Chapter 2
Multilingual Narrative Planetary Maps for Children

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Abstract A set of children's maps on the solid-surfaced planetary bodies of the solar system was developed in the framework of the program Europlanet 2012. The surfaces of the six bodies were illustrated by planetary scientists and graphic artists. This is the first project in which such detailed, hand-drawn lunar and planetary maps were created specifically for children, in the most common spoken languages of Europe. The map pages, prepared according to the latest data from space probes, are accompanied by a website where background information and interesting facts can be found in a form understandable for children. The topics covered were

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compiled with the help of questions that children asked about the maps. The map series was prepared with the support of the International Cartographic Association Commission on Planetary Cartography.

Keywords Planetary · Children · Visual

1 Introduction

As part of the outreach activity of the International Cartographic Association (ICA) Commission on Planetary Cartography, we have started to develop a new series of planetary maps targeting young readers. This is the third map series from the commission: the first was published 2000–2011, edited at Dresden University, and published in major European languages; the second was based on this series but re-edited and published in Central European languages (Shingareva et al. 2005). These series were general-theme (topographic), hand-drawn shaded relief maps for a nonprofessional audience from young to middle-aged age groups. The new series focuses on the 8- to 12-year age group, who already can read and are still interested in a wide range of disciplines (first years of elementary school). We decided not to use photomosaics or computer-generated data in the maps, but again used a manual technique.

We selected six planetary bodies that might be the most interesting for children: Venus, the Moon, Mars, Io, Europa, and Titan. When designing the maps, we invited six graphic artists, who were well-known illustrators of children's books with very different visual styles, to create the maps in the visual language of children: András Baranyai (Venus), Csilla Gévai (Europa), László Herbszt (the Moon), Csilla Kőszeghy (Mars), Panka Pásztohy (Titan), and Dóri Sirály (Io). Although the overall structure of the maps is similar, the visual approach to each map is fundamentally different. We consider the series a visual-scientific

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experiment. The initial aim was to determine whether planetary maps could be constructed using new visual approaches, but still in a scientifically accurate way using a standard projection. In other words, we wished to create cartographically and scientifically accurate maps that are attractive but also understandable for children.

The maps are published online in printable, high-resolution PDF files in 11 language versions.

The maps were developed in cooperation with Eötvös Loránd University (Budapest, Hungary) and the ICA Commission on Planetary Cartography.

2 Methods

The illustrators and the technical-scientific editor worked together on the maps from the beginning to the end of the project. The illustrators had the freedom of choosing a visual approach but had the limitation to strictly follow the projection and, with sufficient generalization (e.g., simplification, enhancement), depict the surface landforms where they occur. The actual, standardized, and unique depiction of the landform types was a choice of the illustrators and was varied from completely symbolic to more or less realistic views. The most common landforms have a standardized representation (symbol), whereas the more unusual landforms were depicted more realistically (see Nass et al. 2011 for professional symbology).

Because the surface was shown in a manually designed, landform-emphasized representation, they are not as objective as photomosaic or topographic (relief) maps: they are interpretative maps, similar to regular terrestrial color-coded relief maps. This helps increase the understanding of these unfamiliar landscapes (Hargitai 2012).

The projection used for all of the maps was a two-hemisphere Lambert Azimuthal Equal Area Projection.

The two hemispheres are shown as if they were seen through the windows of an imaginary spaceship, whose control panel occupies the lower portion of the map. This control panel was designed by the illustrators and shows the physical and orbital parameters of the represented body.

2.1 Map Resources

The illustrators received the following raw materials: (1) projected, high-resolution photomosaic maps (depending on body, radar, visuals, and topographics, where available), created specifically for this project (Fig. 1), one of them with nomenclature and several with a representation of the surface focusing on one specific landform type, collected from scientific literature; (2) one projected map that

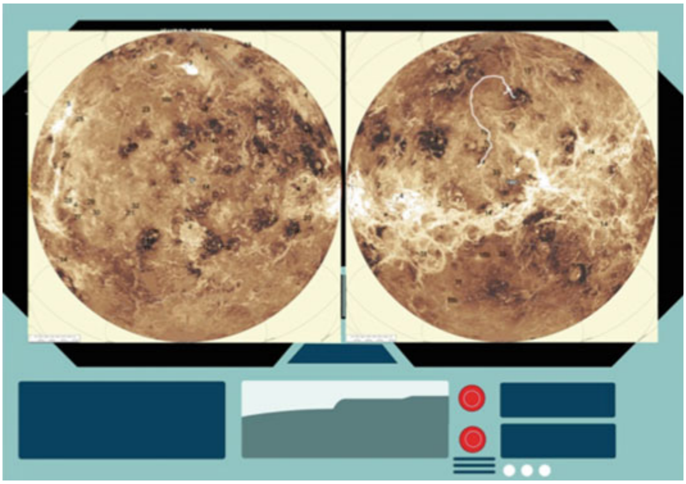

Fig. 1 Raw material provided for the Venus map

showed which selected landforms (most interesting regions/landforms) should appear on the hand-drawn maps (they were shown by numbers, with approximately 15–30 landforms selected for each body); and (3) close-up images of these selected landforms from different illumination and/or viewing angles with short explanations. The selected landforms had very different sizes, varying from regional to local scale.

2.2 Narrative Elements

It was the illustrator's responsibility to also create a unique narrative for the map, which was a specific requirement for this target audience. Although it might be confusing, the maps are populated by stories and creatures. We have used several themes to populate the lifeless surfaces with life. (We added a short note about it on the website, which explains that no life forms are yet known to occur off the Earth.) The children can browse on the map online, finding out the stories behind the features represented on each map. One such theme was the official nomenclature, where commemorative and mythological names provided abundant opportunities. Another theme was the research history of the body (i.e., older theories about its surface and other cultural associations), as well as the imagination of the graphic artists, who created their own stories and life forms. These themes made the maps emotionally charged, which may be a much more important aspect than its scientific content, for the age of the target group. The aim of the series was to raise the interest of young people in planetary science along with the stories that can be imagined on the map sheets; each planetary body serves to fulfill this task.

In addition, they could be starting points to spin-offs of the series: short stories or even story books, using the same localities and creatures. This will be the next stage in the project.

2.3 Translations

The final marginal text from the explanations to the legend was then translated into 11 languages spoken in Europe (Hungarian, German, Spanish, Portuguese, Polish, French, Romanian, Russian, Italian, Romani, and English). Translation to the native language of this age group is essential (Hargitai et al. 2009). The translation was made by earth and planetary scientists to ensure scientific accuracy. The most unique language version is Romani (Gipsy), which is spoken in several Central European countries, and for which several new words had to be created.

The nomenclature was only translated for lunar maria, where we give a bilingual nomenclature; otherwise, it was kept in Latin in all cases (see e.g., Hargitai et al. 2014). Some localization was needed in the marginal parts (e.g., a drawn keyboard).

2.4 Coordinate Grid

It was questioned whether a coordinate grid should be shown in the children's maps. We decided not to include a grid, because these maps are not designed to be used for identifying features from numeric coordinates but to browse on an attractive image. Although the hemispheric surface representations are in fact projected maps, the grid was not found to be necessary; nevertheless, this decision was hotly debated. We displayed crosshairs instead in the middle of each hemisphere, which shows the central coordinates. This can be used to identify the type of coordinate system (east or west longitudes, direction of increasing longitudes, sub- and anti-planet hemispheres).

2.5 Virtual Globes

The completed maps were also transformed to virtual globes. The steps of this process were as follows for each map:

- georeferencing the illustrated hemisphere maps
- transforming the georeferenced maps to Plate Carrée, and assembling the two parts into one globe map
- eliminating the inconsistencies along the joining edges of the hemisphere maps
- publishing the globe on the web as a three-dimensional (3D) object using the X3DOM framework, and creating a downloadable KMZ file.

3 Results

3.1 Maps

Venus. The map shows a wide variety of creatures, from funny to mythological creatures. They are derived partly from the early twentieth century view of Venus of a hot jungle with dinosaurs, as well as from the current female-focused International Astronomical Union–adopted nomenclature. Some of the features that would be invisible at this scale, such as canali (lava channels), are enhanced here for clarity (Fig. 2).

The Moon. The map of the Moon (Fig. 3a) plays with craters and commemorative names: inside some of the selected craters, the person it is named for is shown. Some other craters have funny creatures inside (Fig. 3b). Visually, the map shows many minute details and is drawn in the style of pre-20th-century engravings. The visual design of the control panel uses the Apollo spacecraft's control panels as a model. The map shows the mare-terra albedo distinction along with crater rays and also highlights the optically invisible basin outlines, which can only be seen in topographic maps.

Mars. The map of Mars is the most detailed, showing the different landforms together with "little green men," which interact with the geographic landforms and the landers and rovers in funny micro scenes. The map highlights the hemispheric dichotomy with yellow-orange contrast. Some Martian features, informally referred to by unusual names, are depicted after their informal names (cheese, spider etc.; e.g., Kieffer 2003), which helps to visualize these terms and concepts. The colors refer to different heights but several feature types are shown in perspective-view symbols. Some landforms are emphasized for clarity, such as the Uzboi-Ladon-Margaritifer channel system from Argyre to Chryse (Grant and Parker 2002) (Fig. 4).

Fig. 2 The map of Venus. Illustrator: András Baranyai

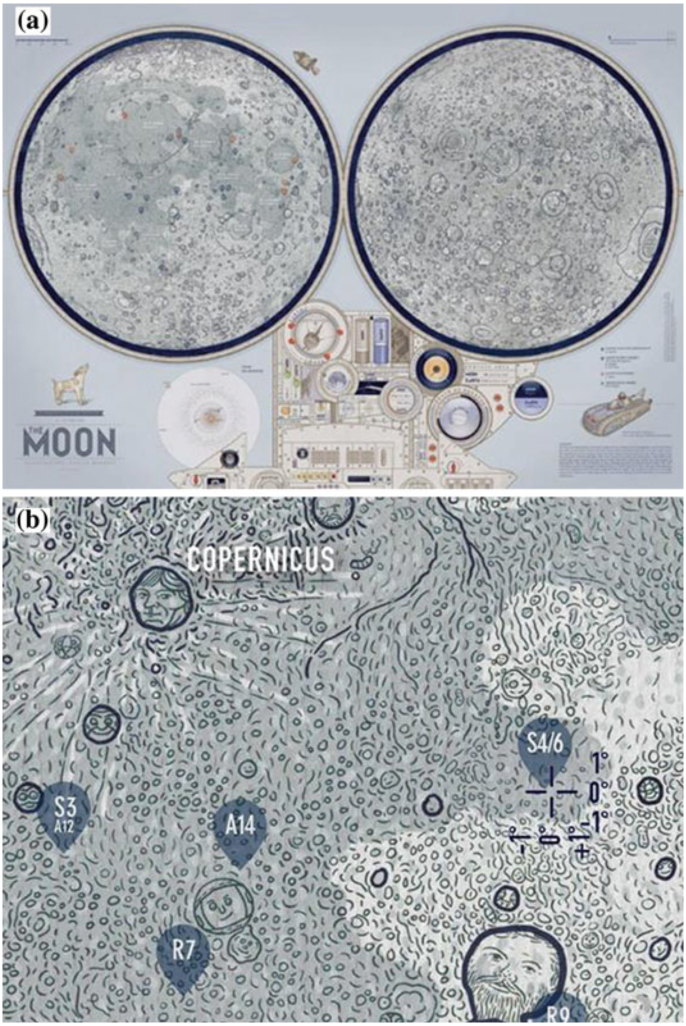

Fig. 3 **a** The map of the Moon. Illustrator: László Herbszt. **b** Detail of the map of the Moon. Illustrator: László Herbszt

Io. The map of Io is the most abstract one: its landforms are shown in hexagonal symbols. This approach gives the appearance of honeycomb cells, which is partly related to the yellow color of sulfur and partly to the Io mythology, of which some scenes are also shown. The main task for the graphic artist was to find a balance between scientific accuracy and the needs of the children, all using the minimalist geometric style. The main character is a young astronaut chasing bees (or horse-flies). Mountain heights are shown for the highest mountains (Hargitai and Schenk 2005). Major active volcanic centers are shown as ejecting material. Geological units are identified from Williams et al. (2011). This map has a very simple legend

Fig. 4 The map of Mars. Illustrator: Csilla Kőszeghy

that explains complicated orbital and physical parameters without words, using only visual elements (Fig. 5).

Europa. The map of Europa features cracks and creatures that interact with the cracks in various “winter-like” scenes. The main characters of the map are two young astronauts, a boy and a girl, floating in a spaceship. For Europa, the most problematic issue was the color: many different false color views have been published; we selected the most “naturally” colored photomosaic, which served as a guide for the colors of the hand-drawn map background (Denk et al. 1998). The

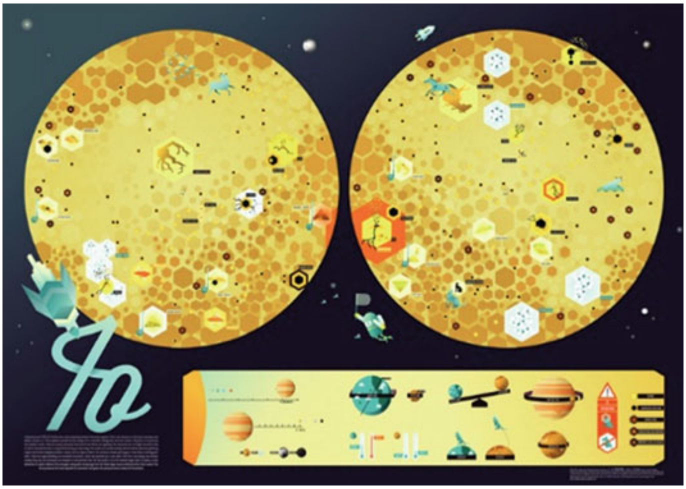

Fig. 5 The map of Io. Illustrator: Dóri Sirály

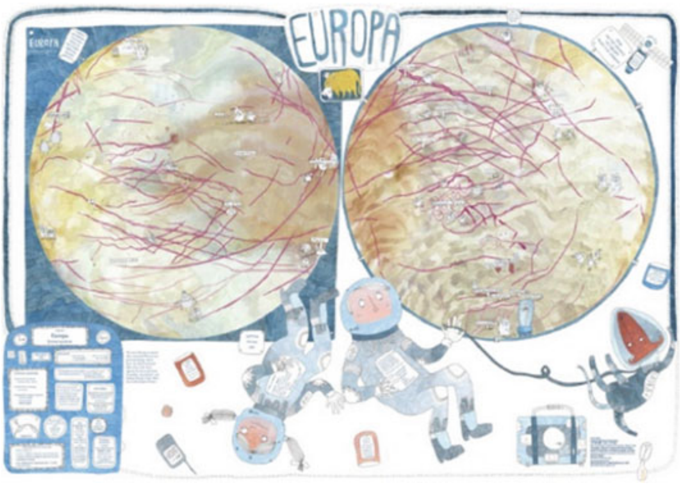

Fig. 6 The map of Europa. Illustrator: Csilla Gévai

map shows the hemispherical color dichotomy of Europa. The trends of the cracks follow the true crack (lineament) configurations that were identified from several images with different illuminations and resolutions (Fig. 6).

Titan. The least understood (at present) world is Titan, where large areas are yet to be mapped and interpreted. The map shows the surface as a perspective spherical landscape, where the various forms are open to interpretation. Ice pebbles fill some of the valleys (Le Gall et al. 2010). White hairy creatures interact with the surface. The physical parameters of the bodies are depicted in a "bookshelf," which should look very appropriate when the map hangs on the wall of a children's room (Fig. 7).

3.2 Virtual Globes

The 3D versions of the maps are published on separate web pages using the WebGL-based X3DOM library for displaying them. In order to fit various devices and screens, these pages take the screen orientation into account. The title appears on the top only when viewing in portrait mode, and it is rotated to the left edge in landscape mode (Fig. 8). This feature is important when the globes are viewed on tablets or other handheld devices.

3.3 Website and Supplemental Materials

The map pages, prepared according to the latest data from space probes, are accompanied by a family of websites (the English version: https://childrensmaps.

Fig. 7 The map of Titan. Illustrator: Panka Pásztohy

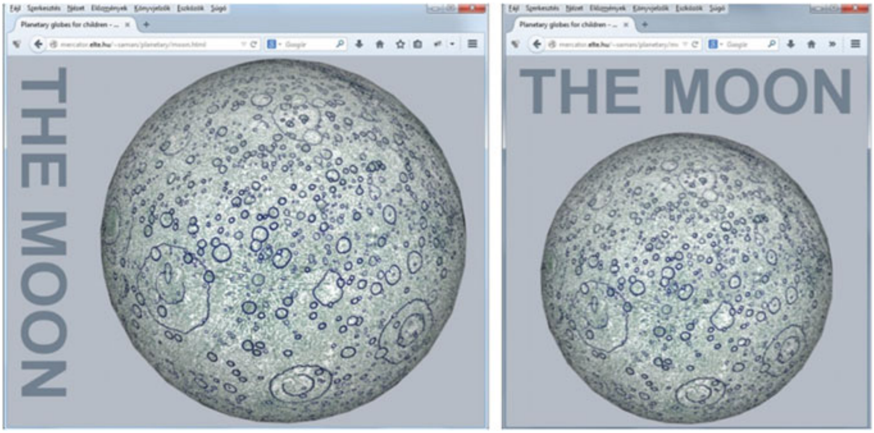

Fig. 8 The Moon as a 3D virtual globe. Web pages displaying the globes detect the orientation of the screen and place the title accordingly

wordpress.com; Fig. 9), where background information and interesting facts can be found in a form understandable for children. The topics covered here are compiled with the help of the children's questions asked about the maps. The website contains a section about the creation of planetary maps (i.e., planetary cartography) in general, which is a unique summary on this topic, especially considering the 11 languages in which this information can be accessed. The aim of this section is to draw the attention of the younger generation to planetary cartography as a potential career option.

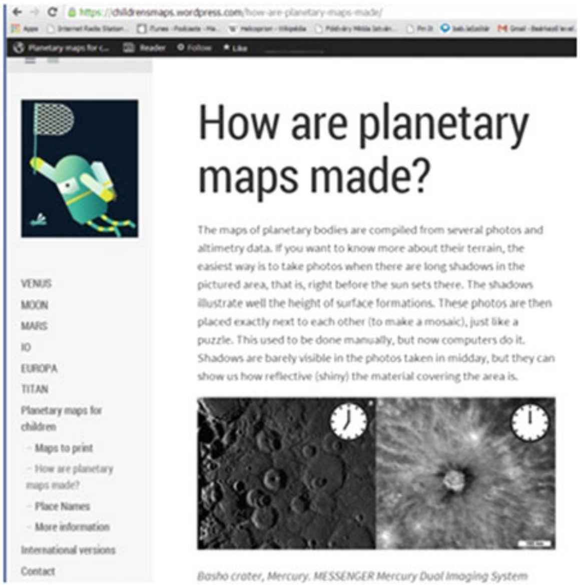

Fig. 9 One page from the english version of the project website

4 First Reactions

In the 2- to 12-year age group, few selected users tested the maps. The youngest children focused on situations and objects they were familiar with, such as an ice cream that fell onto the ground where the alien figure's face expressed a sad expression. First-grade children typed on the printed keyboard shown on the Venus map's control panel. This showed that when interaction is offered with the map, children will use this opportunity. Elementary school-aged children mentioned that they liked the animal figures (dogs, cats, mice). Answers to the scientific questions they asked have been incorporated into the information sheets available in the online version. Older children noticed on the Io map that some of the symbols used in the map were not included in the legends and complained that they did not understand what kind of landform type they signified.

The different language versions online got an overall positive reaction; however, the Hungarian version's website received mostly negative comments, all by amateur astronomers. They concurrently criticized the use of imaginary figures. Their opinion was that this will mislead the children who will regard them as real inhabitants of that planetary body. It must be noted that there was no posts made on the actual geological content, the choice of displayed place names, the control panel's data content, or the artistic visual approach of the landforms.

In fact, the children testers kept asking about why were there humans or other creatures on the maps; even a 5-year-old asked if the hairy creatures (in the Europa map) are "just drawn there," showing that she understood that they do not necessarily belong to the surface in reality. Regarding the geological symbology, they could not understand the nature of purple lines on the Europa map (cracks in ice), the white patch on Mars (ice caps), the yellow color on Mars (a specific, color-coded height), and the hexagons on Io (artistic approach of surface representation). The map of Titan shows rain and clouds, which made one 11-year-old tester ask, “If there is rain and water on Titan, why it is not possible to live there?” This question contained two presumptions: (1) the hairy creatures are not real and (2) rain and clouds are composed of water. This shows clearly what should be explained and what is already understood as part of the imaginary narrative background story.

5 Conclusion

This is the first project in which detailed, hand-drawn lunar and planetary maps were created for children in the most-spoken languages of Europe. We have created experimental maps that use special visual language to communicate scientific information to a young audience. Visual design is becoming of increasing importance in communicating science from news media to university levels (Kereszturi and Hyder 2012; Hargitai 2006). Appropriate symbology is also coming to be recognized as increasingly important in professional planetary maps (Nass et al. 2011). The maps were designed by professional illustrators and were developed together with planetary scientists. This joint work shows that the interpretative representation of these surfaces with new graphic styles requires the use of primary scientific data, collected directly from the most current scientific literature combined with a narrative that tells stories in the visual language of children. Planetary surfaces can be mapped from many approaches—some very different from the automated techniques—but these may be more suitable for the younger generation in communicating scientific information and also raising interest in planetary science than the also visually attractive photomosaic or topographic maps.

6 Future Directions

The most controversial issue with the maps is the choice of narrative story. It should be investigated how the perception of the surface through the map changes depending on the narrative theme used. An experiment should be developed in which children are given the same maps but with different theme layers added, including a “plain” map, a map with human figures, a map with alien figures, or a map series with returning figures as opposed to our current approach of completely different themes with a similar general layout. In a previous survey (Hargitai 2012), children developed slightly different mental views of planetary surfaces when they studied maps with a nomenclature in Latin or their home languages. Different labels emphasized different types of features and different characteristics of the body. Similarly, different themes for a narrative could take the map readers in different directions. We hypothesized in this study that maps with a narrative layer are more attractive for children than maps that display only geological features. However, we have not studied the end products in a manner that produced a statistically acceptable result. It is also a fundamental question how planetary science content will share the children's attention once they focus on the imaginary or narrative content.

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