Louisiana Geological Survey

NewsInsightsonline

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Port Hudson State Historic Site and National Historic Landmark, and Surrounding Areas

Thomas P. Van Biersel

North of Baton Rouge, Louisiana, lays the Port Hudson State Historic Site and National Historic Landmark. This area was the site of an unrenowned battle and siege of the American Civil War. For 48 days in the spring of 1863, 6,000-6,800 Confederate soldiers held back 30,000-40,000 Union soldiers and a Union Fleet, which intended to move north to help capture Vicksburg. The fortifications at Port Hudson were initially built to protect New Orleans from an attack down the Mississippi River. Upon the capture of New Orleans by the Union Army in May, 1862, and of Baton Rouge in August, 1862, the strategic purpose of Port Hudson changed. Port Hudson's new purpose was to protect the confluence of the Red and Mississippi Rivers, which was a vital source of supply to the Confederacy. In addition, Port Hudson was counted on to protect Vicksburg from an attack from the south (Van Biersel, under review; Cunningham, 1994; Hewitt, 1994: Bonham, 1965; Brown, 1936; and Cook, 1934).

The National Historic Landmark is one of the 45 "Class A" Civil War sites, which were identified by the Civil War Sites Advisory Commission of the U.S. Department of the Interior's National Park Service as having had a direct impact and a decisive influence on the outcome of the Civil War. Besides its strategic importance in the geography of the Civil War, the siege of Port Hudson also included the first significant use of uniformed African-American soldiers. At Port Hudson, the First and Third Louisiana Native Guards of the Union Army's Corps d'Afrique was pressed into battle (Cunningham, 1994 and Cook, 1934).

The Port Hudson and Mount Pleasant bluffs north of Baton Rouge were the first recognizable high ground, as early explorers traveled up the Mississippi River. The bluffs are famous for the early researchers who visited and described them. Among those were Mr. William Bartram (Bartram, 1791), Sir Charles Lyell (Lyell, 1855) and Prof. Harold Fisk (Fisk et al, 1938). Prof. Fisk, of the Louisiana Geological Survey (LGS), reported that it was at

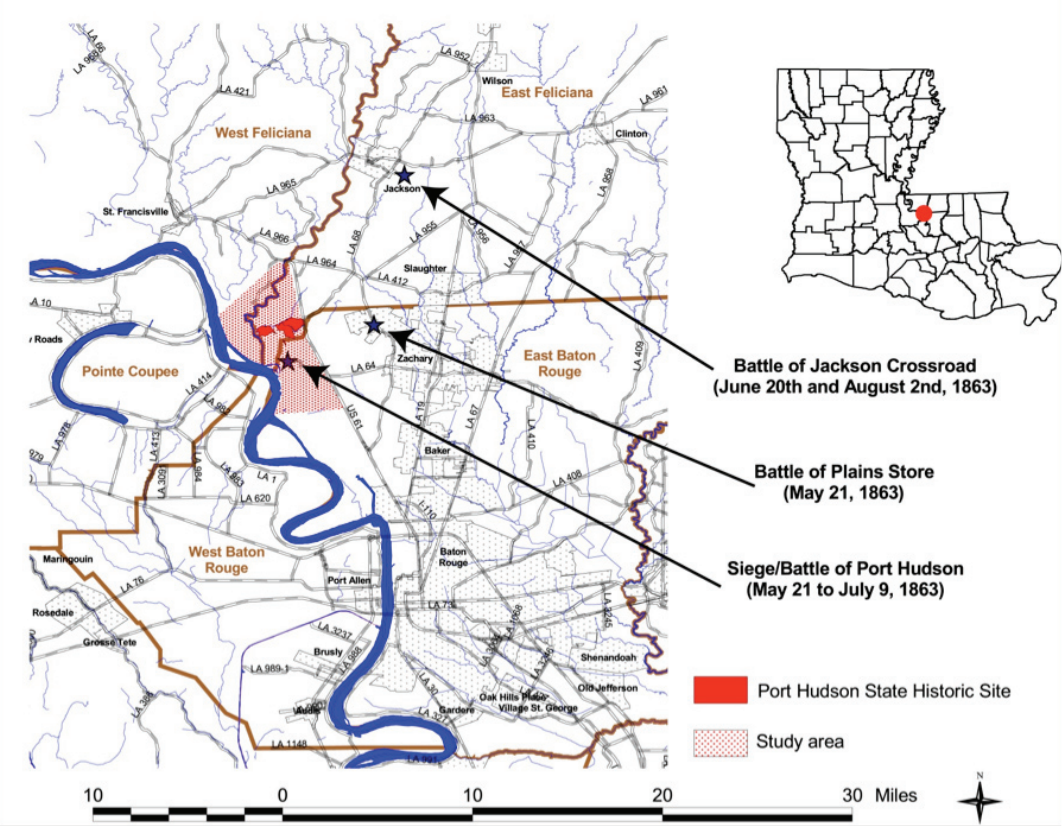

Figure 1. Location map of the Port Hudson battleground (from Van Biersel, under review).

The Louisiana Geological Survey

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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.

these bluffs that loess was first recognized in North America (by Sir Lyell). Beginning in August, 1862, the Confederate Army began construction of strategic fortifications on top of the bluffs, which overlooked a sharp meander of the Mississippi River. The fortifications and batteries on top of the bluff were there to prevent the upriver movement of the Union navy. The battle raged on from May 22nd, 1863 until July 8, 1863, when the "last bastion on the Mississippi" became the "Sebastopol" of the Confederacy, ending the longest siege in American military history (48 days).

The surficial geology at Port Hudson, similar to that of Vicksburg, Mississippi (the Confederate Gibraltar), significantly impacted the way in which the battle was fought. The presence and engineering properties of loess at Port Hudson had a profound impact on the resilience of the Confederate earthworks, and provided the presence of a natural obstacle to assaulting Union forces, in the form of a steep ravine and vertical bluff. The 48-day siege, and associated bombardment, denuded the landscape and resulted in severe erosion, which occurred in the years following the battle.

A LGS State Park and Lands Series report is currently being edited and revised, which will describe the natural and historical significance of the site.

Figure 2. View (from the south) of the Mount Pleasant Bluff, the first high ground along that Mississippi River as you travel up river (from Van Biersel, under review).

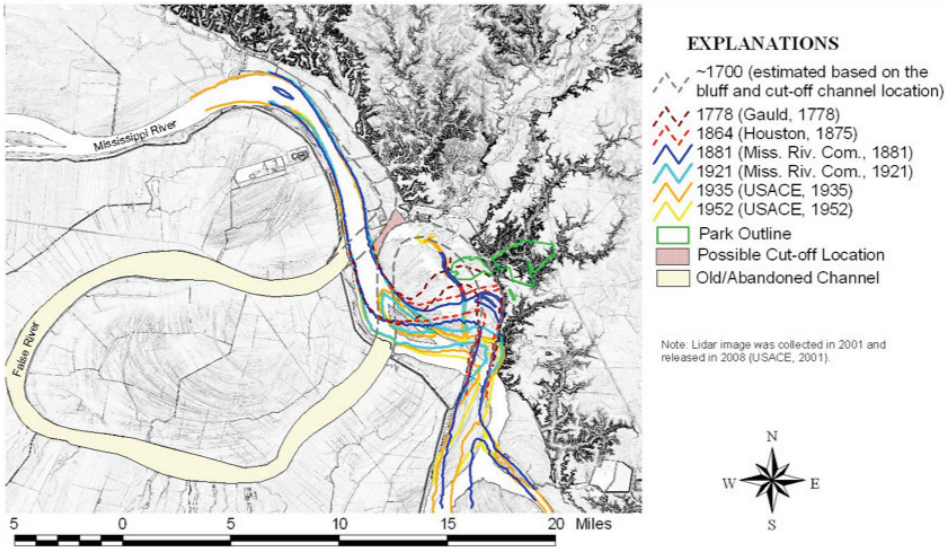

Figure 3. Migration of the Mississippi River meander bend at Port Hudson over time (from Van Biersel, under review).

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Baseline Water Quality Study of Aquifers in Bossier, Caddo and De Soto Parishes

Douglas Carlson

Starting this summer and lasting through December of 2011, Professors Douglas Carlson and Thomas Van Biersel of Louisiana Geological Survey will in collaboration with Gary Hanson, Director of Red River Watershed Management Institute and a LSU-Shreveport graduate student will work on an extensive groundwater quality study of the Carrizo-Wilcox and Red River Alluvial aquifers in southern Caddo (Townships 14 north to 18 north) and Bossier (Townships 15 north to 17 north) Parishes, and northern De Soto Parish (Townships 13 north to 16 north). The study will include the collection of groundwater samples from approximately 1,000 domestic water supply wells. Each sample will be analyzed for Arsenic, Boron, Bromide, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iron, Lead, Magnesium, Manganese, Nickel, Nitrate, Nitrite, Potassium, Phosphates, Phosphorus, Rubidium, Sulfate, Silicon, Sodium, Strontium, and Zinc, as well as pH and specific conductance in the field. Water levels will be collected where the well construction allows. This project is receiving $216,596 of support from the Bossier, Caddo, and De Soto Parish Police Juries.

This study seeks to develop a regional baseline water quality data set prior to major groundwater resource development associated with drilling and hydrofracking activity related to the resource development of Haynesville Formation Shale natural gas play, which underlies the study area (Figure 1). Hydrofracking uses large quantities of water. On average, reported volumes of water used for hydrofracking is 3.1 million gallons if groundwater is the source and 5.1 million gallons if surface water is the source (Louisiana

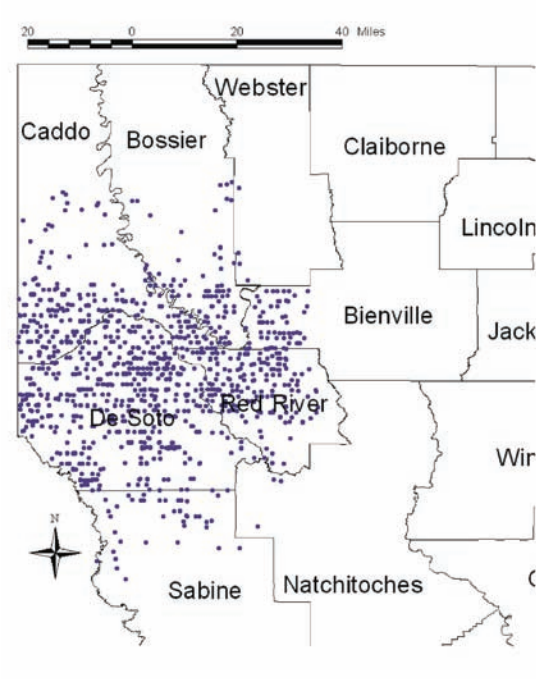

Figure 1. Location of current drilling associated with development of the Haynesville Formation, blue dots are well sites (Source of data Louisiana Department of Natural Resources, 2010b).

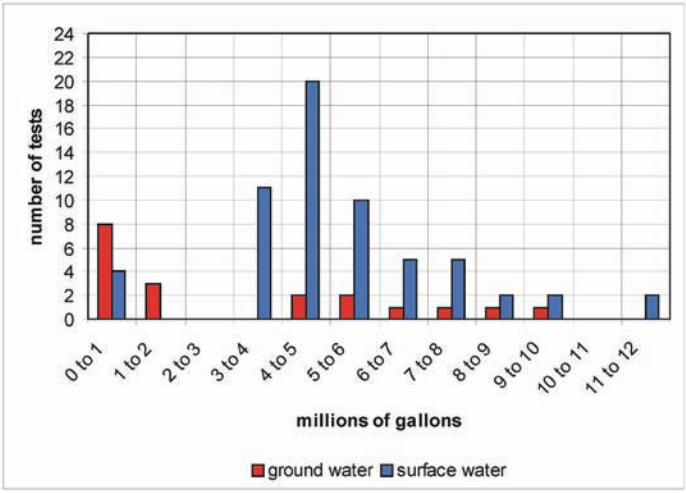

Figure 2. Reported volumes used for hydraulicfracturing the Haynesville shale (Louisiana Department of Natural Resources, 2010a).

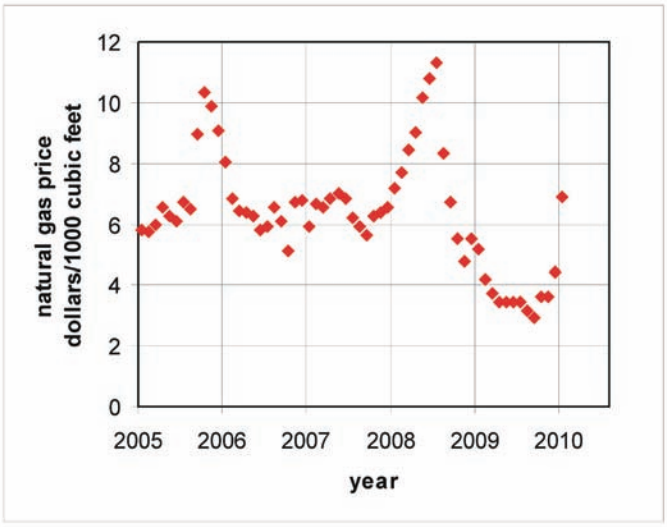

Figure 3 Price of natural gas at the wellhead January 2005 to January 2010 (Energy Information Administration, 2008, and 2010).

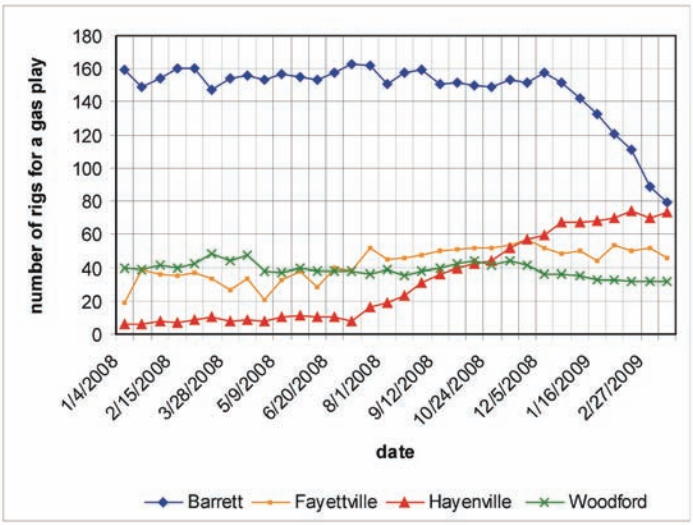

Figure 4 Drilling activity with Haynesville Formation compared to other major gas plays (Durham, 2009)

Department of Natural Resources, 2010a). Hydrofracking use per well can be up to approximately 11 million gallons (Figure 2). Each well could be hydrofracked more than once during its productive life (Gary Hanson personal communication, 2008). Within the study area there is the potential of thousands of these wells being hydrofracked. Even if hydrofracking occurs only one time per well, a vast amount of water will be used. It is estimated in 2009 De Soto Parish approximately will use 2 billion gallons of water (John Neilson personal communication, 2008) or approximately 6 million gallons per day. That is 50% greater than all other uses of groundwater (3.52 millions per day) in De Soto Parish (Sargent, 2007). A large increase in demand would increase the rate at which water levels are falling within the aquifers and possibly impact water quality within these aquifers. This could occur by drawing water from areas within the aquifers that have been identified as having high concentrations of chloride, salty water, or from the fairly salty Red River itself (Van Biersel, et al., 2010).

This study is being undertaken in order to have a regional water quality data set prior to significant drilling-hydrofracking's impact on water supply, hydraulic gradients and water quality, resulting from the development of the Haynesville Formation shale. This will occur anytime when gas prices are significantly over $7/1000 ft^3 for any extended period of time, the price that is considered profitable (Kurt Ley, personal communication, 2008). Recently the natural gas price has been significantly below $7/1000 ft^3. However, even with low prices, average $4.12/1000 ft^3, for natural gas since October 2008 and a lower average of $3.83/1000 ft^3 and since March 2009 (Energy Information Administration, 2010) the drilling activity for the Haynesville play has been generally increasing (Figure 3 and 4).

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Haynesville Gas Play and Other Unconventional Gas Shales Changes Gas-Oil Relationships

Douglas Carlson

For decades natural gas and petroleum fields were often associated with each other where the gas would lie above the petroleum in a conventional trap associated with either a structural feature (dome or fault) or a stratigraphic feature (lateral change of lithology) (Jensen and Bateman, 1979; and Hutchinson, 1983). The conventional idea was that there was need of a source rock, a reservoir rock and a cap/trap rock to develop a reserve/pool of oil and gas (Hutchinson, 1983). Typically the source rock of oil and gas is a shale or coal beds (Ebenhack, 1995). The reservoir rock is typically a highly permeable sandstone or a fractured or coarse grain/crystalline limestone or dolostone (Jensen and Bateman, 1979; and Ebenhack, 1995). The cap is usually impermeable shale (Jensen and Bateman, 1979).

Horizontal drilling techniques were refined and improved in the mid 1980s, and became common practice within the oil and gas industry (U.S. Energy Information Administration, 1993; and Carr and Gerlach, 2001). Horizontal holes with their far larger contact area within a geologic unit changed the requirement of what types of rocks could be possible sources of natural gas and act as a hydrocarbon reservoir. Thus, unconventional source rocks for natural gas became economically viable. These unconventional natural gas resources are either within coal beds or shales (U.S. Energy Information Administration, 2008).

Prior to the major impact of unconventional gas shales (between 1945 and 2000) the ratio of proven reserves of natural gas to petroleum was approximately 8,000 cubic feet of natural gas to 1 barrel of petroleum (oil) (Figure 1). After the year 2000, gas shale

plays with their vast reserves rapidly increased the ratio of proven reserves to approximately 13,000 cubic feet of natural gas for each barrel of crude oil (Figure 1). There has also been a rapid increase in production from shale gas plays. For example, between 2000 and 2006 annual production for five large plays (Antrim, Barnett, Lewis, New Albany, and Ohio) has increased from approximately four hundred billion cubic feet (Bcf) to one trillion cubic feet (Curtis et al., 2007). However, of greater importance is the vast size of gas shale plays. Estimates of the Haynesville play range from 29 to 200 trillion cubic feet (Oilshalegas.com, 2009a, Marshallnewsmessenger.com, 2010) and for Marcellus play range from 50 to 500 trillion cubic feet (Oilshalegas.com, 2009b; and Geology.com, 2010). These two estimates are similar to the volumes of all of the conventional reserves, 244 trillion cubic feet (U.S. Energy Information Administration, 2010b). One estimate of gas resources in shale is 1,836 trillion cubic feet (American Petroleum Institute, 2010), approximately 7.5 times conventional reserves.

For decades between 1945 and 2000, the price of natural gas increased relative to petroleum. In 1945 the price of 1000 cubic feet of natural gas was approximately 0.02 (2%) of the price of a barrel of oil (Figure 2). By 2000 the price of 1000 cubic feet of natural was approximately 0.16 (16%) of the price of a barrel of crude oil (Figure 2). This was probably a result of natural gas being a cleaner and more convenient fuel for home heating among other uses. With the advent of gas shales, which increased the proven reserves of natural gas relative to oil upwards (Figure 1), gas availability relative to oil in turn decreased the relative price of natural gas to oil downward. By 2009, 1000 cubic feet of natural gas was approximately 0.07 (7%) of the price of a barrel of oil. This decrease of relative cost of natural gas to oil between 2000 and 2009 was over 50% (Figure 2).

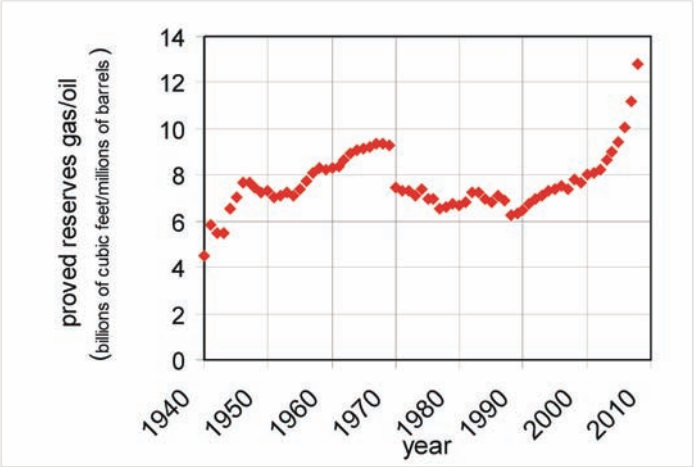

Figure 1. Ratio of United States natural gas proven reserves to petroleum proven reserves (source of reserve information is the U.S. Energy Information Administration, 2010 a and b)

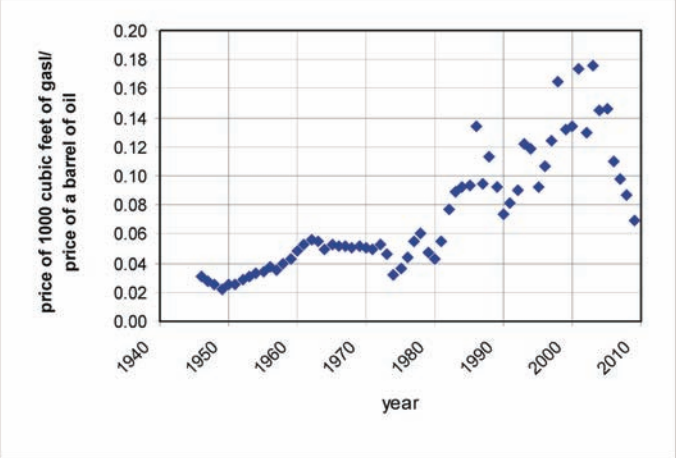

Figure 2. Ratio of the price of petroleum to natural in the past sixty years (source of price information is the U.S. Energy Information Administration, 2010 c and InflationData.com, 2010)

In additon, to gas shales such as the Haynesville causing the price of natural gas to fall relative to oil, the tie between the prices of these two fuel resources was largely broken. For decades there was a strong correlation between the price of natural gas and oil. For example between 1960 and 1980 the average yearly price of natural gas to oil price had a correlation coefficient of approximately 0.97 out of 1 (Figure 3), which is considered a very strong correlation (TimeWeb, 2010). By contrast, after 2000 when gas shale resources impacted proven reserves and prices, the price of oil and natural gas became poorly correlated. This is shown by the relationship between average monthly price of natural gas and oil for the months between January 2005 and December 2009. During this interval of time, the correlation of natural gas price to oil had a correlation coefficient of 0.23 out of 1, which is considered a weak and very insignificant (TimeWeb, 2010) (Figure 4).

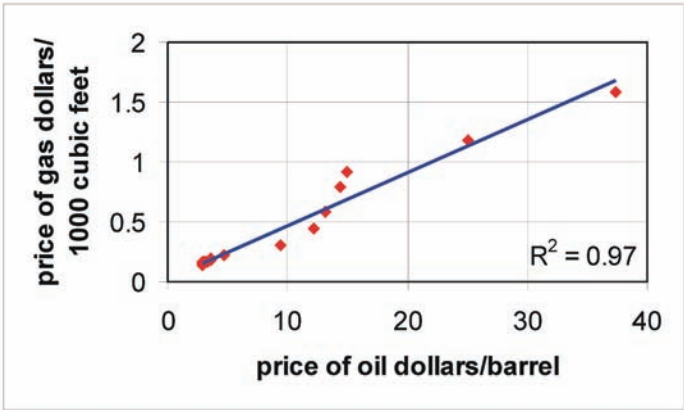

Figure 3. Correlation of natural gas price to petroleum price yearly averages between 1960 and 1980 (source of price information is the U.S. Energy Information Administration, 2010c and InflationData.com, 2010)

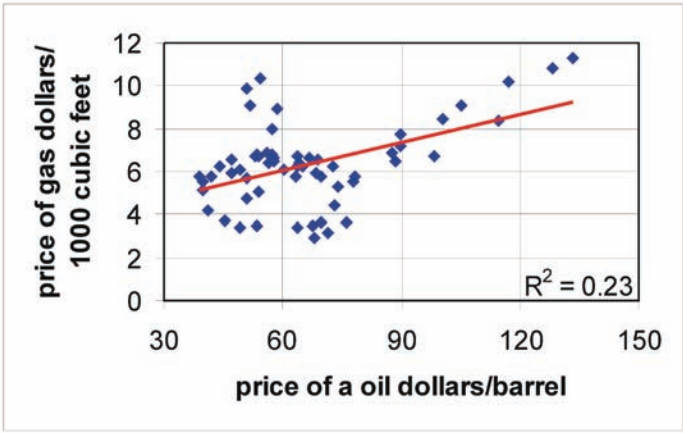

Figure 4. Correlation of natural gas price to petroleum price monthly averages between January 2005 and December 2009 (source of reserve information is the U.S. Energy Information Administration, 2010d and e)

In summary, the presence of efficient horizontal drilling has completely altered relationships between natural gas and oil. There have been four major changes: (1), natural gas exploration no longer needs the reservoir and trap rocks required for oil fields and hence source rock alone can be an economically viable source of natural gas without the need of these other two types of rock; (2), adding many gas shales with their vast resources the availability of natural gas relative to oil has greatly increased; (3), the increased availability of natural gas relative to oil has driven the relative price of natural gas to oil in the last decade down by approximately 50%; (4), the tie between the price of natural gas and petroleum has been broken, as evidenced by the correlation of price dropping from a very strong correlation (approximately 0.97 out of 1) to a weak correlation (approximately 0.23 out of 1).

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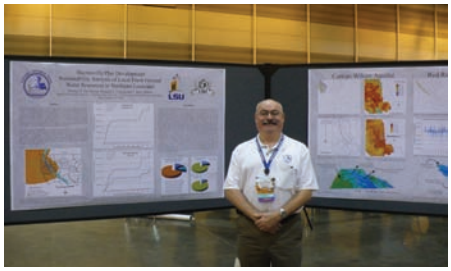
Conferences

AAPG Annual Convention

The 2010 American Association of Petroleum Geologists Annual Convention and Exhibition was held at the Morial Convention Center in New Orleans from April 11-14 and was attended by over 6500 professionals from around the world. LGS personnel attending the Convention were Chacko John, Douglas Carlson, Thomas Van Biersel and Warren Schulingkamp. LGS had an exhibit booth displaying the updated 2008 Oil and Gas map of Louisiana and other publications and maps. The map of the Oil and Gas fields attracted much attention from industry personnel who were also very interested in other ongoing research at LGS, particularly in the oil and gas and geologic mapping areas. Douglas Carlson (Secretary-Treasurer of DEG) and Chacko John (Gulf Coast Section Councilor of DPA) attended their respective Division of Environmental Geology and Division of Professional Affairs meetings held prior to the start of the main convention program. Thomas Van Biersel presented a poster paper dealing with the sustainability of groundwater resources for the Haynesville shale Development.



GCAGS Convention

The 60th. Annual Convention of the Gulf Coast Association of Geological Societies (GCAGS) and the Gulf Coast Section of the Society of Sedimentary Geology (GCSSEPM) will be held from October 10-12, 2010, at the Henry B. Gonzalez Convention Center in San Antonio, Texas. LGS faculty members will be presenting the following papers at this Convention:

Marty Horn: Problems and Progress in Defining Louark Group Lithostratigraphic Boundaries:Results from Examination of Well Samples and Recent Geophysical Logs.

Thomas Van Biersel: Natural History, Geology, and the Civil War Battlefield at Port Hudson, Louisiana

Douglas Carlson: Influence of Lithology on Scaling Factors for Permeability of Louisiana Geologic Units.

Douglas Carlson: Influence of Lithology on Vertical Anisotrophy of Permeability at a Field Scale for Select Geologic Units.

Contracts/Grants

Water Quality of the Carrizo- Wilcox, Red River Alluvial and other Aquifers in Bossier, Caddo, and DeSoto Parishes; Caddo Parish Commission, $216,595. P.I. Douglas Carlson, Co-P.I. Thomas Van Biersel.

Geologic Data Creation for Three Louisiana Parishes (Iberville, Point Coupee, and West Baton Rouge Parishes) for use in the USGS National Geologic Carbon Dioxide Sequestration Assessment; USGS, $50,000. P.I. Chacko John, Co-PI's Brian Harder, Reed Bourgeois, Warren Schulingkamp.

Geologic Review 2010- 2011 (continuing project); Louisiana Department of Natural Resources, $105,000.P.I.- John Johnston

Assistance in Developing the Statewide Water Management Plan; Ecology and Environment, $ 70,237. P.I. Thomas Van Biersel, Co-P.I's Douglas Carlson, Riley Milner.

Quaternary Geology of the Louisiana Coastal Plain and Continental Shelf: Part -I - Small Scale GIS Compilation; La Dept. of Natural Resources (Coastal Restoration) , $33,073. P.I. John Snead, Co-PI's Hampton Peele, Paul Heinrich, Riley Milner.

Inventory and Digital Infrastructure of Historic Louisiana Geologic Map Date; USGS, $27,962. P.I. John Snead, Co-PI's Hampton Peele, Patrick O'Neill, Robert Paulsell.

LGS Statemap 2010-2011: Geologic Mapping and Compilation of Atchafalaya Bay, Monroe North, and Morgan City 30x60 Minute Quadrangles, Louisiana; USGS #141,983. P.I. Richard McCulloh, Co-PI's Paul Heinrich, Hampton Peele, John Snead, Robert Paulsell, Marty Horn.

State Geological Survey Contributions to the National Geothermal Data System (3 years); DOE funded through the Arizona Geological Survey, 299,799. P.I. Chacko John, Co-PI's Brian Harder, Reed Bourgeois, Bobby Jones, Robert Paulsell.

Louisiana Tank Geothermal Demonstration Project (3 years): DOE funded through Louisiana Geothermal Co. LLC $297,820.

P.I. Chacko John, Co-PI's Brian Harder, Reed Bourgeois, Warren Schulingkamp, Bobby Jones, Thomas Van Biersel.

Coal bed Atlas of Louisiana (5 years); USGS, $75,000. P. I. John Johnston.

Monitoring and Reporting Coal Bed Natural Gas Drilling Activities (5 Years) ; USGS funded through Univ. of Louisiana at Lafayette, $20,000. P.I. Warren Schulingkamp.

Statewide Ground Water Management Plan for Louisiana

The Water and Environment Section of LGS has been participating in the preparation of the Statewide Ground Water Management Plan for Louisiana. Thomas Van Biersel, Doug Carlson, and Riley Milner have been compiling and summarizing the existing water resources data/information available for Louisiana's aquifer and fresh surface water sources. The work is being performed under a subcontract with Ecology & Environment, Inc. for the Department of Natural Resources.

Educational Outreach Activities

February 25, 2010 Research Associate Riley Milner gave a presentation to the 3rd Grade classes at Highland Elementary School. His presentation was on the geologic history and physical development of the State of Louisiana as we know it today.

On March 13, 2010 LGS participated in the BREC Park Bluebonnet Swamp Nature Center's all day activity "Rockn' at the Swamp." The LGS exhibit booth was manned by Research Associate Riley Milner and assisted by Director Chacko John. Nearly 700 visitors were informed of the recent discovery of a meteor impact crater located in southwestern St. Helena Parish, and identified as "The Brushy Creek" late or possibly terminal (~11,000 years BP) Pleistocene impact crater. The LGS display of LGS researcher Paul Heinrich's GCAGS poster of the Brushy Creek impact crater, and a Scope-on-a-Rope with a petrographic microscope and displayed on a 32" television were well received by all attendees. Thin sections of the Greenwell Springs meteorite, which was found in the front yard about 8 feet from the home of Mr. Freddie Rapuana in 1987, were shown to the attendees. Many other thin sections of varies type of rock were also shown, and hand specimens of rock and minerals that can be found in Louisiana along with many other rocks and minerals from around the United States. Other activities for the attendees by participating organizations and dealers were demonstrations of gem and mineral polishing, faceting gems and cabochons, collection of minerals placed at various locations through out the trails in the park.

Rockin' at the Swamp 2010

National Park Service Geologic Resources Inventory Meeting

Rick McCulloh and Paul Heinrich attended a Geologic Resources Inventory (GRI) Scoping Meeting for the Jean Lafitte National Historical Park and Preserve held by the Geologic Resources Division of the National Park Service (NPS) on April 15, 2010, at the French Quarter headquarters building on Decatur Street in New Orleans.

Participants included NPS staff from the park and preserve, the Geologic Resources Division, and the Gulf Coast Network, as well as cooperators from Colorado State University and LGS. The GRI Program is designed to generate digital geologic maps and geologic resources inventory reports for National Park System units. To accomplish this, geologic scoping meetings are held to summarize geologic mapping coverage and needs, evaluate the adequacy of existing geologic maps for resource management, discuss park-specific geologic resource management issues, review distinctive geologic features and processes, identify potential monitoring and research needs, and conduct a site visit with knowledgeable park personnel.

As part of the meeting agenda McCulloh gave a presentation entitled, "Geologic Overview of Jean Lafitte National Park." This was based in large part on ongoing geologic mapping of the New Orleans and Terrebonne Bay 30 x 60 minute quadrangles being prepared at 1:100,000 scale with co-principal investigators Paul Heinrich, Marty Horn, and Hampton Peele for a fiscal-year 2009 project supported by the National Cooperative Geologic Mapping Program, STATEMAP component under cooperative agreement with the U.S. Geological Survey.

LGS Publications

Hinks, S. J., Robinson, R. R., Heinrich, P. V., Lombardi, K. M., Belfast J. A., and Fuess, M. T., 2010, Phase 1 Archaeological Survey of the Bossier Parish East-West Corridor (Winfeild Road Extension), Bossier Parish, Louisiana. Draft report by Michael Baker Jr., Inc., Moon Township, Pennsylvania, for Northwest Louisiana Council of Governments, Shreveport, Louisiana, and Federal Highway Administration, Baton Rouge, Louisiana.

McCulloh, R. P., Heinrich, P. V., Williamson, D., and Hanson, G., 2009, GCAGS 2009 Field Trip Hanson Brick Clay Pit Midway Group and Wilcox Group Contact, September 26, 2009. Gulf Coast Association of Geological Societies, Austin, Texas.

Perrault, S. L., Saucier, R. T., Heinrich, P. V., Lee, D., and Ryan, J., 2009, Phase I Cultural Resource Survey of the Lake Kilarney Ecosystem Restoration Project, West Feliciana Parish, Louisiana. Report by Coastal Environment, Inc., Baton Rouge, Louisiana, for New Orleans District, U.S. Army Corps of Engineers.

Survey Remembers Ann Tircuit

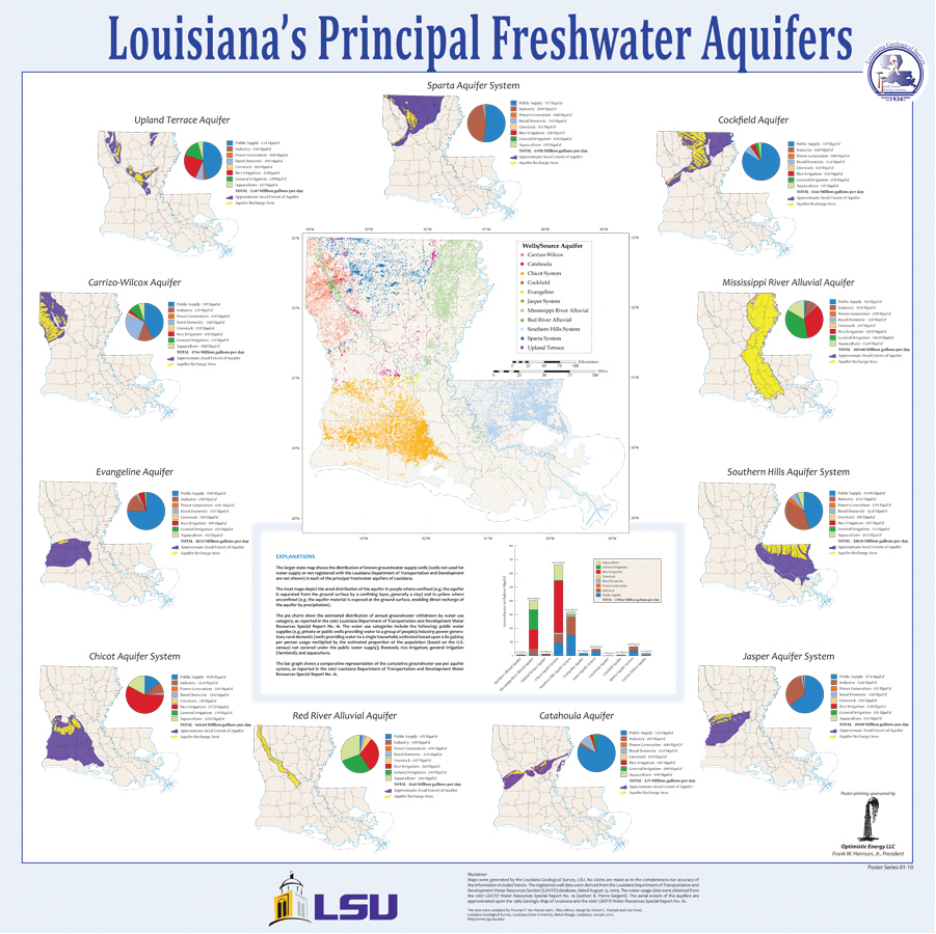
In May, the LGS lost its long-time administrative assistant, Frances "Ann" Tircuit, after a brief illness. Ann managed the daily affairs for the Survey.

She is survived by three sons and their wives, Jason and Julie Starns, Adam Starns and Reagan Fontenot, and Tommy Tircuit and Misty Farmer; a daughter and son-in-law, Mary Ann and Rodney Fleming; and eight grandchildren. Ann lost her beloved husband Allyn only three months before her death.

In spite of her grief and recent setbacks in her health, Ann remained positive and was always a pleasure to work with.

Louisiana's Principal Freshwater Aquifers

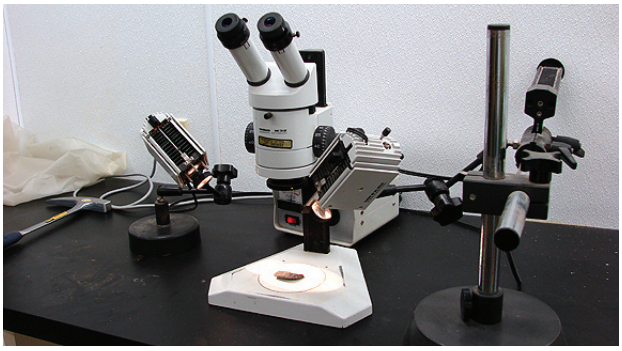
In 2009, Dr. Thomas Van Biersel and Riley Milner of Louisiana Geological Survey (LGS) compiled an educational poster as a response to the Secretary of the Louisiana Department of Natural Resources and Chair of the Louisiana Ground Water Resources Commission's suggestion that it would be very useful and beneficial to have a single document depicting all of Louisiana's aquifers. The poster's graphic design was finalized by Robert Paulsell and Lisa Pond of LGS' cartography section. The poster produced depicts the principal aquifers of the state, as well as the use of those resources and the distribution of registered water supply wells. It updates the confined and unconfined extent of the aquifers from a previous publication. These updates take advantage of LGS' new GIS format geologic maps and the distribution of water wells in specific aquifers listed in the Louisiana Department of Transportation and Development's water well registry database (now at the Louisiana Department of Natural Resources).



The poster's printing (500 copies) was sponsored by Mr. Frank Harrison, president of Optimistic Energy, LLC, and a member of the LGS' Advisory Board. The posters were distributed by LGS to member of the Louisiana Ground Water Resources Commission and meeting attendees, as well as members of the Ground Water Management Advisory Task Force and meeting attendees. Members of the Louisiana Department of Natural Resources' Office of Conservation distributed these posters as part of their 2010 Ground Water Education tour. They were also distributed in northwestern Louisiana at a Caddo Parish Drinking Water Protection Program Committee meeting. A few posters are still available for pick-up from the LGS publication office at Louisiana State University.

LGS Resource Center Moves to New Location

The Louisiana Geological Survey's Core Repository and Log Library have moved to a new location. All of the well core and logs in the LGS collection are now in a common location about 1.5 miles from our main office. We are now in the process of cataloging all core samples to reflect the new stacking arrangement.



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