



LUCYNA SZANIAWSKA  
Polish Academy of Sciences, Institute of the History of Science  
Team for the History of Cartography  
lucyna-szaniawska@wp.pl

## Geological content on maps and in accompanying texts developed until the end of the 18th century

**Abstract.** For many centuries on general geographical maps and early maritime maps geological information was rarely included. The map of the Wadi Hammamat valley, the Borgia world map, the Catalan world map and *Carta de nauigar per le Isole nouamente...* portolan chart were indicated as examples. Places where minerals occurred were presented mainly using textual descriptions.

Among Renaissance maps and later maps published before the second half of the 18th century, the map of the Kingdom of Bavaria by Philipp Apian and the map of the Duchy of Świdnica in Silesia by Johann Wieland and Matthaüs Schubart were discussed as examples. Distribution of raw materials and places of their extraction were shown using simple geometric signs with graphic characteristics for a given period.

Mineralogical maps published in the second half of the 18th century were described based on the example of maps by Jean-Étienne Guettard and Johann Jirasek. Their content was compared with the texts accompanying them, developed under patronage of the contemporary scientific institutions and relevant methods of geological information presentation were described. From the late Renaissance symbols signifying extraction sites of raw materials had simplified and rather random shapes which indicates 'unhurried' development of cartographic methods on geological maps.

**Keywords:** history of cartography, geological cartography, mineralogical maps, Philipp Apian, Jean-Étienne Guettard, Johann Jirasek

### 1. Introduction

For many centuries on general maps geological information was rarely included, and the content of such maps clearly indicates that they were drawn for other reasons than documenting the occurrence of rock formations or raw materials. Geological features were rarely included, more as curiosities or exceptionally valuable goods for which the areas presented on the maps were famous.

From general maps published before the second half of the 18th century, maps which presented distribution of raw materials and rocks in a manner typical for a given period when they were created, are selected for discussion. Because they were not *sensu stricto* geological maps, the information included on them was not compared with geological knowledge included in scientific works published at that time. The examples are presented to show a se-

lection and geological data presentation methods in the earlier period and to show new solutions on geological maps from the second half of the 18th century easily.

The analysis included only those mineralogical maps<sup>1</sup> published in the second half of the 18th century which apart from explanations placed directly on the maps were accompanied by extensive texts (dissertations or monographs) developed by contemporary scientific institutions.

Stratigraphic maps started to be developed only at the beginning of the 19th century, and

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<sup>1</sup> A.J. Wójcik (2012, p. 178) defines the maps as showing most of all characteristic and distinct rock formations; and H.M. Wallis and A. H. Robinson (1987, p. 146) A mineral maps display the location and character of mineral and ore-bearing rocks, coal seams, and mineral workings such as mines and quarries. They preceded geological maps but are closely related to them.

maps of geological phenomena, such as volcanic eruptions and earthquakes, even later. Therefore, they were not discussed in this article. For centuries, large-scale maps of extraction sites for various raw materials and mining plans were created. Such documents showing a particular deposit include among others three plans of salt mine the Żupa Wielicka delineated by Marcin German at a scale of approx. 1:3,800 published by Wilhelm Hondius in Gdańsk in 1645 (A. Jodłowski et al. 2005, pp. 15–51). In this article, such maps are not discussed due to their different purpose.

## 2. Maps published in ancient times and the Middle Ages

The oldest map presenting the occurrence of minerals was drawn on papyrus after 1,100 BC. It was created in ancient Egypt upon request of Pharaoh Ramses IV and it documented the path of his expedition sent to obtain building materials<sup>2</sup>. A part of the preserved map shows the Wadi Hammamat valley in eastern Egypt (*History of Cartography* 1987, pp. 121–124). An important commercial road leading from the Nile valley in the vicinity of Thebes east to the Red Sea runs there. A map illustrating a caravan trail has a form of a sketch presenting among others the location of quarries and gold mines as well as cliff hills surrounding the valley (A. Czerny 2015, p. 15; A.J. Wójcik, pp. 339–340).

On the medieval maps of the world called *mappae mundi* as a result of their small scale, it was possible to present only important features, however sometimes to the political content information about extracting gold or its abundance was added. For instance, it is proved by a well-known map of Cardinal Stefano Borgia<sup>3</sup> – a copperplate by an anonymous creator from 1410–1458 (*The Borgia World Map* 2010, pp. 1, 8, 20)<sup>4</sup>. The inscription placed in the forks of White and Blue Nile says: ‘Christian Nubia, seat of Father John, whose empire stretches from the Strait of Gades (Strait of

Gibraltar) to the Golden River (Rio d’Ouro) (L. Szaniawska 1981, p. 68)<sup>5</sup>.

Information about the wealth of the African ruler Mansa Musa is presented by other medieval *mappae mundi* apart from the Borgia World Map, among others *the Catalan map of the world, 1450*<sup>6</sup>: ‘Here rules king Mansa Musa, ruler of Guinea, he is rich and the most powerful lord in the entire land thanks to the abundance of gold he collects on his land’ (L. Szaniawska 1981, p. 70)<sup>7</sup>.

Also, later in the Middle Ages and in early Renaissance on portolan maps, on which most of all geographical features located on seashores were shown, sometimes individual gold collecting centers were marked inland. With the discovery of new lands, to information about goods from exotic lands, information about gold-bearing areas was added. That is how on the portolan map of the world entitled *Carta de nauigar per le Isole nouamente...* delineated by Albert Cantino in 1502 upon request of Prince Ferrara, gold mines were placed among others on Madagascar: ‘There is a lot of gold, silver, silk, irregular pearls and amber on this island’ (L. Szaniawska 1981, p. 73)<sup>8</sup>, in the area of Sofala port: ‘Here is a gold mine in which there is an abundance of gold, more than in any other’ (L. Szaniawska 1981, p. 73)<sup>9</sup> and in Sierra Leone: ‘In Sierra Leone there is a lot of gold, it is better than elsewhere, it is taken to Portugal along with numerous slaves...’ (L. Szaniawska 1981, p. 73)<sup>10</sup>. Information about the occurrence of gold and its extraction or possession in ‘great abundance’ was repeated on subsequent copies and editions of portolans as well as on maps illustrating exotic lands printed later.

<sup>5</sup> The original: Nubia christianorum sedes presbiteri Johannis cujus imperium ab ostio gadis par meridiem usque ad fluvium auri (L. Szaniawska 1981, p. 15).

<sup>6</sup> The map is stored in Biblioteca Estensa in Modena.

<sup>7</sup> The original: Assi senyoraie vn rey musa-melli senyor de guinea es rich e pus poderos senyor de tota sta partida par labundancia de l’or ques recull an la sua terra (L. Szaniawska 1981, p. 21).

<sup>8</sup> The original: Em esta ilha ha muito ouro e prata e seda e aljofar e plas ambar (L. Szaniawska 1981, p. 32).

<sup>9</sup> The original: Aqui he amina douro emque dia multra abundancia de la mais que em outra... (L. Szaniawska 1981, p. 34).

<sup>10</sup> The original: Em esta serra leoa a muito ouro este he o mais fino que ay em nenhua parte e traenlom pera portu gall a muitos escravos... (L. Szaniawska 1981, p. 33).

<sup>2</sup> Papyrus stored at the Egyptian Museum in Turin.

<sup>3</sup> Map kept in the Biblioteca Apostolica Vaticana.

<sup>4</sup> In the article the map is dated as such, while in the table of contents it is dated as 1430.

### 3. Maps published from the 16th century to the mid of the 18th century

Along with getting to know the natural environment of Europe, on maps of countries of the continent the density of information about mines and ore increases, and because of the use of larger rocks it became possible to show a larger number of places of their extraction. On Renaissance general geographic maps, apart from typical elements of the landscape, such as cities, main roads, rivers, lakes and forests, mines with metal, coal and salt ores were sporadically marked; however, the graphic characters used were selected rather randomly. In the explanations of symbols for a 24-sheet map of Bavaria entitled *Bairische Landtaflen XXIII. Darinne(n) das Hochlöblich Fürstenthumb Obern vnnnd Nidern Bayrn...* at the scale of 1:140,000 (elaborated by Ph. Apian and placed in *Chorographia Bavariae Beschreibung des Lands und Fürstenthumbs Obern und Nidern Baiern...* in Ingolstadt in 1568) next to features such as: the free city of the Reich, bishopric, monastery, town, market town, castle, village, symbols were included at the end: mirror smelter (*Spieglhütt – sit Spiegelhütte*), glass smelter (*Glaßhütt – sit Glasshütte*)<sup>11</sup>, salt works (*Salzpfan – sit Salzpfanne*), ore mines (*Aertzgrüb – sit Erzgrüben*), hot springs (*Wiltpadt – sit Wildbad*) (A. Czerny 2015, pp. 20–21). Figure 1 presents the appropriate part of the legend placed on sheet no. 13 of the map.

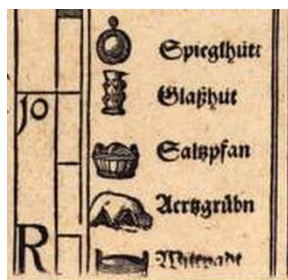


Fig. 1. A part of the legend concerning raw materials, their extraction and processing on sheet no. 13 of the map by Ph. Apian, 1568 (the collection of Bayerische Staatsbibliothek in Munich)

<sup>11</sup> Information about glass and mirror smelters was included here due to high probability that appropriate quality quartz sand would occur next to them.



Fig. 2. Entrances to ore mines on sheet no. 24 of the map by Ph. Apian, 1568

On sheet no. 24, south from Salzburg (*Saliburg*), along the Salzach River only areas of ore mines were marked on the entire map. They were marked with symbols explained in the legend – several ‘holes’ in the mountain sides and two miners pushing wheelbarrows with spoil were placed next to them (fig. 2).

Although on sheet no. 12 there was a special text *Remarks on peculiar things in Bavaria*<sup>12</sup> concerning the occurrence of raw materials important for the economy of the country, it is hard to find it in the map content. While in the text, natural resources in the Kingdom of Bavaria were relatively abundantly listed, among others four-foot game animals, birds, fish, cultivated plants, including grains, herbs, ornamental shrubs and trees, and then it was written: ‘Nearly all ore: gold of the highest quality is in the district of Salzburg. Silver, copper, iron and other minerals like vitriol (copper sulphate, iron, sulphate and others), alum, sulfur, antimony, etc., in the area of Salzburg and at the river Regen and in the Upper Palatinate’<sup>13</sup>. Marble of

<sup>12</sup> The original: *Observatio Rerum Bavariae Insignum*.

<sup>13</sup> The original: METALLA fere omnia: Aurum probissimum in agro Salisburg. Argentum, cuprum, ferrum, et alia mineralia, vt vitriolum, alumen, sulphur, stibium etc., tum in Salisb. agro, tum ad Regenum fluium, et in Palatinatu superiori.

various types: including the most perfect, white, black, red and multi-color<sup>14</sup>. Glass and mirror factories common near the mountains of the Czech Forest<sup>15</sup>. Salt works were numerous, such as in Reichenhall, Halle near Salzburg and in the area of Berchtesgaden<sup>16</sup>. Hot springs such as Gastein: therapeutic water in Abbach, Göppingen [?], Wemding, Heilbronn Bur. [?] etc.<sup>17</sup>. The most perfect petroleum near the Tegernsee lake and monastery<sup>18</sup>. Natural sites – ‘mountains, forests, lakes, rivers; as well as buildings and towns (of which there are 34), strongholds 96, monasteries 72, castles, villages, houses, gardens and others’ (fig. 3) were listed as other items of wealth of the kingdom. As one can observe, in the *Remarks* mines

were not distinguished in any particular manner, but they were only placed among other goods in 16th century Bavaria.

Another map entitled *Principatus Silesiae Schwidnicensis secundum ejusdem Circulos Schweidnitz, Striegau, Bolckenhain-Landeshut et Reichenbach divisi et geometr. a I. W. Wieland geometrae et locumtenente dimensi exactissima tabula geographica ob praematuram mortem authoris denuo rectificata per Caesareum locumtenent: architect. militarem Matthaeu Schubarth* at a scale of approx. 1:125,000 included in *Atlas Silesiae* published by the Imprint of Homann's Heirs in 1750 also constitutes a suggestive example of the continuity of a similar manner to present geological



Fig. 3. “Remarks on peculiar things in Bavaria” on sheet no. 12 of the map by Ph. Apian, 1568

<sup>14</sup> The original: MARMORIS genera plura: eaque prestantissima, candida, nigra, rubra, et colore variegata.

<sup>15</sup> The original: OFFICINAE vitri et speculorum non paucae iuxta Bohemiae sylvam.

<sup>16</sup> The original: SALINAE complures, vt Reichenhalae, Halae Salisb. et in agro Berchtesgadensi.

<sup>17</sup> The original: THERMAE vt Gasteniae: aquae medicae Abacenses Göngkingenses (recte: Göppingenses ?), VVendingenses, Hailbrunae Bur. Etc.

<sup>18</sup> The original: PETROLEVM praestantissimum apud lacum et monast. Tegernsee.

features on general geographic maps for nearly two centuries.

While the legend of the 16th century map of Bavaria by Apian had only two distinctions of mines – ore mines and hot springs, in the legend of the 18th century map of the Duchy of Świdnica by Johann Wieland and Mattheus Schubart there were four such distinctions: silver, copper and iron deposits as well as mineral waters. The layout of explanations con-

cerning the mines in the legend remained unstructured and sign graphics – apart from a jug to mark places where water is collected – are random (fig. 4).



Fig. 4. A – a part of the legend, B – a part of the map *Principatus Silesiae Schwidnicensis* (Duchy of Świdnica), 1750 (the collection of the National Library of Poland in Warsaw)

More examples could be provided showing that until the second half of the 18th century raw materials on general maps were only marked in some places of their extraction and they were listed 'breathlessly' with other natural resources and anthropogenic objects. In the map content, a few geological objects were included, although knowledge about their occurrence was more detailed which is proved by *Remarks* on the map by Apian, however, rock formations were not shown yet which are typical for later geological maps.

#### 4. Mineralogical maps developed in the second half of the 18th century

In the middle of the 18th century during the age of enlightenment thematic maps based on developing knowledge within natural sciences turned out to be necessary to illustrate and explain various types of phenomena. Among them, geological maps were not the first ones with a strictly specified natural subject and content, but because they turned out to be helpful in solving important economic problems, more attention was drawn to presentation methods used on them. Data collected as a result of numerous field studies was arranged into systems with a scientific basis, extending geological knowledge in this way. Maps begun to be developed showing not only sites of extraction of raw materials, but also areas of various rock formations.

Maps determined today as mineralogical were also called geognostic or petrographic maps before. Such terms occurred in the titles of maps published in the second half of the

18th century, and later also in various scientific centres of Europe. Maps showed distribution of raw materials against topography graphically dominated by the geological content. Apart from the map title and content, explanations and texts about the occurrence of minerals accompanying the maps indicated their geological theme (H.M. Wallis and A.H. Robinson (1987, pp. 144–150).

As examples of the earliest geological maps, two basically different maps by a French physician, naturalist and geologist (a mineralogist to be precise) Jean-Étienne Guettard (1715–1786) were selected (P. Daszkiewicz, R. Tarkowski 2008, pp. 308–312). The older and more important map from the perspective of development of geological sciences was presented to the Academy of Sciences in Paris on the 19th of February 1746. In his lecture the author discussed the occurrence of minerals and rocks in the area of northern and central France, England and Wales, recognized during field studies initiated by the Academy. The aftermath of his lecture at the Academy was *Carte minéralogique où l'on voit la nature et la situation des terrains qui traversent la France et l'Angleterre Dressée sur les observations et pour un mémoire de Mr Guettard. Par Philippe Buache*<sup>19</sup> elaborated by a known French geographer and cartographer Philipp Buache (1700–1773)

<sup>19</sup> Map range 53°30' N, 45°40' S, 5°10' W, 5°10' E Greenwich.

made as a copperplate at a scale of approx. 1:2,760,000. The topographic base consists of a network of rivers, administration borders, towns and the terrain depicted with mounds<sup>20</sup>. The map was attached to the dissertation *Mémoire et carte minéralogique sur la nature & la situation des terrains qui traversent la France & l'Angleterre* and published in 1751 (with a date of 1746)<sup>21</sup> (J.-É. Guettard 1751, p. 392, pl. 32).

The map contains a legend entitled *Explication des Caractères* with 36 positions and another one entitled *Suite de l'Explication des Caractères* containing 46 position consisting of alphabetically arranged names of minerals and rocks. Their list starts with magnetite

*Fontaine Minérale...* and rocks such as granite *Granite*, gravel *Gravier*, marble *Marble*, as well as white rocks *Pierre Blanche*, blue rocks *Pierre Bleue*, black rocks *Pierre Noire*, also among others limestone rocks *Pierre Talqueuse*, sand *Sable*, metamorphic slate *Schiste*, kitchen salt *Sel Commun*, talc *Talc* and mercury *Vif Agent*<sup>22</sup> (fig. 5). Alphabetical arrangement of distinctions regarding rocks and minerals in the legend obviously does not explain their origin and co-occurrence. In the dissertation to which J.-É. Guettard attached the map there is no such information, either. The dissertation only describes the manner of observation and field studies and presents their results in the form of text.

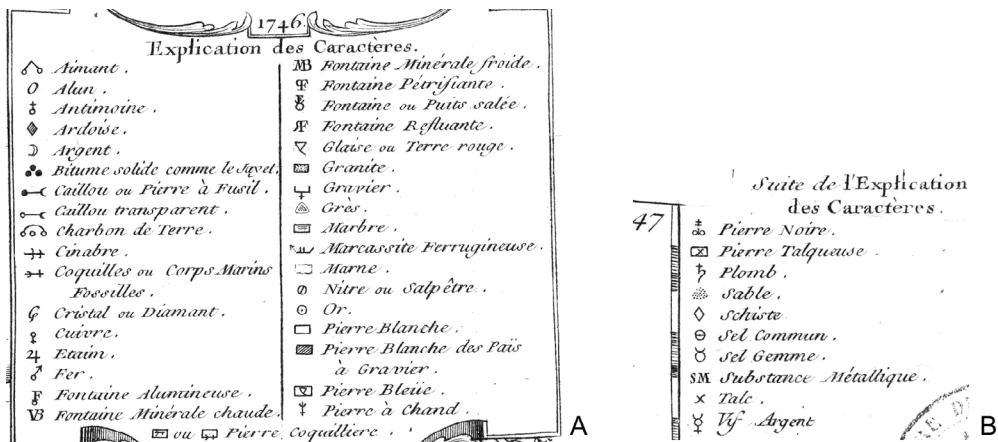


Fig. 5. The legend of the map by J.-É. Guettard *Carte minéralogique où l'on voit la nature et la situation des terrains...* printed in 1751 (the collection of the Bibliothèque nationale de France)

*Aimant*, and then among others the following were listed: antimony *Antimoine*, shales *Ardoise*, bitumens, carbon *Charbon*, fossilized shells of marine animals *Coquilles ou Corps Marins Fossilles*, mountain crystals *Cristal ou Diamant*, also copper ore *Cuivre*, tin and lead ore *Etain*, iron ore *Fer*, sources of various mineral waters

On the part of the map presented here (fig. 6) showing an area of France south of the lower course of the Loire River to the Sevre River, one can see numerous places of occurrence of natural resources, such as shales *Schiste* (roofs of most houses in the Loire region were covered with it), limestone rocks *Pierre Talqueuse* and granite *Granite* used as a construction material e.g. to build fortified castles.

<sup>20</sup> The original: M. Blauche, dont les connaissances de la Géographie phisique, sont assi étendues que celles qui'il a de la Géographie topographique, a bien voulu se charger de cette construction.

<sup>21</sup> A.J. Wójcik (2012, p. 175, fig. 2) presents another map printed with the same dissertation *Carte minéralogique où l'on voit la nature du terein d'une portion de l'Europe*.

<sup>22</sup> The presented translation of the names of rocks as well as their original names should be currently treated as common names and not as official geological terms (e.g. the term "blue rocks" is used to name approx. 20 different types of rocks).

Showing distribution of raw materials using simple geometric symbols provides only the approximate location of deposits and in such a generalized manner also in the text their occurrence in the area of north-west provinces of France and counties of England and Wales was described. The narration was arranged in the order of J.-É. Guettard's journeys in the regions of France, starting from Poitou, Maine

on the 22nd of December 1762<sup>23</sup>. The topographic base consists of a river network, administration borders, towns and the terrain depicted with mounds. Although its title and the title of the dissertation accompanying it suggest that raw materials were presented, the geological information about minerals in the area of Poland on the map is very modest. In the area of norther and central Poland only



Fig. 6. A part of the map by J.-É. Guettard, 1751 presenting natural resources in the area between Loire River and Sèvre River

and Normandy, later through the central provinces from Île de France and eastern provinces to Champagne and Burgundy. After pointing out the hills in the areas of the Havre and Dieppe ports, discussion on the rocks and minerals in the area of England was commenced which was also laconic and it focused mainly on signaling the distribution of useful minerals without characterizing their reach, abundance, etc.

The second later mineralogical map by J.-É. Guettard is *Carte Minéralogique de Pologne*. The map at a scale of approx. 1:4,400,000 (R. Fleszarowa 1962, p. 79) was printed using the copperplate technique and published in the dissertation entitled *Mémoire sur la Nature du Terrain de la Pologne et des Minéraux qu'il renferme. Seconde Partie* based on the lecture given at the Academy of Sciences in Paris

sand formations *bande sablonneuse* were shown marked with a dot pattern, and in Podkarpacie (Subcarpathia) – salt formations *bande saline* marked with a line pattern (fig. 7). The map does not have any legend, and the other two formations distinguished in the text: marl [*bande*] *marneuse* and containing metals [*bande*] *métallique*<sup>24</sup> were not shown on the

<sup>23</sup> J.-É. Guettard, *Mémoire sur la Nature du Terrain de la Pologne et des Minéraux qu'il renferme*, in: „Histoire de l'Académie Royale des Sciences”, after 1762, ed. 1764, Première Partie, pp. 234–257, Seconde Partie, pp. 293–336, pl. I–VI and the map. In the same yearbook also *Mémoire sur les Mines de sel de Wieliczka en Pologne*, pp. 493–516, pl. 28 *Carte des Mines de sel de Wieliczka*.

<sup>24</sup> The original: En suivant ces principes, je peux diviser la Pologne en quatre grandes parties ou bandes: savoir, en bande sablonneuse, marneuse, saline & schitteuse ou métallique (J.-É. Guettard, Première Partie, p. 236).

map. To present geological matters the surface method was selected, but only 2/3 of Poland was considered. The two rock formations were shown in a very general way, without marking places where salt and any other raw materials are extracted (R. Fleszarowa 1962, p. 79; S. Wołkowicz et al. 2009, p. 5).

As it can be seen on figure 7, there is no information about other useful minerals extracted for ages in Poland which have great economic significance other than salt and sand on the map. They include flint deposits (among others in the area of Ostrowiec Świętokrzyski), iron ore (mainly in the Świętokrzyski Region), natural dyeing ram materials (Polish highlands), construction stones: in the north – glacial boulders, in the south – limestone and sandstone, and in central and northern Poland – clays to fire bricks as well as clays to produce pots and other items (Z. Wójcik 1992, p. 34 and Z. Wójcik 2000, pp. 12–19)<sup>25</sup>.

In comparison to the discussed map of France and England, such modest information about Polish minerals are not understandable, in particular in light of quite abundant literature on the subject, among others included in the encyclopedia by Gabriel Rzączyński entitled *Historia naturalis curiosa Regni Poloniae...* published in 1721 (Z. Wójcik 1992, p. 35<sup>26</sup> and S. Wołkowicz, K. Wołkowicz 2014, p. 624) referred to by J.-É. Guettard on the first page of his dissertation (J.-É. Guettard 1764, *Premiere Partie*, p. 234). Materials collected by this French geologist during his two-year stay in Poland and the journey he undertook as an expert in metal mining was also abundant (Z. Wójcik 1992, p. 44; R. Tarkowski 2005 pp. 41–45 and R. Tarkowski, P. Daszkiewicz 2010, pp. 63–68). In his published two-part dissertation *Mémoire sur la Nature du Terrain de la Pologne et des Minéraux qu'il renferme* on sixty-six pages the author described mineral resources in a much more specific way than shown on the map. The text is well-assessed by Polish historians of geological sciences (among others Zbigniew Wójcik, Regina Fleszarowa, Radosław Tarkowski and Piotr Dusz-

kiewicz) as bringing new knowledge about the geological structure and raw fossil materials in Poland as well as, inspiring for further field observations. It seems that the map did not manifest the level of the contemporary knowledge of the geological resources of Polish lands due to its very general nature.

There were two maps from the area of Czech developed by a royal survey engineer<sup>27</sup> Johann Jirasek (1754–1797): a map of the area between Prague and Pilsen<sup>28</sup> and a map of Czech and Silesian Karkonosze (Giant Mountains), which were developed later than the discussed mineralogical maps by J.-É. Guettard.

The earlier mineralogical map entitled *Petrographische Karte derer Kammeral-Herrschaften Zbirow, Toczniok, Königshof, Miroschau und Wossek*<sup>29</sup> at the scale of 1:100,000 made using the copperplate method was attached by Jirasek to his dissertation *Versuch über die Naturgeschichte einigen in Berauner Kreise gelegenen Kammeral-Herrschaften, besonders Zbirow, Toczniok...*<sup>30</sup> published in 1786. The topographic base consists of rivers, administration borders, towns and the relief presented by hachuring. As shown by the legend in the bottom right corner (fig. 8) on the map the following rocks and minerals were marked with signs and colors: jasper *Jaspis*, porphyry *Porphir*, breccias *Breccia*, iron ore *Eisenerze*, flint *Petro-silex*, quartz *Qwarz*, chert *Hornschief*, limestones *Kalchst.[ein]*, sandstones *Sandst [ein]*, shales *honschiefer*, graves and sandstones *Sandschutter*, clays *Thorn u[nd] Leimen*. In the second legend (upper left corner of the map) to typical explanations of topographic characters, explanations of symbols meaning: mines of iron ore, limonite swamp ore, jasper and agate, granite, hard coal (J. Kozák et al. 2016, p. 27) and color clay (*Bolar Erde*, in Latin terra bolaris – used for gold decorations and layouts in painting) were added.

<sup>27</sup> Entry on the map of Czech and Silesian Karkonosze: Johann Jirasek Konigl. Landesingenieur.

<sup>28</sup> Discussed based on a copy stored in Narodni knihovna ČR in Prague.

<sup>29</sup> Currently Zbiroh, Točník, Krusovice, Mirošov and Osek.

<sup>30</sup> Dissertation in: *Abhandlungen der Böhmischen Gesellschaft der Wissenschaften auf das Jahr 1786 nebst der Geschichte derselben mit Kupfern*. Prag und Dresden 1786 in der Waltherische Hofbuchhandlung, chapter VI, pp. 60–106, map.

<sup>25</sup> These and other minerals were described in the dissertation which is broadly discussed by Regina Fleszarowa (1962, pp. 80–84).

<sup>26</sup> Encyclopedia by Gabriel Rzączyński contains approx. 500 references to works of different authors.



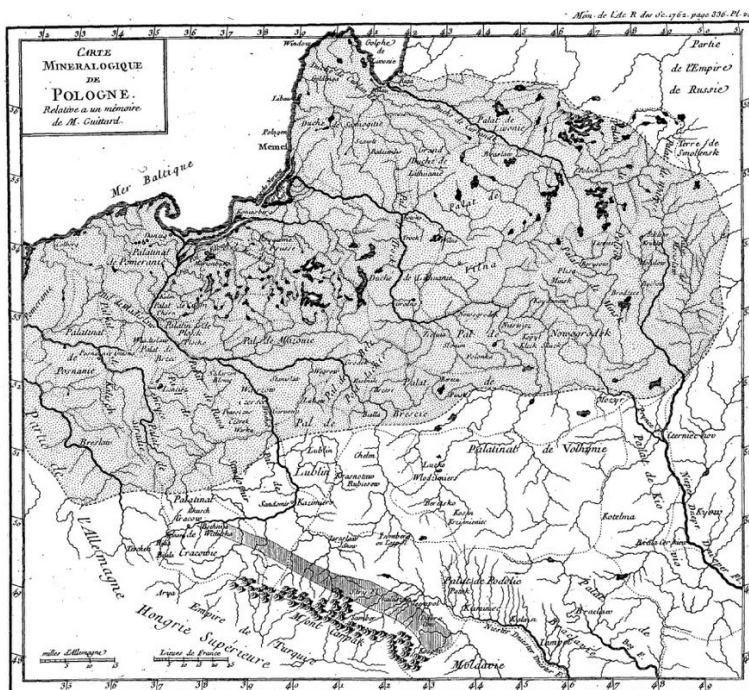


Fig. 7. Map Carte Minéralogique de Pologne by J.-É. Guettard, 1764

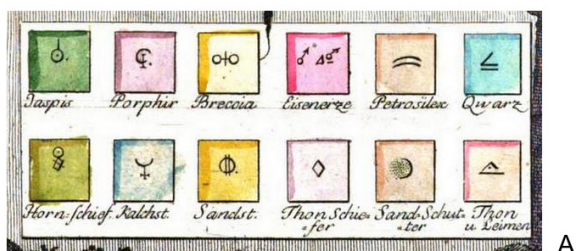


Fig. 8. A – the legend placed in the right upper corner of the map *Petrographische Karte derer Kammeral-Herrschaften Zbirow...* by J. Jirasek, B – a part of the map where on the upper left – side limestone rocks were marked and in the lower left corner – iron ore and the mine, and in the center on a larger area – flints *Petrosilae* (the collection of the Narodni knihovna ČR in Prague)

While in the dissertation entitled *Versuch über die Naturgeschichte einiger im Berauner Kreise gelegenen Kammeral-Herrschaften...*, to which the discussed map was added, there is a lot of information about extraction of particular raw materials, both marked on the map and not marked, e.g. *Terre rubra Solaris* (J. Jirasek 1786, p. 66). In the text, there is also a lot of information about the natural character, e.g. about the occurrence of wild animals, e.g. mice, bears, wolves and lynx (J. Jirasek 1786, p. 82). The text also includes demographical data, such as population of a given area<sup>31</sup>. The dissertation is about nature and geography, information about raw materials does not dominate in it.

The second map by J. Jirasek is an image of the Bohemian and Silesian Karkonosze entitled *Petrographische Charte eines Theils de Böhmisches Riesengebirges an der Schlesischen Gränze* at a scale of approx. 1:82,600 in western orientation. It was also made using the copper-plate method and published with the dissertation entitled *Die mineralogischen Bemerkungen auf einer Reise nach dem Riesengebirge in 1791*<sup>32</sup>. The topographic base consists of rivers, administration borders, towns and relief presented by hachuring. Like in the case of the previous map, J. Jirasek provided abundant information about minerals. The legend of the map *Erklärung der Farben u. Zeichen* contains less distinctions than the legend of the previous map. It consists of: occurrence of granites *Granit* on the surface (red), gneisses *Gneus* (green), mica slate *Glimerschiefer* (yellow), limestones *Kalk* (blue) and shales *Thon schiefer* (grey) (J. Kozák et al. 2016, p. 33; M. Graniczny et al. 2006, p. 761, map<sup>33</sup>; S. Wołkowicz 2009, p. 5, map; S. Wołkowicz 2016, pp. 362–363, map). On the map places of their extraction can be seen (fig. 9).

The text by J. Jirasek entitled *Die mineralogischen Bemerkungen auf einer Reise nach*

*dem Riesengebirge*, accompanied by the map was included in a collective work and – as indicated by its title – it was created based on observations made during his expedition to the Karkonosze initiated by the Royal Czech Society for Science and Art. Particular chapters concern matters in the field of botany, physical geography, meteorology and ethnography. Geological matters, i.e. in this case the occurrence of various minerals and rocks, J. Jirasek discussed according to the regions he visited subsequently. Rocks occurring on the surface of mountain ranges and particular mountains on which studies were conducted were described; it was written e.g. in the following manner: ‘The mountains of the Heidelbach and Weißwasser rivers are of granite in various variants’<sup>34</sup> – they were marked red on the map. Of the two names listed, on the map only the *Weiswasser* River was placed which separates areas of granites (in the north) from areas of gneisses (in the south). Another example: the rocks in the area along the banks of the upper Elbe River were marked as gneisses or mica slates<sup>35</sup>, using green.

Despite a clear indication to the mineralogical theme in the title *Die mineralogischen Bemerkungen...* (Mineralogical remarks ...), in the dissertation by J. Jirasek, apart from information about the geological structure of the Karkonosze, also numerous curiosities within the field discussed can be found, e.g. ‘in the countertrade of coffee and butter with Silesia, mainly linen canvas is used; by the way life here is very simple, however it seems to be very cheerful’<sup>36</sup>.

## 5. Conclusions

For centuries data concerning found and extracted minerals was included on general geographic maps among other elements of the

<sup>31</sup> E.g. the original: im Jahre 1784 war auf der Kammeralherrschaft Zbirow von 8496 Menschen (J. Jirasek 1786, p. 63).

<sup>32</sup> In collective work: *Beobachtungen auf Reisen nach dem Riesengebirge*, von Johann Jirasek, Abbé Gruber, Thaddäus Haenke, Franz Gerstner, veranstaltet und herausgegeben von der Königl. Böhm. Gesellschaft der Wissenschaften. Erste Abtheilung, pp. 3–30, map.

<sup>33</sup> Only two copies known to me in K.K. Hofbibliothek Österr. Nationalbibliothek in Vienna and in the collections by S. Wołkowicz maintained colors separating areas of the occurrence of rocks; in other the paint has faded.

<sup>34</sup> The original: Die Gebirge von Heidelbach und Weißwasser sind Granit in verschiedenen Abänderungen (J. Jirasek 1791, p. 13).

<sup>35</sup> The original: Von Bumersdorf bis Hohen=Elbe ist abwechselnd Gneuß und Glimmerschiefer (J. Jirasek 1791, p. 26).

<sup>36</sup> The original: Die Hauptnahrung ist die Flachsspinnereien, sodann der Käfe und Butterhandel nach Schlesien; übrigens lebt das Volk sehr einfach, wobei es dennoch ungemein vergnügt scheint (J. Jirasek 1791, pp. 28–29).

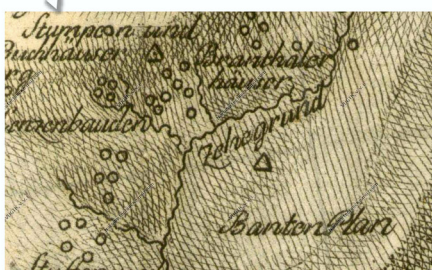
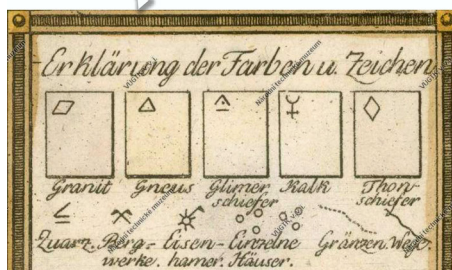
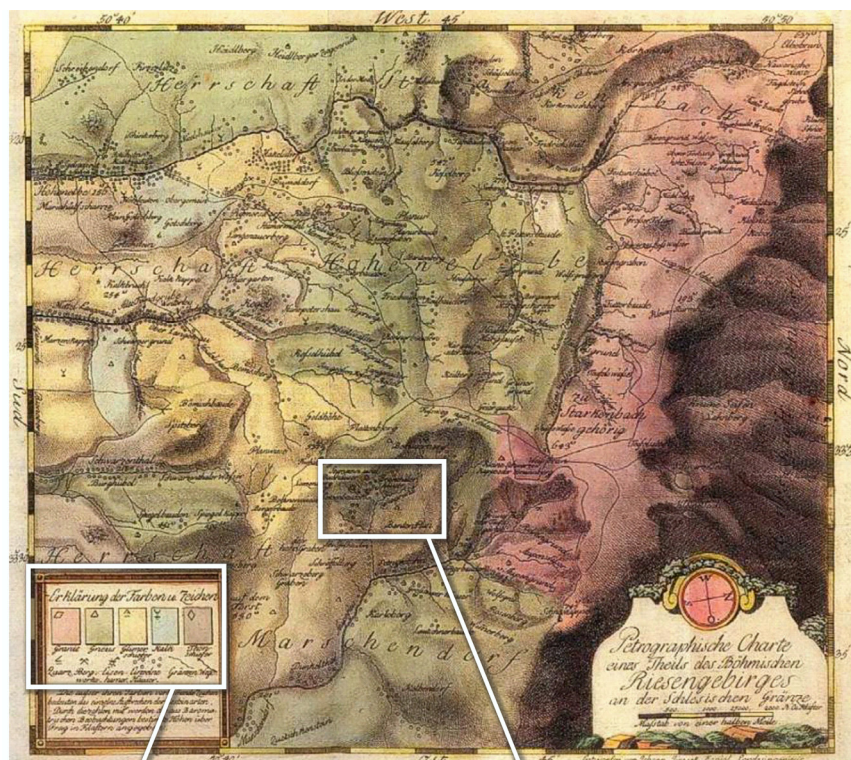


Fig. 9. A – the legend placed in the lower left corner of the map *Petrographische Charte eines Theils de Böhmisches Riesengebirges an der Schlesiſchen Gränze* by J. Jirasek, 1791, B – a part of the map with two extraction places of gneisses *Gneus* (triangles) and single houses (circles) marked (the collection of the Národní technické museum in Prague)

geographical content. Initially such places were not precisely marked as they were only indicated using textual descriptions. From the Renaissance to the half of the 18th century the occurrence of minerals was marked using the method of symbols and only on mineralogical maps using the surface method – information about rock formations and the reach of their occurrence was added.

In the case of both mineralogical maps by Johann Jirasek, comparison of their content with the content of texts accompanying them does not indicate indispensability of the maps. Reading these texts one could expect other thematic maps in the field of natural sciences just as much. Texts by Jean-Étienne Guettard contain more information about raw materials. His maps vary significantly: the map of France

and England brings very specific information about minerals, while the map of Poland contains only two rock formations, however places of extraction of rocks or minerals are not marked.

The task of geological maps published until the end of the 18th century was most of all to show minerals and rock formations. Symbols used on the maps to mark places of extraction of raw materials took the form of simple signs with rather random shapes which may indicate unhurried development of the geological cartography methods. Explanations included on the maps show a gradual increase in the scope and systematization of geological knowledge which was confirmed by the parts of extensive texts accompanying the maps referred to.

A characteristic of geological maps developed in the second half of the 18th century was the

shaping of the content based on information from field observations and connecting areas into formations based on the similarity of rocks occurring there. Despite numerous field studies, information on geological maps has changed only quantitatively, and not qualitatively. While, establishment of a chronological order of formations based on fossils and attempts to reproduce the geological history of particular regions and continents were commenced several years later. The following stage of development of the geological map content was the appearance of information about stratigraphy at the beginning of the 19th century, and then maps of geological phenomena as well as maps based on theories of landscape origination and evolution.

## Literature

- The Borgia World Map*, PDF <http://www.myoldmaps.com/late-medieval-maps-1300/237-the-borgia-map-pamundi/237-borgia.pdf>, w: <http://www.myoldmaps.com/> Established 1994 (Henry Davis Consulting), re-establish 2010, last updated: 12 November 2016 (access 18.04.2017).
- Cartographical Innovations. An International Handbook of Mapping Terms to 1900*, 1987. Ed. by Helen M. Wallis and Arthur H. Robinson. The International Cartographic Association. London: Map Collector Publications.
- Czerny A., 2015, *Powstanie i etapy rozwoju map topograficznych do końca XIX wieku*. In: *Dawne mapy topograficzne w badaniach geograficzno-historycznych*, Lublin, pp. 11–83. <http://phavi.umcs.pl/at/attachments/2016/0708/103742-czerny-dawne-mapy-07-07-low-res.pdf> (access 18.04.2017).
- Daszkiewicz P., Tarkowski R., 2008, *Biblioteka i bibliograficzne źródła Jean-Étienne Guettarda – nowe dane na temat historii badań przyrodniczych w Polsce*. „Przegląd Geologiczny” T. 56, nr 4, pp. 308–312.
- Fleszarowa R. 1962, *Najstarsza mapa geologiczna i najstarszy opis geologiczny Polski. Dwóchsetciecie*. „Studia i Materiały z Dziejów Nauki Polskiej, Seria C: Historia nauk matematycznych, fizyko-chemicznych i geologiczno-geograficznych” Z. 5, pp. 79–86.
- Graniczny M., Kacprzak J., Urban H., 2006, *Mapy geologiczne ziem polskich w XVIII i pierwszej połowie XIX wieku*. „Przegląd Geologiczny” T. 54, nr 9, pp. 759–763.
- Guettard J.-É., 1751, *Mémoire et carte minéralogique sur la nature & la situation des terrains qui traversent la France & l'Angleterre*. In: „Histoire de l'Académie Royale des Sciences”. Année de l'DCCXLVI..., pp. 363–392, pl. 32.
- Guettard J.-É., 1764, *Mémoire sur la Nature du Terrain de la Pologne et des Minéraux qu'il renferme*. In: „Histoire de l'Académie Royale des Sciences”. Année M.DCCLXII..., Première Partie, pp. 234–257, Seconde Partie, pp. 293–336, pl. I–VI and a map. *History of Cartography. Volume One. Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean*, 1987. Ed. by J.B. Harley, D. Woodward. Chicago: University of Chicago Press.
- Jirasek J., 1786, *Versuch über die Naturgeschichte einigen in Berauner Kreise gelegenen Kammeral-Herrschaften, besonders Zbirow, Tocznik, Königshof, [...] Miroschau und Wossek*. In: *Abhandlungen der Böhmischen Gesellschaft der Wissenschaften auf das Jahr 1786 nebst der Geschichte derselben mit Kupfern*. Prag und Dresden, in der Waltherische Hofbuchhandlung, chapt. VI, pp. 60–106, one map.
- Jirasek J., 1791, *Die mineralogischen Bemerkungen auf einer Reise nach dem Riesengebirge* von Johann Jirasek, Landes Ingenieur. In: *Beobachtungen auf Reisen nach dem Riesengebirge*, von Johann Jirasek, Abbé Gruber, Thaddäus Haenke, Franz Gerstner, veranstaltet und herausgegeben von der Königl. Böhm. Gesellschaft der Wissenschaften. Erste Abtheilung, pp. 3–30, one map.
- Jodłowski A., Walczy Ł., Gawroński W., 2005, *Obrazy Żupy Wielickiej i miasta Wieliczki na mapach Wilhelma Hondiusa z 1645 roku*. „Zabytki Polskiej Kartografii” Z. 9, Warszawa: Biblioteka Narodowa.
- Kozák J., Čejchanová A., Kukul Z., Pošmourný K., 2016, *Early Geological Maps of Europe. Central Europe 1750–1840*. Cham: Springer.
- Szaniawska L., 1981, *Mapa jako dokument wiedzy o Afryce w dobie odrodzenia*. „Studia i Materiały z Historii Kartografii” T. 2, Warszawa: Biblioteka Narodowa.

- Tarkowski R., 2005, *Nowe materiały dotyczące podróży przyrodnika francuskiego J.-E. Guettarda do Polski (1760–1762)*. „Przegląd Geologiczny” T. 53, nr 1, pp. 41–46.
- Tarkowski R., Daszkiewicz P., 2010, *Badania geologiczne Jeana-Etienne Guettarda w Rzeczypospolitej (1760–1762)*. „Przegląd Górniczy” T. 66, nr 1-2, pp. 63–68.
- Wołkowicz S., Wołkowicz K., Miecznik J., 2009, *Kartografia geologiczna ziem polskich do roku 1919. Katalog wystawy*. Warszawa: Państwowy Instytut Geologiczny.
- Wołkowicz S., Wołkowicz K., 2014, *Geological cartography in Poland in the 19th century*. „Geological Quarterly” Vol. 58, no. 3, pp. 623–658.
- Wołkowicz S., 2016, *Ewolucja map geologicznych Dolnego Śląska na przykładzie bloku karkonosko-wizerskiego*. „Biuletyn Państwowego Instytutu Geologicznego” 466, pp. 361–376.
- Wójcik A.J., 2012, *Ewolucja europejskiej kartografii geologicznej do początków XX w.* „Analecta” T. 1-2, pp. 173–202.
- Wójcik, A.J., *Historia nauk geologicznych*. In: *Historia nauki o Ziemi*, pp. 293–333. <http://www.orenji.jawnet.pl/NAUKI%20O%20ZIEMI.pdf> (access 22.04.2017).
- Wójcik A.J., *Zarys historii kartografii*. In: *Historia nauki o Ziemi*, pp. 338–375. <http://www.orenji.jawnet.pl/NAUKI%20O%20ZIEMI.pdf> (access 22.04.2017).
- Wójcik Z., 1992, *Znajomość ważniejszych kopalin na ziemiach polskich w epoce Oświecenia*. „Kwartalnik Historii Nauki i Techniki” T. 37, z. 2, pp. 33–66.
- Wójcik Z., 2000, *Oświeceniowe koncepcje stratygrafii geologicznej w Polsce*. „Prace Komisji Historii Nauki Polskiej Akademii Umiejętności” T. 2, pp. 5–19.