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KRYSTYNA CIARKOWSKA*, ANNA MIECHÓWKA

University of Agriculture in Krakow, Institute of Soil Science and Agrophysics, Soil Science and Soil Protection Department
Al. Mickiewicza 21, 31-120 Kraków, Poland

Gypsic rendzinas of Nida Basin (southern Poland): a review

Abstract: The article presents the overview of the gypsic rendzinas that occur in the Nida Basin (Niecka Nidziańska) as based on authors' results and observations and also literature data. The influence of gypsum forms (selenite, shale and compact gypsum) and allogenic admixtures on the properties of rendzinas was described. Furthermore, attention was paid to the specific climate conditions of the Nida Basin reflected in the native vegetation cover on the gypsum-derived soils. Finally, there is a proposal for classification of this area's gypsic rendzinas and the soil properties were described for the specified soil units.

Key words: Rendzinas, gypsum, Nida Basin, xerothermic grasslands

INTRODUCTION

The Nida Basin location, gypsum rock characteristics and landscape values

The Nida Basin (in Polish: Niecka Nidziańska) is a vast depression in the Małopolska Upland located between the Świętokrzyskie Mountains and the Kraków-Częstochowa Upland (Southern Poland), situated at an altitude of 200–300 m a.s.l. The Nida Basin is a Jurassic syncline filled with the upper Cretaceous marls, on which a warm, shallow sea appeared in the Tortonian age (Miocene) leaving a series of evaporation deposits (Rutkowski 1986). The chemical sedimentation cycle started with the precipitation of gypsum, as the least soluble, and ended with the precipitation of the most soluble potassium, sodium and magnesium salts. In the northern part of the gypsum sedimentation basin, a change of sulphate to carbonate faction occurred, manifested as lithothamnium limestone laterally contacting with gypsum rocks (Kwiatkowski 1972a, 1972b). Other Miocene sediments remaining after the sea regression are sandy loams, clays and marls. In the Pleistocene period, the Nida Basin was enveloped by Sanian glaciation only (Marks 2005), which resulted in terrain coverage with glacial sands, loams, loess and alluvial sediments. The Nida Basin has been to a large degree free of a glacial cover during the further Pleistocene glaciations mainly due to its higher location compared to the central Polish lowlands. Therefore a characteristic landscape feature are the semi spherical hills with a gypsum core on the left bank of the Nida river. This landscape associated with gypsum outcrops can be observed in many places mainly around the towns Wiślica, Busko Zdrój, and Pińczów. Also, the gypsum landscape is characterized by the gypsum karst phenomena, which is unique for Poland (e.g. in the vicinity of Skorocice village) (Flis 1954).

Gypsum deposits have a regular and uniform character. A layer of large crystalline gypsum (socalled selenite) with crystals up to 3 m long, set vertically and with characteristic 'swallow tails' forms the basement. The overlying layer is a gypsum breccia, consisting of chaotically arranged selenite crystals with spaces containing marl-gypsum infilling. Moreover, an alabaster (compact gypsum) and shale gypsum occur in the uppermost layer of the gypsum deposits. Each of the gypsum forms appears on the land surface as a geological substratum for the soil formation (Kwiatkowski 1972b, Rutkowski 1986, Bąbel 1987, Kasprzyk 1988). Apart from gypsum, the main components of gypsum rock include calcite, clay minerals (about 4% of each) and quartz (1.5–10%) (Kasprzyk 1988).

The Nida Basin climate and native vegetation

The climate of the Nida Basin differs from the surrounding eastern and western parts of the Małopolska Upland. The annual precipitation is lower than in the surrounding regions and amounts to about 540–700 mm. Deviations from the average appear as periods of droughts that occur usually every 2 years. The majority of precipitation (65–69%) takes place normally from April to September, which indicates its continental distribution. The area is characterized by a higher mean annual temperature than the Polish

**Krystyna Ciarkowska, rrciarko@cyf-kr.edu.pl*

average, ranging between 7.2 and 7.6°C (Paszyński and Kluge 1986). The xerothermic conditions, prevailing especially on the slopes of gypsum hills with southern and south-western exposure, contribute to the strong heating of soils.

The specific microclimate of the Nida Basin results in vegetation cover that is both unusual for the landscape of Poland and characterized by high biodiversity. Soils on the gypsum hills are covered with xerothermic grass communities, mainly of the *Festuco-Brometea* class, and also: *Sisymbrio-Stipetum capillatae*, *Potentillo-Stipetum capillatae, Koelerio-Festucetum rupicolae*, *Seslerio-Scorzoneretum purpureae, Thalictro-Salvietum pratensis*, *Adonido-Brachypodietum pinnati* (Medwecka-Kornaś 1959, Łuszczyński and Łuszczyńska 2009, Towpasz and Stachurska-Swakoń 2012). Also the moss communities, mainly from the family of *Potinaceae*, occur together with xerothermic grass interwoven within the patches of termophilous hazel scrubs and small oak forests. These communities are usually loosely scattered and form a semi-natural landscapes similar to "park forest" or forest-steppe of the south-eastern Europe (Medwecka-Kornaś 1959). Specific climate conditions of the Nida Basin and steppe plant associations caused the preservation of relic thermophilic insects habitats (Flis 1956). Xerothermic plant associations have been preserved in places unsuitable for agriculture, mainly on slopes covered with shallow soils, presently protected as nature reserves. However, most of the area of the Nida Basin is occupied by deep and fertile soils, typically used for agriculture.

A brief review of the studies on the gypsic soils in the Nida Basin

Gypsum rocks have been the subject of scientific research for over 100 years. These attracted interest due to the need to identify gypsum resources as a raw material for possible exploitation (Flis 1956, Kwiatkowski 1972b, Łyczewska 1972, Rutkowski 1983, Bąbel 1987, Kasprzyk 1988). Wala (1962) and Barcicki (2004) presented a very detailed lithostratigraphic division of the gypsum series that distinguished the layers repeated throughout the entire Nida Basin area. The Nida Basin has also been the object of interest for naturalists. Many studies have been dedicated to landscape values and the area's unique vegetation (e.g. Cabaj and Nowak 1986, Drzał and Kleczkowski 1986, Nowak 1986, Bednarz 1987, Szwagrzyk 1987, Medwecka-Kornaś and Kornaś 1992). A detailed description of plant communities present in the Skorocice Reserve was provided by Medwecka-Kornaś (1959), whereas the role of vegetation in the weathering of gypsum rocks was emphasized by Lelek (2007). However, the gypsum soils formed in the area under discussion have not been a frequent subject of detailed research. The only major item dealing with these soils was Strzemski's work (1950). He characterized the rendzinas and gypsum deluvial soils, called "borowiny" near Busko and Wiślica towns, based on the field studies and laboratory analysis. Strzemski (1950) was the first to establish the area of gypsum rendzinas occurrence, which amounts to 3890 ha, as well as these soils classification. He stated that gypsic soils could be both "mixed" rendzinas derived from gypsum and the Pleistocene (glacial or periglacial) deposits, and the "real" gypsic rendzinas that have some admixture of quartz and aluminosilicates resulting from their presence in gypsum rocks, thus possibly being as "pure" as carbonate rendzinas. Strzemski (1950) divided the real gypsic rendzinas according to the gypsum form that was the parent rock: selenite, alabaster and selenite-alabaster rendzinas. Among the latter, he distinguished the rubble rendzinas (usually thin, up to 25 cm) and the fine rendzinas (usually deep, >75 cm). Moreover, Strzemski (1950) introduced a distinction of gypsic rendzinas into the real proper gypsic rendzinas and deluvial gypsic rendzinas ('borowinowe'). Real proper rendzinas were derived *in situ* from gypsum and their humus horizons were accumulated *in situ,* whereas in deluvial gypsic rendzinas ('borowinowe rendzinas') the humus horizons were washed away and deposited on the gypsum rocks.

Properties of gypsic rendzinas were also briefly described in the Rendzinas of Poland monograph (Dobrzański et al. 1987) and by Medwecka-Kornaś (1959) mentioned in a study of Skorocice Reserve vegetation. Kuźnicki and Skłodowski (1968) investigated the humus fractions mainly in the carbonate rendzinas, but they showed also the characteristics of gypsic rendzina Nida Basin humus.

A set of papers was written later on by Ciarkowska (1999, 2000, 2001), Niemyska-Łukaszuk and Ciarkowska (2001), as well as Ciarkowska and Niemyska-Łukaszuk (2002), who presented the detailed characteristics of Nida Basin gypsic rendzinas with particular attention paid to the mineral composition of the clay fraction, sorption properties, abundance in macronutrients (P, K, Mg), factors determining humus quantity and quality as well as the microstructure of the humus horizons. Ciarkowska (2000) distinguished also the mixed brown and pure rendzinas derived from compact (alabaster) and shale gypsum.

Soils derived from gypsum rocks occur very rarely but they are interesting for soil scientists as they are an uncommon example of the formation of soils with a small share of quartz–silicate components (like soils on limestone). Furthermore, the soils are derived from the parent rock, which is one of the most easily weathered, and soluble, thus most of the processes duration taking place in gypsum rocks is comparable with the human time scale (Goryachkin et al. 2003).

Besides gypsum soils in Nida Basin, soil formed on hard gypsum rocks were described by Goryachkin et al. (2003) in the northern taiga of European Russia. These authors stated that the existence of the soil profile on hard gypsum was only possible in the case when the rate of physical disintegration of gypsum rock was much higher than the rate of its dissolution. In the northern taiga, soils formed on hard gypsum had an acid reaction in organic horizons and a slightly acid reaction in mineral horizons, and were both non-calcareous and calcareous. Calcite in calcareous soils formed on hard gypsum were inherited from the parent rock. Ciarkowska et al. (2002) and Ciarkowska and Niemyska-Łukaszuk (2004) studied soils derived from gypsum in the Italian Dolomites. They compared gypsic rendzinas from the Nida Basin to those derived from gypsum in Italian Dolomites, finding that the gypsic soils in both regions were similar in texture, pH and soil organic matter (SOM) content, but different in terms of humification process intensity SOM in Italian gypsic rendzinas was more humified and characterized by a higher biological activity than in the gypsic rendzinas of the Nida Basin because of the differing climatic conditions (higher rainfalls and temperature in the Dolomites than in the Nida Basin).

The main aim of the present work was to familiarize the reader with rendzinas derived from gypsum located in the Nida Basin (southern Poland). The characteristic features of these exceptional soils were presented using the literature data as well as unpublished results including the author's own insights and observations.

PROPOSAL OF CLASSIFICATION OF NIDA BASIN GYPSIC RENDZINAS

The classification of the gypsic rendzinas was adapted to the specifics of the rendzinas derived from the gypsum. Gypsic rendzinas included soils containing, at the depth of not more than 50 cm:

a) a solid gypsum rock, or

b) containing at least 10% of the gypsum skeleton and the gypsiric or calcaric material (*sensu* IUSS Working Group WRB, 2015), or

c) above 50% $CaSO_4 \cdot 2H_2O$ in the earth parts

Four types of the gypsic rendzinas were distinguished (Table 1). English terminology of gypsic rendzinas used in this work is after Świtoniak et al. (2016).

TABLE 1. Proposal of gypsic rendzinas classification

Types	Characteristics
Raw rendzina	thickness ≤10 cm
Proper rendzina	thickness > 10 cm, no diagnostic horizons*
Chernozemic rendzina	having mollic or chernic horizon*
Brown rendzina	having cambic*, no mollic horizon*

**sensu* IUSS Working Group WRB (2015).

MORPHOLOGY AND PROPERTIES OF RENDZINAS DERIVED FROM GYPSUM

The gypsic rendzinas in the Nida Basin were derived from all forms of gypsum including selenite, compact gypsum and shale gypsum. The criteria for abovementioned rendzinas are those most often met in soils derived from selenite. In soils derived from compact and shale gypsum (thus forms that are easily weathered and contain higher amounts of minerals, mainly quartz and clay minerals, other than gypsum), at up to 50 cm of depth, skeletal parts do not occur and in fine earth parts minerals other than gypsum prevail. The form of gypsum influenced soil texture and especially the amount of clay. Selenite soils usually contained less than 15% of clay, whereas rendzinas derived from compact and shale gypsum were heavier with the amount of clay exceeding 15% (Table 2). Among the gypsic rendzinas, both pure and the mixed were identified. The pure rendzinas were derived from gypsic rock, which contain some admixtures quartz or clay minerals, whereas the mixed rendzinas were formed from gypsum and geologically younger sedimentary rock, usually Pleistocene sand or loess overlying gypsum. The mixed rendzinas can be distinguished from the pure by (i) a change in texture within the soil profile, (ii) accumulation of quartz in topsoil horizons observed in the thin sections and (iii) accumulation of SiO_2 in topsoil horizons.

A common feature of all gypsic rendzinas is very high base saturation exceeding 90% in a majority of profiles, neutral or basic soil reaction (usually pH_{KCl} between 6.7–7.4) and a presence of carbonates including the secondary kind. Another feature of these soils is the black colour (2/1 by Munsell charts) unusual for Polish soils, high content of humus (1.4–12.5%) of soil organic carbon (SOC)) and a low C/N ratio (7.9–10.9) in topsoil or even in deeper horizons, and an extremely well developed and strong crumb structure, stabilized by calcium cations.

TABLE 2. Properties and WRB classification of selected gypsic rendzinas

Profile	Depth (cm)	Colour	>2 mm (%)	Texture FAO (2006)	<0.002 mm (%)	pH_{KCl}	$CaCO_3$	SOC (%)	C/N	BS (%)
1. Raw rendzina, *Eutric Gypsiric Lithic Leptosol (Siltic)*, Chotel Czerwony, slope 20°S, selenite, xerothermic grassland										
AC	0–7	10YR 7/2	30	SiL	9	4.8	0.0	1.8	10.3	98.6
2. Raw rendzina, *Eutric Gypsiric Lithic Leptosol (Loamic)*, Chotel Czerwony, slope 70° N, selenite, xerothermic grassland										
AC	0–9	10YR 1.7/1	30	SL	2	6.3	0.0	12.5	11.2	77.1
3. Proper rendzina, *Calcaric Gypsiric Endoleptic Regosol (Siltic, Humic)*, Gacki, flat area, shale gypsum, xerothermic grassland										
Ak	0–27	7.5YR 4/1	0	SiL	8	7.2	5.0	1.4	9.1	99.5
AC	27–37	7.5YR 6/2	0	SiL	8	7.3	4.6	0.9	8.4	99.6
Ccacs	37–67	7.5YR 8/2	0	SiL	7	7.4	6.4	0.3	8.3	99.8
4. Proper rendzina, *Eutric Gypsiric Epileptic Regosol (Siltic, Humic)*, Skorocice, ridge of a mild slope 8°W, selenite with Pleistocene sand, xerothermic grassland										
A	0–5	10YR 2/1	10	SL	9	5.8	0.5	7.6	8.5	82.2
A/C	5–20	10YR 8/1 and 5/2	20	SiL	13	7.2	4.0	2.1	8.2	99.7
Ccs	20–35	10YR 8/1	30	SiL	15	7.3	1.5	nd	nd	99.5
Ccs	35–(55)	10YR 8/1	30	SiL	15	7.3	1.5	nd	nd	99.5
5. Chernozemic rendzina, *Calcaric Gypsiric Endoleptic Chernic Phaeozem (Loamic)*, Stawiany, flat area, compact gypsum, arable land										
Ap	0–14	10YR 3/1	0	CL	32	7.1	5.5	5.3	9.9	96.8
Ak	14–45	10YR 2/1	0	CL	32	7.2	4.7	3.2	9.2	97.1
AC	45–87	10YR 2/1	10	CL	27	7.8	9.0	2.6	8.3	97.2
Ccacs	>87	10YR 6/1	15	CL	29	7.9	9.1	nd	nd	nd
6. Chernozemic rendzina, *Calcaric Gypsiric Endoleptic Chernic Phaeozem (Loamic)*, Stawiany, flat area, selenite with Pleistocene sand, xerothermic grassland										
Ak	0–18	10YR 1,7/1	0	SL	8	7.1	3.8	3.93	12.3	98.4
AC	18–35	10YR 2/1	5	SL	6	7.3	1.4	2.64	8.5	98.8
Cca	35–43	10YR 8/2	90	Si	7	7.7	1.5	nd	nd	99.1
7. Chernozemic rendzina, *Calcaric Gypsiric Endoleptic Chernic Phaeozem (Loamic)*, Skotniki Górne, flat area, selenite with Pleistocene sand, xerothermic grassland										
A1	0–25	7.5YR 1.7/1	5	SL	10	7.5	20.4	3.52	11.1	98.7
A2	25–55	10YR 2/1	20	SiL	10	7.6	24.7	1.91	9.1	99.1
Cca	55–96	10YR 8/3	30	SiL	9	7.6	30.0	nd	nd	99.2
8.Typical brown rendzina, *Eutric Gypsiric Epileptic Cambisol (Loamic, Humic)*, Bogucice, selenite with Pleistocene sand, undulated area, xerothermic grassland										
A	0–19	7.5YR 2/2	5	SL	6	6.7	0.0	2.8	9.5	97.6
BC1	19–35	7.5YR 4/3 and 8/4	10	SL	10	7.3	0.0	0.2	11.5	99.5
BC2	35–40	7.5YR 8/3	20	SL	11	7.1	0.0	nd	nd	99.0

SOC – soil organic carbon, SiL – silt loam, SL – sandy loam, L – loam, Si – silt, CL – clay loam, BS – base saturation.

Raw rendzinas

Raw rendzinas are shallow soils that can be found in higher parts of steep hill slopes or in rock crevices, cracks or fissures in which plant roots have entered dissolving gypsum (Lelek 2007). There are pure and mixed rendzinas underlaid by a selenite with big glossy crystals. Humus horizons lying directly on the rock contain a selenite skeleton. In earth parts of pure raw rendzinas, gypsic minerals dominate, which is indicated by a high SO_3 content (Table 3, profile 1). When in earth parts of mixed rendzinas, smaller or bigger admixtures of younger deposits occur – most often fluvio-peryglacial sands which constitute the prevailing fine earth parts (Table 1, profile 2). Pure and mixed rendzinas are often located in the close neighborhood (Table 1, profiles 1 and 2). Selenite is the most pure among the gypsum forms, containing between 90–95% of $CaSO_4{\cdot}2H_2O$ (Kwiatkowski 1972b), thus the soils derived do not contain carbonates and have an acidic or slightly acidic soil reaction (Table 2, profiles 1, 2). Raw rocky rendzinas' features

TABLE 3. Total chemical analysis of fine earth parts in Na_2CO_3 of selected gypsic rendzinas

Profile	Horizon	Depth (cm)	LOI* (%)	SiO_2	Al_2O3	Fe_2O_3	CaO	MgO	SO_3
1	AC	0–7	21.2	4.0	0.6	0.4	31.6	0.5	40.0
2	AC	0–9	22.6	54.4	5.6	3.4	2.3	1.4	0.1
3	Ak	0–27	24.9	8.1	0.9	0.4	23.6	0.5	31.2
	AC	27–37	24.1	5.0	0.6	0.4	27.3	0.8	37.8
	Ccacs	37–67	22.6	3.6	0.8	0.5	27.6	0.6	37.9
4	A	0–5	42.4	26.2	3.0	0.4	9.4	1.2	12.1
	A/C	5–20	24.6	13.1	0.7	0.6	27.7	0.6	32.5
	C1cs	20–35	22.2	11.4	1.6	1.1	21.7	0.9	32.9
	C2cs	35–(55)	21.7	1.4	0.4	0.3	25.1	0.8	38.3
5	Ap	0–14	18.5	58.5	9.4	4.0	4.7	2.2	0.1
	Ak	14–45	15.6	63.1	8.6	3.6	4.6	2.2	0.1
	AC	45–87	18.0	61.9	8.2	2.6	3.9	1.8	0.1
	Ccacs	>87	26.1	3.4	0.2	0.2	26.6	0.5	37.5
8	A	0–19	9.6	48.4	3.1	1.5	7.6	1.2	21.2
	BC1	19–35	18.6	11.0	1.2	0.7	23.6	1.7	35.5
	BC2	35–40	14.3	14.9	1.9	0.9	25.4	1.1	39.3

*LOI: Loss on ignition (960^0C).

are affected strongly by slope exposure. Soils on the sunny and dry southern slopes are shallower with a much lower amount of the organic matter (below 2% of SOC) than the ones situated on the northern slopes. The northern slopes are comparatively shady, therefore the soils situated there are somewhat deeper, more humid, and have a higher content of organic matter (up to 12.5% of SOC). Raw rocky rendzinas are covered most often with 'feather-grass steppe' (*Sisymbrio-Stipetum capillatae*). However, gypsum rock appears on the land surface locally between the clusters of grasses and perennial herbs. In spring, a lot of annual flowers bloom there i.e. *Arabis recta, Medicago minima, Veronica praecox* etc. (Medwecka-Kornaś 1959, Medwecka-Kornaś and Kornaś 1992).

Proper rendzinas

Proper rendzinas can be found on the slopes usually below the raw rocky rendzinas mainly on shale or selenite gypsum. Their profiles are composed of humus horizons, then the transitional or mixed horizons which contain humus and powdered gypsum, underlaid by the unweathered gypsum rock (Table 2, profiles 3 and 4). Some contain a high amount of organic carbon (SOC) in topsoil horizons that are too thin to meet the criteria of mollic horizons (Table 2, profile 4). The form of gypsum from which they derived determines the content of rock fragments and carbonate content. Shale gypsum contains more carbonates and is faster disintegrated than selenite thus rendzinas derived from this form of gypsum and contain more carbonates and less skeletal parts, which are strongly weathered and crumbling. Typical proper rendzinas derived from shale gypsum are pure (Table 2, profile 4), contain small and equal amounts of SiO_2 and high amounts of SO_3 in the whole profile (Table 3, profile 3). In its top horizon, secondary carbonates in forms of pore incrustations (risolites) occurred as indicated by micromorphological studies (Ciarkowska and Niemyska-Łukaszuk 2002). Calcium carbonate accumulation in upper part of profiles resulted mainly from the translocation of soluble bicarbonates in the soil solution and their precipitation (Ferreira et al. 2016). Some proper rendzinas (Table 2, profile 4) belong to mixed rendzinas. They are slightly gravelly in the top horizon and medium in bottom. In the topsoil horizon, small amounts of carbonates with a high amounts of SiO_2 and Al_2O_3 resulting from the Pleistocene sand admixture occur (Table 3, profile 4). Typical proper rendzinas, similarly to raw rendzinas, are usually covered with the 'feather-grass steppe' (*Sisymbrio-Stipetum capillatae*). These can be found in the Skorocice Reserve under the *Seslerio-Scorzoneretum purpureae* association (Medwecka-Kornaś 1959).

Chernozemic rendzinas

Chernozemic rendzinas are usually located on flat areas or in footslopes regardless of their exposition. The main characteristics of these soils is the presence of chernic or mollic horizons and the depth of the whole humus horizon may exceed 60 cm. Soils of this type are quite deep (even deeper than 90 cm), without rock fragments in the humus horizons and with increasing amounts of skeletal parts and carbonates as the profiles deepen (Table 2, profiles 5, 6, 7). Secondary carbonates are also observed, both macroscopically as a white powder on soil aggregates, and microscopically as carbonate concretions, nodules or pore incrustations. Chernozemic rendzinas often are mixed, as these have high SiO_2 content accumulated in the upper and medium part of the soil profile besides the bottom horizon. Usually, in the major part of the soil, there are small amounts of SO_3. High SO_3 (about 40%) content is most often found only at the bottom horizons (Table 3, profile 5). A characteristic feature of chernozemic rendzinas was also the uniformity of the soil solum related to the action of earthworms and other soil fauna representatives of which large amounts of fecal pellets were observed in thin sections (Ciarkowska and Niemyska-Łukaszuk 2002). The activity of soil fauna has led to the homogenization of the soil material and, as a consequence, to the formation of spongy microstructure composed of well-decomposed organic matter mixed with calcium carbonate in a form of mullicol (Brewer and Sleeman 1988). Gypsic humic rendzinas are deep, warm and rich in organic matter and calcium carbonate, as well as they have a slightly alkaline reaction and therefore these soils form a very attractive habitat for soil fauna, even in soils used as arable lands. Chernozemic rendzinas are covered with the following plant associations: *Seslerio-Scorzoneretum purpureae* (Medwecka-Kornaś 1959, Towpasz and Stachurska-Swakoń 2012) *Thalictro-Salvietum pratensis* (Medwecka-Kornaś 1959) and *Adonido-Brachypodietum pinnati* (Łuszczyński and Łuszczyńska 2009) or used as arable land.

Brown rendzinas

Gypsic brown rendzinas, which have a well-developed cambic horizon, are the least common type of soil derived from gypsum rock. These could be found on the outskirts of the occurrence of proper gypsic rendzinas. Gypsic brown rendzinas were described by Ciarkowska (2000) as soils characterized by 'in situ' accumulation of clay with a characteristic lattice-like arrangement (seen in thin sections). Brown rendzinas are covered by xerothermic grasslands or are used as arable land.

CONCLUSIONS

The rendzinas derived from gypsum occur in Poland mainly in one relatively small area, i.e. in the Nida Basin, and all share similar climatic and physiographic conditions. A specific microclimate of the Nida Basin (warmer and drier than average in Poland) resulted in xerothermic grassland, which forms a natural cover for gypsic soils.

Diversity of the gypsic rendzinas is caused by both a variety of gypsum forms, mainly by the differences in chemical composition, such as the content of carbonates and sand as well as admixtures of geologically younger, foreign material (sand or loess).

Gypsic rendzinas are most often derived from selenite. Soils derived from shale or compact gypsum are often deeper and without skeletal parts and therefore they sometimes do not meet the criteria for rendzinas. Selenite is the purest among gypsum forms, thus the soils formed have lower carbonate, silicate and clay content unless they have admixtures of allogenic material (mainly sand).

The gypsic rendzinas have usually been described and classified at the margins of-carbonate rendzinas. In the proposed classification, four types of gypsic rendzinas were listed among which the raw, proper, and chernozemic rendzinas differ mainly in the thickness of the profile or the thickness of humic horizons.

It is worth noting that deep soils without gypsum rocks fragments in their profiles occur on Nida Basin gypsum rocks that were not included in this review as they do not meet the requirements of rendzinas. Considering the geological diversification of Nida Basin area, and the not as yet fully recognized process of soil formation from gypsum rocks under the specific climatic conditions of this area, further studies on these rare very interesting soils are required.

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Rędziny gipsowe Niecki Nidziańskiej (południowa Polska)

Streszczenie: W artykule przedstawiono charakterystykę rędzin wytworzonych z gipsów występujących w Niecce Nidziańskiej w oparciu o dane literaturowe oraz niepublikowane wyniki autorów. Zwrócono uwagę na specyficzne warunki klimatyczne Niecki Nidziańskiej i naturalną roślinność pokrywającą rędziny gipsowe. Ponadto przedstawiono rezultaty dotychczasowych badań rędzin gipsowych tego regionu. Scharakteryzowano wpływ różnych form skał gipsowych (selenit, łupek ilasty i gips zbity) oraz ich domieszek na właściwości wytworzonych gleb. W pracy zamieszczono propozycję klasyfikacji rędzin gipsowych terenu Niecki Nidziańskiej oraz podano charakterystykę właściwości gleb według wyróżnionych jednostek taksonomicznych.

Słowa kluczowe: rędziny, gips, Niecka Nidziańska, murawy kserotermiczne