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Glacial deposits of the northern region adjacent to Petuniabukta in the light of mineralogical and chemical studies, central Spitsbergen

ABSTRACT: Mineralogical and chemical analysis of the glacial deposits of the Petuniabukta region, laid down due to glacial advances occurring from the Billefjorden Stage to the Little Ice Age has been made. The deposits have substantial carbonate contents which, however, vary depending on rock types of which the bedrock is built up. The calcium ion is the main component of the sorption complex of the deposits under investigation. A proportion of other ions, including magnesium, sodium and potassium, is markedly lower. An increase in the magnesium, sodium and potassium ion contents of the sorption complex with age and a concurrent decline in calcium ions have been reported from glacial tills. The illite clay minerals prevail in glacial deposits occurring around Petuniabukta. Apart from them, there are large quantities of the chlorite and kaolinite clay minerals. The glacial deposits of Spitsbergen remain markedly richer in the chlorite group than glacial tills of Poland. Simultaneously, they contain markedly smaller amounts of minerals of the smectite group and illite/smectite mixed-layer minerals. This is due to a fainter effect of the weathering processes on the glacial deposits of Spitsbergen, compared with the glacial tills of Poland.

Key words: Arctic, Spitsbergen, glaciology, geochemistry.

Introduction

The main thrust of research has been directed towards glacial deposits derived from the Petuniabukta region in central Spitsbergen. This area underwent multiple modifications by several glacier advances, land uplift and the action of sea (Boulton 1979, Kłysz, Lindner, Marks and Wysokiński 1988, Salvigsen 1984, Salvigsen 1979, Stankowski 1988).

Samples subjected to analysis were taken by the members of the expedition Spitsbergen '84 organized by the Quaternary Research Institute of

Table 1

Scheme of sample stratigraphy

Age	Type	Location	Lab. No.
Little Ice Age	glacial till in statu nascendi (morainic mud)	Ebbabreen	8
		Ragnarbreen	19
		Bertrambreen	20
	glacial till	Hörbyebreen	21
Land uplift, accumulative and abrasive sea action, gravitational processes			
Glacier advances ca. 6.500 years BP	glacial till	the foot of Løvehovden	3
		Ragnardalen	6
		Ragnardalen	7
		Ragnardalen	17
		Ragnardalen	18
Billefjorden Stage — upper series	glacial till	Ragnardalen	4
		Hörbyedalen	14
Billefjorden Stage — middle series	glacio-aqueous deposit (mixtures) silts clays	Hörbyedalen	10
		Hörbyedalen	11
		Hörbyedalen	15
Billefjorden Stage — lower series major advance	glacial till	Ragnardalen	1
		Ragnardalen	5
		the foot of Løvehovden	2
		Hörbyedalen	16
		Hörbyedalen	9
Billefjorden Stage — initial part	clay	Hörbyedalen	12
	glacial till	Hörbyedalen	13

the Adam Mickiewicz University. Characteristics of deposits, sampling sites and their stratigraphic positions are presented in Table 1 based on Stankowski's study (Stankowski *et al.*, *this volume*).

In the studies the emphasis was on glacial and glacio-aqueous deposits, as well as aqueous sediments occurring as clays laid down during the glacial advance called Billefjorden Stage. It took place at about 35.000—40.000 years BP. This time interval has been demonstrated in the Petuniabukta region in a distinct series of glacial tills (the lower series — the master horizon: samples 1, 2, 9, 16) and a thin series of glacial tills (the upper series: samples 4 and 14). The intervening series relating to the Billefjorden Stage is composed of glacio-aqueous sediments (sample 10), silts (sample 11) and varved clays (sample 15). The earliest deposits related to the initial part of the Billefjorden Stage comprise glacial tills (sample 13) and clays deposited in stagnant water (sample 12).

Attention has also been given to glacial tills resulting from the glacier advance of about 6.500 years BP (samples 3, 6, 7, 17, 18), glacial tills dated to the Little Ice Age (sample 21) and sediments being melted out nowadays (samples 8, 19, 20).

The input material for the deposits under investigation was largely provided by the Upper Paleozoic (Carboniferous and Permian) sedimentary rocks and those of Devonian and pre-Devonian age. Crystalline rocks remaining in the study area as linear trains of firm rocks had a certain effect as well. The major characteristic of bedrock lithology is a large proportion of carbonate rocks (Gayer *et al.* 1966, Harland *et al.* 1974, Hjelle *et al.* 1982, Ohta 1982).

Results

Particle-size distribution

The glacial deposits of the Petuniabukta region mostly consist of fine particles (Tab. 2). The fraction of 0.102—0.002 mm prevails. Figure 1 illustrates simplified characteristics of the deposits. Particularly significant is relatively high homogeneity of samples in respect of the particle-size distribution. Apart from silts and clays (samples 11, 12, 15), only glacial till samples 9 and 18 are dominated by the silt-sized fraction smaller than 0.1 mm.

Sorption complex

The analysis of the sorption complex involved removing replaceable cations by the use of ammonium chloride (Tab. 2). The calcium ion is the main component of the sorption complex of the glacial deposits under investigation. Its values range from 16.5 to 37.00 mv 100 ^{1}g ^{1}, resulting in the mean of 26.1. This ion represents 85.2 to 94.0 per cent of the whole sorption complex with the average of 91 per cent.

The proportions of other ions, *i.e.* magnesium, sodium and potassium, are markedly lower. The sodium and potassium ions occur in similar amounts. The ratio between them approaches 1. On the average, the potassium and sodium ions account for 3.8 and 3.7 per cent, respectively, of the sorption complex. The magnesium ion contents remain lowest, ranging from 0.2 to 0.9 mv100 ^{1}g ^{1}. These ions make up 1.7 per cent of the sorption complex, on the average.

Table 2

Particle-size distributions and sorption complex of the glacial deposits of Petuniabukta

Age		Type	Lab. No.	Particle-size distribution. Fractions as a percentage: over 10mm	10.0-1.02mm	1.02-0.102mm	0.102-0.002mm	below 0.002mm	Sorption complex mv · $100^{-1}g^{-1}$: Ca^{++}	Mg^{++}	Na^{+}	K^{+}	% mv: Ca^{++}	Mg^{++}	Na^{+}	K^{+}
Little Ice Age		glacial till in statu nascendi	8	7.7	23.6	21.6	33.1	14.0	36.0	0.4	1.3	1.2	92.4	1.0	3.4	3.2
			19	2.5	15.3	24.4	43.8	14.0	25.0	0.5	1.1	1.2	90.1	1.7	4.0	4.2
			20	14.7	16.5	21.9	36.8	10.1	32.0	0.5	0.8	1.2	93.0	1.3	2.2	3.5
		glacial till	21	10.0	30.5	23.3	29.2	7.0	29.5	0.2	0.9	0.8	94.0	0.6	2.8	2.6
Glacier advances ca. 6.500 years BP		glacial till	3	15.7	22.0	17.0	30.7	14.6	25.0	0.3	1.1	1.1	90.8	1.2	3.6	4.0
			6	6.6	18.5	24.9	32.8	17.2	17.0	0.4	0.9	1.0	88.5	1.8	4.6	5.1
			7	25.2	16.2	17.5	27.1	14.0	21.0	0.4	1.3	0.9	89.1	1.6	5.4	3.9
			17	9.8	14.3	16.5	37.3	22.1	26.5	0.3	0.8	1.0	92.7	3.4	2.7	3.4
			18	0.0	4.0	6.4	69.2	20.4	29.5	0.4	0.9	1.1	92.4	1.3	2.8	3.5
Billefjorden Stage	upper series	glacial till	4	0.8	7.0	17.2	50.0	25.0	19.5	0.5	0.8	1.1	89.2	2.0	3.6	5.1
			14	15.4	19.7	15.7	38.4	10.8	29.0	0.5	1.3	1.1	90.5	1.5	4.1	3.5
	middle series	mixtures	10	22.2	24.5	10.1	40.4	2.8	37.0	0.7	1.0	1.2	92.9	1.7	2.9	4.2
		silts	11	0.0	0.0	0.0	75.0	25.0	24.0	0.6	1.3	1.1	88.7	2.4	4.8	4.1
		clays	15	0.0	0.0	0.0	70.0	30.0	21.5	0.5	0.8	0.9	90.8	2.3	3.3	3.7
	lower series	glacial till	1	13.4	12.5	28.6	34.6	10.9	27.5	0.3	1.1	1.4	90.5	1.2	3.6	4.7
			5	8.7	15.1	21.2	37.7	17.3	16.5	0.4	0.8	1.1	88.2	2.1	4.2	5.7
			2	8.4	25.3	20.8	34.9	10.6	36.0	0.5	0.9	1.2	93.4	1.2	2.3	3.1
			16	5.3	23.6	18.1	43.9	9.1	—	—	—	—	—	—	—	—
			9	0.0	0.4	0.6	75.5	23.5	36.0	0.5	1.2	1.1	92.8	1.2	3.1	2.9
	initial part	clay	12	0.0	1.9	1.7	69.7	26.7	19.5	0.9	1.3	1.2	85.2	3.9	5.8	5.1
		glacial till	13	10.7	22.5	14.8	40.9	11.1	19.5	0.5	1.3	1.2	86.9	2.0	5.9	5.2

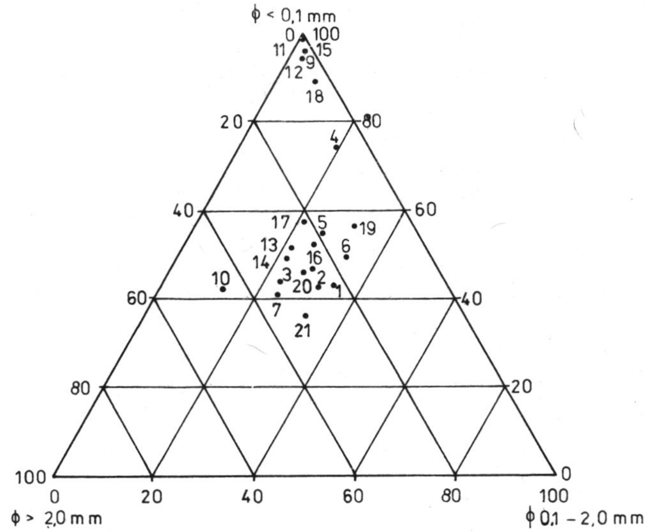

Fig. 1. Particle-size distributions of the glacial deposits of Petuniabukta

There are certain slight variations in the sorption complex, depending on sediment types.

In clayey deposits the calcium ion contents of the sorption complex are somewhat lower, while magnesium, sodium and potassium ions occur in larger amounts.

Within glacial tills the magnesium, sodium and potassium ion contents of the sorption complex increase with age, whereas there is a decline in calcium ions. A similar tendency has been observed in Poland's glacial tills of different ages (Stankowska and Walna 1989).

In general, however, all deposits represent the identical sorption complex type. Its composition is characteristic of deposits accumulating in freshwater (Vu Ngoc-Ky, Szczepańska and Szczepański 1981). This inference is of major palaeogeographical significance for the morphogenesis of the study area.

Carbonates

The glacial deposits of Petuniabukta contain 7 to 50 per cent of carbonates (Tab. 3). In general, their carbonate contents are high. In 29 per cent of samples the carbonate contents are over 30 per cent, in 14 per cent of samples they range from 20 to 30 per cent, in 43 per cent of samples they are 10 to 20 per cent and only in 14 per cent of samples these contents are up to 10 per cent. The carbonate contents of tills of the Petuniabukta region are higher, compared with figures available for the glacial deposits of south Spitsbergen (Choiński, Stankowska and Stankowski *in press*).

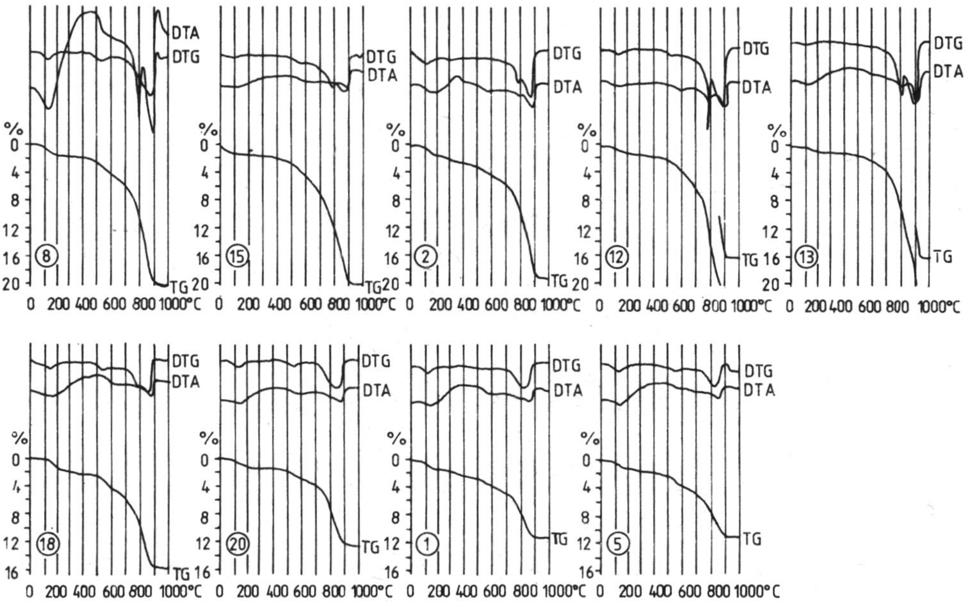

Fig. 2. Derivatograms of the glacial deposits of Petuniabukta. Natural samples. DTG: 1/5, DTA: 1/10, TG: 200 mg

Variations in the carbonate contents are related to the sampling site and thus, they depend on rock types of which the bedrock is built up. Therefore, glacial deposits sampled from the foreland of Hörbyebreen contain large carbonate amounts of the order of over 20 per cent, regardless of their stratigraphic variation and facies variability except for sample 21 which is not so rich in carbonates as it contains only 6.6 per cent of them.

The thermal analysis of deposits has shown a distinct two-phase endothermic response at the temperature range of 700—1000°C. It indicates that the carbonate minerals are dolomites (Fig. 2). A two-phase response is less marked in the glacial tills sampled from Hörbyebreen (no. 21).

The analysis of derivatograms of crude samples allows estimation of the carbonate contents of the deposits and comparison of the results with gasometric data on the Scheibler unit. Thermal curves TG and DTG are in accord with the gasometric data for samples with the carbonate contents of below 30 per cent. At higher carbonate contents the thermal analysis provides higher figures than the Scheibler method. Table 3 gives a list of the gasometric data.

Clay minerals

The nature of clay minerals was determined by a few analytical techniques, including cation-sorption capacity determination, the thermal analysis and *X*-ray examination (Stankowska 1981). The study was made of the fraction smaller than 0.002 mm in which the clay minerals are incorporated. Crude powder samples, glycerine- and glycol-saturated samples, as well as those heated at the temperature of 550°C and treated hot with 2n hydrochloric acid were subjected to the *X*-ray examination. The proportions of clay minerals were determined by analysing the ratio between integral intensities of basic lines 001, the ratio between basic line intensities for pure minerals being taken into account.

Due to the complex mineral composition of the samples quantities of particular clay mineral groups cannot be determined. The quality of the clay mineral components has been assessed, as well as it has been determined which of the minerals prevails in a given deposit. The order of occurrence of other clay minerals has been established according to their proportions.

The thermal analysis of natural samples has been carried out (Fig. 2). The thermal curves indicate the predominance of silicates and carbonates in the deposit under investigation. A distinctive characteristic of the till sample in statu nascendi from the Ebbabreen terminus (no. 8) is an additional exothermic response at the temperature range of 250—580°C.

The analysis of loss of hydroxyls, *i.e.* the second endothermic response at the temperature range of 400—700°C, in crude samples belonging to the fraction smaller than 0.002 mm is a procedure for determining the amount of clay minerals present in the deposit under investigation (Wyrwicki 1988). This information is of significance for further determination of the composition of clay minerals occurring in the deposit.

In the glacial deposits of Petuniabukta the amounts of clay minerals range from 40 to 60 per cent with the average of 50 per cent. Only in the case of two samples, one from the middle series glacio-aqueous deposits associated with the Billefjorden Stage (no. 10) and the other from the lower series glacial till relating to the Billefjorden Stage (no. 16), these amounts are considerably smaller as they approximate 20 per cent. Also carbonates occur in large amounts in these samples. They account for 43 and 51 per cent of them, respectively.

Information on clay mineral identification, sorption capacities, the thermal and *X*-ray analysis results is given in Table 3. Figures 3 and 4 show selected examples of derivatograms and *X*-ray diffractograms of the fraction smaller than 0.002 mm. Any details of the determination of the nature of clay minerals are given below.

Cation-sorption capacity in the glacial deposits of Petuniabukta ranges from 31 to 50 $mv100^{-1}g^{-1}$ with the average of 44. There are certain variations in sorption capacity, depending on the sediment type under investigation. Thus, clays possess the highest sorption capacities (66 $mv100^{-1}g^{-1}$ on the average), glacial tills have the average sorption capacity of 48 $mv100^{-1}g^{-1}$ and the capacities average 42 $mv100^{-1}g^{-1}$ in glacial tills in statu nascendi.

Carbonates and clay minerals occurring

Age		Type	Lab. No.	Carbonates %	Sorption capacity $mv \cdot 100^{-1} g^{-1}$
Little Ice Age		glacial till in statu nascendi	8	22.6	40.00
			19	10.5	41.50
			20	17.3	45.00
		glacial till	21	6.6	31.50
Glacier advances ca. 6.500 years BP		glacial till	3	14.4	48.00
			6	6.6	68.25
			7	14.9	67.50
			17	13.1	50.00
			18	17.3	50.00
Billefjorden Stage	upper series	glacial till	4	9.2	43.50
			14	27.8	42.50
	middle series	mixtures	10	42.6	41.75
		silts	11	34.6	70.00
		clays	15	21.2	57.50
	lower series	glacial till	1	15.0	45.50
			5	12.1	44.50
			2	17.8	45.00
			16	51.2	42.75
			9	39.6	42.50
	initial part	clay	12	42.3	62.50
		glacial till	13	34.8	43.25

Within the glacial tills sorption capacities tend to increase slightly with deposit age.

Sorption capacities of the glacial deposits of Petuniabukta are higher than those of similar deposits of south Spitsbergen. The mean sorption capacity of the latter deposits is 25 $mv100^{-1}g^{-1}$ (Choiński, Stankowska and Stankowski *in press*).

The thermal analysis shows two endothermic responses with a maximum at the temperature ranges of 140 to 160°C and 590 to 600°C in combination with step-by-step loss of the mass. The latter lost by heating to the temperature of 1000°C averages 11.8 per cent (from 10.2 to 13.8 per cent). Out of this, 45 per cent, on the average, are due to the first response (33—35 per cent). The ratio of intensity of the first endothermic response to that

Table 3

in the glacial deposits of Petuniabukta

Fraction smaller than 0.002 mm								
Thermal analysis Loos of mass				X-ray analysis Powder sample				Clay minerals I: illite M: smectite Ch: chlorite K: kaolinite
TG 1000°C	TG I ef.	TG II ef.	TG I/II	Line intensity % 7Å	10Å	14Å	Crystal-linity 10Å	
12.2	5.3	6.0	0.9	40	52	8	1	
12.6	5.2	6.8	0.8	48	45	7	1	I > K, Ch
12.6	6.2	5.6	1.1	27	67	6	1	
12.8	4.3	7.0	0.6	46	48	6	8	I > Ch, K
11.0	5.2	5.0	1.0	20	71	9	2	
12.4	4.8	6.4	0.8	51	41	8	1	
13.0	5.5	5.0	1.1	49	22	9	1	I > Ch, K
13.8	6.0	7.0	0.9	55	45	—	1	
12.4	5.8	5.6	1.0	32	57	11	2	
10.8	5.2	4.8	1.1	17	72	11	1	I > Ch, K
11.4	5.6	4.8	1.2	31	50	19	3	
11.8	6.5	4.6	1.4	—	—	—	—	
10.2	4.2	5.4	0.8	33	51	16	6	I > Ch, K
10.2	4.3	5.2	0.8	33	52	15	8	
12.0	6.2	4.8	1.3	20	80	—	1	
12.2	5.6	5.9	0.9	29	63	8	2	
12.4	6.2	4.4	1.4	26	50	24	1	I > Ch, K
11.7	4.7	5.8	0.8	—	—	—	—	
11.0	5.0	5.0	1.0	27	49	24	4	
10.8	4.6	5.2	0.9	30	51	19	4	I > Ch, K
11.2	5.0	4.8	1.0	22	65	13	5	

of the second is 0.8 to 1.4 with the average of 1.0. Thus, their intensities are similar.

The effect of loss of the hydroxyls is relatively wide, asymmetrical and predominantly at a higher temperature.

The endothermic response takes place at the temperature of 300°C in combination with loss of the mass which should be attributed to ferrous hydroxide, perhaps goethite.

The character of derivatograms and the parameters are similar for all the samples under investigation. Variations are not associated with age or origin.

The *X*-ray analysis of powder samples indicates that the 7 Å, 10 Å and 14 Åbasic lines are shown by all the deposits under investigation (Fig. 4).

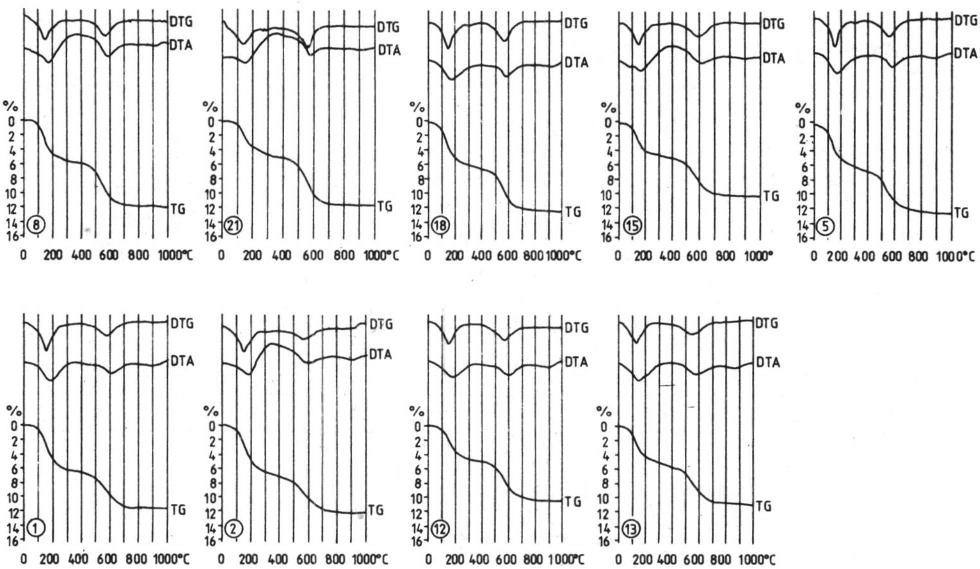

Fig. 3. Derivatograms of the glacial deposits of Petuniabukta. The fraction smaller than 0.002 mm. DTG: 1/5, DTA: 1/10, TG: 200 mg

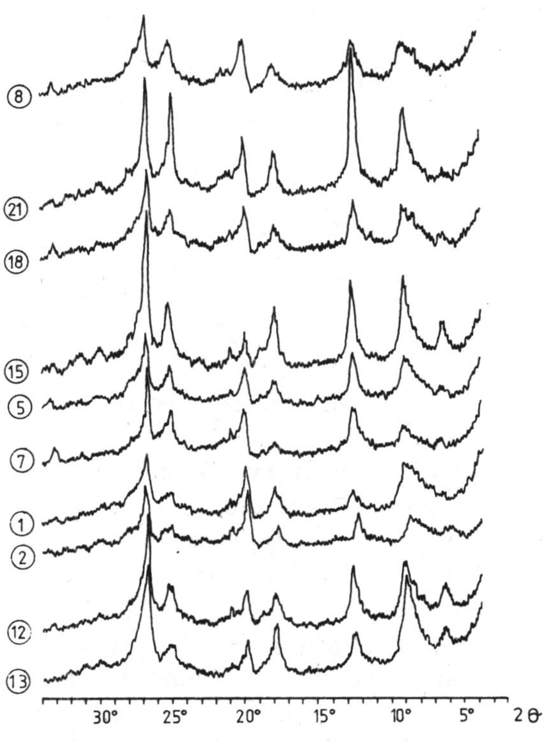

Fig. 4. Diffractograms of the glacial deposits of Petuniabukta. The fraction smaller than 0.002 mm

Samples from clay minerals (no 11, 12, 15) and single samples from glacial tills (no 13 and 21) have better crystallinity at the above basic lines, especially at the 10Å line shown by illite. Crystallinity of the above samples for the basic line shown by illite is 4 to 8 while that of other samples is 1 to 3. However, it is markedly lower with regard to the glacial deposits of south Spitsbergen where the crystallinity averages as much as 20 (Choiński, Stankowska and Stankowski *in press*).

The *X*-ray analysis of glycerine-and glycol-saturated samples shows a small proportion of swelling minerals. The swelling is most likely due to the presence of illite/smectite mixed-layer minerals.

The analyses of diffractograms, intensities of the basic lines for powder samples, those heated at the temperature of 550°C and treated with hydrochloric acid indicate the occurrence of the chlorite and kaolinite clay minerals in large amounts in all the deposits under investigation. Particularly striking is an increased amount of the kaolinite clay minerals in till sample 19 and a larger chlorite proportion of the clayey sediments.

The final inferences from the identification of the clay minerals are given below.

The illite clay minerals have assumed dominance in the glacial deposits of Petuniabukta. In addition to them, the chlorite and kaolinite minerals occur in large amounts. Small quantities of illite/smectite mixed-layer minerals are also found. Their presence can be linked to the weathering processes that change the illite group.

There are certain variations in parameters of the clay minerals occurring in the glacial deposits of Petuniabukta. The clayey deposits have high cation-sorption capacities, better crystallinity of the clay minerals and large amounts of the chlorite minerals. Parameters of the glacial tills vary to a certain extent but their variations are not associated with age. However, note should be made of the fact that the tills were deposited over a relatively narrow period of time (the Billefjorden Stage, the Little Ice Age). On the other hand, newly deposited tills have lower sorption capacities, poor crystallinity of the clay minerals and larger amounts of the kaolinite minerals.

The results of identification of the clay minerals occurring in the glacial deposits of Spitsbergen. Poland and Canada indicate marked stratigraphic and regional variations (Choiński, Stankowska, and Stankowski *in press*, Stankowska 1981).

The illite and smectite groups are the predominant clay minerals in Poland's glacial tills of different ages. The deposits are illite-smectite or smectite-illite in nature. In Poland's territory there is a uniform tendency towards an increase in the smectite minerals with the age of glacial tills. Changing quantities of the clay minerals relative to the age of the glacial tills are additionally subjected to regional or even subregional fluctuations.

This is indicative of undoubted influence of the Sub-Quaternary bedrock on the composition of the clay minerals occurring in the glacial tills.

In the glacial tills of Canada that are the product of the Visconsin glaciation the illite clay minerals have gained a marked advantage over other clay minerals, including the smectite group, the illite/smectite mixed-layer minerals, the kaolinite and chlorite groups.

In the glacial deposits of Spitsbergen, including both Hornsund and Petuniabukta, the illite minerals prevail. In addition to illites, the chlorite and kaolinite minerals occur in large amounts. There are no marked stratigraphical differences in the composition of the clay minerals. However, the research theme covers the latest glacial deposits associated with a relatively narrow time interval. The glacial deposits vary to a certain extent in respect of regional characteristics and origin.

The glacial deposits of Spitsbergen, including Hornsund and Petuniabukta, are markedly richer in chlorite than the glacial tills of Poland and Canada. They also contain markedly smaller amounts of the smectite and illite/ /smectite mixed-layer minerals. Diffractogram details and high crystallinity of the basic lines are suggestive of a fainter effect of the weathering processes on the conversion of hydromicas into smectites in the glacial deposits of Spitsbergen, compared with the glacial tills of Canada or much more from Poland's territory.

Concluding remarks

The glacial deposits of the Petuniabukta region were laid down during a relatively short time period between the Billefjorden Stage glacial advances and the Little Ice Age. They were composed of glacial and glacio-aqueous sediments and clays.

In general the glacial deposits consist of fine particles. The fraction ranging from 0.102 to 0.002 mm dominates the distribution of these deposits. There is high uniformity of the particle-size distribution of deposits of the same type.

The calcium ion is the principal part of the sorption complex. A proportion of the other ions, including magnesium, sodium and potassium, is markedly smaller. The sorption complex components are characteristic of sediments deposited in freshwater.

There are certain slight variations in the sorption complex depending on sediment types. Within glacial tills the magnesium, sodium and potassium ion contents of the sorption complex increase with age and there is a concurrent decline in calcium ions. This is a tendency similar to that observable in Poland's glacial tills of different ages. Stratigraphical variations have yet to be subjected to further study.

The glacial deposits of Petuniabukta have high carbonate contents of up to 50 per cent. There are large variations of the carbonate contents associated with sampling sites and thus depending on rock types of which the bedrock is built up.

The illite clay minerals are predominant in the glacial deposits under investigation. Large amounts of the chlorite and kaolinite minerals ar also found.

The glacial deposits of Spitsbergen are markedly richer in the chlorite minerals than Pleistocene glacial tills of Poland. They also contain smaller amounts of smectites and the illite/smectite mixed-layer minerals. This is due to a fainter effect of the weathering processes on the conversion of hydromicas into smectites in the glacial deposits of Spitsbergen, compared with Poland's glacial tills.

References

Boulton G. S. 1979. A model of Weichselian glacier variation in the North Atlantic region. — Boreas, 8: 373—395.

Choiński A., Stankowska A. and Stankowski W. (*in press*). Effect of bedrock and sedimentary environment on properties of glacial deposits in South Spitsbergen. — Questiones Geographicae.

Hjelle A. and Lauritzen O. 1982. Geological Map of Svalbard 1:500 000, sheet 3G, Spitsbergen northern part. — Norsk Polarinst. skr. 154 C: 15 pp.

Kłysz P., Lindner L., Marks L., and Wysokiński L. 1988. Rzeźba i osady czwartorzędowe wschodniego obramowania Petuniabukta. Summary: Quaternary Landforms and sediments of the eastern Petuniabukta seaside (Olav V Land, Spitsbergen). — XV Symp. Polarne, Wrocław, Mat.: 45—52.

Mangerud J. and Salvigsen O. 1984. The Kapp Ekholm section, Billefjorden, Spitsbergen: a discussion. — Boreas. 13: 155—157.

Ngoc-Ky Yu, Szczepańska J. and Szczepański A. 1981. Rekonstrukcja warunków paleohydrochemicznych na podstawie składu kationów wymiennych w osadach ilastych. Summary: Reconstruction of palaeohydrochemical conditions on the basis of composition of exchangeable cations in clay deposits. — Kwartalnik Geol. 25, 1:199—213, Warszawa.

Ohta J. 1982. Morpho-tectonic studies around Svalbard and the Northernmost Atlantic. Artic Geology and Geophysics. — Proceedings of the Third International Symposium on Arctic Geology Society of Petroleum Geologists: 417—428. Calgary Alberta Canada.

Salvigsen O. 1979. The last deglaciation of Svalbard. — Boreas, 8: 229—231.

Stankowska A. 1981. The clay mineral variability of glacial tills in Poland. — Quaestiones Geographicae t. 7: 107—120.

Stankowska A. and Walna B. 1989. Kompleks sorpcyjny w osadach glacjalnych Polski i Spitsbergenu. Summary: Characteristics of sorption complex in glacial deposits of Poland and Spitsbergen. — Badania Fizjogr. nad Polską Zachodnią t. XL: 52—70.

Stankowski W. 1988. Interakcja działalności morza, lodowców oraz jezior glacjalnych w morfogenezie międzyfiordzia Bille-Aust. (Spitsbergen środkowy). Summary: The interaction of sea, glaciers and glacial lakes in the morphogenesis of the Bille-Aust interfjord region, middle Spitsbergen. — XV Symp. Polarne, Wrocław, Mat.: 25—33.

Stankowski W. 1989 (*this volume*). Interaction of marine, glacial and lacustrine processes throughout morphogenesis of the region between the Bille and Aust fjords: prelimainly interpretation. — Pol. Polar Res., 10: 411—417.

Wyrwicki R. 1988. Analiza derywatograficzna skał ilastych. Warszawa, 54—70.

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Streszczenie

Analizowano osady glacjalne rejonu Petuniabukta, zdeponowane podczas nasunięć glacjalnych od Billefjorden Stage do Małej Epoki Lodowej. Były to osady lodowcowe, lodowcowo-wodne oraz iły. Szczegółową charakterystykę miejsca poboru próbek, ich pozycję stratygraficzną przedstawiono w tabeli 1, w oparciu o pracę Stankowskiego (artykuł wstępny w niniejszym zeszycie).

Analizowane utwory glacjalne charakteryzują się ogólnie drobnym uziarnieniem. Dominującą frakcją w badanym osadzie jest frakcja 0,102—0,002 mm (tab. 2, fig. 1). Obserwuje się dużą jednorodność składu mechanicznego w obrębie poszczególnych typów genetycznych osadów.

Głównym jonem wchodzącym w skład kompleksu sorpcyjnego wszystkich analizowanych osadów jest jon wapniowy (tab. 2). Udział pozostałych jonów magnezu, sodu i potasu jest zdecydowanie niższy. W obrębie glin morenowych obserwuje się z wiekiem wzrost zawartości w kompleksie sorpcyjnym jonów magnezu, sodu i potasu przy spadku udziału jonów wapnia.

Osady glacjalne Petuniabukta charakteryzują się znaczną węglanowością (do 50% — tab. 3, fig. 2). Obserwuje się duże zróżnicowanie zawartości węglanów, związane z miejscem pobrania analizowanego osadu a zatem uzależnione od skał budujących podłoże.

Minerałami ilastymi dominującymi w badanych utworach są minerały grupy illitu. Obok nich, w znacznych ilościach występują minerały grupy chlorytu i grupy kaolinitu (tab. 3, fig. 3 i 4).

Osady glacjalne Spitsbergenu są wyraźnie bogatsze w minerały grupy chlorytu niż gliny morenowe Polski. Równocześnie są wyraźnie uboższe w minerały grupy smektytu i minerały struktur mieszanych typu illit/smektyt. Jest to wynikiem mniejszego udziału procesów wietrzeniowych, przeobrażających minerały grupy hydromik w minerały grupy smektytu, w osadach glacjalnych Spitsbergenu w stosunku do glin morenowych Polski.