

Digital Geologic Mapping for the Commonwealth

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The Digital Geologic Mapping Program

The Digital Geologic Mapping program (www.uky.edu/KGS/mapping/mapping.html) has been one of the largest and most successful programs of the Kentucky Geological Survey during the past 7 years. It is providing the foundation of digital mapping and the database structure for future digital and Web-based products and services. It is a cooperative effort between KGS and the U.S. Geological Survey, as part of the National Cooperative Geologic Mapping Program (ncgmp.usgs.gov).

The program began in the early 1990's when Donald Haney, the eleventh director of KGS, was instrumental in securing national legislation that would allow the United States to be mapped geologically. Of specific interest was a provision that allowed states such as Kentucky, who were already mapped, to convert existing maps into digital products.

Public Law 102-285, the "National Geologic Mapping Act," was signed into law by President Bush in May 1992. It

mandated that the entire United States be mapped geologically. The legislation was reauthorized in 1998.

The Kentucky Geological Survey has used funding from this program to produce 7.5-minute digital geologic quadrangle maps at a scale of 1:24,000 (1 inch=2,000 feet).

Program achievements

The initial goal was to have complete digital coverage for the entire state by the year 2007. Currently, the program staff are ahead of schedule, and complete digital coverage is expected by the end of 2004.

When the digital coverage for the entire state is completed, Kentucky will become the first state in the nation to achieve this milestone. By the summer of 2003, more than 650 of the 707 quadrangles (7.5-minute, 1:24,000 scale) had been digitized.

The versatility and power of digital data: DVGQ's

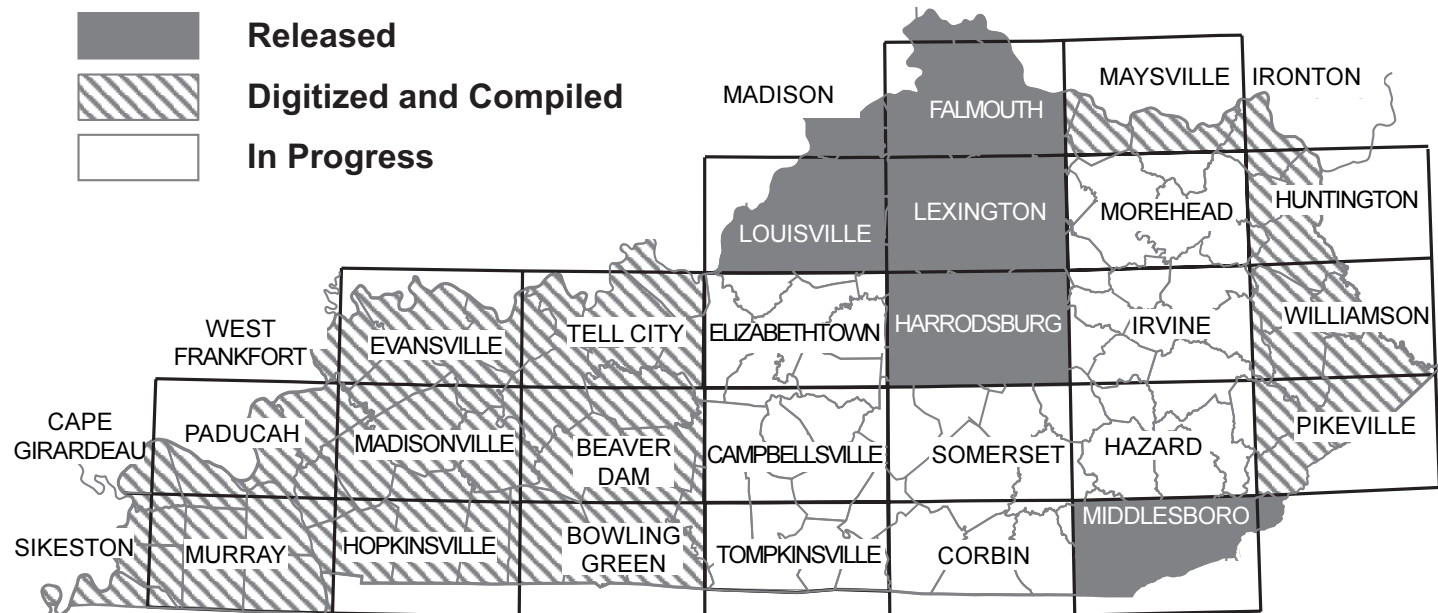
Geologic maps are complex; they contain various kinds of informa-

tion that relate to the age, composition, and structure of mineral features.

Because of this complexity, the information cannot be stored in a single data structure. Individual themes must be created to represent different kinds of geologic features in a digital format. Geologic features are rendered in vector format to permit variation in scale without degrading quality. The geologic map data are supplied in ESRI shapefile format for use in geographic information systems. Commercially and publicly available software can be used to view or analyze the shapefiles on a personal computer.

The availability of the data in GIS format allows the data to be manipulated and separated into their component parts. This is achieved by creating a database of information that is attached to the digital files. The databases of geologic information are referred to as "digitally vectorized geologic quadrangles." The DVGQ's are not a facsimile of the original published paper map.

In the DVGQ's, which are released on CD-ROM, geologic features are



Areas for which DVGQ's have been released. This map shows 30 x 60 minute quadrangles. Each 30 x 60 minute quadrangle is compiled from multiple 7.5-minute quadrangles.

represented as vector points, lines, or areas. Characteristics and descriptions of the features are also provided.

Geologic features stored in a DVGQ database can include:

- ◆ formation area: the surficial areas of rock units that compose a geologic map
- ◆ formation contacts: the upper and lower surface boundary of each rock unit
- ◆ structural features: structure contours, erosional surface contours, and anticlinal and synclinal axes
- ◆ structural measurements: strike and dip measurements for bedding and joint surfaces
- ◆ faults: faults, fractures, and fault scarps
- ◆ thin beds: rocks units that were too thin to digitize as polygons
- ◆ coal locations: coal outcrop locations
- ◆ economic features: arcs of mineral veins and mine outlines
- ◆ economic locations: noncoal and economically significant mineral outcrops and prospects, mines, quarries, pits, shafts, etc.
- ◆ drillhole locations: locations of geologically significant drillholes
- ◆ intrusive features: dikes and sills
- ◆ intrusive locations: points of dikes and sills
- ◆ fossil locations: fossil locations and sample sites
- ◆ fossil horizons: fossil layers and sample transects.

As many as 14 different themes that relate to geologic features on the original geologic quadrangle map make up the database, but not all are present for every DVGQ. Of the more than 650 digitized geologic quadrangle maps, 150 have been released on CD-ROM as DVGQ's.

Information from other digital products, such as digital ortho-quarter quadrangles, digital elevation models,

digital raster graphic images, and satellite imagery, can also be used as a base for the DVGQ data. The digital geologic data, when combined with other spatially referenced data, can create a powerful geologic information management system.

Information about the DVGQ data sets and a sample data set are available at www.uky.edu/KGS/gis/DVGQ/homepage.htm. Information on the digital geologic maps and other GIS products are available at www.uky.edu/KGS/gis/intro.html and www.uky.edu/KGS/mapping/mapping.html.

The value of digital geologic maps

Digital geologic information can be used for land-use planning, environmental protection, hazards mitigation, and mining activities. Digital map data are also valuable for assessment of coal, mineral, and petroleum resources; construction and urban development; engineering, planning, and reclamation; and water-supply and waste-disposal studies.

Geologists at KGS have cooperated with the Kentucky Transportation Center at the University of Kentucky and the Kentucky Transportation Cabinet to provide digital geologic maps for the proposed I-66 highway corridor between Somerset and London, as well as the Glasgow to Bowling Green segment. In 2000 KGS staff used digital geologic data to assess the remaining near-surface coal resources in eastern Kentucky for the U.S. Office of Surface Mining. These cooperatively funded projects demonstrate the multidisciplinary value of geologic maps.

New geologic maps and derivative map products

The digital geologic data have been used to create several new geologic map series. The first is a 1:100,000-

scale compilation of the 7.5-minute data. These paper maps provide a regional perspective of geology with the fidelity of detail of the original 1:24,000-scale geologic quadrangle maps. A county geologic map series is planned as well; the first maps are being published on a print-on-demand basis for the central Kentucky area.

The digital data are being used to make maps for county land-use planning. Each map provides a simplified geologic map of the county and an interpretation of the local geology in nontechnical language. The maps include information on how the underlying rock in an area affects land use (for example, excavation and foundations, on-site wastewater treatment systems, residential and industrial developments, highway and street development, pond and reservoir construction, etc.). Photographs of sites in the area are used to illustrate the geologic discussion. This derivative map product can be used by homeowners, developers, and planners.

Future directions

The newly created digital map data are being incorporated into a database of spatial information that will be accessible through the Web. An Internet map server is being used in conjunction with the database to provide easy access to the land-use planning maps.

The new maps and derivative map products can be viewed using the Internet map services at kgsweb.uky.edu/arcimsSearch.asp. A tutorial for their use is provided.

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