

# INFORMATION TECHNOLOGY FACULTY POSITION IN APPLIED GEOPHYSICS

## **RATIONALE FOR PROJECT**

The Department of Geology and Geophysics proposes to hire a new faculty member in applied geophysics to expand our research, graduate training, and teaching in three-dimensional characterization of the subsurface. We propose a scientist with specialization in acquisition and high resolution modeling of electrical, electromagnetic or seismic methods. These subdisciplines include electromagnetism, electrical resistivity, spontaneous potential, induced polarization, ground penetrating radar, and high-resolution reflection seismology. These are rapidly expanding areas of applied geophysical research with broad applications in environmental studies, mineral exploration, and engineering. The electrical conductivity and seismic velocity of rocks and sediments varies with clay content, water content, and pore water salinity. Thus, electrical measurements and/or seismic methods can be used to distinguish sands from shales, high porosity from low porosity, and fresh water, brine or hydrocarbons/non-aqueous phase liquids in the pore spaces. Of particular interest to us is that electrical or electromagnetic properties of earth materials can be applied on land, over water, or in swamps, and data acquisition is rapid and relatively non destructive.

A new faculty member in applied geophysics would complement existing research programs in reflection seismology (Lorenzo and Bart), rock magnetism and electrical resistivity (Ellwood), geodynamics (Nunn), and hydrogeology (Hanor and Nunn). We seek a dynamic researcher and teacher who uses applied geophysical methods to produce a high-resolution characterization of the often highly heterogeneous and anisotropic subsurface geology. A strong applied geophysics program in Geology and Geophysics could develop new collaborations with Physics and Astronomy (computational laboratory and LIGO), Computer Science (three dimensional image processing), Civil and Environmental Engineering (road and building construction, hydrology), Mechanical Engineering (location of buried cables), Petroleum Engineering (reservoir modeling and signal processing) and Electrical Engineering (signal processing). It also may foster cooperation with groups working in the broad field of environmental sciences (chemistry, biology, agronomy, and the Louisiana Geological Survey). Interpretation of subsurface data is now routinely done in three dimensions. 3D seismic data have been a boon to oil and gas geologists because these data allow them to characterize the subsurface more accurately. It is important that our teaching and research also take advantage of new techniques and technologies. The proposed faculty member will strengthen our ties to both the oil and gas, and environmental industries. We will also explore new collaborations with engineering firms as these geophysical methods can be used to locate man-

made objects (underground pipes or cables) in the shallow subsurface and/or constrain models of fluid movement.

Applied geophysics will be an integral part of educational programs in earth sciences at LSU. Most of our students go on to careers in oil exploration and production or environmental geology where geophysical skills, breadth of knowledge, and the ability to collaborate with engineers are essential. It will provide hands-on experience to students in all aspects of geophysical techniques: planning, data acquisition, processing, and interpretation. Synthesis of three-dimensional data using multiple techniques also provides students with valuable experience in critical thinking and problem solving. Training of students in these areas will prepare them to meet the needs of high technology industry.

Applied geophysics may be used to study a variety of local problems including: damage to structures built across active growth faults, leakage of salty water out of old oil field brine pits, ground subsidence associated with fluid withdrawal, and seepage of salty and/or hot water into wells. These are important environmental problems, which impact the economy and the quality of life in Louisiana. Applied geophysics is also increasingly used in mineral extraction. For example, secondary recovery techniques used in shallow oil fields involve injection of carbon dioxide or steam to flush out remaining hydrocarbons. However, this can have serious consequences if the subsurface is not adequately known, because some secondary recovery methods can destroy production. An applied geophysics assessment before application of such techniques can significantly reduce or eliminate some of these problems. In addition, cross well seismic tomography can be used to monitor where steam or carbon dioxide goes in the subsurface and how effectively it sweeps out the remaining hydrocarbons.

## **PROMOTION OF ECONOMIC DEVELOPMENT**

*Oil and Gas Industries:* Many oil companies are still actively interested in onshore Louisiana prospects. ExxonMobil, Marathon, and Chevron-Texaco have major onshore Louisiana exploration interests. Most other oil and gas companies have major exploration or development programs offshore Louisiana. Much of this money will be spent in Louisiana. Offshore wells (\$5-20 million) and platforms (\$1-2 billion) are extremely expensive and thus there is strong reliance on geophysical data to characterize the subsurface in advance of drilling.

*Environmental Quality:* Like many other states, Louisiana is struggling to balance economic development and environmental quality. This is difficult in Louisiana because of the shallow water table and the complex subsurface plumbing system of interfingering sands and shales created by fluvial-deltaic deposition. In some areas, past and present pollution problems are inhibiting industrial expansion. Geophysicists are needed in industry, geotechnical consulting firms and government agencies to help provide answers to these complex problems. There was a recent article

in the Baton Rouge Morning Advocate describing a rice farmer who had lost his entire crop this year because of salty well water, possibly resulting from upward movement of brines along an old oil well. As Louisiana has literally tens of thousands of oil wells, the potential impact is enormous. Electrical and electromagnetic methods are excellent tools for locating abandoned oil wells because metal, PVC, and concrete all have significantly different electrical properties than natural earth materials.

Groundwater resources are an economic and political issue in Louisiana. There was a recent editorial in the Baton Rouge Morning Advocate regarding proposals to build nuclear power plants in Louisiana, which would be cooled by groundwater. Industry and agriculture already heavily utilize some aquifers in south Louisiana, such as the Chicot. A strong program in applied geophysics will provide hands-on training for geologists and engineers interested in environmental problems related to groundwater resources and contaminant transport. This should enhance the developing relationship between LSU and Louisiana industries. The facility would also be a resource for Louisiana industries and state agencies, such as the Department of Environmental Quality, and Department of Natural Resources.