ROCK LORE

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Petrified wood found on gravel bar at Chain of Rocks on the Mississippi River during March field trip of the SLMGS. Specimens and photo by Charles Calkins 2009, used with permission.

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GEORGIA STATE GEMSTONE: QUARTZ

In 1976, quartz was chosen as the official state gem. It is common in Georgia and found in a wide variety of colors. The resolution making quartz the state gem cited two particular forms: the amethyst, which is mostly used in jewelry, and the clear quartz, which, when faceted, resembles the diamond.

Act of Georgia General Assembly
March 18, 1976
OFFICIAL STATE MINERAL, FOSSIL, AND QUARTZ DESIGNATED.
No. 104 (House Resolution No. 517-1385).
A Resolution.

Designating staurolite as the official State mineral, the shark tooth as the official State fossil and quartz as the official State gem; and for other purposes. Whereas, Georgia has a wealth of minerals and gemstones; and Whereas, staurolite is a mineral found in old crystalline rocks and is particularly well known and abundant in north Georgia; and

Whereas, staurolite crystals are known mostly as "Fairy Crosses" or "Fairy Stones", and generations after generations have collected them for good luck charms; and Whereas, the shark tooth is a relatively common fossil in Georgia and in fossil form can be traced back 375,000,000 years; and Whereas, the teeth are especially prized for fossil collectors and range in color from the more common blacks and grays to white, brown, blue and reddish brown; and Whereas, quartz is the second most abundant mineral on Earth, and Georgia is blessed with a great deal of it in a wide variety of colors; and Whereas, quartz is the amethyst that has been most used in jewelry, and clear quartz when faceted resembles diamond; and Whereas, the importance of Georgia's minerals to the industrial growth and heritage of this State should be appropriately recognized.

Now, therefore, be it resolved by the General Assembly of Georgia that the following designations are hereby made:

(1) Staurolite is designated as the State of Georgia's official mineral.

(2) The shark tooth is designated as the State of Georgia's official fossil.

(3) Quartz is designated as the State of Georgia's official gem.

Approved May 18, 1976.

Source: Ga. Laws 1976, pp. 567-68.

From: Georgia Info, http://georgiainfo.galileo.usg.edu/1976resn-1.htm

CREATING GEOLOGIC MAPS

By Charles Calkins

Introduction

When collecting an interesting rock, a question that often comes to mind is where more of the like can be found. If the rock was found *in-situ*, knowing what geologic formations are in the immediate vicinity, and where other exposures of the same formations can be found, can give a clue as to where the rock hunt should continue.

While geologic maps are available, they are normally for cost, and, as they are generally printed on paper, do not let the viewer interact with the data, such as to zoom into smaller regions, or to add annotations other than by pen or marker.

The Geographic Information System (GIS) data that is used to generate maps for Missouri and Illinois is freely available, however, as is software which can manipulate that data. Unfortunately, the free software packages tend to be limited in features as compared to expensive commercial applications, so multiple packages tend to be needed to accomplish a given task, but this article will show how to use them to produce interactive geologic maps.

The Data

GIS data is available in multiple “flavors,” depending on the nature of the data being stored, with the two main categories known as "vector" and "raster" data. Examples of vector data include cave openings represented by points, roads by lines, and geologic formations by areas (closed polygons). Raster data includes aerial photographs and satellite images.

In a GIS software application, a given data set is loaded into a "layer." A layer has properties, such as how to color or label the features represented in the layer. Overlaying a series of layers produces a composite map.

Data can be stored in multiple formats. The two formats that I reference in this article are Arc Interchange Format, with a .e00 extension, and Shapefile, with a .shp extension. Not all free software packages read both formats, or can open all versions of a given format, so multiple packages are needed.

GIS data for Missouri and Illinois are available from multiple sources, including the Illinois State Geological Survey (ISGS) (http://www.isgs.illinois.edu), and the Missouri Spatial Data Information Service (MSDIS) at the University of Missouri, Columbia (http://msdis.missouri.edu).

The Software

A large amount of free software is available for viewing and manipulating GIS data, though the packages for the novice are limited in functionality. To accomplish all steps in this article, a number of software packages are needed. The version numbers and locations of the applications listed below are current at the time of writing.

ArcExplorer 9.3.1

http://www.esri.com/software/arcexplorer/download.html

Forestry GIS 2005.09.13

http://www.forestpal.com/fgis.html

Import71

http://www.esri.com/apps/products/download/?downloadid=175

or http://software.geocomm.com/translators/arcview

FWTools 2.47

http://fwtools.maptools.org/

ArcINFO2Shape.zip

http://www.mediafire.com/?njtuyjmyzyn

(copy "ArcINFO2Shape GUI.exe" into the bin directory of FWTools as per http://freegeographytools.com/2007/converting-e00-vector-data-to-shapefiles-a-free-and-fairly-painless-approach)

How each software package will be used in the creation of a map will be described below.

Making a Map

We will use MSDIS data to create a map of Missouri's geological formations, showing roads and collecting areas, using ArcExplorer as our primary GIS viewer. We will create multiple layers of data, compose them together, and generate a map as an image file. To begin, create the directory C:\geo for use as a working directory.

Layer 1 – Geology

MSDIS provides a statewide data file containing geologic features which is directly usable in ArcExplorer. From ftp://msdis.missouri.edu/pub/state download the file st_bedrock.zip and save it to C:\geo. To do so, enter the address site in a web browser such as Firefox or Internet Explorer, and a list of files will be shown. Click on st_bedrock.zip to download it, and choose C:\geo as the directory where to save it.

Extract this file into the directory C:\geo\st_bedrock. The directory will then contain the file BEDROCK.shp, and associated files.

Open ArcExplorer and add this as a layer. To do so, click on the plus-sign icon, and the "Catalog" dialog will appear. Ensure that the "File Type:" is "Shapefiles", and select the path Local -> C:\ -> geo -> st_bedrock from the dialog that is displayed. A shapefile with the name BEDROCK of type "polygon" will be shown on the right side of the dialog, as shown in Figure 1. Highlight "BEDROCK" and click on the plus sign icon to add the layer to ArcExplorer. Close the popup dialog.

Returning to ArcExplorer shows BEDROCK as a layer in the project. Click on BEDROCK to select it (it becomes outlined with a black rectangle), and select the "Layer" menu, and the "Layer Properties…" option. This displays a dialog to configure the display of the layer. From the "Symbols" tab, change the "Draw features using:" selection to "Unique Symbols", the "Field for values" to "GEOLOGY", "Color Scheme" to "Minerals", and "Style" to "Solid fill". The table in the lower half of the dialog will show geologic formation abbreviations with the "Minerals" color palette, as shown in Figure 2.

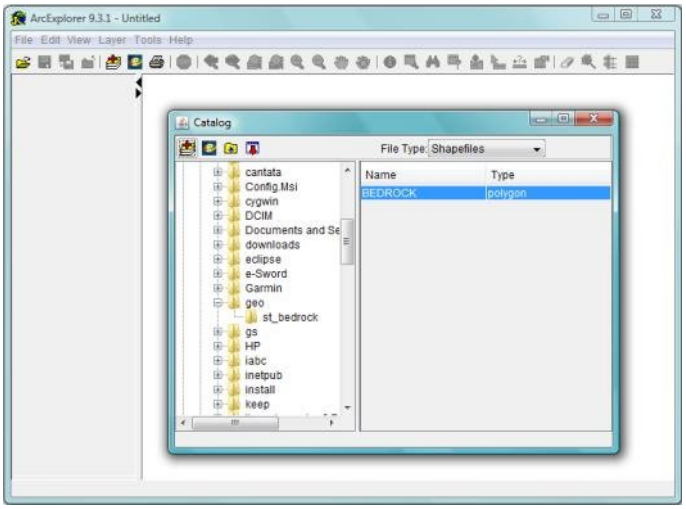

Figure 1

Switch to the "Labels" tab, and change "Label features using" to GEOLOGY, as shown in Figure 3. This will add labels to each of the colored areas. Click "OK" to dismiss the dialog.

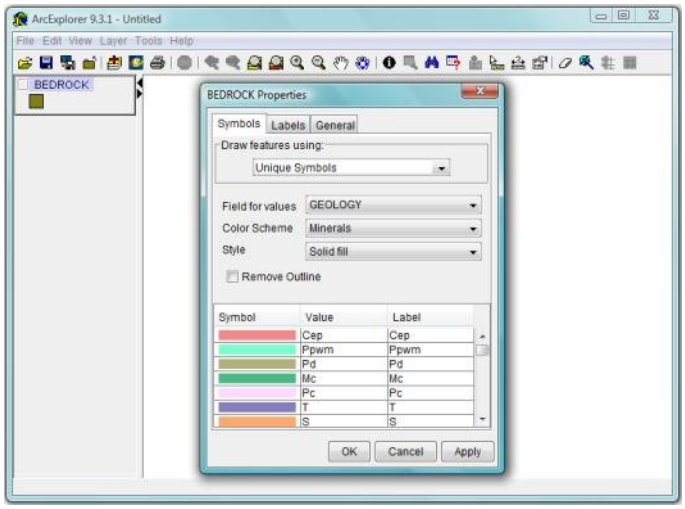

Figure 2

After returning to ArcExplorer, click on the check box next to the BEDROCK layer to make it visible, and then on the "Zoom Extents" icon (the magnifying glass above the yellow lines) to see the

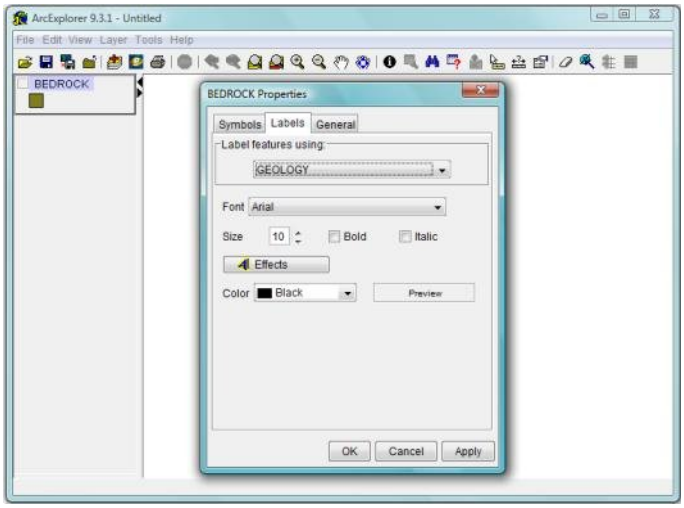

Figure 3

entire range of the map. A geologic map of Missouri will be displayed as shown in Figure 4.

The formation abbreviations are explained in the metadata that accompanies the st_bedrock file, and can be found at http://tin.er.usgs.gov/geology/state/metadata/mo.html. For instance, "Odp" is an abbreviation for "Ordovician, Decorah and Plattin formations."

Layer 2 – County Boundaries

For our next layer, we will add county boundaries. Return to ftp://msdis.missouri.edu/pub/state, download st_county.zip, and save it in C:\geo. Extract this file to C:\geo\st_county. The directory will

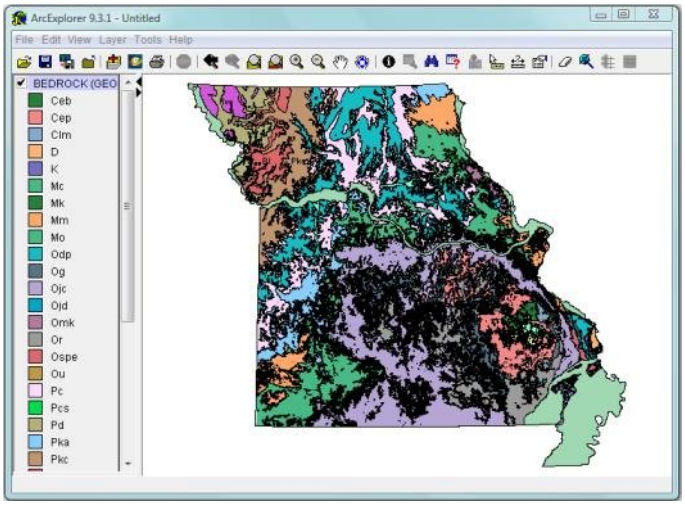

Figure 4

then contain st_county.shp and associated files.

As with the bedrock layer, add it as a new layer – select the new layer (plus sign) icon to open the Catalog, and select the COUNTY shape file from C:\geo\st_county. It may be necessary to right-click on the geo subdirectory and select "Refresh" for the st_county directory to appear. Click on the plus sign in the "Catalog" dialog to add the COUNTY layer. Close the dialog and return to ArcExplorer.

Select the COUNTY layer, and choose "Layer" -> "Layer properties…" Select a "Style" of "Transparent fill", an "Outline style" of "Solid line", and "Red" for both color selections. If the style is not transparent, the county map layer will obscure the geologic feature layer. Click "OK" to dismiss the dialog to return to ArcExplorer.

Click on the check box next to the COUNTY layer to display it. The map will now appear as in Figure 5.

Layer 3 – Roads

While the county lines will give a general idea of where geologic features are located, adding roads will make locating features easier.

Go to ftp://msdis.missouri.edu/pub/state/transportation/modot and download the latest archive of road data, st_modotrds0908.zip as of this writing, to C:\geo. Extract this file to C:\geo\st_modotrds0908.

Unfortunately, this archive contains an Arc Interchange Format file, so it must be converted to Shapefile format before it can be opened in ArcExplorer. The conversion process is described in detail on this page: http://freegeographytools.com/2007/

converting-e00-vector-data-to-shapefiles-a-free-and-fairly-painless-approach, so I will only summarize the process here.

Run Import71 and select C:\geo\st_modotrds0908\st_modot.e00 as the "Export Filename" to convert. Select C:\geo\st_modotrds as the "Output Data Source" and click "OK" to perform the conversion. This

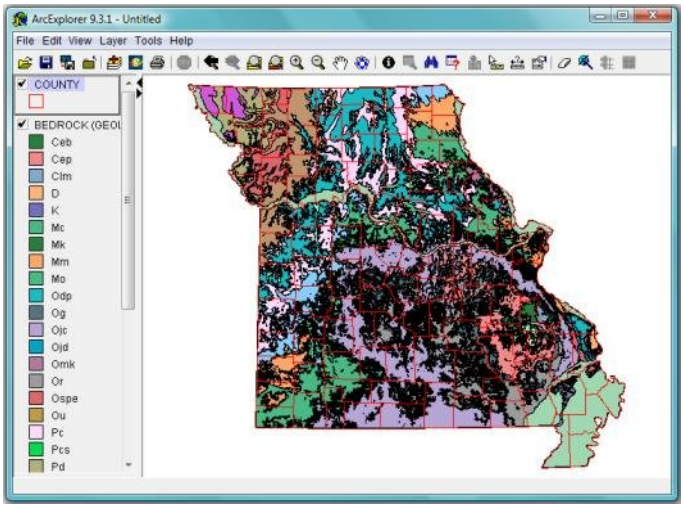

Figure 5

will convert the file to ArcINFO coverage format.

Use ArcINFO2Shape GUI as a front-end to FWTools to convert the ArcINFO coverage files just created to Shapefile format. To do so, select the C:\geo\st_modotrds directory from the file selection window, enter MODOTRDS as the "Shapefile ID", and click the "Execute Conversion" button. When the conversion is complete, MODOTRDS.shp and related files will have been created in the C:\geo\st_modotrds directory.

Return to ArcExplorer, and add MODOTRDS.shp as a new layer. Edit the layer properties and change the color to "Cyan." Close the properties dialog to return to ArcExplorer, and check the checkbox next to MODOTRDS_ARC to make the layer visible. The result will appear as Figure 6.

Layer 4 – Points of Interest

While the previous three layers are sufficient to produce geologic maps, it is interesting and useful to correlate known good collecting sites with geologic formations. Once the formations that yield good sites are identified, the other layers of the map can show where else the same formations can be found, and the roads to take to reach the areas.

One way to determine the location of good collecting sites is to mark the sites via a GPS receiver, and to identify their latitude and longitude. For instance, waypoints marked on a Garmin GPS receiver can be downloaded to a PC into Garmin's MapSource software application. In MapSource, properties of individual waypoints can be displayed and their latitude and longitude shown, or the waypoint list in its entirety can be exported to a text file.

A second way is to use Google Maps (http://maps.google.com). After zooming in to a map location, right-clicking and selecting "What's here?" will show the latitude and longitude of the point in the Google Maps search bar. Displaying roads in conjunction with satellite maps is an effective way to identify road cuts, gravel bars or other areas that one has visited.

Once points have been determined, they can be converted to Shapefile format for use on the map. Start by creating a directory, C:\geo\points, containing a text file named points.txt. For the first line of that file, add the column headings of "ID,X,Y,Label" (no quotes). Add additional lines, one per point of interest, in this format: an identifier, comma, longitude in decimal degrees, comma, latitude in decimal degrees, comma, and a short description. Be sure that no spaces are between the fields and the commas separating them, and that the identifier and description for each point of interest are enclosed within double quotes. As a final step, the current map view can be saved as an image file. Choose "Edit" -> "Copy Map Image to File…" and provide a file name to save a JPEG image. As an example, this file contains collecting

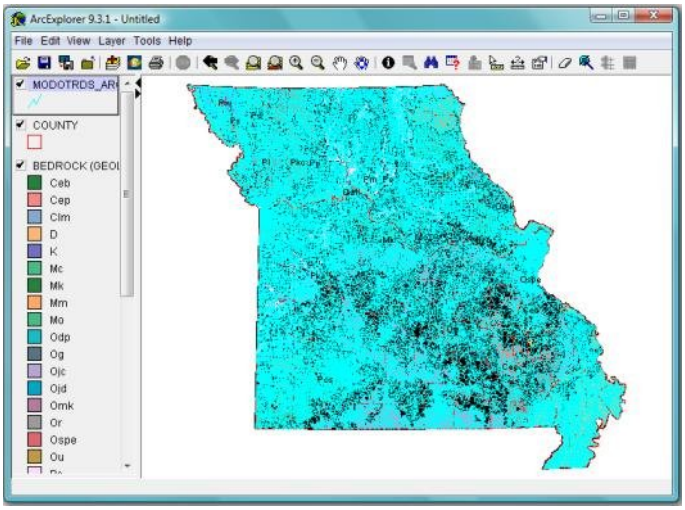

Figure 6

locations on or near MO 21 that I have found to be productive:

ID,X,Y,Label

"Site 1",-90.5467300024,38.291859962,"Site 1 - calcite"

"Site 2",-90.47916,38.42032,"Site 2 - calcite"

"Site 3",-90.48183,38.41879,"Site 3 - fossils"

"Site 4",-90.48986,38.41212,"Site 4 - coral, calcite"

"Site 5",-90.50723,38.37744,"Site 5 - fossils, chert"

"Site 6",-90.51373,38.32551,"Site 6 - large cut"

"Site 7",-90.55316,38.26215,"Site 7 - galena, barite"

To convert this to Shapefile format, open Forest GIS, and enter any name for the project file. From the main menu, select "Utilities" -> "Import XY Text Table to Shapefile". Click the "Input Text Table" button and select C:\geo\points\points.txt. Click on "Output Shapefile" and enter C:\geo\points\points.shp. Be sure that the "Delimiter" is set to "Comma", and click the "Import" button. This will create the shapefile. Close the dialog box to return to the Forest GIS main window.

Although a shapefile has been created, the points in the file must be transformed to the same coordinate system used by the other maps – the Universal Transverse Mercator (UTM) system. As shown on the UTM map (http://www.dmap.co.uk/utmworld.htm), these points lie in UTM15. From the Forest GIS main menu, select "Utilities" -> "Shapefile Projection Utility". For the "Input Shapefile Projection:" select "Lat./Lon." as the original file was presented in that format. For the "Output Shapefile Projection:" select "UTM15". Leave the "S" boxes unchecked as these points are in the northern hemisphere. Click on "Input Shapefile" and select C:\geo\points\points.shp. Click on "Output Shapefile" and enter C:\geo\points\points_utm15.shp. Click on "Convert" to perform the conversion. Close the conversion dialog, and close Forest GIS.

Return to ArcExplorer, and add C:\geo\points\points_utm15.shp as a new layer. Edit the layer properties to set the symbol color to "White" on the "Symbols" tab, and on the "Labels" tab set "Label features using:" to the "LABEL" field, set the color to "White" and the "Size" to 18. Click "OK" to dismiss the dialog, and check the checkbox next to points_utm15 to make the layer visible.

Click on the magnifying glass icon and drag a box over Jefferson County to zoom into the region as shown in Figure 7 (see back cover).

The map illustrates why MO 21 is a very interesting place for rock hunting. As one proceeds south from the Meramec River, one passes through a number of different formations, and the types of rocks found confirm the variety. From the map, one can see that galena and barite are found in the pink area identified as Ojc, "Ordovician, Jefferson City and Cotter formations," but that fossil-bearing formations are found to the north of it.

Zooming in to the upper part of MO 21, choosing the BEDROCK layer, selecting the icon of an "i" in a black circle, and clicking in the green near the marker for site 5 shows that the green area corresponds to "Mo," the "Mississippian, Osagean Series." The USGS page for the Osagean Series (http://tin.er.usgs.gov/geology/state/sgmc-unit.php?unit=MOMo%3B0) indicates that the series includes the fossiliferous Burlington Limestone, which correlates with finds at that location. Use of the "Identify Results" dialog is shown in Figure 8.

Conclusion

This article has demonstrated how to generate a geologic map and how to annotate it with custom markers. Identifying the geologic formations of known good collecting sites can help to locate other promising areas. Although guessing where to look for rocks is fun in itself, a guide to where chances may be greater of finding interesting things can only be a help.

Sources:

ArcExplorer 9.3.1, **http://www.esri.com/software/arcexplorer/download.html**

Forestry GIS 2005.09.13, **http://ww.forestpal.com/fgis.html**

Import71**, http://www.esri.com/apps/products/download/?downloadid=175, or http://software.geocomm.com/translators/arcview**

FWTools 2.47, **http://fwtools.maptools.org/**

ArcINFO2Shape.zip, **http://www.mediafire.com/?njtuyjmyzyn**