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STUDIES OF THE CHEMICAL COMPOSITION OF GLAUCONITE FROM THE ORDOVICIAN SEDIMENTS OF NE POLAND

PART I. SEPARATION OF GLAUCONITE GRAINS AND THEIR MORPHOLOGY, DETERMINATION OF DENSITY AND CATION-EXCHANGE CAPACITY, THERMAL ANALYSIS

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Abstract. The glauconites studied were derived from the Ordovician (Arenigian) glauconitites of NE Poland. This paper describes the method of separation of glauconites from the parent rocks and their purification. Determinations of density, cation-exchange capacity, and thermal analysis were performed on 15 glauconite samples. The results, as well as the morphology of glauconite grains, are a subject of discussion.

INTRODUCTION

Petrographic studies of the Ordovician sediments of north-eastern Poland revealed that a number of drill cores contained a thin intercalation of a rock defined as glauconitite, with glauconite as the principal rock-forming mineral (Langier-Kuźniarowa, 1967, 1968, 1969, 1971, 1974, 1974a, b, 1977). Stratigraphic investigations permitted assigning this glauconitite to the Arenigian (Tomczykowa, 1964; Znosko, 1964; Modliński, 1973; Szymański, 1973). Some problems related to the genesis, age and properties of the glauconite originating from the Ordovician glauconitites of NE Poland were discussed by Turnau-Morawska (1963), Langier-Kuźniarowa, Lazarenko, Fienoshina (1963), Parachoniak (1968), and Turnau-Morawska, Łacka, Wiewióra (1975).

The above petrographic and stratigraphic determinations afforded a rare opportunity to perform experimental studies of the chemical composition and properties of glauconites of defined and identical age. Investigations were carried out on 15 glauconite samples which were separated from glauconitites derived from 14 boreholes situated in (Fig. 1):

1. Baltic Depression – boreholes Bartoszyce, Gołdap, Kętrzyn IG-1, Olsztyn IG-2,

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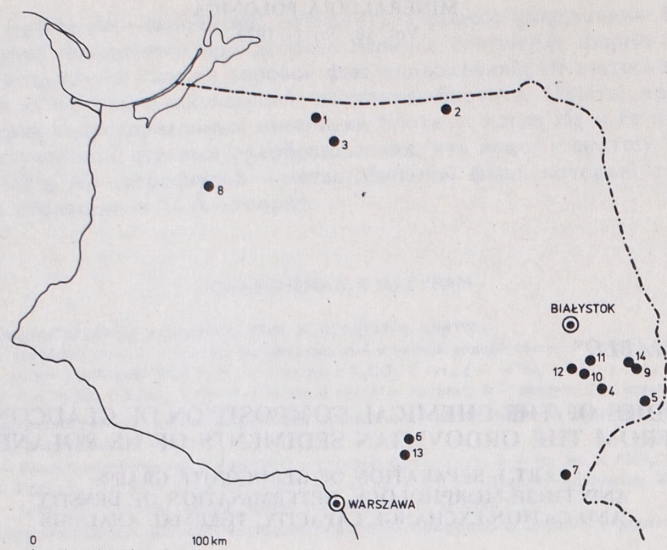


Fig. 1. Location of boreholes from which glauconite samples were derived

1 - Bartoszyce, 2 - Goldap, 3 - Kętrzyn IG-1, 4 - Krzywa, 5 - Krzyże, 6 - Łochów IG-1, 7 - Mielnik, 8 - Olsztyn IG-2, 9 - Podborowisko, 10 - Rajsk, 11 - Ryboły, 12 - Strabla, 13 - Tłuszcz, 14 - Wałki

2. Podlasie Depression - boreholes Krzywa, Krzyże, Łochów IG-1, Mielnik, Podborowisko, Rajsk, Ryboły, Strabla (light and dark glauconite varieties), Tłuszcz, Wałki.

The names of boreholes, sampling depth, and the size of glauconite grains in thin sections acc. to Langier-Kuźniarowa are given in Table 1.

EXPERIMENTAL

Separation of glauconite grains and their morphology

Glauconites were carefully ground in a steel mortar. The broken material was sifted many times through a sieve of a mesh diameter selected so as to allow the largest, free from intergrowths, glauconite grains to pass freely. Then the whole

Table 1

List of boreholes, sampling depths and sizes of glauconite grains (after Langier-Kuźniarowa, 1967, 1968, 1969, 1971, 1974, 1974a, 1974b, 1977)

Localization of borehole	Sampling depth m	Grain-size of glauconite (in thin section) mm
Bartoszyce	1890.3	0.2-0.8
Goldap	1479.6	0.08-0.6
Kętrzyn IG-1	1612.8	0.08-0.2
Krzywa	439.9	0.04-0.7
Krzyże	483.7	0.2
Łochów IG-1	1633.2	up to 2.0
Mielnik	1177.9	0.15-0.5
Olsztyn IG-2	2445.1	0.08-0.8
Podborowisko	398.5	0.01-1.0
Rajsk	542.9-543.4	0.08-0.7
Ryboły	524.4	0.08-0.7
Strabla	576.8	0.1-0.3
light variety		and smaller
Strabla	576.8	0.1-0.3
dark variety		and smaller
Tłuszcz	1990.3	0.04-1.0
Wałki	374.9	0.04-2.0

sample was placed on a 0.06 mm - mesh sieve and washed with water until the < 0.06 mm fraction was separated. This fraction was discarded as pure glauconite could not be obtained from it by any known method. The fraction > 0.06 mm was dried at room temperature.

According to the need, glauconite concentrate was obtained either from the whole sample or one size-graded into fractions every 0.1 mm, using single or repeated electromagnetic separation and separation in bromoform. From the glauconite concentrates small samples were taken by quartering, from which grains of pure glauconite for infrared spectroscopic investigations were hand-picked with the aid of a magnifying glass. The concentrate failed to be obtained from the Olsztyn IG-2 sample because of the lack of sufficient material. The bulk of glauconite concentrates was treated with hot 2% HCl solution, washed with distilled water, dried, and separated again electromagnetically and in bromoform. The resulting concentrates contained over 95% of glauconite. Final purification of glauconite was done by hand under the binocular microscope. Samples of purified glauconite were ground in an agate mortar and subjected to chemical, infrared spectroscopic, thermal and X-ray analyses, as well as to determinations of the cation-exchange capacity.

On the basis of microscopic observation at varying magnifications, the glauconite grains were divided according to their external features into three groups.

To the first group were assigned dark-green grains from the samples Bartoszyce, Goldap (Phot. 1), Olsztyn IG-2, and somewhat lighter grains from the sample Kętrzyn IG-1 (Phot. 2). A few light-green grains were also found in the samples Bartoszyce and Olsztyn IG-2. The grains of this group show differentiation in size and shape, the maximum size being 0.8 mm, but grains more than 1 mm also occur in the Goldap sample. Among large grains flattened, triangular, reniform, and sometimes elongate specimens can be encountered. Medium and small grains are usually oval, elongate and flat. The surface of grains is smooth and lustrous or mat. The grains from the samples Bartoszyce and Olsztyn IG-2 are sometimes coated with white rims.

The second group is represented by grains from the sample Łochów IG-1, Mielnik (Phot. 3), Podborowisko, Rajsk and Ryboły (Phot. 4). The grains vary in colour from dark-green, commonly lighter at the edges (Podborowisko), through intermediate between dark-green and green (Rajsk, Ryboły), to green (Łochów IG-1, Mielnik). The size of grains is differentiated, medium-sized grains up to 0.25 mm being prevalent. The maximum grain size varies from 0.6 mm in the sample Mielnik to more than 2 mm in the sample Łochów IG-1. The grains are little diversified in shape, showing the prevalence of rounded forms. Flat and elongate grains are present in the samples Rajsk and Ryboły. The grain surface is smooth and mat, with visible traces of a brown substance (Łochów IG-1), cracks and fissures (Mielnik, Phot. 3), and a delicate white coating which is more conspicuous at the edges (Ryboły, Phot. 4).

Grains from the samples Krzyże (Phot. 6), Strabla - light variety (Phot. 7), Strabla - dark variety (Phot. 8), Tłuszcz and Wałki were assigned to the third group. The sample Krzyże consists of green and sample Tłuszcz of dark-green glauconite grains. The samples Strabla and Wałki are a mixture of green and dark-green glauconite grains. Since the grains of the Strabla sample differ in magnetic properties, it was possible to separate this mixture and investigate both the light and dark variety. In the sample Wałki green grains are prevalent while the less common dark-green grains are usually larger. The glauconite grains belonging in this group are smaller than those of groups 1 and 2, generally not exceeding 0.3 mm. The microscopic image of the grains is changed due to the grinding of

the rock sample. This refers particularly to the sample Tłuszcz, which is difficult to break because of the considerable hardness and compactness of this glauconitite. However, the features common to all grains of this group are their diversified shapes and sharp, ragged outlines (Photos. 6, 7, 8).

The differences in the habit of grains from the sample Krzywa (Phot. 5) did not allow assigning them to any of the groups discussed. The sample in question consists of green glauconite grains of 0.7–0.8 mm in diameter. The grains are generally oval, with traces of a brown substance on the surface. Their surface is mat, with impressions left by grains of the accompanying minerals (Phot. 5).

Determination of the cation-exchange capacity (CEC)

The cation-exchange capacity of the glauconites studied was determined using the modified method of Cimbalniková (1971). The modification involved a longer treatment of the sample with calcium chloride solution, and a change of the method of calcium determination from complexometric to atomic absorption.

The following procedure was adopted: 1 g of ground glauconite was put in a polyethylene container adding 50 cm³ of 0.25 N calcium chloride, and the container was sealed. Then the sample was shaken for 2 min. every 15 min. within 7 hrs and left overnight. After 24 hrs from the moment of adding CaCl₂, the sample was shaken for 2 min., filter paper pulp was added, the content was shaken again for 2 min. and then passed through hard quantitative filter paper. The filter content was washed with distilled water until reaction for chlorides with silver nitrate was negative. To release calcium from the sample, the filter content was washed with 250 cm³ of 3 N HCl. The resulting acid filtrate was evaporated to dryness, the residue was dissolved in 1 cm³ of 60% HClO₄, and the calcium content was determined using atomic absorption. The residue left on the filter was analyzed for calcium. It was found that the residue of all samples contained less than 0.01% of calcium.

The cation-exchange capacity (CEC) was calculated in mval per 100 g of glauconite, deducting calcium combined with phosphorus. This assumption seems to be correct considering partial at least solubility of calcium phosphates in 3 N HCl, and the virtual absence of calcium in the glauconite samples filtered after the ion exchange. The results are presented in Table 2.

Determination of density

The density of glauconites was determined by the pycnometric method, using glass pycnometers and carbon tetrachloride. Measurements were made on glauconite grains more than 0.15 mm in diameter (Table 2).

Thermal analysis

Thermal analysis of the glauconites studied was kindly made by Professor

Table 2
Density and cation exchange capacity (CEC)
of glauconites

Localization of borehole	Density g/cm ³	CEC mval/100 g
Bartoszyce	2.89	12.92
Goldap	2.85	9.04
Kętrzyn IG-1	2.85	10.28
Krzywa	2.84	15.02
Krzyże	2.84	16.92
Łochów IG-1	2.89	10.92
Mielnik	2.87	13.08
Olsztyn IG-2	2.84	15.98
Podborowisko	2.81	17.02
Rajsk	2.83	15.92
Ryboły	2.82	15.46
Strabla	2.84	13.62
light variety		
Strabla	2.85	13.12
dark variety		
Tłuszcz	2.84	10.92
Wąski	2.82	15.32

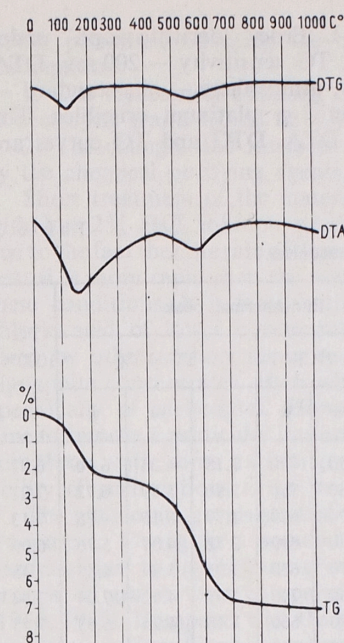


Fig. 2. Thermal analysis curves for Goldap glauconite

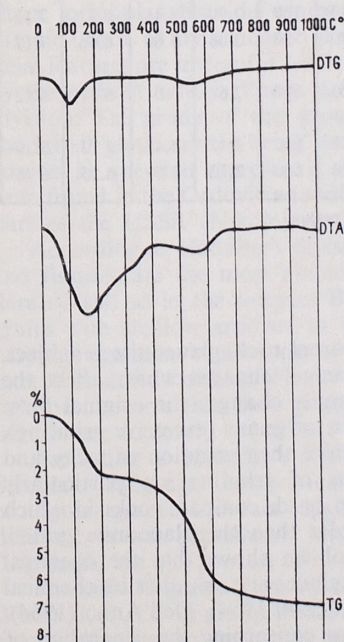


Fig. 4. Thermal analysis curves for Mielnik glauconite

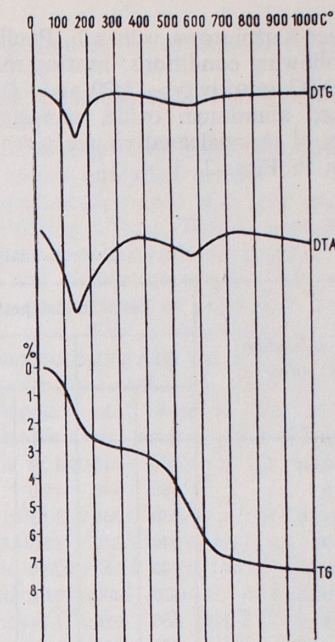


Fig. 3. Thermal analysis curves for Krzyże glauconite

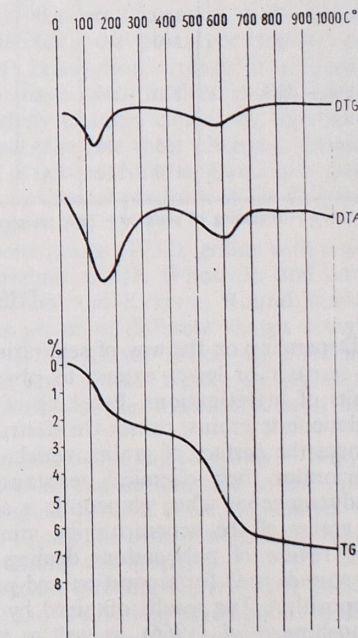


Fig. 5. Thermal analysis curves for Ryboły glauconite

Langier-Kuźniarowa with a F. Paulik, J. Paulik, L. Erdey "derivatograph" under the following conditions: heating rate 10°C/min., TG sensitivity – 200 mg, DTA and DTG sensitivity – 1/20 and 1/15 respectively, atmosphere – air, standard – calcined aluminium oxide, sample mass – about 1 g; platinum crucibles. The results of thermal analysis are given in Table 3. DTA, DTG and TG curves are shown in Figs. 2, 3, 4, 5.

Table 3

Thermal analysis data for glauconites

Localization of borehole	Endothermal peak				Endothermal peak						TG 1000°C w %
	DTA (°C)		TG w %		DTA (°C)			TG w %			
	<i>m</i>	<i>k</i>	<i>m</i>	<i>k</i>	<i>p</i>	<i>m</i>	<i>k</i>	<i>p</i>	<i>m</i>	<i>k</i>	
Bartoszyce	150	410	1.19	2.02	440	570	700	2.18	4.24	6.10	6.47
Goldap	160	440	1.80	2.86	440	580	700	2.86	5.19	6.72	7.21
Kętrzyn IG-1	150	360	1.63	2.47	425	570	680	2.77	5.10	6.58	7.13
Krzywa	140	340	1.26	1.88	460	570	690	2.72	4.82	5.76	6.09
Krzyże	160	360	2.18	2.98	400	570	630	3.15	5.88	6.85	7.35
Łochów IG-1	120	400	2.01	3.02	500	560	700	3.91	4.92	7.04	7.84
Mielnik	150	380	1.74	2.57	490	570	660	3.48	4.95	6.53	7.15
Olsztyn IG-2	160	400	2.01	2.77	460	580	760	3.02	5.13	7.03	7.52
Podborowisko	155	330	1.99	3.08	340	570	700	3.18	5.86	7.63	8.04
Rajsk	160	360	1.80	2.82	480	580	660	3.38	5.41	6.54	7.22
Ryboły	160	340	1.88	2.54	440	590	700	2.90	5.46	6.53	7.12
Strabla – light variety	140	360	1.85	2.42	420	590	700	3.08	5.60	6.66	7.17
Strabla – dark variety	120	200	1.60	2.10	400	570	680	2.61	5.01	6.21	6.82
Łuszcz	155	370	1.25	1.84	430	570	660	2.12	4.42	5.73	6.39
Wałki	170	320	1.43	2.15	430	570	660	2.72	4.50	6.25	6.76

Symbols: p – beginning of peak, m – peak temperature, k – end of peak.

DISCUSSION

Depending on the way of separation from the parent rock, glauconite is subject, to a greater or lesser extent, to physical and chemical changes which affect the results of investigations. Breaking of the rock samples changes the original form of glauconite grains, causes the destruction of a part of grains (excessive grinding), changes the surface of grains, which, in turn, modifies their sorption capacity and deteriorates their chemical resistance. The effects of grinding are particularly disadvantageous when glauconite is separated from hard, compact rocks in which the grains of the accompanying minerals are harder than the glauconite grains.

A review of publications dealing with this problem shows that the chemical compounds used for separation and purification of glauconite can alter its chemical composition. The results obtained by Smulikowski (1924, 1954), Dell'Anno (1964), Fienoshina *et al.* (1966), as well as the instructions concerning the separation of glauconite given in the papers of Hessland *et al.* (1949), Łacka (1968) and Odin

(1969) permitted adopting the experimental procedure based on the following assumptions:

1. The mechanical breaking of rocks should be conducted so that the amount of destroyed grains would be as small as possible.

2. The changes and losses in the chemical composition of glauconite, induced by the chemical purifying agents, should not exceed analytical errors.

Short treatment of the material enriched in glauconite (not of a rock sample) with hot 2% HCl solution produces good purifying effects. This is presumably due to the fact that the rate of decomposition of carbonates and other impurities when heated is more rapid than the rate of corrosion and dissolution of glauconite under these conditions. It is feasible that, depending on the kind of impurities, hydrochloric acid of lower concentration could be used. The concentration of acids given by other authors seems to be higher than necessary for the purification of glauconite concentrates. Hydrochloric acid is perfectly suitable for decomposition, specifically of carbonates. However, an appropriate acid must be selected each time to remove a particular impurity. It is inadvisable to use acids capable of forming complexes with some cations (e.g., aluminium or iron) in view of the increased ability of such cations to go into solution.

The glauconite grains studied were divided into three morphological groups. Owing to a somewhat different nature, the sample Krzywa has not been assigned to any of these groups. In order to define their type, the distinguished groups of grains were compared with the morphological division of Triplehorn (1966, 1967). It appears that the grains of groups 1 (Photos. 1, 2) and 2 (Photos. 3, 4) are intermediate between spheroidal-ovoidal and tabular discoidal grains. The grains of group 1 are flatter and more commonly elongate than those shown by Triplehorn as spheroidal-ovoidal. The grains of group 2 generally correspond in shape to tabular discoidal grains but are usually thicker. The grains of the Krzywa sample (Phot. 5) are similar in shape to the spheroidal – ovoidal type, yet their surficial features are uncomformable to Triplehorn's description. Group 3 distinguished by the present author (Photos. 6, 7, 8) does not have its equivalent in Triplehorn's division. The grains of this group are affected by changes caused by separation, the initial glauconites being hard and compact. Despite these changes, the glauconites in question represent a different type of grains. Similar glauconite grains were found in the Ordovician sediments of the continental platform of the European part of the USSR (Nikolajeva, Borodajevskaja *et al.*, 1971).

According to Hadding's division of glauconite grains (1932), grains with cracks and fissures are the most abundant in the Mielnik sample (Phot. 3), and considerably less so in the samples Bartoszyce, Łochów and Krzywa. Round, smooth grains with shallow grooves, as well as tabular grains of different shapes occur in varying amounts in all samples except those from Krzyże (Phot. 6), Strabla – light and dark varieties (Photos. 7, 8), Łuszcz and Wałki. Basing on Hadding's opinion, it seems that these grains, except from the samples mentioned, must have been more intensely reworked.

According to Hadding's division (1932), grains belonging to group 3 (Krzyże, Strabla – light and dark varieties, Łuszcz, Wałki) can be assigned to the group of angular grains. This fact suggests that the original form of these glauconites was different. It was presumably larger glauconite aggregates which were broken into fragments, but the process of abrasion and rounding was stopped.

The bulk of grains from the samples Bartoszyce, Goldap, Kętrzyn and Olsztyn (Photos. 1, 2), i.e. of group 1 according to the author's division, corresponds in their external features to the grains of types I and Ia in the classification of Nikolajeva, Borodajevskaja *et al.* (1971). These are unaltered (type I) or slightly altered (type Ia)

dark-green grains free from inclusions, with a smooth, usually lustrous surface, few fissures and spots (Olsztyn IG-2), and scarce light-green rims (Bartoszyce).

Grains of type II are poorly represented in the samples studied. Pale green grains containing large inclusions, numerous spots on the surface, a lighter core, and showing evidence of dissolution were rarely detected under the microscope. This type of grains also failed to be found in thin sections (Langier-Kuźniarowa 1967, 1968, 1969, 1971). These facts confirm the observations of Nikolajeva, Borodajevskaja *et al.* (1971) that grains showing this kind of alteration occur in the north-eastern region (near Leningrad).

Group 2 (samples Łochów, Mielnik, Podborowisko, Rajsk, Ryboły) is represented by grains of green glauconite which generally correspond to type III described by Nikolajeva, Borodajevskaja *et al.* (1971). The shape of grains is frequently similar to types I and Ia, but other features are peculiar to type III. The group in question contains fewer broken grains than noticed in the material of type III.

The grains assigned to group 3 (Krzyże, Strabla – light and dark varieties, Tłuszcz, Wałki) resemble in their surficial features (sharp, ragged outlines, rough surface) grains of type IV according to the cited classification. The group in question differs from type IV in colour because the grains in samples Strabla – dark variety, Tłuszcz and Wałki are dark-green. In the sample Krzyże green grains are prevalent although lighter ones are present as well. The sample Wałki contains green grains alongside of the dark-green ones, while the sample Strabla consists of green and dark-green grains in equal proportions. There are virtually no pale green or whitish grains in this group, and, in general, the grains are not multi-coloured or spotted.

The grains of sample Krzywa (Phot. 5) correspond in shape to grains of type Ia, but their colour and the mat surface with impressions show similarity to type III in the cited classification.

It seems that the material under study generally corresponds to the types distinguished by the cited authors. It is worth noting, however, that the samples studied show less advanced changes associated with chemical processes (no evidence of dissolution, lower K_2O content) than glauconites from the Ordovician sediments occurring north-east of the area under study.

According to the data collected by Cimbáliková (1971), the cation-exchange capacity of glauconites ranges between 5 and 40 mval/100 g of glauconite, depending on the surface properties of glauconite grains, the deficiency of potassium cations (exchange cations can occupy the vacant interlayer sites), and the presence of an expanding component of the montmorillonite type (Grim, 1953; Carroll, 1959). It has been found that an increase in the content of the expanding component in glauconite is attended by an increase in the cation-exchange capacity (CEC) and a decrease in the potassium content (Manghnani, Hower, 1964; Cimbáliková, 1971, 1971a). The cation-exchange capacity of glauconites containing 5% and 10% of the expanding component is 5–12 mval/100 g and 7–18 mval/100 g, respectively (Manghnani, Hower, 1964). The corresponding data obtained by Cimbáliková (1971) are: for glauconites containing less than 5% of the expanding component 4.24–24.96 mval/100 g, and for 5–10% of the expanding component – 13.96–22.46 mval/100 g. The cation-exchange capacity of the glauconites studied is 9.04–17.02 mval/100 g (Table 2), which corresponds to an expanding component content of 10% according to Manghnani and Hower (1964), or to 5–10% according to Cimbáliková (1971).

The high potassium content (7.55–8.47% K_2O) in the samples studied also assigns them to the group of glauconites having a low content of the expanding

component (0–10%), which is consistent with the data of Manghnani and Hower (1964) and Cimbáliková (1971a).

The density of the glauconites studied varies over a narrow range from 2.81–2.89 g/cm³ (Table 2). Deer, Howie and Zussman (1962) give for glauconites values of 2.4–2.95 g/cm³. Cimbáliková (1970) cites many data whose range is still wider while her own data for Cretaceous glauconites range between 2.59 g/cm³ (at 20–25% of expanding layers) and 2.79 g/cm³ (at 5% of expanding layers). Valetton (1958) thinks that glauconites showing high density (2.80–2.85 g/cm³) have, as a rule, a structure of the 1M type whereas those regarded to have the 1Md structure show lower density. His opinion was confirmed by Shutov *et al.* (1973), who found that Palaeozoic glauconites had a density varying over a narrow range (2.80–2.85 g/cm³), which was due to the absence of the expanding component, the ordered structure of the 1M type, and the fixed chemical composition.

Thermal curves obtained for glauconites display two or three endothermic peaks at 110–245°C, 450–690°C and 800–980°C (Cvetkov, Valiashichina, 1956; Deer, Howie, Zussman, 1962; Langier-Kuźniarowa, 1967a; Kornieva, Nikolajeva, 1971; Cimbáliková, 1971b; McRae, 1972). The results of thermal analysis are presented in Table 3. Since DTA, DTG and TG curves for the glauconites studied show close similarity, those for the samples Goldap, Krzyże, Mielnik and Ryboły have been selected to provide an illustrative case (Figs. 2, 3, 4, 5).

The first endothermic peak, due to the release of absorption water, is pronounced on the DTA curves. Its maxima are in the temperature range 120–170°C, for most samples between 140–160°C. The corresponding weight loss was read from the TG curves and was found to vary from 1.19% to 2.18%. In the region of the first endothermic peak, the DTA curves slope steeply down to the maximum for all the investigated samples. The first DTA peak is either sharp and narrow (samples Krzyże – Fig. 3, Łochów, Rajsk) or fairly broad (samples Goldap, Mielnik, Ryboły – Figs. 2, 4, 5, and others). Then the DTA curve rises, usually more gently than it slopes down in the initial stage of the effect. The first DTA endothermic peak is not symmetrical. The final temperatures of the first DTA peak and the initial temperatures of the second DTA peak (Table 3) are only approximate because the shape of DTA curves (Figs. 2–5) fails to define precisely these important points.

The second DTA endothermic peak is due to the release of water from hydroxyl groups. Its maxima are at 560–590°C, for 9 out of 15 samples being at 570°C (Table 3). The weight loss corresponding to the second DTA peak, read from TG curves, varies from 4.24% to 5.88%. In the region of the second endothermic peak, DTA curves have gentle slopes, and the peak is well-marked and symmetrical.

The samples studied failed to produce the third DTA endothermic peak which, according to Kornieva and Nikolajeva (1971), some Lower Palaeozoic glauconites display at 900–970°C. The samples Strabla – light and dark variety were the only ones to show a small endothermic peak at about 850°C, but its origin is not clear.

According to Kornieva and Nikolajeva (1971), the first endothermic peak maximum for unaltered Ordovician glauconites appears at 140°C and the corresponding weight loss is 1.8–2.7%. The second endothermic peak reaches its maximum at 560–580°C. The total weight loss varies from 6.6 to 8.0% and the smaller it is, the better ordered is the structure of glauconite, close to the polytype 1M. At the same time, DTA curves for glauconites of the 1M type do not show the third endothermic peak. It appears, therefore, that, except for the Strabla samples, the investigated glauconites satisfy the above conditions.

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Adam CHABŁO

BADANIA SKŁADU CHEMICZNEGO GLAUKONITÓW Z UTWORÓW ORDOWIKU PÓŁNOCNO-WSCHODNIEJ POLSKI

CZĘŚĆ I. WYDZIELANIE I MORFOLOGIA ZIARN GLAUKONITU,
OZNACZENIE GĘSTOŚCI I ZDOLNOŚCI KATIONOWYMIENNEJ,
ANALIZA TERMICZNA

Streszczenie

Badania geologiczne materiałów wiertniczych pochodzących z NE Polski wykazały obecność w wielu rdzeniach wiertniczych cienkich wkładek glaukonity-tów przynależnych do ordowiku (arenig).

W pracy przedstawiono dostosowany do charakteru tych glaukonitytów sposób oczyszczania i wydzielania z nich próbek glaukonitu. Rozkład węglanów, rozluźnianie zrostów i częściowe rozpuszczenie innych zanieczyszczeń uzyskuje się przez krótkie działanie gorącego 2% HCl na koncentrat glaukonitu otrzymany przez elektromagnetyczne i w bromoformie wzbogacenie w glaukonit rozdrobionych próbek glaukonitytów.

Na podstawie podobieństw cech zewnętrznych, ziarna 15 badanych próbek glaukonitu zostały podzielone na 3 grupy. Morfologia wydzielonych grup ziarn glaukonitu została przedstawiona w nawiązaniu do wyników prac Triplehorna (1966, 1967), Haddinga (1932) oraz Nikołajewej, Borodajewskiej i in. (1971).

Гęstość glaukonitów wyznaczono metodą piknometryczną stosując czterochlorek węgla. Oznaczono też ich zdolność kationowymienną (CEC).

Krzywe DTA badanych glaukonitów mają dwa efekty endotermiczne z maksimumami w zakresie temperatur 120–170 oraz 560–580°C.

Wyniki oznaczania gęstości i zdolności kationowymiennej (tab. 2) oraz wyniki analizy termicznej (tab. 3, fig. 2, 3, 4, 5) wskazują na brak lub tylko nieznaczną zawartość fazy pęczniejącej w badanych próbkach glaukonitu, sugerując wysoki stopień uporządkowania jego struktury.

OBJAŚNIENIE FIGUR

Fig. 1. Rozmieszczenie otworów wiertniczych, z których pobrano próbki glaukonitytu

Fig. 2. Krzywe DTA, TG i DTG glaukonitu Gołdap

Fig. 3. Krzywe DTA, TG i DTG glaukonitu Krzyże

Fig. 4. Krzywe DTA, TG i DTG glaukonitu Mielnik

Fig. 5. Krzywe DTA, TG i DTG glaukonitu Ryboły

OBJAŚNIENIA FOTOGRAFII

Fot. 1. Ziarna glaukonitu z próbki Gołdap. Pow. × 25

Fot. 2. Ziarna glaukonitu z próbki Kętrzyn. Pow. × 70

Fot. 3. Ziarna glaukonitu z próbki Mielnik. Pow. × 25

Fot. 4. Ziarna glaukonitu z próbki Ryboły. Pow. × 70

Fot. 5. Ziarna glaukonitu z próbki Krzywa. Pow. × 70

Fot. 6. Ziarna glaukonitu z próbki Krzyże. Pow. × 70

Fot. 7. Ziarna glaukonitu z próbki Strabla, odmiana jasna. Pow. × 70

Fot. 8. Ziarna glaukonitu z próbki Strabla, odmiana ciemna. Pow. × 70

Адам ХАБЛО

ИЗУЧЕНИЕ ХИМИЧЕСКОГО СОСТАВА ГЛАУКОНИТОВ ИЗ ОРДОВИКСКИХ ОТЛОЖЕНИЙ СЕВЕРО-ВОСТОЧНОЙ ПОЛЬШИ

ЧАСТЬ I. ВЫДЕЛЕНИЕ И МОРФОЛОГИЯ ЗЕРН ГЛАУКОНИТА ОБОЗНАЧЕНИЕ ПЛОТНОСТИ И КАТИОНООБМЕННОЙ СПОСОБНОСТИ ТЕРМИЧЕСКИЙ АНАЛИЗ

Резюме

Геологические исследования кернов из северо-восточной Польши выявили во многих кернах присутствие тонких прожилок ордовикских (арениг) глауконитов.

В настоящей статье представлен, подобранный к характеру этих глауконитов, способ очищения и выделения глауконита. Распад карбонатов, расщепление сростов и частичное растворение других загрязнений осуществляется при помощи кратковременного воздействия горячим 2% HCl на концентрат глауконита, полученный путём электромагнитического и в бромформе обогащения глауконитом его измельченных образцов.

На основании сходства внешних свойств зерна 15 изучаемых образцов были они разделены на 3 группы. Морфология выделенных групп зёрн глауконита была описана в соответствии с результатами работы Триплгорна (1966, 1967), Годдинга (1932) и Николаевой, Бородаевской и др. (1971).

Часть глауконита была отождествлена пикнометрическим методом с использованием четырёххлористого углерода. Была тоже исследована его катионообменная способность (CEC).

Кривые DTA изучаемых глауконитов характеризуются двумя эндотермическими эффектами с максимумами при температурах 120–170 и 560–580°C.

Результаты обозначения плотности и катионообменной способности (табл. 2) и результаты термического анализа (табл. 3, фиг. 2, 3, 4, 5) обнаруживают отсутствие или незначительное содержание разбухающей фазы в изучаемых образцах глауконита, что можно объяснить большой упорядоченностью его структуры.

ОБЪЯСНЕНИЯ К ФИГУРАМ

Фиг. 1. Распределение буровых скважин, из которых были отобраны образцы глауконита

1 — Бартошце, 2 — Голдап, 3 — Кентшин IG-1, 4 — Кшива, 5 — Кшиже, 6 — Лохув IG-1, 7 — Мельник, 8 — Ольштын IG-2, 9 — Подборовиско, 10 — Райск, 11 — Рыбоły, 12 — Страбля, 13 — Тлуць, 14 — Васьки

Фиг. 2. Кривые DTA, DTG и TG для глауконита Голдап

Фиг. 3. Кривые DTA, DTG и TG для глауконита Кшиже

Фиг. 4. Кривые DTA, DTG и TG для глауконита Мельник

Фиг. 5. Кривые DTA, DTG и TG для глауконита Рыбоły

ОБЪЯСНЕНИЯ К ФОТОГРАФИЯМ

Фото 1. Зерна глауконита из образца Голдап. Увеличение × 25

Фото 2. Зерна глауконита из образца Кентшин. Увеличение × 70

Фото 3. Зерна глауконита из образца Мельник. Увеличение × 25

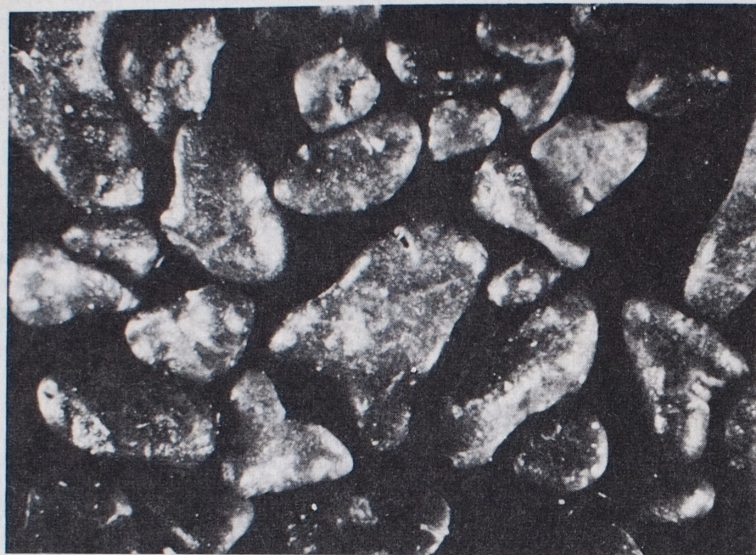
Фото 4. Зерна глауконита из образца Рыбоły. Увеличение × 70

Фото 5. Зерна глауконита из образца Кшива. Увеличение × 70

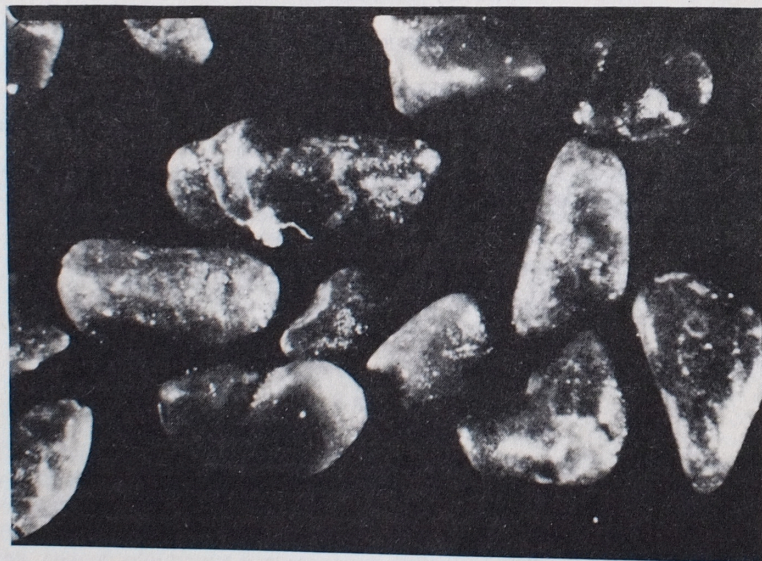
Фото 6. Зерна глауконита из образца Кшиже. Увеличение × 70

Фото 7. Зерна глауконита из образца Страбля, светлая модификация. Увеличение × 70

Фото 8. Зерна глауконита из образца Страбля, тёмная модификация. Увеличение × 70



Phot. 1. Glauconite grains from the sample Goldap. Magn. $\times 25$



Phot. 2. Glauconite grains from the sample Kętrzyn. Magn. $\times 70$

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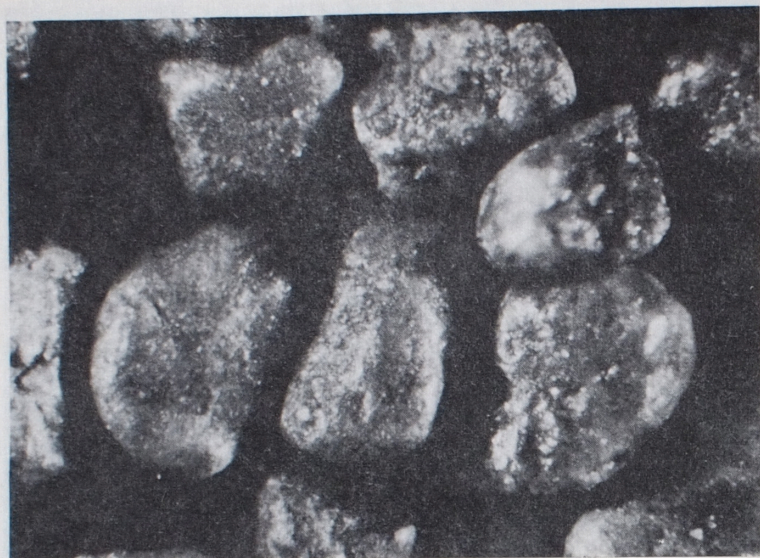


Phot. 3. Glauconite grains from the sample Mielnik. Magn. $\times 25$

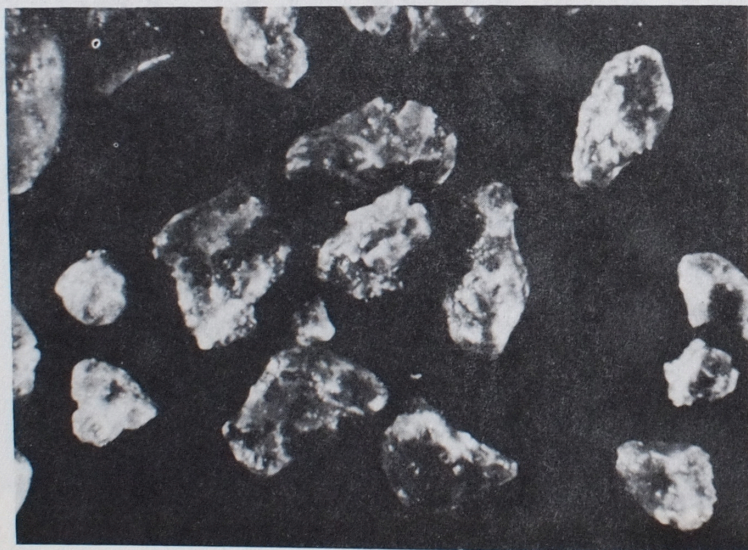


Phot. 4. Glauconite grains from the sample Ryboły. Magn. $\times 70$

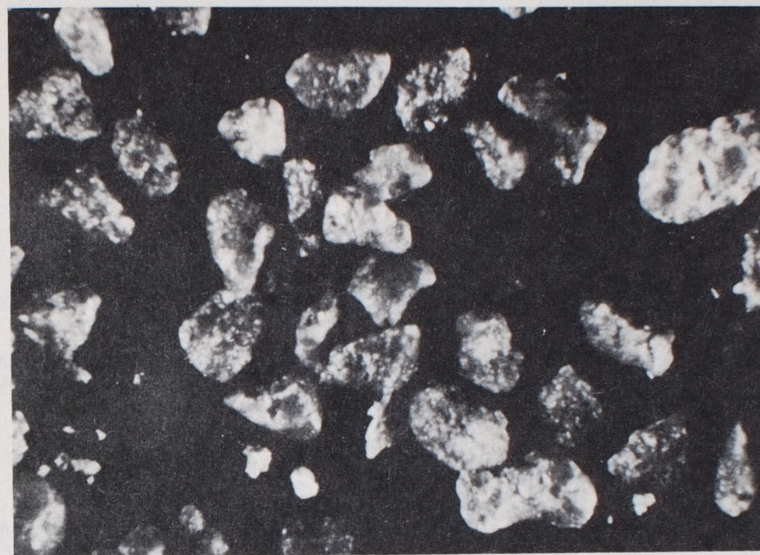
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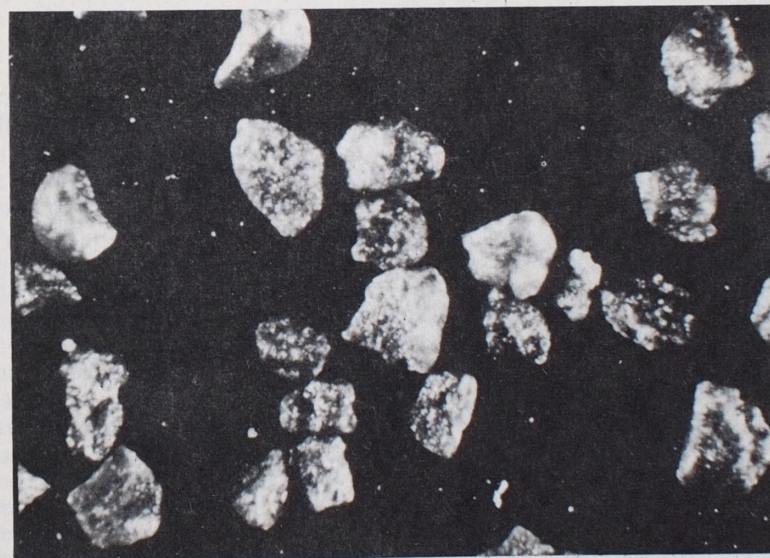
Phot. 5. Glauconite grains from the sample Krzywa. Magn. $\times 70$



Phot. 6. Glauconite grains from the sample Krzyż. Magn. $\times 70$



Phot. 7. Glauconite grains from the sample Strabla, light variety. Magn. $\times 70$



Phot. 8. Glauconite grains from the sample Strabla, dark variety. Magn. $\times 70$