

Converting Geologic Maps from Paper to Vector Format

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Abstract

Recent mapping projects in east-central Alabama and west Georgia have produced geologic maps at 1:24,000 scale that are useful for delineating and developing hard rock aggregate sources in the vicinity of the Fall Line, to serve one of the world's largest aggregate markets. By converting existing geologic maps from paper format to GIS vector format, geologic information can be readily accessed, and GIS analytical techniques can be utilized by mining companies to examine potential aggregate materials sources. Supplementary geological and aggregate material data can be gathered and added to the digitized versions of the geologic maps to augment the functionality of the end product.

Additionally, the project aims to develop a practical manual for the production of digital geologic maps that are compatible with formats used by the Geological Survey of Alabama and the U.S. Geological Survey. Thus far, the procedure requires that existing PDF files of geologic maps be digitized in a heads-up manner, to create feature classes contained within a personal geodatabase.

Introduction

New Federal and State regulations have increased restrictions regarding quality standards for aggregate materials used in asphalt, concrete, and other types of construction. These recent increases in restrictions have rendered many previously used 'soft' sedimentary sources of the Gulf and Atlantic Coastal Plain provinces inadequate for the production of quality aggregate stone that meets specifications. Given the high cost of transporting rock materials, the closest 'hard' rock (crystalline) aggregate materials suitable for construction

projects within the Gulf and Atlantic Coastal Plains will require the development of more quarries along the Fall Line.

Geologic maps are fundamental to the mining industry because they provide the most basic information needed for exploration, development, and the reclamation of industrial stone quarries. Recent mapping projects provide the aggregate industry with valuable information on the geology in the vicinity of the Fall Line. However, these maps have not yet been produced in a vector format that would enable GIS analytical techniques and, therefore, they are less effective and the quantity of information shown on the maps is limited when compared to what could be included in a GIS file. This project uses existing maps to produce high-quality vector format maps at a scale most applicable to the exploration and development of aggregate resource sites, and aims to supplement the final product with spatial geologic data relevant to the production of high-quality aggregate stone.

Project Goals

The goal of our project is to prepare a GIS project composed of vector format, seamless geologic map information at a scale of 1:24,000 that includes five adjacent quadrangles (Tallassee, Carrville, Notasulga, Loachapoka, and Auburn quadrangles; see figure 1). The maps will contain a traditional representation of geological data, a DEM, and other available spatial information and appropriate metadata, as well as information on rock materials testing as available from governmental (for example, Alabama Department of Transportation) and industrial sources. GIS based exploration techniques pertaining to the development of aggregate material will be investigated. The maps must be seamless in order for bedrock types and their structures (for example, Appalachian folds and faults) as mapped on the individual geologic quadrangle maps

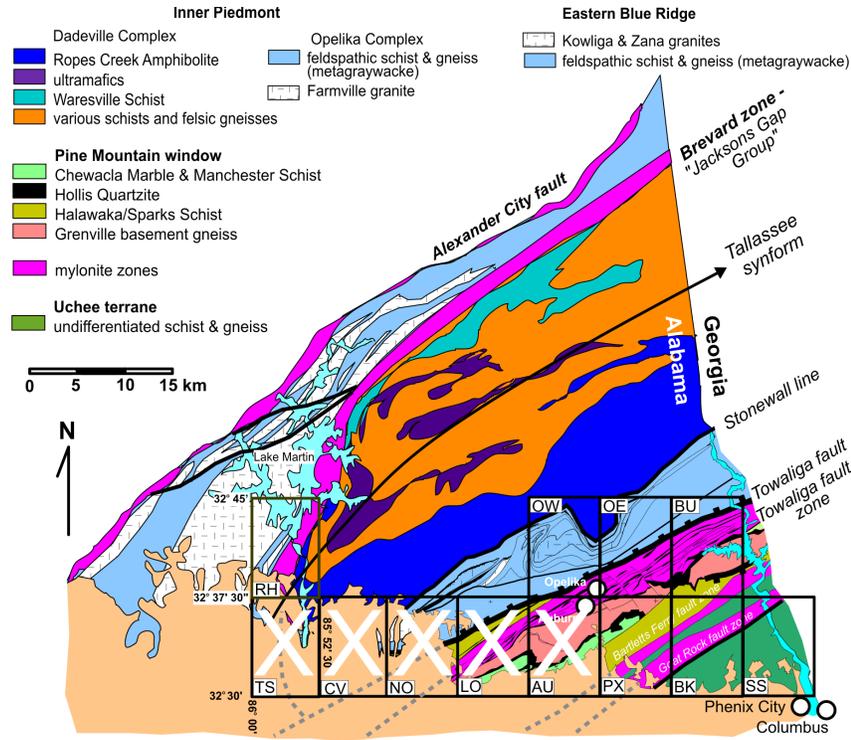


Figure 1. Fall Line quadrangles mapped, or being mapped (for example, Red Hill) by the Principal Investigator and his students, superimposed on a tectonostratigraphic map of the Alabama Piedmont (from Osborne and others, 1988; Steltenpohl, 1996; Steltenpohl and Kassos, 2003; Steltenpohl and Sterling, 2004; Steltenpohl and others, 2005; and Steltenpohl and White, 2007). The Brevard zone separates the eastern Blue Ridge from the Inner Piedmont along the west limb of the Tallassee synform. Large white X's are quadrangles we now have digitized. Coastal Plain rocks are tan colored, and dashed gray lines are sub-Coastal Plain, Piedmont geophysical lineaments from Horton and others (1984). Quad abbreviations: AU = Auburn; BK = Bleeker; BU = Beulah; CV = Carrville; LO = Loachapoka; NO = Notasulga; OE = Opelika East; OW = Opelika West; PX = Parker's Crossroads; RH = Red Hill; SS = Smith's Station; TS = Tallassee.

to follow ore seams across a broader area, in order to allow for the formulation of an exploration model. Furthermore, a manual illustrating the standard processes for the digitization of geologic maps using ArcGIS will be produced.

Methods

Data Collection

Collection of geologic data through fieldwork has been completed using conventional mapping techniques. The data have been displayed in the traditional format of 7.5-minute quadrangle geologic maps. These maps were produced using Corel Draw® and other computer graphics programs and stored as both PDF files and paper copies. Field notes taken during the mapping process are incorporated to supplement

information projected on the map. Additional information will be collected using a GPS-enabled field instrument. We have found that additional fieldwork is generally needed along the borders of the individual quadrangle maps in order to assure that the rocks and structures are properly joined across their boundaries.

Digitization

The digitization process is completed using ArcGIS. A PDF file of a geologic quadrangle is loaded in ArcMap and georeferenced to its corresponding topographic quadrangle, which was acquired from Alabama View (www.alabamaview.org). ArcCatalog is used to create a Personal Geodatabase containing a Feature Class within a Feature Dataset. The feature type is set to Polygon Feature. A preliminary attributes table is constructed for geologic units. The new Feature Class is then added to ArcMap and the editing process begins.

A Wacom tablet and pen are used in conjunction with the editor Sketch tool to add vertices to create polygons, lines, and point data. Polygon attribute tables are populated with the appropriate data. Line features are created in a similar fashion, to represent faults and contacts. Point features and attributes are added for locations of recorded point data and include the strike and dip of units and the orientation of other features.

The methods described here are modeled after those of Philip Dinterman, Alabama Geological Survey (AGS), with some modifications. Please refer to his poster from the 2008 DMT proceedings for details on the AGS map production techniques (http://ngmdb.usgs.gov/Info/dmt/docs/DMT08_Dinterman.pdf).

Progress

To date, the bedrock units on five geologic quadrangle maps (Tallasse, Carrville, Notasulga, Loachapoka, and Auburn quadrangle; see figure 1) are completely digitized. The process of revising the attribute tables is underway. Line and point data have been added to these four maps. Another quadrangle, the Auburn quadrangle, is in preparation for the digitization stage of the process. A manual for the process is under development and copies are available by request.

References

- Horton, J.W., Jr., Zeitz, I., and Neathery, T.L., 1984, Truncation of the Appalachian Piedmont beneath the Coastal Plain of Alabama: Evidence from new magnetic data: *Geology*, v. 12, p. 51-55.
- Osborne, W.E., Szabo, M.W., Neathery, T.L., and Copeland, C.W., Jr., compilers, 1988, Geologic map of Alabama, northeast sheet: Alabama Geological Survey Special Map 220, scale 1:250,000.
- Steltenpohl, M.G., 1996, Geologic map of the 1:24,000 Auburn quadrangle, Alabama: Alabama Geological Survey Open-File Special Map.
- Steltenpohl, M.G., Buchan, O.C., and Garner, G.P., 2005, Geologic map of the 1:24,000 Carrville quadrangle, Alabama: Alabama Geological Survey Open-File Special Map.
- Steltenpohl, M.G., and Kassos, G., 2003, Geologic map of the 1:24,000 Loachapoka quadrangle, Alabama: Alabama Geological Survey Open-File Special Map.
- Steltenpohl, M.G., and Sterling, J.W., 2004, Geologic map of the 1:24,000 Notasulga quadrangle, Alabama: Alabama Geological Survey Open-File Special Map.
- Steltenpohl, M.G., and White, T.W., 2007, Geologic map of the 1:24,000 Tallasse quadrangle, Alabama: Alabama Geological Survey Open-File Special Map.

