

Oldest geological maps of the territory of Lithuania (the period until 1926)

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The geological mapping of the present territory of Lithuania has a long history and rich traditions. The first map showed the distribution of occurrence of rock and mineral deposits only, while the modern ones include the stratigraphic concepts and with the help of colours depict the order of sediments according to age. To the present knowledge, the oldest map with geological information on the present Polish and Lithuanian territories was compiled in 1764 by Jean Etienne Guettard (1715–1785). The map is black and white and shows four mineralogical (geological) zones. The next historical fact in geological cartography is the geological map compiled by the Polish philosopher, geologist and geographer Stanisław Staszic (1755–1826) in 1806. This map was very informative at that time. Other maps with geological information on the present territories of Poland and Lithuania were compiled after partition of the country in 1795. One of these maps belongs to I. Domeyko. 1840 is the date of stratigraphic identification of Devonian rocks in the Eastern Baltic region, when L. von Buch in Freiberg analysed fossil fish samples and determined Devonian sandstones, distinguishing them from Estonian limestone. An outstanding contribution to geological cartography was done by Konstantin Grewingk, Antanas Giedraitis, Eduard Toll, Anna Missuna and other famous geologists and geomorphologists.

Key words: history of cartography, Lithuania, oldest geological maps

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INTRODUCTION

The development of geological sciences is closely connected with progress in geological mapping and, therefore, the contents of geological maps represent the level of geosciences at any given time quite exactly (Brezsnyansky, Turczy, 1998). The first maps showed the distribution of the occurrence of rocks and mineral deposits only. More modern ones incorporate stratigraphic concepts and with the help of colours depict the order of sediments according to their relative age. The geological mapping of the present territory of Lithuania has a long history (Lietuvos..., 1981), however, its development has a close relationship with compilation of maps of adjacent areas, especially of Poland (Satkūnas et al., 2006).

History of geological research in Lithuania can be subdivided into several periods (Lietuvos..., 1981). The first period is recognized as a period from the first notes on geology in general until 1926 when systematic investigations of Lithuanian territory were launched at the Vytautas the Great University in Kaunas under the leadership of Professor Juozas Dalinkevičius. J. Dalinkevičius initiated a systematic development of the geological maps reflecting and upgrading the understanding of the

geological structure of the country. The paper deals only with the first period of geological cartography, which has to be supplemented with new data.

OLDEST CARTOGRAPHIC REFLECTIONS OF THE BALTIC SEA REGION AND LITHUANIA

It is worth mentioning some oldest cartographic works of ancient geographers depicting certain knowledge on hydrography and geomorphology (Lietuva..., 2002). According to the present knowledge, the first fragment of the cartographic view of Lithuania belongs to the Greek scientist Claudius Ptolemy (approximately 90–168 AD) in his work “Geography”. The Baltic Sea is shown on this map with the inflowing rivers: Vistula, Nemunas (Chrones), Dauguva (Rubon). In the area between the rivers Nemunas and Daugava the lands of Baltic tribes are marked. Interestingly, the chain of hills shown on this map rather well coincides with the marginal highland of the last glaciations on the territory of present Lithuania. In later maps, e. g., those compiled by A. Kreskvas in 1375, N. Cusanus in about 1450, some geomorphological features are also clearly depicted, however, in no case these maps can be regarded as geoscientific. The most



Fig. 1. Map by M. Beneventanus of Poland, Hungary, Bohemia, Germany, Russia and Lithuania, scale 1:3 750 000, Rome, 1507

1 pav. Lenkijos, Vengrijos, Bohemijos, Vokietijos, Rusijos ir Lietuvos žemėlapis. M 1:3 750 000, parengė M. Beneventanus, Roma, 1507

characteristic example of oldest geographical maps with some relief elements is the map by M. Beneventanus, composed in 1507 (Fig. 1).

THE FIRST PERIOD: GEOGNOSTIC CARTOGRAPHY

The very beginning of geological investigations in Lithuania is related with first the publication dealing with geology in 1780. It was a description of quartzified fossils (agate) published by J. E. Gilibert (Lietuvos..., 1981). However, this fact should be revised in view of the map with geological information on the territory of Poland and Lithuania, compiled and published by J. E. Guettard in 1764 (Fig. 2.). This map is regarded as the oldest map of geological contents of the present Polish and Lithuanian territories. Jean Etienne Guettard (1715–1786)

made an outstanding contribution to the geological cartography of Europe, and France in particular (Fleszarowa, 1962; Tarkowski, 2005). The map was printed in a volume of the *Histoire de l'Académie Royale des Sciences à Paris* and was entitled *Carte minéralogique de la Pologne. Relative à un mémoire de M. Guettard* (Fleszarowa, 1962). The map is black and white and shows four mineralogical (geological) zones. However, this map was not very informative. For example, the whole of Lithuania was simply depicted in the sandy zone which comprises two thirds of the map. Nevertheless, this was the first example of geoscientific cartography of the territory under discussion.

The next historical fact in geological cartography is the geological map compiled by the Polish philosopher, geologist and geographer Stanisław Staszic (1755–1826) in 1806. This map at that time was very informative not only from the geological but



Fig. 2. The map of Polish and Lithuanian territories drawn in 1764 by Jean Etienne Guettard (Tarkowski, 2005).

2 pav. J. E. Guettard'o Lenkijos ir Lietuvos teritorijų žemėlapis, 1764 (Tarkowski, 2005)

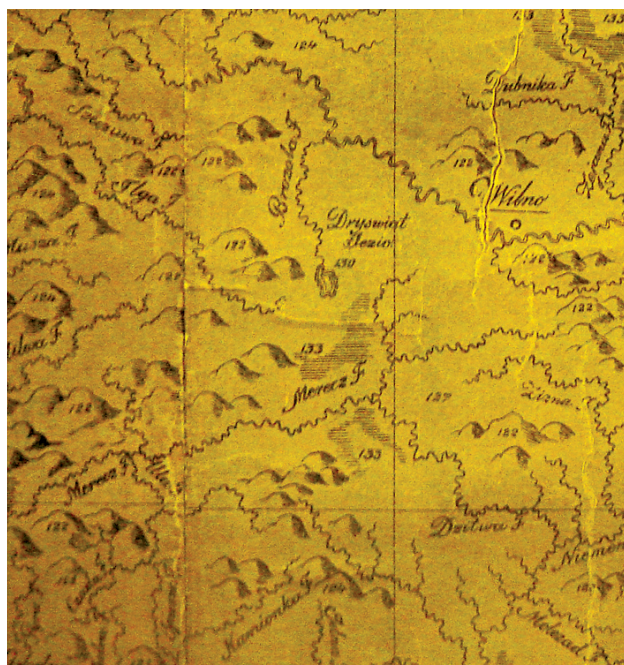


Fig. 3. Fragments of geological map by S. Staszic of entire Poland, Moldavia, Transylvania and parts of Hungary and Valakhia, 1806

3 pav. S. Staszico Lenkijos, Moldavijos Transilvanijos, dalies Vengrijos ir Valachijos teritorijų geologinio žemėlapių fragmentai, 1806

also from the hydrographical points of view. The size of the map is 636×454 mm, scale $1 : 4\,000\,000$. It covers Poland, Moldova, Transylvania, part of Hungary and Valakhia. Six geological formations are depicted using different colours. These formations have a structural and stratigraphical meaning: *Montagne Primitive* (Precambrian), *Montagne secondaire ou première stratiforme* (Lower Palaeozoic), *Montagne Antemarine* (Palaeozoic, Mesozoic), *Montagne Marine* (Tertiary), *Ferres d'alluvium* (Quaternary). This subdivision is characteristic of the neptunistic standpoint which prevailed in geology in the beginning of the 19th century. Additionally, types of rock (granites, gneisses, porphyries, gypsum, etc.) are indicated by figures according to the legend. The map was later on published by S. Staszic in his book "On the Origin of Carpathians and other mountains and plains of Poland" (Staszic, 1815) (in Polish). A copy of this map is available at the Vilnius University Department of Geology and Mineralogy (Fig. 3).

Chronologically, another cartographic work reflecting some features of the geological structure of the Baltic region was published in 1822. It was a geognostic sketch at a scale of $1 : 7000\,000$, elaborated by W. Strangways for the "Outline of geological map of European Russia" (Žalūdienė, 2006). This sketch covers the present territory of Curonia, Estonia, Northern Latvia and the European part of Russia (Russian Plate). The above mentioned maps were based mainly on speculations of their authors and very scarce and fragmented materials of observations. The first research – geognostic expeditions in the territory of Lithuania – were organised only in the third decade of the 19th century. Researchers V. Severgin and J. von Ulman in 1825 carried out a geognostic overview of Vilnius, Minsk, and Grodno governorates. The report on this research describes outcrops of limestone and iron ore in Papilė, gypsum layers in the vicinities of Pasvalys and Biržai (Ульман, 1827). Geognostic expeditions were organised in the territory of Lithuania and adjacent are-

as by Vansovich and Leman (1826), Karl Eduard von Eichwald (1829), however, these investigations were not concluded into regional cartographic works (Lietuvos..., 1981).

In 1830, M. Engelhard and E. Ulprecht published an overview of the structure of rocks of Estonia and Latvia, supplemented with a geognostic map of Kurzeme at a scale of $1 : 1\,500\,000$. Occurrences of limestone, sandstone, gravel are indicated on the map which is supplemented by an explanatory note and a list of references. Differences of the geological age of limestone and sand in Estonia and South Latvia were noted (Engelhard, Ulprecht, 1830).

In the same year (1830) naturalist and researcher of geology Frédéric Dubois de Monpereaux (1798–1850) published a geognostic map of Lithuania and Southern Latvia (scale $1 : 1$



F. Dubois de Monpereaux (1798–1850) geognostinis žemėlapis: 1 – klintis; 2 – molis; 3 – gipsas; 4 – mineralinės versmės. Spalvoti ženklai pakelti štrichiniais

Fig. 4. The geognostic map of F. Dubois de Monpereaux (Lietuvos..., 1981): 1 – limestone, 2 – clay, 3 – gypsum, 4 – mineral springs

4 pav. F. Dubois de Monpereaux geognostinis žemėlapis: 1 – klintis, 2 – molis, 3 – gipsas, 4 – mineralinės versmės



Fig. 5. The geological map of Lithuania and Poland by I. Domeyko, 1850

5 pav. I. Domeikos Lenkijos ir Lietuvos geologinis žemėlapis, 1850

800 000) (Dubois, 1830) (Fig. 4.). The map was supplemented by the explanatory article describing mineral resources of the area. The map was coloured and displayed occurrences of limestone, tufa, clay and gypsum. Evidently, taking into account the similarity of the contents and concept of the maps of M. Engelhardt, E. Ulprecht and F. Dubois de Monpereaux, they could be regarded as related, and most probably their authors maintained contacts during compilation of these cartographic works.

About 1837, Ignacy Domeyko (1802–1889) completed four maps of Poland and Lithuanian territories, which depicted water, earth, forest and the political situation. These maps were published in 1850 in the *Atlas de l'ancienne Pologne* (Dufour, Wrotnowski, 1850). I. Domeyko's original maps were considered to be lost for a long time (Chałubińska, 1961, 1962). The geological map ('Earth') was compiled at a scale of 1:3 500 000. The hydrographic map was used as the base map (Fig. 5). The legend had nineteen colours, each indicating a different type of geological formation, identified by lithological properties or characteristics. However, the exact date of the beginning of the cartographic work of I. Domeyko is still unknown, although the draft of the geological map was probably done before 1835 (Graniczny et al., 2002).

The relationship of the maps by I. Domeyko to the geognostic map of Lithuania (scale 1 : 1 800 000) compiled by F. Dubois de Monpereaux in 1830 (Lietuvos..., 1981) is also still uncer-

tain. The scientific heritage of I. Domeyko, his relations with contemporaneous researchers and role in the development of geological mapping requires further investigation. However, his contribution to the development of geological cartography is undoubtedly very significant. The geological map compiled by I. Domeyko is amongst the pioneer works not only for Poland and Lithuania, but also for Europe more widely, and is one of the most important studies of this type. I. Domeyko is the first geologist who performed a morphographic and geological zonation of Lithuania (Gaigalas, 2002). However, serious financial difficulties of the Polish exiles, as well as I. Domeyko's departure to Chile delayed the final production of the map.

GEOLOGICAL MAPPING AND STRATIGRAPHY (PERIOD SINCE 1840)

The period of investigations and compilation of geological maps starting about 1840 is closely related to the development of stratigraphic knowledge and therefore this period marks the beginning of mapping based on the stratigraphic concept. However, in this period geological investigations in the territory of Lithuania still were fragmentary and discontinuous, carried out by single researchers mainly from universities of Warsaw, Kenigsberg, Tartu, St. Petersburg and elsewhere.

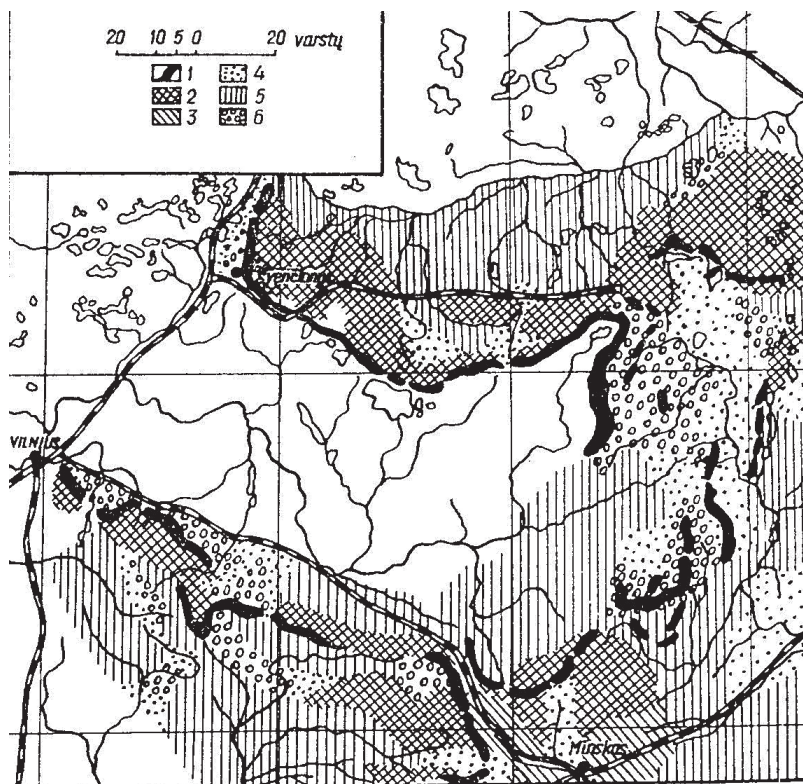


Fig. 6. Geomorphological map of A. Misuna, 1903. 1 – marginal moraine, 2 – basal-moraine landscape, 3 – drumlins, 4 – sand (sandur), 5 – morainic marl, 6 – morainic sand
6 pav. A. Misunos geomorfoliginis žemėlapis, 1903: 1 – galinė morena; 2 – dugninės morenos kraštovaizdis, 3 – drumlinai, 4 – smėlis (zandras), 5 – moreninis mergelis, 6 – moreninis smėlis

1840 is the date of stratigraphic identification of Devonian rocks in the Eastern Baltic region, when L. von Buch (Buch, 1840) in Freiberg analysed fossil fish samples and determined Devonian sandstones, distinguishing them from Estonian limestone, which were attributed to the Silurian. Approximately at the same time proceedings by Georg Gottlieb Puch and Leopold von Buch were published as a first palaeontological evidence of the Jurassic age of rocks outcropping in the Papile town (North-West Lithuania).

Gregor von Helmersen in 1841 compiled a map of European Russia in which, on the basis of palaeontological data by E. Eichwald and L. von Buch, he indicated a Devonian system in North Lithuania and Cretaceous and Tertiary rocks in the south, in the vicinities of Grodno (Гельмерсен, 1841). It was the best map at that time compiled according to the stratigraphic principle (Žalūdienė, 2006).

An outstanding contribution to geological cartography was made by Konstantin Grewingk (1819–1887). In his first work, published in 1857, K. Grewingk subdivided the Devonian of Lithuania and Latvia into three stages. On the basis of palaeontological and structural data, in 1861 he compiled a geological map at scale of 1 : 1 200 000, which quite in detail reflected the main features of the geological structure on the main part of Latvia and Northern Lithuania. In 1879, K. Grewingk published his second map (scale 1 : 600 000) with an extensive explanatory text. In this map, first at all the areas of Permian and Triassic rocks and Cretaceous outcrops (in the Kaunas vicinities) were indicated (Lietuvos..., 1981). It should be noted that in this period some researchers already were trying to compile maps containing palaeogeographic information and covering the whole European part of Russia or even the whole Europe (Žalūdienė, 2006). For example, a very extensive Devonian belt was assumed by S. Kutorga in his sketch map from 1858 (Fig. 6.).

Much more comprehensive data on the geological structure of the Baltic region were obtained only after drilling the first comparatively deep boreholes after 1874 when E. Bieske drilling company, located in Keningsberg, started its services. The first boreholes in the present territory of Lithuania were drilled in its western part – in the Purmaliai and Ripeikiai villages. Data from these wells were used for compiling later geological maps (Lietuvos... 1981). A valuable contribution to the stratigraphy of the Baltic region belongs to J. Semiradzki and E. Dunikowski (Semiradzki, Dunikowski, 1891). In their geological overview of Poland and adjacent areas they present the description of the Devonian, Permian, Jurassic, Cretaceous, Triassic and Quaternary rocks.

The foundation of the Geological Committee in St. Petersburg in 1882 must be noted as a very important fact in relationship to the development of geological cartography. The Committee, in the very beginning of its activities, undertook a task of compiling a geological map at a scale of 1 : 82 400 for the whole territory of Russia. Due to accomplishment of this task in the present territory of Lithuania, Antanas Giedraitis, Ana Misuna, Czeslaw Chmielewski significantly contributed to the development of geological cartography.

Antanas Giedraitis (1848–1909) is the first who in detail described Lithuanian Quaternary deposits from the point of view of theory of continental glaciations. He published his materials in 1895 (Гедройц, 1895), and the volume contained a map of outcropping rocks and sediments. This map should be regarded as the first Quaternary geological map of the territory of Lithuania, totally covered by the Quaternary deposits. However, the map also presents a number of Tertiary and Cretaceous outcrops discovered and investigated by the author.

On the order of the Committee of Geology, Eduard Toll (1858–1902) in the last decade of the 19th century was mapping North

Lithuania and Kurland (Northwest province of Latvia). He investigated Devonian and Quaternary deposits, documented well logs in Klykoliai and Mažeikiai, in the vicinities of Žagarė and Bauske described fossils found in dolomites of the Devonian system.

According to the present knowledge, the first geomorphological map was compiled by Ana Misuna (1869–1922). She studied the forms and genesis of the present relief, and her studies resulted in a geomorphological map of a territory east of Vilnius, completed in 1903. The map, reflecting glacial marginal belts, was built on the hypsometric map of Aleksej Tillo (1839–1899), published in 1889 at a scale of 1 : 2 500 000 for the whole European Russia. The geomorphological map by A. Misuna was very precise and was actually in use for several decades (Guobytė, 2000).

Early in the 20th century, in Western Lithuania geomorphological research was carried out by B. Doss, H. Hausen and H. von Wichdorff. The latter researcher performed a rather detailed mapping of the Klaipėda region and the Curonian Spit. B. Doss in 1910 composed a geomorphological sketch map of Northern Lithuania, depicting on it the Linkuva ridge, drumlins, glacial and glaciolacustrine plains (Kudaba, 1988). In geomorphological maps compiled by H. Hausen (1913), the Baltic marginal highland is clearly mapped, as well as other marginal moraine ridges can be identified. However, as the first geomorphological map covering the whole territory of Lithuania should be undoubtedly regarded the map compiled by the German scientist H. Mortensen in 1924. The map was based on all geomorphological evidence published by earlier researchers such as A. Misuna, B. Doss and others (Guobytė, 2000).

DISCUSSION

Maps, being a reflection of the comprehensive understanding of geological knowledge, are always dependent on the availability level of geological factual data, especially on stratigraphy. However, geological mapping starts with the geognostic regional sketches of Guettard, Monpereaux and other researchers who were combining all factual data with their regional hypothetical considerations. Some of the results, so important in stratigraphy or mineralogy, were not completed in the form of geological maps.

The mapping of the territory of Lithuania is closely related to the mapping history of adjacent countries and regions, especially of Poland and Russia (European part), but the mapping of the territory of Lithuania was developing simultaneously with that of the rest of Europe.

In this paper, we attempted to list the main cartographic works that played a certain role in the development of the understanding of the geological structure of the area and were noted in the history of geological investigations. Maybe some cartographic works are missing in the present overview and the list could be supplemented. Hopefully the paper will provoke new discoveries and notes in the history of mapping.

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SENIEJI LIETUVOS ŽEMĖLAPIAI (IKI 1926 M.)

Santrauka

Geologinio kartografavimo Lietuvoje istorija yra labai turtinga, turi senas tradicijas (Lietuvos..., 1981; Satkūnas ir Grigelis, 1996). Senieji Lietuvos ir gretimų teritorijų žemėlapiai ne tik yra istoriškai reikšmingi, kartais jie nustebina savo conceptualumu. Sudarant pirmuosius geologinius žemėlapius, turimą labai negausią faktinę medžiagą, ypač duomenis apie giluminę geologinę sandarą, buvo stengiamasi kompensuoti mokslinė prielaida, teoriniais samprotavimais. Pirmuosiuose Lietuvos geografiniuose žemėlapiuose yra pateikta ir tam tikrų hidrografijos bei geomorfologijos žinių: tai Vidurio Europos žemėlapis (N. Cusanus, 1450) ir Lenkijos, Vengrijos, Bohemijos, Vokietijos, Rusijos ir Lietuvos žemėlapis (M. Beneventanus, 1507). Pastarajame pirmą kartą paminėtas Lietuvos vardas. Iki 1926 m. svarbiausių kartografinių Lietuvos ir gretimų teritorijų atvaizdų bei geognostinių žemėlapių autoriai yra S. Staszicas (1806), J. Guettard'as (1764). Vėlesni žemėlapiai atsirado po Lenkijos padalijimo ir jų autorystė siejama su D. Monpereaux ir I. Domeikos vardais. Daug kartografinės medžiagos surinko pavieniai tyrinėtojai – V. Severginas, J. von Ulmanas Lemanas. Didelę įtaką turėjo europinėje Rusijoje, Voluinėje, Podolėje atlikti tyrimai, ypač E. Eichvaldo gamtamokslinė ekspedicija. 1830 m. buvo iš-

leistas M. Engelhardo ir E. Ulprechto Kuržemės dalies plotų, Estijos ir Latvijos geognostinis žemėlapis, informatyvumu pasižymėjo 1891 m. Semiradzko ir Dunikowskio žemėlapis. Ženklių indėlį į kartografijos istoriją įnešė K. Grewingko darbai (1857). XIX a. pabaigoje Lietuvoje dirbo Rusijos geologinio komiteto darbuotojai A. Misuna, A. Giedraitis, E. Tollis. Išsamūs, gausia faktine medžiaga pagrįsti jų geologiniai, geomorfologiniai žemėlapiai buvo naudojami keliasdešimt metų ir tapo stimulu tolimesniems išsamesniems darbams.

Йонас Саткунас, Гайле Жалудене

ДРЕВНИЕ КАРТЫ ТЕРРИТОРИИ ЛИТВЫ (ДО 1926 Г.)

Резюме

История геологического картографирования в Литве имеет древние традиции. Древние карты Литвы и смежных территорий не только имеют историческое значение, но часто поражают своей концептуальностью. Составляя первые геологические карты и располагая малочисленным фактическим материалом, особенно о глубинном геологическом строении, исследователи старались компенсировать это научными предположениями, теоретическими выкладками. Следует упомянуть и первые географические карты Литвы, в которых представлены некоторые сведения по гидрографии и геоморфологии. Это карта Средней Европы, составленная N. Cusanus (1450 г.), карта Польши, Венгрии, Богемии, Германии, России и Литвы, составленная M. Beneventanus (1507 г.). Наиважнейшими картографическими отображениями и геологическими картами Литвы и смежных территорий до 1926 г. являются карты S. Staszic (1806 г.) и J. Guettard (1764 г.). После разделения Польши важное значение имели карты D. Montpereux и I. Domeyko. Много картографического материала собрали отдельные исследователи: V. Severgin, J. von Ulman, Leman. Огромное значение имели исследования смежных областей Европейской России – в пределах тогдашней Волынской и Подольской губерний. Исторической была экспедиция профессора Э. Эйхвальда. Информативны изданные в 1830 г. геогностические карты M. Engelhard и E. Ulprecht территорий Эстонии, Латвии, части Курляндии. В 1891 г. была издана карта J. Semiradzki и E. Dunikowski. Значительным вкладом в историю картографии являются работы K. Grewingko (1857 г.). В конце XIX в. в Литве работали сотрудники Российского геологического комитета А. Мисуна, А. Гедройц, Е. Толь. Составленные ими карты были исчерпывающими, обосновывались обильным фактическим материалом. Ими использовались несколько десятилетий, и такие карты являлись стимулом для дальнейших работ.