Problems and Solutions in the Digital Compilation and Production of the "Map of Surficial Deposits and Materials in the Eastern and Central United States (East of 102° West Longitude)"

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ABSTRACT

The "Map of Surficial Deposits and Materials in the Eastern and Central United States (East of 102° West Longitude)" (Fullerton and others, 2003) depicts the areal distribution of surficial geologic deposits and other materials that accumulated or formed during the past 2+ million years, the period that includes all activities of the human species. These materials are at the surface of the earth. They make up the "ground" on which we walk, the "dirt" in which we dig foundations, and the "soil" in which we grow crops. Most of our human activity is related in one way or another to these surface materials that are referred to collectively by many geologists as "regolith," the mantle of fragmented and generally unconsolidated material that overlies the bedrock foundation of the continent. The map is based on 31 published maps in the U.S. Geological Survey's Quaternary Geologic Atlas of the United States (U.S. Geological Survey Miscellaneous Investigations Series I–1420). It was compiled at a scale of 1:1,000,000, to be viewed as a digital map at a nominal scale of 1:2,000,000 and to be printed as a conventional paper map at 1:2,500,000.

The map unit descriptions provide information about genesis (processes of origin) or environments of deposition; age; properties, that is, the physical, chemical, and mechanical or engineering characteristics of the materials; and thickness or depth to underlying deposits or materials or to bedrock. The map and associated database provide information about areal distribution of more than 150 types of materials. The map and database also show the maximum limits of glacial advance during selected time periods. The database is available as ArcInfo export files and ArcView shapefiles at <http://pubs.usgs.gov/imap/i-2789/>.

Preparation of the digital database consisted of the following steps:

1. The number of map units on this map is much smaller than the total number of map units on the 4° x 6° quadrangles on which the map is based. The individual map unit descriptions were cut from each published map, and each description was labeled with respect to genetic class, age or age range, and quadrangle name. These descriptions were sorted by genetic class (for example, eolian deposits, alluvium, solution residuum). Then, within the genetic classes, they were sorted by age or age class (for example, Holocene). Within each genetic or age class, the descriptions then were grouped by particle size or texture; lithology or composition; engineering properties; stratigraphic relationships; and other information in the unit descriptions. Each group of individual unit descriptions constituted a single unit on the new map. Each group was taped onto pages in notebooks and assigned a new unit name and letter symbol. The letter symbols chosen were arbitrary. The list of map units for the surficial geologic map then was prepared from the hierarchy of units organized in the notebooks. The number of map units was greatly reduced. As an example, map unit **cl** on the surficial geologic map represents 13 different map units in 11 individual 4° x 6° quadrangles. All 13 units were colluvium derived from clastic rocks (conglomerate, sandstone, quartzitic sandstone, siltstone, shale) in various combinations. The distinctions on the source maps at 1:1,000,000 are not warranted on this map. The unit descriptions for the surficial geologic map were compiled from all of the cut-and-taped descriptions that were assembled into a new map unit. The published

descriptions were generalized and simplified.
2. Each 1:1,000,000-scale, 4° x 6° quadrangle map in the Quaternary Geologic Atlas of the United States was simplified; for example, some small or narrow units were deleted or units were combined. In some quadrangles, map units were revised or modified to accommodate information that was not available when the maps were published (for example, the age of a deposit subsequently may have been revised). The contacts of the new simplified or revised map units were inked on a paper copy of each 4° x 6° quadrangle, and letter symbols were assigned to the new map units from the new generalized and simplified map descriptions.
3. Because the quadrangles of the Quaternary Geologic Atlas of the United States were compiled and printed in different projections and on different bases, the projections and bases had to be converted to a common one for publication. But first, the source geology had to be recompiled to match the digital base on which the map was to be printed, the Streams and Waterbodies GIS file from the National Atlas of the United States. This file was converted to the projection of each published Quaternary Geologic Atlas map, clipped to the area of each 4° x 6° quadrangle, and printed in blue ink on mylar at 1:1,000,000.
4. The mylar hydrographic base for each quadrangle was placed over the inked paper map on a light table. The map units then were traced in black ink on the mylar overlay. The contacts of surficial deposits and materials in and adjacent to major valleys were traced onto the overlay by matching stream junctions, river bends, lakes, reservoirs, and other components of the hydrography on the paper map and the overlay. That procedure was accomplished in increments. Within each major valley, geologic contacts were "fitted" on the mylar within an area approximately 1 inch square, then "fitted" in an adjacent square. When the geology in and adjacent to all of the major valleys had been transferred to the mylar base, the geology in the areas between valleys was "fitted" in increments by using the valley deposits and materials, hydrographic features (for example, minor streams and lakes), state boundaries, and other guides.
5. The limits of selected glacial advances indicated on the Quaternary Geologic Atlas maps also were transferred to the mylar overlays. Those lines were used for most of the glacial limits coverage, but were altered in some areas to incorporate more recent geologic mapping.
6. A paper copy of the completed mylar quadrangle map was produced. Letter symbols were added to the paper map, and the map units were differentiated by color (using colored pencils). The colored paper sheet with letter symbols served as a guide for attribution of the map units.
7. The mylar plots of the geology then were scanned, vectorized with the LT4X computer program, and converted into ArcInfo (ESRI) coverages. Polygons and lines then were attributed. Map data for the individual quadrangles were unprojected to geographic coordinates, appended to one another, and edge-matched. Selected shorelines, lakes, and rivers were added from the hydrographic coverage. The geology was reconciled along the borders of the adjacent quadrangles, and the entire map was then converted to the Lambert azimuthal equal area projection.
8. Errors in polygon labeling were checked by using standard ArcInfo routines.

Following peer review, the database, checkplot, and map unit descriptions were reviewed by a map editor and a map layout was prepared. Production procedures for this map generally followed those described by Lane and others (1999): importing ArcInfo shapefiles for the geologic database and planimetric base into Adobe Illustrator through the MAPublisher plugin (Avenza software); assigning line styles, colors, and patterns through the "Select by Attribute" function of MAPublisher; and adding text, figures, and marginalia in Illustrator. For this map, polygons were labeled by using the "Feature Text Label" function of MAPublisher.

Our greatest obstacle in the production of the map layout was the "spider web" effect that resulted from importing the polygons in the ESRI shapefiles into Adobe Illustrator through MAPublisher. This distortion of the imported polygons is the result of some polygon boundaries having too many vertices for Illustrator to handle. We first split the original polygon coverage into two coverages, north and south, but this splitting did not eliminate the "spider web" effect. We considered generalizing the boundaries in ArcInfo, but it might have changed the linework in unpredictable and unacceptable ways. Instead, we chose to construct grids and superimpose them on the polygons of the problem coverages. Cutting the polygons up in this way simplified their boundaries. Arcs in the new coverages had fewer vertices, and we could import them into Adobe Illustrator without generating "spider web" distortions.

The procedure involves the following two steps, which may be repeated as needed to break up the polygons (because of the complexity of the polygon coverages, we found it necessary to impose a series of grids on the original polygons):

1. Create a grid coverage, drawing the lines of the grid so they intersect arcs that have the most vertices.
2. UNION the grid coverage with the original polygon coverage to create a modified polygon coverage.

The modified polygon coverages actually consisted of more polygons than did the original coverages. However, each part of an original polygon that was intersected by a gridline was attributed the same as the parent polygon. After importing the modified polygon coverages into Illustrator, we used the “Select by Attribute” function of the MAPublisher plugin to assign colors and patterns to the polygons, and to label the units.

Dividing the original coverage into two areas, north and south, required us to select most of the 185 map units twice in order to assign colors, patterns, and unit labels—twice the work of these operations on one coverage.

SOFTWARE CITED

Adobe Illustrator—Adobe Systems Inc., 345 Park Ave., San Jose, CA 95110-2704, (408)536-6000, <http://www.adobe.com>.

ArcInfo—Environmental Systems Research Institute (ESRI) Inc., 380 New York St., Redlands, CA 92373-8100, (909) 793-2853, <http://www.esri.com>.

LT4X—Infotec Development GIS Products & Services, 500 NE Multnomah, Suite 329, Portland, OR, 97232.

MAPublisher—Avenza Systems Inc., 6505-B Mississauga, Ontario, CANADA L5N 1A6, <http://www.avenza.com>.

REFERENCES

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Lane, D.E., Donatich, A., Brunstein, F.C., and Shock, N., 1999, Digital geologic map production and database development in the Central Publications Group of the Geologic Division, U.S. Geological Survey, *in* Soller, D.R., ed., Digital Mapping Techniques ‘99—Workshop Proceedings (May 1999, Madison, Wisc.): U.S. Geological Survey Open-File Report 99–386, p. 11–15., <http://pubs.usgs.gov/of/of99-386/lane.html>.