Accidental cARTographer

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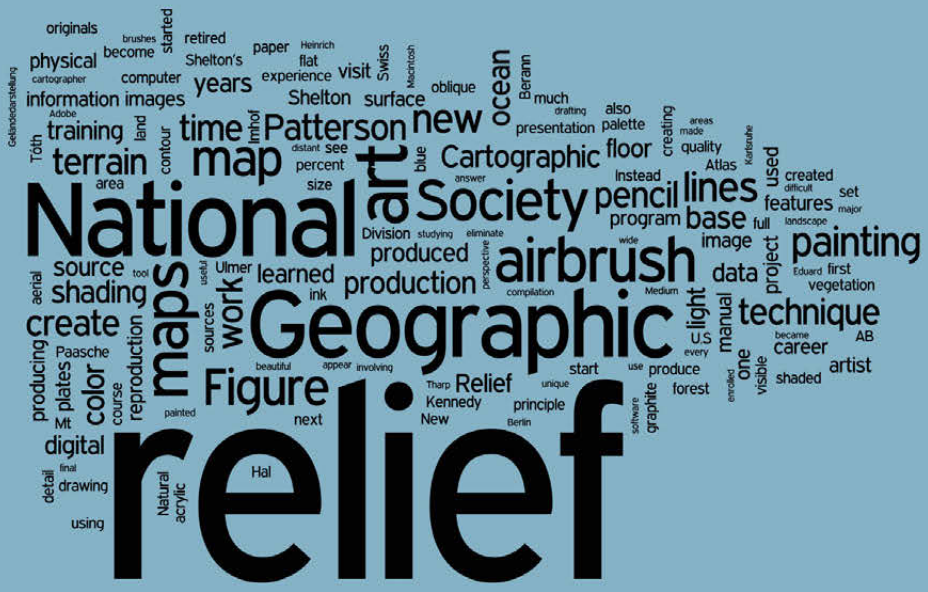

ABSTRACT

This paper gives a retrospective of my forty-year career as a relief artist, much of it for the National Geographic Society. I discuss the manual development of relief art created by pencil, airbrush, and acrylic painting. The paper ends with digital relief shading, a production method that complements earlier manual methods.

BACKGROUND

At age eighteen, I was a gymnast in Hungary planning to go to college to become a physical education teacher. Had this come to pass, today, over five decades later, I would be long retired and reminiscing about somersaults and handstands. Instead, through one of life's unexpected turns, I learned about a training program that gave me a new profession, one offering life-long learning and growth. I became a cartographer.

PENCIL RELIEF

I enrolled in an eighteen-month training program with emphasis on traditional pen and ink drafting, but it also exposed me to "Schummerung" (the German word used in Hungary for relief shading), involving a smudge

stick dipped into graphite powder to create rather crude relief images. After completion of the program, for the next ten years I worked as a cartographic draftsman at Freytag-Berndt & Artaria (Vienna, Austria), American Geographical Society (New York), and the National Geographic Society (Washington, D.C.), where I had the opportunity to produce several pencil relief originals. However, it was not until the National Geographic Society undertook a map of Mt. Kennedy, Canada, that my budding career as a relief artist gained momentum. This map, a joint research project involving the National Geographic Society, Boston Museum of Science, Michigan State University, and the University of New Brunswick, was to feature a new design: relief art in the Swiss topographic style. Because National Geographic Society had no in-house expertise in this area, they engaged the services of a retired Swiss cartographer, Paul Ulmer, to instruct a number of us in the relief presentation style made famous by Professor Eduard Imhof, Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule), Zurich. At the end of the training program, Ulmer selected me to draw the relief for the map of Mt. Kennedy published in August 1968 (Figure 1a).

IT WAS NOT UNTIL THE NATIONAL GEOGRAPHIC SOCIETY UNDERTOOK A MAP OF MT. KENNEDY, CANADA, THAT MY BUDDING CAREER AS A RELIEF ARTIST GAINED MOMENTUM.

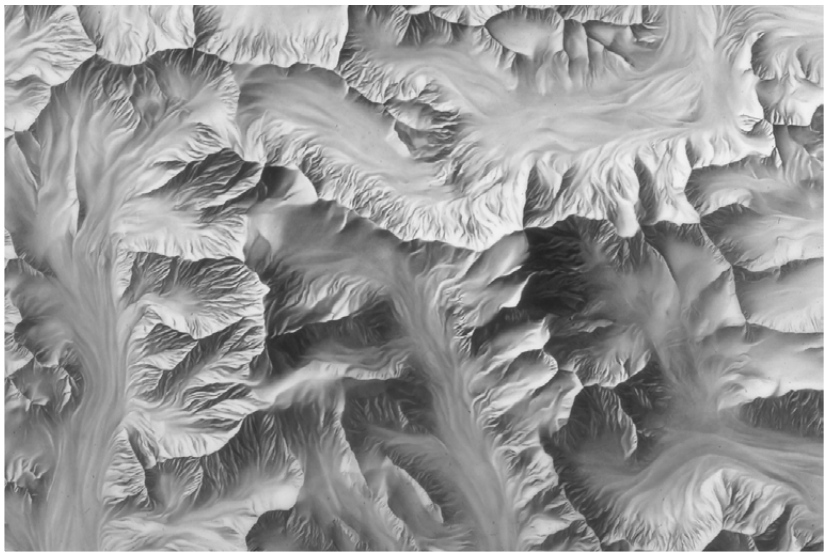

Figure 1a: The massif of Mount Hubbard, Mount Alverstone, and Mount Kennedy. 1968, 1:31,680. Washington: National Geographic Society.

The Mt. Kennedy shaded relief was a major departure from past practices at the National Geographic Society. Abandoning the prevailing practice of drawing relief at 150 percent of size, I drew the relief for the first time at 100 percent, the final reproduction size. Instead of paper, the base was fine-grained Cronaflex drafting film that was dimensionally stable. On this surface I created a wide range of light gray to solid black tones using 4H (hard) to 6B (soft) Koh-i-Noor graphite leads, the same brand preferred by artists.

WITH THE AERIAL PERSPECTIVE EFFECT PROPERLY APPLIED, MOUNTAINS APPEARING ON A FLAT PAGE GIVE THE ILLUSION OF PRONOUNCED THREE-DIMENSIONALITY.

The relief shading principle of aerial perspective is the most important lesson that I learned from Ulmer and from reading Imhof's Kartographische Geländedarstellung (1965) (English translation: Imhof (1982)), which has application for both monochromatic and full color relief images. The basis for the principle is the real-life effect of atmospheric haze. When we view a landscape

obliquely, features that are far away, or near the horizon, appear soft and flat, while the features closest to us are visible in all of their details. Translating this principle to a map viewed from directly above, looking straight down, the illusion of depth enables us to see the highest peaks, the terrain that is closest to us—with more detail and contrast than the more distant lowlands that are subdued by comparison. With the aerial perspective effect properly applied, mountains appearing on a flat page give the illusion of pronounced three-dimensionality.

WHEN COMPARED TO THE PENCIL SHADING TECHNIQUE, THE AIRBRUSH'S GREATEST BENEFIT IS THAT IT CUTS BACK ON THE PRODUCTION TIME BY AS MUCH AS ONE HALF.

The graphical quality and accuracy of shaded relief created by pencil depends largely on the artist's skills: drawing ability, interpreting contours, and portraying the resulting mental image as a three-dimensional terrain on the page. In regard to production time, pencil drawing and painting with acrylics (which will be discussed below) are the most time-consuming methods of illustrating terrain, as well as the most difficult to learn.

AIRBRUSH RELIEF

My next major project for National Geographic was The Map of the Earth's Moon. The initial prototype that I drew with pencil had a rigid, chiseled look that did not quite look like the moon—creating this piece obviously would require a new way of working. I enrolled in a one-week course at the Lowell Observatory in Flagstaff, Arizona, to learn how to use a Paasche Type AB airbrush. This sophisticated device allowed me to create a shaded relief of the moon with realistic impact craters and broad lunar seas (Figure 1b). For an information source, I depended on 1966-67 U.S. Lunar Orbiter photographs that covered 99.5 percent of the Moon's surface.

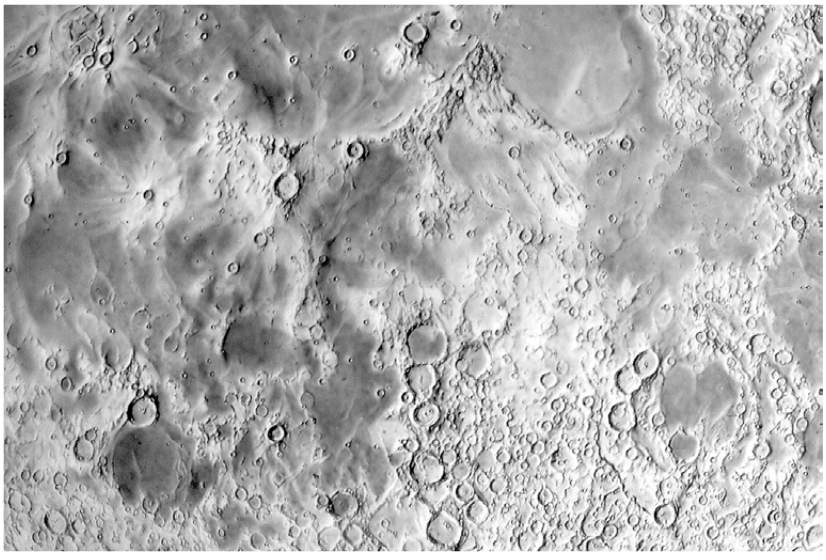

Figure 1b: The Earth's Moon. 1969, 1:11,620,000. Washington: National Geographic Society.

Producing high quality relief with a Paasche AB airbrush has demanding requirements: 1) regulating compressed air via a pressure gauge to provide a clean, dry and steady flow; 2) sharpening airbrush needles to a finer point than that provided by the factory; 3) creating a free-flowing mixture of black Pelikan T

ink, distilled water, and a drop of ammonia to further break down the ink particles to prevent clogging; and 4) using a hand-held, adjustable-speed electric eraser to eliminate any slight oversprays and to sharpen highlights.

When compared to the pencil shading technique, the airbrush's greatest benefit is that it cuts back on the production time by as much as one half. Unlike the reflective art produced by graphite pencil, which requires special care in camera reproduction, airbrush art has a matte surface conducive to photography.

FULL COLOR RELIEF

After producing additional black-and-white airbrush relief art, the next challenge was to create relief in full color. Rather than develop a color technique from scratch, the National Geographic, Cartographic Division arranged for me to meet with Hal Shelton, the American master of relief painting, at his studio in Golden, Colorado.

To simply say that the two-day visit was useful would be a gross understatement. The technique that he shared with me was priceless. Immediately upon my return to Washington I started work on a series of continental physical maps (Figure 2a) for the National Geographic Atlas of the World, art that saw repeated reprints as recently as the 2005 edition. There was only one disappointment with my visit—I was unable to see any of Shelton's relief originals because they were stored in a vault at a distant location.

Figure 2a: Physical Map of Africa, National Geographic Atlas of the World. 1992, 1:16,950,000. Washington: National Geographic Society.

The colored National Geographic Atlas plates depict potential natural vegetation zones, the land cover that existed before/without any human influence such as farming, built-up areas, etc. I compiled this information

from a wide variety of sources, the most useful being A.W. Küchler's Potential Natural Vegetation map series. For terrain features, I depended on the landform maps made by fellow Hungarian, Erwin Raisz; jet navigation charts at 1:2,000,000-scale; and the 1954 edition of Atlas Mira, maps which provide very good small-scale contour information.

From these sources I generalized potential natural vegetation into eight categories: tundra, evergreen forest, mixed forest, deciduous forest, grass, shrub, desert, and ice. Following Shelton's palette as a general guide, I mixed Cadmium Red Medium, Phthalo Blue, Cadmium Yellow Medium, and Titanium White Liquitex acrylic paints to create a unique palette. National Geographic Society physical maps carried this color scheme for many years afterwards (for details, see Patterson 2004).

Following Shelton's practice, I initially painted the color relief originals on so-called "deep-etched" offset press plates. On these plates, the base map compilation consisting of lines appeared as shallow incisions cut into the metal. When painting, the lines were visible as guides if a light source were set at a shallow angle coming from the top left. During photographic reproduction, these lines disappeared under full frontal illumination.

After two or three maps produced in this time-consuming manner, I abandoned metal plates in favor of double-weight Bainbridge 80 Illustration Board. Compilation lines appeared on this super-white surface as blue lines, applied as a light-sensitive emulsion and exposed through photographic negatives to an extremely bright light source.

Visitors to the Cartographic Division frequently asked me, "How do you paint color relief?" Giving a satisfactory answer was always difficult because my process was as much about technique as it was "visualizing and feeling" the terrain. When pressed, I would give a simplified step-by-step answer. "First, lightly airbrush flat vegetation tints over the blue-line base. Then comes the detail work: after carefully studying the terrain characteristics, and imagining that I am viewing the area from high up in space, I start sketching in the relief, modeling features with darker tones and light highlight colors. Always referring to contour lines and other information sources, I continue building the relief image until I am satisfied with the result. Finally, sometimes after hundreds of hours of effort, to prepare the art for final reproduction, I eliminate the still visible blue lines in the compilation base by applying liquid bleach spray."

PAINTING THE OCEAN FLOOR EMPLOYS BASICALLY THE SAME TECHNIQUE AS THAT USED FOR TERRESTRIAL AREAS, BUT WITH THE OBVIOUS DIFFERENCE OF A LIMITED BLUE PALETTE.

Another milestone in my relief career came in the early 1970s when Austrian artist, Heinrich Berann, visited National Geographic Society. His beautiful, brilliantly colored panoramas were and still are unmatched by anyone's work, and his ocean floor paintings brought to life a yet unexplored part of our world. That meeting, and subsequent extensive studying of his work, eventually enabled me to start the production of the Society's new set of ocean floor maps (Figure 2b).

Painting the ocean floor employs basically the same technique as that used for terrestrial areas, but with the obvious difference of a limited blue palette. As a source for bathymetric detail, I used the General Bathymetric Chart of the Oceans (GEBCO), ocean bottom charts produced by Marie

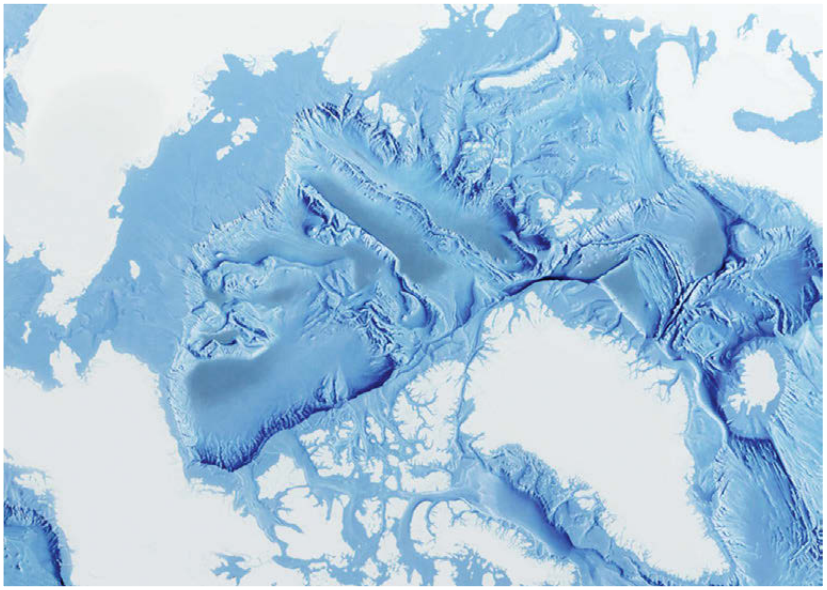

Figure 2b: Arctic Ocean Floor (Ocean relief only), National Geographic Atlas of the World. 1992, 1:10,100,000. Washington: National Geographic Society.

Tharp and Bruce Heezen (Lawrence 1999), and earlier Berann maps interpreting the original Tharp and Heezen data.

The Heart of the Grand Canyon was the largest (36 x 36 inches) and most time consuming (1,075 hours) relief that I painted during my twenty-two years at the National Geographic Society. I like to think of this work as my "relief thesis" because it effectively incorporated all that I had learned about relief shading up to that point (Figure 3). I produced it with a combination of airbrushing and acrylic painting with size "0" brushes. The base map with contour lines that guided me resulted from a 1972 aerial photography and field survey, so I am confident that the relief is the most accurate and detailed relief painting of Grand Canyon even to this day.

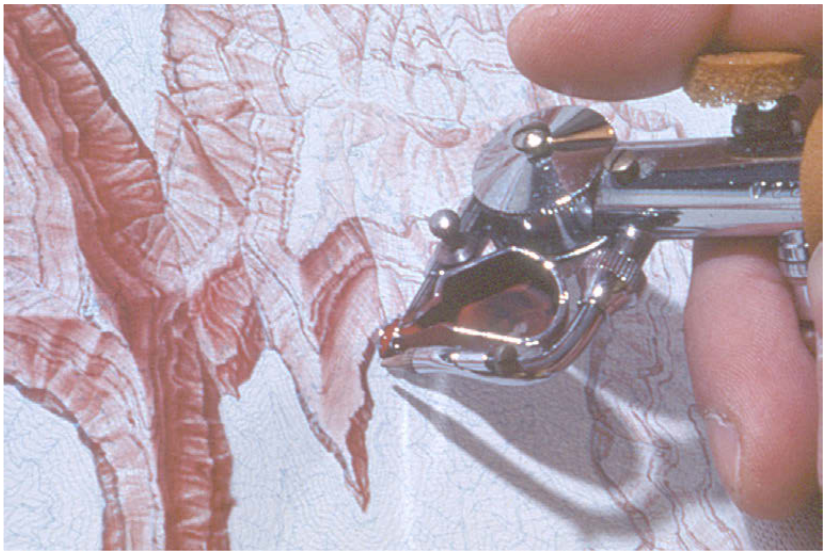

Figure 3: The Heart of the Grand Canyon. 1978, 1:24,000. Washington: National Geographic Society.

DIGITAL RELIEF

MY ENTRY INTO THE DIGITAL ERA STARTED IN 1993 ... I OBSERVED SOMEONE USING A DIGITAL AIRBRUSH TECHNIQUE ... TO PRODUCE GRAYSCALE RELIEF.

I [LATER] LEARNED THAT DIGITAL ELEVATION MODELS (DEMS) AND BRYCE SOFTWARE COULD PRODUCE COMPUTER-GENERATED RELIEF IMAGES.

In 1986 I left the employ of National Geographic to become a freelance relief artist (Tóth Graphix 2009). However, my working relationship with the Society continued unabated with each new relief art commission that I received from them. This change in career coincided with a groundbreaking new way of producing relief art.

My entry into the digital era started in 1993 when, during a visit to National Geographic, I observed someone using a digital airbrush technique on an Apple Macintosh computer to produce grayscale relief. I was eager to find out more about this new technique, with which I had no prior experience. Through the courtesy of the Cartographic Division, I became familiar with computer basics, the use of the Wacom tablet and Adobe Photoshop airbrush tool, and the amazing "undo" command. I purchased my first Macintosh computer and immediately "retired" my manual airbrush, brushes, and paints. Since going to an all-digital workflow, I no longer struggle with a splattering Paasche AB airbrush and dentist drill-like sounds. Now I listen to music.

On another visit to National Geographic I learned that digital elevation models (DEMs) and Bryce software could produce computer-generated relief images. So, the learning curve started all over again, this time with help from Tom Patterson at the U.S. National Park Service (Patterson 2009). Patterson, an early adopter of Bryce for creating relief art, has freely shared his techniques.

Presently my favorite application for rendering planimetric and oblique relief is Natural Scene Designer Pro 5.0 by Natural Graphics. With this fast and simple-to-use software, I start by producing a base relief image with resolution-bumped DEMs (Patterson 2001). As good as these images may appear at first glance, closer inspection reveals data-related deficiencies requiring retouching or, in extreme cases, more extensive over-painting. For these tasks I am grateful for all those years of conventional relief experience. For example, to create the oblique relief image of Hispaniola (Figure 4a), I spent more than half of my production time on re-painting the relief with

Figure 4a: Central portion of West Indies. National Geographic Magazine. March 2003. Supplement map. Washington: National Geographic Society.

the Adobe Photoshop airbrush tool. To create smaller-scale relief art, the low resolution (30 pixels per degree) and poor data quality of the ETOPO2 (or even CleanTOPO2 (Patterson, n.d.)) source data necessitates manual retouching. This is especially true for the ocean floor that generally receives disproportionally more of my attention than the land (Figure 4b).

Figure 4b. Oblique Caribbean Sea digital relief created with Natural Scene Designer Pro and repainted with Adobe Photoshop airbrush tool; unpublished.

CONCLUSION

For me, relief portrayal on maps is not only a job but also an enjoyable and challenging artistic activity (Tóth 1986, 2005, 2006). The more projects I work on, the more I realize that there is no definite work routine to this wonderful madness of digital relief production. Each project presents a different set of challenges and will require its own unique solutions. Be it an illustration depicting the sunrise over the Mediterranean (Figure 5), an oblique view map of the Alps for the National Geographic Magazine (Figure 6), or a physical map of Europe produced for Columbus Verlag, Germany (Figure 7), this "Accidental cARTographer" relishes new challenges.

Through the years, every project that I have worked on has become a growth opportunity, and my development in relief shading has mirrored National Geographic Society's notable progress in the field. I consider myself fortunate to have met and learned from two of the world's greatest artist-cartographers, Hal Shelton and Heinrich Berann. Both men come from a fine art background and merged their wonderful talents and visions with their love of cartography.

Shelton, who clearly recognized the importance of art to relief depiction on maps, and noting my lack of formal art training, advised to pursue training in this area. On the strength of his advice I took the Famous Artists correspondence course, hoping to gain exposure and experience in landscape painting. Instead, the course led me to the love of portraiture and to the realization that every time I create a relief, I am not only making a map but also am painting a portrait of our Earth's old, wrinkled, beautiful face.

BOTH [HAL SHELTON AND HEINRICH BERANN] COME FROM A FINE ART BACKGROUND AND MERGED THEIR WONDERFUL TALENTS AND VISIONS WITH THEIR LOVE OF CARTOGRAPHY.

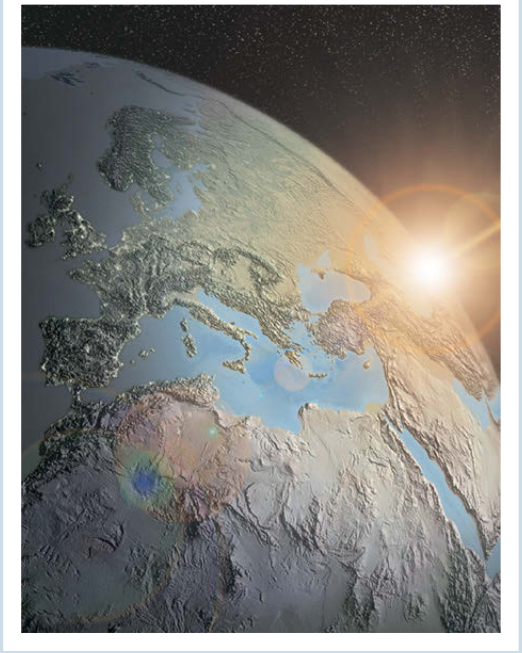

Figure 5. Mediterranean Sunrise produced with Natural Scene Designer Pro. Digital; unpublished.

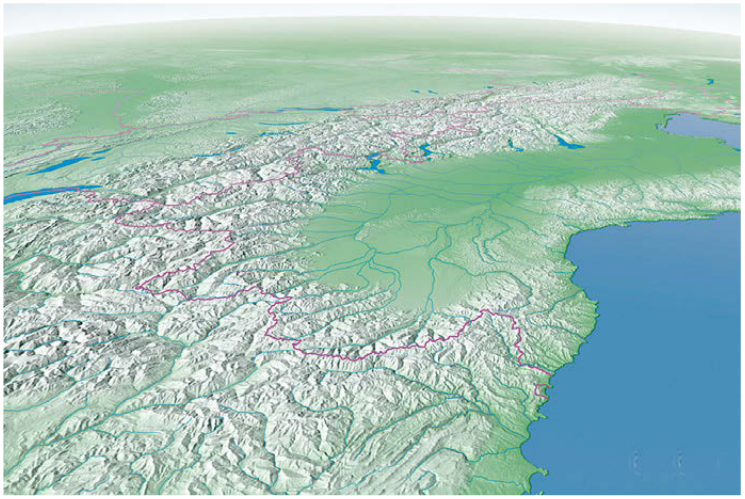

Figure 6: Meltdown in the Alps. 2006. National Geographic Magazine. Feb. 2006, 102–103. Washington: National Geographic Society.

Figure 7: Europa. 2007, 1:6,500,000. Krauchenwies, Germany: Columbus Oestergaard.

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