CO-044

ROCK DRAWING FOR TOPOGRAPHIC MAPS

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ABSTRACT

The maps of the Federal Office of Topography swisstopo – the Swiss national mapping agency – are renowned for their combination of shaded relief, contour lines, scree rendering and rock drawing, which creates the so-called Swiss style of topographic mapping. During the era of analogue map production, rock drawing was executed with scribing on coated glass plates. With the ongoing computerization of cartography, swisstopo switched to a digital production line a few years ago. However, high-quality Swiss-style rock drawing for topographic maps is still a very labor-intensive process. At swisstopo, revisions to rock representations are carried out using interactive mouse-based drawing tools, as automated procedures do not currently exist. The Federal Office of Topography swisstopo and the Institute of Cartography of ETH Zurich therefore carry out a joint study to evaluate the potential of digital techniques for automating rock drawing. The first step of this project is a detailed study of the current manually drawn rock depiction, including design principles and geometric dimensions. This paper discusses current mouse-based drawing techniques applied by swisstopo for their official map series and then shortly describes the graphical design principles for Swiss-style rock drawing. Metrics for individual rock hachures are included.

SWISS-STYLE ROCK DRAWING

Rock drawings are an importation map element in high-mountain areas. Cliffs, rock faces, karst areas and scree-covered slopes are important obstacles when navigating, but are also visually outstanding terrain features that help map readers orient on the ground. Topographic maps therefore generally indicate rocky areas, using a variety of styles and design principles. The Swiss style of rock drawing is particularly descriptive and vivid. Swiss style maps generate a strong three-dimensional relief impression by combining shaded relief with rock drawing and scree patterns that together simulate the effect of an illuminated terrain surface. In the past, cartographers have experimented with a variety of graphic alternatives for rock drawing. For a discussion of these attempts, see Imhof (1982), Hurni et al. (2001), and Dahinden (2008). In this paper, we concentrate on the current style as applied for the official maps series of the Federal Office of Topography swisstopo, the National Mapping Agency. This particular style was developed by various Swiss cartographers during the second half of the 18th century and the first half of the 19th century.

The purpose of the present study is to formalize design principles for a later use in an algorithmic approach, as only partial solutions exist for the automatic or semi-automatic rock drawing in Swiss style (Hurni et al., 2001; Dahinden, 2008). Drawing inspiration from swisstopo maps for digital rock drawing seems obvious, as these maps have set a standard that is internationally renowned for its graphical clarity and elaborate mapping style. The depiction of mountainous terrain on Swiss maps is regarded as exemplary by Knowles and Stowe (1982: 108) who suggest that they are “distinguished by their very fine draughtsmanship and in particular by the manner in which relief is shown”; Keates (1996: 257) compares the treatment of relief by various mapping agencies and finds that “the most sophisticated and elaborate representation is the Swiss, using contours in three colors […], detailed rock drawing and hill shading”; and Hodgkiss (1981) writes: “it is [] in the depiction of mountain and glacier landscapes that the Swiss excel”.

The design principles and metrics described in this report are partially based on publications by Imhof (1982), Spiess et al. (2002), and swisstopo (2008), but mainly derived from manually created topographic maps by swisstopo. Our long-term goal is to transfer their particular manual style for rock mapping to the digital realm. This paper reports on initial steps, presenting first results of an analysis of swisstopo rock drawing.

Figure 1 shows a typical section of a rock and scree drawing by swisstopo for the 1:25,000 scale. At 1:25,000, swisstopo includes contour lines at 100-meter intervals in steep rock faces, but omits intermediate contours at 20 meters, as they would be too dense. A rock face is depicted as it appear to the observer standing in front of it – and not as it would appear in an aerial photography taken from vertically above. Cartographers accentuate geomorphologically characteristic features, and remove irrelevant or small details, while accentuating the third dimension of the terrain (Imhof, 1982; Gilgen, 2008). Rocks are among the most challenging map features to represent, because rock drawing requires both cartographic and artistic talent. The manual drawing is extremely labor-intensive and accordingly expensive. A partially or fully automated digital method is therefore highly desirable.

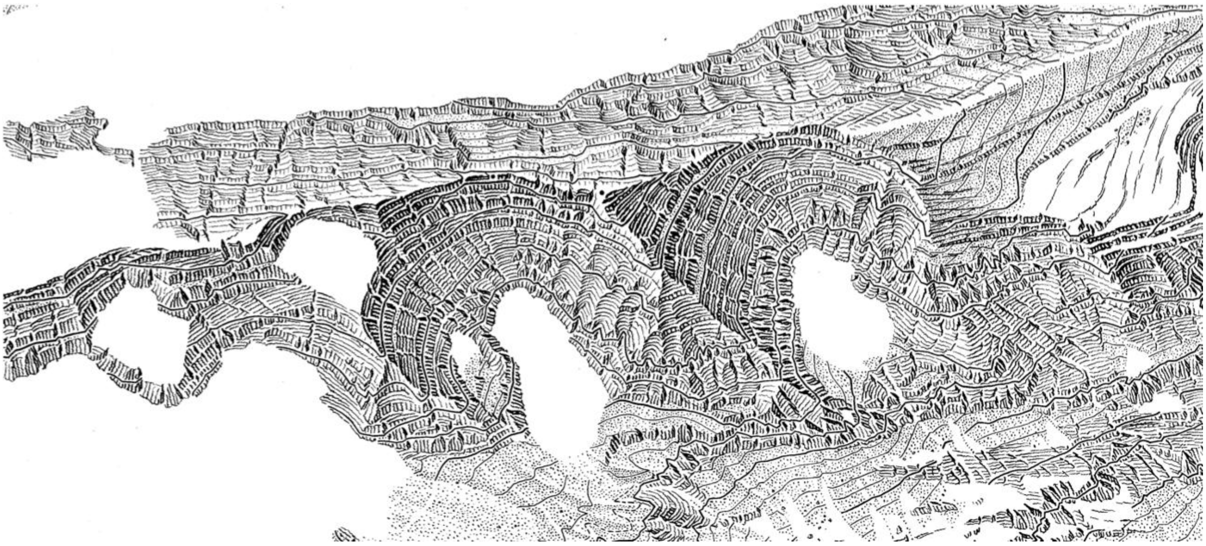

Fig. 1: Rock drawing for the Swiss national map series at 1:25,000, sheet Tödi 1193 (1963), enlarged.

CURRENT DRAWING TECHNIQUE AT SWISSTOPO

From 1953 to 2000, swisstopo produced and revised the full-tone map features of their topographic maps in a negative scribing and etching technique. The rocks and most other full-tone map features (such contour lines, traffic networks, buildings etc.) were scribed for the first map edition. From the second edition onwards, the etching technique was applied to copy the still valid map content of the previous map edition to the following one. Since then, map production and updating have undergone a series of changes at swisstopo. In 1996, the cartographic application DRY/Nuages by Lorienne was introduced, and since 2000/2001 all swisstopo maps are produced and updated with a completely digital workflow (Gilgen and Jenny, 2010).

The computerization and automation of map drawing is ongoing and affects all map elements, including the rock drawing. The Swiss national map series are currently redesigned, and will be regenerated from new vector data. Future updates to the rock rendering will be drawn with raster graphics software (Adobe Photoshop) in combination with a graphics tablet (Wacom). In comparison to the current workflow based on vector graphics software (LorikCartographer), an increased productivity is expected. This is mainly due to the ability of the Wacom pen tablet to control the position and width of a stroke in an intuitive and natural way. For a more detailed comparison of vector and raster based rock drawing, see Gilgen and Jenny (2010). It is important to note that with today's digital techniques, the same cartographic design principles are still applied. This is also the case for digital rock drawing, which is executed in the renowned Swiss style, originally developed for analogue scribing on coated glass plates.

DESIGN PRINCIPLES

The rock drawing in swisstopo maps is modulated according to a shading model. The combination of a shaded relief image, the modulated rock drawing and an equally modulated scree representation depicts mountainous areas as a continuous three-dimensional surface, which is of primordial importance. The map should show the main structures of the terrain surface at a glance, while still providing detailed information about the morphology of the terrain when focusing on a small section of the map. A virtual light source from the top left is used to generate a three-dimensional illumination effect that helps the map-reader perceive the third dimension. The illumination effect is generated by modulating the brightness of the shaded relief, the rock drawing and the scree pattern. At a scale of 1:25,000, an additional faint yellow tone highlights areas fully exposed to the virtual light. It is the interplay of these four elements that generates a three-dimensional illumination effect.

Additionally, the effect that aerial perspective has on the perception of the terrain is simulated. High mountain peaks are closer to the map reader, who is observing the terrain from a distance. These peaks are accordingly rendered with more contrast. More distant lower areas, in contrast, appear blurred to the observer, and the contrast between dark and bright slopes is therefore reduced. Hence, the brightness contrast is increasing with altitude. Sunlit slopes are brightened further, and shaded slopes are dimmed. This graphical device is applied to shaded relief, as well as scree and rock drawing.

Individual hachures are the basic element for rock drawing. The hachures are arranged in small rock formations, which in turn fill a rock area. The drawing principles are documented by Imhof (1982) and Gilgen (1998). Cartographers at swisstopo additionally use an internal, unpublished manual (swisstopo, 2008) for instructional purposes. However, design principles are mainly transmitted by practical training.

Cartographers of the manual era knew which etching needle to use for placing the different hachures and judged the density of hachures based on their aesthetical experience and a few rules of thumb. They ignored the precise geometrical dimensions, such as the exact line widths or line lengths, etc., as these metrics were simply of not much practical use. Before a digital method can be developed, however, the graphical design principles and geometrical dimensions for rock drawing must be identified.

On average, 7 hachures are placed on a distance of 2 millimeters. This results in a mean distance of approximately 0.3 mm between two hachures. To generate a shading effect, the line widths and the distance between hachures is varied. In dark and shaded areas, 9 thicker hachures are placed per 2 mm, whereas on sunlit slopes, 4 to 5 thinner hachures are used.

CONCLUSION

The mentioned project, including a precise inventory of the current design principles, is ongoing. The resulting metrics and formalized design principles will be the basis for experiments aiming at a further automation of rock drawing. A full or partial automation of rock drawing is highly desirable, but, unfortunately, previous attempts resulted in methods that are either still relatively labor intensive (Hurni, 2001; Dahinden, 2008), or aimed at developing alternative representations that are different from Swiss-style rock drawing (Dahinden, 2008; Gondol et al., 2008).

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