When Maps Were Scribed: USGS Geologic Map Production in the 1970's

By Will R. Stettner and Paul Mathieux

U.S. Geological Survey
National Center, MS 903
12201 Sunrise Valley Drive
Reston, VA 20192
Telephone: (703) 648-4343
Fax: (703) 648-6138
email: wstettne@usgs.gov

INTRODUCTION

With its history as a science and mapping agency, the U.S. Geological Survey (USGS) has always been on the forefront of embracing new technologies that would improve how maps are produced. During the 1960's, the USGS evaluated plastic films, known as mylars, and mylar engraving tools for use in map production. This technological advance would replace the production method of inking on board and metal mounts. In the 1970's, scribing on coated mylars and color separation using peelcoats became the method for producing maps and would not change significantly until the introduction of computers.

PUBLICATIONS DIVISION

Except for topographic maps, which were the responsibility of the Topographic Division, the production of geologic and hydrologic map products and book size publications was the responsibility of the Publications Division, which provided editorial review, cartographic preparation, typesetting, photo lab support, and printing services. By the 1970's the Publications Division had established an efficient map production process using various types of films and mylars and a documented set of cartographic standards that addressed every aspect of geologic map production, including layout, symbols, fonts, line weights, colors, and materials to be used.

CARTOGRAPHIC TOOLS

Cartographic production was performed by individuals who were classified as cartographic technicians. The tools required by a technician included an assortment of scribing tools used to engrave or remove the red- or yellow-colored emulsion on mylar known as Scribecoat. Basic three-legged metal engraving tools, using phonograph needles as scribing points, were developed into an array of specialized tools with attached magnification lenses; some had swivel points, ideal for scribing smooth, flowing lines. The 1970's saw the introduction of a lighter plastic scribing tool, known as an Astrascribe, with interchangeable and predefined sapphire points that never required sharpening. Rapidograph pens, magnifiers, opaque brushes, X-Acto knives, burnishing tools, and leather-covered weights rounded out most of the tools required for cartographic preparation (Figure 1). All films and mylars had to be punch-registered. The Aldis punch system, an offset punch hole system, was used to punch film so that registration pins could hold all working copies in perfect registration.

MAP DESIGN

Cartographic preparation could not begin until the author's materials or mill copy received a technical review and had subsequently been given Director's Approval for publication. Only then could the technician begin with map design or "lay out" using the geologist's compilation. The compilation would be an inked copy on a greenline, which consisted of a topographic base photographically applied in green on to a piece of frosted mylar. The layout used all the components (for example, the map itself, correlation of map units, explanation of map symbols, text, title, and explanatory notes) that a geologist identified to be part of the report. The layout would be "locked into position" on a pre-punched 34x44 inch or 42x58 inch piece of clear mylar which would then be submitted to the photo lab for a negative. This negative would be exposed onto a color-coated opaque mylar (Scribecoat) that

Figure 1. Shown are some of the tools such as scribing tools, a sharpening stone, magnifiers, registration pins, and various other tools, required by the cartographic technician of the 1970's.

was then used to scribe all color boundaries, such as geologic map units and water bodies. That same Scribecoat would later be used to finish scribing all other line features, such as faults, anticlines, and synclines.

COLOR SELECTION

Early in the Survey's history, a standard color and pattern scheme was established for geologic age groupings (browns for Proterozoic; yellows for Quaternary; and so on). This color scheme is still in use today. Selecting map unit colors was identified as a specialized activity and required a color expert and was not done by the cartographic technicians. The ages and type of rocks identified in the correlation and explanation of map units served as a starting point for color and pattern selection. Colors were defined using percentages and combinations of cyan, magenta, yellow, and black (CMYK), known to printers as the process colors. The color and pattern scheme for a particular map was identified on the map's color guide. The color guide identified each geologic map unit and its letter symbol, the percentages of CMYK identified for each map unit, and any additional information, such as units whose colors were determined from adjoining maps (Figure 2). This color guide could then be used by the technician to identify the number of peelcoats needed to create the map's color scheme.

TYPE SETTING

Irrespective of the methods used in map production, activities are defined by a set of procedures that reflect current technology. During the 1970's, typesetting services were provided by the Publications Division for all USGS offices by using teletype communications. Type was set on a Merganthaler photo typesetter. The cartographic standards defined how text and type were to be written, coded, and submitted on a type order form. Every characteristic, such as type font, size of type, alignment and spacing of type, and the pica width of lines had to be identified on this form. A film or paper proof of the typeset type was then returned to the technician for review and then resubmitted for corrections. When all corrections were finalized, a photographic exposure was made onto thin waxed-backed film or strip film. Type on the strip film would then be cut out by the technician with an X-Acto knife and positioned and burnished onto a punch-registered clear piece of mylar, known as the type overlay.

SYMBOL AND TYPE PLACEMENT

A green plastic template (also used for topographic maps) became a critical tool for scribing consistent and uniform symbols on a geologic map. Following the instructions provided by the cartographic standards, this template could be used to construct complex geologic map symbols (Figure 3). Even though scribed symbols produced a high-quality reproducible copy, it was determined that the scribing of complex symbols was inefficient because once scribed, symbols could not be repositioned. For that reason a set of scribed symbols was reproduced photographically onto strip film, which could then be cut out with an X-Acto knife and correctly positioned on the type overlay. All map text, base and credit notes, and other miscellaneous type was placed on this type overlay, which was then made into a negative and used in conjunction with the other black printing separates.

Figure 2. The CMYK color and pattern charts from which selections were made and entered onto the map's color and pattern guide.

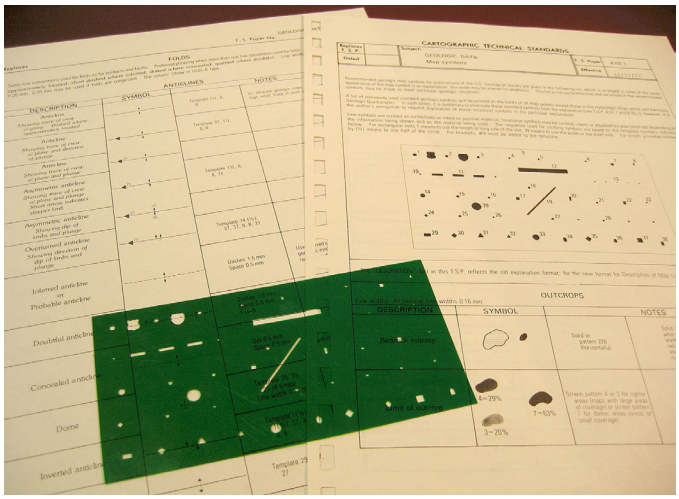

Figure 3. The plastic template used to construct geologic structure symbols. When following the USGS Cartographic Technical Standards, the combination of template numbers 14, 37, 8, and 31 would result in the symbol for an overturned, plunging anticline

Figure 4. A peelcoat where the thin film is being removed within the two etched lines that define a geologic unit. The open area will then have a halftone screen applied, required for the unit's color as defined by the color and pattern guide.

COLOR SEPARATION

Peelcoats were mylars with a photosensitive coating that when developed were etched with lines that replicated the scribed color contacts on the Scribecoat (Figure 4). Because the peeling up of the thin film between contact lines left the mylar clear, halftone screens identifying screen percentages could be placed on the peelcoat and would later be exposed in the photo lab for combination negatives. Depending on the CMYK color, the technician was also required to apply these screens at their appropriate angles in order to avoid moirés. This was done with the aid of various screen angle determination devices that identified a screen offset of 15° for each color.

MAP PROOF

Once all the map components (Scribecoats, type overlays, peelcoats, and base separates) were prepared, these separates were submitted to the photo lab for a proof. A proof was made by applying one of the CMYK colors to a white opaque mylar and exposing it to all the separate pieces of mylar requiring that color. Exposed areas were fixed, unexposed areas were washed off, and the process continued until all items were exposed for their appropriate colors. The proof would then be reviewed by the technician's supervisor, the technical editor, and the author for omissions and errors. Once corrections were made, all separates were then combined onto the printing negatives required for process color (CMYK) printing.

SUMMARY

This was the cartographic procedure employed during the 1970's, which, of course, could always be complicated by using additional colors, graphics, cross sections, and bases that didn't fit. It should be kept in mind that many of the procedures used in the 1970's evolved from procedures and standards developed during the previous 100 years. It can also be stated that the digital procedures in place today reflect the developments and procedures of the 1970's.