monitoring earthquakes in Oklahoma. It was in 2007, however, that seismic activity began to be on the upswing and more and more people in urban areas began to feel the quakes. Since then, a great deal of staff time has been spent dealing with the shaking and related issues and giving the news media the latest updates. Seismologist Austin Holland is a much sought after interview, even from reporters in other countries. In the past year, the main focus of the media's interest has been injection wells and induced seismicity (see Energy section of this report). Dr. Keller pitches in on many occasions, but, to Dr. Keller's great relief, Holland seems to be on everyone's speed dial when the ground starts shaking.

From January 2–December 1, 2012, the OGS recorded 979 quakes; during the first three quarters of 2013 there were 673 counted with 54 felt. From January 1 to March 31, 2013, there were 21 felt quakes and 122 located earthquakes on Oklahoma County alone. Most of these were consistent with the ongoing Jones earthquake swarm. Another 45 events occurred in Lincoln County with the majority of these associated with aftershocks of the Nov. 2011 M5.6 Prague Earthquake sequence.

Along with the monitoring of earthquakes Holland is involved in updating earthquake ground-motion parameters for the Arcadia Dam in Oklahoma with the Army Corp of Engineers and evaluating possible earthquake magnitudes and hazards for the Meers Fault with the Oklahoma Office of Emergency Management. He also works closely with federal agencies such as FEMA, GAO and EPA, the Oklahoma Corporation Commission, the Oklahoma Dept. of Environmental Quality and a number of other agencies and organizations. Much of his time also is spent in presenting papers and preparing articles for publication.

**Environment:** The OGS is part of a CO<sub>2</sub> Sequestration Assessment Program, with activities led by geologist Rick Andrews. Using structurecontour maps depicting the tops of the Arbuckle Group and the Hunton Group in Oklahoma, the project results are identifying a number of very favorable areas for CO<sub>2</sub> storage in the state. The Arbuckle is an ideal sink for high-volume storage, while any formation within the Hunton may have good porosity development and lateral/vertical seals which make it an excellent candidate as well. Important tools for Andrews and his students are an isopach map and an extensive database of subsurface formation tops of the Arbuckle and basement. The database is dynamic and will be updated continually to reflect new information and provide quality checks.

Dr. Ken Luza continues to be involved in work and issues in the Picher Field and Tar Creek Superfund Site, as he has since the 1980s. He has played an important role in research and mapping as well as in the lives of the residents he came to know over the years. He is working with OGS geologist Dr. Tom Stanley on a field trip guidebook to the geology and mining resources of the area.

He also works on other projects that require an engineering geologist's skills, including important water issues in the Panhandle, and serves as chairman of the Oklahoma Board on Geographic Names.

**Programs:** The Survey is completing work on a grant from the National Geological and Geophysical Data Preservation Program administered by the USGS. This ongoing effort is centered on completing work with the Survey's collection of mud logs, with header information

for the more than 3,300 logs inventoried. Previous work involved metadata describing almost 9,000 individual cores maintained at OPIC.

Dr. Keller, Kevin Crain and Vikram Jayaram continue to study the deep structure of Oklahoma and surrounding areas for their 3-D geophysical models. This is part of an NSF funded project on the mid-continent rift.

The OGS is working on new integrated studies made along the Ouachita orogenic belt This work is based on industry 3-D seismic data from that area.

Dr. Keller has published a number of papers and articles, including an invited review paper of the Moho of North America.

Dr. Neil Suneson is reviewing literature on the Stanley Group as a potential petroleum resource, which will result in a field trip and other associated projects.

He is working on the 2013 issue of *OKLAHOMA ROCKS! State Parks*, and a series of informational signs for trails in the Wichita Mountains with the Red Earth Desk and Derrick Club.

Additionally, he divides his time among teaching Subsurface Methods, writing articles for many publications, serving on the editorial board of the Oklahoma City Geological Society's *Shale Shaker*, serving on thesis committees, presenting talks, leading field trips, and serving on many civic and professional committees and panels.

Dr. Stan Krukowski keeps track of Oklahoma's mineral resources and works with various professional groups and companies within the state. His research projects include: contributing to the Directory of Oklahoma Mines; as well as industrial minerals utilization by Native Americans.

The Krukowski and the Survey participated in the *12<sup>th</sup> Annual Oklahoma Aggregates Association Field Trip and Meeting* (316 attending), on January 22-23 in Oklahoma City.

**Mapping:** STATEMAP, with Dr. Tom Stanley and Dr. Julie Chang, marks its 16th anniversary in 2013. The produced maps are part of the ongoing effort to create a new 1:500,000-scale geologic map of the state.

More than 41 detailed 7.5' geologic maps at a scale of 1:24,000 and 16 reconnaissance maps at 1:100,000 are complete and available on the website, and in hard copy and digital format upon request. This aspect of STATEMAP continues with the northwest to southeast sweep of the state.

Currently, mapping is proceeding in the Tishomingo 1-degree sheet. The detailed, 1:24,000-scale, mapping of the Tulsa Metro Area was completed this year. Plans to continue detailed mapping of selected parts of Oklahoma will center on the Ada area next.

Dr. Stanley also serves as an Adjunct Professor for the ConocoPhillips School of Geology and Geophysics.

**Hydrogeology:** The OGS issued its fifth Newspapers in Education program titled: *OKLAHOMA ROCKS! Groundwater* 2012. The 16-page publication, compiled by Dr. Kyle Murray, was provided free with 25 copies per classroom, along with 6 lessons in the *Daily Oklahoman*, an online teacher's guide and classroom activities to enrolled teachers. The project, sponsored by the *Daily Oklahoman*, has been extremely successful, and reaches more than 350 classrooms. Additional copies are given to the OGS for scouts, educational groups and civic organizations.

Dr. Murray is involved in efforts across the Mewbourne College of Earth and Energy to study issues involving water. He also assists in planning the Water Innovation Research Laboratory at OU, which is a \$15 million building project to accommodate space for core water quality and analytical studies, as well as more research labs, office, educational and outreach areas.

His current emphases at OGS and OU are on the interplay among water and conventional,

unconventional, and renewable energy resources. His research is designed to provide practical scientific perspectives on water issues and to influence responsible management and sustainable practices.

**Public Service:** The OGS researchers are very active in publishing and in membership and service to many professional and government organizations on a local, national and international level.

Survey staff members are an important part of the MCEE College as well, teaching classes, giving special lectures, and serving on many thesis committees. For example, Dr. Keller has just had his 100th graduate student finish his PhD, and he has other students now in that same pipeline. In addition, Neil Suneson and Rick Andrews teach an important sub-surface methods class for college.

As a service to the Oklahoma geological community and friends of the OGS, the Survey publishes four issues each year of the venerable *Oklahoma Geology Notes*, maintains an active website, and adds material to it regularly. Most Survey maps and publications are available to download at no charge.

As of this writing, the OGS is at work on the 6<sup>th</sup> edition of Oklahoma Rocks, an important and popular teaching tool going free to more than 350 classrooms.

As always, the Survey workshops have been extremely popular, and staff members are frequently called on for news interviews about the industry and issues surrounding it as well as general geology topics.

Many inquiries are taken and carefully answered each day from the general public, and staff members devote time to government issues and conferences on local, state and national levels.

As one staff member recently stated the issue: "The OGS is one-stop-shopping for geology in Oklahoma."

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