

GIS Activities in the USGS Central Energy Resources Team: A Model for Expanding GIS Utilization*

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Abstract

A primary objective for the implementation of Geographic Information System (GIS) technologies by the Central Energy Resources Team (CERT) of the U.S. Geological Survey is to improve access to maps, data, and other geospatial services. The effort, in turn, is intended to improve the capability of decision makers to analyze layers of disparate data in a common geographic space.

Use of GIS technologies by the CERT is enhancing research activities related to project workflow and information access and discovery by providing: (1) efficient, centralized data management and data visualization, (2) ease in sharing data and interpretations among project personnel, and (3) dissemination of information and products to customers in an easily usable format.

CERT GIS activities include Internet Map Services and Metadata Services, which are also being leveraged in global networks that provide the infrastructure needed to support the sharing of geographic information. These portals include the National Spatial Data Infrastructure, the Geography Network, and the GeoSpatial One-Stop. Major tasks include technical issues related to application deployment, security, and system architecture. Demonstrations of the National Assessments of Oil and Gas at NOGA Online, Gulf Coast Geology at GCG Online, the Gulf Coast Information Access System, and World Energy Assessment applications illustrate how interactive maps and publication services provide easy access to organized assessment results, geology, and other CERT project data and interpretations.

U.S. Geological Survey Energy Team Projects and GIS Products

Introduction

The U.S. Geological Survey (USGS) is responsible for providing the Federal Government with objective scientific information to support decisions regarding land management, environmental quality, and economic, energy, and strategic policy. To fulfill this responsibility, the USGS periodically assesses the Nation's energy resources.

National Assessment of Oil and Gas

The Central Energy Resources Team (CERT) of the USGS has completed assessments of the undiscovered oil and gas potential in selected priority geologic provinces as part of the National Assessment of Oil and Gas (NOGA) program. Figure 1 is a map of the conterminous U.S. illustrating the current status of assessment results and products, and also contains a link to the NOGA Home Page (NOGA Online).

Assessments of the petroleum potential in these priority provinces is based on geologic elements used to define a total petroleum system (TPS) – hydrocarbon source rocks (source rock maturation, hydrocarbon generation, and migration), reservoir rocks (sequence stratigraphy and petrophysical properties), and hydrocarbon traps (trap formation and timing). Using this geologic framework, the USGS defines assessment units as parts of a TPS.

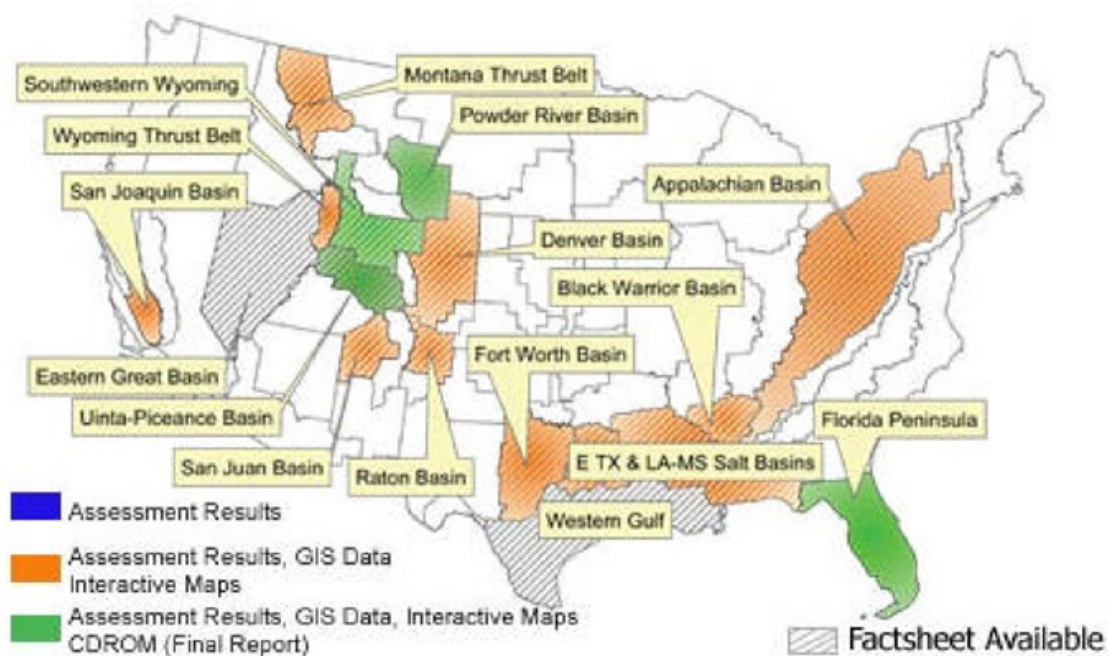


Figure 1. Map of the conterminous U.S. illustrating the current status of assessment results and products. URL of NOGA Online is: <http://energy.cr.usgs.gov/oilgas/noga/>.

A GIS focusing on each TPS defined in a province is developed as a visual-analysis tool for the USGS assessments of undiscovered, technically recoverable oil and natural gas resources. The CERT has also developed an Internet Map Service to deliver GIS data to the public. This mapping tool utilizes information from a database about the oil and natural gas endowment of the U.S., including physical locations of geologic and geographic data, and converts the data into visual layers. Portrayal and analysis of geologic features on an interactive map provides a better tool for understanding domestic oil and gas resources that bears directly on strategic planning, formulating economic and

energy policies, evaluating lands in the purview of the Federal government, and developing sound environmental policies. Assessment results can be viewed and analyzed, or downloaded from the internet website.

National Coal Resource Assessment

More than half of the electricity produced in the U.S. is generated by coal-fired power plants (Energy Information Administration, 2000). Understanding where coal is most readily available and of sufficient quality to meet current emission standards is important to ensure adequate energy supplies in the future. The National Coal Resource Assessment (NCRA) was a multiyear effort (1995 – 2000) by the USGS Energy Resources Program with three general goals:

- To assess selected coal beds and zones that will be the most important in the next few decades.
- To create publicly available digital data bases of stratigraphic, geochemical, and geographic information to answer questions for government and industry decision makers and the general public.
- To provide interpretive geologic and geochemical information on the major coal resources of the Nation.

Selected coal resources, including those on Federal lands, were assessed in five priority regions, as shown in Figure 2:

- Appalachian Basin
- Illinois Basin
- Gulf Coast
- Colorado Plateau
- Northern Rocky Mountains and Great Plains (Pierce, 2001, <http://pubs.usgs.gov/fs/fs020-01/fs020-01.pdf>).

The USGS NCRA is the first assessment program to use digital data bases and to combine all coal parameters into integrated GIS layers. The ability to compile many types of spatial data allowed the USGS to:

- (1) Gain a fuller understanding of coal occurrence.
- (2) make new stratigraphic correlations.
- (3) Integrate geologic and resource information across State boundaries.

ArcView Data Publisher projects were published on CD-ROM for each priority region. The GIS products are being web enabled for improved access of these data for future coal assessments.

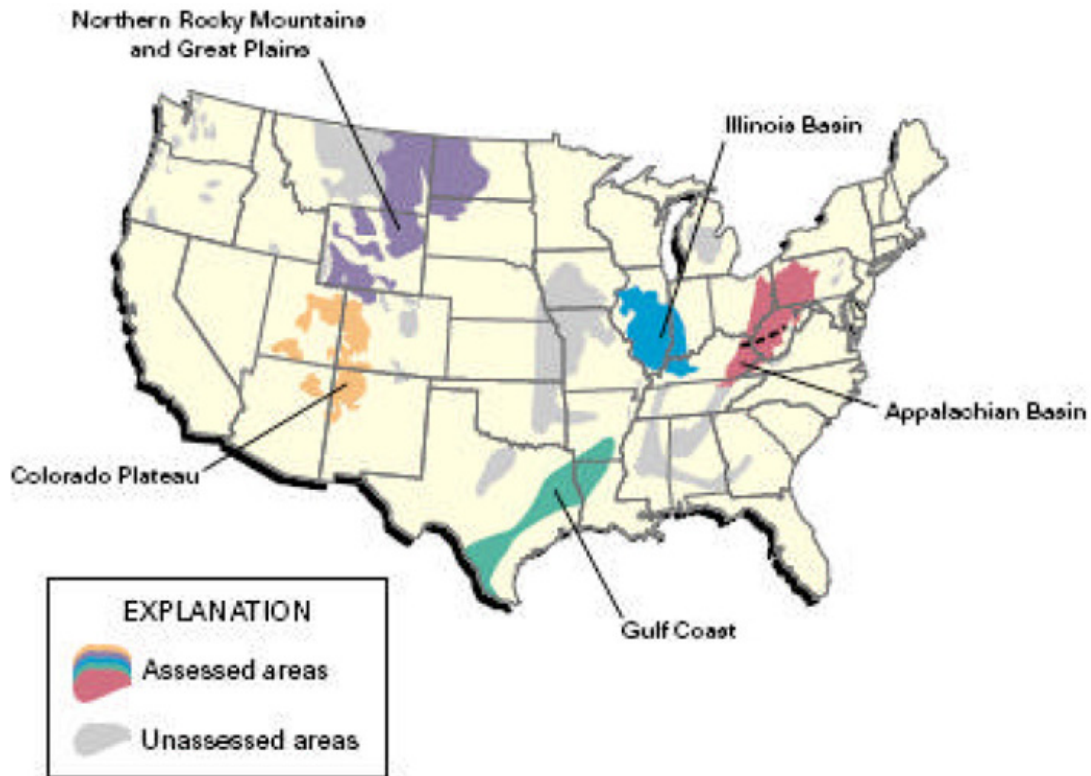


Figure 2. Map of the conterminous U.S., showing the five priority regions of coal resources.

World Energy Products

The USGS undertook a world petroleum assessment that was conducted over the same 5-yr period as the NCRA (from 1996 to 2000, U.S. Geological Survey World Energy Assessment Team, 2000). The purpose of the World Energy assessments is to provide impartial, scientifically-based, societally-relevant petroleum resource information essential to the economic and strategic security of the U.S. The assessments are based on extensive geologic studies rather than a statistical approach. The petroleum resources assessed are in accumulation categories judged to be viable in a 30-yr forecast span.

The Energy Team web room for World Energy assessments provides navigation of thousands of products by content type, theme, and spatial location. This web presence facilitates seamless access to:

- USGS world energy reports
- GIS and tabular world energy data
- Metadata
- World energy interactive maps

Figure 3 is a map from the World Energy Assessment home page that is used for navigation of USGS products by spatial location.

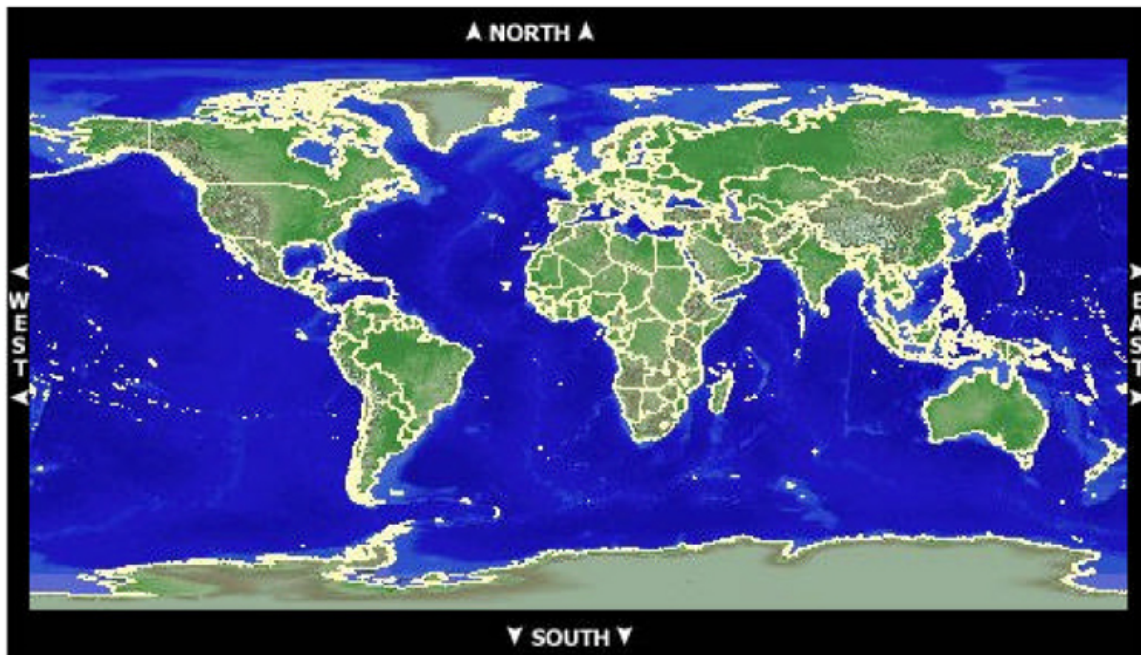


Figure 3. Home page for World Energy Assessment. Click on map to go to the homepage.

Gulf Coast Geology (GCG) Online and the Gulf Coast Information Access System

A large percentage of the present and future energy resources of the U.S. reside in the Gulf of Mexico Basin (Huffman et al., 2004 [<http://pubs.usgs.gov/fs/2004/3143/j>]).

Gulf Coast Geology (GCG) Online is a GIS that facilitates the geologic, geophysical, and geochemical framework studies essential to the current and future reassessment of energy resources (coal, gas, and oil) in the Gulf Coast Region. Version 1.0 of the Miocene (Huffman et al., 2004) deals almost entirely with southern Louisiana, primarily due to the availability of data, especially the biostratigraphy. Publicly available data have been used wherever possible; however, in the case of proprietary data, only derivative products are made available. In addition to the data specific to southern Louisiana, a number of regional geologic coverages that will be applicable to all versions are also included for reference.

Figure 4 is the default screen for the internet map service of the GCG Online—Miocene of Southern Louisiana.

In addition to GCG Online, the Gulf Coast Information Access System at http://certmapper.cr.usgs.gov/gulf_metadata/ is available for search and discovery of USGS Gulf Coast products by content type, theme, and spatial location.

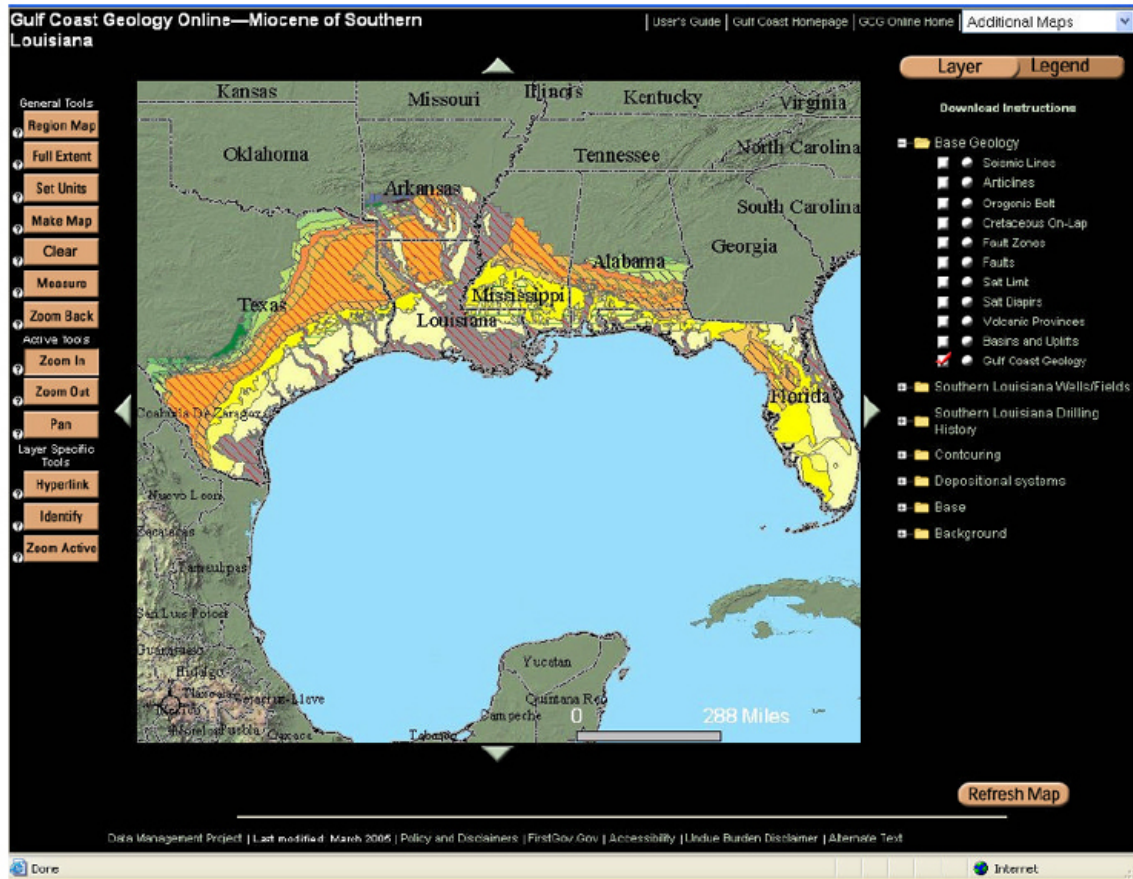


Figure 4. Default screen for the internet map service of the GCG Online—Miocene of Southern Louisiana. Click on map to the report.

Enabling Non-Technical Users

USGS assessments involve large amounts of geologic, geophysical, geochemical, and paleontologic data, in addition to well and field databases. In mature provinces and especially in larger ones such as the Gulf Coast, the existing data sets can be large, which makes data management a critical element in the assessment process. Furthermore, the many scientists working on a given assessment project require ready access to all of these data as well as to the most recently developed data and interpretations resulting from the ongoing efforts of the scientists themselves. An additional requirement is that the output be easily usable not only by project personnel but by customers who may or may not have any GIS expertise or access to sophisticated equipment. This is a particularly important aim of the USGS, whose primary mission is to provide the best and most current information possible to decision makers and the public.

Within the CERT, the GIS technologists work with the researchers to provide them with GIS functionality without the burdens of data management and GIS data processing. Some of the benefits of this model are:

- Everyone on the project has access to the same data.

- Each research scientist can add and share their interpretations.
- Centralized project libraries are developed and archived.
- This provides more seamless migration from working data to published interactive products.

This poster presentation provides information on how we are using Environmental Systems Research Institute (ESRI) ArcGIS tools to provide our research scientists with groups of data layers that they can work with in either ArcMap or via their browsers. The technical aspects of the USGS GIS operations are advanced and complex. Major tasks include technical issues related to application deployment, security, and system architecture. This poster presentation does not go into the details of all technical aspects, but does provide sources for such information.

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