Cartographic analysis of portolan charts with use of digital methods

Summary of doctoral (PhD) thesis

Krisztina Irás

Doctoral School of Earth Sciences
Head of Doctoral School:
Dr. Gyula Gábris

Doctoral Programme on Cartography
Head of Programme:
Dr. István Klinghammer

Supervisor:
Dr. Zsolt Török

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Introduction

There are only a few notes about portolan charts in Hungarian publications on the history of cartography. These Medieval nautical charts, considered as typical products of the Renaissance and the Great Explorations, are usually dealt only with a few words, generally separated from Hungarian historical and carto-historical events. In Hungarian, it is possible to read longer about portolan charts in „*Térképtörténet"* (History of Cartography) by Lajos Stegena and „*Térképtudomány. A pálcikatérképtől az űrtérképig"* (Science of Maps. From Stick Maps to Space Maps) by Árpád Papp-Váry.

Main objectives of the thesis:

1. Presentation of general characteristics of portolan charts; presentation of contradictory scientific opinions and results concerning origin, projection and other elements of these charts;

2. Presentation of portolan charts that represent the Hungarian Kingdom in detail with a short summary of the main elements of the Hungarian foreign and domestic policy; value and arrange Hungarian data of charts according to their type;

3. Analysing the 16th century MS portolan chart Cod. Lat. Medi aevi No. 353 preserved in National Széchényi Library (OSZK) and identifying its author; presentation of a 15th century portolan atlas and two charts also preserved in the Library.

Methods used in the research

1. The portolan chart and the atlas preserved in OSZK were used to examine the general theories about compilation of portolan charts.

When looking for a possible projection of a chart, coastline contours of OSZK Cod. Lat. Medi aevi No. 353 were compared to coastlines formed by projections mentioned the most frequently in scientific publications on the topic, ie Equidistant Cylindrical, Equirectangular (of Marinus), Stereographic and Mercator projections. In the comparison, three different digital methods were used: 1. georeferencing the original chart and transforming it to the projections; 2. comparing coastlines without georeferencing; 3. creating distortion grid.

The chart was georeferenced with Global Mapper software. In this process, image (pixel) co-ordinates of the scanned map were transformed to projection co-ordinates. After this, the chart was transformed to the projections mentioned above. Three base points were set on the chart to join the original chart to the projections: at the Straits of Gibraltar, at Genoa and at an easily recognisable cape in the Eastern basin of the Mediterranean.

When contour lines of the non-georeferenced chart are compared to contours determined by projections, pixels of the digital image keep only the image co-ordinates (and none of any projections). In this part of the research, contour lines prepared in the four projections were laid upon the manuscript chart. As the chart had been created before the measurement of geographical lengths was elaborated, its inaccuracy in E-W direction is greater than its general inaccuracy. Therefore, projected contours were

fitted separately to the Eastern and to the Western basin of the Mediterranean.

Another way to compare projections or geometry of the two maps is to create a distortion grid. With such a grid system, it is possible to determine the location of points of our chart on a reference map which projection is known. For this, a set of control point pairs are necessary with a link between the ones on the old chart and the ones on the reference map. With the use of MapAnalyst software, we can create a distortion grid, we can visualise displacement vectors and it is also possible to calculate the scale of the chart if the scale of the reference map is known.

After setting the control points, the software creates the grid lines according to the position of points on the reference map, and than distorts it according to the position of the same points on the old chart. In this research, portolan chart of OSZK was compared to Mercator's world map (1569) by a grid system built on 124 pairs of control points. In the resulting image, red dislocation vectors and distorted grid lines clearly show the difference between the two maps.

2. Drafting of portolan charts has also brought many debates among scholars. According to a theory, rhumb lines of portolan charts were used not only in navigating boats on the sea but also in sketching the charts themselves. Grazioso Benincasa's atlas (1474) was examined in enlarged details to determine the sequence of sketching cartographic elements on the parchment.

3. Portolan charts showing the Hungarian Kingdom were represented in chronological order in parallel with the main events of the Hungarian history of the period (15-17th century). The quality and quantity of data about Hungary on these charts are in connection with domestic and foreign policies, therefore Hungarian toponimies of the charts were identified and divided into groups according to their type (country, region, town, river, etc).

4. To identify the author of the chart OSZK Cod. Lat. Medi aevi No. 353 (16th century), it was compared to adequate sheets of Battista Agnese, Venetian chartmaker's atlases (1546, 1553). Coastlines, coastal names and decorative elements on these three maps were examined in details. The names were collected in two regions: in Central and Southern Italy and on the Iberian Peninsula. Names are written in the thesis as they are read on the maps. Conformity of coastlines was proved with two digital methods: copying and overlaying coastlines of the atlases onto the chart and creating distortion grid by setting up control points on the coastal contour lines. Further cartographic elements were compared in groups according to their types.

Results

1. Examination of projections resulted local matches with Stereographic projection and with Mercator projection along the coastline of OSZK chart but it is not possible to identify the whole chart with any of the projections used in this research. Furthermore, a seven degree rotation to the North in the map drawing is clearly seen in the region of the Eastern Basin and of the Black Sea. All these results prove the theory that this portolan chart was

prepared on planimetric way.

The distortion grid shows similarity of the chart to Mercator's world map but also a seven degree counter clock wise rotation in the Eastern part of the Mediterranean Basin.

2. Sketching and drafting a portolan chart was described on a well preserved atlas made by Grazioso Benincasa in 1474. The groups of different cartographic elements were drawn on the parchment in the following sequence: 1. scale bars in the sheet corners; 2. wide coloured bands and narrow black contours of coastlines; 3. toponymy; 4. rhumb lines; 5. colouring; 6. corrections. The rhumb line network was obviously put on the parchment after the coastlines had been ready, therefore these lines could not serve forming the continents.

3. More than twenty portolan charts and atlases, that contain any data about the Hungarian Kingdom, were collected for this research. Names and other elements were identified and grouped on each piece of work. In comparison of toponymy of the charts and atlases, I found a remarkable decrease in quantity of information about the country from the beginning of the 15th century. Loss of maps containing such data can be one of the reasons of this change but it is likelier caused by events in foreign and domestic policies of Hungary and all over Europe (eg wars within the country or wars with the Ottoman Empire).

Those charts that show the Danube and the Central European river network, depict trade ways of the time not only on sea but also on rivers.

4. For identifying the author of the portolan chart OSZK Cod. Lat. Medi aevi No. 353, I used sheets from Battista Agnese's atlases of 1546 and 1553. The form of the coastlines and the river network, the toponymy of the sample regions and the construction of the wind roses, with minimal alterations, are completely identical. There is wider variation among decorative elements (eg towns, sovereigns, mountains, forests), but more differences appear in the comparison with the earlier exemplar. The results of the comparison to the atlases show that the portolan chart of OSZK was created with the same models and with the same drafting and decorating methods as Agnese's other works. This means the chart was prepared in Agnese's workshop.

Digital methods have already gained greater role in researches of history of cartography with a wide variety of possibilities from simple image processing to transforming image co-ordinates to projection co-ordinates or to visualise distortions with grids and vectors. However, there is no yet any easily accessible software that would make determining projections of old maps possible.

Further historical researches could reveal the reasons of the combination and of the changes of elements of Hungarian data on portolan charts. Furthermore, it is necessary to continue comparing the chart Cod. Lat. Medi aevi No. 353 to Agnese's other works to have a complete knowledge about the origin of this beautiful masterpiece preserved in the National Széchényi Library.

List of publications that were used during the research

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List of publications on the topic of the research by Krisztina Irás

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2004. GEO 2004. A magyar földtudományi szakemberek VII. Világtalálkozója, Szeged
K, Irás*: Jan Huygen van Linschoten „India Orientalis" című térképének szerepe és portugál forrásai*

2005. 21. International Conference on the History of Cartography
K, Irás: *Settlements of the Kingdom of Hungary on portolan charts*

2007. 22. International Conference on the History of Cartography
K, Irás: *Portolan charts in Hungary – Treasures of the National Széchényi Library*

2009. 22. International Conference on the History of Cartography
K, Irás: *Anonymous portolan chart in Hungary: A possible Agnese work*

2. Articles published in scientific periodicals

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3. Popular articles

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