Louisiana Geological Survey

NewsInsightsonline

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Since the Louisiana Geological Survey was first organized in 1869, it has been providing geologic information reflecting its primary mission of promoting the environmentally sound economic development of the energy, mineral, water and environmental resources of Louisiana. Recognizing the importance of geologic information to the state's various economic and other developmental projects and activities, the Louisiana legislature permanently established LGS in 1934 (Act 131). The LGS was originally affiliated with the Louisiana Department of Natural Resources though its offices were always and currently located on the campus of Louisiana State University. LGS was legislatively transferred to LSU in 1997 and currently reports through the Executive Director of the LSU Center for Energy Studies to the LSU Vice President of Research and Economic Development. LGS currently has 14 full time and 2 part time staff including all categories of personnel. Results and reports of LGS research projects are first provided to the project funding sponsors and after their approval are made available to interested parties. LGS staff regularly makes research presentations at appropriate technical conferences and submit papers for publication in professional journals. LGS publications and maps are also available for sale at very moderate prices.

Over the last five to six years, continuous budget cuts to LGS has resulted in budget instability causing the departure of some key staff personnel and decreased LGS's capability to attract externally funded projects. Research projects undertaken and supported by LGS funds have also been affected and travel for required field work for such projects and for staff to attend professional conferences for making research presentations and networking have been considerably reduced. Continuous success and expansion of LGS research activities will require an increased stable budget and the hiring of additional qualified personnel. Current research projects are conducted primarily under the following four sections:

1.**Geologic Mapping and Mineral Resources Section** - conducts investigations of the surface geology of Louisiana including surface mapping funded by the State Map Program managed by the U.S. Geological Survey.

2.**Water and Environmental Section** – currently monitors and provides data on stream and lakes to add to the state water data base which supports the efforts of the Louisiana Department of Natural Resources along with the USGS for management for the states' water resources.

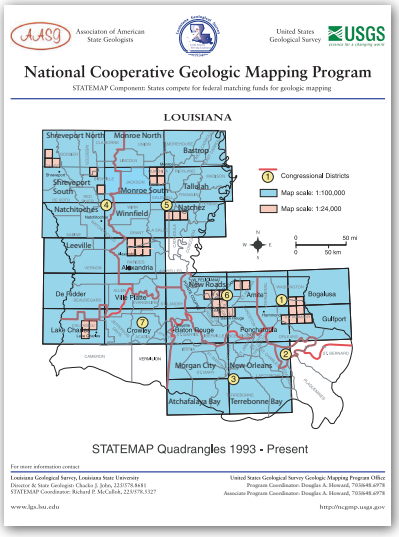
3. **Basin Research Energy Section** – was previously the Basin Research Institute at LSU and is now integrated into LGS and conducts oil, gas, coal, and unconventional energy resources related investigations.

4. **Cartographic Section** – prepares the final maps, reports, desktop publications, various types of geological bulletins, posters, etc., and does the GIS work on research projects. Over the years, maps and brochures produced by the LGS Cartographic Section have received national awards for the excellence of its projects.

Contracts/Grants

Geologic Mapping

In the past year LGS completed its coverage of the state by 30 × 60 minute geologic quadrangles at 1:100,000 scale, comprising a mix of open-filed GIS compilations and sheets produced as published lithographs. During this period three new lithographs (Bastrop, Tallulah, and Leesville) were prepared, and LGS also produced three open-file 7.5-minute geologic quadrangles at 1:24,000 scale. The statewide 30 × 60 minute geologic quadrangle coverage presently totals 23 lithographs and seven open-file compilations; the 7.5-minute geologic quadrangle coverage now totals 49 open-file sheets. The principal sponsor supporting this geologic mapping activity at the 80+ percent level at both scales has been the STATEMAP component of the congressionally authorized National Cooperative Geological Mapping Program. Basic geologic information of the kind presented on these geologic maps should have value in the addressing of a host of environmental and economic issues of increasing importance in the state in years to come.



The Louisiana Geological Survey

LOUISIANA GEOLOGICAL SURVEY
Chacko J. John, *Director and State Geologist*
Professor-Research

Board of Advisers
Frank W. Harrison, Jr., Chair
Don Briggs
Karen Gautreaux
James M. Coleman
William B. Daniel, IV
William Fenstermaker

LGS News Staff
Editor/Chacko John
Production Manager/Lisa Pond
Publication Sales/Patrick O'Neill

Telephone: (225) 578-8590
Fax: (225) 578-3662

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Location & Mailing Address
Louisiana State University
Room 3079, Energy, Coast & Environment Bldg.
Baton Rouge, LA 70803
Telephone: (225) 578-5320
Fax: (225) 578-3662

LGS Mission Statement

The goals of the Geological Survey are to perform geological investigations that benefit the state of Louisiana by:

(1) encouraging the economic development of the natural resources of the state (energy, mineral, water, and environmental);

(2) providing unbiased geologic information on natural and environmental hazards; and

(3) ensuring the effective transfer of geological information.

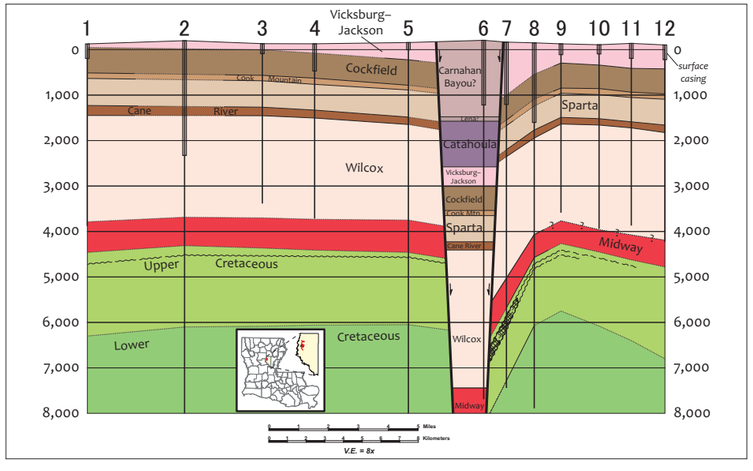
The Louisiana Geological Survey was created by Act 131 of the Louisiana Legislature in 1934 to investigate the geology and resources of the State. LGS is presently a research unit affiliated with the Louisiana State University and reports through the Executive Director of the Center for Energy Studies to the Vice Chancellor for Research and Graduate Studies.

In this issue.....

Cross Section Through Little Creek Structure, Northwestern La Salle Parish

Little Creek is unique among geologic structures in Louisiana and possibly in the U.S. The surface feature is a tight collapse structure 4.3 km (2.7 mi) across, which drilling shows extends to a minimal depth of nearly 8,000 ft (approximately 2,440 m). Fisk (1938) originally mapped the surface structure in detail on his geologic map of La Salle Parish (his Plate II), and mapped the subsurface structure at a regional scale using oil and gas well data (his plates VI and VII). Since his work, little information about the feature has appeared in the public domain, though it appears to have garnered attention from some geologists at least intermittently. One of these is J. E. Rogers, with whom consultation in connection with the compilation of the Louisiana state geologic map in the early 1980s (Rogers, 1982) revealed his interpretation, based on correlation of water well logs, of the feature's surface unit as Carnahan Bayou Formation, Fleming Group rather than the Catahoula Formation of Fisk's original mapping. This interpretation greatly increases the displacement attributable to the structure at the surface and in the shallow subsurface.

A summary paper by Echols and McCulloh (1998) listed three hypotheses of origin of the Little Creek structure known to the authors: (1) salt withdrawal marking the location of a former salt diapir near the southeastern edge of the north Louisiana salt basin (J. E. Rogers), (2) long-term response to a meteor impact that occurred during deposition of the Upper Cretaceous chalk (M. D. Butler), and (3) response to emplacement of a deep post–Jurassic igneous diapir (D. H. Wilson). The paper contained a dip section through the structure that utilized oil and gas wells laid out with an arbitrary horizontal spacing in order to maximize the number of wells included and the length traversed. Thus, the section had no consistent horizontal scale, and its vertical exaggeration also was not uniform. The section nevertheless portrayed in condensed fashion the shallower, tight collapse feature and its areal coincidence with a broader, deeper-subsurface overall positive structure marked by areally restricted unconformities in Upper Cretaceous strata.



Late Quaternary Stream and Estuarine System Responses to Holocene Sea Level Rise on the OCS Louisiana and Mississippi: Preservation Potential of Prehistoric Cultural Resources and Sand Resources

This project was initiated to better understand how prehistoric coastal plains and contintinental shelves responded to sea-level rise and determine the preservation of paleo-landscapes. The preservation of paleo-landscape is important because it is a factor in the preservation of scientifically signficant archaeological deposits during the submergence of Pleistocene and Holocene coastal plains during the Holocene trasnsgression to form the modern continental shelf.

During terminal Pleistocene and Holocene sea-level rise, a variety of sedimentary processes extensively modified the Louisiana coastal plain and continental shelves. As the Late Pleistocene – Holocene trangression occurred, both shoreface and tidal processes deeply eroded the interfluves of coastal plain interfluves. This erosion created well-defined ravinement surfaces and likely destroyed the existing archaeological deposits and sites within this part of submerged coastal plains. However, segments of paleo-landscapes and their associated archaeological deposits could have escaped shoreface and tidal erosion and destruction when buried below the ravinement surface within deeply cut paleovalleys. In additiuon, the backstepping of fluvial and estuarine sedimentation during period of rapid sea level rise offered possibility of for the preservation of isolated segments of the paleo-landscape and associated archaeological deposits.

The evaluation of the circumstances that resulted in the preservation of paleo-landscapes required the interpretation of internal stratigraphy, structure, and relative age of individual paleovalleys. this was done using a geographic information system (GIS) compilation of the southwestern Louisiana continental shelf was developed from industryhazards survey maps with interpreted paleovalley deposits for 131 blocks, seismic profiles, and boring data.

An examination of this data resulted in the recognition of five Upper Pleistocene to Holocene stratigraphic units and four associated unconformities. For a few units, unambiguous correlations could be made with units previously dated, and characterized onshore for their sedimentology and geoarchaeology. It was found that shallow seismic and scant vibracore data lack the resolution to discern the nature of paleovalley fills and determine if features such as paleosols, middens, etc. are present. Moreover, constraining the age of paleovalley fills is difficult because of their stratigraphic amalgamation, time - transgressive nature, limited absolute dates, difficulty correlating onshore-offshore, and stratigraphic incompleteness. Existing models used for predicting prehistoric cultural resource potential should be revisited to account for multiple sea-level fluctuations and further refined using absolute dating methods and sedimentological models.

Investigative and GIS development of the Buried Holocene-Pleistocene Surface in the Louisiana Coastal Plain

The Louisiana Geological Survey was contracted by The Water Institute of Gulf on behalf of Coastal Protection and Restoration Authority of Louisiana to investigate, assess, and develop a three-dimensional GIS dataset of the buried Holocene-Pleistocene surface, a regional unconformity sometimes known as the "base of the Holocene", for coastal Louisiana.This investigation was undertaken because of a lack of a single comprehensive map delineating the Holocene-Pleistocene surface that covers the entire Louisiana coastal plain and coastal waters. Rather, the available data consisted of maps created by various authors at different times in different study areas and using different criteria. As a result, many gaps exist in the coverage of these maps as well as conflicts in their interpretation.

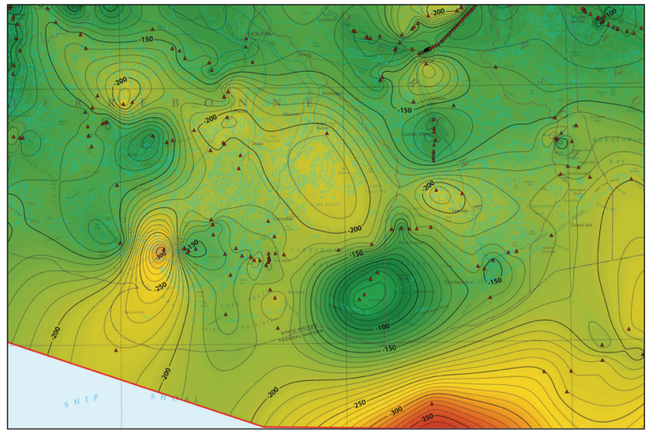
The technical work conducted for this project consisted of: (1) a search and investigation of 15,863 existing published and unpublished boring locations; (2) an assessment of the effectiveness of the source data; (3) data development and compilation of 3,012 useful H-P data points; (4) the development of a GIS dataset of the Holocene- Pleistocene surface; and (5) the preparation of deliverable GIS datasets, digital maps, and a final report with an interpretation of the data.

It is intended that the Holocene-Pleistocene surface model of the entire Louisiana coastal plain will offer improvement in understanding geologic variables in engineering design for coastal restoration projects, reduce uncertainties in accessing future geo- environmental conditions, support decision-making on coastal issues, and help improve data and assumptions used in predictive subsidence modeling.

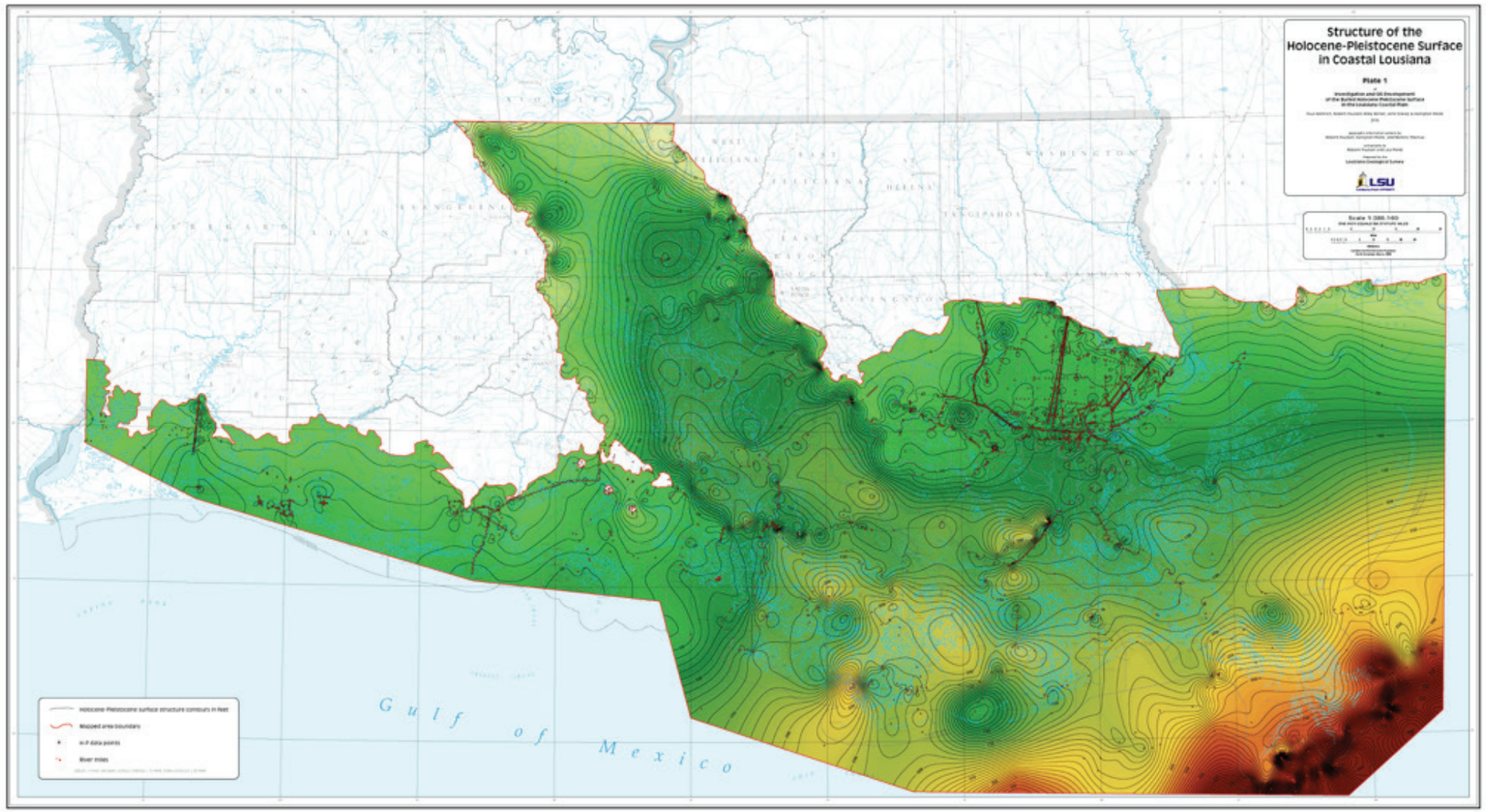
The creation of a more comprehensive database of subsurface data for the shallow subsurface of the Louisiana coastal zone is needed. It will require more than just data concerning the depth of the Holocene-Pleistocene surface to fully understand the variation of subsidence rates. Eventually the variability in the stratigraphy, morphology, and lithology of the individual facies of the many fluvial, deltaic, and marine deposits that overlie it will have to be understood as thoroughly as the older geologic units underlying it, now revealed by deep oil and gas geophysical logs, micropaleontology, and 3D seismic technology.

Robert Paulsell presented preliminary results of this study at the 2015 Louisiana Remote Sensing and Geographic Information Systems (LaRSGIS) workshop in Baton Rouge, Louisiana. RSGIS 2016 will be held in Lafayette, Louisiana.

Surface geology and geographic regions of the Louisiana coastal plain. Adapted from Snead and McCulloh (1984) and Spearing (1995).



Barataria – Structure map of the H-P surface within the Barataria/Terrebonne area. Red triangles show location of boring data.



Structure of the Holocene-Pleistocene Surface in Coastal Louisiana. Small scale reduction of the 1:380,160 original

Top: LGS staff conducting a Flow Tracker® survey of Shettleworth Bayou near Shreveport, Louisiana.
Botom: A close up view of the Flow Tracker® in operation for survey.

Stream Gauging and Rates Curve Study of Louisiana streams after two years of study

This study determined stream discharges at 51 sites and the developed rating curves from the discharge and stream gage height results. At least eight discharge values are measured at each stream selected for rating curve development. Louisiana Geological Survey (LGS) staff that worked on this project were: Reed Bourgeois, Douglas Carlson, Brian Harder, Marty Horn, Chacko John, Riley Milner, Patrick O'Neill, and Robert Paulsell. Project work started in March of 2013 and continued till June 2015. The goal of eight measurements was exceeded for nine streams: Bayou Courtableau at Washington, Bayou Vermilion near Carencro, Little Sandy Creek at Peairs Road near Milldale, Mc Cain Creek near Blanchard, Paw Paw Bayou near Greenwood, Shettleworth Bayou near Blanchard, Ward Creek at Essen Lane near Baton Rouge, West Colyell Creek at Joe May Road near Port Vincent, and Willow Chute Bayou at Swan Lake Road near Bossier City.

Discharge data was determined by using two different instruments. The River Surveyor is used for larger streams where the depth of water is usually over 1.5 feet, while the Flow Tracker® is used for smaller streams where the depth of water is generally less than 2 feet.

Within the last year, River Surveyor bridge pull measurements were completed with a single person handling the boat's rope and the cell phone, an alternative for recording and displaying results to the computer. The boat measures stream depth and flow velocity, as one walks back and forth across the bridge pulling the boat or pulling boat back and forth across the stream with ropes twice for usually four trips.

The Flow Tracker® is a two man operation where one person reads position along a tag line, depth of water from the staff on the instrument and the velocity from the Flow Tracker® while the second person records the information. For smaller streams a single person was able to complete all tasks associated with a Flow Tracker® measurement. These positions, depths and velocities are entered into a spreadsheet that solves for stream discharge using three techniques and then averaged. The resulting discharge is correlated to a gage height as recorded at a nearby USGS gaging station for a point for the stream rating curve that was developed.

Discharge measurements have ranged from approximately 11,050 cubic feet per second (cfs) for the Amite River at Grangeville, LA on March 2, 2015; to less than 0.02 cfs for Willow Chute Bayou, Bossier City, LA on November 19, 2013. The River Surveyor discharge measurements for larger streams were generally larger than Flow Tracker® discharge measurements for smaller streams. The average discharge for the 315 measurements made by the River Surveyor is 1,124 cfs, while the average discharge for the 100 measurements made by the Flow Tracker® is 19.6 cfs. Among the River Surveyor measurements for the 118 bank pull measurements the average measured discharge is 299 cfs while for the 197 bridge pull measurements the average measured discharge is 3,317 cfs.

Rating curves have been developed for each of the 51 stream site within the study. In general, the correlation coefficients for rating curves were over 0.8. Although rating curves have been developed for all 51 streams, they lack high discharge observations which tends to lead to many possible days of flow/gage height in the extrapolation range, which has a great deal of uncertainty. It is critical to observe flood events in the range of the three year flood event to yield a rating curve that is useful for prediction of extreme events. At the present time only five streams in the LGS data set have an observation range over 90% of the 3 year range of daily mean gage height values recorded.

The four monitoring sites which were setup by LGS have been successful in measuring water levels over the past two years. They have observed water level changes that were planned for and completed in the case of Black Lake, False River and Henderson Lake and included a reasonable response after a 7 inch rainfall event at New Roads. In the case of Black Lake results are reasonable and similar, correlation coefficient is almost 0.95. Lastly results at Lake Bruin are reasonable, responding to seasonal variation in a damped down version of the Mississippi River that lies approximately one half mile east of the lake.

In summary, both aspects of the study have been a worthy contribution to understanding these streams and lakes. When fully developed the set of rating curves will increase by almost 70% the streams with discharge values noted by the United States Geological Survey (USGS).

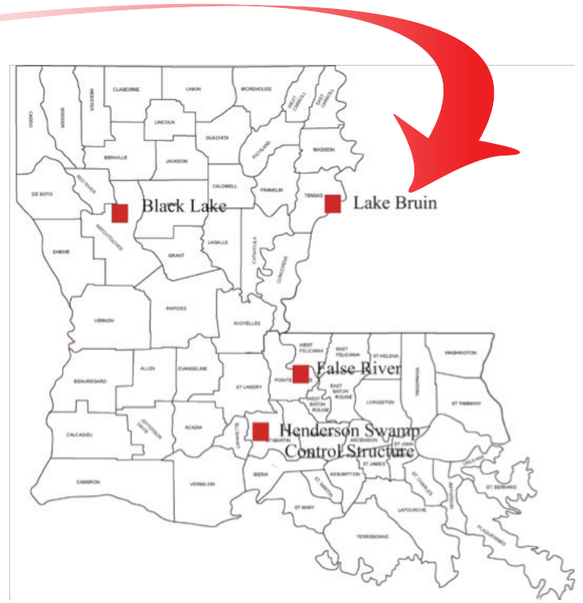
LGS Finishes Coal-Bed Methane Study under National Coal Resources Data System (NCRDS)

In June of this year, Louisiana Geological Survey completed a multi-year evaluation of Louisiana coal seams as an economically viable sources of methane (coal-bed methane, or 'CBM'). The study was sponsored by the United States Geological Survey under the National Coal Resources Data System (NCRDS) program to assess coal and coal-related energy resources nation-wide. The program's findings are made publicly available and are of particular interest to producers and stewards of energy resources in the United States.

Louisiana coal-bed methane is largely confined to the north Louisiana subsurface with sufficient structural and stratigraphic trapping to sequester economically important volumes of methane gas. The LGS study examined Tertiary coastal fluvo-marine siliciclastic strata with particular focus on the Paleocene-Eocene Wilcox Group of muds and fine sandstones.

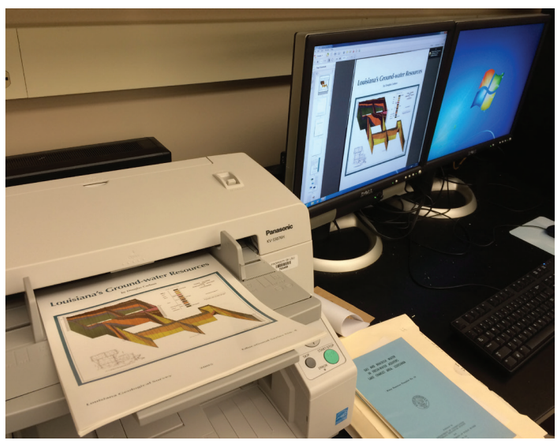
Wilcox stratigraphic architecture is notoriously complex, making consistent nomenclature an unwieldy task, but creating ideal localized trapping of coal-bed methane. The greatest volume of CBM production to date is along a trend reaching from Woolen Lake field, southern Richland Parish, south-southwestward through Riverton field, Caldwell Parish, and to Olla field, northern LaSalle Parish. Along this trend basal Wilcox depth ranges from about 2000 feet to 4000 feet, implying Wilcox CBM, or at least the majority of it, is biogenic, a conclusion confirmed by geochemical analyses.

North Louisiana CBM volume estimates are based upon the proportion of gas to coal volume and the volume of coal, which in Wilcox occurs as an anastomosing network of seams mostly less than ten feet thick over most of the study area, locally up to 20 feet thick. Measurements based upon unique geophysical signatures in neutron-density and sonic well logs yield the important source parameters of maximum and net coal-seam thickness. Combining these measures with areal extent gives an approximate net volume of subsurface Wilcox coal of about 80 trillion cubic feet. Based upon gas:coal volume ratios observed elsewhere, this corresponds to about 800 to 1000 Tcf methane. Once rates of historical production and methane generation are established, these results will permit estimation of coal-bed methane reserves remaining in-situ.



Digital Infrastructure and Data Rescue of Historic Louisiana Geological Publications

Most LGS publications will soon be available in digital format (pdf), thanks to funding provided by the United States Geological Survey's National Geological and Geophysical Data Preservation Program (NGGDPP). The Fiscal Year 2015 phase of the project involved the scanning and digital preservation of over 180 items in the LGS Publications Catalog in digital form. This includes several documents that were published by predecessor agencies as far back as 1869. Metadata records of each have been entered into the National Digital Catalog.



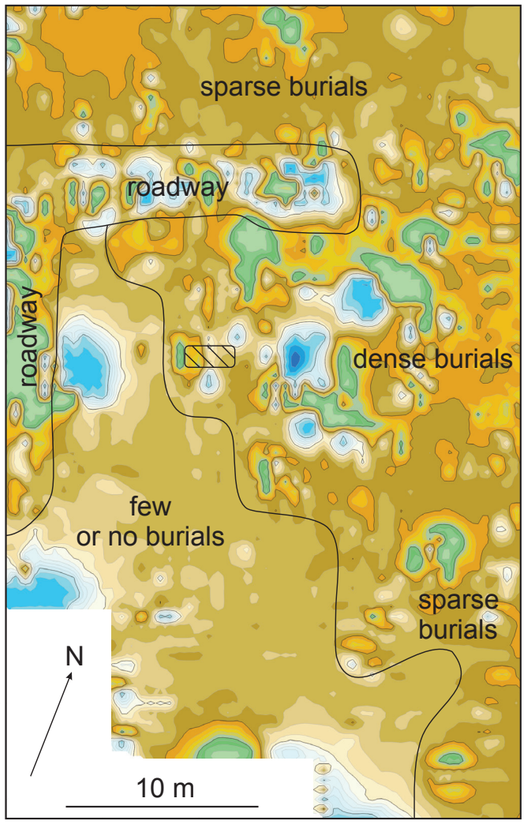
The long-term effect of Geologic Review has been an overall 75% reduction in the average length of canals and board roads built in the Louisiana Coastal Zone.

Geologic Review

Geologic Review is an environmental geology program providing regulatory technical assistance to the Coastal Management Division of the Louisiana Department of Natural Resources and to three districts of the U.S. Army Corps of Engineers. It assists in the implementation of section 404 of The Clean Water Act and the Louisiana Coastal Resources Program regulations, both of which impact oil and gas operations by mandating that only the least damaging feasible alternative be permitted. Oil and gas permit applications made to these two agencies which involve significant environmental impact to vegetated wetlands or other environmentally sensitive areas have their geology, engineering, lease, and site-specific data reviewed and evaluated by the Louisiana Geological Survey in order to determine if any less-damaging feasible alternatives are available. Such alternatives may include reducing the size of ring levees and slips, reducing the length of board roads and canals, the use of directional drilling, and the use of alternate and less-damaging access routes, the goal being to avoid or minimize any environmental damage. Geological Review involves interagency participation; up to ten state, federal, and local agencies may be involved on any given oil and gas permit under review. An annual reduction in permitted impact footage versus requested footage of 85+% is not uncommon. The long-term effect of Geologic Review, which began in 1982, has been an overall 75% reduction in the average length of canals and board roads built in the Louisiana Coastal Zone.

Geophysical Investigation of Bishop Cemetery, St. John the Baptist Parish, Louisiana

The Louisiana Geological Survey conducted a 2-week geophysical investigation of Bishop Cemetery, near Garyville, Louisiana, to test geophysical techniques for determining, as accurately as possible, the distribution of cemetery burials. Magnetometry - measurement of spatial variations in Earth's magnetic field, and probing – measurement of soil resistance to penetration by a pointed rod – applied over the cemetery generated a database for anomaly maps which can be interpreted in terms of burial location, orientation, and distribution. Under ideal conditions both methods can resolve individual burials, however in locations where burials are concentrated or clustered, interpretations are necessarily limited to simply defining the cluster boundary. These two field techniques are routinely applied in geophysical investigations of archeological sites (Reynolds, 1997; Bevan, 1998, Gaffney and Gater, 2003; Oswin, 2009; Milsom and Eriksen, 2011) and with some success in identification of cemetery burials, in particular (DeVore, 2011; Gregory et al, 2015). Three instruments were applied in this study, but results from electrical resistivity measurements were of little use due, apparently affected by a high water table and the abundance of wet clay in the subsurface sediment.



Magnetic gradient anomaly map of part of Bishop Cemetery. Blue = high positive values, green = low negative values, gold = near zero gradient

Bishop Cemetery

Bishop Cemetery is located in St. John Parish, Louisiana, near San Francisco Plantation and the town of Garyville. The availability of authentic documents and published studies related to the history of the cemetery are limited and none were discovered for this study, but anecdotal claims indicate that the cemetery opened in 1910 to serve workers at San Francisco Plantation and their descendants (Gilger, 1984). The cemetery property was apparently part of the plantation at one time during its height in the early – middle 19th century. Only a few burial markers currently exist in the cemetery, so this investigation and its results are crucial to plans for management of future interments.

Results

Manual probing and magnetic gradient measurements over the cemetery produced anomaly patterns that can be interpreted as areas of burials vs. areas where few, if any, burials occur. For magnetometry, field tests conducted by LGS show that little or no disturbance to Earth's magnetic field is induced by either wood or the human body. Conversely, strong magnetic field anomalies are induced by steel, which occurs in cemeteries as reinforcement in concrete headstones or footers, as components of grave decorations, as coffin hardware, or as the entire coffin hull. Hence, cemetery burials are interpreted vicariously from magnetic gradient anomalies that correspond to burial-related steel items. In some instances, individual burials can be inferred from isolated anomalies of appropriate breadth and shape.

The color-contour map shows the magnetic gradient anomaly pattern for part of Bishop Cemetery in shades ranging from blue (high positive gradient) to green (low negative gradient), with gold shades corresponding to near zero magnetic gradient. Clustered of anomalies indicate two distinct features: an abandoned roadway lying west-east in the northern half, and a concentration of burials in the eastern two-thirds. The southwestern area, in contrast, apparently hosts few, if any, burials. A number of anomaly peaks are oblong and oriented roughly north-south suggesting these represent north-south oriented headstone footers for graves that are oriented west-east. Several individual burials can be discerned in the map using these criteria, an example of which is shown with a diagonal pattern (near center).

The LGS Bishop Cemetery provided an excellent opportunity to test geophysical techniques for resolving burials or areas of burials in historic cemeteries where markers no longer exist. The absence of burial markers is a common problem in 19th century cemeteries throughout the state, but geophysical methods may offer at least a partial solution to locating and mapping the burials.

References

Bevan, Bruce W., 1998, "Geophysical Exploration for Archeology: An Introduction to Geophysical Exploration", Midwest Archeological Center, Special Report No. 1, Midwest Archeological Center, Lincoln, Nebraska, 107 p. + 177 figs.

DeVore, Steven L., 2011, "Geophysical Investigations of Four Selected Areas within the Fort Jessup Military Reservation Site (16SA212) in Sabine Parish, Louisiana", Louisiana Archeology, pp. 7 – 41.

Gaffney, Chris, and John Gater, 2003, "Revealing the Buried Past", Tempus Publishing, Ltd., Stroud, Bloucestershire, UK, 192 p.

Gilger, Kristin, 1984, "Plant Hides Cemetery", The Tuscaloosa News, Thurs., December 12, 1984, https://news.google.com/newspapers?nid=1817&dat=19841212&id=AzQdAAAAIBAJ&sjid=m6UEAAAAIBAJ&pg=4979.4778909&hl=en

Gregory, B., M. Horn, and Brooks Ellwood, 2015, "Trials of Near-Surface Geophysics at Archeological Sites in SE Louisiana", Gulf Coast Association of Geological Societies Transactions, v. 65, p. 619.

Milsom, John, and Asger Eriksen, 2011, "Field Geophysics", 4th ed., John Wiley & Sons, Ltd., Chichester, West Sussex, UK, 287 p.

Oswin, John, 2009, "A Field Guide to Geophysics in Archeology", Springer-Praxis, Chichester, UK, 221 p. + 11 plates.

Reynolds, John M., 1997, "An Introduction to Applied and Environmental Geophysics", John Wiley & Sons, Ltd., Chichester, West Sussex, UK, 796 p.

Evaluation of Water Permit Requests

The Louisiana Geological Survey has entered into a renewal contract with the Department of Natural Resources. LGS will provide technical support in hydrology for the evaluation of applications for withdrawal of running surface water resources submitted to the Secretary of Natural Resources pursuant to Act 955 of 2010. This data collected will be incorporated into a working "water budget" for the running water resources of Louisiana.

Revised Oil & Gas Map of Louisiana

The Louisiana Geological Survey (LGS) is working on producing a revised and up to date Oil and Gas Fields Map of Louisiana which is expected to be published digitally by the middle of 2016. The last map was published by LGS in 2008 and showed active depleted, and inactive oil and natural gas fields including streams, main highways and parish boundaries.

Investigation of Unconventional Potential Shale for oil plays

As mentioned in the previous issue of this publication (volume 24, 2014) the geopressured- geothermal unconventional resources of the Gulf Coast states represent a future major energy resource when the technology is fully developed and the economics of commercial development become profitable and feasible. The Tuscaloosa Marine Shale (TMS) continues to be developed as a significant oil play covering Louisiana and Mississippi and many commercially successful wells have already been completed in this play. The 1997 LGS paper published in the Basin Research Institute (now part of LGS) bulletin (Volume 7, August, p. 3-23) remains a landmark reference on the TMS play. LGS has also initiated a study to evaluate the existence of unconventional potential shale gas/oil plays including bypassed oil/gas resources in Louisiana especially in depleted fields and hopes to find a suitable funding source for this project in due time.

Cartographic Projects

New Geologic Map of Louisiana

The 1984 Geologic Map of Louisiana was the first modern state geologic map published and has proven very useful, having gone through three printings. But much has changed in the last 30 years. The 1984 map was compiled, designed and produced entirely by hand, well before the availability of digital satellite imagery, computer graphics, and geographic information system (GIS) technology. Three decades of new field geologic investigations at 1:24,000 and the publication of a new 1:100,000 geologic quadrangle series has made many new interpretations available. Recently LIDAR technology has revolutionized the mapping of geomorphic landforms in a state where 55% of the area is comprised of Quaternary units.

A new state geologic map is now being prepared by the Louisiana Geological Survey to take advantage of the new technologies and new interpretations. The map will be designed for a scale of 1:380,160, the same scale as the popular Official Map of Louisiana, the Louisiana Coastal Zone map, and the Louisiana Shoreline Change 1937-2000 map. The new Geologic Map of Louisiana will be made available both as a traditional published lithograph, a GIS dataset, and a digital PDF map useful on computers and digital devices. The project is anticipated to take two years to complete.

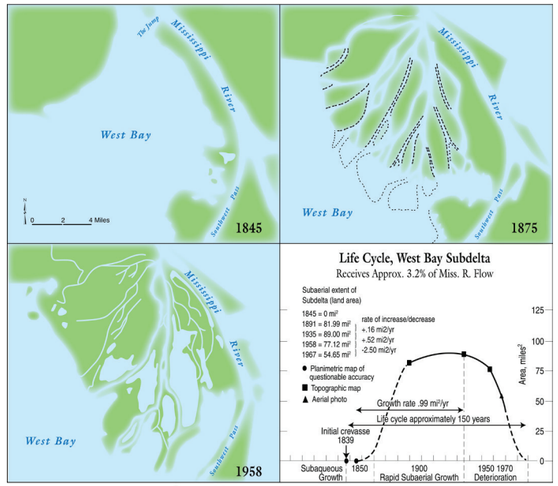
Bayou Teche Paddle Trail and Historical and Cultural Map

Cartographers with the Louisiana Geological Survey (LGS) at LSU, won "Best of Category in the Recreational/Travel Map Category" in the 2015 Cartography and Geographic Information Society (CaGIS) Map Competition. Their entry, "Bayou Teche Paddle Trail and Historical and Cultural Map" received the award at the 42nd CaGIS Map Design Competition at Montgomery College, Rockville, MD. The map was produced in conjunction with the TECHE Project, a non-profit organization that manages the Bayou Teche Paddle Trail, a US Department of the Interior Water Trail.

The two-sided waterproof map shows canoe and kayak access points on Bayou Teche beginning at Port Barre traveling over 131 miles to Morgan City, La. Informative symbols show paddlers what to expect along their journey. The reverse side, Historical and Cultural Map of Bayou Teche, highlights locations and events that have happened throughout the years along the bayou, as well as text entries titled "The Legend of the Teche" and "Natural History of the Bayou." Native American place names are shown in the language of the local Chitimacha tribe.

The Mississippi River Source to Sink System: Perspectives on Tectonic, Climatic, and Anthropogenic Influences, Miocene to Anthropocene

This article published in the Journal Earth-Science Reviews, Volumn 152 authored by Sam Bentley, PhD; Michael D Blum, PhD; and Jillian Maloney, PhD. and co-authored Lisa Pond and Robert Paulsell examines the Coastal and Shelf Sediment Transport Processes and Products of the Northern Gulf of Mexico with focus on influences of the Mississippi River Sediment dispersal system (MRS) over Neogene timescales. It also looks into the integration of fluvial and marine processes with the valley to shelf to deepwater regions. Including a discussion of MRS evolution through the late Pleistocene and Holocene. The article concludes with an evaluation of Anthropocene MRS morphodynamics and source-to-sink connectivity in a time of profound human alteration of the system.



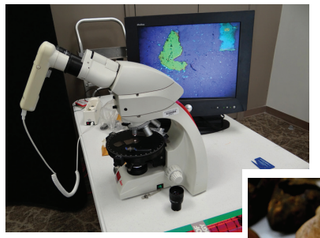
LGS Outreach Activities

Ninth Annual Groundwater Symposium: This past April, 16, 2015 the Louisiana Geological Survey (LGS), Baton Rouge Geological Society (BRGS) and Louisiana Water Resources Research Institute hosted the ninth annual Ninth Annual Louisiana Groundwater, Water Resources & Environmental Symposia. The symposia was held at the Energy Coast and Environment Building in Dalton Wood Auditorium and adjacent conference room throughout the morning and afternoon of April 16, 2015. Many staff members were involved in all aspects of this symposium from the start to its finish. The attendance was approximately 100 which was the largest of the nine symposia hosted by LGS and BRGS throughout the last decade. Those who attended represented universities, consulting firms throughout Louisiana as well as both LGS and the United States Geological Survey (USGS).

There were 40 papers presented. Papers were presented by faculty and students from a number of Louisiana universities, staff from Louisiana state agencies, staff from local consultants and staff from LGS and USGS. Papers covered a variety of subjects which focused mainly on water quality and water supply of groundwater and fresh surface water. A number of papers concerning water management, water treatment and legal aspects of water management were also presented.

This was the first symposia since the start of the registration of geoscientists by Louisiana Board of Professional Geoscientist (LBOPG). With this in mind a paper was presented by John Johnston III, LGS, in regards to the history and development of the current Louisiana Professional Geosciences practice act which requires registration and licensing of professional geoscientist. One of the requirements of this act is that professional geoscientist need to yearly earn a defined number of continuing education hours. The symposium provided many professionals an opportunity to complete a significant portion of the continuing education requirements as define by the LBOPG. Professional geoscientists of general educational hours required and many completed their ethics requirement as defined by LBOPG which is one hour yearly. At this symposium William Schramm, Louisiana Department of Environmental Quality, presented an hour long class on ethics titled "Ethics for Geoscientists and Engineers". The full schedule of this meeting and abstracts for each presentation are available at http://lwrri.lsu.edu/conference/.

Rockin' At The Swamp: LGS participated in "Rockin' the Swamp", a one-day educational outreach event for schools and the general public organized by Baton Rouge Parks and Recreation Bluebonnet Swamp Nature Center on Saturday March 7, 2015. The LGS exhibit booth displayed a poster of the Brushy Creek Meteorite Impact Crater in St. Helena Parish, rocks and minerals specimens found in Louisiana and other places, and thin sections of rocks and the Greenwell Springs Meteorite which was discovered in 1987 just northeast of Baton Rouge, LA in Livingston Parish. The LGS's Scope-on-a-Rope was set up to view rock and mineral specimens, or anything else attendees desired to view (i.e. skin, plant parts etc.) on a TV/monitor screen. Fossils specimens from Louisiana and around the world were also displayed. The LGS booth proved to be one of the star attractions for the hundreds of children and adults attending the event. The event also featured gem and mineral vendor booths and other natural science exhibits.



Abstracts of Research presentations at GCAGS Conference, Houston, TX, September 20-22, 2015

Changes of Global Sea-Level Rise and Relative Sea-Level Rise in Coastal Louisiana in the 21st Century

Douglas Carlson

The rate of relative sea-level rise has been measured for approximately 200 years at ports largely in the north Atlantic and measured at sites along the Gulf of Mexico coast of Louisiana for nearly 100 years. The rate of relative sea-level rise (RSLR) has been determined to be accelerating due to global warming measured over the past 130 years. However, in the past 18 to 20 years there has been observed a pause of global warming when the temperature has remained approximately constant. Has the temperature pause impacted RSLR for Louisiana? For the Louisiana coast line RSLR was impacted more by local subsidence than global sea-level rise. A number of studies have determined Louisiana RSLR is to up to ten times greater than that due to only global RSLR. For the Louisiana coast line has a reduction in oil production during the past twenty years impacted RSLR significantly?

Values of RSLR in Louisiana and Florida were determined using U.S. Geological Survey tidal gaging stations located in those states, which were located in rivers or streams where records clearly show the daily influence of tides. This set of data includes over a dozen stations in Louisiana and Florida. The RSLR value at each station was determined by taking a linear regression of daily mean gage values. Stations records are typically 10 to 15 years in length. Florida is considered a stable area where RSLR lacks any significant impact from local subsidence. By contrast, Louisiana is an area where RSLR is dominated by local subsidence due to isostatic flexure caused by a thick pile of sediment, over 50,000 feet thick that has been dumped into this region by the Mississippi River and ancestral versions since the Jurassic. This explains the difference of average RSLR between Louisiana and Florida.

The Environmental Impact of No-Till Farming on Lower Mississippi River Quality

Douglas Carlson

Mississippi River water quality has been studied for approximately 175 years. Many of these studies focus on total suspended sediment (TSS), and/or nutrients. There have been a number of changes to the river itself and the surrounding watershed that impacted water quality. One of the major changes that has recently occurred within the watershed is the adoption of no-till farming practice, mainly in the last 25 years. How, has this change impacted water quality?

Numerous studies indicate that no-till farming reduces sediment loss by approximately 80% to 100% and nutrient loss of 20 to 40%, when compared to conventional tillage practices. In the last three decades, millions of acres of cropland within the watershed have been converted to no-till cultivation practice. What has the change of TSS and nutrient concentration been at stations with long histories, generally over 30 years? For example, the concentration of TSS for the Mississippi River at New Orleans has fallen from typically 700 ppm in the 1920s, to 500 ppm in 1950s, to 200 ppm in 1970s, and to 100 ppm in 2010s. Changes through 1970 are largely the result of construction of control structures. However, these structures were largely completed by 1970. If so, why has TSS concentration been cut in half and there been a reduction in nutrients, even though sale and consumption of fertilizers has remained approximately constant over the past 30 years? The focus study is on results for the lower Mississippi River. However, dozens of sites within sub-watersheds throughout the Mississippi River watershed are examined in order to see if the changes within the full watershed are mainly a result of change in cultivation practice towards no-till practice. This involved the comparison of concentrations prior to no-till farming in the 1970s to concentrations in last decade, using two different nonparametric statistical tests of Median and Mann-Whitney Ranks.

Trials of Near-Surface Geophysics at Archeological Sites in Southeast Louisiana

Brittany Gregory, Marty Horn, and Brooks Ellwood

The Louisiana Geological Survey, in coordination with LSU, conducted a series of geophysical surveys at archeological sites in the gulf coast region of southeastern Louisiana to evaluate instrument and field technique performance in densely vegetated, organic-rich, water-saturated, and nonconsolidated sedimentary substrate. Test measurements of magnetic field intensity and electrical resistivity over appropriately sized and spaced sampling grids at 19th c. sites in the Baton Rouge – New Orleans area aimed to detect known or suspected anthropogenic features. Magnetic gradiometer data successfully resolved artifacts in these settings, such as subsurface occurrences of building foundations, steel or iron objects, and cemetery burials. Electrical resistivity and induced polarization data also resolved cemetery burials and abandoned pathways, depending upon electrode array configuration

Both field methods have strengths and weaknesses that are significant to investigation in the Louisiana coastal setting. Measurements us-

ing the proton precession magnetometer are not affected by water table level and the raw data require minimal processing. However, the instrument does not differentiate between artifacts vs. irrelevant modern steel clutter from over two centuries of human habitation. The 4-electrode electrical resistivity survey is less sensitive to small isolated objects and can resolve stratigraphic horizons, but is impacted by ground water and the data typically require processing. Nevertheless, application of both instruments constitutes a valuable component of archeological exploration. Continued development of field and data processing techniques will broaden application to settings with fewer interpretive constraints, making them attractive tools for inexpensive and noninvasive exploration of archeological sites, particularly when applied in conjunction with archeological observations and expertise.

Late Quaternary Stratigraphic Evolution of the Southwestern Louisiana Inner Continental Shelf: Paleo-Landscape Preservation Potential and Implications for Offshore Sand Resources

Paul Heinrich, Michael Miner, Robert Paulsell, and Richard McCulloh

Understanding how exposed coastal plain shelves respond to sea-level rise is important to determine paleo-landscape and associated intact prehistoric cultural resource preservation potential within the modern shelf. During sea-level rise, wave and tidal ravinement eroded the coastal plain interfluves. Backstepping fluvial and estuarine sedimentation within incised valleys potentially preserved landscape features below the depth of ravinement. Along-strike variable shoreface retreat rates locally favored preservation landward of barrier islands, shoals, and headlands as adjacent landscapes were eroded.

Shallow seismic and scant vibracore data lack the resolution to discern the nature of paleovalley fills and determine if features such as paleosols, middens, etc. are present. Moreover, constraining the age of paleovalley fills is difficult because of their time - transgressive nature, limited absolute dates, difficulty correlating onshore-offshore, and stratigraphic incompleteness.

To interpret better internal stratigraphy, structure, and relative age of individual paleovalleys, a geographic information system (GIS) compilation of the southwestern Louisiana continental shelf was developed from industry hazards survey maps with interpreted paleovalley deposits for 131 blocks, seismic profiles, and boring data. Five Upper Pleistocene to Holocene stratigraphic units and four associated unconformities are recognized. For a few units, unambiguous correlations can be made with units previously dated, and characterized onshore for their sedimentology and geoarchaeology. Chronostratigraphy is refined based on cross-cutting relationships and identification of bounding surfaces identified in previous studies adjacent to the southwestern Louisiana shelf, and indicates that existing models used for predicting prehistoric cultural resource potential should be revisited to account for multiple sea-level fluctuations and further refined with absolute dating methods.

Geological Society of America annual meeting, Baltimore, November 1–4, 2015

Richard McCulloh

Finalized and submitted an abstract to a poster-format session on the status and future of geologic mapping in commemoration of the 200th anniversary of the publication of William Smith's geological map of part of Great Britain, to accompany a display featuring the Black Bay and Mississippi River Delta 30 x 60 minute geologic quadrangles.

Geologic Mapping Of The Mississippi River Delta Region At 1:100,000 Scale

Richard McCulloh, Paul Heinrich, and Chacko John

In the post–World War II era, the Holocene Mississippi River delta complexes were first defined in work by oil companies (e.g., H. R. Gould and D. E. Frazier of Esso Production Research Company, H. N. Fisk and E. McFarlan, Jr. of Humble Oil & Refining Company, and R. J. Leblanc of Shell Oil Company); the Louisiana State University Coastal Studies Institute (especially W. G. McIntire, J. P. Morgan, J. M. Coleman, and H. H. Roberts); the U. S. Army Corps of Engineers (USACE) Waterways Experiment Station (e.g., C. R. Kolb, J. R. Van Lopik, and R. T. Saucier); and others. Their depictions of the delta complexes were very small-scale and either as vegetation, facies, or in the case of the USACE, in stack-unit format; they were not treated at larger scales as mapped polygons representative of suites of surface-geologic map units. The Louisiana state geologic map (1984) also did not depict delta-complex polygons at 1:500,000 scale, and showed marsh types in the delta plain instead. The plate depicting Quaternary geology of the Lower Mississippi Valley prepared to accompany the volume on Quaternary non-glacial geology of the conterminous United States for the Geological Society of America's Decade of North American Geology series (1989) depicted the delta complexes, but at a scale of 1:1,100,000.

Among the Louisiana Geological Survey's titles in its 30 × 60 minute geologic quadrangle series, begun in 2000, six sheets cover nearly the entire delta plain at 1:100,000 scale. The most-recent and final delta-plain sheets completed in the series are Black Bay and Mississippi River Delta; these show the distribution of meanderbelt, natural levee, and undifferentiated delta-plain deposits of the Plaquemines–Balize (modern), Lafourche, and St. Bernard delta complexes as polygons for the first time at this level of detail.

Gulf of Mexico Offshore Sand Management Working Group

LGS staff, Robert Paulsell, Paul Heinrich, Riley Milner, and Rick McCulloh, attended the Bureau of Ocean Energy Management (BOEM), in partnership with the Gulf of Mexico Alliance, convened the Gulf of Mexico Offshore Sand Management Working Group (SMWG) on October 13,2015 at the Intercontinental Hotel in New Orleans, Louisiana.

The meeting took place the day before the American Shore and Beach Preservation Association's 2015 National Coastal Conference. Participants included representatives from federal, state, and local agencies, academic and research institutions, and consultancies. The meeting purpose and objectives were to:

- Provide the working group and interested stakeholders with an update on BOEM's Marine Minerals Program (MMP)'s and SMWG efforts;
- To share information on gulf-wide sand inventory initiatives from various states;
- To discuss lessons learned from recent sand management efforts;
- And to identify opportunities for continued GOM SMWG activities.

Marine Minerals Program Science Exchange 2015

LGS staff, Paul Heinrich, Riley Milner, and Rick McCulloh, attended the U.S. Bureau of Ocean Energy Management (BOEM), Gulf of Mexico Region, Marine Minerals Program (MMP) Science Exchange 2015 at the Astor Crowne Plaza Hotel on December 2nd, 2015 in New Orleans, Louisiana.

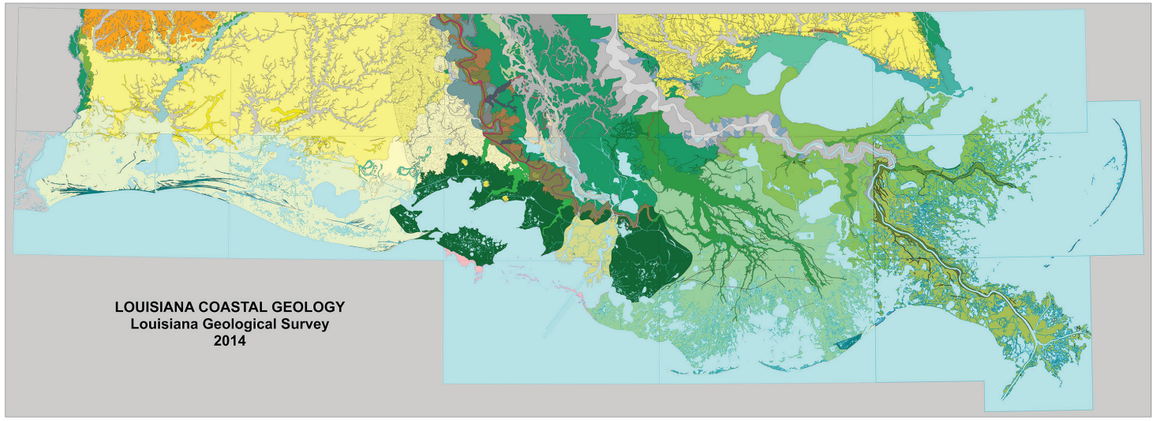
Participants included scientific investigators from Gulf Coast states conducting BOEM- sponsored research.

The meeting purpose was to receive and share updates on BOEM Gulf of Mexico Region MMP scientific research across the full range of supported disciplines, including marine ecology, underwater acoustics, OCS archaeological- and sand-resource potential, wave and current monitoring, and sedimentation in dredge pits.

2015 Annual Remote Sensing and Geographic Information Systems (RSGIS) workshop

R. Hampton Peele and Richard P. McCulloh presented an overview of the LGS geologic mapping process and status at the 2015 Louisiana Remote Sensing & GIS Workshop (larsgis.org) in May. The workshop was held at the Pennington Biomedical Research Center. Final review of these GIS data and associated metadata preparation is underway for the coastal Louisiana series.

Beginning in the late 1990s, LGS undertook the construction of GIS data of the surface geology of Louisiana, using light tables, mylar and colored plastic lead mechanical pencils to draw the geologic contacts and faults. The mylar sheets were then scanned and digitized using Intergraph MGE software. Years later, ESRI ArcGIS was selected as the software of choice for digitizing the mylar sheets. Subsequently, the geologists began using ArcGIS to digitize the geology in a "heads-up" GIS environment. The GIS mapping was the initial stage of data development producing open-file geologic map publications, available as plots on demand. Final reviews and edits are made when 30 x 60 minute quadrangles are selected to go through cartographic design and publication as color lithographs. The geologic lithographs are then uploaded to the LGS website for download, in PDF format. In the final stage, GIS data are edited according to the final reviews; and FGDC-compliant metadata files are populated in final preparation for GIS data release.



Katrina & Rita: A Decade of Research & Response

On Friday, August 29, LSU's Office of Research & Economic Development (ORED) hosted a symposium to reflect on the contributions that LSU made to the response effort and related research in the decade following Hurricane Katrina. R Hampton Peele provided an overview presentation of the Disaster Response Mapping Support that LGS and other LSU departments and personnel provided in the weeks following the Hurricane Katrina disaster. In 2005, LSU personnel were called upon to assist in the Katrina Disaster Response effort in many and varied ways. One very significant effort was to provide Disaster Response Mapping and other Geospatial Solutions in the Louisiana State Emergency Operations Center, which had no in-house mapping support. A small team of GIS professionals setup a GIS mapping operation in the situation room of the LA-EOC, on the fly. Almost immediately, mapping request began flowing in. The LSU Mapping Team grew rapidly, providing 24-7 service to any and all requesting agencies: federal, state, military, intelligence, local governments, and others. A network of personnel from LSU, State Agencies, and volunteers provided a wide variety of support services to the Mapping Team. Sixteen days later, after the LSU Mapping Team had taken some 150 mapping requests and Hurricane Rita had made landfall, FEMA announced that they would take all mapping requests in the future. Louisiana Geological Survey was a leader in this effort as well as in other related Katrina mapping response efforts. LSU is in the process of creating a digital repository. When the repository is created, there will be links to the presentations from the symposium.

Geologists Certification

The state of Louisiana now requires certification for professional geologists in the state. Details can be viewed at the Louisiana Board of Professional Scientists website www.lbopg.org. LGS staff member John Johnston III is the 2015-16 Chair of the Board.

Earth As Art Exhibit Coming To The Manship Gallery at Manship Theater

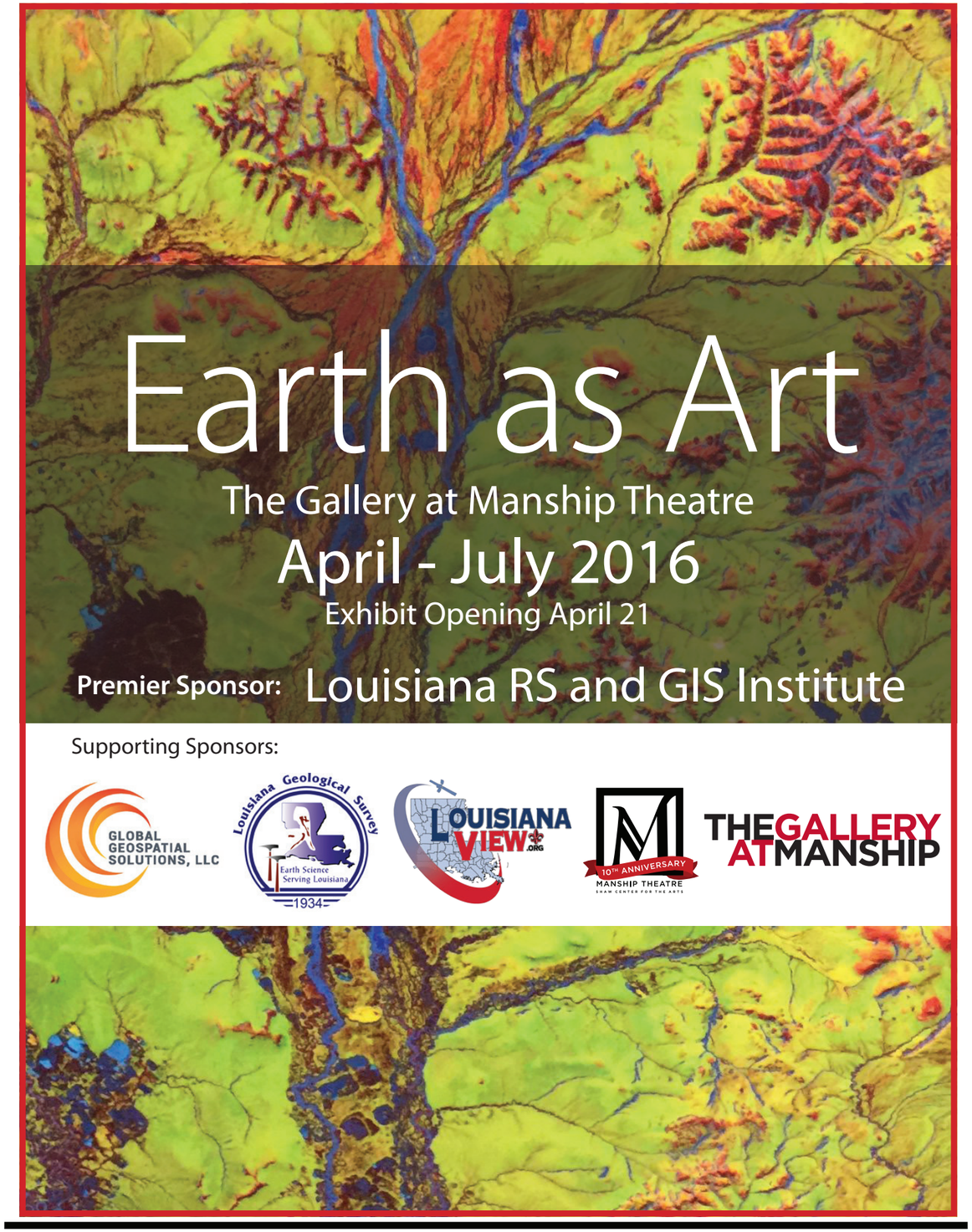
Hampton Peele (LGS) has teamed up with Fran Harvey of Global Geospatial Solutions, LLC, Brent and Samantha Yantis of Louisiana View, and the staff of the The Gallery at Manship to co-sponsor an exciting art exhibit that will be on display at The Manship Gallery (April – July, 2016) in Baton Rouge. This exhibit will feature stunning images of the surface of Planet Earth, captured by remote sensing sensors aboard the LANDSAT satellites, jointly operated by USGS and NASA. These dazzling images showcase Planet Earth from perspectives unavailable before the advent of remote sensing satellites.

The Earth As Art exhibit will go on display in April, just ahead of Earth Day (April 22); and, the exhibit opening and reception will be held in the early evening on April 21. In conjunction with the exhibit, the Manship Theater will offer documentary films focused on Planet Earth, throughout the month of April. The premier sponsor of the exhibit is the Louisiana RS and GIS Institute (LRSGIS), a local non-profit organization. The exhibit is free and open to the public.

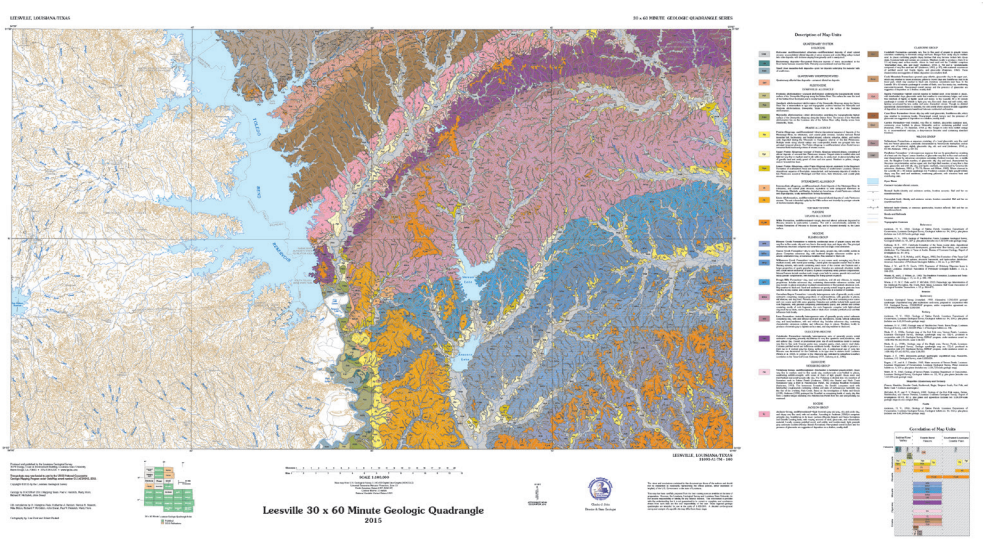
In association with the planning of this exhibit, Hampton Peele volunteered to attend an day-long educational workshop for interested high school students on GIS Day (Nov. 18, 2015) to present a dozen of the Earth As Art images to the students, give explanations of the technology and geography involved, and answer the students questions. The workshop, entitled "Mighty Maps Institute", was held at the Louisiana Educational Resource Center, co-sponsored by Global Solutions, LLC and LRSGIS, and funded by a grant from ESRI.

LGS Resource Center

The LGS Resource Center consists of a core repository and log library. It is located behind the old Graphic Services building on River Road. Most of our cores are from the Smackover and Wilcox Formations. The core facility has more than 30,000 feet of core from wells mostly in Louisiana. The well log library contains over 50,000 well logs from various parishes in the state. The Core Lab is equipped with climate controlled layout area, microscopes, and a small trim saw. The core and log collections are included as part of the LSU Museum of Natural History as defined by the Louisiana Legislature and is the only one of its kind in Louisiana.The LGS Resource Center is available for use by industry, academia and government agencies, and others who may be interested. Viewing and sampling of cores can be arranged by calling Patrick O'Neill at 225-578-8590 or by email at poneil2@lsu.edu. Please arrange visits two weeks in advance. A list of available cores can be found at the LGS web site (www.lgs.lsu.edu).



Now available
2015 Geologic Quadrangle Lithograph



Louisiana Geological Survey Personnel

Administrative Personnel

Chacko J. John, Ph.D., director and state geologist, professor-research

Patrick O'Neill, research associate, LGS Publications Sales and Resource Center

Basin Research Energy Section

John Johnston, research associate (retired - part time)

Brian Harder, research associate

Reed Bourgeois, computer analyst

Geological Mapping & Minerals Mapping Section

Richard McCulloh, research associate

Paul Heinrich, research associate

Water & Environmental Section

Marty Horn, assistant professor-research

Douglas Carlson, assistant professor-research

Riley Milner, research associate

Cartographic Section

John Snead, cartographic manager (retired - part time)

Lisa Pond, research associate

Robert Paulsell, research associate

R. Hampton Peele, research associate

Staff

Melissa Esnault, administrative coordinator

Jeanne Johnson, accounting technician

www.lgs.lsu.edu

Louisiana Geological Survey

3079 Energy, Coast & Environment Building

Louisiana State University

Baton Rouge, LA 70803

Telephone: 225-578-5320

Fax: 225-578-3662