

DIGITAL ROCK AND SCREE DRAWING IN VECTOR AND RASTER MODE

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ABSTRACT:

This paper explains how rock representations are drawn in vector and raster mode at the Federal Office of Topography swisstopo, the National Mapping Agency of Switzerland. The drawing efficiency is compared of both LorikCartographer by Lorienne, a cartographic application for drawing in vector mode, and the raster graphics application Photoshop by Adobe. Additionally, Scree Painter is introduced, a specialized complementary application for the automatic drawing of scree representations.

Keywords: *Rock representation, swisstopo, LorikCartographer, Adobe Photoshop, Scree Painter.*

A BRIEF HISTORY OF MAP DRAWING AT SWISSTOPO

The Federal Office of Topography swisstopo, the Swiss National Mapping Agency, produced and revised the full-tone map features of its topographic maps in a negative scribing and etching technique from 1953 to 2000. The full tone map features (such as rocks, contour lines, traffic networks, buildings etc.) were scribed for the first map edition. The lettering, on the other hand, was produced phototechnically and then etched in the engraving coat on glass plates. From the second edition onwards, the etching technique was also applied to copy the still valid map content of the previous map edition to the following one. Later on, certain symbols (such as spot heights, churches, camp sites, boundary lines etc.) were also produced phototechnically and etched in the engraving coat on glass plates. Halftone areas (such as woods or lakes) were drawn in ink and then screened photomechanically. The continuous-tone shaded relief, on the other hand, was airbrushed and subsequently screened photomechanically.

Since then, map production and updating have undergone a series of changes at *Swisstopo (2010)*. The milestones were:

- 1984: The first graphic workstation, a Scitex computer, was introduced at swisstopo.
- 1989: The first attempts to digitally revise topographic maps were launched.
- 1996: The cartographic application DRY/Nuages by Lorienne was introduced.
- 1997: The first digitally revised map sheet, 1273 Biasca at 1:25,000, was published.
- 2000/2001: The negative scribing technique was finally replaced by digital cartography.

All swisstopo maps are since then produced and updated with a completely digital workflow.

- 2006: The first attempts in rock drawing with Photoshop and a Wacom pen tablet were undertaken during a rock drawing course for cartography trainees.

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The computerisation of map drawing is ongoing and affects all map elements, including the rock and scree representations. However, 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 developed for analogue scribing on coated glass plates (Fig. 1) (Bühler, 1938; Gilgen, 1998; Gilgen, 2008; Imhof, 1982; Spiess et al., 2002).



Fig. 1 The rock representation scribed in an etched, red engraving coat with blueprints on a glass plate. The rock scribing tool, a triangularly shaped, whetted steel engraving needle in a wooden holder, is visible in the centre. The pale yellowish map content is etched whereas the bright white shining elements in the centre have been scribed. Enlarged extract from the swisstopo map 1274 Mesocco, 1:25,000, 1998

Rock drawing in vector mode with LorikCartographer

Introduction: LorikVartographer at Swisstopo

Since 2008, the full-tone and the halftone map content of swisstopo's topographic maps in the scales 1:25,000, 1:50,000, and 1:100,000 have been updated with LorikCartographer, the redesigned DRY/Nuages by Lorienne (www.lorienne.com, 2010). A noteworthy feature of LorikCartographer is its hybrid work file: The previous, still valid map content is stored in a mosaic raster file (a tiled image), whereas the map revision is executed with vector art, including Bézier curves. All full-tone map features, including rock, scree and glaciers, as well as all halftone features, such as woods or lakes, are currently updated in vector mode with LorikCartographer.

Rock drawing with LorikCartographer

In LorikCartographer, all stroke widths for drawing hachured rock representations are stored in a template library. Stroke widths range from 0.06 up to 0.22 mm, in steps as small as 0.02 mm, which corresponds to the dimension of one pixel at the resolution of 50 lines/mm or 1270 dpi. The colour of rock hachures is black, and the stroke extremities have a rounded end.

Hachures are polylines specified by a sequence of straight line segments connecting consecutive vertices (Fig. 2). A polyline is the wireframe of the pixelated rock hachure. The digital rock drawing creates a relatively high amount of vector data compared to other vector map elements, because the polyline points are placed very densely. However, this causes no problems for current computer hardware.

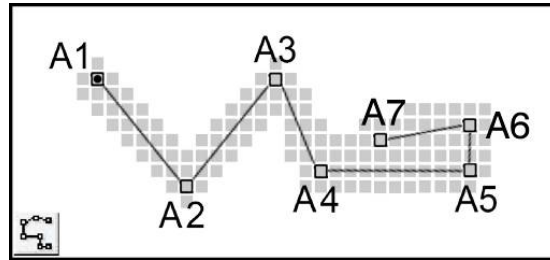


Fig. 2 A rock hachure drawn in vector mode with LorikCartographer. The grey pixels were added by the authors

In LorikCartographer the stroke width cannot change between the start and the end point of a single polyline. Hence, the width of the rock hachure has to be modulated otherwise. One method is by finishing the stroke with a line segment in backwards direction to generate a thicker end, which indicates more shade (**Fig. 2** the line segment between A6 and A7). Another method consists in tediously constructing each rock hachure from a series of short unconnected lines and assigning them different stroke widths. This latter method is less recommendable as the workflow is constantly interrupted.

The drawn hachure remains editable: A new stroke width can be assigned, or line elements can be displaced or deleted. These are the main manipulations to amend a rock drawing during a revision process. The «Copy», «Paste» and «Rotate» commands are also sometimes applied to rock drawing.

Working at an adequate zoom level enables the cartographer to see the drawing in a near WYSIWYG mode. One has to bear in mind that there is a slight difference between the raster representation (i.e. the still valid map content), which appears thinner and brighter, and the vector presentation (i.e. the updated map content), which appears wider and darker on the computer display than on the printed map.



Fig. 3 The rock representation updated with LorikCartographer, enlarged extract from the swisstopo map 1284 Monthey, 1:25,000, 2000. The drawing tool is the mouse

Drawing glacier and scree representations

Glacial features, like ice walls, crevasses, seracs and so on, are drawn with a blue colour representing hydrographic features, in the same manner as the rock representation (Bühler, 1938; Gilgen, 1998; Gilgen, 2008; Imhof, 1982; Spiess et al., 2002).

The scree representation, on the other hand, is stamped in LorikCartographer from roughly screened patterns of modulated dots. Single dots are interactively moved if necessary to achieve the desired relief shading effect and to enhance the representation of important geomorphological features, like gully lines (Bühler, 1938; Gilgen, 1998; Gilgen, 2008; Imhof, 1982; Spiess et al., 2002).

Results

At the end of a map revision, binary TIFF images with PackBits compression are created at a resolution of 1270 dpi. These files are consecutively used for offset printing in spot colours, and for other derived digital products.

The major advantage of LorikCartographer is that rock, scree and glacier representations can be revised in the required quality during a map revision process together with all other map features in one go. No additional application or data conversion between applications is necessary.

The major disadvantage of LorikCartographer is that the efficiency of rock drawing is not increased in comparison to the prior analogue scribing on coated glass plates. Since brightness contrasts are very important in an expressive portrayal of a rock surface in the classic swisstopo style with rock hachures, the stroke width has to be changed very frequently.

Rock drawing in raster mode with Adobe Photoshop

Introduction: Photoshop at Swisstopo

Photoshop (www.adobe.com, 2010) has been successfully applied for producing orthophotos, updating shaded reliefs and for other tasks at swisstopo. Since 2009, Photoshop has been used for special mapping tasks, such as preparatory work concerning rock representations for the new database-driven production process, the so-called OPTINA-LK project (Gilgen, 2006; Kreiter, 2005; Neuffer et al., 2006; www.esri.com, 2010). Photoshop will be used for future revisions of rocks, glaciers and shaded reliefs in the OPTINA-LK 1:25,000 workflow. An important argument for using Photoshop to revise rock drawings at 1:25,000 in the future workflow is that it is the most commonly used professional graphics editor for raster images. Moreover, Photoshop is combinable with a Wacom graphics tablet (www.wacom.com, 2010), which remarkably improves the efficiency of rock drawing compared to working with a mouse.

Rock drawing with Photoshop

The «Pencil Tool» is mainly used to draw rock representations with Photoshop. The desired average «Master Diameter» is chosen in pixel units, the pencil tip shape is set to «Hard Round», and a black foreground colour is selected. Hachures are drawn with a pressure-sensitive and tilt-sensitive pen on a Wacom graphics tablet, which provides a dynamic control of the stroke width: The more pressure applied, the wider the diameter of the pixelated stroke. Cartographers may also customize the pen's tilt-sensitivity to their needs. The Photoshop/Wacom combination offers several practical features to improve the efficiency of rock drawing: For example, with the eraser on the other end of the physical drawing pen one can rapidly and intuitively change to the «erasing» mode by simply turning the pen.

Many more tools exist in Photoshop, however, the majority of them are not reasonably applicable to rock drawing. Useful exceptions are the «Maximum» and «Minimum» filters

to shrink or expand black rock hachures. Moreover, selected areas can be displaced or manipulated in any other desired way.

Drawing in the «Actual Pixels» mode, ensures a perfect WYSIWYG: The cartographer really sees what the final result looks like.

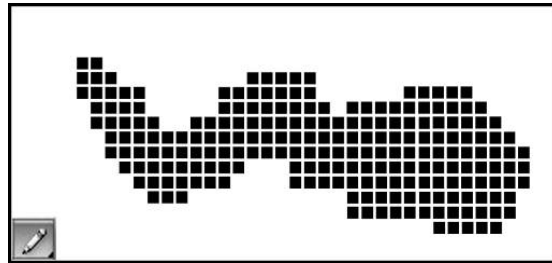


Fig. 4 A rock hachure in raster mode, drawn with one stroke of the Photoshop pencil tool. The white pixel borders were added by the authors

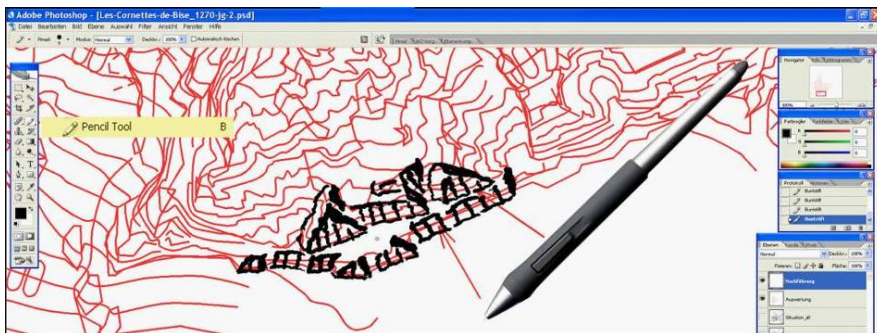


Fig. 5 A rock representation updated with Photoshop and a Wacom pen tablet, enlarged extract from the swisstopo map 1284 Monthey, 1:25,000, from a course for cartography trainees, 2006

Drawing glacier representations

Glacial features, like ice walls, crevasses, seracs and so on, are drawn with a blue foreground colour, similar to the rock representations (Bühler, 1938; Gilgen, 1998; Gilgen, 2008; Imhof, 1982; Spiess et al., 2002).

Results

The rock and glacier representations are finally saved to binary TIFF images with PackBits compression at a resolution of 1270 dpi, as in the vector based revision process. These images are then integrated into the new OPTINA-LK database, and used for offset printing in spot colours and for digital cartographic products.

The major advantage of the Photoshop/Wacom combination is the increased productivity compared to the current method based on LorikCartographer. 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. An exact efficiency gain cannot yet be quantified because of insufficient experience in the actual map production.

The major disadvantage of the Photoshop/Wacom combination is that there are new interfaces between different applications. Data must be exchanged between ArcGIS and Photoshop for rock drawing. Such data conversions are not required with LorikCartographer, where all cartographic drawing is carried out in a single application environment (excluding relief shading).

Scree drawing with scree painter

Introduction

A pattern of modulated dots representing scree areas can be generated with Scree Painter, an open-source software by the Institute of Cartography of ETH Zurich (*Jenny et al., 2010*). Scree Painter was developed especially for the OPTINA-LK map production workflow, but is freely available for other users and runs on various operating systems (www.screepainter.com, 2010).

Scree Painter generates scree representations from a set of input data. A shaded relief image controls the size and density of dots. Where this greyscale image is dark, denser and larger dots are generated. Scree dots are placed inside polygons that are imported from a shape file. An «Obstacle Mask» image automatically masks out unnecessary dots that would be placed on top of other map features or too close to them. Such map features are contour lines, large erratic blocks, roads, buildings, hydrographic features, and the lettering in scree areas. Furthermore, a digital elevation model is used to detect and symbolize gully lines, which are represented by small dots arranged along a line.

Minor interactive editing

The first data output generated with default settings is carefully checked by a cartographer, and if necessary, interactively corrected. The following three corrections are applied:

(1) The gully lines in contradiction to cartographic principles are edited. The gully lines automatically generated by Scree Painter are exported to an ESRI Shape file, and then imported into a GIS, e.g. ArcGIS, for interactive editing.

(2) A «Large Stone Mask» is created in Photoshop to accentuate areas where larger stones should be placed. Larger stones and small boulders are often deposited at the foot of larger slopes. A greyscale mask, painted in Photoshop and exported to TIFF, PNG or JPEG format, locally enlarges the dots in the generated scree representation.

(3) A «Gradation Mask» is created in Photoshop to highlight small, but important terrain features (e.g. small moraines), which are inadequately portrayed in the first output. This greyscale mask, also in TIFF, PNG or JPEG format, locally increases the brightness contrast in the generated scree representation and hence accentuates important terrain features. Such small, but outstanding features are important for map readers to easily orient themselves on the terrain.

Result

After loading the edited «Gully Lines», the «Large Stone Mask» and the «Gradation Mask» into Scree Painter, the final scree representation is generated. The final version can be exported to various formats, including DXF, Illustrator, JPG, PDF, PNG, SVG, Shape or Ugenerate. At swisstopo, scree is exported to a PDF file, which is then converted with Photoshop to a binary TIFF image (again with PackBits compression at 1270 dpi), and integrated into the cartographic database.

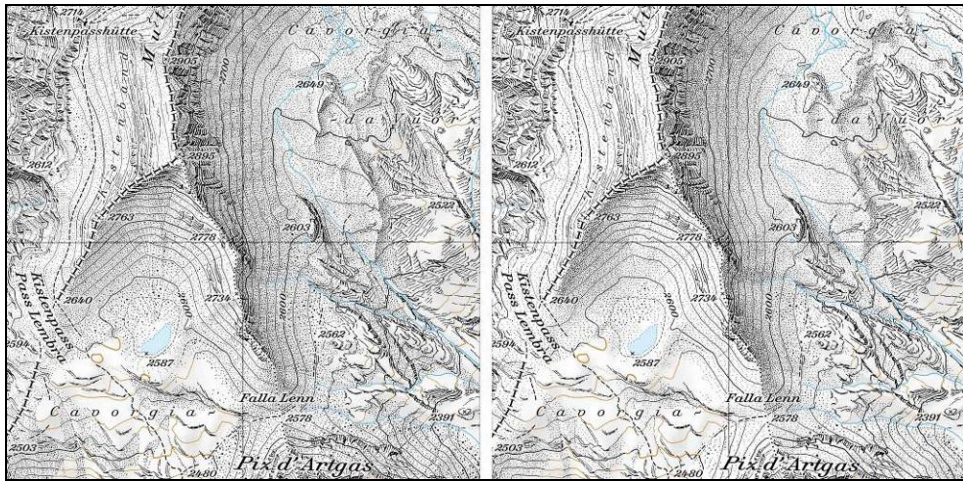


Fig. 6 Manually created scree representation in the map 1193 Tödi, 1:25,000 (left) in comparison to a representation generated by Scree Painter with minor interactive editing (right)

The expenditure of cartographic labour is considerably cut down thanks to Scree Painter compared to the interactive drawing in LorikCartographer and to the prior scribing on coated glass plates. The exact efficiency gain, however, cannot be quantified yet, because Scree Painter is not yet used in map production. As with Photoshop, the major disadvantage of Scree Painter is that additional data and file format conversions are necessary between ArcGIS, Photoshop and Scree Painter.

CONCLUSIONS

Rock and glacier representations are more efficiently drawn with Photoshop raster tools than with LorikCartographer, where revisions are carried out in vector mode. Future revisions of rock drawings at 1:25,000 will be executed with Photoshop and a graphics tablet, which will increase efficiency. Hence, swisstopo will continue using their renowned and still convincing style of rock and glacier representations in the future map series at the 1:25,000 scale.

The scree representation generated with Scree Painter is of a quality that requires only little interactive improvements. The efficiency is enormously improved compared to drawing in vector mode with LorikCartographer and to the prior scribing on coated glass plates.

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