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Compilation and Production of the 1:500,000-scale Geologic Map of Washington State, and Some Aspects of 1:24,000-scale Map Production at the Washington Division of Geology and Earth Resources

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The 1:500,000-scale Geologic Map of Washington State (Schuster, 2005) presents the geology of Washington State at a scale that allows the entire state to be shown on one sheet of reasonable size (Figure 1). It is the first new 1:500,000-scale geologic map of Washington published since 1961, and is intended primarily for wall display. Map compilation involved both digital and hard-copy sources, and production was entirely digital (Figure 2).

DIGITAL CAPTURE OF THE SOURCE DATA

This map was compiled from four 1:250,000-scale geologic maps, each covering a quadrant of Washington State (Walsh and others, 1987; Stoffel and others, 1991; Schuster and others, 1997; Dragovich and others, 2002). Much of the data presented on the 1:500,000-scale map was compiled and published at 1:100,000 and 1:250,000 scales before the Division began using digital methods. Three of the four quadrants (southwest, northeast, and southeast) of Washington State were compiled at 1:250,000 scale from open-filed 1:100,000-scale geologic maps using manual and photographic methods. The 1:100,000-scale geologic maps were reduced photographically to 1:250,000 scale, and the authors simplified them to a level of complexity suitable for presentation at 1:250,000 scale by combining geologic units with different formal or informal names, but with the same geologic age and general lithology. These maps were manually registered to a 1:250,000-scale mylar grid and used as masters for scribing the faults, folds, contacts, and other features. The scribecoats and peelcoats became original materials for the photographic preparation of composite negatives from which printer's press plates for the published 1:250,000-scale maps were made. The scale-stable and other materials from this process became the source documents for digitizing and attributing arcs, points, and polygons at 1:250,000 scale. Digitizing for the southwest, northeast, and southeast quadrants was done in ArcInfo 8.3 on a backlit digitizing table.

The northwest quadrant was prepared using digital methods from 1:100,000-scale geologic quadrangle maps prepared by Division and U.S. Geological Survey geologists. Some of these maps were produced using manual methods, while others were produced digitally; those that were not created digitally were digitized in ArcInfo. The digital data for all 1:100,000-scale maps in the northwest quadrant were then appended and simplified by merging geologic polygons of the same age and lithologic range. Line and point features were simplified on-screen, as guided by the authors. The resulting ArcInfo coverages were used to produce the published map of the northwest 1:250,000-scale quadrant and, eventually, in the compilation of the 1:500,000-scale map.

These procedures resulted in several ArcInfo 8.3 coverages for each of the four 1:250,000-scale quadrants of Washington State. These four groups of ArcInfo coverages were appended and converted to shapefiles in ArcGIS 9.0, and the geology was simplified for publication at 1:500,000 scale.

SIMPLIFICATION OF THE SOURCE DATA

Simplification of the 1:250,000-scale geologic information was an iterative process with the goal of producing 1:500,000-scale geologic data that is easy to read everywhere on the map. Small water polygons were eliminated early-on, as were the shortest faults, folds, and dikes. Then the 1:250,000-scale map units were lumped into units with broader age and lithologic ranges. In two iterations the number of map units were decreased from about 400 at 1:250,000 scale to 53 at 1:500,000 scale. The original labels for units that were to be lumped were changed to the new label, and then a dissolve was performed on the polygons to create one polygon. Some remaining areas were too complex and not clearly legible, so additional small polygons were deleted unless they were important for defining the extent of a map unit. Small polygons in close proximity to each other were manually combined into larger polygons, which involved snapping arcs together to make the outline of the new polygon, building the coverage, running a label error check, and deleting any extra labels. Some faults, folds, and dikes in crowded areas were deleted as well.

MAP PRODUCTION

Shapefiles were imported into Adobe Illustrator using the Avenza MAPublisher plug-in. MAPublisher provided access to line and polygon attributes in order to assign line types for contacts, faults, and folds, as well as geologic unit labels and colors for geologic polygons. However, line ornaments needed to be placed directly into Illustrator as EPS files generated by ArcInfo, because we do not have the ability to ornament arcs through MAPublisher and Adobe Illustrator so that the ornaments can be displayed satisfactorily for publication.

The legend for the Washington 1:500,000-scale geologic map contains a useful detail found on the recently-published Pennsylvania statewide geologic map (Miles, 2003); that is, a small index map next to each geologic unit description in the legend shows the distribution of that unit. An ArcInfo AML is used to generate the state outline for this legend icon. Within each legend icon, the locations of each geologic feature are plotted by AML cursors. Because of the small size of the legend icons, each geologic polygon is represented as a dot, positioned at its centroid. Glaciers and ice fields, tectonic zones, dikes, dike swarms, and eruptive centers are represented in the legend in similar fashion. Finally, the AML saves the legend as an EPS file, to be loaded into Illustrator. This map won both Best Map of 2005 and Best Geologic Map in the Avenza 2005 MAPublisher Map Competition. Additional information is provided on the DMT'07 poster, at http://ngmdb.usgs.gov/Info/dmt/schuster07b.pdf.

SOME ASPECTS OF 1:24,000-SCALE MAP PRODUCTION

Each year, under the U.S. Geological Survey STATEMAP program, we produce new 1:24,000-scale geologic maps of 7.5-minute quadrangles in Washington. We use a variety of software to make our maps: ArcInfo, ArcGIS, MAPublisher, Adobe Illustrator, CorelDraw, and Adobe InDesign. In the course of map production, we have developed several map production tools that may be useful to others producing similar products.

We have developed two Python scripts for use in ArcGIS that you may find useful (see Figure 2):

- Some point files, such as strike and dip, require symbols to be rotated. The rotation angle is typically recorded as the compass angle (zero = north; increasing clockwise). Illustrator, however, uses the arithmetic angle (zero = east; increasing counterclockwise). Python script *calculate_plotangle.py* converts the compass angle to an arithmetic angle, which MAPublisher uses to interpret the correct strike orientation. Both the original compass angle and the resulting arithmetic angle are stored as attributes.
- Because of their projection, georeferenced maps are usually tilted, but for publishing purposes they are rotated into an upright position. Python script *calculate_rotation_angle.py* calculates the quad boundary rotation angle and stores it as an attribute in the boundary file. After importing shape layers into Illustrator via MAPublisher, the script refers to the angle field to rotate all layers precisely.

We have also developed a set of ArcMap layer files containing geologic symbols for draft-quality maps, and symbol palettes for Adobe Illustrator for our final publication-quality maps. The above-referenced scripts, layer files, and symbol palettes are available for download at *ftp://198.187.3.44/geology/DMT07/*.

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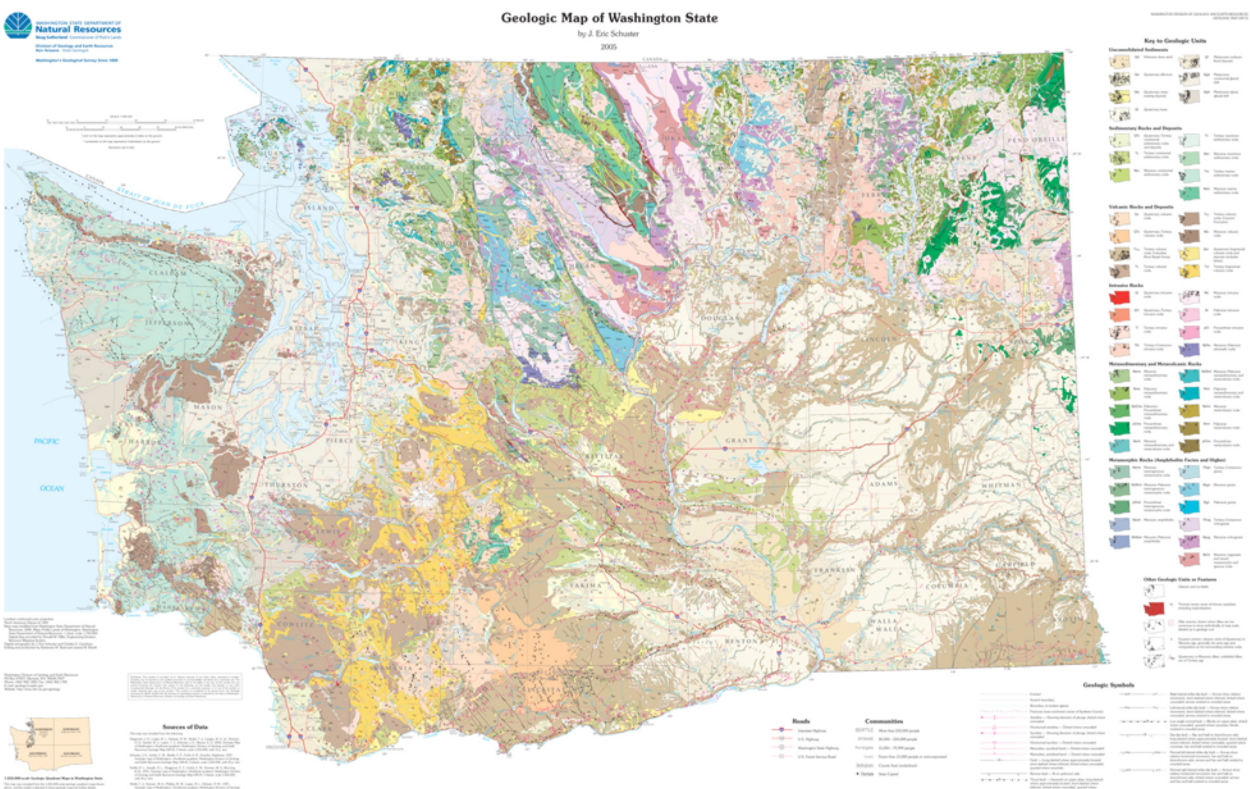

Figure 1. Geologic Map of Washington State (presented at DMT'07 as a poster; see high-resolution image at http://ngmdb.usgs.gov/Info/dmt/schuster07b.pdf).

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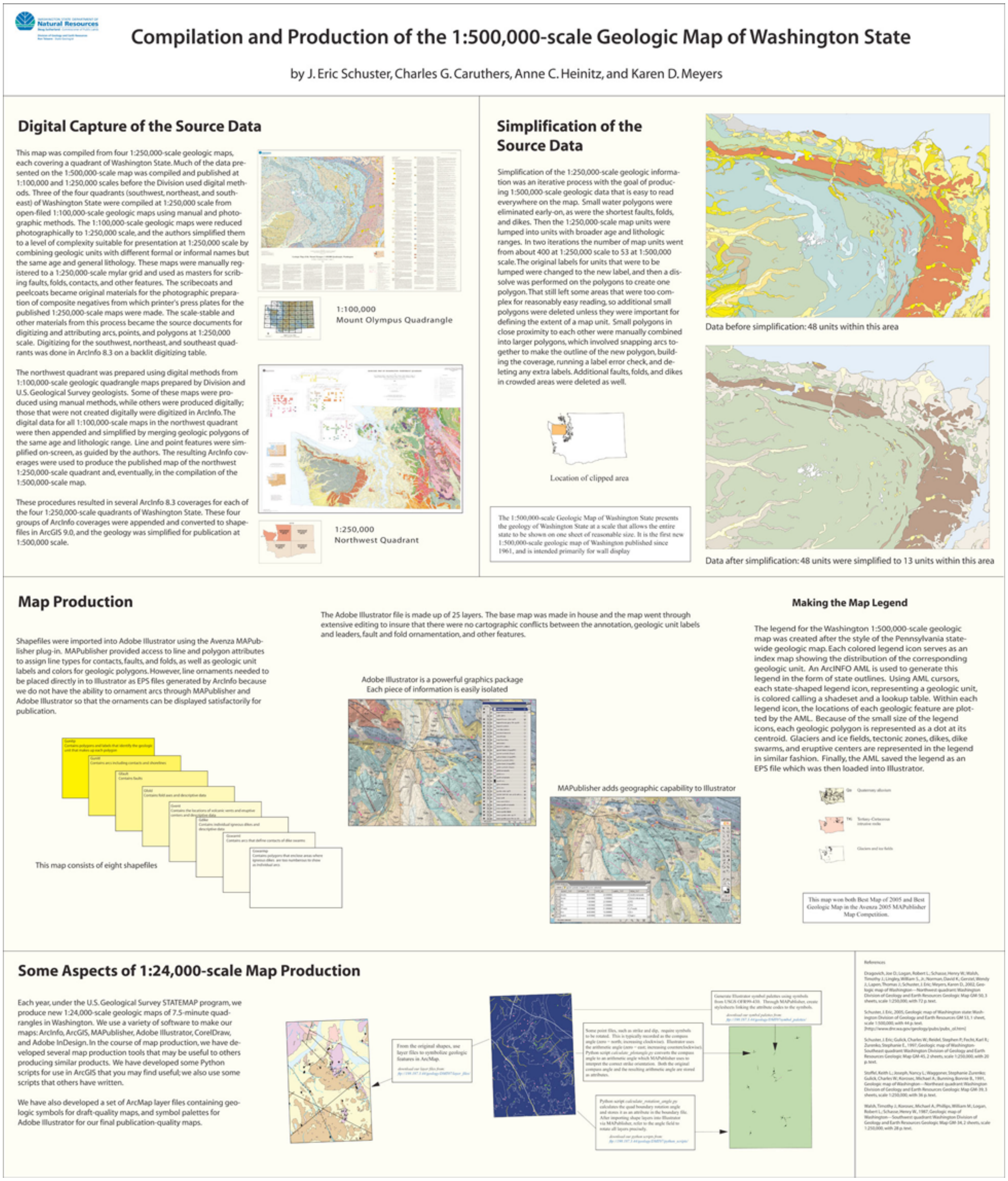

Figure 2. Compilation and production of the 1:500,000-scale Geologic Map of Washington State (presented at DMT'07 as a poster; see high-resolution image at http://ngmdb.usgs.gov/Info/dmt/schuster07a.pdf).