

# The first large geological map of Central and Eastern Europe (1815)

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The first large geological map of Central and Eastern Europe was compiled by Stanisław Staszic in the early 19th century. The map is based on the geological survey that Staszic performed in different parts of Poland and adjacent areas. In 1814, Staszic presented his ideas on the geology and mineral sources of Poland and Lithuania. In 1815, he completed the book-length descriptive analysis *O ziemi i mineralach Karpatów i innych gór i równin Polski przez Stanisława Staszica*, which was published in Warsaw and complemented by a large geological map of Central and Eastern Europe. His later studies were compiled in a historico-philosophical treatise titled *Ród ludzki* (1819–1820). The complete edition of Staszic's works, *Dzieła*, which also included these publications, appeared over 1816–1820.

The geological field survey that he performed over several years, and his study of social-economic problems enabled Staszic to draw in great detail a geological map of the Carpathians, the Central Polish Highlands, Volhynia (modern Ukraine) and the Eastern Alps, as well as the areas of the Polish–Lithuanian Lowlands, the southern coast of the Baltic Sea, Polesye (modern Belarus), Moldova, Transylvania, and Hungary. Staszic was interested in the exploration of mineral deposits, particularly in Poland, which had rock salt, copper and iron ores, and coal. In his monograph and map, he adopted a stratigraphic subdivision based on types of rock contents and organic fossils, which was a slightly modified version of Werner's classification system. The lithological legend sets five classes and 135 different types of rock, and 15 types of ore deposits, using the French names for these. In general, Staszic was an advocate of Werner's paradigm; however, he did not follow exactly the ideas of the German geologist.

Staszic's fundamental work recapitulates his views on geological history of Central and Eastern Europe, and brings to an end the Enlightenment period in the geology of that part of Europe.

**Key words:** Stanisław Staszic, geological cartography, Central and Eastern Europe

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## INTRODUCTION

The goal of this paper is to present the first large geological map of Central and Eastern Europe, which was created by Stanisław Staszic in the early 19th century. This map is significant to the development of European geology and geological cartography, but it is still little known to Lithuanian readers. Unsurprisingly, after its publication in 1815, and over the next two centuries, Staszic's monumental work was discussed by numerous Polish authors, including W. Zawadzki (1860), T. Wiśniowski (1915a, 1915b), Cz. Leśniewski (1926, 1931 ed.), W. Goetel (1955), and Z. Wójcik (1999, 2006; for a complete list see Wójcik, 2005). However, nearly all of the more than 350 articles were published in Polish, and, as Wiśniowski observed, "[...] not that many foreign geologists have read *Ziemięrodztwo in the original*" (1915a, p. 36).

Stanisław Staszic was born on 6th November 1755 in the small town of Piła, Western Poland<sup>1</sup>, where his father had a land and for a time was the mayor. A priest, geologist, educator, and philosopher, Staszic was an outstanding geoscientist, president of the Society of Friends of Sciences in Warsaw from 1808 to 1826, a patron of sciences and arts, and a Minister of State (Fig. 1). He died on 20 January 1826 in Warsaw at the age of 71. An old family house still exists in the centre of the town Piła and is now the Staszic Museum.

Staszic studied theology in Poznań from 1770 to 1778 and natural sciences from 1779 to 1781 at the Collège de France in Paris. In the French capital he met G. L. L. Buffon whose monograph *Les époques de la nature* (1778) he translated into

<sup>1</sup> At that time a little town Schneidemühl, West Prussen.



Fig. 1. Stanisław Wawrzyniec Staszic. A lithograph made by Adam Grabowski. Warsaw, 1917

1 pav. Stanisławas Wawrzynecas Staszicas. Adamo Grabowskio litografija. Varšuva, 1917

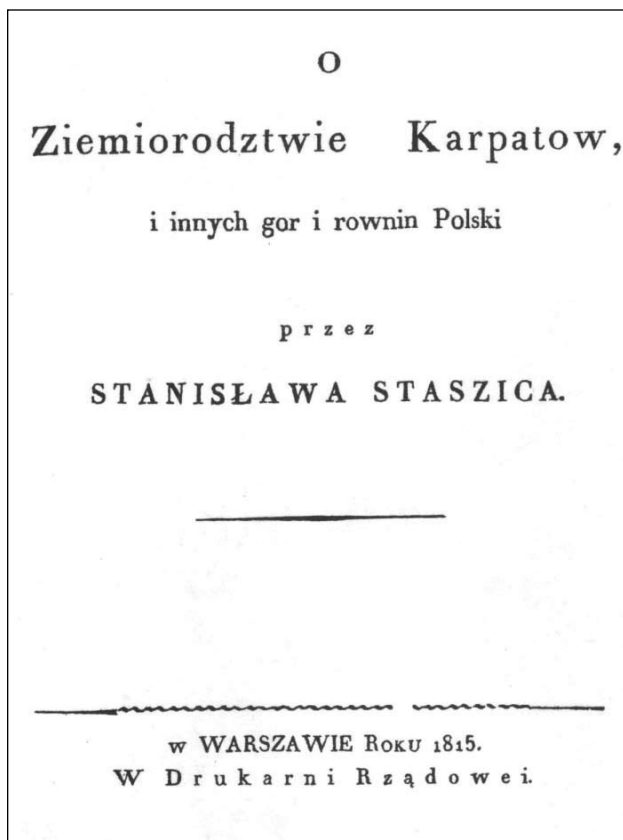


Fig. 2. Title page of S. Staszic's monograph *O ziemiordztwie Karpatów i innych gór i równin Polski*, Warszawa, 1815

2 pav. S. Staszico monografijos *Apie Karpatų ir kitų Lenkijos kalnų ir lygumų žemės kilmę* titulinis lapas. Varšuva, 1815

Polish and published in Warsaw in 1786. After leaving Paris in 1781, Staszic decided to conduct geological studies of Poland in a larger regional context, by visiting France, Italy, and Austria. Upon returning home he was employed as a tutor for the noble Zamoyski and Sapieha families. In 1783, he was awarded a doctorate in civil and canon law at the Zamoyski Academy.

From 1805 to 1809, carrying out his geological surveys, Staszic presented his first report, *O ziemiordztwie gór dawniej Sarmacji, a później Polski*<sup>2</sup> at a meeting of the Society of Friends of Sciences in Warsaw on 13 December 1805 (Staszic, 1806). The report gave a description of the Polish Lowlands, the Łysogóry Belt, and part of Beskidy and Bielawy. In particular, he noted that the country presents an endless lowland stretching from the lower coast of the Baltic Sea through Lithuania up to Volyn' and Kyiv, covered with clay, pebbles, stones, sand, and marls, and crisscrossed by many lakes.

Over 1806–1809 Staszic produced four new reports devoted to the geology of various regions of Poland and adjacent areas (see Wójcik, 2005, p. 11). In 1814, he presented his thoughts on geology and mineral sources at the meeting of the Society of Friends of Sciences in Warsaw, where he talked about his studies on geology of Poland and Lithuania:

*"The sources of all the resources of our country are the Earth, time, and work. Thus there is an urgent need to enrich knowledge on our territory. Geology is the primary part of the philosophy of nature, a supplement to the physics of the Earth. The country that possesses detailed geognostic knowledge of its territory may look optimistically toward its future"* (Wójcik, 1999, p. 105).

In 1815, Staszic composed his reports into a monograph-length description entitled *O ziemiordztwie Karpatów i innych gór i równin Polski przez Stanisława Staszica*, which he published in Warsaw<sup>3</sup>, together with the first large geological map of Central and Eastern Europe (Fig. 2). His later studies were compiled into a historic-philosophic treatise *Ród ludzki*<sup>4</sup> (1819–1820). A complete edition of Staszic's works, *Dzieła, Tom I–IX*, which includes these two studies, appeared over 1816–1820. Selected works of S. Staszic were published in Moscow in 1951 (Сташиц, 1951).

#### CARTA GEOLOGICA: THE AREA BETWEEN THE BALTIC AND BLACK SEAS

Based on a geological field survey that he performed over several years, and on his study of social-economic problems, Staszic mastered in the utmost detail the geology of different Central European regions, in particular the Carpathians, the Central Polish Highlands, Volhynia (modern Ukraine) and the Eastern Alps, with which he was well acquainted. His monograph and geological map also included the less-studied Polish–Lithuanian Lowland<sup>5</sup>, the southern coast of the Baltic Sea, Polesye (modern

<sup>2</sup> Engl. title: "On geology of the mountains of ancient Sarmatia and later Poland".

<sup>3</sup> Engl. title: "On geology of the Carpathians and other mountains and lowlands of Poland".

<sup>4</sup> Engl. title: "The Human Race".

<sup>5</sup> After Cz. Leśniewski (1931), the east-northern margins of points described by Staszic during his travels were limited by Drohiczyn, Siemiatycze, Lublin, Lubartow (15 July – 12 August 1799), and later Wisnice–Radzyn–Łuków (28 November 1803–?); Polesye was well known to him, also vicinities of Mława (Zamoyski's estate Biezuń) in Mazury.

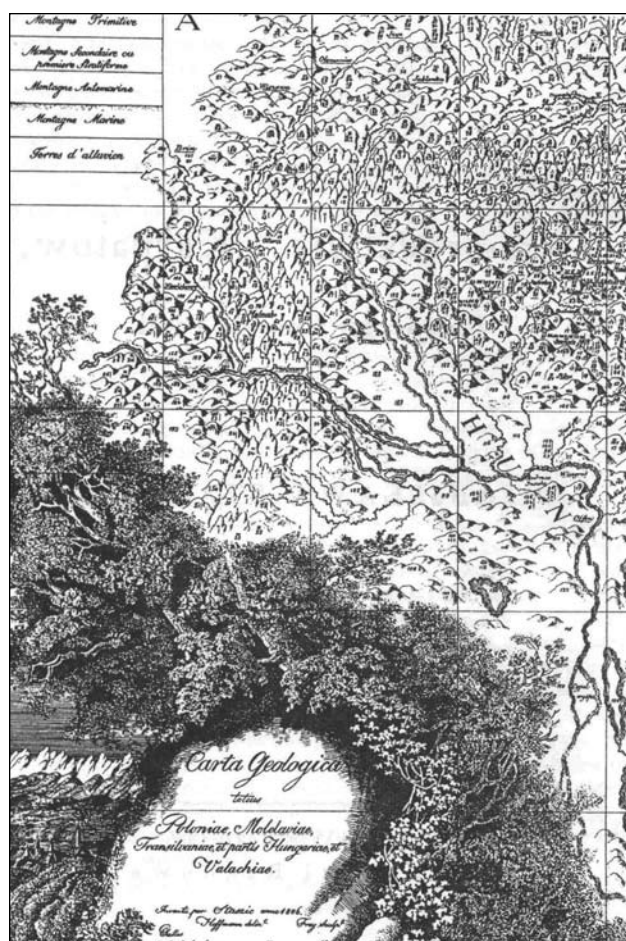


Fig. 3. Splendid vignette and southwestern part (sheet A) of the *Carta Geologica*, showing the central part of the Western Carpathians; stratigraphic chart shows definite geological formations and their colours

3 pav. Puošni S. Staszico *Carta Geologica* vinjetė ir pietvakarių lapas (A), vaizduojantis vidurinę Vakarų Karpatų dalį; stratigrafinėje legendoje išskirtos geologinės formacijos ir jų spalvos

Belarus), Moldova, Transylvania and Hungary. Staszic was interested in the exploration of mineral deposits, particularly in Poland, which had rock salt, copper and iron ores, and coal. He was also interested in tectonics: on the basis of rock types and palaeontological data, he sought to determine the depth of these deposits, particularly those of rock salt.

The edition of Staszic's geological monograph *On the geology of the Carpathians and other mountains and lowlands of Poland* (1815) is complemented by the map entitled *Carta geologica totius Poloniae, Moldaviae, Transilvaniae, et partis Hungariae, et Valachiae. Inventa per Staszic anno 1806. Hoffmann delin. Frey Sculpt.*<sup>6</sup> (hereafter *Carta Geologica*). At the time this was the largest published geological map of Central and Eastern Europe, covering c. 1,000,000 km<sup>2</sup>, supplemented by a detailed monograph-length description of the area under study (Czarniecki et al., 2008). The map was originally printed on 4<sup>4</sup> folio sheets, lettered counterclockwise by A, B, C, and D, between

<sup>6</sup> Cited after a fully completed edition published in *Dziela Stanisława Staszica*. Tom trzeci [Warszawa], [1816], 390 pp., I–X, ill., coloured maps. [Stored in the Central Library of Vilnius University; three non-coloured copies of the atlas are stored also in the Library of the Lithuanian Academy of Sciences]. – AG.

33°–52°E–45°–55°N; every sheet is 66 × 47.5 cm in size, with a scale of approx. 1:1 182,000 (Wiśniowski, 1915a, p. 11; Wójcik, 1979, p. 54)<sup>7</sup>. The map was printed in Warsaw on special paper with the watermark *J. Hömig und Zoonen*; it is hand-colored, although some versions of it are not colored.

Sheet A, showing the southwestern quadrangle, presents the mountainous area of the western Carpathians and contains a nicely decorated map title (vignette) and a stratigraphic table of the formations depicted (Fig. 3). Sheet B, showing the southeastern quadrangle, presents the area north of the Danube River, extending to the Tartaria Minor desert on the Black Sea coast. Sheet C, showing the northeastern quadrangle, presents the lowland area of the Russian plain up to the Kyiv–Smolensk line. Sheets B and C contain the map legend. Sheet D, showing the northwestern quadrangle, presents the Polish–Lithuanian lowland area bordering on the Baltic Sea.

The individual colors on the map show the definite stratigraphy of the geological formations. The different rock types and mineral raw materials, strikes, dips of beds, and measured altitudes of elevations are labeled by number. The mountains are presented as tumuli, but special altitude signs (dashes, dots) are used. The topographic background is limited to schematically presented hydrography. The names of the more important localities are given, but their localizations are approximate.

## STRATIGRAPHY CONTENTS

In the monograph, Staszic adopted a stratigraphic subdivision based on the type of rock contents and organic fossils, and modified slightly from Werner's classification (see Fig. 3). The legend presents a fivefold classification, 135 different kinds of rocks, and 15 kinds of ore deposits, using the French names for these. The terms on the map legend are given in French but explained in the monograph in Polish (Staszic, [1816], p. VII–VIII):

1. The term *montagne primitive* represents monolithic, non-bedded primary rocky blocks that are not intercalated with rocks of other type. These are shown in white, with 9 symbols in the legend, which recently correspond to pre-Cambrian magmatic and younger metamorphic rocks.
2. The term *montagne secondaire ou primitive stratiforme* represents bedded rocks composed of different rock types and containing no traces of vegetable and animal remains; these are colored pink and consist of 58 symbols, recently corresponding to the Cambrian–Devonian periods.
3. The term *montagne antemarine* is used for intermediate rocks between the secondary and marine rocks, which often form the basement of the latter mountains. These are colored light yellow and consist of 20 symbols, recently corresponding to the Carboniferous–Permian periods.
4. The term *montagne marine* refers to rocks deposited in a marine environment and abounding in various mollusks and other animals which still live in the seas. These are colored blue and consist of 18 symbols, recently corresponding to the Mesozoic eratheme and Tertiary period.

<sup>7</sup> J. Satkūnas & G. Žalūdienė (2007) erroneously pointed the size of the map to be 636 × 454 mm, and the scale 1:4,000,000.

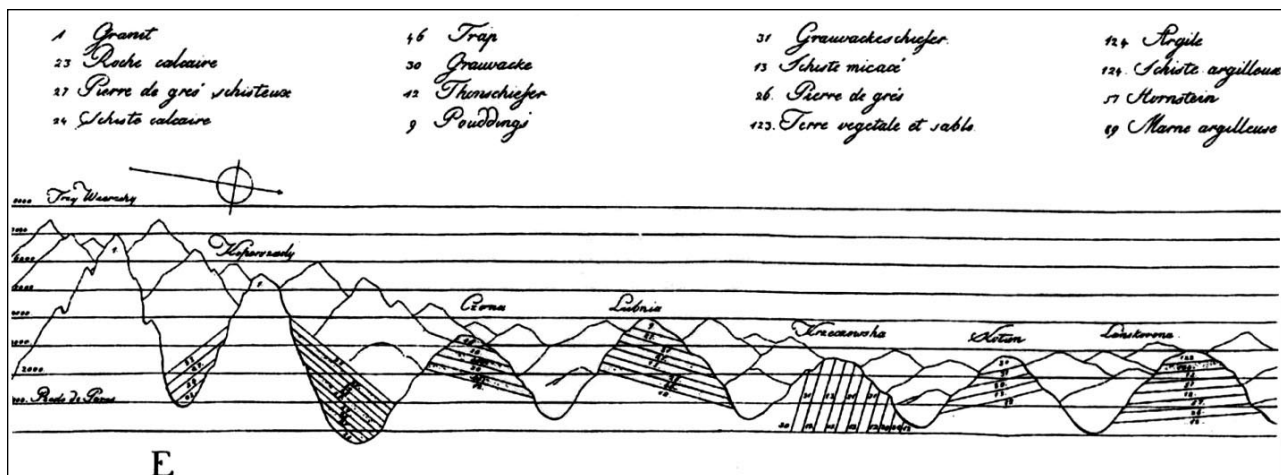


Fig. 4. Fragment of geological cross-sections showing bedrock layering and tectonic structures of the High Tatra Mountains

4 pav. Aukštųjų Tatrų kalnyno sluoksnių paplitimo ir tektoninės sandaros geologinio pjūvio fragmentas

Explication des Nombres dans les Montagnes primitives	Urtrap. . . . .	46	Concretions bitumineuses ou bitume durci. . . . .	98.
Granit . . . . . 1	Grünstein . . . . .	47	Schiste bitumineux. . . . .	99.
Gneis . . . . . 2	Trappes . . . . .	47	Empreintes des végétaux . . . . .	100.
Roche calcaire primitive . 3	Basaltes . . . . .	48.	Gypse . . . . .	101.
Glaz ou Pierre de Gres primitive . . . . . 4	Basalt porphyre . . . . .	49.	Strombiana . . . . .	102.
Quartz cristallin de Roche . . . . . 5	Pierres ponces . . . . .	50.	Sol gemme . . . . .	103.
Serpentine . . . . . 6	Alumine dure et Strahlstein . . . . .	51.	Sources salées . . . . .	104.
Porphyre . . . . . 7	Jaspe . . . . .	53.	Sol de Glauber sulfate de sodium	170.
Grenat . . . . . 8	Stéatite . . . . .	54	Dans les Montagnes marines	
Dans les Montagnes secondaires ou Primieres Stratiformes			Poudings au passage des Montagnes primitives aux Montagnes secondaires 9	
	Hornstein . . . . .	57	Concretions bitumineuses aux Montagnes marines . . . . .	105.
	Hornstein porphyre . . . . .	57	Pierre de gres calcaires	106.
	Agate . . . . .	58.	Pierre calcaire avec des coquilles marines . . . . .	107.
	Chalcédoine . . . . .	59.	Craye . . . . .	108.
	Graustein . . . . .	60.	Marne argilleuse avec des coquilles	109.
	Améthiste . . . . .	61.	Marne calcaire avec des coquilles	110.
Dans les Mines des Metaux			Petrifications . . . . .	111.
Sources des eaux Minerales Cr. natif. . . . .	Or natif. . . . .	62.	Empreintes des corps des animaux . . . . .	112.
les Gneis en couches . . . . . 10.	Argent natif . . . . .	63.	Coquilles dont le especis . . . . .	113.
Thon Schiefer . . . . . 11.	Fer natif . . . . .	64.	Ossements des animaux dont les especis n'existent plus . . . . .	114.
Thon alumine . . . . . 12	Mine d'or . . . . .	65.	Ossements des Mamouths . . . . .	115.
Schiste Micacé . . . . . 13.	Mine d'argent . . . . .	66.	Ossements des Elephans . . . . .	116.
Hornblende . . . . . 14.	Mine de fer Marocaine . . . . .	68.		
Porphyre schisteux . . . . . 15.	Mine de fer . . . . .	69.		
Perlstein . . . . . 0.	Alimant . . . . .	69.		
Perlstein=porphyre . . . . . 16.	Mine de plomb . . . . .	70.		
Sinit porphyre . . . . . 17.	De cuivre . . . . .	71.		

Fig. 5. Fragment of the legend, presenting classification of rock types  
5 pav. Uolienuj rūšių suskirstymą vaizduojantis legendos fragmentas

Table 1. Comparison of Werner's and Staszic's stratigraphy and its modern equivalents

1 lentelė. A. G. Verneiro ir S. Staszico stratigrafijos palyginimas ir jos šiuolaikiniai atitikmenys

Werner, 1796	Staszic, 1815	Modern equivalent
Urgebirge	<i>Montagne primitive</i>	Archean and Proterozoic
Übergangsgebirge	<i>Montagne secondaire ou primitive stratiforme</i>	Upper pre-Cambrian and Lower Paleozoic
Flözgebirge	<i>Montagne antemarine</i>	Upper Paleozoic, Mesozoic, Tertiary
	<i>Montagne marine</i>	Tertiary and partly Quaternary
Aufgeschwemmte Gebirge	<i>Terres d'alluvion</i>	Quaternary

5. The term *terres d'alluvion* (latest alluvial deposits) refers to sediments formed by the action of recent sedimentary and eolian factors from rocks of various types. These are colored light green and consist of 30 symbols, recently corresponding to the Quaternary period.

The first and second units form the highest mountains, the Carpathians, whereas the Central European Highland is composed predominantly of the third and fourth units, and the fifth unit occurs in the Polish–Lithuanian and Pannonian lowlands. The modern equivalents of Werner's and Staszic's stratigraphy are compared in Table 1.

The map contains a colored cross-section from the Baltic Sea to the Tatra Mountains, in the central portion of the western Carpathians, showing the stratigraphic sequence of layers, geological and tectonic conditions of magmatic, metamorphic and sedimentary rocks (Fig. 4). The monograph also contains pictures of fossils, both flora and fauna, including fossils of extinct mammals. Graphic elements are correlated with the corresponding fragments of the text of Staszic's monograph.

## CLASSIFICATION OF ROCKS

Petrography is of secondary importance in Staszic's map, but its very rich rock terminology evidence his strong knowledge of this branch of the geological sciences. In the five groups of "mountains", Staszic distinguished each rock type by number (Fig. 5). The French nomenclature is taken primarily from R. J. Haüy's *Traite de minéralogie* (Paris, 1802), and the German names from A. G. Werner's publications. Many of the Polish rock terms stem from older papers by Polish authors, primarily Józef Osieński's *Opisanie polskich zelaza fabryk* [Description of Polish iron factories] (Warszawa, 1782) and Krzysztof Kluk's *O rzeczach kopalnych* [On mineral raw materials] (Warszawa, 1781), but Staszic himself also enriched the Polish petrographical nomenclature. His map indicates precisely the occurrence of different rock types and mineral rock materials in the mountains and lowlands.

Under *montagne primitive*, or "primitive mountains", he distinguishes eight rock types: granite, gneiss, porphyry, primary limestone (marble), and sandstone, as well as several rocks named after their main mineral: quartz (rock crystal), serpentine and garnet.

Much richer is the group of rocks occurring in the *montagne secondaire ou primitive stratiforme*, or "secondary or primary stratiform mountains", which contains more than 50 rock types. The series begins with conglomerates showing the boundary between the primary and secondary mountains. Here also the petrographic terms (conglomerate, mica, arenaceous and clayey schists, layered porphyry, gray wacke, phonolite, melaphyre, diabase, basalt, greenstone, hornstone, etc.) are mixed with terms based on the main minerals of rocks, e. g., hornblende, actinolite, tremolite (amphibolites), cyanite, talc (metamorphic schists), and agate. This group also contains fifteen ore minerals of such elements as iron, manganese, bismuth, cobalt, nickel, gold, silver, lead, zinc, copper, titanium, chromium, and uranium.

The younger *montagne antemarine*, or "non-marine mountains", in the bottom section also contains conglomerates, followed by about twenty rock and mineral types, including various marls, siliceous rocks, clay and bituminous shales, together with useful mineral deposits of brown coal, gypsum and rock salt, sphalerite, ozokerite and mineral waters.

The series *montagne marine*, or "marine mountains", which is the product of marine sedimentation, occurring in the Central European lowlands, is represented by nearly thirty five rock types and other natural and geographic objects, many of which contain well-preserved fossils. Apart from conglomerates, organogenous limestones, sandstones, various marls, clays, erratic boulders and alluvial deposits, there are numerous animal remains and some salts.

In the youngest *terres d'alluvion*, or "alluvial deposits", which correspond to the present Quaternary sequence and consist predominantly of loose sands, gravels, clays and boulders, Staszic did not distinguish any specific rock type that differed from those occurring in older "mountains". The terminology used for the group *Dans les terein des terres d'alluvion* is given in Table 2.

## TOPOGRAPHY BACKGROUND

The topographic background of Staszic's map shows schematically the contours of rivers, lakes and sea coast lines, drawn in a rather incomprehensible manner. The title list of the map states that it was delineated by Jan Chrystian Hoffmann and "sculpted" by Jan Zachariusz Frey. Hoffmann was a professor of law and administration at the Warsaw School, who had much in common with Staszic (Wojcik, 1979, p. 68). Hoffmann helped Staszic compile the map, drawing a chart under the latter's supervision. The first version of the map was produced in 1810. Frey, who had an engraving shop in Warsaw, made the copper-plates of this map.

Staszic did not indicate which topographic background was taken as a base for his geological map. Antoni Andrzejowski, a zoologist and botanist from the Volhynia Liceum in Krzemieniec and probably the first naturalist traveling in the field together with Staszic's map in hand (Andrzejowski, 1823), speculated that the topographic base for this geological map was taken from the *Map of Poland* at a scale of 1 : 692,000 compiled by G. A. Rizzi-Zannoni (Rizzi-Zannoni, 1772)<sup>8</sup>. This guess seems reasonable,

<sup>8</sup> Giovanni Anthony Rizzi-Zanoni (1736–1814), Italian cartographer, was appointed by Joseph Alexandre Jablonowski, Palatyn of Nowogrod, to compile a geographical map of Rzeczypospolita (Poland and Lithuania). [Atlas Rizzi-Zannoni contains 24 sheets and is stored in the Library of the Lithuanian Academy of Sciences]. – AG.

Table 2. Original Staszic's map terminology for the group "alluvial deposits" and its equivalents  
 2 lentelė. Originali S. Staszico žemėlapis „aliuvininių nuosėdų“ terminologija ir jos atitikmenys

Number on map	French (original)	Polish	English
122	Terres d'alluvions	Osady aluwialne	Alluvial deposits
123	Sables	Piaski	Sand
124	Argilles	łly	Clay
124'	Schiste argilleux	łupki ilaste	Clayey shale
127	Granits roulés	Narzutniaki	Erratic blocks / boulders
128	Glaz ou pierres de gres roulés	Głazy narzutowe obtoczone	Erratic boulders rounded
141	Bois fossiles	Kości kopalne	Fossil bones
128'	Ambre	Bursztyn	Amber
129	Rivieres	Rzeki	Rivers
130	Laes	Loessy	Loess
133	Terres Maréeageuses	Ziemia błotnista	Boggy land
134	Terres Végétales	Gleby	Soil
135	Ossemens humains	Kości ludzkie	Human bones
140	Exalate d'alumine	Szczawian glinu	Alumina
141	Coquilles de Mer	Muszle morskie	Marine shells

but as Andrzejowski and later authors noted, it is unclear why the river-bed configuration was shown on the map rather unusually, indicating that the rivers were strongly meandering. This style of depiction of riverbed hydrography is not shown on Rizzi-Zannoni's map or on the other maps of Eastern Europe compiled in the 17th and 18th centuries.

Also, Rizzi-Zannoni's work, which was published as an atlas on 24 sheets, depicted the main roads and was very popular and useful for land use purposes. However, the roads are absent on Staszic's map, and its scale is approximately two times smaller than Rizzi-Zannoni's; the map projection also differs. Considering these circumstances, as well as the sea coast contour and riverbed sight, the topography of Staszic's map probably is closer to the well-known maps of Poland and adjacent areas compiled by W. Grodecki (1570), the maps of the Grand Duchy of Lithuania by T. Makowski and M. K. Radziwiłł (1613), and the latest versions of the latter map, by, among others, H. Hondijus (1639–1650), P. Schenk and G. Walk (1750; see Buczek, 1966; Lithuania on the Maps, 1999).

While carrying out zoologico-botanical research between the Bug and Dniester rivers in 1814 and 1816–1818, Andrzejowski found quite a few inaccuracies in topography, hydrography and even geology on the map by Staszic, whom he named as a "highly educated scholar" (1823, p. 4). In the conclusion to his study, Andrzejowski remarked:

"[...] I have compared my geological notes with the Staszic's map. But going down to the Black Sea I have found some mistakes both in determining geological strata and in geography of this land. The description of mountains in the area between the Zbrucz river and the Sea is erroneous... The whole map was copied from Zannoni, but he has drawn correctly only the provinces situated closer to the capital, neglecting other regions of our land. His errors were widespread in Europe, and all geographers are placing in Ukraine the mountains which in fact are situated far from it. It is the reason of mistakes in Staszic's map. I would not dare to point these mistakes if I did not check them in the field. I have traveled with Staszic's map from Międzyboże to Cherson and

from Jampol to the mouth of the Dniestr. Therefore, my conclusions are based on these observations. Nevertheless, we should not neglect these mistakes since till now we have no detailed map of this region. Consequently, the Staszic map will be the only index map for naturalists examining our land, which will be copied by them" (1823, p. 109–112).

When Andrzejowski met Staszic in Warsaw in 1821 and told him about his observations, Staszic listened, but it was not possible to make any corrections of the map by that time. Besides, other naturalists from Wilno and Krzemieniec, i.e. Besser, Eichwald, Zborzewski and Jundzill, used Staszic's map while he was still alive (Wójcik, 1979, p. 75). Wiśniowski (1915, p. 11), in an essay on Staszic as a geologist, did not pay attention to the topography of the Staszic map, but observed that R. Danysz had discussed the geographic content of the map in detail in her dissertation *Étude critique d'une carte ancienne de Pologne dressée par Stanisl. Staszic (1806)* (Paris, 1913).

#### THE CONCEPT OF THE GEOLOGY OF THE CARPATHIANS

An analysis of Staszic's map gives the impression that his stratigraphic subdivision refers indirectly to Buffon's epochs. Staszic did not follow the epochs strictly, however, but instead, he furthered Guettard's ideas (1764). Guettard had distinguished and marked on his map four units: *metallic*, in the south (Carpathians), *saline*, more to the north (Wieliczka and Bochnia mines), *marly* (Central Polish Highland), and *sandy* (Central European Lowland). Staszic modified this division by marking five units, in correspondence to the postulates of Werner's school (1791). It appears that in 1806, Staszic was an advocate of Werner's paradigm; however, he did not follow the latter's ideas exactly, either (Czarniecki et al., 2008).

In accordance with the concepts of French geologists of the second half of the 18<sup>th</sup> century, Staszic accepted the idea that the cooling Earth globe had a morphologically diversified surface. The depressions were filled with solutions showing the composi-

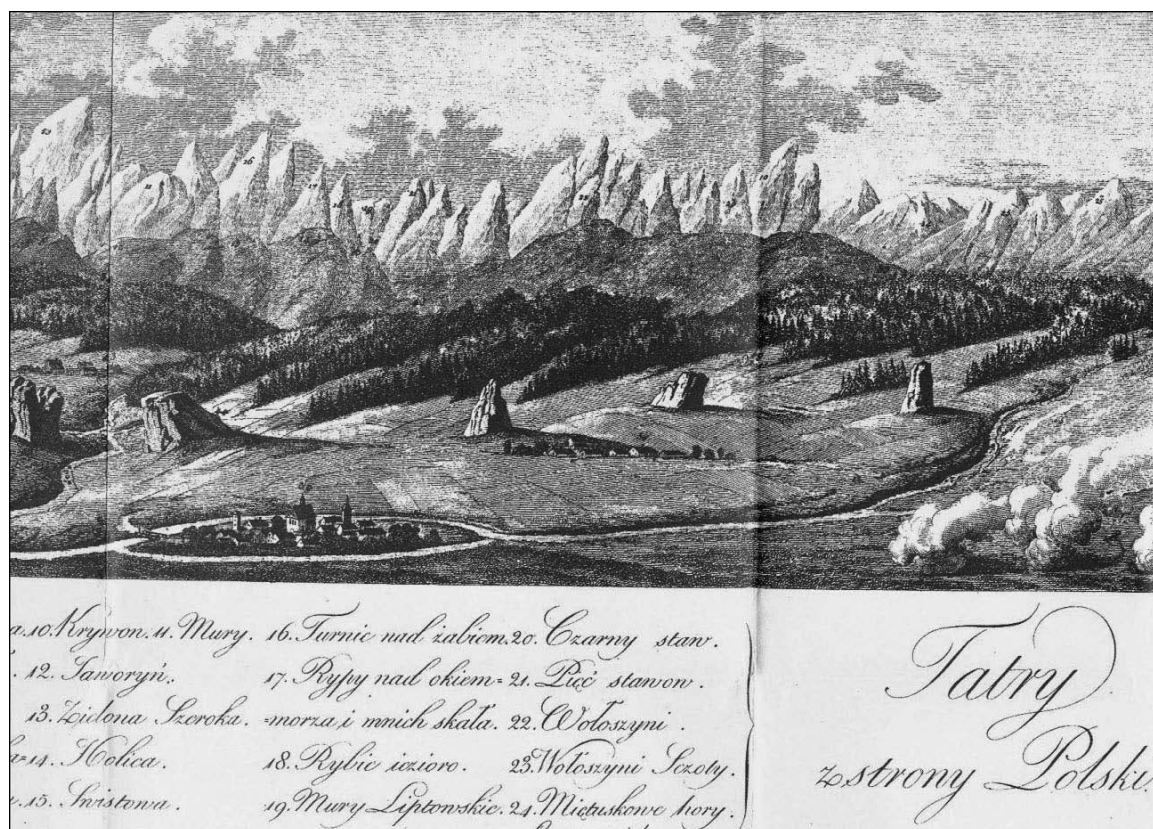


Fig. 6. Panoramic view of the Tatra Mountains seen from the north, designed in 1804 by Zygmunt Vogel  
 6 pav. Tatry kalnyno panoraminis vaizdas iš šiaurės pusės. Zygmunto Vogelio piešinys, 1804

tion different from later marine waters. Primary rocks existed earlier. Bedded rocks were formed by precipitation of chemical substances from later solutions. In this sea, mainly after the deposition of salts, organic life started developing, what resulted in the formation of transition beds. Consequently, limestones of organic origin appeared, resembling those occurring actually (marine beds). The disappearance of morphologic denivellements resulted in the outflow of waters from intra-mountain lakes. In the southern and eastern areas, these processes caused the carrying away of loose rocky material and its deposition in the lowlands, forming alluvial deposits. Thus the youngest deposits cover the older ones. In the Central European lowlands, the latter rocks are deeply buried, but the highlands are locally exposed, e. g., in the Holy Cross (Świętokrzyskie) Mountains. Northwards from the main Carpathian range (Fig. 6), the primary rocks of the Tatras and Volhynian massif provided mainly erratic boulders commonly occurring in the Central Polish Lowland.

At least from 1803 on (see Staszic's notes in the second edition of Buffon's *Epoki Natury*), Staszic accepted the presence of volcanic rocks in the Carpathians and its northern fore-deep. Moreover, he did not negate the occurrence of volcanic phenomena in the southeastern Carpathians but, in contrast to Fichtel (1791–1794), his opinion in this respect was moderate. Later, although he was familiar with volcanism in France and Italy, Staszic completely excluded the presence of volcanic rocks in this region. Nevertheless, it is not reasonable to consider Staszic an advocate of neptunism in its extreme Wernerian version.

## DISCUSSION

In his work, Staszic elaborated a modified stratigraphical conception and tended to collect possibly the most detailed data on mineral raw materials (Wójcik, 1999, p. 98–99). The geological map in question was compiled on the basis of his own field observations, available publications on the subject, and contemporary cartographic data. In the latter case, with regard to the Polish territory, Staszic had at his disposal the earliest observations and maps by Guettard (1764), Carosi (1781–1784), and Hacquet (1790–1796); however, his map was based on a different concept and is incomparably more detailed.

Considering the nature of Staszic's map in the context of early geo-map construction in c. 1800–1820, which can be seen as a transition period for so-called "protogeological" maps, Kozák and Čejchanová (2007) note that Staszic's large *Carta geologica*, which offered a more complex information on geology, stratigraphy and rock classification of the described region, played a crucial role in the development of the early geological cartography of Central and Eastern Europe. Apart from any ranking of Staszic's map, this fundamental work presents a recapitulation of his view of geological history of Central and Eastern Europe and brings to an end the Enlightenment period in the geology of this part of Europe (Wójcik, 2000; Czarniecki et al., 2008). Staszic's successors published important works in the 1830s and 1840s based on a more detailed analysis of fossils, petrography, tectonics and palaeogeography. This later stage of studies is best represented by Pusch's *Geologischer Atlas von Polen* (1836), Eichwald's

*Naturhistorische Skizze von Lithauen, Vohynien und Podolien* (1830) and Dubois de Montpereaux's *Geognostische bemerkungen über Lithauen* (1830).

## CONCLUSIONS

The international significance of Staszic's classical work is, **first**, that he modified the stratigraphical conception and collected the most detailed data on mineral raw materials; **second**, that his geological map is compiled on the basis of his own field observations, available publications and contemporary cartographic data; and **third**, his map is based on a completely new concept when compared with the previous observations and maps of Guettard (1764), Carosi (1781–1784) and Hacquet (1790–1796).

Staszic's map of 1815, which was his only work of this type, contains more than merely the essential stratigraphic units and their contours (Vai, 2007). It is evident that Staszic used the map to convey his views on the dynamics of geological processes. This is clear not only in the map's presentation of meandering rivers, but in the designation of muddy areas in the map's northeastern sheet C. In Staszic's view, the diluvial waters had retreated in historical times. This opinion is expressed in the last sentence of the work: "In our land the mountains, the waters flowing around them, the plants and animals have changed. What was happening since ages will be continued. This refers to the mountains, waters, plants and animals" (Staszic, 1815, p. 390).

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#### PIRMASIS DIDELIS VIDURIO IR RYTŲ EUROPOS GEOLOGIJOS ŽEMĖLAPIS (1815)

##### *Santrauka*

Straipsnyje aptariamas pirmasis Vidurio ir Rytų Europos geologijos žemėlapis, kurį XIX a. pradžioje sudarė lenkų dvasiškis, geologas, švietėjas, filosofas Stanisławas Staszicas 1755–1826) ir kuris buvo svarbus geologijos ir geologinės kartografijos raidai Europoje. 1815 m. pasirodžiusį žemėlapią bei jo autorius veiklą beveik per du šimtus metų aptarinėjo daugelis autorių: W. Zawadski (1860), T. Wiśniowski (1915), Cz. Leśniewski (1926, 1931 ed.), W. Goetelis (1955), Z. Wójcik (1999, 2006) ir kiti (žr. Wójcik, 2005). Per tą laikotarpį iš daugiau kaip 350 publikacijų apie S. Staszicą apie 90% buvo išleista lenkų kalba, todėl jis mažai žinomas Baltijos bei kitų Europos šalių skaitytojams. S. Staszico žemėlapis paminėtas tarp senųjų Lietuvos geologijos žemėlapių (Satkūnas, Žalūdienė, 2007), tačiau jo dydis ir mastelis nurodyti neteisingai.

1805 m. Mokslo mylėtojų draugijai Varšuvoje S. Staszicas pateikė savo pirmąjį pranešimą „O ziemiorodztwie gór dawniej Sarmacji, a później Polski“, o 1806–1809 m. pasirodė dar keturi jo pranešimai apie įvairių Lenkijos bei gretimų vietovių geologiją. 1814 m. S. Staszicas apibendrinė savo požiūrį į geologiją ir naudingąsias iškasenas Mokslo mylėtojų draugijoje Varšuvoje, kalbėdamas apie savo geologinius tyrimus Lenkijoje ir Lietuvoje.

1815 m. S. Staszicas parengė monografiją *O Ziemiorodztwie Karpatów i innych gór i równin Polski przez Stanisława Staszica* ir paskelbė ją Varšuvoje kartu su pirmuoju didžiuoju Vidurio ir Rytų Europos geologijos žemėlapio. Vėlesnes savo studijas jis apibendrinė istoriniame filosofiniame veikalė *Ród ludzki*, kuris buvo išleistas 1819–1820 metais. S. Staszico darbų rinktinė (*Dziela*) pasirodė 1816–1820 metais, rinktiniai raštai rusų kalba 1951 m. paskelbti Maskvoje (Stašic, 1951).

Remdamasis savo per kelius metus atliktais geologiniais tyrimais ir socialinių ekonominių problemų nagrinėjimais, S. Staszicas stengėsi kuo daugiau aprašyti įvairių Vidurio Europos regionų, ypač Karpatų, Vidurio Lenkijos lygumų, Voluinės ir Rytų Alpių, geologiją, nes su šiais regionais jis buvo gerai susipažinęs. Savo monografijoje ir geologijos žemėlapyje jis pateikė duomenų ir apie mažiau jam žinomų vietovių – Lenkijos-Lietuvos žemumos, Pietryčių Baltijos pajūrio, Polesės (dabar Baltarusija), Voluinės (dabar Ukraina), Moldovos, Transilvanijos

ir Vengrijos – geologiją. S. Staszicas domėjosi ir naudingosiomis iškasenomis, ypač esančiomis Lenkijoje (druskos, vario ir geležies rūdos, akmens anglies). Pagal uolienas ir paleontologinius duomenis jis mėgino nustatyti šių iškasenų, ypač druskos, slūgsojimo gylį, todėl domėjosi ir tektonika.

Monografijoje S. Staszicas pateikė stratigrafinius padalinius, kuriuos išskyrė remdamasis duomenimis apie uolienas ir organines fosilijas pagal modifikuotą Wernerio klasifikaciją. Legendoje pateiktos penkios klasės ir 135 uolienų tipai, taip pat 15 tipų rūdinių uolienų pavadinimai prancūzų kalba. Terminai žemėlapyje taip pat parašyti prancūzų kalba, bet pačioje monografijoje jie paaiškinti ir lenkų kalba (Staszic, 1816).

Aptariamajame darbe yra pateiktas ir spalvotas geologinis pjūvis nuo Baltijos jūros iki Tatrų kalnų (vidurinės Vakarų Karpatų dalies), kuriame pavaizduota stratigrafinė sluoksnių seka, geologinės ir tektoninės magminių, metamorfinių ir nuosėdinių uolienų sąlygos, pateikti fosilijų piešiniai – floros ir faunos, taip pat išmirusių žinduolių. Grafiniai elementai pažymėti raidėmis ir koreliuoti su atitinkamais S. Staszico monografijos teksto fragmentais.

Analizuojant S. Staszico žemėlapių susidaro įspūdis, jog pateiktas stratigrafinis suskaidymas galėtų būti netiesiogiai susijęs su Buffono epochomis, tačiau jis griežtai jų nesilaikė, o labiau plėtojo J. É. Guettardo idėjas (1764). J. É. Guettardas savo žemėlapyje išskyrė ir pažymėjo keturis vienetų: metalo – pietuose (Karpatai), druskos – šiauriau (Veličkos ir Bochnijos kasyklos), mergelio (Vidurio Lenkijos aukštuma) ir smėlio (Vidurio Europos žemuma). S. Staszicas modifikavo šį suskaidymą ir pažymėjo penkis padalinius pagal A. G. Wernerio mokyklą (1791). 1806 m. jis tikriausiai tikėjo A. G. Wernerio paradigma, tačiau šių Vokietijos geologo idėjų skrupulingai nesilaikė.

Išskirtinė tarptautinė S. Staszico klasikinio darbo reikšmė pirmiausia yra ta, kad jis sukūrė modifikuotas stratigrafines sąvokas ir stengėsi surinkti kuo išsamesnius duomenis apie naudingąsias iškasenas, antra – geologijos žemėlapis sudarytas remiantis jo paties lauko stebėjimais, prieinamomis publikacijomis ir to meto kartografiniais duomenimis ir trečia, šio žemėlapyje koncepcija yra visiškai kita negu J. É. Guettardo (1764), J. P. Carosi (1781–1784) ir B. Hacqueto (1790–1796) žemėlapių, jis yra kur kas detalesnis.

S. Staszico žemėlapis, kaip jo požiūris į Vidurio ir Rytų Europos geologijos istoriją santrauka, užbaigia Šviečiamąjį amžiaus geologijos tarpsnį šioje Europos dalyje. Jo sekėjai trečiajame ir ketvirtajame XIX a. dešimtmetyje išleido svarbių darbų apie dar išsamesnius fosilijų, petrografijos, tektonikos ir paleogeografijos tyrimus: G. G. Pusch *Geologischer Atlas von Polen* (1836), E. K. Eichwald *Naturhistorische Skizze von Lithauen, Volhynien und Podolien* (1830) ir F. Dubois de Montpereaux *Geognostische bemerkungen über Lithauen* (1830).

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#### ПЕРВАЯ КРУПНАЯ ГЕОЛОГИЧЕСКАЯ КАРТА ЦЕНТРАЛЬНОЙ И ВОСТОЧНОЙ ЕВРОПЫ (1815)

##### *Резюме*

В статье рассмотрена первая в Европе крупная карта начала XIX века, составленная Станиславом Сташицем (Stanisław Staszic), которая сыграла важную роль в развитии европейской геологии и геологической картографии, но мало известна читателям в Балтийских странах. После ее публикации в 1815 году еще два века феномен С. Сташица изучали многие ученые: В. Завадски (W. Zawadski, 1860),

Т. Вишневи (T. Wiśniowski, 1915), Ч. Лешневски (Cz. Leśniewski, 1926, 1931 ed.), В. Гетель (W. Goetel, 1955), З. Вуйцик (Z. Wójcik, 1999, 2005, 2006). Из более чем 350 работ главная часть опубликована на польском языке.

В 1805–1809 гг. на основе своих геологических исследований С. Сташиц опубликовал эту работу. В 1805 г. он представил свое первое сообщение *O ziemiordztwie gór dawniej Sarmacji, a później Polski* Обществу друзей естественных наук в Варшаве, в 1806–1809 гг. он представил еще четыре сообщения о геологии разных частей Польши и прилегающих территорий. В 1814 г. С. Сташиц изложил свои взгляды на геологию и полезные ископаемые на заседании Общества друзей естественных наук в Варшаве, где он говорил о своих геологических исследованиях в Польше и Литве.

В 1815 г. С. Сташиц закончил монографию *O Ziemiordztwie Karpatów i innych gór i równin Polski przez Stanisława Staszica* и опубликовал ее в Варшаве с первой крупной геологической картой Центральной и Восточной Европы. Его последующие исследования были включены в историко-философский трактат *Ród ludzki* (1819–1820 гг.). Полное собрание работ С. Сташица (*Dziela, Tom I–IX*), в том числе обе вышеуказанные, издано в 1816–1820 гг. Избранные труды С. Сташица в переводе с польского опубликованы в 1951 г. в Москве.

На основе своих полевых геологических исследований, проведенных в течение нескольких лет, а также изучения социально-экономических проблем С. Сташиц старался как можно более детально проанализировать геологию разных областей Центральной Европы, особенно Карпат, Центрально-Польской возвышенности, Вольны (ныне на Украине) и восточных Альп, поскольку он хорошо знал эти области. Он включил в свою монографию и геологическую карту менее исследованные участки Польско-Литовской равнины, побережья южной Балтики, Полесья (ныне в Беларуси), Молдовы, Трансильвании и Венгрии. С. Сташица интересовали также исследования полезных ископаемых, особенно тех, которые могли быть использованы в Польше (каменная соль, медная и железная руда, каменный уголь). По известным сведениям о породах и фоссилиях он пытался определить глубину залегания этих ископаемых, особенно каменной соли; поэтому он интересовался также и тектоникой.

В своей монографии С. Сташиц применял стратиграфическое разделение, проведенное на основе данных о породах и органических фоссилиях, по несколько модифицированной классификации Вернера. В легенде представлено пять классов, 135 типов пород и 15 типов рудных залежей, при этом использовались французские наименования. Терминология в легенде карты французская, но в монографии имеются разъяснения на польском языке (Staszic, 1816).

Рассматриваемая работа содержит цветной геологический разрез, идущий от Балтийского моря до Татр (центральной части западных Карпат), в котором показано стратиграфическое деление пластов, геологические и тектонические условия магматических, метаморфных и осадочных пород. В работе содержатся рисунки фоссилий – флоры и фауны, а также вымерших млекопитающих. Графические элементы обозначены буквами и скоррелированы с соответствующими фрагментами текста в монографии С. Сташица.

Анализ карты С. Сташица создает впечатление, что применяемое им стратиграфическое деление косвенно относится к эпохам Бюффона. Однако он не следует им строго, а скорее придерживается идей Ж. Гэттара (Guettard, 1764), который выделил и отметил на своей карте четыре подразделения: металлическое на Юге (Карпаты), соляное (копи Велички и Вохнии) – севернее, мергелевое (Центрально-Польская возвышенность) и песчаное (Центрально-Европейская низменность). С. Сташиц модифицировал это разделение и обозначил пять подразделений по постулатам школы А. Г. Вернера (Werner, 1791). Похоже, что в 1806 г. С. Сташиц верил парадигме А. Г. Вернера, однако строго не следовал идеям германского геолога.

Международное значение классической работы С. Сташица заключается прежде всего в том, что он разработал модифицированные стратиграфические концепции и старался собрать как можно больше детальных данных о полезных ископаемых; во-вторых, его геологическая карта составлена на основе собственных полевых наблюдений, доступных публикаций и картографических данных того времени; в-третьих, его карта основана на совершенно иной концепции, чем предшествующие наблюдения и карты Ж. Э. Гэттара (Guettard, 1764), И. Ф. Карози (J. P. Carosi, 1781–1784) и Б. Гаке (B. Hacquet, 1790–1796), кроме того, она несравненно более детальна.

Фундаментальная работа С. Сташица представляет собой обобщение его взглядов на геологическую историю Центральной и Восточной Европы и заканчивает эпоху Просвещения (XVIII в.) в геологии этой части Европы. Его последователи опубликовали важные работы в третьем и четвертом десятилетиях XIX века на основе более детальных исследований фоссилий, петрографии, тектоники и палеогеографии. Эти последующие исследования представлены наилучшим образом в следующих работах: Г. Г. Пуш *Geologischer Atlas von Polen* (Pusch, 1836), Э. К. Эйхвальд *Naturhistorische Skizze von Lithauen, Volhynien und Podolien* (Eichwald, 1830) и Ф. Дюбуа де Монпере *Geognostische Bemerkungen über Lithauen* (Dubois de Montpereaux, 1830).