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 OU's 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 the wise use of Oklahoma's natural resources consistent with sound environmental practices. The Survey is not a regulatory agency.*

New Publications and Programs Examine Southern and Southwestern Oklahoma

—The Wichita Mountains in Oklahoma: Their Story Through Time by Dr. M. Charles Gilbert, has been released by the Survey as Guidebook 39. The 44-page book includes many great photographs of the area, GPS locations and stop descriptions for 15 stops, a geologic time scale, an outline of the igneous stratigraphy, a guide to minerals and rocks, simplified stratigraphic column, and an introduction and summary that give readers a thorough background on the geologic history of the mountains and their surroundings.

Dr. Gilbert has spent many years working in the Wichitas and his enthusiasm for them is evident in this publication. He intended the book to be useful to the general public as well as to beginning geologists, students, and professional geologists. He also helped in a project, mentioned below, to place new informational signs on hiking trails in the area. It is a popular spot for recreational use, and this book and the signs are welcome additions for the many visitors that enjoy the area.

Guidebook 39 is available for $10, and will soon be available to view on the OGS website.

—Igneous and Tectonic History of the Southern Oklahoma Aulacogen, OGS Guidebook 38, was in the very final stages of printing and binding as this report was written. The publication represents a major effort for the OGS and Dr. Neil Suneson, who edited the volume. This 405-page book measures 1 in. thick, and is printed on high-quality paper in a large format that allows ample room for good-sized color photos and illustrations. The price of the book is $35.

The guidebook is an outgrowth of an OGS field conference held in March, 2014. All 8 of the stops from that two-day field trip are written up in the guidebook, along with an additional 15 original research papers on various aspects of the Southern Oklahoma Aulacogen. The stops on this field trip focused on the igneous rocks of the Arbuckle Mountains and Wichita Mountains. The trip leaders are the experts in those areas, and are the authors of the stop descriptions for the book. A total of 37 people attended the field trip, coming from as far away as Ottawa, Canada, Pittsburg, PA, and Houston, TX.

The book is a tribute to Rodger E. "Tim" Denison, a 1954 and 1969 graduate of the University of Oklahoma and former Oklahoma Geological Survey employee who has spent much of his career in the study of Oklahoma geology. He was one of the authors of *Basement Rocks and Structural Evolution of Southern Oklahoma*, OGS Bulletin 95, a 1964 publication that still is widely cited by those studying the southern mid-continent. Tim's often humorous account of the making of Bulletin 95, and his own history, is included in the guidebook. The group was fortunate that Tim attended the field trip and was able to share his insights from nearly 60 years of work in the area.

—Oklahoma Rocks! What Lies Beneath! In addition to these two guidebooks, to complement and extend its studies of the areas covered by these new publications, the Survey is at work on its sixth edition of *OKLAHOMA ROCKS!* This offering is *OKLAHOMA ROCKS! What lies Beneath!*, and will examine the rocks and structures below Oklahoma, in particular the formations of the Ouachitas, the Wichitas, the Southern Oklahoma aulacogen, Anadarko basin, and Meers fault. This is part of the *Daily Oklahoman's* Newspapers in Oklahoma program that provides 25 paper copies of a 12 to 16 page workbook, a teacher's guidebook, lessons and various activities and projects at no cost to classrooms across Oklahoma. This project will be issued in the fall of 2014, and will be and available also, along with all past issues of *OKLAHOMA ROCKS!*, on the NIE website under the *Curriculum* tab, then *Previous Programs*.
http://nie.newsok.com/educators/curriculum/

—Burford Lake Trail Signs. Also in this area of the State, the Survey cartographic department and Dr. Neil Suneson worked in cooperation with the Red Earth Desk and Derrick Club, the ConocoPhillips School of Geology and Geophysics at the University of Oklahoma, and federal government naturalists to make new interpretive signs for the geology seen along the Burford Lake Trail in the Wichita Mountains Wildlife Refuge in southwestern Oklahoma. The signs are built to withstand weather and animals and will be enjoyed by visitors for many years to come. Also instrumental to this project was Dr. M. Charles Gilbert, a retired geologist, long-time OGS collaborator and author, and former professor and director of the OU School, who has extensive expertise in the Wichitas. Dr. Gilbert's enthusiasm for the area is evident in OGS Guidebook 39, which is mentioned above, and in this project.

Fortunately, the geology along the Burford Lake Trail is well known and well exposed. The Wildlife Refuge has some 1.7 million visitors per year, and is the third-most-visited refuge in the U.S. The area is famous because of its excellent camping facilities, hiking and rock climbing venues, wildlife (bison, longhorn cattle and prairie dogs) and scenery, especially the drive to the top of Mount Scott.

Seismic Studies

Earthquakes continue to be the topic of much study and interest as quakes became even more frequent in populated areas near and in Edmond and Guthrie, just north of Oklahoma City, and close to Ponca City and Stillwater. Requests for media interviews and speakers come to OGS now from around the world as well as local media and civic groups, and in far greater numbers than the staff could possibly accommodate.

Upgrades and additions to the seismic network will help the Survey research the activity and gain far better understanding of the mechanics at work underneath the State. Funding through RPSEA will help address questions with respect to geologic conditions, monitoring and predictive modeling necessary to evaluate potential causes of this increased seismicity. The Survey is building, testing, and updating volumetric (ED) geologic interpretations based on information from existing well and well-log databases, rock-mechanics

data, rock properties and seismic imaging. This will be tested against existing and newly acquired gravity data as well as the ongoing seismic monitoring.

The geologic interpretation will be examined along with production and water disposal information, as well as reservoir and rock mechanics modeling to look at changes through time associated with oil and gas production, while incorporating additional information dimensions (4D) to enhance the study.

In response to the growing work load surrounding these earthquakes and the potential for induced seismicity, additional staff members have been added to help with seismological work: Amberlee Darold and Jennifer Morris are now analyzing data, installing seismographs and helping answer questions about the earthquakes.

Energy

A new petroleum geologist was hired by the Survey in this time frame. Stacey C. Evans, who graduated from the University of Oklahoma with an M.S. in geology in 2011, joins the staff coming from her job as an exploration geologist with Concho Resources in Houston. She also has experience with Apache Corp. in Houston, and Chesapeake Energy in Oklahoma City. Her previous Oklahoma experience will serve her well at the Survey, as she joins Rick Andrews in the petroleum section.

As the issue of oil and gas activities and induced earthquakes continues to make the news, and the Survey again spent a good amount of time and staff energy during this fiscal year fielding questions from the public and the media about production and other issues related to the industry itself and the seismic activity.

As a service to the state, the OGS also continued its technical meeting program with the following:

- The Fluid Injection Induced Seismicity Workshop held on July 16, 2013 had 73 attendees.
- The Oklahoma Shale Gas & Oil Workshop had 203 attendees November 20, 2013.
- The Oklahoma Shale Gas & Oil Field Trip on November 19, 2013 had 30 attendees.
- Shale Gas Field Trip held on November 21, 2013 had 34 attendees.

Many public service requests arrive each year at 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.

—Geothermal

Dr. Julie Chang continues her geothermal studies at OGS to help in understanding heat production generated from Precambrian igneous and metamorphic rocks from the Arbuckle Mountains, and Cambrian granites from the Wichita Mountains. The data greatly enhance knowledge of Oklahoma's geothermal resource potential and have been submitted to the State Geothermal Data project. These data, as well as all geothermal information compiled for the state of Oklahoma, are available to the public at the National Geothermal Data System website (http://geothermaldata.org). Additional heat production information is being reported as new data become available.

Mapping

Mapping: STATEMAP, with Dr. Tom Stanley and Dr. Julie Chang, marks its 17th anniversary in 2014. The produced maps are part of the ongoing effort to create a new 1:500,000-scale geologic map of the state.

- More than 42 detailed 7.5' geologic maps at a scale of 1:24,000 and 17 reconnaissance maps at a scale of 1:100,000 are complete and available on the website and in hard copy upon request.
- Detailed, 1:24,000-scale, mapping of the Ada Metro Area is currently in progress. The Vanoss 7.5' quadrangle was mapped in 2014, and the Roff North 7.5' quadrangle will be mapped in 2015.
- Mapping of 1:100,000-scale maps is progressing with a northwest to southeast sweep of the state. The Tishomingo and Oklahoma part of the Sherman 1-degree sheets (1:100,000) were mapped in 2014, and the Pawhuska 1-degree sheet will be mapped in 2015.

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

Nomenclature Committee

Because the state of Oklahoma does not have an official guide or chart showing the formally accepted positioning, classification, and nomenclature of stratigraphic units in Oklahoma, OGS has created an Oklahoma Stratigraphic Nomenclature Committee to reconcile existing nomenclature issues, review proposed changes, and create an up-to-date stratigraphic guide and chart for the State of Oklahoma. All resulting publications will be available on the Oklahoma Geological Survey's website. The committee is chaired by OGS geologist Brittany Pritchett.

The objective of the committee is to review, update, and standardize the stratigraphic nomenclature for Oklahoma, develop and publish formal stratigraphic guides and charts for each geologic province in Oklahoma, and create a Lexicon of Geologic Names of Oklahoma after the formal stratigraphic guides and charts have been published.

Hydrogeology

Dr. Kyle Murray represents the OGS in many ways. In addition to his research, he attends many professional and government meetings, conferences and working groups, but still manages to find time to speak to school and civic groups about important water issues facing the state. He also is very involved with the Mewbourne College of Earth and Energy studies of water, and 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 projects include compiling data on injection and produced water wells, examining nitrate levels in the Rush Springs Aquifer and evaluating changes there, and studying arsenic and chromium levels in Oklahoma water. His studies involve both ground and surface water.

His basic studies examine the interplay of water among conventional, unconventional, and renewable energy resources. In fulfilling the Survey's Constitutional mission, his research is designed to provide practical scientific perspectives on water issues and to influence responsible management and sustainable practices.

Ongoing Research

Ongoing research at the OGS includes: Brian Cardott's studies of vitrinite and coal-bed methane, and gas shale completions; CO_2 sequestration; study and mapping of Oklahoma deep structures; non-fuel mineral investigations; and coal studies.

Outreach

The OGS staff is very mindful of its responsibility to public service, and as such: Answers many questions by phone or in person; maintains an active website; helps supply needed maps and data to the public and other agencies; is involved in educational activities and school visits; cooperates with the Mewbourne School in teaching and field camp activities; organizes and leads field trips; and fills many other roles to help inform and educate the public about Oklahoma's geology and it use and conservation.

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