Development of an ArcGIS Map Template to Support Standard Geologic Map Production in Kentucky

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Overview

The Kentucky Geological Survey (KGS) first used the ESRI ArcMap template for the Fiscal Year 2007 U.S. Geological Survey STATEMAP surficial geologic mapping deliverables. Several mappers were working on eight geologically similar 7.5-minute quadrangle maps in the Ohio River Valley of western Kentucky. This region of Kentucky includes Pleistocene lacustrine, glacio-fluvial outwash, and alluvial floodplain deposits, with bedrock-cored uplands typically mantled by loess (fig. 1). Processes during the evolution of the Ohio River Valley affected all the tributaries during flooding and erosion. Therefore, the deposits are similar in material, age, and sequence within the study area. To understand this complex region and prepare maps useful to other disciplines, a regional research strategy was used. Soil boring sites were selected to examine the vertical variability of all the deposits within the region, regardless of quadrangle boundaries. Since geologic map units were developed for the entire region, KGS chose to reflect this regional perspective on each published map with a diagram showing the correlation of map units. This allowed all regional map units to be included in a template that contained all possible map unit symbol boxes filled with an appropriate color from an ArcMap style file. A customized ArcMap template was used to make map production more efficient for the geologists and to ensure standard cartographic styles across the region. The USGS Geologic Map Style Guide, version 1.4 (2004), and the FGDC-STD-013-2006 (FGDC, 2006) cartographic standards were used to the extent possible in the design layout of the template. All mappers considered this appropriately designed template to be an efficient way to standardize map elements and minimize their cartographic effort.
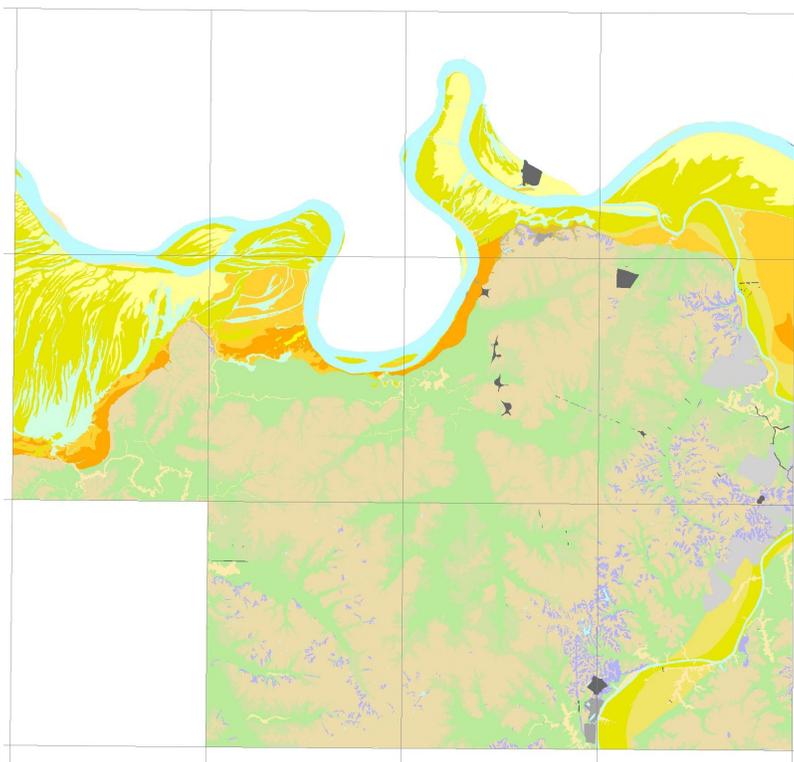

Figure 1. Regional map of the Ohio River Valley of western Kentucky showing the extent and continuity of the deposits in this 11-quadrangle area.

Template Design

Every ArcMap document, by default, opens with a blank virtual layout page and one empty data frame. After data are entered into the data frames, the data frames are added to the appropriately resized layout page along with other map elements such as legends and scale bars. Ordinarily this document is saved and becomes a map document; however, it can also be saved as a custom template and selected in place of the default template when opening ArcMap. KGS designed a custom template to contain all of the standard cartographic elements common to each individual quadrangle (fig. 2). The layout of the template contains five data frames, into which are inserted shapefiles (or geodatabase layers) containing the geologic map, a cross section, quadrangle location, quadrangle index map, and the correlation of map units illustration. The template also contains other graphic and text elements for adding or customizing the map collar information. The position and spacing of each element, as well as title and font specifications, conform to the USGS style guide. Most of the collar elements contain default text stored as a Word file; some text documents are edited for each map by clicking on the embedded Word file, while other text files are standard for all maps. The description of map units contains descriptions that are generalized for the entire region and map unit symbol boxes that contain a standard legend color. The colors are assigned by the geodatabase to an attribute value, through an ArcMap style file that is referenced with the template design.
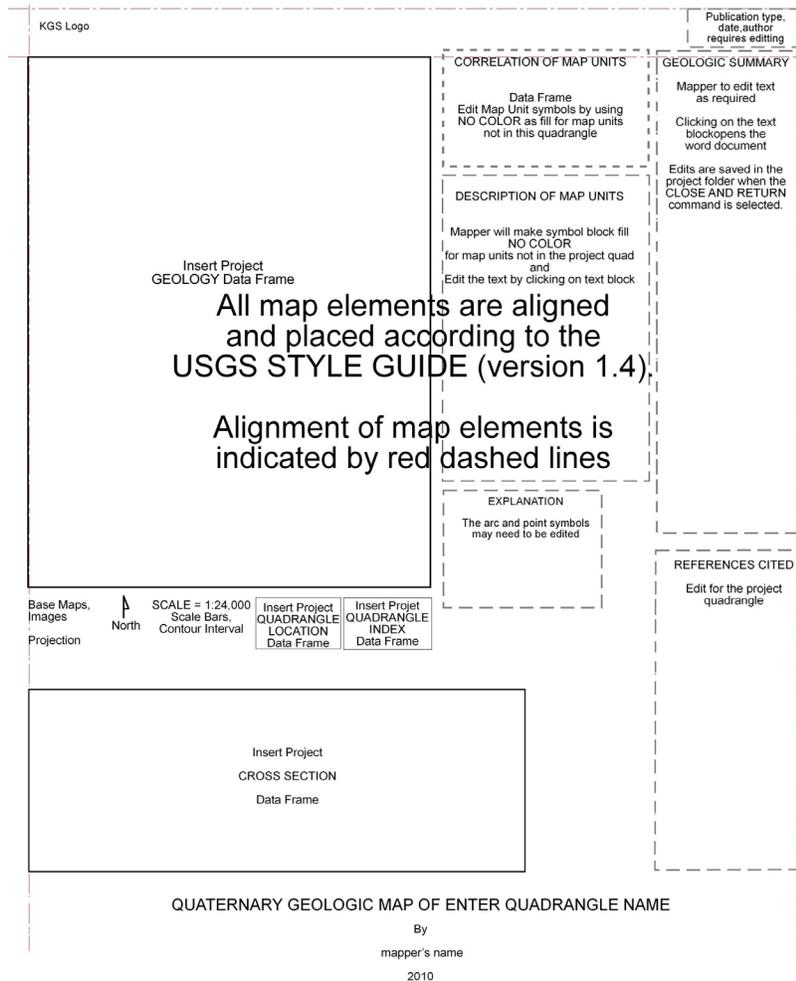

Figure 2.   ArcMap template with position and type sizing of standard elements to be added by each mapper.

Template Use

Each mapper opens a new ArcMap project by specifying the custom template. Simple text edits are then made, such as the title, authors' names, publication number, and corner coordinates for the specific map area. The authors then add and edit text, as required, for the description of map units, geologic summary, and references sections, within each designated area of the template. Editing the text ensures the formatting is retained. Any new text must be formatted by the mapper. This is done by the mapper with these steps in ArcMap: in the project Layout View use the "Insert" tool, select "Object", click "Create from File", use "browse" to access the template text folder and select a text block that is correctly formatted, then properly place this object into the Layout View. Double click this text block in the layout view to open the Word-formatted text, edit the text, and select "Close & Return to project.mxd". Data such as shapefiles, annotation, and imagery are added to the geology, cross section, quadrangle index, and quadrangle location data frames (the correlation of map units shapefile is the same for all maps of the region). The custom style file is used to symbolize the arcs and polygons of the legend, the map unit symbol boxes in the description of map units, and the geologic map and cross section data frames. This approach ensures standard color assignments across the region and within the map. It also serves to validate the attribution of the shapefiles, because any errors in attribute assignment to arcs or polygons will show on the map or cross section with an incorrect color, and misspelled attribute values will be assigned the color for "other" in the ArcMap legend. These errors are readily apparent, and are then corrected. Although all of the map unit descriptions for the region are retained in the final publication of each quadrangle map, those that do not occur on a particular map must have their colors removed in order to indicate that they are shown only for context. Figure 3 shows part of the geology and correlation of map units data frames, with the appropriate edits, for a specific map. Note that the correlation of map unit symbol boxes Qao, Qafp, Qot1, Qot2, and QTg do not have color fill.

Developing an ArcMap template requires significant set-up time by someone familiar with the design process. The ESRI template is designed so that only the designer of the template can edit the template or associated text files. All map-specific customizations are stored in the user's local map project folder.

Each mapper estimated that the 2006 deliverable map, which was done without using the template, required at least 3 weeks for cartography. For the 2007 deliverables, using the template, the mappers prepared the cartography in 3 days or less.
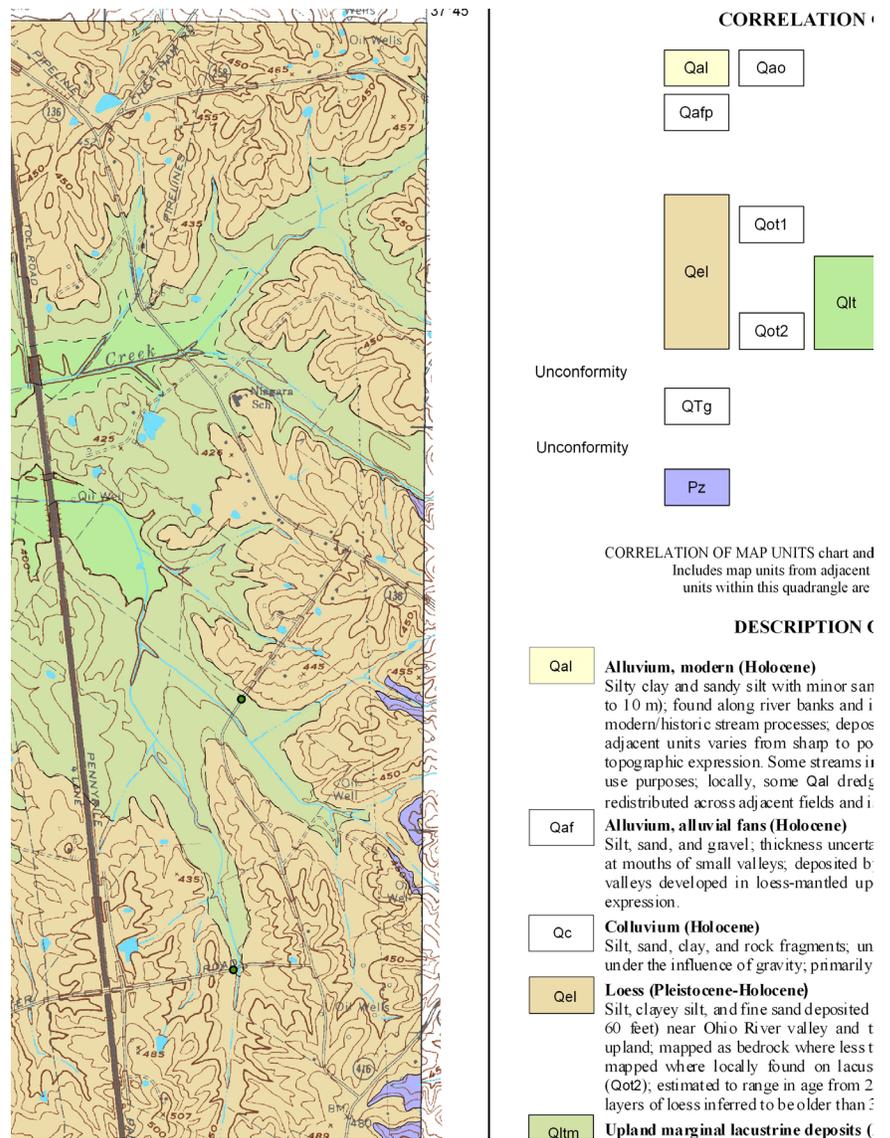

Figure 3. Detail of a completed map at 1:24,000 scale, showing parts of the Geology and Correlation of Map Units data frames modified for this particular quadrangle.

Standards

KGS developed this template and associated style file prior to the formal release of the ESRI implementation of the FGDC cartographic standard. KGS followed the new FGDC cartographic standard, in spirit. This standard specifies the symbols in decimal millimeter units, but the ArcMap Line Symbol creation menu specifies symbols in picas. Because picas are in whole units, whereas millimeters are not necessarily so, converting between picas and decimal millimeters required deviation from the standard. Therefore, the lines generated by KGS are not exact replicas of those in the FGDC standard, but follow in intent.

Line styles in the Legend, in close proximity, are readily distinguishable. However, these same lines, when distanced on the map, may closely resemble several different lines depicted in the Legend, causing uncertainty as to which symbol is being indicated. KGS followed a draft FGDC symbol style file provided by T.A. Lindquist, USGS (personal communication, 2008). Ms. Lindquist warned that ESRI may use a different computer process/language for future symbol generation. Therefore, only a limited number of replicated FGDC symbols were entered into the KGS style file for testing. The names of selected styles were abbreviated for the KGS attribute table, in order to accommodate ArcPad applications.

References

Federal Geographic Data Committee, 2006, FGDC Digital Cartographic Standard for Geologic Map Symbolization: Prepared for the Federal Geographic Data Committee by the U.S. Geological Survey, FGDC-STD-013-2006, 290 p., 2 plates, *http://ngmdb.usgs.gov/fgdc_gds/*.

U.S. Geological Survey, 2004, Geologic Map Style Guide (version 1.4): From Cartographic Technical Standards of the U.S. Geological Survey, 1978, and recent updates, one pdf file. The link is no longer available.