DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2002/103

Heavy Mineral Exploration in Europe 2002

Summary Report no. 2

Steen Lomholt, Jørn Bo Jensen and Christian Knudsen

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MINISTRY OF THE ENVIRONMENT

GEUS

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Contents

1. Summary

The potential of locating high grade ilmenite deposits in Europe has been evaluated in the period 2000 to 2002. This has ben done during cooperation with the national geological surveys, and the emphasis has been on countries with exposed Neogene sands. Samples from Denmark, Sweden, Germany, Poland, Holland, Lithuania, Belarus and Italy have been analysed.

1.1 Sediment maturity

It is striking that all medium-grained Neogene and older sands analysed have high-grade Ilmenite. Further, it is found that the older the sand, the higher is the grade of the ilmenite. This indicates that the chemical alteration of the ilmenite doesn't stop because the sand is deposited and covered. This may not be a major surprise, but it gives us a lead in further exploration. However, the older the sand, the smaller the area of outcrop and accordingly the chance of locating continuos mineralised bodies. Further, the risk of lithification of the sand increases with geological age. Accordingly, the focus has been on Neogene sediments, which occur widespread and unlithified throughout the region.

However, the Mesozoic sands containing high-grade ilmenite, may be the source of the high-grade ilmenite in the Neogene sediments. To test this hypothesis and thereby get an understanding of high-grade ilmenite deposits, it is important to date the alteration of the ilmenite. This work is currently underway at GEUS.

Another intriguing fact is that contemporaneous fine-grained sands have low-grade ilmenite, less mature paragenesis as well as more angular grain-shapes. It should be the opposite, with increasing degradation of the grains (chemically and physically), the grain-size should decrease and the maturity increase. The only explanation we can think of is that the fine-grained material is transported faster and further, and accordingly exposed to less alteration on the route to final deposition. And on top of this, deposited in more fine-grained sediments, less prone to ground water percolation.

1.2 The potential of the individual countries

The work that led to the Danish discoveries was orders of magnitude more intensive, and the review given below is not exhaustive. A summery of the Danish exploration will be given in other reports.

The Netherlands

Considerable work has been conducted by the Dutch Geological Survey in describing heavy mineral assemblages, and they have done geophysical logging as well as extensive chemical analysis of cores. Based on this work, the best sites located by the survey have been evaluated.

The Neogene sands of the Netherlands and Belgium is know as the source of very fine glass sands, and the area supply the region with high purity sands. This in turn could lead to two very different conclusions: Either that the sands here generally are very pure by nature, or that the heavy minerals are concentrated somewhere.

As we (and the local geological survey TNO) have not been able to locate layers with more than ca.1% heavy minerals, the conclusion at this stage is, that the background level of heavy mineral content is too low to be of economical interest. The local glass sand producers recover heavy minerals (as impurities) at some of their plants, but the volume is probably to small and scattered to be of economic interest. Estimated theoretical resources of Ilmenite + Leucoxene + Rutile = 0.2 % in 30 mill. Ton (total prod. sand from the region incl. Belgium and adjacent Germany) = 60.000 ton per year.

No further exploration is recommended in the Netherlands and Belgium.

Germany

In Schleswig-Holstein it has not been possible to locate near-surface deposits of medium-grained sands, and the ilmenite is too fine-grained and too low grade.

In Mecklenburg-Vorpommern, Sachsen and Brandenburg, samples have been taken in lignite quarries. Medium-grained Neogene sands have been found. The heavy mineral content is generally less than 1 %, and it has not been possible to locate beach/barrier deposits with elevated heavy mineral contents. However a few samples will be analysed to confirm the assumed high-grade character of the ilmenite.

Apart from a few analyses of samples, no further exploration is recommended in Germany.

Denmark (other than Miocene deposits)

The danish onshore deposits have been screened during initial phases of exploration. The sediments are of Quarternary age, little altered and generally with low grade ilmenite. However, there may be reworking of Mesozioc and Kenozoic sands offshore, so offshore samples available at GEUS have been analysed. Samples from two offshore areas, in the Baltic and the North Sea respectively have been analysed using CCSEM. This to evaluate possible potential in drowned, Quaternary beach/barrier deposits and reworking of pre-Quaternary deposits into the more recent marine deposits.

In the Baltic area near Bornholm the content of heavy minerals in the sands is low (< 0.5 %). However, it was found, that there is considerable reworking of pre-Quaternary Mesozoic deposits, and that there may be a potential for high-grade ilmenite in drowned beach/barrier systems in the Polish sector. This is currently being followed up together with the Polish Geological Survey, who has made a report on the matter and samples from potential heavy mineral deposits offshore Poland.

Considerable amounts of sand is mined and used for coastal protection along the Danish, German and Dutch coast, and 9 samples representing different geological environments in the Danish sector was analysed. The scope of this was to evaluate if it could be viable to beneficiate the heavy minerals when the sand is processed anyway. Some diffences was seen, indicating that some of the geological environments contain reworked Miocene sands. However, the total content of heavy minerals is too low to justify further work.

Sweden

4 Samples were collected in a sandpit in Jurassic sands. The scope was mainly to evaluate the grade of the ilmenite. It was found that the grade was very high (in the 60'ties). However the total content is < 1% and the area with Mesozoic sands too small to justify further exploration.

Poland

Data on the heavy mineral paragenesis in the Quarternary sands in Poland was recieved from the Polish Geological Survey. It was found, that the paragenesis is imature, the total content of heavy minerals rather low with a low proportion of valuable heavy minerals and slim chances of finding high-grade ilmenite considered to be too low.

There is widespread occurences of Neogene sediments in Poland. There is large scale extraction of lignite from these layers and one possibility could be to make a byproduction of ilmenite from the overburden being removed to get to the lignite. It was found, that the grade of the ilmenite is elevated, highest in the eastern part of Poland. This maybe it has its provenance from the Mesozoic sediments. However, the HM contents in the Miocene sands is very low and it will be difficult to beneficiate the ilmenite here as part of lignite extraction

Sand from the Hel Peninsular contain high concentrations of HM and fairly high-grade ilmenite. This is a coastal barrier deposit. Further, lag sediments on the seafloor also contain fairly high concentrations of HM (composition not known yet). Finally, there is indications pointing at the prescence of offshore deposits of barrier sands in the Baltic close to the Hel Peninsular. These deposits form an obvious target for possible further exploration.

Lithuania

The Geological Survey of Lithuania has made a comprehensive study of the Quaternary sands in the country. The result of this, is that the HM assemblage is immature and the ilmenite low-grade on average. However, initial CCSEM analysis showed the precence of high-grade ilmenite in the source. Accordingly the Pre-Quaternary deposits has been sampled.

High grade ilmenite has been found in samples of Devonian and Neogene age. In one of the samples, there is also high contents of HM (6.5 %) with high proportion of VHM. This could be an exploration target.

Belarus

The geology of Belarus should be favourable for locating high-grade ilmenite located between high-grade ilmenite terrane in both Lithuania and Ukraine. Accordingly, samples from Eocene and Oligocene sands were aquired from a number of sites. The HM assemblage is mature and the ilmenite grades generally fairly high. However, the total content of HM in the sands generally less than 1 %. Atempts has been made to get cooperation from the Belarus Geological Survey, but as this has not been possible, and because the general conditions for working in the country is poor, no further work is recommended at this stage.

Ukraine

Ukraine has a major potential for ilmenite exploration and production. A total reserve at 900 tonnes of Ilmenite and rutil is estimated by the Academy of Sciences in Kiev. As Ukraine actually produces high-grade ilmenite there is no dought either that high-grade ilmenite occurs in the placer deposits

Placer deposits have been developed in the area since Late Jurassic time. Many different ore-types are found in the country: Regolith, alluvial, marine bars or spits. In the present material it is difficult to evaluate the grade of the illmenite. In the Malishev deposits the TiO_2 content is above 60 % (see previous section), but in the Irsha region (Table 15) the TiO_2 varies between 48 and 67 %. Many of the deposits are not developed yet.

It is recommend that samples should be collected and analysed from the most promising areas. It is also recommended that more detailed information on volume's and quality of deposits, to calculate possibly in place and reserves. The possibility for exploitation should be described, together with the legislation and commitment in a development phase. Finally, Ukraine could be a good candidate for provenance analysis, due to the fact, that many different kind of placers are present in the area probably with different sources and genesis combined with different HM paragenesis and TiO_2 content.

However, Ukraine is a difficult country to work in, and one way of doing it is to join up with the company currently extracting the minerals.

Romania

Attempts have been made to get cooperation from the local geological survey, so far unsuccesfully. The geological environment is favourable, as Neogene sediments occur at the prequarternary surface and these may be target as well as reworked Neogene in Quarternary sediments. We will continue to get coorporation from Romania.

2. Introduction

The aim of this report is to review the results of the GEUS/DuPont titanium exploration in Europe 2000 to 2002 (excluding Miocene of Denmark. This will be reported separately). The report contains a general geological introduction briefly describing the tectonic and sedimentological framework for the Tertiary. Further, the actual work is described in more detail and the analytical results are summarised.

The starting point for the exploration in Europe was the high-grade ilmenite tied to medium-grained marine Miocene beach/barrier deposits in Denmark. Would it be possible to find similar deposits in the extensive Neogene deposits in Europe?

This again based on the assumptions that:

- Highly mature sands may be widespread in Europe in Neogene deposits.
- Fluctuating sea level was likely to have generated a number of beach/barrier deposits at the rim of the "proto- North Sea".

To be able to test the first assumption, we had to get samples from medium-grained sands throughout the region. An indication of the second assumption was the fact that a heavy mineral deposit of Pliocene age had been located in Niedersachsen, namely the "Midlum" deposit near Bremerhafen. This was drilled by the local survey in the 80'ties and found to be too deep (about 60 m. overburden).

The first attempt was to try to locate similar deposits in Northern Germany together with the local German geological surveys. The result of this was that we found that it was possible to get active co-operation from the local survey, which located the relevant samples and relevant information. However, the sediments recovered were too fine-grained and with too low-grade ilmenite.

Using this approach, we took contact to the geological surveys in Poland, Lithuania, Belarus, Ukraine and Holland to get similar co-operation. We got similar good response from these surveys, and a large number of samples have been sent to GEUS for analysis. In the case of Lithuania, the Survey got contact to a local consultant (Ginutis, a former survey employee), that conducted the fieldwork.

Ukraine is the only European country wit existing production of HM. A report has been provided by Proffesor L.Galetskiy Svetlana, Kiev (Appendix 2). A summery is presented in this report.

3. The Cenozoic geological evolution in Europe

The main emphasis has been on the Cenozoic deposits, and accordingly the geological evolution in the period is highlighted in this chapter.

3.1 The effects of Cenozoic platetectonics in Europe

After the early Eocene crustal separation between the European craton and Greenland the Western and Central Europe was dominated by the convergence of the Africa-Arabian and the Eurasian plates due to continued northward drift and counter clockwise rotation of the African-Arabian plates, which gave rise to the Eocene to early Miocene main orogenic phase of the Alpine fold belt.

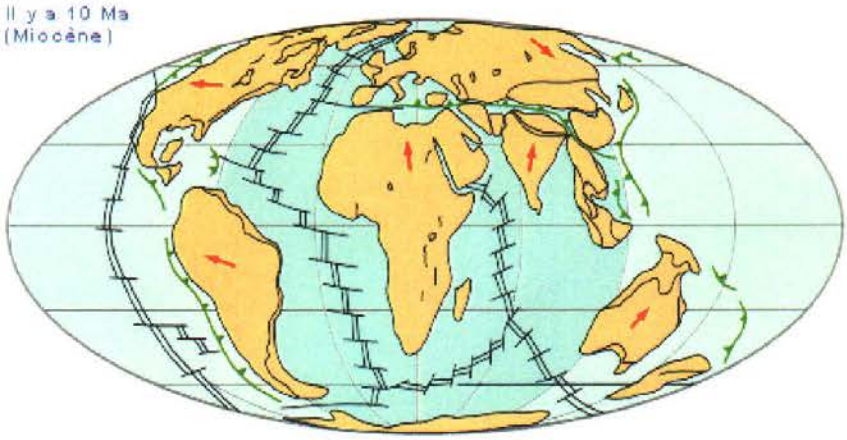


Figure 1. Miocene continental drift.

In this tectonic loaded flexural subsidence phase the Alpine–Charpatian foreland basin developed. During the Miocene and Pliocene late phases of the Alpine orogeny, the foreland basins were partly overridden by napes and scooped out by thrust sheets. Deformation patterns and the distribution of earthquake epicentres indicate that during the Neogene and Quaternary the convergence direction between Eurasia and Africa-Arabia gradually changed and is now dominated by dextral wrench faulting.

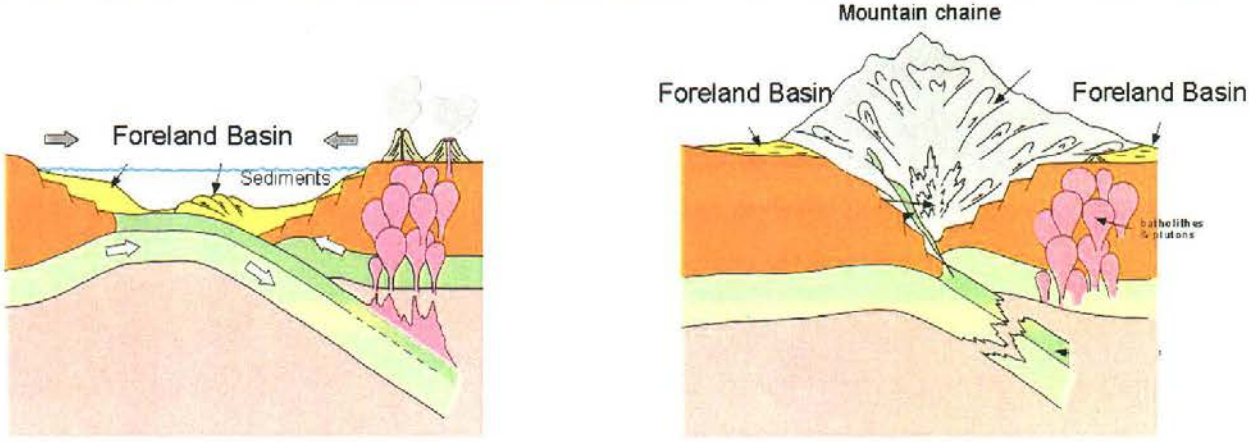


Figure 2. Convergence of to continental crusts.

During the late Eocene and Oligocene the Alpine foreland was transected by the Rhine-Rhone rift systems, which remained active until present. This was contemporaneous with compressional deformation of a number of older graben structures and tensional subsidence of intra-Alpine basins.
The geodynamic Alpine orogeny processes controlled the development of the Cenozoic basins in the Western and Central Europe. The basin deposits are outlined in figure. 3, which provide an impression of the distribution and thickness of the basin sedimentary, fill while the palaeogeographical evolution is summarised in figures. 6, 7 and 8.

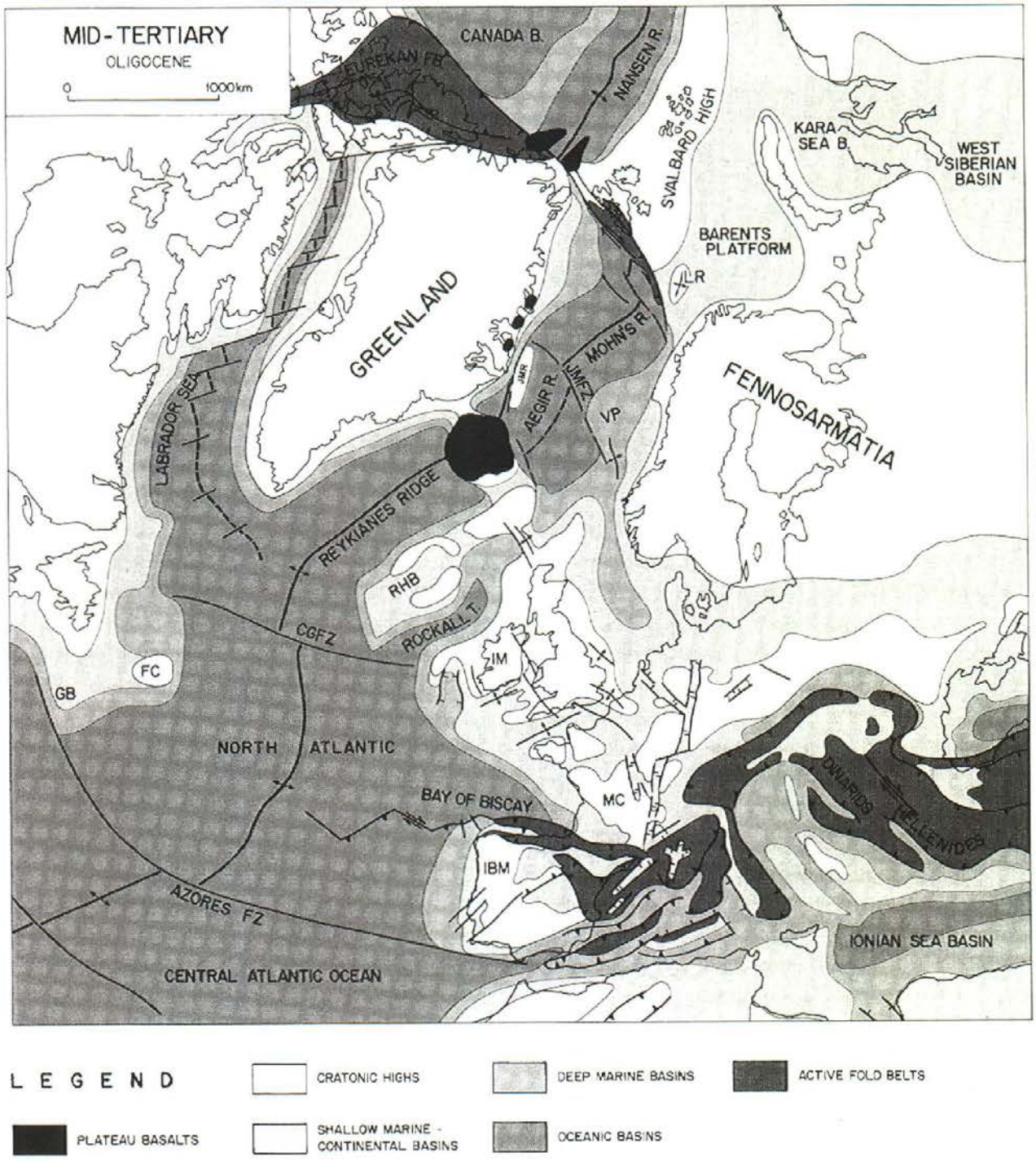
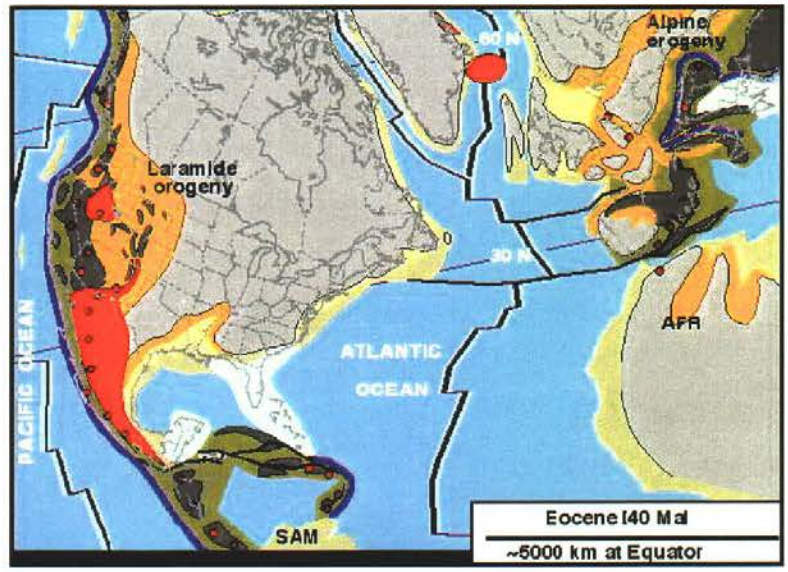
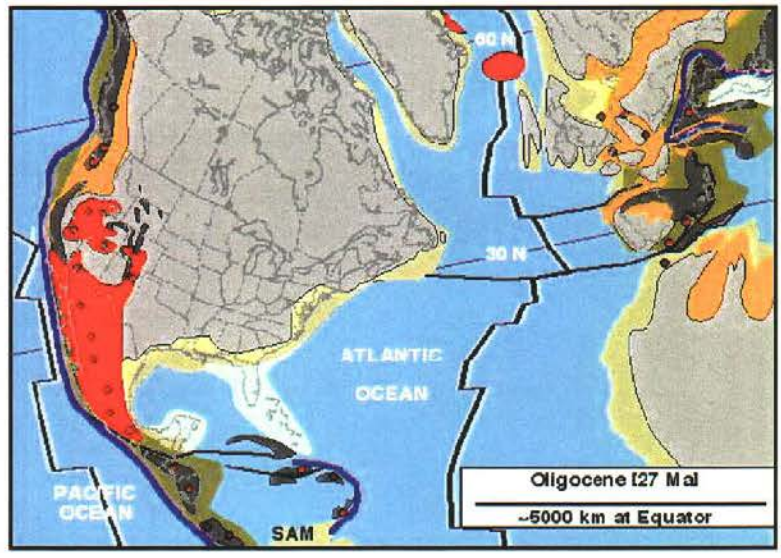


Figure 3. Oligocene framework of the North Atlantic domain.

A clear westward shift in tectonic activity can be recognised, which is thought to be the expression of changes in the convergence direction between the Africa-Arabian and the European cratons. The general pattern of Eocene-Oligocene and late Oligocene – Miocene deformation zones are illustrated in figure 4.


Alpine
orogeny
60 N
Laramide
orogeny
30 N
PACIFIC OCEAN
ATLANTIC
OCEAN
AFR
SAM
Eocene [40 Mal
~5000 km at Equator


60 N
30 N
ATLANTIC
OCEAN
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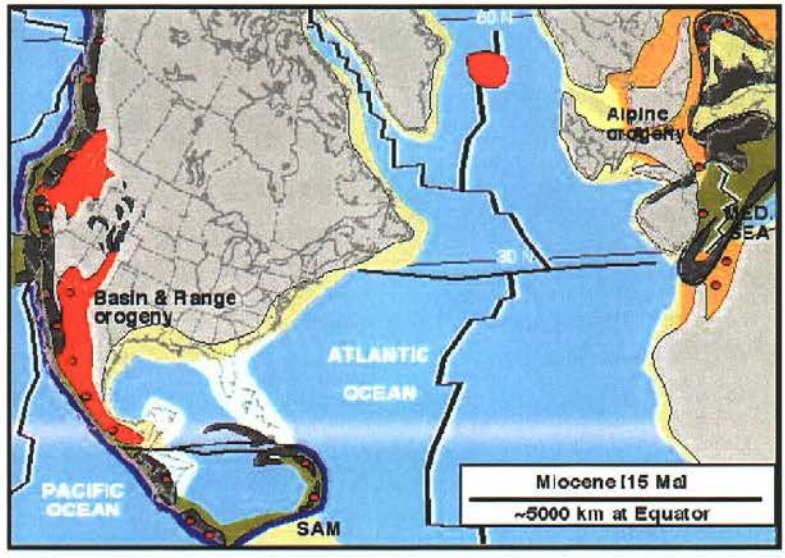
OCEAN
SAM
Oligocene [27 Mal
~5000 km at Equator

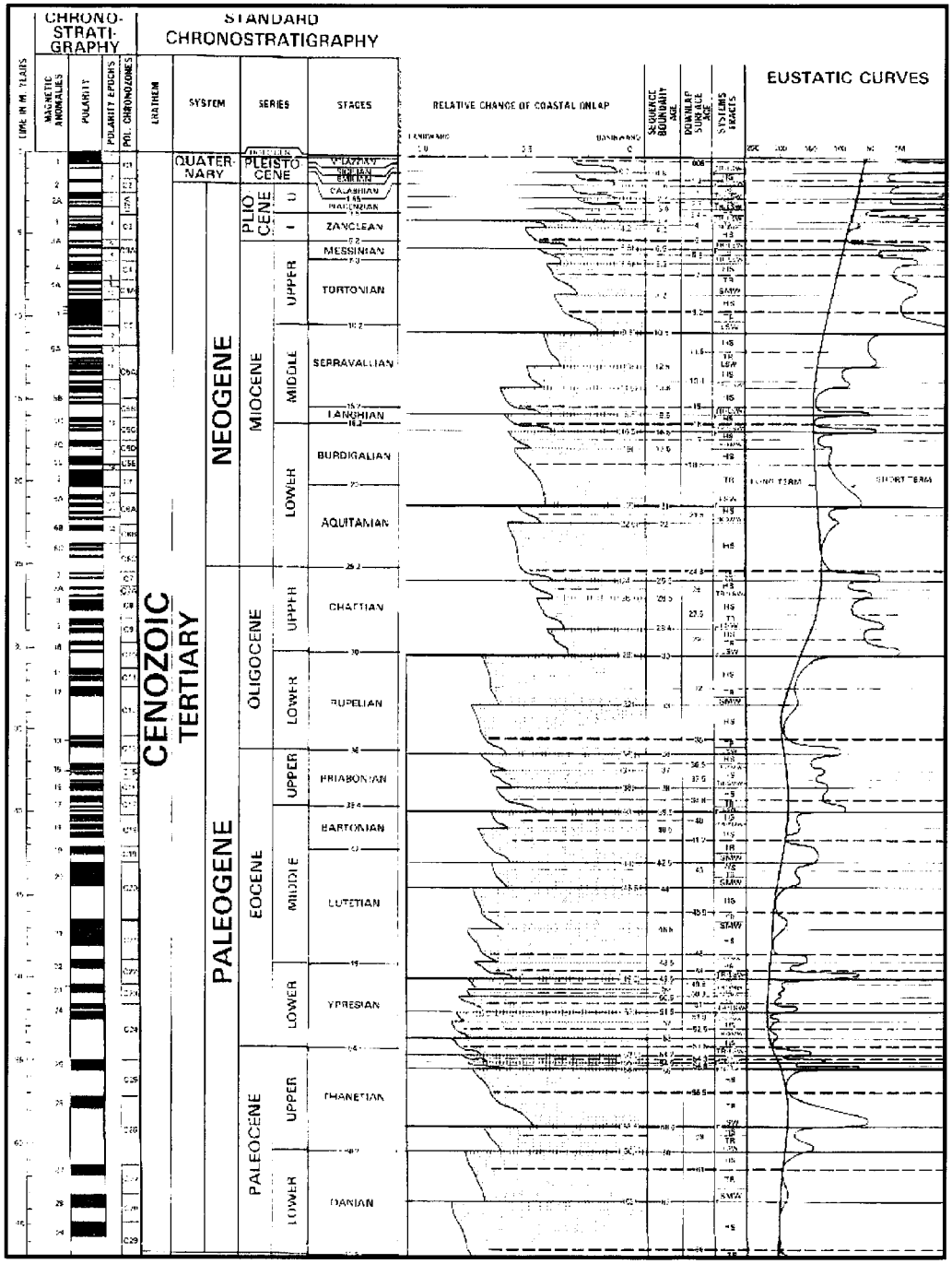

60 N
Alpine
orogeny
30 N
Basin & Range
orogeny
ATLANTIC
OCEAN
PACIFIC
OCEAN
SAM
Miocene [15 Mal
~5000 km at Equator

rmation zones.

3.2 Cenozoic Sea-level Changes

A gradual long-term fall in global sea levels characterises the Cenozoic period (Figure 5). This is overprinted by high frequency and high-amplitude short-term sea-level fluctuations that can be related to the glaciation of polar areas starting in Eocene in Antarctica and Miocene in the Northern Hemisphere.

The sedimentary record of the Cenozoic North Sea Basin reflects these eustatic sea-level changes in broad terms; however difference between the locally derived sea-level curve and the global curve have to be attributed to stress-induced intra-plate deformations that gave rise to relative changes in sea level.



3.3 Cenozoic palaeogeographical evolution

The Cenozoic evolution of Western and Central Europe is controlled by the combination of continental drift and changes in global sea level described in the previous paragraphs. Great thickness of Tertiary and Quaternary sediments exist in the North Sea basin while only thin Tertiary sediments is present in the Northern German and Polish platforms. Northern Germany and Denmark were marginally influenced by the North Sea subsidence pattern locally increased by intense diapirisme of Permian Salts while the eastern part of Germany and Poland formed a stable platform throughout the Cenozoic. Neogene and Quaternary uplifts have resulted in erosion of large areas but in spite of this, former palaeogeographical stages covering Eocene, Oligocene and Mio-Pliocene have been reconstructed on basis of sedimentological and palaeobiological criteria (Figures 6, 7 and 8).

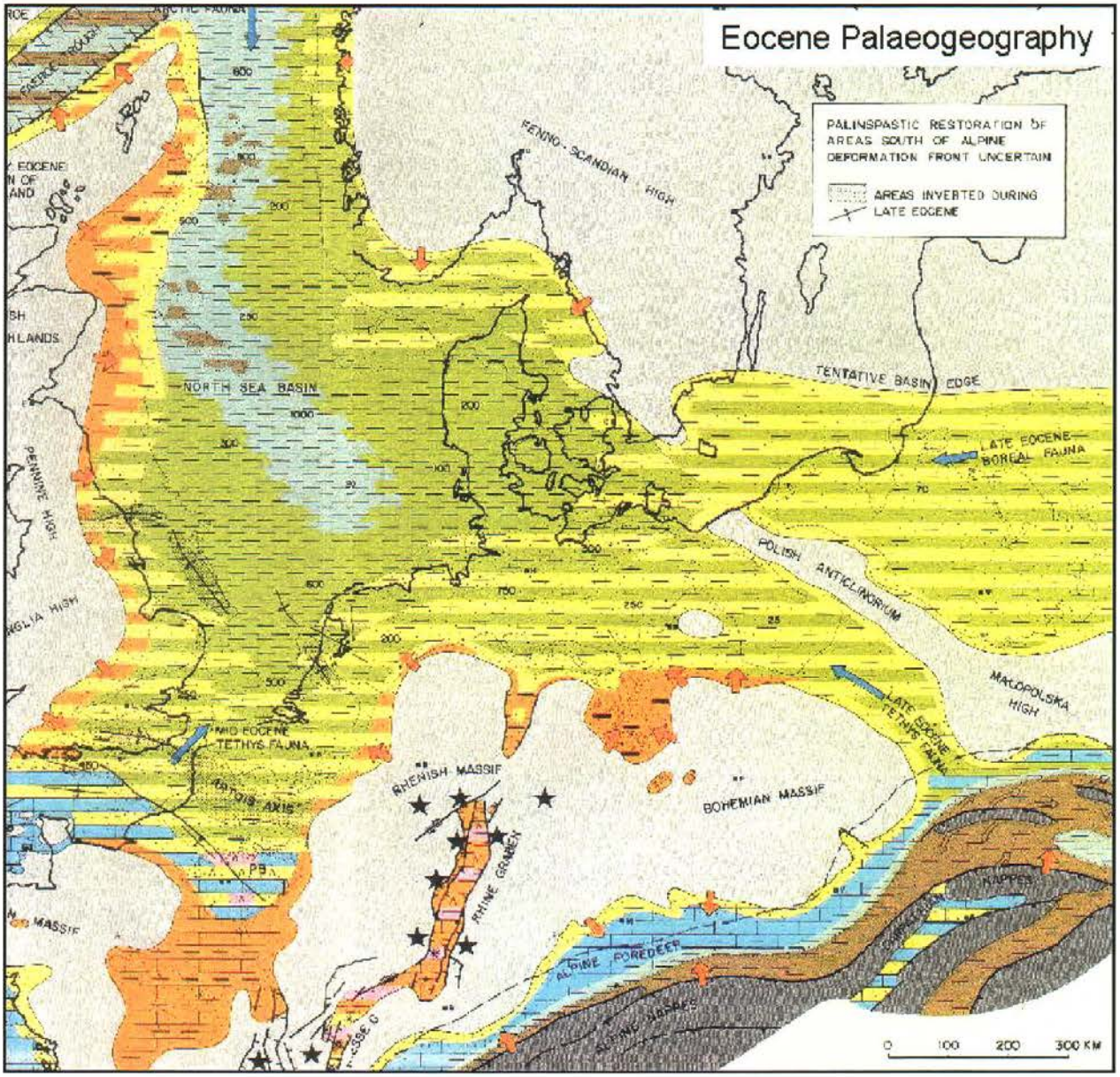


Figure 6. Eocene palaeogeographical map of Europe (From Ziegler 1990).

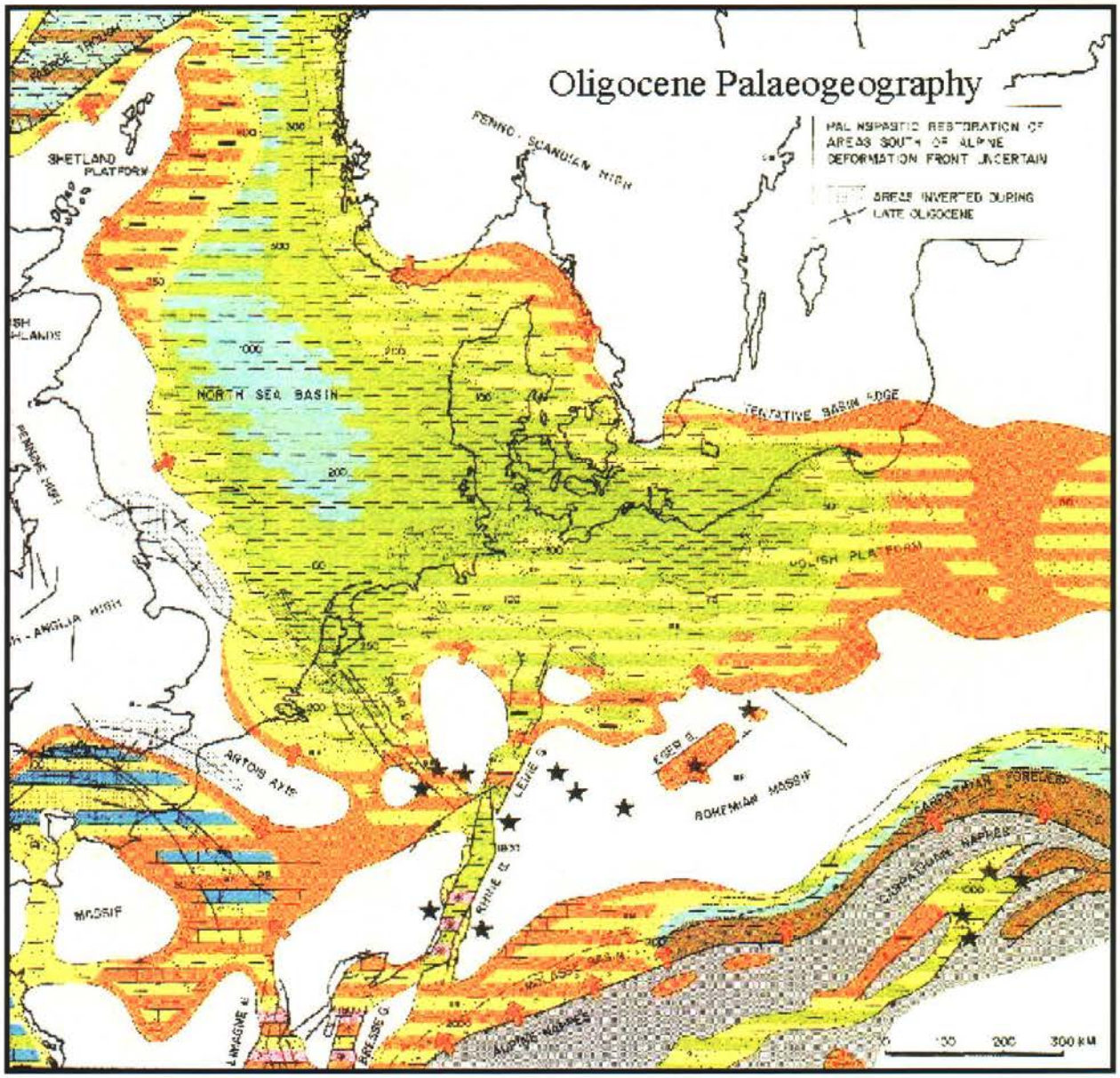


Figure 7. Oligocene Palaoegeographical map of Europe. (From Ziegler 1990).

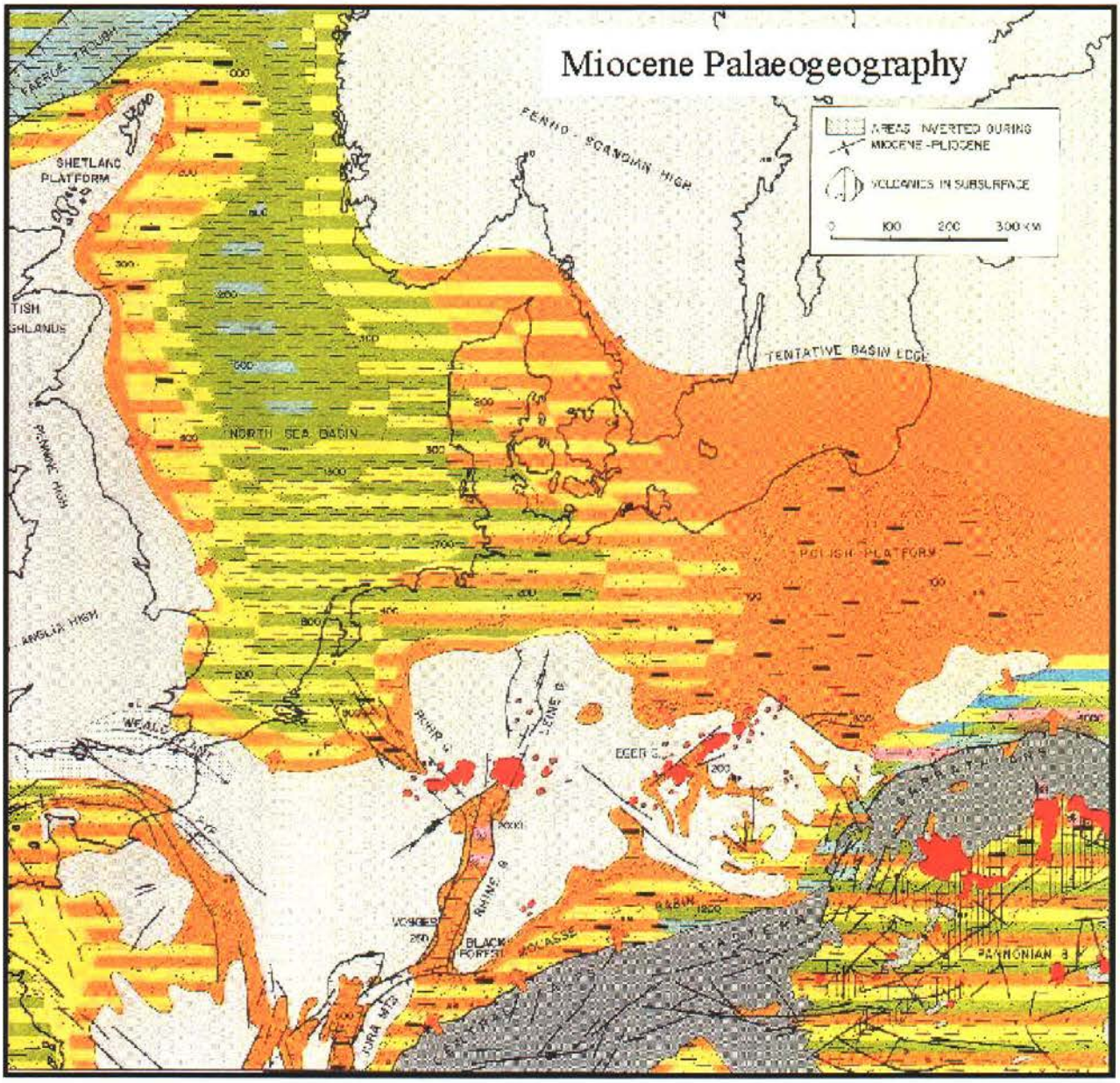


Figure 8. Miocene palaeogeographical map of Europe. (From Ziegler 1990).

Eastern North Sea Basin area Danish part

Progressive thermal subsidence of the North Sea area, combined with a relative rise in sea level, caused a regional transgression during the early Eocene. Deep-water marine shale facies in the North Sea and Danish sector implies that the coastal facies must have been onshore the present Norway. The sediment infill of the basin was initiated in the Late Palaeocene dominated by clay. The deposition of fine-grained sediments continued through the Eocene. Clear evidence for progradation of major coarse-grained coastal systems is documented from Oligocene sourced from the present day Norway with a southward progradation. This pattern continued through the Oligocene and Lower Miocene. The depositional environment was related to spit systems and lagoons on and north of the Ringkøbing – Fyn High and more open marine conditions towards the south. In the Middle Miocene a distinct change in sediment supply occurred as the source area shifted eastward to the Fenno-Scandia Shield probably caused by a regional tectonic re-organisation. A coinciding distinct eustatic sea-level rise resulted in a major flooding and retreat of the shoreline.

Southern North Sea Basin area Dutch part

In the area of the West and central Netherlands, inversion movements resumed during the Late Eocene as is evident by convergent reflection patterns in Eocene sediments, and a base Oligocene unconformity that is Arial confined to a Northwest-trend gentle anticline feature, over which Eocene sediments were eroded. Transgressive Oligocene marine strata overstepped this feature and are in turn disconformably overlain by Miocene and younger sequences. Late Oligocene sediments are generally absent and the mid- Oligocene hiatus was accompanied by minor deformations that were mainly induced by salt movements. Development of the Northwest-trending Ruhr Valley Graben, which forms the northwestern branch of the Rhine rift system, provides for late Oligocene to Pleistocene subsidence anomalies.

In the Rhine Graben, initial synrift deposits consists of middle and late Eocene lacustrine shales and carbonates and fringing clastics. Distal marine incursions reached the basin during the latest Eocene and Early Oligocene from the West Alpine foreland basin. During the early Oligocene, rifting propagated northward and breached the Rheinish Shield. This led to the development of a narrow seaway that linked the Alpine foreland basin via the Rhine and Leine grabens with the Northwest European Basin. Late middle to late Oligocene northwestward rift propagation into the Netherlands is evident from the stratigraphic record.

The Northern German – Polish Platform

The Cenozoic evolution of the onshore parts of Northwest Europe differs widely from that of the North Sea Basin. Northern Germany and Denmark were still marginally influenced by the North Sea Subsidence pattern whereby, in many areas, the intense diapirisme of the Permian salts caused local subsidence anomalies. The eastern part of Germany and Poland formed a stable platform throughout the Cenozoic.

In those parts of the North German-Polish Platform that were not affected by the Sub-Hercynian and Laramide inversion movements, deposition of transgressive shallow-marine shales and basin-margin clastic series characterised the Late Palaeocene and Eocene period. Transgressive conditions persisted during the Eocene whereby the basin margins were progressively overstepped. Middle Eocene

sandstone corresponds to a regional correlative deltaic complex that prograde from the southern basin margin. The cause of this middle Eocene increase in clastic supply to the southern and eastern parts of the Northwest European Basin is not clear as it does not correspond to an eustatic low-stand in sea level.

On the North German Platform, the late Eocene corresponds to a regional transgression that extended into early Oligocene. The base of the middle Oligocene is marked by a regional depositional and, in places, erosional hiatus.

In the northern and central Poland, the Oligocene and Neogene series are developed in a continental facies and contain major brown-coal deposits. Westwards, these strata interfinger with the deltaic sequences of Northern Germany, which prograde into the North Sea Basin.

A hiatus marks the base of the Miocene over wide areas. During the Miocene and Pliocene sedimentation was dominated by an increasing clastic influx from the Baltic area the Rheinish Shield and the Bohemian Massive.

The topographic relief of the Polish Anticlinorium was rapidly degraded during the Eocene so that late Eocene shallow-marine clastics and shales began to encroach on its remnant relief. By the mid-Oligocene, even the axial parts of this major structural feature had been overstepped.

4. Investigation areas in Europe

During the recent years GEUS has carried out an intensive "scouting" for high-grade Ilmenite deposits in Europe (Fig. 9). The approach has been to identify potential depositional settings and collect samples to be able to make a proper evaluation of the grade of TiO_2 in the Ilmenite.

Besides the placers developed in Ukraine during Late Jurassic to Neogen, the most interesting setting have turned out to be marine coastal sands and terrestrial sands represented by the Tertiary time periods Eocene, Miocene and Oligocene found in Holland, Germany, Poland and Belarus. Besides the Tertiary samples few samples from Jurassic coastal and deltaic sediments have been taken in Sweden and off the Danish Island Bornholm while a screening of the Pleistocene-Holocene sediments have been carried out in Poland and Lithuania.

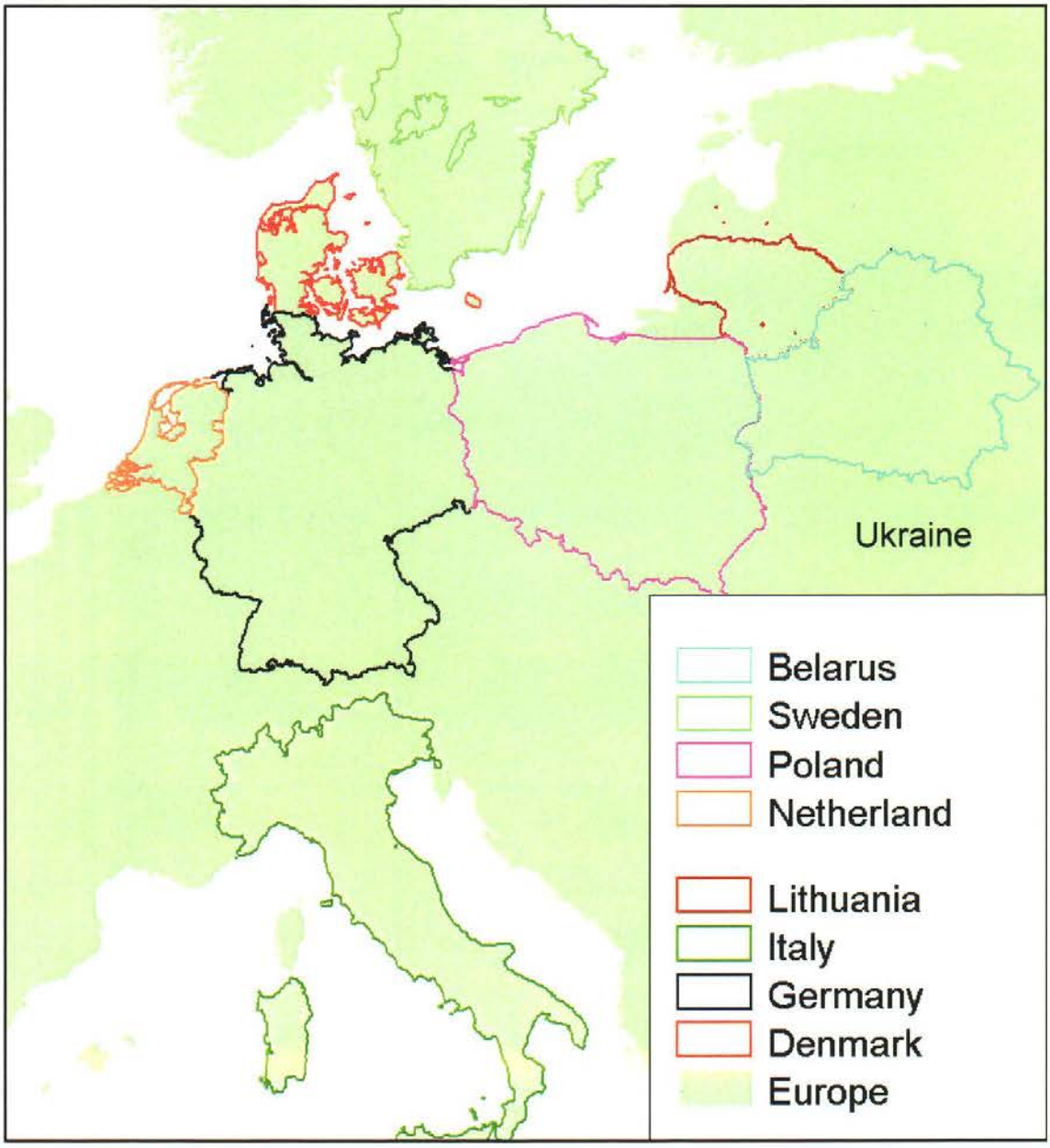


Figure 9. European countries from where samples have been provided.

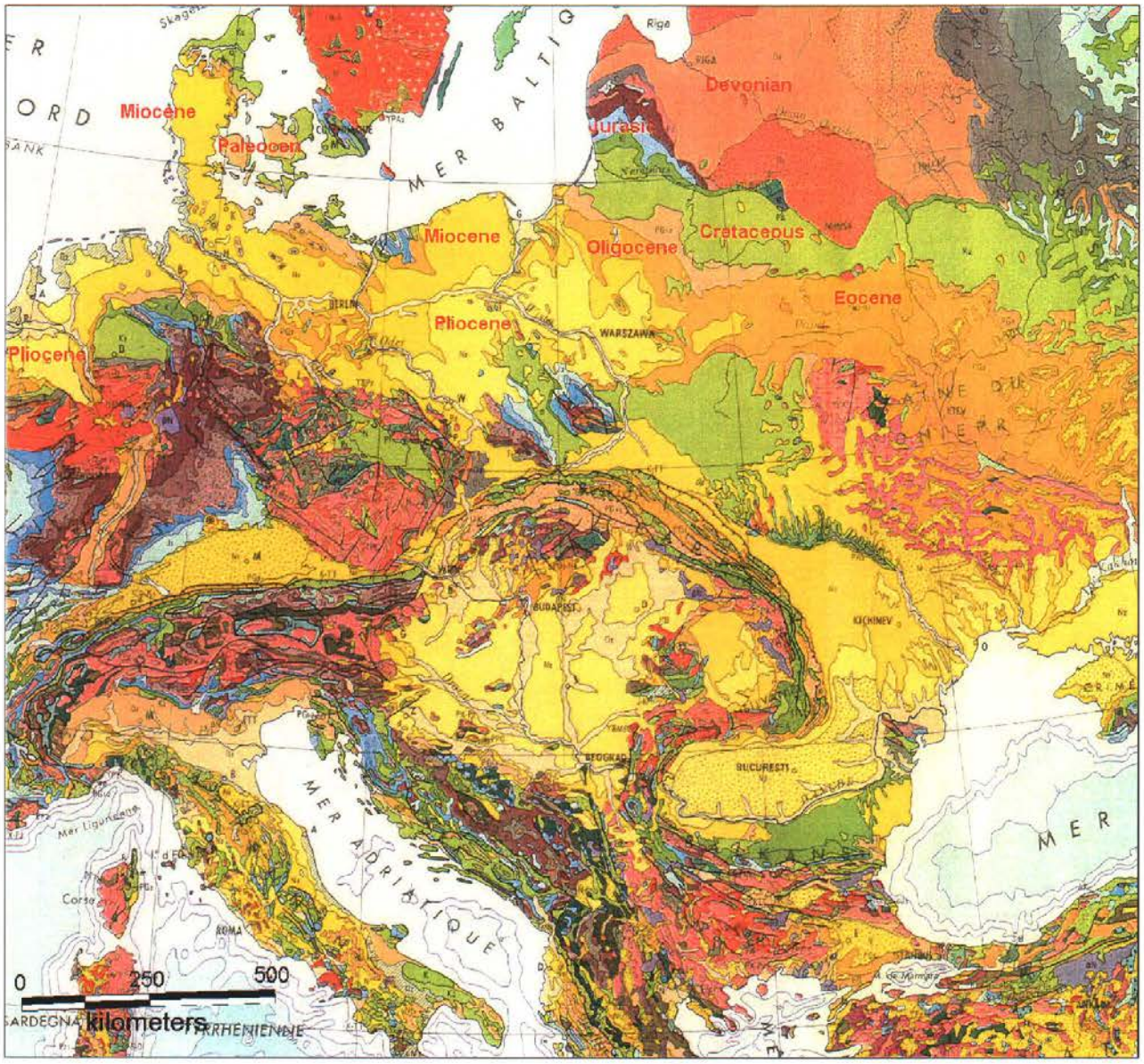


Figure 10. Pre-Quaternary surface map of Europe.

5. Netherlands

The Dutch Geological Survey (TNO) has provided samples from a glass-sand quarry in Limburg and from counterflush borings in the Boxmeer area.

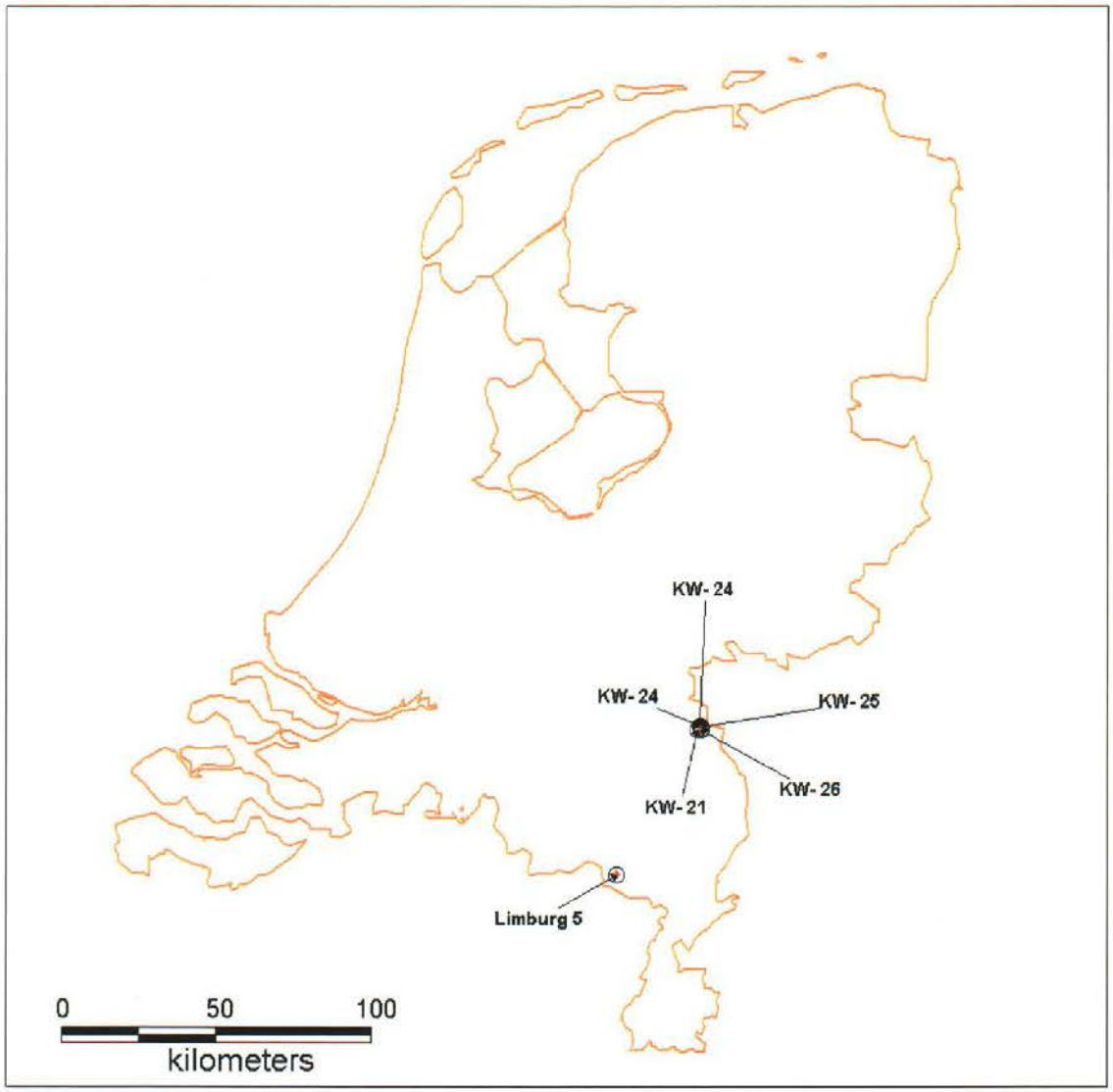


Figure 11. Sample locations in the Netherlands.

5.1 Limburg

Limburg is located in the southeastern most part of the Netherlands close to the Belgian boarder in an area dominated by prequaternary Miocene and Pliocene deposits.

The sand samples are taken from Miocene deposits that are interpreted as erosion products of a rejuvenated, heavily weathered peneplain, (Gullentops 1972). The Ardennes has supplied the majority of the minerals, but a more remote source area is needed for others. The transport was essential fluvial, but the uniform grain size is best understood by final deposition in tidal, estuarine conditions.

5.2 Boxmeer

Boxmeer is located in the easternmost part of the central Netherland rather close to the Rhine River. In a project called BOPROZ a number of counterflush corings were carried out. GEUS has received 5 samples from the corings 4 from the late Miocene marine Breda formation (KW21, KW24, and KW26) and 1 from the boundary between the Quaternary Tegelen and the late Miocene Breda formation.

In the area in the order of 20 – 30m of Pleistocene formations (Tegelen, Veghel and Nuenen) covers the Late Miocene (Breda Formation). The Breda formation consists usually of fine or medium-sized sands with an extremely zircon-rich association called the Haps Sands. The percentage of garnet is in general largest in the Boxmeer area. These usually slightly glauconitic marine sands sometimes contain gravel rich in fissure quartz.

General analysis of the sand shows an extreme well sorting with a median between 150 and 300 micron. Two parameters characterise the geochemistry. High contents of glauconite and heavy minerals. The glauconite gives high contents of K, Fe, As and locally phosporite shows a pike of contents of P. The high contents of heavy minerals is mainly Zr combined with Ti and Cr.

5.3 CCSEM analysis from the Netherlands

Holland								Heavy mineral				TIO %			Ave. TiO_2
Name	Long	Lat	Geology	Depth	D50	Heavy Min %	Illmenite %	Illmenite	Leucoxene	Rutile	Zircon	Illmenite	Leucoxene	Rutile	all TiO_2 min.
	x	y		in m	mm	of total sand	of total sand	%	%	%	%	%	%	%	%
KW- 21	05 59,9	51 39,5	Miocene	27-28	0,09	0,53	0,11	21,4	9,8	21,2	20,6	57,5	76,4	92,8	75,4
KW- 24	06 00,5	51 40,0	Miocene	16-17	0,09	0,56	0,12	20,7	14,0	20,0	20,3	57,2	77,1	92,5	76,6
KW- 24	06 00,5	51 40,0	Miocene	21-21,8	0,09	0,55	0,09	17,2	8,7	8,5	23,8	56,1	74,9	93,5	68,9
KW- 25	06 01,0	51 39,7	Miocene	9-10	0,10	0,38	0,10	26,2	10,7	13,6	22,1	56,8	75,7	91,9	70,6
KW- 26	06 01,0	51 39,3	Miocene	11-12	0,11	1,07	0,04	3,7	3,4	1,5	3,0	58,6	76,5	92,5	70,3
Limburg 5	05 37,5	51 14,9	Miocene	-	0,12	0,23	0,09	38,0	7,6	21,2	12,6	60,6	75,1	92,5	74,1

Table 1. Netherlands samples

The heavy mineral concentration in the 6 samples collected in the Netherlands is very low. Only 1 sample has more than 1 % heavy mineral content and the ilmenite content is less than 0,1 % of total sand. Limburg-5, has high-grade Ilmenite with TIO_2 content above 60 %. However the heavy mineral content is low and there are no data based on the geological maps and informations from the area that could enhance the interest for this area. It is therefore recomended, that no futher work is done in this area.

6. Germany

The state Schleswig–Holstein has been visited in 2000 and the Lausitzer Braunkohle Revier in 2001 while a number of samples from SW Mecklenburg-Forpommern have been provided by the Geological Survey of Mecklenburg-Vorpommern. In Schleswig-Holstein samples were provided from a number of wells while a number of samples were taken in open pits mines in the Lausitzer Braunkohle region.

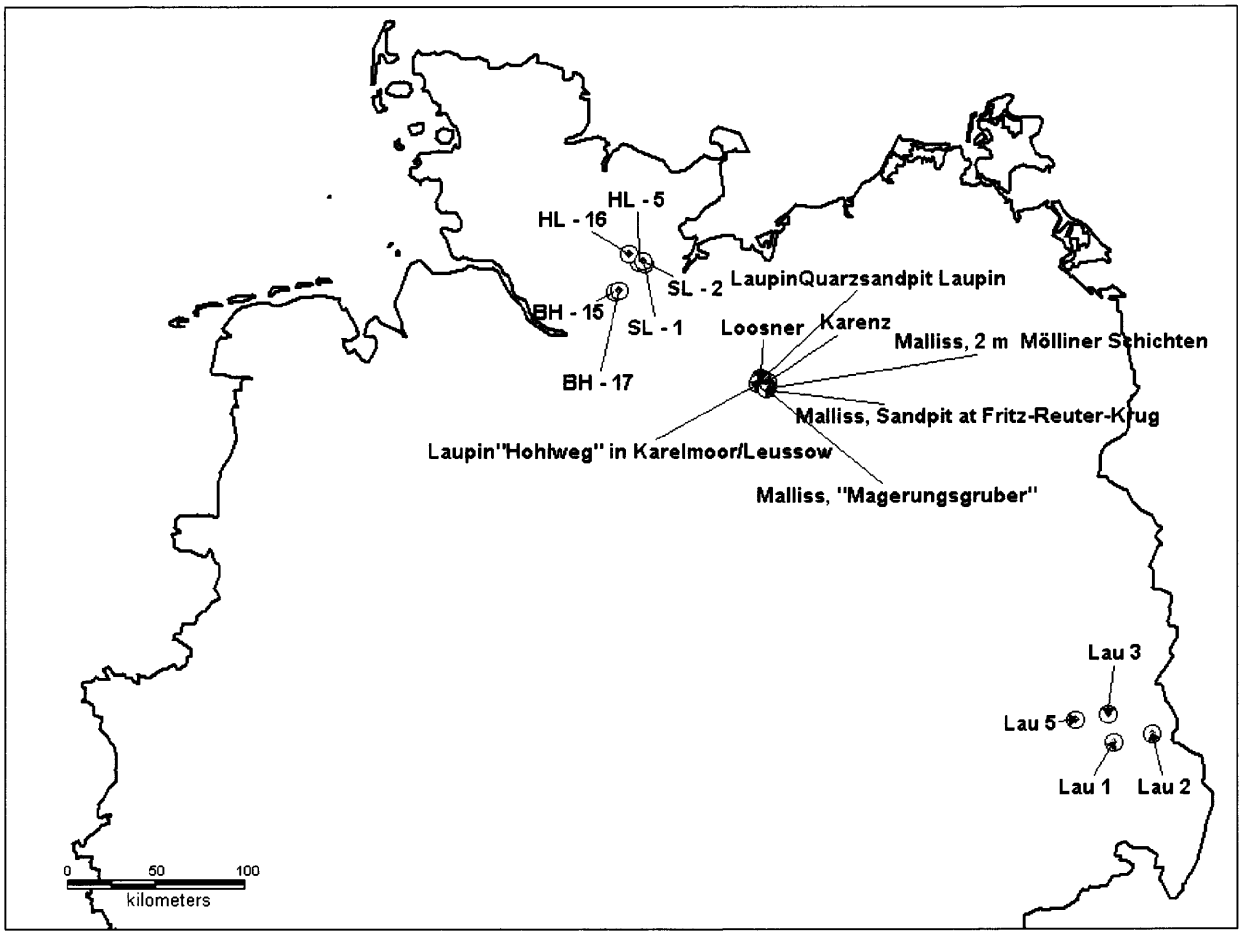


Figure 12. Sample locations in Germany

6.1 Schleswig-Holstein

Schleswig-Holstein is located in the northwesternmost part of Germany just south of the border to Denmark. The region is dominated by Miocene sands below the Pleistocene sediments.

Due to a transgressive hiatus only little Oligocene sediments are preserved compared to Eocene and Miocene deposits that were eustatically controlled and locally much influenced by halokinetically formed diapirs.

In the Eocene period sand was transported in to the area from a southern source area and graded into clay northwards. In contrast the Miocene (Vierlandian and Hemmorian) lignite sand came from the east. Large quantities of freshwater transported the sand and caused weak brackish conditions at the mar-

gins of the marine area. The sand transport ended abruptly in late Miocene but in the Pliocene sand transport began again, this time from Scandinavia.

A total of 7 samples have been analysed from different wells at an average depth of about 230m. Of the samples, 6 have been taken in Hemmoor-Reinbek Miocene marine fine sand and 1 just above in Pleistocene sand.

Germany								Heavy mineral				TIO %			Ave. TiO_2
Name	Long	Lat	Depth	Geol-ogy	D50	Heavy Min %	Illmenite %	Illmenite	Leucoxene	Rutile	Zircon	Illmenite	Leucoxene	Rutile	allTiO_2 min
	x	y	in m		in mm	of total sand	of total sand	%	%	%	%	%	%	%	%
HL – 5	10 25,6	53 52,7	321-324	Mioce.	0,17	1,19	0,35	29,3	3,7	11,6	1,7	51,9	76,7	94,4	54,2
HL – 16	10 20,7	53 54,8	486-495	Mioce.	0,08	3,45	0,49	14,3	0,8	1,8	3,4	52,1	76,6	93,8	55,7
SL – 1	10 28,7	53 52,0	90-110	Mioce.	0,07	2,87	0,51	17,6	6,0	3,5	3,9	53,1	76,1	93,0	64,3
SL – 2	10 27,6	53 53,0	240-257	Mioce.	0,08	2,32	0,33	14,2	1,5	3,8	3,6	53,1	77,3	92,7	61,8
AB – 11	- -	- -	90-95	Mioce.	0,13	0,53	0,12	23,1	4,1	4,9	1,3	53,9	77,6	92,0	61,6
BH – 15	10 14,1	53 44,0	102-117	Mioce.	0,08	3,46	0,30	8,7	1,3	1,7	1,0	52,1	76,2	91,5	58,4
BH – 17	10 16,0	53 44,0	276-282	Pleisto	0,09	2,46	0,51	20,8	4,5	3,5	4,7	52,6	75,2	92,6	60,8

Table 2. Schleswig-Holstein samples

The heavy mineral concentrations in the 7 samples collected form wells in Schleswig Holstein are rather high. 6 of the samples from the area have more than 1- % heavy mineral content. The ilmenite content is less than 1 % of total sand in all the samples. The Ilmenite in this area is low grade with TIO_2 content of 51-54 %.

6.2 Mecklenburg-Forpommern

The Geological Survey of Mecklenburg-Vorpommern has sent a number of samples from a variety of Pliocene and Miocene sands from the SW of Mecklenburg.

The SW of Mecklenburg was characterised by a partly coastal environment during the Miocene and Pliocene. Detailed information about the stratigraphy of the different unit's samples can be obtained from Bülow 2000, but in general the lower Miocene Mölliner- and Mallisser Schichten consists of brown coal and quartz sand gradually changing to middle Miocene marine silts and sands and upper Miocene (Laupiner Schichten) fluviatile Quartz sand and upper Pliocene (Loosener Schichten) fluvial sand.

A total of 7 samples have been analysed from the SW of Mecklenburg. Four of these are from the lower Miocene Mölliner Schichten (Samples 1,2,3 and 4), while 2 samples are from the Laupiner Schichten quartz sand (Samples 5 and 6) and 1 sample from the Loosener Schichten (Sample 7).

Germany	Long	Lat.	Material	Material	% heavy minerals	% heavy minerals
Name	x	y	< 0,045mm in %	>0,71mm in %	in material <0,71mm	Thereof
			of whole sample	of whole sample	>0,045mm	of whole sample
Loosner	11 24,0	53 18,8	1,27	12,92	0,16	0,14
Laupin"Hohlweg" in Karelmoor/Leussow	11 23,3	53 17,0	6,34	0,19	0,05	0,04
Laupin Quarzsandpit Laupin	11 23,3	53 17,0	1,30	3,65	0,24	0,22
Malliss, Sandpit at Fritz-Reuter-Krug	9 26,8	51 15,6	3,27	0,13	1,24	1,20
Malliss, "Magerungsgruber"	9 26,8	51 15,6	0,11	3,23	0,11	0,11
Malliss, 2 m Mölliner Schichten	9 26,8	51 15,6	1,87	0,63	0,14	0,14
Karenz	11 27,7	53 17,3	2,16	0,04	0,88	0,86

Table 3. Mecklenburg-Forpommern samples.

The heavy mineral concentrations in the 7 samples collected in Mecklenburg-Vorpommern are low. Only one sample from Malliss sandpit at Fritz-Reuter-Krug has more than 1. % heavy mineral content. There are until now not made any analysis on heavy mineral composition.

6.3 Lausitzer Braunkohle region.

The Lausitzer Braunkohle Revier have been visited in 2001 and a number of samples from a variety of Pliocene and Miocene sands from open pit mines and adjacent sand dune have been taken.

There are two main periods of sand deposition in the area:
1) Miocene: - sands at the banks of the Miocene ocean
2) Pleistocene to recent: - dunes formed within the "Urstromtal" which runs along the boundary of the ice
The sampled Miocene sands are remarkably even grained and pure and show large-scale (m-scale) crossstratification. The Pleistocene to recent dunes is variable in their mineral content. Within one dune the sands seem to be very homogeneous and a planar stratification as well as cross stratification is only weakly developed. In contrast to other samples of these dunes, LAU-03 exhibits a noticeable content of feldspars and mica.

Four samples were taken:
Miocene: Sample LAU-05. Pleistocene to recent: Samples LAU-01, LAU-02, LAU-03

			Material	Material	% heavy minerals	% heavy minerals
Name	Long	Lat.	< 0,045mm in %	>0,71mm in %	in material <0,71mm	thereof
	x	y	of whole sample	of whole sample	>0,045mm	of whole sample
Lau. 1	14 14,5	51 32,2	0,87	12,28	0,77	0,66
Lau. 2	14 33,0	51 34,8	0,76	4,75	0,58	0,55
Lau 3	14 12,2	51 40,6	0,87	9,31	0,77	0,69
Lau 5	13 56,5	51 38,6	0,15	0,08	0,07	0,07

Table 4. Lausitzer Braunkohle region samples.
The heavy mineral concentrations in the 4 samples collected in the Lausitzer Braunkohle Revierin in the southernmost part of the Brandenburg Council are low. All samples from Lausitzer Braunkohle pit have a heavy mineral content lower than 1%.

6.4 CCSEM analysis.

wo samples have been been selected for CCSEM analysis, one from Mecklenburg-Vorpomeren and another one from Lausitzer Braunkohle region to estimate the heavy mineral composition. Results area listed in table 5.

Germany								Heavy mineral				TIO %			Ave. TiO_2
Name	Long	Lat	Depth	Geology	D50	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leu-coxene	Rutile	All TiO_2 min
	x	y	in m		imm	of total sand	of total sand	%	%	%	%	%	%	%	%
Lau-1	11 27,7	53 17,3		Pleisto-cene	0,15	0,66	0,07	11,2	1,7	2,5	3,0	54,8	78,0	94,0	62,3
Mölliner Schichten	9 26,8	51 15,6		Miocene	0,09	0,14	0,07	52,9	14,5	7,0	10,8	55,4	75,8	93,9	64,1

Table 5. CCSEM analysis on samples from Mecklenburg-Vorpomeren the Lausitzer Braunkohle region.

The heavy mineral concentrations in the 2 samples are low, with a heavy mineral content at less than 1%. The Ilmenite concentration is low and the TIO_2 content is around 54-55 %. It is not recommended to do further stydies in these areas.

7. Denmark

The danish onshore deposits have been screened during initial phases of exploration. The sediments are of Quarternary age, little altered and generally with low grade ilmenite. However, there may be reworking of Mesozioc and Kenozoic sands offshore, so offshore samples available at GEUS have been analysed. Samples from two offshore areas, in the Baltic and the North Sea respectively have been analysed using CCSEM. This to evaluate possible potential in drowned, Quaternary beach/barrier deposits and reworking of pre-Quaternary deposits into the more recent marine deposits.

4 samples have been taken offshore Bornholm and 9 samples from the North Sea.

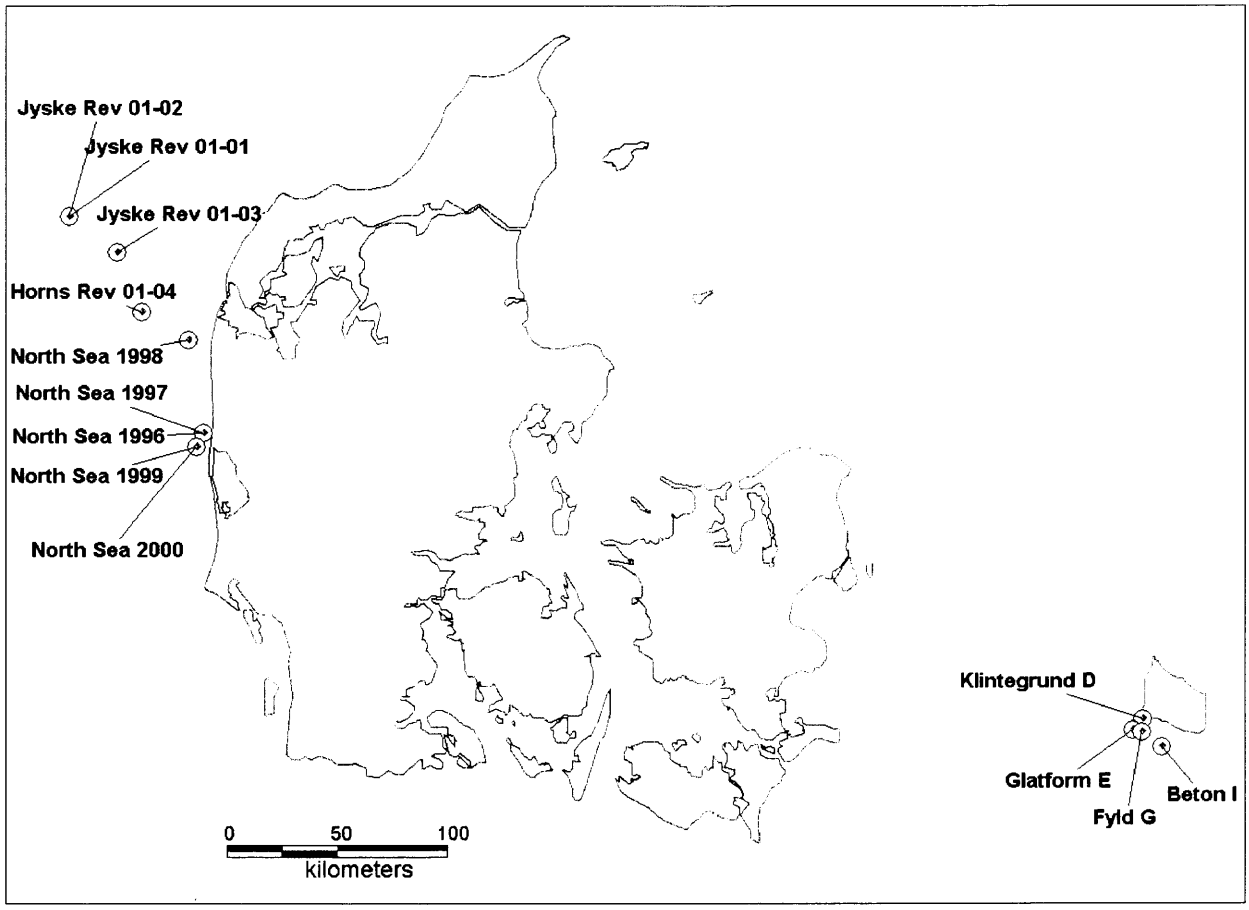


Figure 13. Sample locations in Denmark.

7.1 Offshore Bornholm

Four samples have been taken offshore Southwest of Bornholm, in the Southwestern Baltic Sea.
The company A/S Silversand from an area Southwest of Bornholm has provided the samples (D, E, G and I).

The samples have been sub-sampled from a suctiondredger representing different depositional environments:

- Sample D is taken on Klintegrund from the Jurassic Bagå formation used by A/S Silversand as quartz sand.
- Samples E and I are taken in Holocene marine sand used by A/S Silversand as sand for concrete.
- Sample G is taken in what is supposed as Late Weichselian meltwater sand used by A/S Silversand as fill material. G

General geology

The geology of Bornholm differs from that of the other parts of Denmark, amongst others, by the fact that the land surface of the northern part of the island is made of bedrock of granite and gneiss from the Archaean era. In the southwestern parts of the island old coastal deposits exists from the earth's Middle Ages (Mesozoic, 65 – 230 million years ago).

In these strata that originally were formed as coastal deposits pure quartz sand is found. Apart from that coastal processes, the climate, had worn the sand grains on the earlier Bornholm was warm and moist. That meant that bedrock strata were exposed to strong weathering, which caused a transformation of feldspar minerals into kaolin-type clay minerals. The river waters and waves at the coast could therefore easily erode this clay, and a pure quartz sand was left, which afterwards formed the barrier coast sediment strata of the Robbedale Formation. The extraction of the onshore raw material yielded problems for the water supply of the town of Rønne, since the sand layers of the Robbedale Formation form its most important ground water reservoir. In the beginning of the 1980's it was therefore decided, that a phasing out of the production should occur in course of a number of years. At the same time a detailed seabed-mapping program was initiated, focusing on the area Southwest of Bornholm. The mapping was carried out as a combination of a seismic survey and extensive dredging tests. It was demonstrated that in large parts of the area younger sediments, with the Mesozoic strata widespread outcropping not, or hardly, covered the seabed.

Movements of the earth crust have resulted in uplift and subduction of sedimentary strata, that in a complex pattern have been folded along zones of weakness and faults (Fig. 3). The purpose of the mapping was, among others, to unravel the fault pattern and to investigate the strata that were relevant for raw material extraction. It was shown that the Robbedale Formation was not present in the offshore area, but folded strata of presumably delta deposits (Bagå Formation) were found instead. The latter consist of clay and coal-bearing layers, which were deposited in the marsh environments of the delta, and of quartz sand, which was deposited along the river channels of the delta. In the area Southwest of Rønne, favourable conditions occur with dipping strata from which it is possible to extract the sand. After a series of investigations and adjustment of the existing production facility, production from the offshore resource area was successful. About 100,000 m^3 of sand is now annually retrieved from the area.

The sand and gravel used on Bornholm for construction and roads is besides crushed onshore bedrock presently taken from offshore Pleistocene resources with a lower quartz content than what is found in the Robbedale Formation:

- Late Weichselian fluvial meltwater deposits normally are characterised as poorly sorted sand and gravel mainly consisting of quartz but with a contents of crystalline
- Holocene marine sand in general deposited in coastal deposits. Compared to the Mesozoic sands a lower content of quartz is observed.

The samples

The four samples taken south-west of Bornholm have been analysed using CCSEM.

Sample D from Klintegrund
Sample D shows the highest contents of Ti-minerals among the samples with a high TiO_2 content. A single top on the distribution of TiO_2 contents in Ti-minerals, the low contents of silicate and magnetite and a high content of pyrite indicates that it is an in situ Jurassic sample with no signs of redeposition. This confirms the mapping results described in section 1.1. The grain size distribution shows a D50 of about 0.220mm.

Sample E, Glatføre
Sample E is characterised by a high TiO_2 contents in the Ti-minerals but with a less well defined distribution top than sample D. A high contents of pyrite indicating an in situ sediment type is conflicting with a high contents of magnetite. In combination with the mapping information from section 1.1 the sample is believed to be Mesozoic sand influenced by a minor Holocene redeposition.

Sample G, Fyld
Sample G is characterised by well-rounded heavy mineral grains with a D50 of about 0.200mm and a relatively high TiO_2 contents in the Ti-minerals. A remarkable high percentage of the minerals are unclassified. The unclassified minerals may be phosphorite, which means that the sediment may be, reworked Cretaceous Greensand.

Sample I Beton
Sample I am similar to sample G with rounded heavy mineral grains a D50 of about 0.200mm and a relatively high TiO_2 content in the Ti-minerals. Also the percentage of unclassified minerals is high. Information from mapping in the region (fig. 2) shows that sample I am taken from a major Holocene marine sand accumulation with a clear imprint of Cretaceous Greensand.

Denmark	WGS84					Heavy Mineral					TIO %			Ave.TiO_2
Name	Long	Lat.	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leucoxene	Rutile	all TiO_2 min
Bornholm	x	Y	mm		of total sand	of total sand	%	%	%	%	%	%	%	%
Klintegrund	14 40,9	55 02,8	0,22	Jurassic	0,24	0,06	27,0	26,3	2,8	6,6	63,1	73,8	91,6	71,5
Glatføre	14 36,7	55 00,2	0,22	Mesozoic	0,21	0,03	13,4	8,0	1,1	1,3	61,7	75,2	92,8	69,3
Fyld	14 40,8	54 59,8	0,19	C. (Rew.)	0,50	0,08	16,0	8,5	2,0	1,2	57,8	78,0	91,4	67,0
Beton	14 49,0	54 56,3	0,2	Holocene	0,43	0,09	20,1	4,0	3,3	2,9	58,0	75,7	94,1	65,3

Table 6. Samples from the Bornholm area

A very low content of heavy minerals in all the samples (0.21 – 0.50% of total sample) show that the sands are not a direct target for further prospecting for ilmenite. However, the high TiO_2 content in the Ti-minerals indicate, that deposits containing reworked Mesozoic sediments are of interest. Further, the mineral paragenesis indicate a mature sediment with over 60 % VHM in the Klintegrund sample.

If fossil beach deposits eg. related to the Holocene evolution of the Baltic can be located, these are likely to contain high-grade ilmenite.

7.2 North Sea

In the Danish North Sea 9 samples have been taken in Holocene marine drowned coastal deposits and in recent sand waves.

Five samples have been taken from offshore Vibrocores of the Danish North Sea near the West Coast of Jylland. Three samples are also taken from Vibrocores from the Northern part of the West Coast offshore area of the Danish part of the North Sea at Jyske Rev. This area is characterised by a huge sand accumulation. The last core is from Southern part of the West Coast offshore area of the Danish part of the North Sea at Horns Rev. All the cores are at maximum 6 m in length. No exact positions and lithology are available from the cores, but all samples are sand of possibly Holocene age.

The sample represents a unit of sub-Recent, marine, fine to medium and coarse sand with some lamination due to the changing grain size. The unit has been penetrated from the seabed to 4.5-m depth. The unit shows evidences of a sediment transport from the west to the east depositing into a minor depression. On the basis of a series of C-14 dating it has been established that the unit was deposited within a time span of 1.000 years. The sedimentation rate of the ca. 4.5-m thick unit is in the range of 4.5 mm/yr.

Jyske Rev

Samples 1, 2 and 3:

The 3 samples represent the widely distributed Jutland Bank Sand Unit. This deposit of marine sand is associated with large sand bodies and other large scale bedforms with thickness up to 25 metres. The unit consists of fine to coarse, very well sorted sand. It is assumed that the sediment originates from a shallow marine and coastal environment in the early Holocene. Due to the rising sea level the original glacial landscape successively drowned and a huge amount of sediments were mobilised. A considerable reworking of the coastal sediments followed this. The initial development of the sand bodies is assigned to as tidal sandbanks deposited in the early Holocene when the tidal influence was more dominating than the present. Now these forms are found at water depths of 20-40 metres. However, the presence of active bedforms on top of the unit indicates an ongoing reworking process and sediment transport.

North Sea off the Westcoast of Jylland

Samples 96, 97, 98 and 99:

The samples represent Holocene marine, very well-sorted sand distributed as well-defined sandbank complexes. Two of these large sand accumulations have been identified in the area. Thickness is between 0 and 6 m. C-14 dating consider the sandbanks to be of recent – sub-Recent age. This fact and the presence of active mobile bedforms indicate that the banks are in more or less dynamical equilibrium with the present hydrodynamic regime.

The origin of the sediment is doubtful. However, the material most likely originates from the adjacent Weichselian outwash plain areas and high lying Tertiary deposits.

	WGS84							Heavy Min.				TiO_2			Avg. All
Name	Long	Lat.	Geology	Depth	D50	Heavy Min.		Ilmen.	Leucox.	Rutile	Zircon	Ilmen.	Leucox.	Rutile	Ti min.
North Sea	x	y		in m	In mm	in sand	sand	%	%	%	%	TIO2 %	TIO2 %	TIO2 %	TiO_2 %
North Sea 1996	8 05,04	56 10,42	Holocene	18,6-18,7	0,2	0,43	0,09	21,5	3,1	1,8	1,2	56,5	79	94,4	59,2
North Sea 1997	8 05,04	56 10,42	Holocene	20,6-20,7	0,15	0,7	0,14	20	2,4	1,6	4	54,6	75,8	94,5	57,4
North Sea 1998	7 58,53	56 32,48	Holocene	21,0-21,1	0,19	0,88	0,20	23,1	2,3	2,1	4	55,9	75,2	92,3	57,1
North Sea 1999	8 02,11	56 07,17	Holocene	18,0-18,1	0,16	0,84	0,20	23,8	6,4	2,1	3,4	54,6	76,9	92,4	61,1
North Sea 2000	8 02,11	56 07,17	Holocene	20,0-20,1	0,13	0,78	0,15	19,7	6,8	1,7	1,5	55,1	75,8	92,4	61,9
Jyske Rev 01	7 08,12	57 01,38	Recent	28,5-28,6	0,19	1,21	0,14	11,3	1,7	0	1	54,9	77,9	94	54,6
Jyske Rev 02	7 08,12	57 01,38	Recent	30,0-30,1	0,15	1,13	0,11	10	1,3	1,1	1,6	55,3	73,2	93,9	55,8
Jyske Rev 03	7 28,23	56 53,09	Recent	33,1-33,2	0,07	1,69	0,28	16,5	4,2	3,2	4,4	53,3	74,5	93,2	60,4
Horns Rev 04	7 39,01	56 38,90	Holocene	15,3-15,4	0,17	0,17	0,05	29,7	6,3	2	1,6	54	74,8	93,3	59,4

Table 7. The North Sea area samples

The heavy mineral concentrations in the samples are relatively low. Only samples from Jyske Rev have Heavy Mineral concentrations higher than 1 %. There are differences in the content of Valuable Heavy Minerals, where it is low at Jyske rev (Avg. 18.8 %) and higher off the West Coast (30.5 %). Further the grade of the ilmenite is higher off the West Coast compared to Jyske Rev (55.3 and 54.5 % TiO_2 respectively). Ther paragenesis as well as the grade indicate that some reworking of Miocene sands has taken place off the West Coast. However, the best mineralogy is found where the total content of heavy minerals is low, and the content of VHM is less than 0.5 % and 0.2 % on average. It is therefore recommended not do further investigations in this area based on Holocene marine materials.

8. Sweden

Four samples were taken in a Jurassic quartz sand quarry in Eriksdal, southern Sweden.

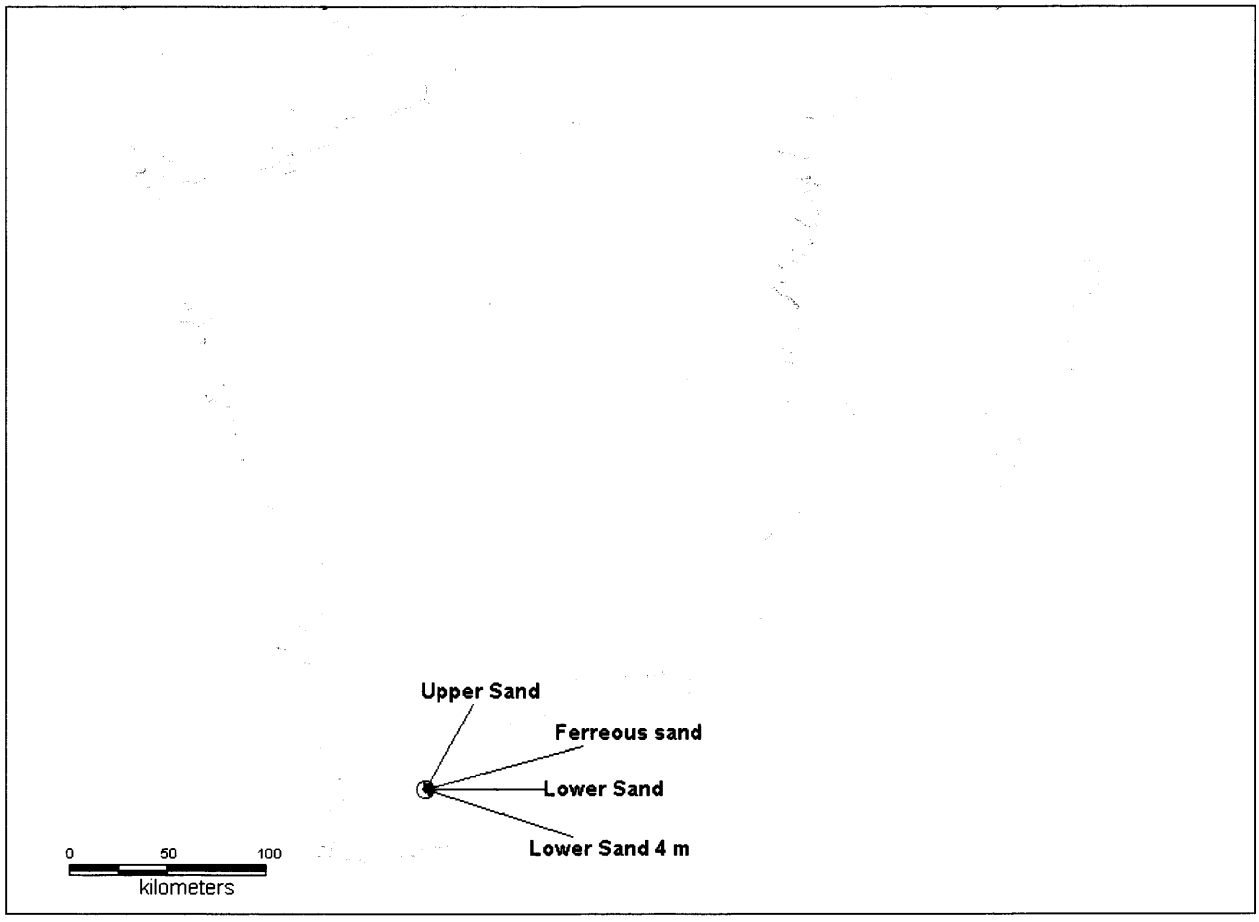


Figure 14. Sample locations in Sweden.

The location of the sample region is the Fennoscandian Border zone characterised as the borderline between the Scandinavian Bedrock in the north and the basin areas in the south. Deposits from the Jurassic time period 160 – 140 mill years ago are close to being orientated with layers in a vertical position.

The deposits consist of marine near coastal to deltaic sands, clay and coal representing a transgression. The reason for the contorted layering is tectonically movement in relation to the opening of the Atlantic Sea in the Tertiary time period.

The deposits consist of marine near coastal to deltaic Jurassic sands. In the sand there are several coal beds and layers of Siderite Iron carbonate, $FeCO_3$. Pyrite conglomerates are observed connected with the coal beds. A regional mapping (Sweden- Denmark and Poland) based on literature on presence of coastal Jurassic sediments along the Fennoscandian Border zone could enhance the understanding of distribution of high TIO_2 content in the sands in this area.

A total of 4 samples have been analysed

Sweden								Heavy mineral				TIO %			Avg.TiO_2
Name	Long	Lat.	Depth	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leucoxene	Rutile	All Ti min.
Eriksdal	x	y	m	mm		of total sand	of total sand	%	%	%	%	%	%	%	%
Ferrous sand	13 40,9	55 40,7		0,16	Jurassic	0,43	0,07	15,4	53,6	11,3	4,6	64,7	74,8	90,6	77,1
Lower Sand 4 m	13 40,9	55 40,7		0,09	Jurassic	0,58	0,12	20,7	33,3	18,0	2,6	63,8	75,3	90,6	78,2
Lower Sand	13 40,9	55 40,7		0,16	Jurassic	0,28	0,10	36,9	35,9	3,3	6,8	62,5	75,7	90,8	73,1
Upper Sand	13 40,9	55 40,7		0,13	Jurassic	0,28	0,07	26,1	44,1	13,0	7,0	64,9	74,9	91,0	76,0

Table 8. Sweden, Eriksdal samples.

Heavy mineral concentration in all four samples collected in Eriksdal gravel pit in Sweden is low but they are all characterised by high-grade Ilmenite with a TIO_2 content of more than 60 %. Further the HM assemblage is very mature with the VHM accounting for 70 to 90 % of the total HM.

9. Poland

Three sets of data will be presented:

1. Data about heavy mineral composition of Quaternary sands in Poland provided by the Polish Geological Institute in Warsaw (PGI)
2. Sand samples provided by (PGI) and analysed by GEUS. Sands from Miocene lignite mines and corings as well as Pleistocene alluvial sands and Holocene alluvial and spit sands have been analysed
3. Samples from two offshore bank accumulations the Odra and the Slupsk Bank. Both samples are Holocene marine sands.

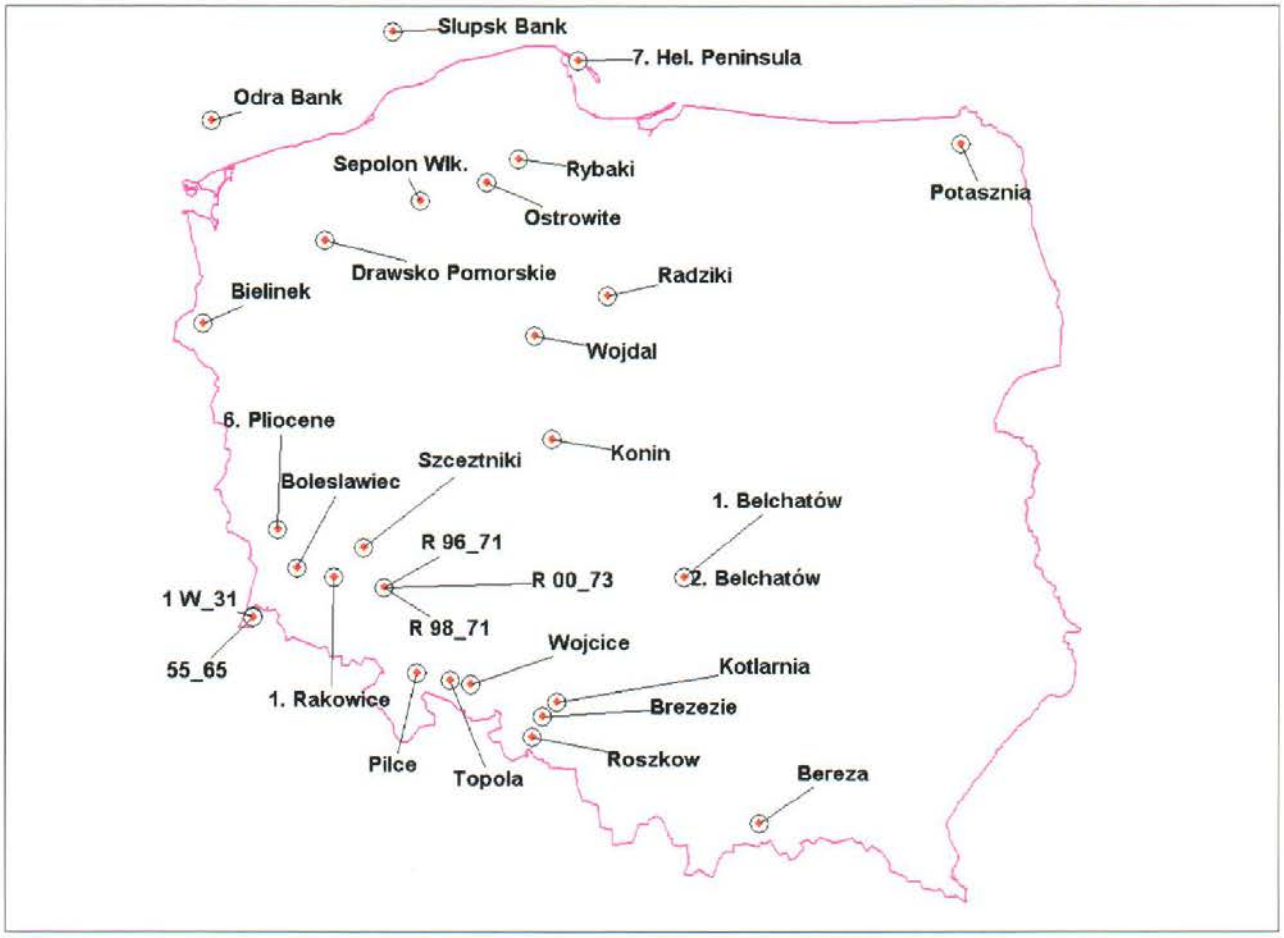


Figure 15. Sample locations in Poland.

9.1 General geology

During the late Palaeocene and early Eocene, deposition of transgressive shallow-marine shale's and basin-margin clastic series took place in Poland. The transgressive conditions persisted during the Eocene whereby the basin margins were progressively overstepped. The base of the middle Oligocene is marked by a regional depositional, and in places, erosional hiatus. A similar hiatus marks the base of the Miocene over wide areas. Transgressive, basal mid-Oligocene sand was derived from the south

while the Miocene and Pliocene sedimentation was dominated by an increasing clastic influx from the Baltic area.

Miocene and early Pliocene continental sequences host important brown coal and lignite deposits that have been exploited on a large scale. Westwards, these strata interfinger with the deltaic delta sequences of northern Germany.

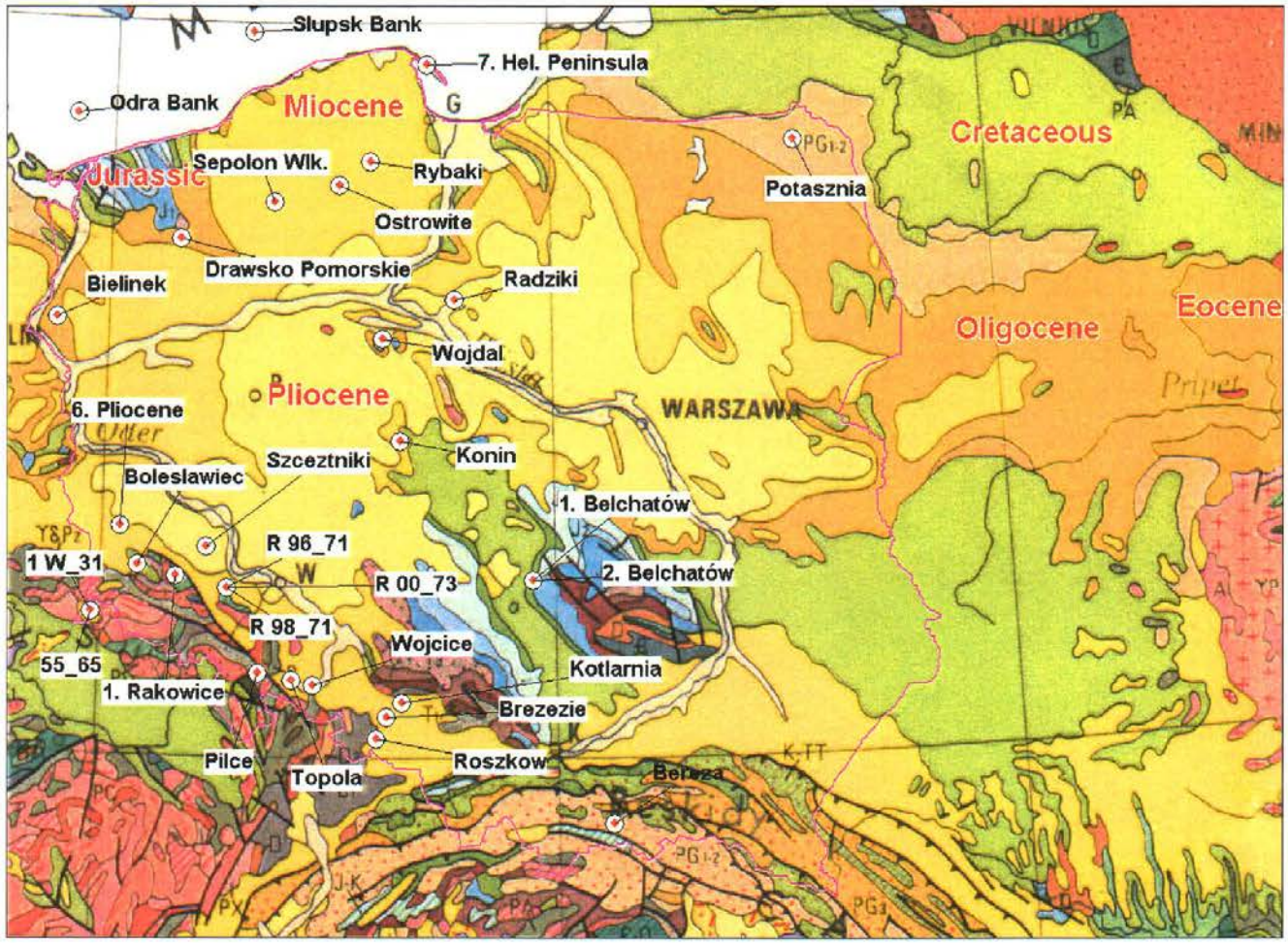


Figure 16. Poland samples located on the Pre-Quaternary surface map.

9.2 Heavy mineral analysis

The 3 sets of data mentioned above gives the following results

Onshore data provided by the Polish Geological Institute (PGI)

Information on heavy mineral content of Ilmenite and Rutile are available from 17 Quaternary deposits in Poland as shown in table 9.

Poland			Heavy mineral		
Name	Long	Lat.	Ilmenite	Rutile	Zircon
	x	y	%	%	%
Kotlarnia	18 21,6	50 23,0	33,3	10,0	18,0
Brezezie	18 12,0	50 17,1	31,7	12,2	-
Wojcice	17 24,5	50 30,1	11,8	2,1	1,0
Pilce	16 48,9	50 34,3	15,3	1,9	1,0
Roszkow	18 05,7	50 08,4	16,7	-	0,0
Topola	17 11,0	50 31,6	9,5	1,7	1,0
Radziki	18 54,8	53 08,3	17,6	0,8	2,0
Boleslawiec	15 29,3	51 17,1	4,9	2,8	3,0
Drawsko Pomorskie	15 47,9	53 30,9	18,1	3,8	5,0
Bielinek	14 27,0	52 57,0	10,8	1,5	3,0
Wojdal	18 06,7	52 52,0	12,0	1,1	3,0
Sepolon Wlk.	16 50,9	53 47,3	22,6	1,7	2,0
Rybaki	17 56,2	54 04,5	20,2	3,3	3,0
Szczeznik	16 13,5	51 25,6	36,3	5,2	5,0
Ostrowite	17 34,9	53 54,8	17,5	1,3	3,0
Potasznia	22 49,1	54 10,7	19,6	0,0	2,0
Bereza	20 35,9	49 33,1	33,3	1,2	5,0

Table 9. Poland samples provided by PGI.

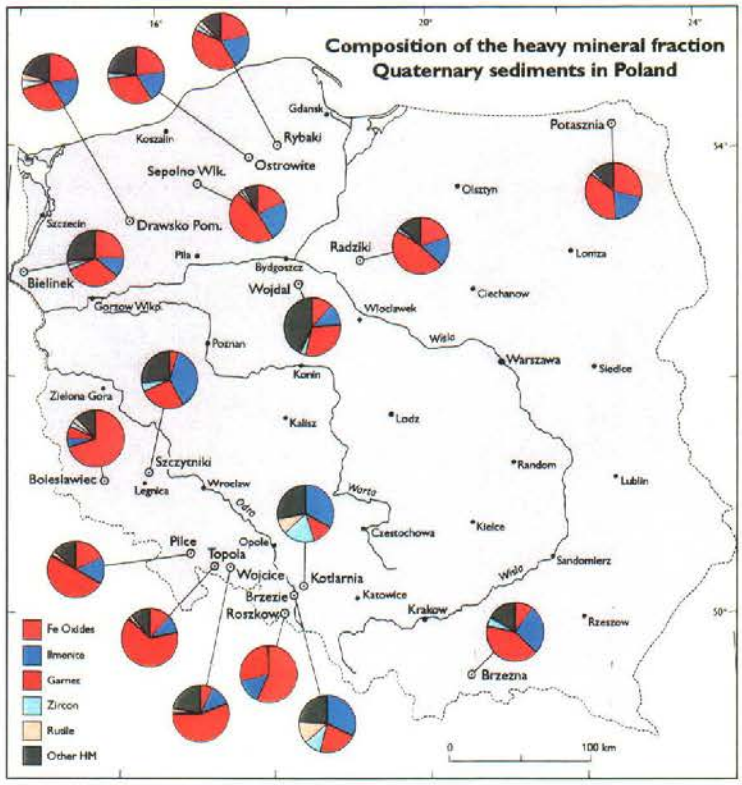


Figure 17 Heavy mineral paragenesis in Quarternary samples analysed by the Polish Geological Surey.

Samples analysed by GEUS

12 samples have been analysed by GEUS (Table 10). 9 of these are Miocene sands from lignite mines characterised as alluvial sediments, 2 samples are alluvial Pleistocene-Holocene sands and 1 sample is marine spit sand from Holocene.

Poland								Heavy mineral					TIO %		Av.TiO_2
Name	Long	Lat.	Depth	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leu-coxene	Rutile	All Ti min.
	x	y	in m	mm		of total sand	of total sand	%	%	%	%	%	%	%	%
R 00_73	16 27,3	51 09,1	81-98	0,11	Miocene	0,01	0,00	8,7	1,7	5,0	8,6	54,6	76,0	93,6	67,4
R 96_71	16 27,3	52 09,1	131,3-132,3	0,11	Miocene	0,00	0,00	48,6	4,3	7,0	5,6	53,1	75,7	92,9	59,9
R 98_71	16 27,3	53 09,1	40-75	0,12	Miocene	0,00	0,00	23,3	1,7	3,9	5,7	51,5	75,9	93,7	61,6
1 W_31	15 00,1	50 57,3	13,4-20,9	0,14	Miocene	0,00	0,00	0,3	4,9	4,4	6,9	54,0	74,2	91,4	60,4
55_65	15 00,0	50 57,3	162,4-174,6	0,16	Miocene	0,00	0,00	19,0	0,0	0,1	0,1	59,2	0,0	88,6	68,0
1. Rakowice	15 53,6	51 13,4	-	0,20	Holocene	94,30	12,16	12,9	0,4	1,3	4,3	50,3	72,1	94,4	49,8
6. Pliocene	15 16,2	51 33,0	-	0,07	Pliocene	0,15	0,04	25,1	1,8	3,3	0,8	54,2	76,2	90,8	64,2
7. Hel. Penins.	18 35,0	54 44,5	-	0,22	Recent	36,84	5,53	15,0	2,2	1,3	2,3	57,0	75,3	94,4	58,9
1. Belchatów	19 45,9	51 13,3	+ 13	0,10	Miocene	0,17	0,03	17,6	15,7	20,7	14,3	63,8	76,1	93,1	80,8
2. Belchatów	19 45,9	51 13,3	+ 50	0,11	Miocene	0,17	0,02	10,5	18,6	20,3	18,1	52,4	75,8	93,1	79,1
3. Belchatów	19 45,9	51 13,3	+ 94	0,11	Miocene	0,24	0,00	0,5	10,4	11,2	10,3	62,7	75,8	93,5	79,3
Konin	18 18,6	52 10,3	-	0,10	Miocene	0,10	0,03	27,0	1,6	23,7	11,8	61,9	78,3	97,1	95,8

Table 10. Poland samples analysed by GEUS (Racowice was preconcentrated).

The heavy mineral concentration in the Miocene samples is generally very low. There sems to be a higher ilmenite grade in the samples from Southeastern Poland, Belchatów –1 and - 3 and Konin (Table 10), with TiO_2 content above 60%. These Heavy mineral materials sands are alluvial, Miocene. They are all sampled from lignite mines. The heavy mineral content in the samples is very low and the ilmenite content is less than 0,1 % of total sand. The three samples are from the southeastern Poland. The lignite mines are located nearby the extension of Fennoscandian Fault zone, with elevated areas of Cretaceous and older sediments, which may have been source of sediment during the Neogene.

The sample from the Hel Peninsular has relatively high-grade ilmenite and with TiO_2 in all Ti minerals above 60%. This is a recent barrier at the coast of the Baltic. It will not be posible to mine this due to environmental aspects, but it indicate that the beach/barrier play is relevant in the Holocene deposits tied to the Baltic.

9.3 Offshore data provided by the Polish Geological Institute (PGI)

Information on heavy mineral content of Ilmenite and Leucocene, Rutile and Zircon are available from 2 offshore bank deposits in the Baltic Sea, Poland as shown in table 11.

Poland Offshore							Heavy mineral			
Name	Long	Lat.	Depth	D50	Geology	Ilmenite %	Ill + Leuco.	Leucoxene	Rutile	Zircon
	x	y	m	mm		of total sand	%	%	%	%
Kotlarnia	14 37,9	54 20,5	-10,0	?	Holocene	12,9	38,8	-	1,0	1,4
Brezezie	16 41,95	54 56,3	-15,5	?	Holocene	25,7	39,6	-	0,7	4,8

Table 11. Poland Offshore samples. Data from Polish Geological Survey.

Odra Bank

The Polish Geological Survey (PGS) has conducted a number of surveys on the north and northeastern part of the Odra Bank, and they have investigated 9 areas covering of 9 km^2. The average thickness of the deposit layers is 0.55 m (max. 1 m), and the average heavy mineral content is 4.3% by weight. There are about 16 mill. tonnes of sand enriched with heavy minerals, in which there are over 0.7 mill. tonnes of heavy minerals.

Slupsk Bank

Two areas have been investigated on the Slupsk Bank. Mean percentage of heavy minerals is 13.1 on the first and 3.1 on the second. According to preliminary assessments an average content of ilmenite is about 4 % (field 1) and 1.2 % (field 2). Zircon, rutile and monazite constitute about 0.35 % and 0.25 %, and garnet – 0.3 % and 0.95 % respectively. The thickness of the deposit layers with heavy minerals wasn't investigated (the thickness is probably as on Odra Bank).

The Odra and Slupsk Bank deposits probably representing lag facies at the seafloor, show rather high content of ilmenite, while the TiO2 % is still not investigated (PGS has promissed to send samples). The high ilmenite content is interesting and future investigations will show the grade of the ilmenite.

Other areas offshore Poland

As indicated in the geological atlas of the southern baltic (Figure 18, Dadlez 1995) paleobarrier sand, and sand raw material areas (Figure 19), covers large areas of the Polish waters. The results from the nearby Hel Peninsular from a similar environment, indicate high contents of heavy minerals as well as fairly high grade of the ilmenite and total Ti minerals in this setting. It is recommended that more detailed studies of thes subjects are conducted. Further work should be focussed on the paleobarrier deposits in the Polish offshore sector.

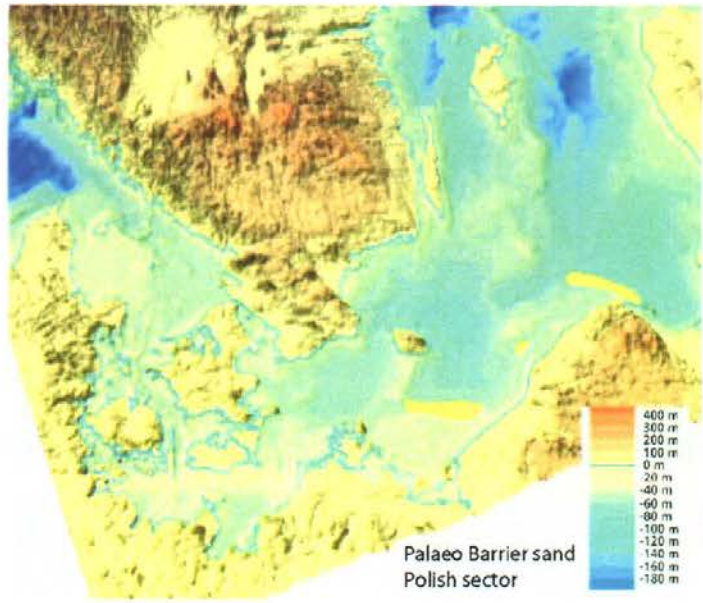


Figure 18 Barrier Sand in the Polish sector.

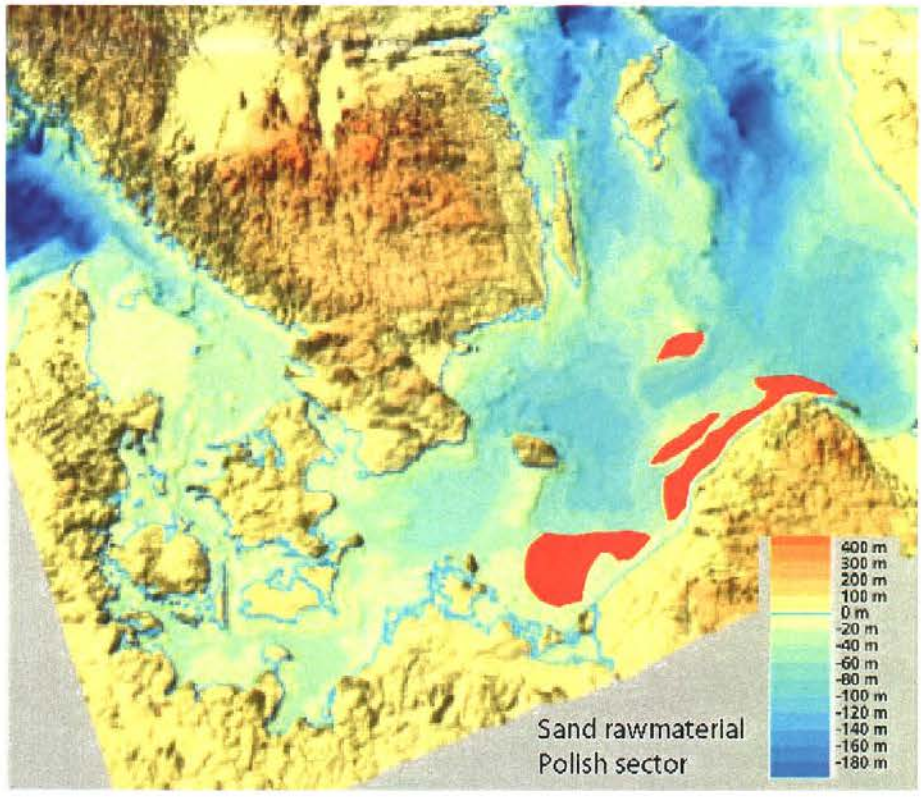


Figure 19 Raw material sand ares in the Polish sector.

10. Lithuania

The Lithuanian Geological Survey has provided samples from different Quaternary depositional environments.

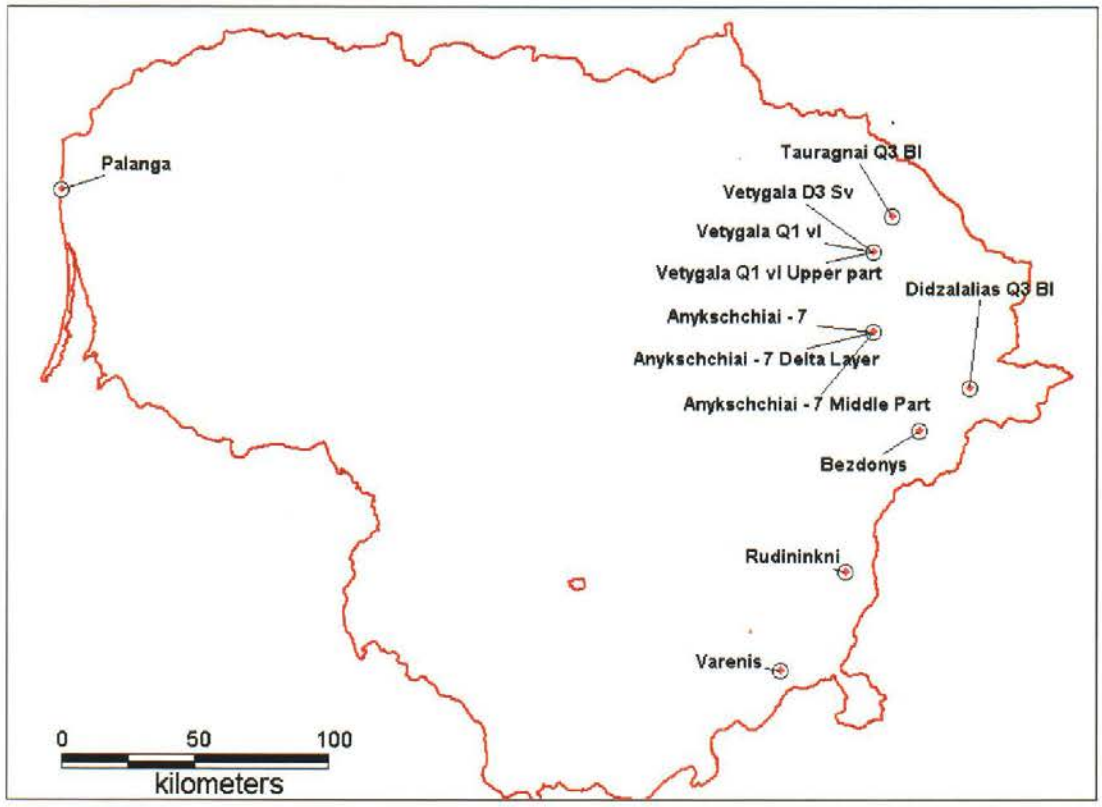


Figure 20 Sample locations in Lithuania.

Lithuania							Heavy mineral					TIO %		Avg.TiO_2
Name	Long	Lat.	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leucoxene	Rutile	All Ti min.
	X	y	Mm		of total sand	of total sand	%	%	%	%	%	%	%	%
Palanga	21 03,5	55 55,2	0,13	Holocene	0,81	0,02	2,6	0,0	0,0	0,3	50,6	-	-	44,7
Varenis	25 11,8	54 20,9	0,13	Recent	1,14	0,19	16,4	0,2	0,5	1,9	54,6	76,0	89,8	51,6
Rudininkni	25 34,0	54 40,4	0,11	Recent	0,78	0,10	12,3	0,4	0,4	2,4	55,4	76,3	92,5	54,6
Bezdonys	25 59,5	55 08,0	0,11	Recent	0,55	0,08	15,1	1,1	1,4	3,1	55,6	75,1	91,0	57,2
Tauragnai Q3 Bl	25 49,9	55 49,9	0,35	Devonian	2,56	0,02	0,6	0,0	0,0	0,4	52,3	-	-	38,0
Didzalalias Q3 Bl	26 16,8	55 16,4	0,38	Devonian	2,83	0,11	4,0	0,0	0,1	0,3	53,4	70,3	94,3	41,3
Vetygala Q1 vl Upper part	25 43,3	55 43,1	0,11	Devonian	6,53	2,76	42,3	18,0	12,1	4,6	60,7	76,5	91,2	70,3
Vetygala Q1 vl	25 43,3	55 43,1	0,14	Devonian	1,81	1,04	57,3	2,6	1,7	10,2	58,1	73,7	93,5	60,7
Vetygala D3 Sv	25 43,3	55 43,1	0,08	Devonian	0,57	0,16	27,3	4,8	4,3	4,9	57,0	75,3	91,0	64,2
Anykschchiai - 7 Middle Part	25 43,6	55 27,3	0,13	Neogene	0,43	0,14	33,6	14,2	18,9	4,4	63,5	77,4	92,5	75,7
Anykschchiai - 7 Delta Layer	25 43,6	55 27,3	0,09	Neogene	0,53	0,14	26,6	21,5	22,4	13,2	63,5	77,1	92,5	78,4
Anykschchiai - 7	25 43,6	55 27,3	0,12	Neogene	0,39	0,11	28,8	16,8	18,3	17,2	63,0	75,6	93,2	76,6

Table 12. Lithuania samples.

The prequaternary sediments in Lithuania consist of Triassic; Jurassic and Cretaceous deposits could be of heavy mineral interest. The Pleistocene and Holocene sediments consist in general of Glacial, glaciofluvial, lacustrine and aeolian sediments deposited in connection to the glacial processes or after the deglaciation. The sorting by fluvial, lacustrine or beach processes might have concentrated heavy minerals.

In total 12 samples are analysed representing Devonian sand, Holocene beach sediments from the Baltic Sea coast and Pleistocene-Holocene aeolian dune sands.

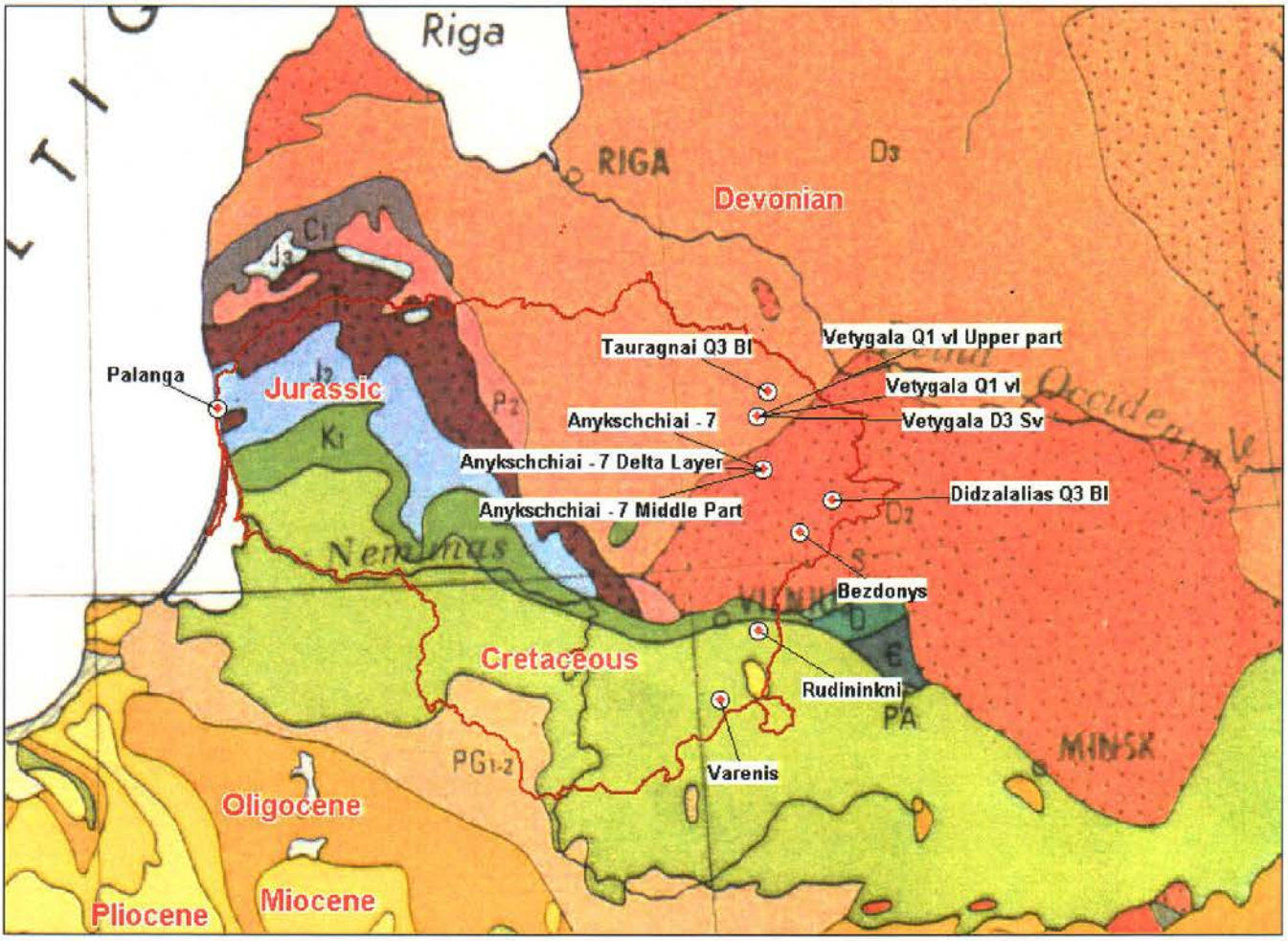


Figure 21 Lithuania samples located on the Pre-Quaternary surface map.

The heavy mineral concentration in samples collected in Lithuania is variable. 5 samples have more than 1. % heavy mineral content. The Ilmenite content is more than 1 % of total sand in 2 of the samples. However 4 samples, Vetygala Q1 vl Upper part and the three samples from Anykschchiai have high-grade Ilmenite with TIO_2 content of above 60 %.

The three samples from Anykschchiai and the sample from Vetygala are from the eastern part of Lithuania. The three samples from Anykschchiai are Neogene alluvial or lake samples. The Anykschchiai - 7 Middle Part is sampled in crossbedded fluvial sand, Anykschchiai - 7

Delta Layer is from a lake delta and the Anykschchiai – 7 are lake sediments. The Vetygala Q1 vl Upper part is Quaternary alluvial or lake sand. The area is characterised with exposure of Devonian sediments which could act as a source for the heavy mineral samples found in the younger sediments in the area. Especially the Vetygala sample is interesting due to the high content of Heavy minerals and high-grade Ilmenite. An Arial distribution of the high-grade minerals could be a possible object for further investigations in this area as it is seen in Ukraine.

11. Belarus

Ginulis Juozapavicius has provided 16 samples from erosive profiles along rivers and from quarries. The sampling activities have been concentrated in two areas the southwestern part of Belarus and the southeastern Gommel Region.

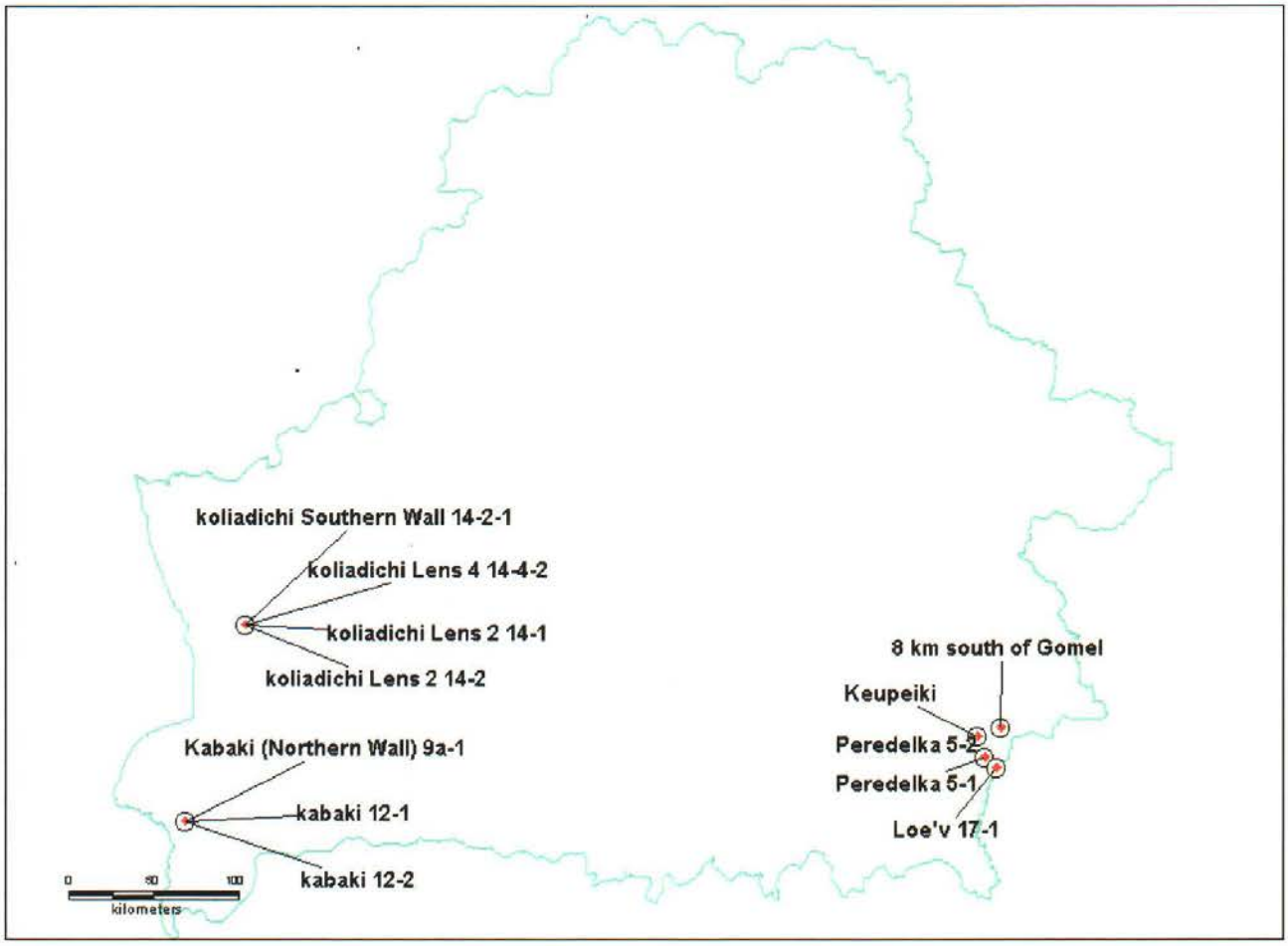


Figure 22 Sample locations in Belarus.

In Belarus the Palaeocene, Eocene, lower and Middle Oligocene deposits were formed mainly in marine conditions while the Upper Oligocene sediments as a rule was deposited in paleoriver valleys and in lakes.

The lower and Middle Eocene sediments mainly consist of glauconitic quartz-sands with interbedding of clay and sandstone.

The Upper Eocene deposits are formed of abyssal marls, clays and near shore fine quartz sands.
The Lower and Middle Oligocene deposits consist of glauconitic quarts-sand containing mica interbedded by hard sandstone's and shale clays.

16 samples has been analysed:

- 7 samples are from the southwestern part of Belarus at the localities Kabaki and Koliadichi. Both localities contain Kievskaya Formation Upper Eocene deposits consisting of marine glauconitic quarts-sand containing mica.
- 9 samples represent the southeastern Gommel Region dominated by Kharkovskaya Formation Lower Oligocene consisting of marine quartz-sands with a presence of dark-coloured minerals and glauconite.
- 2 samples from the locality Yourkovitchi are from the Kievskaya Upper Eocene deposits and consist of fine grained quartz sand.

Belarus							Heavy mineral					TIO %		Avg.TiO_2
Name	Long	Lat.	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leucoxene	Rutile	Zircon	Ilmenite	Leucoxene	Rutile	All Ti min.
	X	y	mm		of total sand	of total sand	%	%	%	%	%	%	%	%
8 km south of Gomel	30 49,5	52 08,9	0,06	U Eocene	0,59	0,10	16,8	12,3	6,4	2,2	55,8	76,8	90,9	70,3
Yourkovitchi 4-1	-	-	0,07	U Eocene	0,59	0,11	17,8	3,9	3,7	7,8	56,6	74,3	93,8	64,6
Yourkovitchi 4-2	-	-	0,09	U Eocene	3,40	0,79	23,1	2,4	2,6	12,4	55,5	74,1	92,1	58,9
Peredelka 5-1	30 39,2	52 00,4	0,19	Oligocene	0,48	0,20	42,3	3,4	6,1	1,4	60,4	77,6	94,6	66,3
Peredelka 5-2	30 39,2	52 00,3	0,20	Oligocene	0,45	0,17	36,8	4,4	3,4	2,4	59,9	74,9	94,2	63,1
Keupeiki	30 37,0	52 07,4	0,21	Oligocene	0,47	0,12	25,4	4,4	4,1	0,5	60,1	75,2	94,4	67,8
Kabaki (North. Wall) 9a-1	23 46,2	52 07,9	0,11	U Oligo.	0,76	0,38	50,0	19,0	11,2	4,9	59,6	76,4	91,4	69,4
kabaki 12-1	23 46,1	52 07,9	0,10	U Oligo.	0,51	0,15	29,3	3,3	4,2	1,5	44,7	76,6	91,7	65.0
kabaki 12-2	23 46,1	52 07,8	0,12	U Oligo.	1,12	0,38	34,2	7,6	4,4	3,1	55,0	77,0	92,8	59,9
koliadichi Lens 2 14-1	24 24,2	53 08,9	0,11	U Eocene	0,74	0,27	36,5	12,3	5,8	2,3	55,5	75,8	92,0	64,7
koliadichi Lens 2 14-2	24 24,2	53 08,9	0,12	U Eocene	1,38	0,54	39,2	9,8	8,3	4,3	54,8	75,5	92,8	64,2
koliadichi South. Wall 14-2-1	24 24,2	53 08,9	0,10	U Eocene	0,43	0,12	28,6	11,2	3,8	2,2	56,7	76,0	91,4	64,8
koliadichi Lens 4 14-4-2	24 24,2	53 08,9	0,08	U Eocene	0,44	0,17	38,4	28,7	11,9	2,8	56,1	32,1	92,1	70,4
Pishki 15-1	-	-	0,12	L. Oligo.	0,40	0,19	47,9	11,1	5,0	4,2	54,9	75,9	91,4	61,6
Pishki Borehole 35	-	-	0,07	L. Oligo.	0,86	0,11	13,3	6,9	3,2	1,4	54,0	76,8	91,5	66,6
Loe'v 17-1	30 44,0	51 56,4	0,10	L. Oligo.	0,80	0,35	43,3	7,8	7,0	3,1	56,2	76,3	93,5	64,3

Table 13. Belarus samples

The heavy mineral concentration in the 16 samples collected in Belarus is rather low. Only 3 samples have more than 1- % heavy mineral content. The Ilmenite content is less than 1 % of total sand in all the samples. However 4 samples, Peredelka 5 –1, Peredelka 5 –2, Kupeiki and Kabaki Northern Wall 9a-1 have an elevated TIO_2 content of about 60 % in Ilmenite.

The three samples from Peredelka 5 –1, Peredelka 5 –2, Kupeiki are from the southeastern Gommel Region in Belarus. They are from marine quartz-sands of Lower Oligocene with presence of dark-coloured minerals and glauconite. The last sample from Kabaki is from the southwestern part of Belarus. This is an Upper Eocene deposits consisting of marine glauconitic quarts-sand containing mica. All four samples are Marine. More detailed information about depositional environment at the 4 sampling localities and possibly paleoenvironment is recommended for this area.

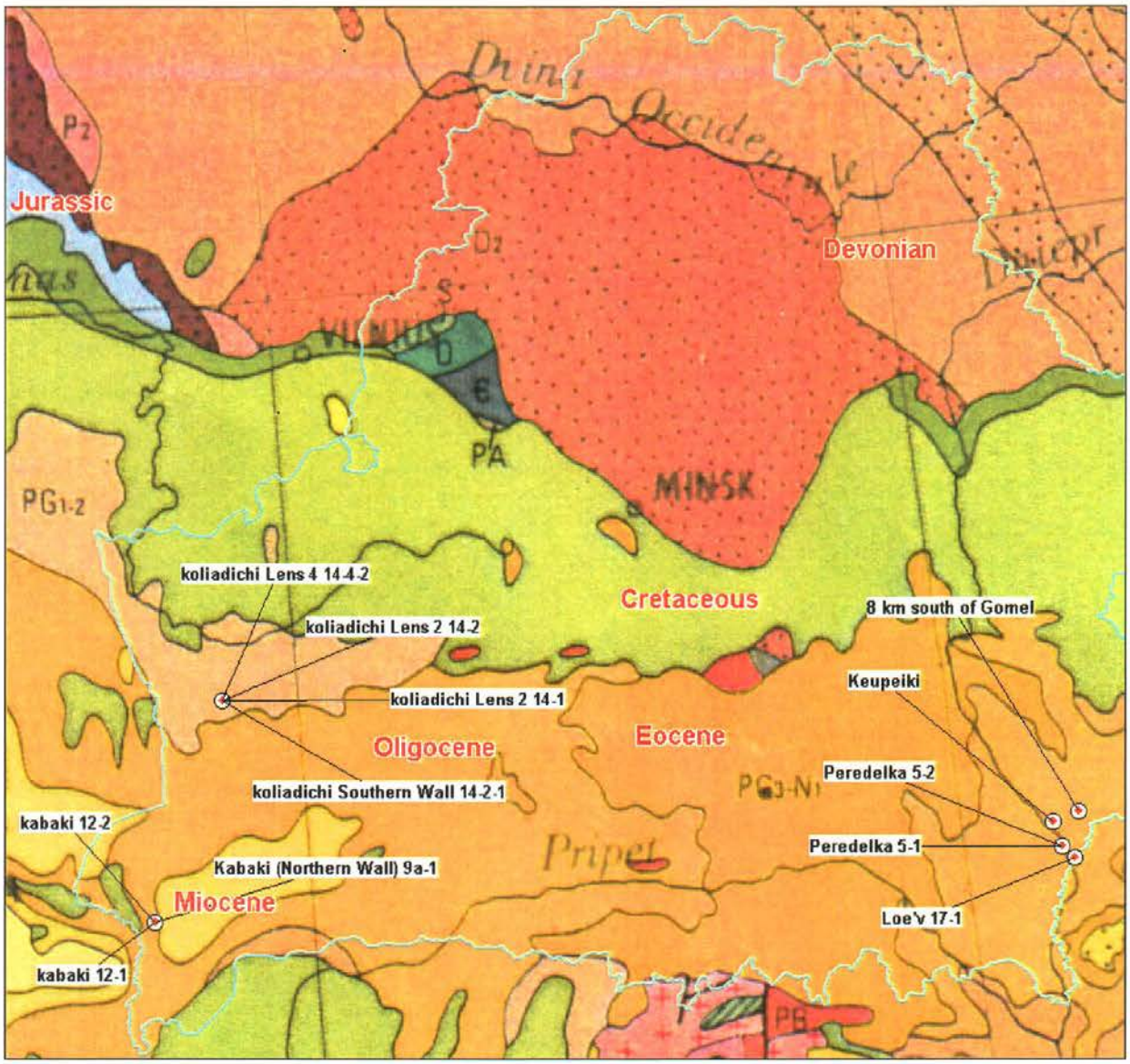


Figure 23. Belarus samples located on the Pre-Quaternary surface map.

12. Italy

One sample has been taken in recent Beach sand in the southwestern part of Italy near the town Agropoli.

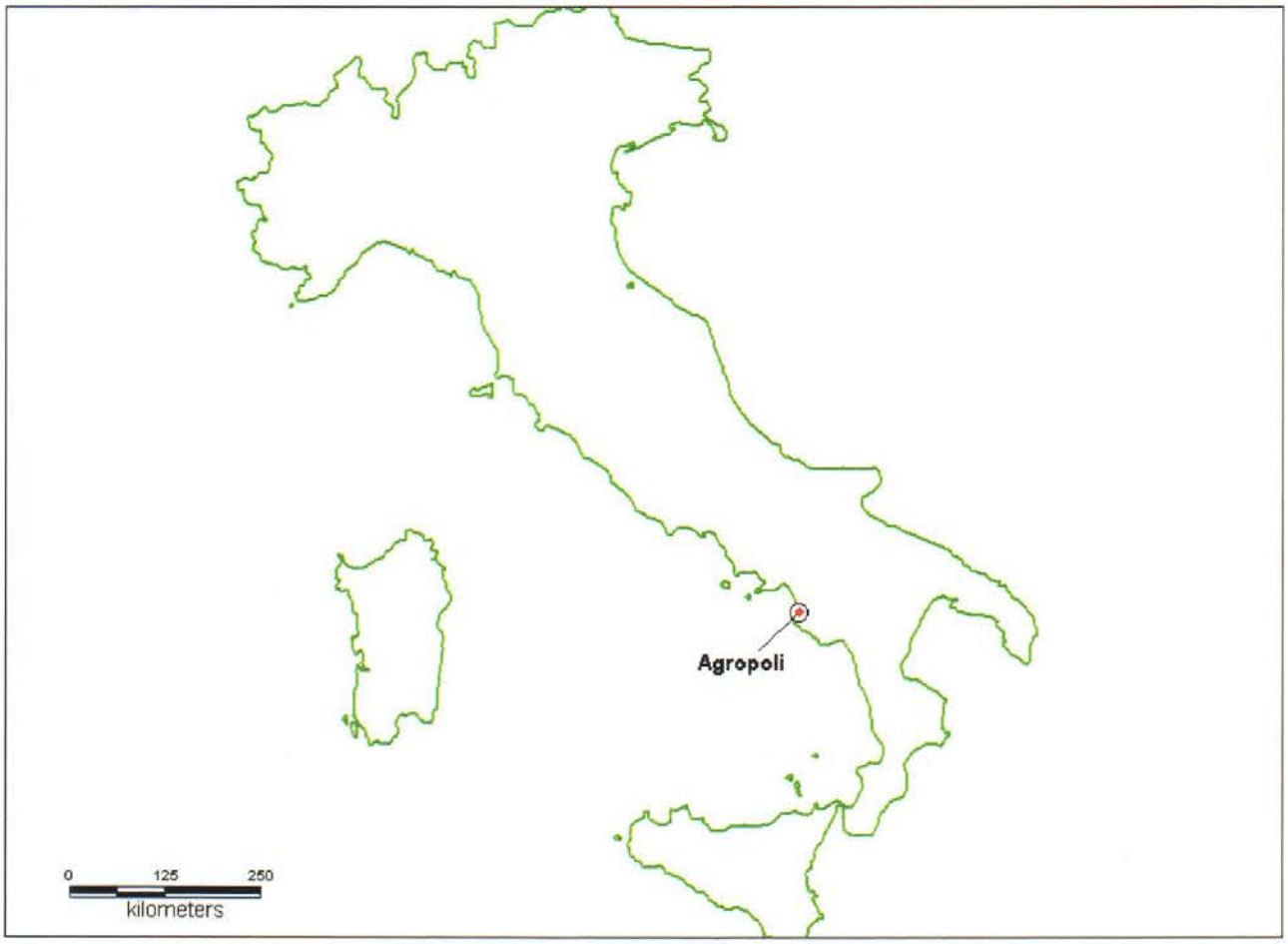


Figure 24. Sample location in Italy.

The sample position is located at the beach area in the northern part of the city. Black sand is exposed at the beach near outcrops of consolidated Paleogene sandstone's at the southern part of the Sele delta plain area. The Sele delta plain area is surrounded with Apennine carbonates, shales and sandstone. Volcanic rocks of various compositions are located to the north of the area in the vicinity of Vesuv volcano.

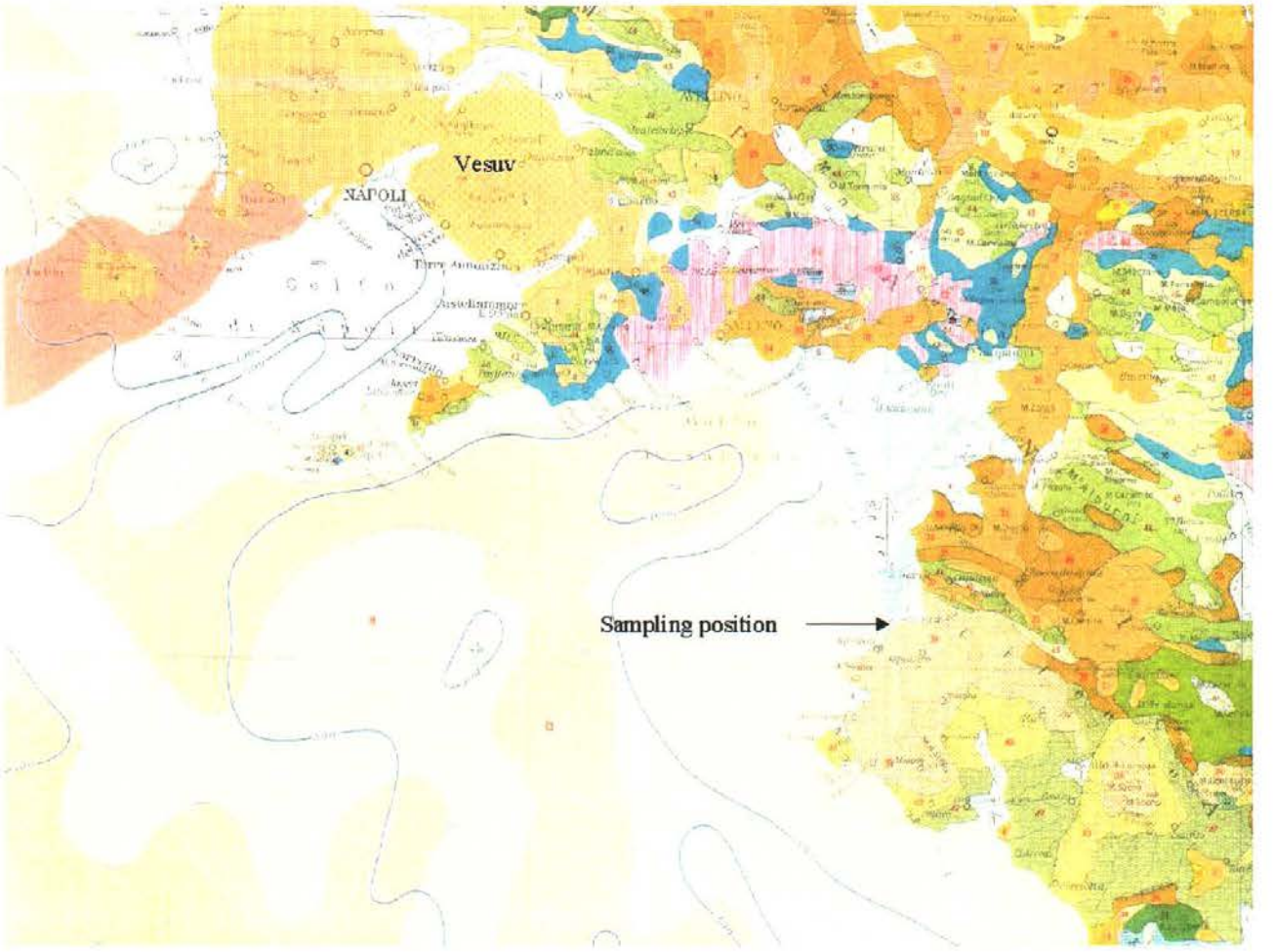


Figure 25. Geological map of the Agropoli region.

One sample from Agropoli Italy taken in recent beach sand

Italy								Heavy mineral				TIO %			Avg.TiO_2
Name	Long	Lat.	Depth	D50	Geology	Heavy Min %	Ilmenite %	Ilmenite	Leu-coxene	Rutile	Zircon	Ilmenite	Leu-coxene	Rutile	All Ti min.
	x	Y	in m	mm		of total sand	of total sand	%	%	%	%	%	%	%	%
Agropoli	14 59,1	40 21,3	-	-	Recent	66,20	0,00	0,0	0,1	0,0	0,1	0,0	69,5	0,0	54,7

Table 14. Italy sample.

The heavy mineral concentration in the sample collected at the beach near Agropoli in the southern Italy is high. The material is sampled in recent material from the active marine zone and there are not any heavy minerals of interest. The source material in the hinterland is not producing any heavy mineral sand with a significant ilmenite content. It is recommended not to do any further work in this area.

13. Ukraine

Ukraine has a curent production of high-grade ilmenite and accordingly an obvious place to do further exploration. The ilmenite and rutile potential is estimated to be 900 million tons (30 % of discovered world reserves). There are 40 titanium deposits in Ukraine, only 5 from them are developed. Only placer deposits are exploited.

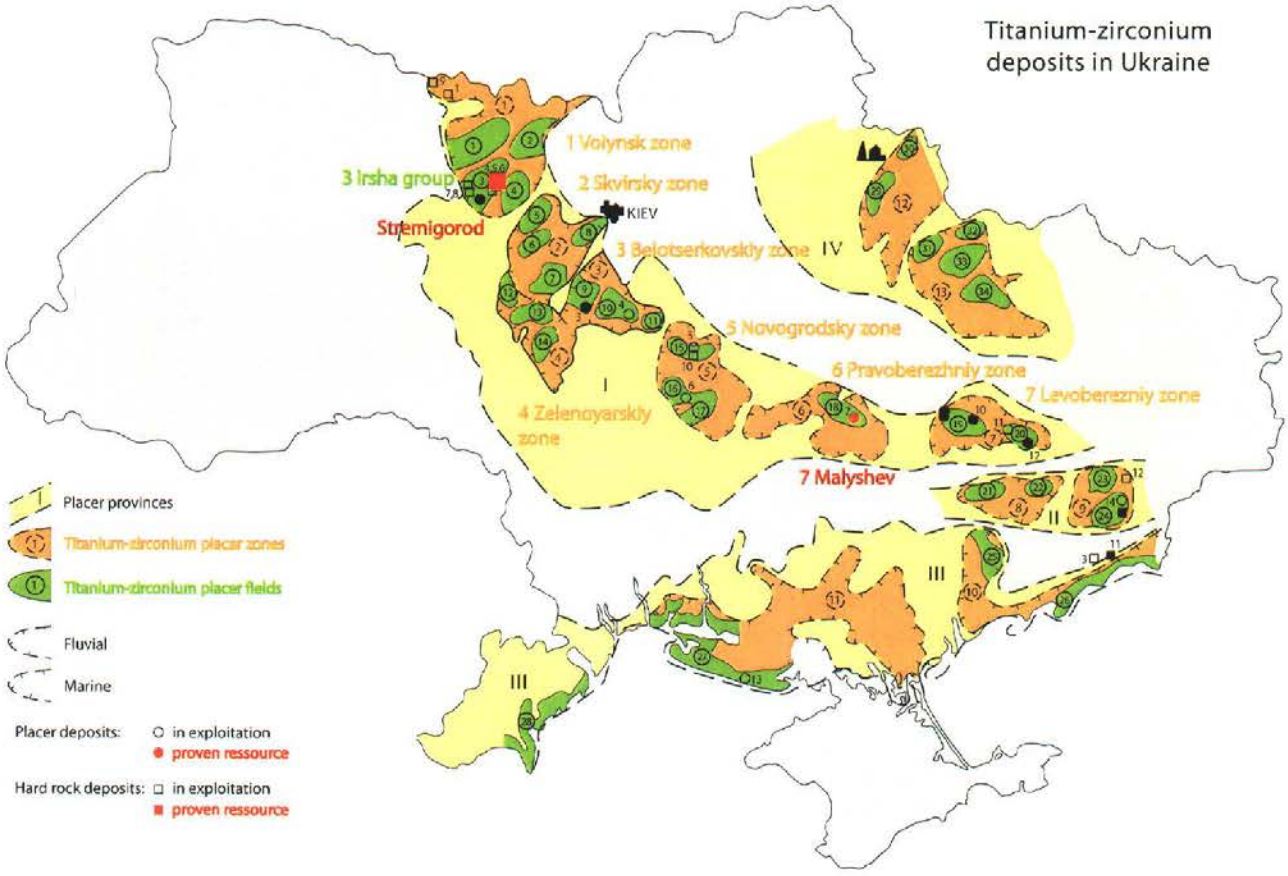


Figure 26 Ressource Map provided by Academy of Sciences in Kiev.

13.1 Geology and Mineral deposits

There are three geological-industrial types of deposits, which are the source base of the titanium industry:

1) Magmatic deposits of apatite-ilmenite ores in Gabbro-norites.
2) Residual deposits of weathered crusts of titanium rich rocks.
3) Ilmenite-rutile-zircon placer deposits.

Stremigorod ilmenite-titanomagnetite deposit (Figure 26) is a hard rock deposit with a weatered cap containing 30,8 % of the total titanium reserves in Ukraine.

The residual titanium deposits in the weathered crusts is also detected in the Korsun-Novomirgorod pluton. The beginning of the weathered crust formed within the Ukrainian Shield (US) is dated to the early Jurassic period.

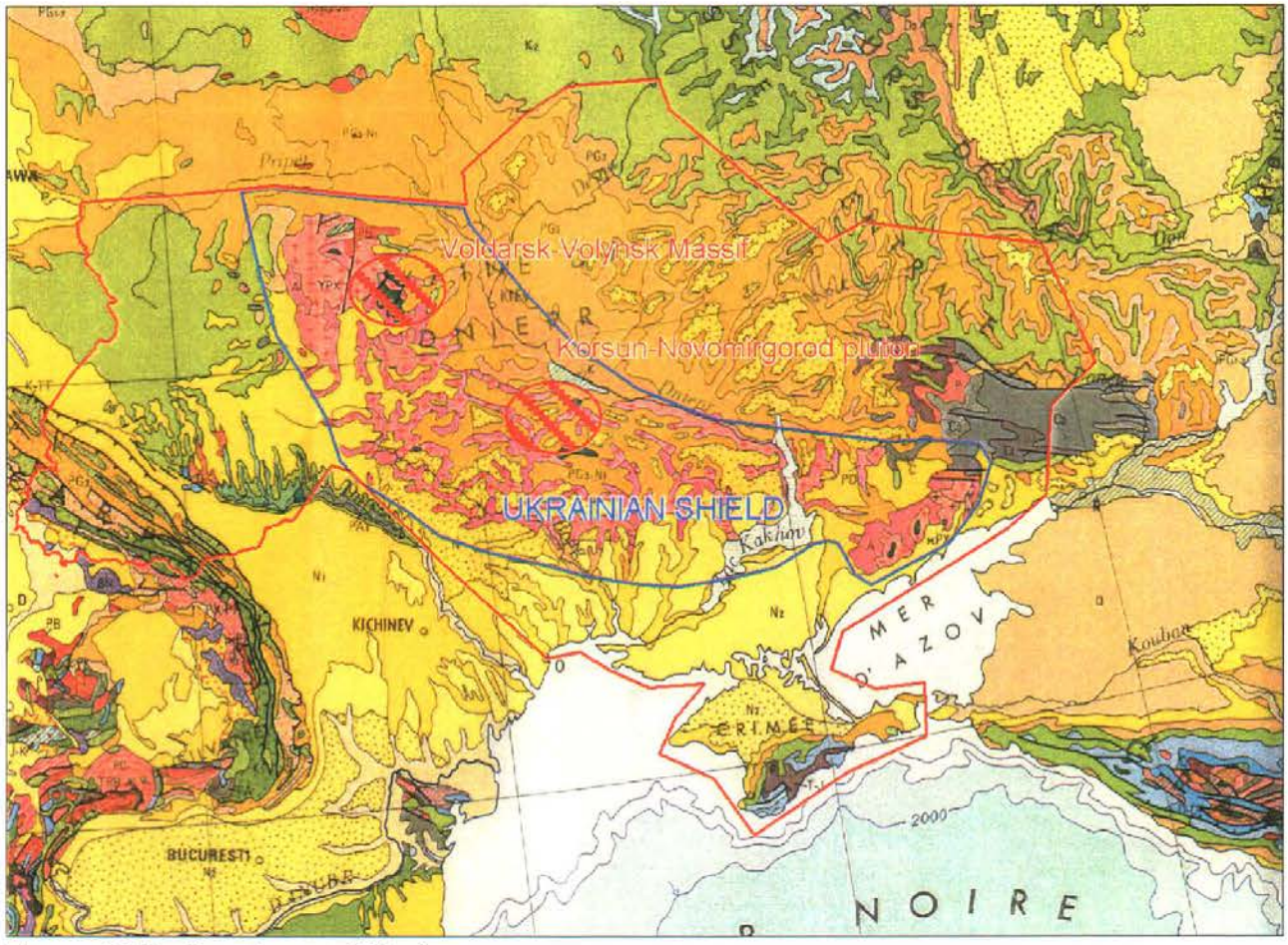


Figure 28 Geologcal map of Ukraine.

13.2 Irsha group placer deposits

The Irsha group placer accumulations (Figure 26) is a large placer ore region including about 20 deposit with main deposits at: Irsha, Verhneirshansky, Lemnensry, Levoberezny, Mezdyretchensky, Ushitsky, Ushomirsky, Zlobitchsky and Valky-Gatskovsky. They are believed to be genetically and spatially connect to the source from the ilmenite rich rocks of the Volodarsk-Volynsk of Lower Proterozoic Gabbro–Anorthosite Massif and they are Mesozoic (Jurassic-Early Cretaceous) in age.

Formation of placers in this region took place during 4 main geological phases: Jurassic and Lower Cretaceous continental, Upper Cretaceous marine and Quaternary continental. In addition the Oligocene-Upper Oligocene Poltava placer accumulation is of some importance. Formation of placer deposits in this region took place in Paleogene, and probably also in Pliocene and during the maximum of the Dnieper glaciation.

The Jurassic placer deposits, were formed in connection with kaolinisation and residual concentration of ilmenite took place. It is considered, that part of the eluvial placer mineral accumulations are younger than Cretaceous.

The productive part of the Ilmenite eluvium varies in thickness from 1 to 15 m. The concentration varies from 0,05-0,25% up to 5-7,5% ilmenite. Besides the Torchinsk deposit, eluvium placer accumulations are known in the Paramovsk and Bukinsk section of Mezhdurechensk deposit,

A lower Cretaceous alluvial placer accumulation, origin from the Gabbro massifs, differs from younger placer accumulations with high clay content and oligomict structure of the granulated part. Concentrations of ilmenite in Lower Cretaceous placer accumulations vary from 2,5 – 5 %, up to 20-55 %.

In the river Lemna basin and in the area in between the two rivers Lemna and Irshitsa (Fig. 28), widespread placer deposit of Lower Cretaceous age are located with mineralised sections from 0,5 m to 2,5 m in thickness. In colluvial accumulations the thickness increases to 10-15 m, but these deposits have often lower concentrations of Ilmenite, than the placer valley-accumulations of Lower Cretaceous age. The Lower Cretaceous placer accumulations include up to 70 % of total TiO_2 of the placer accumulations of Irsha group.

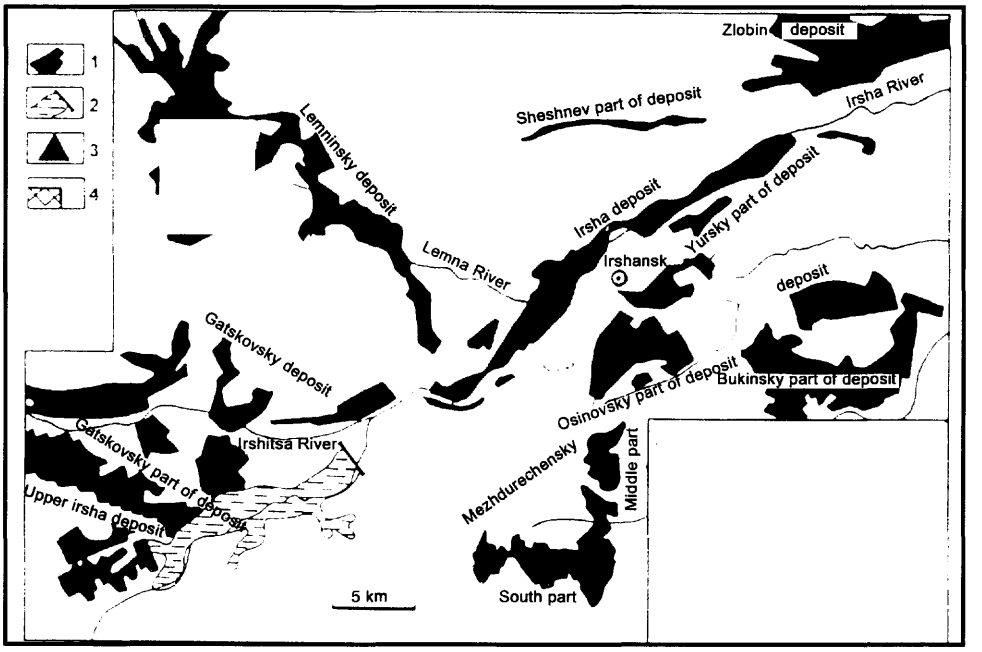


FIGURE 28 Placer deposit and part of the Irsha ore-placer region location (data of Irsha ore mining and processing enterprise).

1 - placer accumulations;
2 - dams and ponds;

The upper Jurassic placer accumulation are littoral to marine in origin. In the area between Uzh and Irsha the mineralised layers are thin (0,5-4m) with low concentration ilmenite 1,25-1,5%. In a few samples concentrations at 5-12,5% is observed. The deposits of this type are known in the Lemnensky, Mezhdurechensky and other deposits (Figure 28).

Paleogene Poltava Ilmenit placer accumulation are sand and sand-gravel formations. Placer accumulations of this age are observed in the buried valleys of the river Zlobich. The Mineralised layers vary from 1 to 10 m, with concentrations from 1% up to 8,5%. These accumulations do not play an important role in placer accumulations of the Irsha group.

Quaternary placer accumulations are numerous, but they do not cover more than 20 % of the Irsha placer accumulations. Except for Lower Pleistocene and Middle Pleistocene Tills, which lie in buried incision, they are located in valleys. The contents of ilmenite in Lower Pleistocene placer accumulations vary from a few up to 5%. In Middle Pleistocene Tills, they do not exceed 3%. In placer terrace and accumulations in the bottom of the valleys they contain respectively 1,5-7,5% and 5-10%. The Irsha placer deposits group is dominated by placer accumulations of quaternary age bound to the recent (post glaciation) valley systems.
Analysis of Ilmenite in the placer accumulations of the Irsha region are shown in the tables 15 and 16. Quality of ilmenite is in the Table 17.

Placer, Region	Genesis, Age	Oxide content, %				
		TiO_2	Fe_2O_3	FeO	P_2O_5	Cr_2O_3
Irsha	al, fgl Q_{II-IV}	50-54	12-15	25-40	0.01-0.05	0.01-0.02
Shershnevsky	m P_3.N1	59-61	35-40	1-5	0.11-0.15	0.03-0.05
Shershnevsky	el J	51-55	20-25	21-26	0.05-0.10	0.01-0.03
Upper-Irsha	el –al K_1	52-56	15-24	26-33	0.05-0.10	0.01-0.02
Gatskovsky	el J	60-67	33-40	0.5-1.0	0.07-0.20	0.04-0.05
Gatskovsky	al K_1	48-56	12-23	28-36	0.01-0.07	0.01-0.03
Lemnensky:						
placer P	al K_1	55-66	14-23	5-29	0.05-0.30	0.03-0.05
placer P	el J	53-55	16-25	25-32	0.06-0.11	0.02-0.04
North-West region	al $J_3 - K_1$	58-62	34-41	1-5	0.10-0.16	0.03-0.05

Table 15. Ilmenite composition from the placer of Irsha region

Group, (stage of changes)	**Concentration in %**				
	TiO_2	**FeO**	**Fe_2O_3**	**$Fe_{general}$**	**P_2O_5**
Ilmenite	48-53	30-45	5-15	30-38	0.02-0.05
Hydratazed Ilmenite	53-59	10-30	15-25	25-30	0.03-0.10
leucoxenezed ilmenite	61-65	5-10	25-30	20-25	0.10-0.20
Leucoxene	65-90	0-5	5-25	3-20	0.20-0.80
Pseudorutile	59-62	1-5	25-35	24-30	0.08-0.10
Secondary Rutile	90-95	0-0	0-5	0-3	0.80-1.50

Table 16. Chemical content of ilmenite and products of their changes from the Irsha placer group (Data from State Institute for rare metals - GIREDMET)

Many of the deposits in the Irsha region are already in production (Fig. 28). The Mezhdurechensky deposit is the most perspective in the region with a total volumen of ore sand calculated to be 150 mill. m^3. It is located in between the two rivers Irsha and Trostyanitsa. The Mezhdurechensky deposit has a polygenetic genesis and include ore beds of two types: ilmenite residual from crust denudation (airing crust) and alluvial-hillside depositions (sand) of late Jurassic-early Cretaceous age. Main parameters from the Mezhdurechensky deposit is listed below in Table 18.

Indexes, units	Deposit, mark Irsha		Lemnensky and Mezhdurechensky		
	КИИ – 1	КИИ -2	КИЛ -1	КИЛ -2	КИМ
Ilmenite content, %	97.0	96.5	96.5	96.5	96.5
TiO_2Content , %,	50.0 -54.0	50.0 -54.0	54.0 -57.0	56.0 -59.0	52.0 -62.0
Admixture content, %					
P_2O_5, no more than	0.08	0.10	0.13	0.16	0.20
Cr_2O_3, no more than	0.05	0.05	0.05	0.05	0.05
Moisture content, %	<1.5	<1.5	<1.5	<1.5	<1.5
maximum size of ilmenite, mm	3.0	3.0	3.0	3.0	3.0

Table 17. Indexes of quality of ilmenite concentrates of Irsha region.

Parts	Average occurrence depth, m	Mineralised zone in m.		Ilmenite content, kg/m^3	
		sands	Airing crust	In the sands	in the airing crust
The North group					
Osinovsky	10,1	9-11	-	50-60	-
Yursky	8,8	8-10	-	75-85	-
The South group					
Middle	9,5	6,5-7,5	1-1,5	85-95	50-55
Emilevsky	7,2	7-8	-	72-76	-
South	8,5	6-7	1,5-2	75-85	45-50
Isakovsky	7,4	6-7	2-3	80-85	79-83
Bukinsky	7,3	2-3	9-12	80-90	50-60

Table 18. The main parameters from the Mezhdurechensky deposit

The thickness of HM layers in the separate placer accumulations varies significantly.

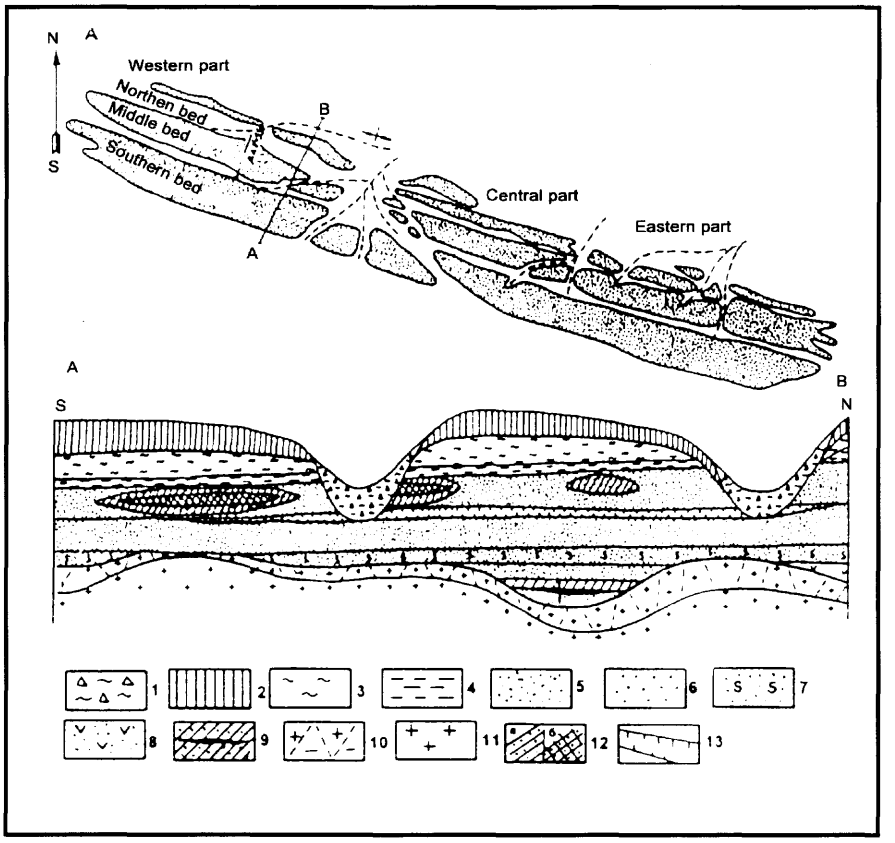
Grain size in mm.	Concentrate from the south-east part of Lemnensky deposit, %
4,0 - 1,6	0,60
1,6 - 1,25	1,30
1,25 - 0,80	9,95
0,80 - 0,56	12,90
0,56 - 0,28	29,60
0,28 - 0,20	15,02
0,20 - 0,14	14,82
0,14 - 0,10	9,90
0,10 - 0,074	4,70
< 0,074	1,20

Table 19. Grain Size of concentrates from the Irsha placer group

Skvirsky, Bilotserkovsky, Zelenoyarsky and Novomirgorodsky placer regions are arranged in a central part of the Prudnieper placer zone. These include continental alluvial, alluvial-talus and near-shore - marine placer deposits (Fig. 26).

13.3 Malishev deposit

This deposits is representative of marine placer accumulations. The deposit is located on a north-east hillside of the Ukraine Shield within the Pravoberezhny placer region which is occupied by the of river Samotkan and the area between the rivers Ingulets and Dnieper (Fig. 26 + 28). The crystalline basement beneath the deposits appears within a depth from a few tens up to 100 m. The basement is covered by "weathered crust", now hardly eroded. The thickness of "weathered crust" is varied from a few up to 25 m. On the top of the "weathered crust", a sequence of sands, clays and Buchak brown coals, sands and marls from the Kiev stages of Eocene, glauconite-quartz sands of the Kharkov stage of Oligocene, sands of the Poltava and Sarmatian stages of Oligocene - Miocene. Above thus section, clays and loams, and beam alluvium of quaternary age is finalizing the complete sequence (Fig. 29).



Scales for the profile:
Vertical **1:5000**
Horizontal **1:50000**

FIGURE 29 SCHEMAS OF LOCATION (A) AND CROSSCUT (B) OF THE MALISHEV DEPOSIT (SARMATIAN PLACER ACCUMULATION)

1-3 - quaternary sediments (beam alluvium and hillside sediments, 2-cover loams, 3-red-brown clays); (Q) 9-1800 thousands years;
4-5 - Sarmatian sediments (4-greenish-grey clays, 5-fine-grained sands); (Q) 9-1800 thousands years;
6 - Poltava fine grained sands; (P_2pl) 23,0-31,0 millions years, Oligocene, Paleogene;
7 - Kharkov glauconite-quartz sands; (P_2hr) 31,0-37,0 millions years, Oligocene, Paleogene;
8 - Kiev sands and marls; (P_2kv) 37,0-54,0 millions years Eocene, Paleogene;
9 - Buchak sands, clays, brown coals; (P_2bc) 37,0-54,0 millions years, Eocene, Paleogene;
10 - crust of weathering; Mesozoic (MZ) 65-250 millions years;
11 - crystalline soils; Proterozoic (PR) 1600-2500 millions years;
12 - ore deposits of Sarmatian age (*a* - rich, *b* - poor); (N_1s) 5,0-13,6 millions years, Miocene, Neogene;
13 - Poltava ore layer; (P_2pl) 23,0-31,0 millions years, Oligocene, Paleogene

The deposit is dated for marine quartz sands of Sarmatian stage of Miocene, sands of Poltava series of Oligocene - Miocene. Almost everywhere zones with enriched zircon, titanium minerals, monazite, disthene, staurolite and other minerals is localized. Component analysis of the deposits is listed in table 20.

Component	Component content in the minerals, %								
	Quartz	Clay fraction	Ilmenite (arizonite)	Leucoxene	Rutile	Zircon	Disthene-Sillinite	Staurolite	Tourmaline
SiO_2	99.5	56.8	0.86	0.71	0.43	31.0	36.35	28.2	36.46
Al_2O_3	0.24	22.45	0.8	0.35	0.1	0.6	62.26	52.3	32.77
TiO_2	0.044	1.57	67.1	83.6	97.18	0.08	0.32	0.78	0.91
FeO	-	-	0.12	0.8	0.2	-	-	0.97	1.87
Fe_2O_3	0.049	2.95	26.6	10.6	0.61	0.06	0.52	13.65	8.23
ZrO_2+ HfO_2	-	0.02	No	0.36	0.35	66.0	0.1	0.65	-
HfO_2	-	-	-	-	-	1.39	-	-	-
MnO	-	-	0.9	0.65	0.1	-	0.005	0.015	0.04
MgO	-	0.87	0.14	0.26	0.27	0.29	0.12	1.6	6.01
CaO	-	1.6	0.09	0.04	0.06	0.4	0.1	?	0.85
P_2O_5	-	-	0.19	0.2	0.081	0.16	0.01	-	-
Cr_2O_5	-	-	0.14	0.14	0.12	-	-	0.21	0.22
V_2O_5	-	-	0.21	0.14	0.47	-	-	-	-
Ta_2O_5	-	-	0.02	-	-.04	no	-	-	-
Nb_2O_5	-	-	0.1	0.17	0.37	<0.01	-	-	-
B_2O_3	-	-	-	-	-	-	-	-	8.2
TR_2O_3	-	-	No	-	-	0.24			
K_2O	-	}0.56	-	-	-	-	0.11	0.087	0.1
Na_2O	-						0.06	0.82	0.04
F	-	-	-	-	-	-	-	-	0.06
SO_3	-	0.03	-	-	0.03	-	0.02	-	-
H_2O	-	3.9	0.4	0.44	0.12	0.16	-	-	0.38
n.n.n.	-	8.92	3.05	1.71	0.28	0.25	0.54	1.13	4.03
Sum	99.83	99.94	100.72	100.21	100.69	100.63	100.69	99.83	101.11

Table 20 Chemical composition of rock forming and ore minerals of the Malishev deposit (avg. data)

№ open-pit	Avg. thickn. of layer, m	Average overburden, m	% Zircon	% Rutile	% Ilmenite
4	13,3	38	0,6	1,0	2,8
5	14,5	38	0,8	0,9	2,4
6	11,6	38	0,5	0,8	2,0
7	11	42	0,5	0,8	2,1

Table 21 The mining and geological characteristics of open-pits

Two almost horizontal orebearing beds, have been selected for analysis. The Upper zone is the industrial Sarmatian layer. The stratigraphic sequence is: in the bottom section- different grainy, clayey, crossbedded quartz sands (4-6 m); in the middle part - fine-grained well graded quartz sands with rhythmic horizontal, oblique and straight slightly-inclined lamination; in top section; shallow- and medium-grained sands (8-10 m), transform to gypsiferous clays. The main productive layer of Sarmatian placer accumulation is the middle complex. The thickness of rich ore bodies is 10-15 m; the total thickness of the productive layer is 20-25 m. Upper, Sarmatian layer occurs on depth at about 40 m and is exploited by several open pits (Table 21).

The Malishev deposit was localised in 1954 and exploited since 1961 by Verkhnepridneprovsky (today - Volnogorsky) mining-and-metallurgical enterprise (EMPE). To day the American company "Cometals" participates in mining. The production is 5 million m^3 of ore sands with 200 thousand ton of concentrate annually. In 1998 the mining was 2,5 million m^3 of sands, with 120 thousand ton of concentrate. An experimental plant (with the capacity of 1 thousand t/year) obtains ilmenite concentrate with low contents of Cr_2O_3 (0,3-0,4 % against 1,2-1,4 % in the typical concentrates emitted by combine). The new product is used for production of TiO_2 pigment.

The main product from the EMPE is: ilmenite (63-65 % TiO2), Rutile (92-95 % TiO2), zirconium (62-65 % ZrO_2), disthene-sillimanite (58 % Al_2O_3) and staurolite (46 % Al_2O_3). The extraction of zircon and rutile in a goods concentrate compounds 90-91 %, ilmenite - 85 %, disthene-sillimanite - 98 %, staurolite- 59 %. Grain size of minerals in concentrates: zircon, Rutile, ilmenite 0,063-0,16 mm; staurolite, disthene, sillimanite- 0,063-0,2 mm. The qualitative behaviours of Malishev sands concentrate in table 22.

Concentrate	Content, %				
	ZrO_2	TiO_2	Al_2O_3	Fe_2O_3	SiO_2
Zirconium	65,50	0,24	1,36	0,10	-
Rutile	0,46	95,0	0,34	2,22	1,24
Ilmenite	-	64,10	2,57	-	1,60
Disthene-sillimanite	1,15	0,73	57,70	0,66	-
Staurolite	1,63	3,08	45,97	-	28,07

Table 22. Quality of goods concentrates emitted by East ore mining and metallurgical enterprise (EMPE)

13.4 The Sarmatian placer accumulation

It is representative of beach placer deposits. It consists of three areas, a Northern, Middle (Central) and Southern, divided by narrow areas (200-300 m) with non-commercial contents of ore components. The Middle (Central) area has a width from 0,3-0,5 km in west up to 0,8-1,0 km in east. The Southern area is narrow. The Northern area consists of several disconnected bodies, 0,1-0,3 km in width. All three areas are simple and practically horizontal with a small slope towards north. The total distance of the developed part of the placer accumulation is 19 km in length and up to 2,5 km in width. The Sarmatian ore sands are characterized by dominance of two granulometric classes: 0,28+0,1 mm and -0,05 mm, content of coarse sand (+0,28 mm) is low in the richest part of the layer.

Main rock-forming minerals of productive sands are quartz (up to 70 %) and clay minerals (8-30 %). Mineral composition of HM fraction (%) is: Ilmenite – 44%, rutile-16%, staurolite-13,6%, disthene+sillimanite-13%, zircon-9,6%, and tourmaline-4%. A clear differentiation of HM on grain-size categories is characteristic. Disthene and sillimanite predominantly concentrate in the class of 0,28-0,16 mm, ilmenite and Rutile 0,2-0,1 mm, and zircon - in the class of 0,1-0,05 mm.

The lower Poltava placer layer is placed directly beneath the Sarmatian placer or separated from it by a barren 6-7m thick interlayer. In the north-eastern part the layer is 5-10 m. HM contents varies from 2% up to 27%. The Poltava layer has a content of: Ilmenite – 54%, disthene + sillimanite – 15%, Rutile + leucoxene - 1,7, staurolite - 6,7%, zircon - 4,6%, tourmaline – 4%. The grain size of ilmenite 0,07-0,25 mm, Rutile 0,07-0,15 mm. The average contents of titanium dioxide in ilmenite are 67,7 %, that points to its essential leucoxenization.

The outline of Sarmatian industrial concentrations is determined by following parameter requirements: a cut off grade of conditional ilmenite is 16 kg / м^3; the minimum industrial contents is 39 kg / m^3; minimum of layer thickness is 2 m. In an outline of commercial ores of Sarmatian sands of A+B+C_1 categories the middle contents of ilmenite is 1,8%, zircon 0,4%, Rutile 0,7%, disthene and sillimanite 0,6%. Malyshev deposit is referred to the largest objects of the world by the reserves (of hundred million. m^3) of ore sands which is concluded in Sarmatian and Poltava placer. Malishev deposit is the complex object. Besides main ore concentrates, Ti and Zr, reserves of staurolite, disthene and sillimanite in Sarmatiam beds, Hf in zircon, Nb_2O_5 and Ta_2O_5 in ilmenite and rutile. In the tailings of dressing - reserves of forming and glass quartz sands are calculated; in the Poltava ore bed in ilmenite concentrate - reserves of Sc and V are taken into account.

13.5 Ukrainian possibilities

The above description is taken from a text recieved from the Academy of Sciences in Kiev. It is written in another tradition, and sometimes a bit confusing. However there is no dought that Ukraine has a major potential for ilmenite exploration and production. A total reserve at 900 tonnes of Ilmenite and rutil is estimated by the Academy of Sciences in Kiev. As Ukraine actually produces high-grade ilmenite there is no dought either that high-grade ilmenite occurs in the placer deposits

Placer deposits have been developed in the area since Late Jurassic time. Many different ore-types are found in the country: Regolith, alluvial, marine bars or spits. In the present material (Appendix 2) it is difficult to evaluate the grade of the illmenite. In the Malishev deposits the TiO_2 content is above 60 % (see previous section), but in the Irsha region (Table 15) the TiO_2 varies between 48 and 67 %. Many of the deposits are not developed yet.

It is recommend that samples should be collected and analysed from the most promising areas. It is also recommended that more detailed information on volume's and quality of deposits, to calculate possibly in place and reserves. The possibility for exploitation should be described, together with the legislation and commitment in a development phase. Finally, Ukraine could be a good candidate for provenance analysis, due to the fact, that many different kind of placers are present in the area probably with different sources and genesis combined with different HM paragenesis and TiO_2 content.

However, Ukraine is a difficult country to work in, and one way of doing it is to join up with the company currently extracting the minerals.

14. References

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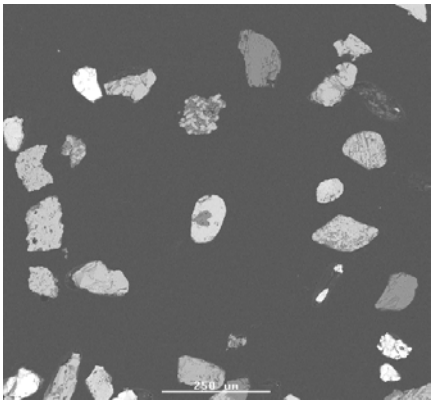
Appendix 1

CCSEM analysis data

Netherlands

Geological Survey of Denmark and Greenland
Thoravej 8, DK-2400 Copenhagen NV
Ph.: +45 38142000, Fax: +45 38142050



Sample Name:	KW21 27-28m	No. of analysed frames:	58
Date:	12-01-01	No. analysed of particles	538
Submitter:	Dupont / Netherland	Heavy minerals in raw sand (%):	0,53
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	120 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	57,5	31,0	1,2	0,1	5,5	1,7	0,7	0,1	0,4	98,2
Leucoxene	76,4	6,4	0,2	0,2	11,3	2,5	0,2	0,1	0,3	97,6
Rutile	92,8	1,4	0,1	0,1	2,5	0,8	0,1	0,1	0,2	98,2
Ti magnetite	40,7	42,7	1,0	0,2	7,3	1,9	1,8	0,0	2,2	97,8
Magnetite	0,6	75,1	1,2	0,3	9,0	4,2	0,5	1,7	0,5	93,1
Chromite	0,2	20,1	0,6	49,0	2,2	16,4	9,1	0,1	0,1	97,9
Pyrite	0,2	32,4	0,3	0,0	1,3	0,4	0,3	0,1	0,5	35,6
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	2,8	0,0	0,0	10,3	3,0	0,3	1,1	2,9	20,4
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	3,1	26,5	1,2	0,1	37,7	20,0	3,2	1,8	0,5	94,2
Sillimanite	0,0	1,2	0,0	0,0	43,2	52,9	0,0	0,0	0,0	97,3
Staurolite	1,3	15,0	0,2	0,0	32,3	47,9	1,4	0,0	0,3	98,5
Zircon	0,2	0,8	0,1	0,1	29,8	0,2	0,1	0,2	63,6	95,2
Silicate	2,8	11,6	0,2	0,2	47,9	26,0	3,8	3,6	0,4	96,4
Unclassified	13,0	16,7	1,3	1,3	27,7	7,8	1,0	0,7	18,4	87,9

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	27,9	12,7	27,7	3,0	1,7	26,9	0,1	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58,6	78,3	94,5	41,6
Fe_2O_3 wt%	31,6	6,5	1,4	43,7
MnO wt%	1,2	0,2	0,2	1,1
Cr_2O_3 wt%	0,1	0,2	0,1	0,2
SiO_2 wt%	5,6	11,6	2,6	7,4
Al_2O_3 wt%	1,7	2,5	0,8	1,9
MgO wt%	0,7	0,2	0,1	1,8
CaO wt%	0,1	0,1	0,1	0,1
ZrO_2 wt%	0,4	0,3	0,2	2,2
Total	100,0	100,0	100,0	100,0

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	21,4	0,1
Leucoxene	9,8	0,1
Rutile	21,2	0,1
Ti magnetite	2,3	0,0
Magnetite	5,6	0,0
Chromite	2,7	0,0
Pyrite	0,4	0,0
Phosphate	0,0	0,0
Monazite	1,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	1,3	0,0
Sillimanite	0,1	0,0
Staurolite	1,1	0,0
Zircon	20,6	0,1
Silicate	9,0	99,5
Unclassified	3,6	0,0
Total	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	75,4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	63,2
Valuable heavy minerals in raw sand:	0,41

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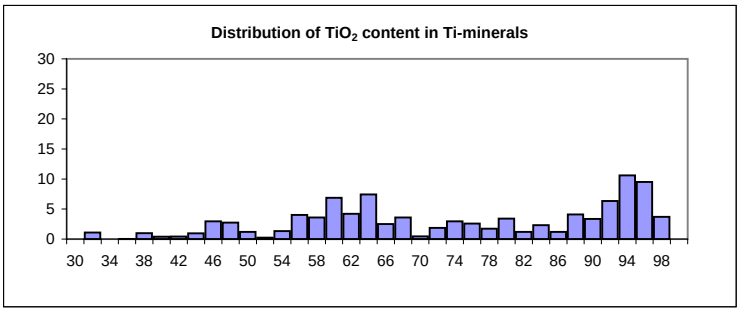
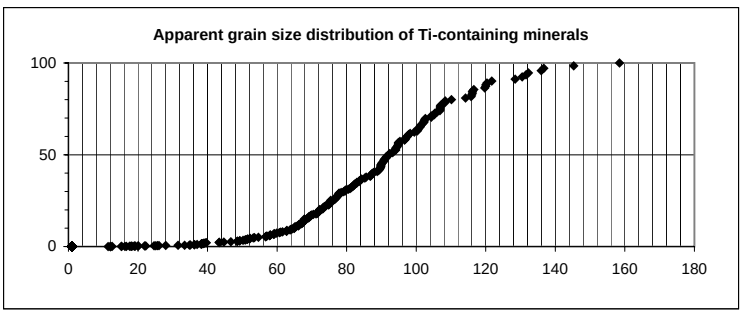
Sample Name:	KW21 27-28m	Analyzed by:	CCA
Submitter:	Dupont / Netherland	Acc. Voltage	17kV
Date:	12-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,5	1,8	309	119	4740	103
Leucoxene	1,6	2,0	388	152	6550	34
Rutile	1,4	1,9	310	120	4688	93
Ti magnetite	1,4	1,7	246	97	3759	13
Magnetite	1,4	1,8	288	111	4606	24
Chromite	1,5	2,1	335	130	4913	11
Pyrite	1,9	2,6	251	107	2038	4
Phosphate	0,0	0,0	0	0	0	0
Monazite	1,5	1,6	209	77	2443	8
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,6	1,7	190	73	2511	13
Sillimanite	1,2	2,3	254	106	2216	1
Staurolite	1,4	1,9	354	140	6086	5
Zircon	1,5	1,6	242	88	3373	135
Silicate	1,5	1,9	325	128	5256	66
Unclassified	1,5	2,1	315	130	4858	28

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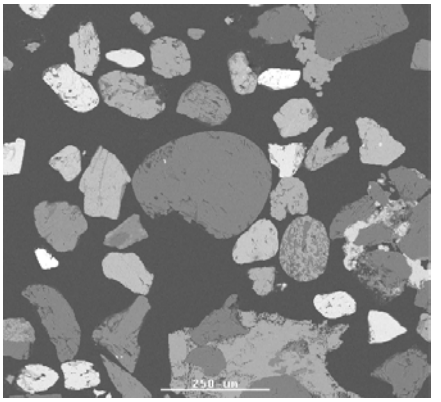

Sample Name:	KW24 21-21.8m	No. of analysed frames:	45
Date:	11-01-01	No. analysed of particles	578
Submitter:	Dupont / Netherland	Heavy minerals in raw	
Analyzed by:	CCA	sand (%):	0,55
Acc. Voltage	17 kV	comments:	
Magnification	100x		
Guard region	120 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56,1	31,5	1,6	0,1	5,7	1,7	0,7	0,1	0,4	97,9
Leucoxene	74,9	6,2	0,3	0,1	11,6	2,9	0,5	0,1	0,3	97,0
Rutile	93,6	1,2	0,1	0,1	2,1	0,5	0,1	0,1	0,2	98,2
Ti magnetite	34,7	42,0	1,2	0,1	12,6	3,7	1,5	0,2	1,1	96,9
Magnetite	0,9	84,6	0,6	0,1	6,3	2,4	0,6	1,2	0,3	97,0
Chromite	1,2	19,1	0,6	50,0	2,5	16,6	7,4	0,1	0,2	97,7
Pyrite	0,2	33,4	0,0	0,1	1,1	0,4	0,7	0,0	0,0	35,8
Phosphate	1,5	3,6	0,0	0,3	0,0	43,2	0,0	5,9	0,0	54,5
Monazite	0,0	0,9	0,0	0,0	7,2	1,4	0,2	1,5	2,3	13,5
Y-phosphate	0,0	2,1	0,0	0,0	0,5	1,6	0,0	0,4	0,0	4,6
Sphene	36,8	0,1	0,2	0,0	30,6	2,2	0,4	28,3	0,1	98,6
Garnet	0,6	30,5	2,8	0,2	38,1	19,9	2,6	2,7	0,3	97,6
Sillimanite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Staurolite	0,4	17,3	0,0	0,0	34,9	43,7	1,4	0,2	0,8	98,7
Zircon	0,2	0,7	0,2	0,1	30,2	0,2	0,1	0,1	63,6	95,5
Silicate	1,6	12,8	0,9	0,1	49,7	21,6	4,2	5,0	0,2	96,2
Unclassified	13,8	15,6	0,6	0,9	27,2	9,7	1,4	0,7	15,0	85,0

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	27,5	14,0	13,6	4,8	2,1	38,0	0,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57,4	77,2	95,3	35,8
Fe_2O_3 wt%	32,2	6,4	1,3	43,3
MnO wt%	1,6	0,3	0,2	1,2
Cr_2O_3 wt%	0,1	0,1	0,2	0,1
SiO_2 wt%	5,8	12,0	2,1	13,0
Al_2O_3 wt%	1,7	3,0	0,5	3,8
MgO wt%	0,7	0,5	0,1	1,5
CaO wt%	0,1	0,1	0,1	0,2
ZrO_2 wt%	0,4	0,3	0,2	1,1
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	68,9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	61,1
Valuable heavy minerals in raw sand:	0,34

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	17,2	0,1
Leucoxene	8,7	0,0
Rutile	8,5	0,0
Ti magnetite	3,0	0,0
Magnetite	8,2	0,0
Chromite	1,3	0,0
Pyrite	0,6	0,0
Phosphate	0,2	0,0
Monazite	3,2	0,0
Y-phosphate	0,2	0,0
Sphene	0,1	0,0
Garnet	1,3	0,0
Sillimanite	0,0	0,0
Staurolite	0,1	0,0
Zircon	23,8	0,1
Silicate	17,1	99,5
Unclassified	6,4	0,0
Total	100,0	100,0

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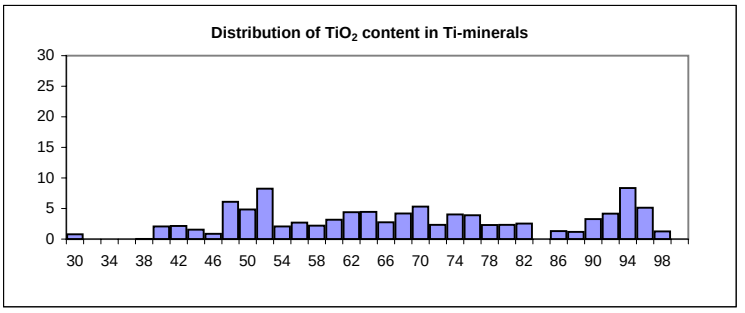
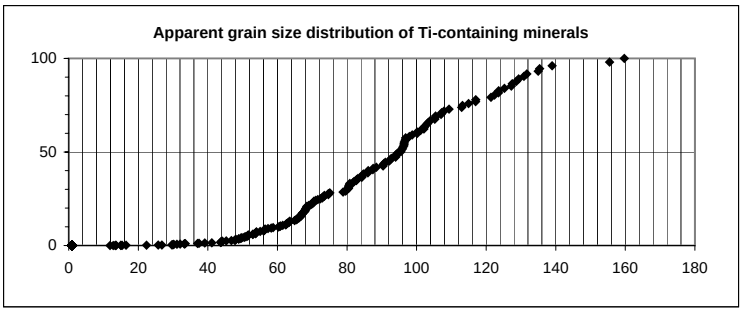
Sample Name:	KW24 21-21.8m	Analyzed by:	CCA
Submitter:	Dupont / Netherland	Acc. Voltage	17kV
Date:	11-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	1,9	324	126	5014	93
Leucoxene	1,5	1,9	379	147	6771	35
Rutile	1,5	1,8	273	103	3767	55
Ti magnetite	1,7	1,9	298	117	4800	16
Magnetite	1,6	2,7	466	203	8785	22
Chromite	1,4	1,7	187	70	2270	14
Pyrite	1,7	2,9	501	221	7568	2
Phosphate	1,3	1,5	330	115	5772	1
Monazite	1,6	1,7	268	103	3899	20
Y-phosphate	1,7	2,0	268	109	2969	2
Sphene	2,5	2,0	233	93	2196	1
Garnet	1,6	1,8	227	92	3117	13
Sillimanite	0,0	0,0	0	0	0	0
Staurolite	1,3	1,9	255	100	2766	1
Zircon	1,5	1,8	281	107	3999	156
Silicate	1,6	2,2	399	161	7296	108
Unclassified	1,7	2,7	467	203	7398	39

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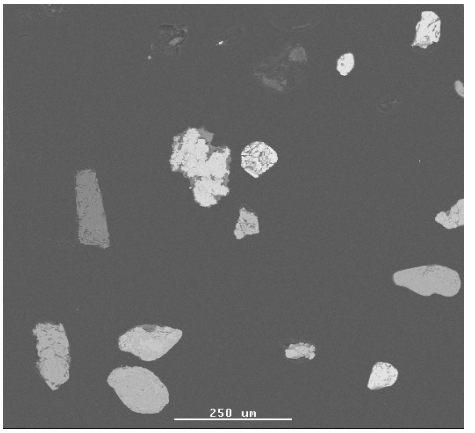

Sample Name:	KW25 9-10 m
Date:	11-01-01
Submitter:	Dupont / Netherland
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	100x
Guard region	120 µm
Sieve	100 µm^2

No. of analysed frames:	81
No. analysed of particles	522
Heavy minerals in raw sand (%):	0,38
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56,8	31,5	1,6	0,1	5,4	1,5	0,6	0,1	0,3	97,9
Leucoxene	75,7	6,2	0,2	0,2	10,4	3,5	0,2	0,2	0,6	97,2
Rutile	91,9	1,3	0,1	0,2	2,7	1,1	0,1	0,1	0,2	97,7
Ti magnetite	39,1	42,6	0,5	0,2	7,5	2,6	2,3	0,1	2,7	97,7
Magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chromite	1,3	28,3	0,9	41,8	1,9	17,4	5,9	0,1	0,4	98,0
Pyrite	0,1	31,1	0,1	0,1	3,0	1,2	0,2	0,1	0,3	36,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	1,0	0,0	0,0	6,3	3,0	0,2	2,1	3,1	15,6
Y-phosphate	1,0	3,5	0,2	1,4	6,0	3,3	0,4	0,6	3,0	19,4
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,1	29,6	2,0	0,3	38,2	19,6	3,2	3,4	0,4	96,8
Sillimanite	0,0	0,6	0,4	0,0	43,0	53,4	0,0	0,0	0,0	97,4
Staurolite	0,6	16,0	0,6	0,0	33,6	46,5	1,4	0,0	0,0	98,7
Zircon	0,2	0,5	0,2	0,2	30,0	0,3	0,1	0,1	63,7	95,3
Silicate	2,3	11,1	1,1	0,2	54,7	19,8	1,7	1,2	0,3	92,4
Unclassified	8,1	9,9	0,3	1,5	33,5	8,8	0,9	0,3	20,3	83,7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	34,3	13,9	17,7	2,8	1,9	28,8	0,5	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58,0	77,9	94,1	40,1
Fe_2O_3 wt%	32,1	6,4	1,3	43,6
MnO wt%	1,6	0,2	0,1	0,5
Cr_2O_3 wt%	0,1	0,2	0,2	0,2
SiO_2 wt%	5,5	10,8	2,7	7,7
Al_2O_3 wt%	1,5	3,6	1,1	2,7
MgO wt%	0,6	0,2	0,1	2,3
CaO wt%	0,1	0,2	0,1	0,1
ZrO_2 wt%	0,3	0,6	0,3	2,8
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	70,6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	62,5
Valuable heavy minerals in raw sand:	0,29

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	26,2	0,1
Leucoxene	10,7	0,0
Rutile	13,6	0,1
Ti magnetite	2,1	0,0
Magnetite	0,0	0,0
Chromite	0,7	0,0
Pyrite	7,7	0,0
Phosphate	0,0	0,0
Monazite	0,7	0,0
Y-phosphate	0,3	0,0
Sphene	0,0	0,0
Garnet	1,5	0,0
Sillimanite	0,4	0,0
Staurolite	0,8	0,0
Zircon	22,1	0,1
Silicate	9,1	99,7
Unclassified	4,1	0,0
Total	100,0	100,0

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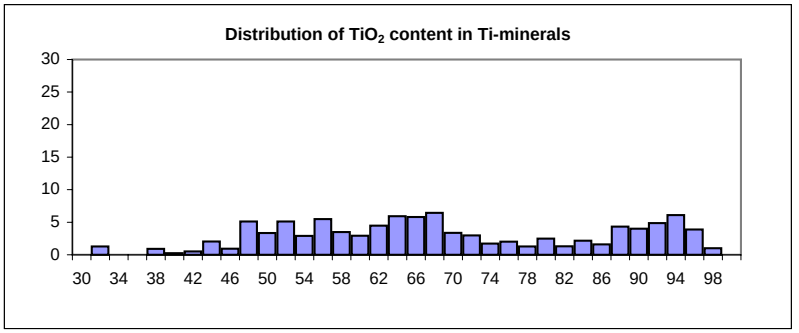
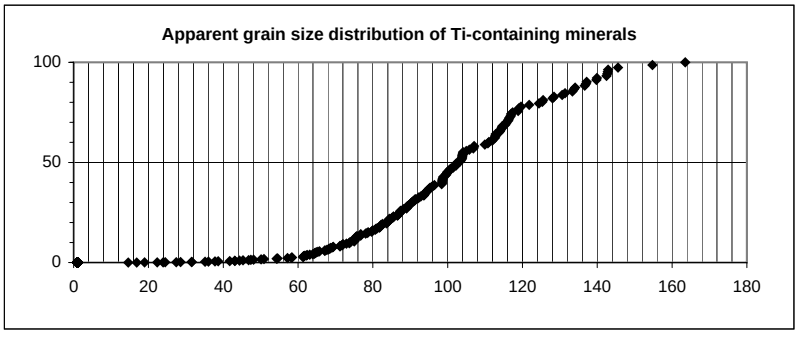
Sample Name:	KW25 9-10 m	Analyzed by:	CCA
Submitter:	Dupont / Netherland	Acc. Voltage	17kV
Date:	11-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	1,9	400	155	7254	107
Leucoxene	1,6	1,9	396	155	7337	43
Rutile	1,5	1,8	344	133	5640	64
Ti magnetite	1,4	2,0	388	157	6610	9
Magnetite	0,0	0,0	0	0	0	0
Chromite	1,5	1,6	264	96	3753	5
Pyrite	1,5	2,2	367	153	7331	28
Phosphate	0,0	0,0	0	0	0	0
Monazite	1,4	1,6	302	109	4651	4
Y-phosphate	1,4	1,7	267	101	3773	2
Sphene	0,0	0,0	0	0	0	0
Garnet	1,7	1,9	309	124	4456	11
Sillimanite	2,6	2,4	720	304	16895	1
Staurolite	2,0	2,5	630	268	13975	2
Zircon	1,4	1,6	297	109	4579	138
Silicate	1,5	1,9	287	114	5731	80
Unclassified	1,5	1,9	343	139	7289	28

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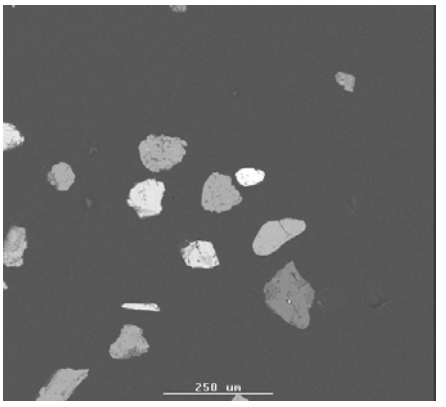
GEUS

Sample Name:	KW24 16-17m
Date:	11-01-01
Submitter:	Dupont / Netherland
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	100x
Guard region	120 µm
Sieve	100 µm^2

No. of analysed frames:	81
No. analysed of particles	563
Heavy minerals in raw sand (%):	0,56
comments:	



	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	57,2	29,7	1,3	0,1	6,9	1,8	0,7	0,1	0,5	98,3
Leucoxene	77,1	5,6	0,2	0,2	10,7	3,3	0,2	0,1	0,2	97,6
Rutile	92,5	1,0	0,1	0,1	2,7	1,1	0,1	0,1	0,2	98,0
Ti magnetite	40,8	40,7	2,0	0,1	7,3	4,0	2,4	0,1	0,4	97,8
Magnetite	0,8	93,0	0,0	0,6	0,4	1,8	0,0	0,0	1,4	98,1
Chromite	1,5	26,2	0,4	40,5	2,9	18,6	7,2	0,4	0,1	97,8
Pyrite	0,2	30,7	0,0	0,0	2,7	1,3	0,1	0,2	0,2	35,5
Phosphate	1,2	7,7	0,0	0,0	0,0	39,9	0,4	4,6	0,0	53,8
Monazite	0,4	0,8	0,0	0,0	16,7	3,2	0,2	0,9	3,6	25,7
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,3	25,8	6,7	0,1	37,6	19,4	3,4	4,6	0,2	98,1
Sillimanite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Staurolite	0,6	14,5	0,6	0,2	33,7	46,7	1,1	0,1	0,2	97,7
Zircon	0,3	0,5	0,2	0,1	30,1	0,4	0,1	0,2	63,6	95,4
Silicate	3,9	10,8	0,4	0,1	53,9	22,5	2,6	2,1	0,2	96,6
Unclassified	16,4	6,7	0,8	2,7	24,8	7,6	1,1	0,7	26,3	87,1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	25,4	23,3	24,5	0,9	1,1	24,9	0,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58,2	79,0	94,4	41,8
Fe_2O_3 wt%	30,2	5,7	1,0	41,7
MnO wt%	1,4	0,2	0,2	2,0
Cr_2O_3 wt%	0,1	0,2	0,1	0,1
SiO_2 wt%	7,0	10,9	2,8	7,4
Al_2O_3 wt%	1,8	3,3	1,1	4,0
MgO wt%	0,7	0,2	0,1	2,5
CaO wt%	0,1	0,1	0,1	0,1
ZrO_2 wt%	0,5	0,3	0,3	0,4
Total	100,0	100,0	100,0	100,0

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	20,7	0,1
Leucoxene	19,0	0,1
Rutile	20,0	0,1
Ti magnetite	0,7	0,0
Magnetite	0,0	0,0
Chromite	2,3	0,0
Pyrite	1,0	0,0
Phosphate	0,5	0,0
Monazite	1,9	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,9	0,0
Sillimanite	0,0	0,0
Staurolite	0,9	0,0
Zircon	20,3	0,1
Silicate	9,1	99,5
Unclassified	2,8	0,0
Total	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	76,6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	67,7
Valuable heavy minerals in raw sand:	0,45

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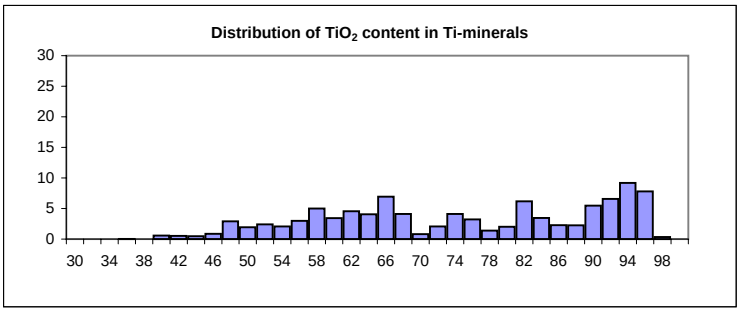
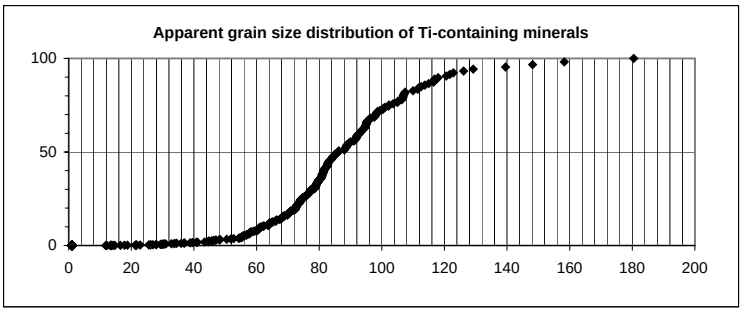
GEUS

Sample Name:	KW24 16-17m	Analyzed by:	CCA
Submitter:	Dupont / Netherland	Acc. Voltage	17kV
Date:	11-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	1,9	300	116	4326	107
Leucoxene	1,5	2,1	376	151	5901	72
Rutile	1,5	1,8	303	115	4520	89
Ti magnetite	1,8	1,8	170	65	1832	8
Magnetite	1,3	1,1	38	14	107	1
Chromite	1,4	1,7	264	99	3501	13
Pyrite	1,5	1,8	170	67	1623	13
Phosphate	1,3	1,4	397	125	9204	1
Monazite	1,5	1,9	310	121	4204	9
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,6	1,7	218	84	2566	9
Sillimanite	0,0	0,0	0	0	0	0
Staurolite	1,4	2,0	275	109	3433	7
Zircon	1,5	1,8	265	100	3483	126
Silicate	1,5	2,0	305	123	4537	76
Unclassified	1,6	2,0	252	102	3286	32

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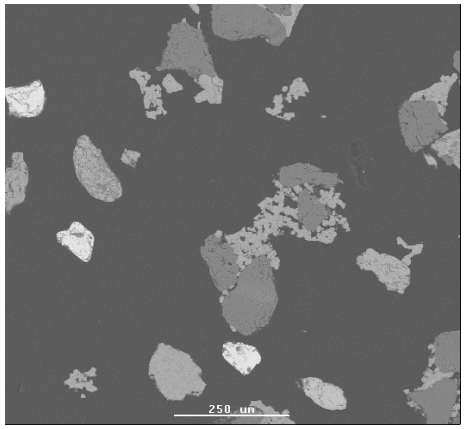

Sample Name:	KW26 11-12m
Date:	11-01-01
Submitter:	Dupont / Netherland
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	100x
Guard region	120 μm
Sieve	100 μm^2

No. of analysed frames:	81
No. analysed of particles	647
Heavy minerals in raw sand (%):	1,07
comments:	Many large (>200 μm) composite grains

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	58,6	26,6	1,8	0,1	6,9	1,9	0,8	0,2	0,2	97,3
Leucoxene	76,5	7,4	0,2	0,3	9,4	2,3	0,3	0,3	0,3	97,0
Rutile	92,5	1,8	0,2	0,2	2,5	0,8	0,2	0,1	0,2	98,5
Ti magnetite	41,6	48,5	0,8	0,1	2,4	1,0	1,4	1,0	0,6	97,4
Magnetite	0,2	78,4	0,7	0,2	6,5	2,6	0,5	5,7	0,5	95,4
Chromite	0,1	30,2	0,5	43,7	2,0	14,5	6,4	0,8	0,3	98,3
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	1,4	0,0	0,0	18,6	2,3	0,7	0,9	3,8	27,7
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,2	35,2	3,4	0,0	34,1	17,5	1,3	6,2	0,1	97,9
Sillimanite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Staurolite	0,6	15,9	1,2	0,2	31,2	47,7	1,5	0,2	0,3	98,8
Zircon	0,1	0,9	0,1	0,1	30,0	0,1	0,1	0,2	63,6	95,4
Silicate	1,0	11,1	0,2	0,1	75,8	4,6	1,0	1,2	0,5	95,4
Unclassified	6,2	26,3	0,9	0,8	28,8	5,2	1,1	3,9	2,8	76,0

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	29,4	26,6	11,6	7,5	1,2	23,8	0,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	60,3	78,9	93,9	42,7
Fe_2O_3 wt%	27,4	7,6	1,8	49,8
MnO wt%	1,9	0,2	0,2	0,8
Cr_2O_3 wt%	0,1	0,3	0,2	0,1
SiO_2 wt%	7,1	9,7	2,5	2,4
Al_2O_3 wt%	2,0	2,4	0,9	1,0
MgO wt%	0,8	0,3	0,2	1,5
CaO wt%	0,2	0,3	0,1	1,1
ZrO_2 wt%	0,3	0,3	0,2	0,6
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	70,3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	66,0
Valuable heavy minerals in raw sand:	0,14

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	3,7	0,0
Leucoxene	3,4	0,0
Rutile	1,5	0,0
Ti magnetite	0,9	0,0
Magnetite	36,6	0,4
Chromite	0,8	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,1	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,1	0,0
Sillimanite	0,0	0,0
Staurolite	0,3	0,0
Zircon	3,0	0,0
Silicate	41,2	99,4
Unclassified	8,3	0,1
Total	100,0	100,0

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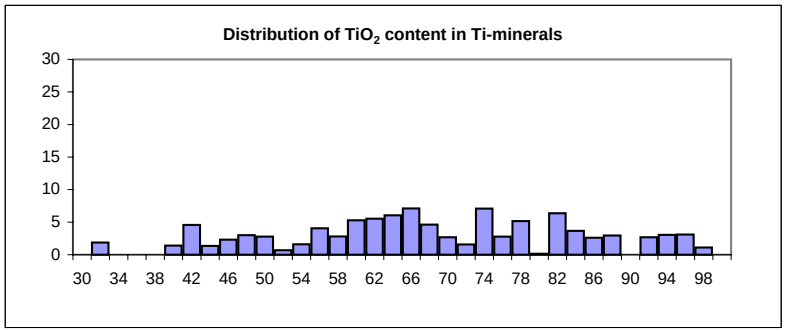
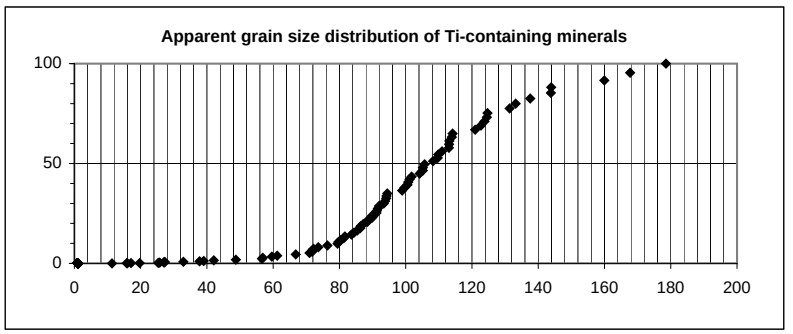
Sample Name:	KW26 11-12m	Analyzed by:	CCA
Submitter:	Dupont / Netherland	Acc. Voltage	17kV
Date:	11-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (μm)	Length (μm)	Area (μm^2)	Total grains
Ilmenite	1,7	2,1	420	169	7319	31
Leucoxene	1,6	2,0	403	158	7918	26
Rutile	1,5	2,0	307	122	4257	19
Ti magnetite	1,4	3,0	579	252	9039	6
Magnetite	1,6	2,6	360	157	5825	332
Chromite	1,4	2,3	461	189	7373	6
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	1,3	1,6	252	95	3716	2
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	2,3	3,1	423	183	5043	2
Sillimanite	0,0	0,0	0	0	0	0
Staurolite	1,8	2,2	505	209	9133	2
Zircon	1,3	1,6	291	103	4677	38
Silicate	1,5	2,8	877	382	31844	134
Unclassified	1,5	2,5	529	233	17318	49

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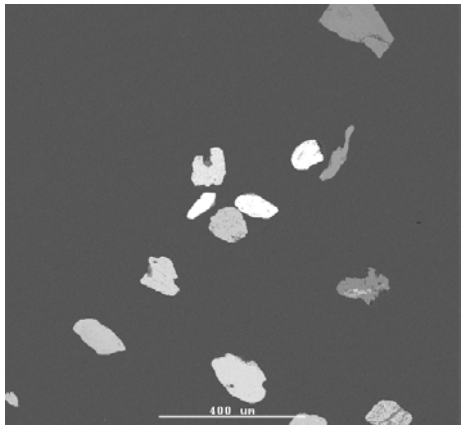

Sample Name:	Limburg 5
Date:	14-11-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	120 μm
Sieve	100 μm^2

No. of analysed frames:	81
No. analysed of particles	409
Heavy minerals in raw sand (%):	0,23
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	60,6	30,6	1,5	0,2	2,5	1,4	0,4	0,1	0,4	97,8
Leucoxene	75,1	10,8	0,4	0,3	7,4	1,9	0,2	0,2	0,4	96,7
Rutile	92,5	1,0	0,2	0,1	2,4	1,0	0,1	0,1	0,3	97,8
Ti magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chromite	0,9	22,3	0,5	45,0	1,1	18,7	8,7	0,1	0,2	97,5
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	14,4	11,9	0,0	0,3	2,7	29,3
Y-phosphate	0,2	1,0	0,4	0,0	8,0	3,5	0,0	0,2	0,0	13,3
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,6	27,7	1,7	0,0	38,1	19,9	4,2	6,6	0,4	99,1
Sillimanite	0,1	0,8	0,0	0,5	42,8	54,3	0,0	0,2	0,0	98,6
Staurolite	0,5	13,0	0,4	0,0	34,5	47,3	1,4	0,1	0,7	97,9
Zircon	0,2	0,3	0,2	0,2	29,6	0,4	0,1	0,2	64,2	95,4
Silicate	2,5	7,7	1,2	0,2	57,6	21,1	2,0	3,7	0,3	96,2
Unclassified	11,7	5,1	0,4	4,4	17,2	38,1	1,7	0,2	13,9	92,7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	47,0	9,5	26,2	0,0	1,5	15,6	0,3	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	62,0	77,7	94,6	0
Fe_2O_3 wt%	31,2	11,2	1,1	0
MnO wt%	1,6	0,4	0,2	0
Cr_2O_3 wt%	0,2	0,3	0,1	0
SiO_2 wt%	2,6	7,7	2,5	0
Al_2O_3 wt%	1,4	1,9	1,0	0
MgO wt%	0,4	0,2	0,1	0
CaO wt%	0,1	0,2	0,1	0
ZrO_2 wt%	0,5	0,5	0,3	0
Total	100,0	100,0	100,0	0

Average TiO_2 content of all the TiO_2 minerals:	74,1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	64,6
Valuable heavy minerals in raw sand:	0,19

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	38,0	0,1
Leucoxene	7,6	0,0
Rutile	21,2	0,0
Ti magnetite	0,0	0,0
Magnetite	0,0	0,0
Chromite	3,5	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,2	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	1,2	0,0
Sillimanite	0,2	0,0
Staurolite	0,7	0,0
Zircon	12,6	0,0
Silicate	5,3	99,8
Unclassified	9,5	0,0
Total	100,0	100,0

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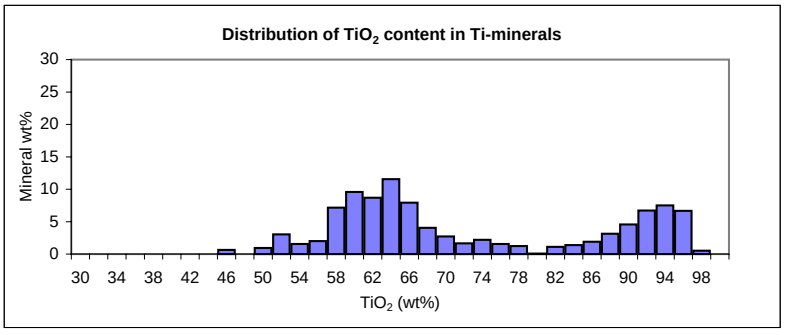
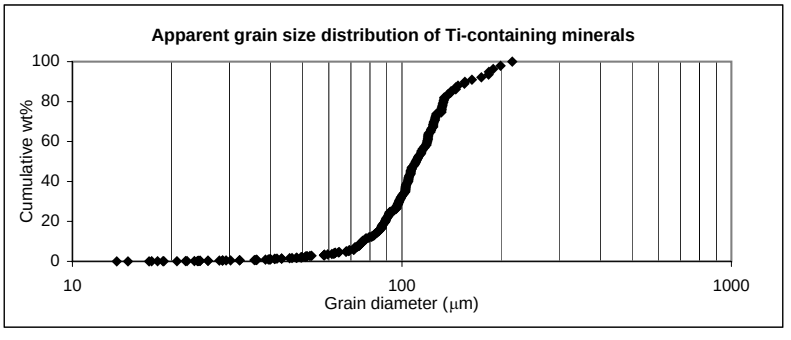
Sample Name:	Limburg 5	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	14-11-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,8	376	144	156
Leucoxene	1,5	1,6	332	121	35
Rutile	1,5	1,8	397	152	71
Ti magnetite	0,0	0,0	0	0	0
Magnetite	0,0	0,0	0	0	0
Chromite	1,6	1,7	342	127	14
Pyrite	0,0	0,0	0	0	0
Phosphate	0,0	0,0	0	0	0
Monazite	1,3	2,1	376	154	1
Y-phosphate	2,0	1,4	73	25	2
Sphene	0,0	0,0	0	0	0
Garnet	1,7	2,2	468	192	5
Sillimanite	1,6	1,7	457	169	1
Staurolite	1,4	2,1	419	167	3
Zircon	1,5	1,6	309	110	67
Silicate	1,6	1,9	417	167	30
Unclassified	1,7	2,3	613	259	24

Germany

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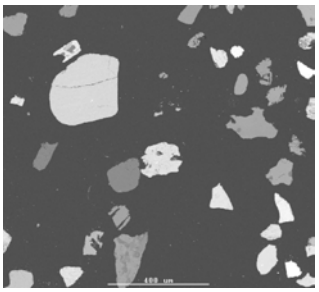
Sample Name:	HL5 321-324
Date:	13-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	180 µm
Sieve	100 µm²

Number of frames: 32

Number of valuable particles analyzed: 585

Heavy minerals in raw sand (%): 1,19



Average content	Category											
	ilmenite	leucoxene	pyrite	rutile	silicate	other Ti-ox	unclassified	zircon	garnet	Monazite	sillimanite	staurolite
TiO_2 w/w	51,9	76,7	0,2	94,4	0,9	36,4	16,5	0,2	0,6	0,0	0,2	2,0
Fe_2O_3 w/w	40,0	7,7	30,8	1,6	11,2	36,0	12,6	1,0	29,8	0,0	0,7	13,6
MnO w/w	2,3	0,5	0,1	0,1	0,3	1,9	1,0	0,1	1,7	0,0	0,3	0,3
Cr_2O_3 w/w	0,1	0,2	0,1	0,1	0,2	0,1	3,5	0,1	0,1	0,0	0,1	0,2
SiO_2 w/w	1,8	4,7	1,9	0,8	44,7	11,1	25,7	28,8	37,9	1,2	41,7	32,0
Al_2O_3 w/w	1,1	4,4	0,7	0,5	20,4	6,6	10,8	0,2	19,8	0,4	54,2	47,8
MgO w /w	0,3	0,2	0,0	0,0	4,7	1,1	1,9	0,1	4,2	0,4	0,0	1,5
CaO w/w	0,2	0,9	0,3	0,1	14,4	1,6	8,0	0,3	3,7	2,6	0,1	0,2
ZrO_2 w/w	0,4	1,0	0,1	0,3	0,2	2,1	10,0	63,5	0,2	2,6	0,3	0,1
Total	98,1	96,3	34,2	98,0	97,0	97,1	90,1	94,3	98,0	7,1	97,7	97,6

Normalised average contents of the valuable Ti-containing minerals:

Average content	Category			
	ilmenite	leucoxene	rutile	other Ti-ox.
TiO_2 w/w	52,9	79,7	96,4	37,5
Fe_2O_3 w/w	40,7	8,0	1,6	37,1
MnO w/w	2,3	0,5	0,1	2,0
Cr_2O_3 w/w	0,1	0,2	0,1	0,1
SiO_2 w/w	1,9	4,9	0,8	11,4
Al_2O_3 w/w	1,1	4,5	0,5	6,8
MgO w/w	0,3	0,2	0,0	1,2
CaO w/w	0,2	0,9	0,1	1,7
ZrO_2 w/w	0,4	1,0	0,3	2,2
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals: 54,2

Average TiO_2 content of all the TiO_2 minerals excl. rutile: 52,1

Weight percent on a mineral basis:

the heavy mineral concentrate

Category	w/w
ilmenite	29,26
leucoxene	3,66
pyrite	11,63
rutile	2,11
silicate	33,97
sphene	0,00
otherTi-ox.	8,67
unclassified	2,41
zircon	1,69
garnet	1,79
monazite	0,26
phosphate	0,00
sillimanite	1,51
staurolite	3,03
Y-phosphate	0,00

the raw sand

Category	w/w
ilmenite	0,35
leucoxene	0,04
pyrite	0,14
rutile	0,03
silicate	99,21
sphene	0,00
otherTi-ox.	0,10
unclassified	0,03
zircon	0,02
garnet	0,02
monazite	0,00
phosphate	0,00
sillimanite	0,02
staurolite	0,04
Y-phosphate	0,00

the valuable heavy minerals

Category	w/w
ilmenite	60,09
leucoxene	7,51
rutile	4,34
otherTi-ox.	17,80
zircon	3,48
garnet	3,68
sillimanite	3,10
Total	100,00

Valuable heavy minerals in raw sand: 0,58

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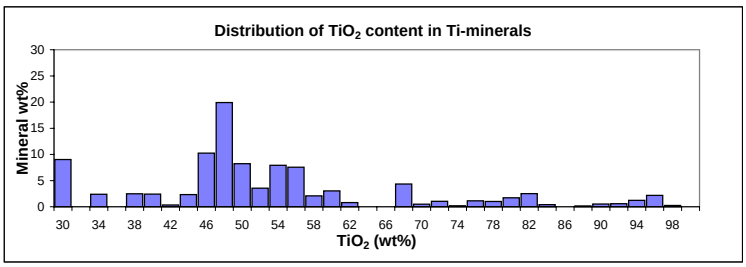
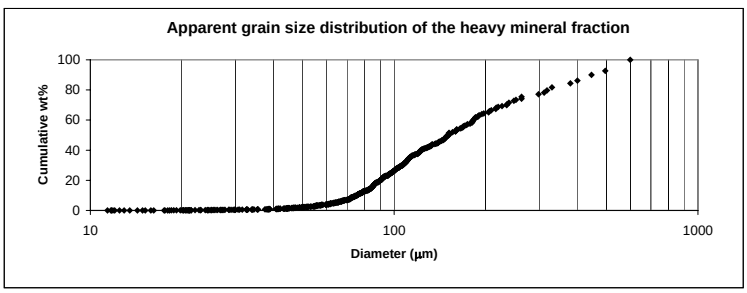
Sample Name:	HL5 321-324
Date:	13-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17kV





Average grain	Category											
parameters	ilmenite	leucoxene	pyrite	rutile	silicate	other Ti-ox	unclassified	zircon	garnet	Monazite	sillimanite	staurolite
Aspect ratio	1,54	1,49	1,40	1,70	1,65	1,62	1,54	1,53	1,80	1,37	1,84	1,37
Circularity	2,23	1,96	1,85	1,90	2,31	3,62	2,39	1,74	2,20	1,41	2,04	3,96
Perimeter (µm)	438,63	371,86	530,44	299,22	452,80	868,45	459,44	315,14	419,02	420,26	413,27	952,35
Length (µm)	182,76	147,25	216,63	117,29	189,69	397,44	196,47	118,43	173,53	138,22	164,43	432,53
Total grains	150	21	21	19	289	19	21	14	12	1	10	8

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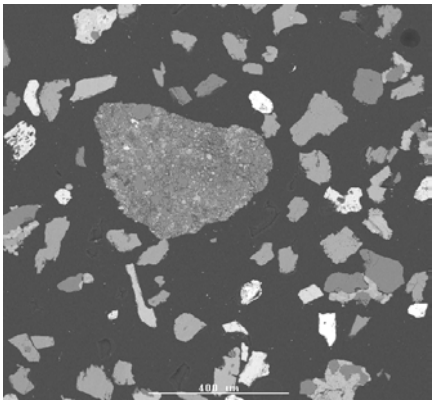

Sample Name:	HL16 486-495
Date:	13-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	180 µm
Sieve	100 µm^2

No. of analysed frames:	25
No. analysed of particles	503
Heavy minerals in raw sand (%):	3,45
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	52,1	40,2	2,0	0,2	1,3	1,0	0,3	0,2	0,4	97,7
Leucoxene	76,6	5,6	0,1	0,1	6,5	4,8	0,3	0,7	1,0	95,7
Rutile	93,8	1,1	0,3	0,4	1,5	0,3	0,0	0,1	0,3	97,8
Ti magnetite	36,8	46,0	1,3	0,2	5,5	2,4	1,1	0,9	0,4	94,4
Magnetite	0,8	75,4	0,8	0,4	6,6	2,7	5,1	3,3	0,5	95,5
Chromite	0,0	41,3	3,4	42,5	0,2	8,4	1,8	0,0	0,0	97,7
Pyrite	0,1	31,7	0,1	0,1	3,2	1,0	0,0	0,1	0,3	36,6
Phosphate	0,2	0,6	0,0	0,0	0,3	0,0	0,0	56,6	1,9	59,7
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	37,3	1,1	0,1	0,6	29,1	1,1	0,0	27,8	0,5	97,4
Garnet	0,4	22,0	1,6	1,1	39,9	21,7	3,2	5,0	0,0	94,9
Sillimanite	0,2	0,6	0,1	0,1	42,4	53,7	0,1	0,2	0,2	97,4
Staurolite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Zircon	0,2	0,9	0,3	0,1	29,0	0,2	0,1	0,6	63,1	94,6
Silicate	0,8	11,5	0,3	0,2	50,7	16,6	4,2	11,0	0,4	95,7
Unclassified	6,7	21,0	0,4	0,1	30,5	16,1	1,0	3,5	11,0	90,4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	57,5	3,2	7,2	13,9	1,8	13,7	2,8	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	53,3	80,1	95,8	39,0
Fe_2O_3 wt%	41,2	5,8	1,2	48,7
MnO wt%	2,1	0,1	0,3	1,4
Cr_2O_3 wt%	0,2	0,1	0,4	0,2
SiO_2 wt%	1,4	6,8	1,5	5,8
Al_2O_3 wt%	1,0	5,0	0,3	2,5
MgO wt%	0,3	0,3	0,0	1,2
CaO wt%	0,2	0,7	0,1	0,9
ZrO_2 wt%	0,4	1,0	0,3	0,4
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	55,7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	51,8
Valuable heavy minerals in raw sand:	0,86

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	14,3	0,5
Leucoxene	0,8	0,0
Rutile	1,8	0,1
Ti magnetite	3,5	0,1
Magnetite	8,7	0,3
Chromite	0,2	0,0
Pyrite	3,5	0,1
Phosphate	0,3	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,3	0,0
Garnet	0,4	0,0
Sillimanite	0,7	0,0
Staurolite	0,0	0,0
Zircon	3,4	0,1
Silicate	56,1	98,5
Unclassified	6,0	0,2
Total	100,0	100,0

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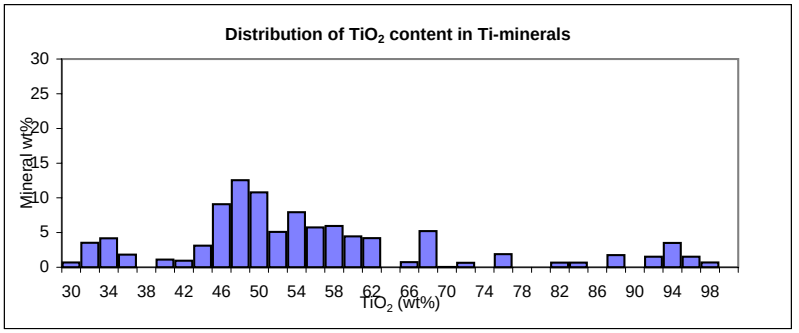
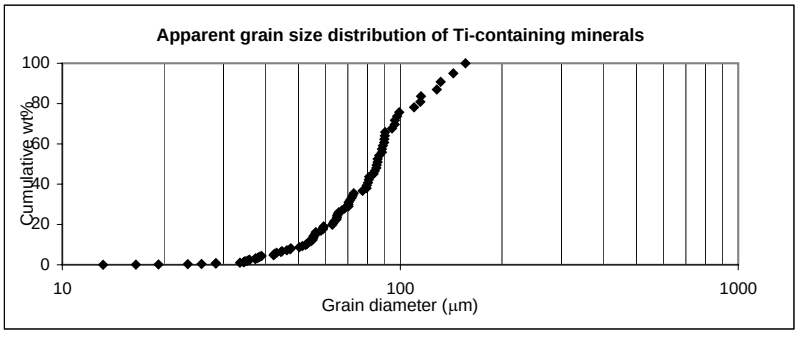
Sample Name:	HL16 486-495	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	13-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	2	2	294	114	63
Leucoxene	1	1	172	60	8
Rutile	2	2	226	86	12
Ti magnetite	2	3	398	170	12
Magnetite	1	2	207	82	50
Chromite	1	1	226	77	1
Pyrite	1	2	329	134	12
Phosphate	1	2	326	126	1
Monazite	0	0	0	0	0
Y-phosphate	0	0	0	0	0
Sphene	2	2	205	72	3
Garnet	2	2	218	85	4
Sillimanite	2	2	341	137	4
Staurolite	0	0	0	0	0
Zircon	1	2	231	83	21
Silicate	2	2	363	149	285
Unclassified	1	3	419	182	27

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GEUS

Sample Name:	SL90-114m
Date:	19-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	200 µm
Sieve	100 µm^2

No. of analysed frames:	33
No. analysed of particles	700
Heavy minerals in raw sand (%):	2,81
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53,1	37,0	2,0	0,2	2,6	1,4	0,3	0,3	0,5	97,4
Leucoxene	76,1	8,6	0,5	0,3	5,3	3,4	0,3	0,9	1,1	96,4
Rutile	93,0	1,5	0,2	0,3	1,2	0,8	0,1	0,1	0,3	97,5
Ti magnetite	42,1	42,2	1,5	0,3	7,2	1,4	1,2	0,7	0,4	97,0
Magnetite	0,7	81,3	1,1	0,1	4,8	1,8	2,7	2,6	0,6	95,8
Chromite	2,1	32,7	0,2	43,1	0,8	12,3	5,5	0,0	0,1	96,6
Pyrite	0,1	31,8	0,0	0,0	4,8	0,8	0,2	0,1	0,4	38,2
Phosphate	0,4	0,5	0,5	0,0	0,6	0,1	0,1	56,7	0,5	59,4
Monazite	0,0	0,0	0,0	0,0	1,5	0,0	0,0	3,7	2,1	7,2
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,3	28,5	1,6	0,0	38,1	20,4	4,9	3,1	0,3	97,2
Sillimanite	0,3	0,9	0,1	0,2	42,3	53,7	0,1	0,1	0,1	97,7
Staurolite	0,5	14,0	0,4	0,0	34,6	45,4	1,9	0,1	0,6	97,6
Zircon	0,4	0,8	0,1	0,1	29,2	0,1	0,1	0,2	63,9	94,9
Silicate	0,8	11,7	0,4	0,2	45,6	17,5	5,9	14,5	0,3	96,8
Unclassified	12,4	11,0	0,4	0,5	21,5	9,0	4,0	24,2	6,5	89,6

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	52,5	17,8	10,5	3,3	3,5	11,5	0,8	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	54,5	78,9	95,4	43,4
Fe_2O_3 wt%	38,0	8,9	1,5	43,5
MnO wt%	2,0	0,5	0,2	1,5
Cr_2O_3 wt%	0,2	0,3	0,3	0,3
SiO_2 wt%	2,7	5,5	1,3	7,4
Al_2O_3 wt%	1,4	3,5	0,8	1,5
MgO wt%	0,4	0,3	0,1	1,2
CaO wt%	0,3	0,9	0,1	0,7
ZrO_2 wt%	0,5	1,1	0,3	0,4
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	64,3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	59,9
Valuable heavy minerals in raw sand:	0,94

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	17,6	0,5
Leucoxene	6,0	0,2
Rutile	3,5	0,1
Ti magnetite	1,1	0,0
Magnetite	11,6	0,3
Chromite	0,5	0,0
Pyrite	7,7	0,2
Phosphate	1,1	0,0
Monazite	0,3	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	1,2	0,0
Sillimanite	0,3	0,0
Staurolite	0,4	0,0
Zircon	3,9	0,1
Silicate	42,9	98,4
Unclassified	2,0	0,1
Total	100,0	100,0

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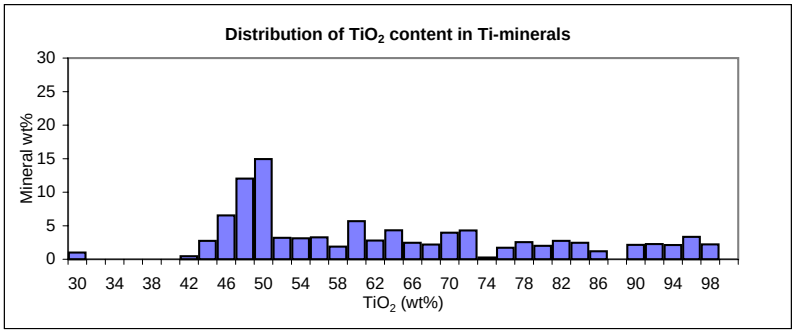
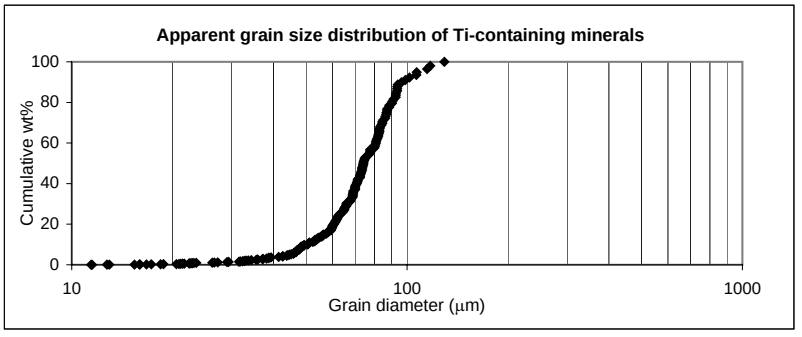
GEUS

Sample Name:	SL90-114m	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	19-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	2	2	244	93	140
Leucoxene	2	2	324	130	31
Rutile	2	2	267	106	24
Ti magnetite	1	2	299	124	7
Magnetite	1	2	385	160	32
Chromite	1	3	419	180	2
Pyrite	1	2	792	328	6
Phosphate	1	2	363	142	4
Monazite	2	2	359	133	1
Y-phosphate	0	0	0	0	0
Sphene	0	0	0	0	0
Garnet	2	2	324	134	8
Sillimanite	2	2	205	83	5
Staurolite	2	2	307	120	3
Zircon	1	2	265	94	23
Silicate	2	2	308	124	394
Unclassified	1	2	245	96	20

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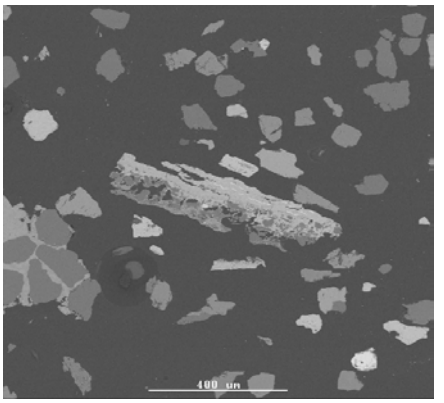

Sample Name:	SL1 240-257m
Date:	19-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	200 µm
Sieve	100 µm^2

No. of analysed frames:	37
No. analysed of particles	835
Heavy minerals in raw sand (%):	2,32
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53,1	37,1	2,0	0,2	3,3	1,3	0,3	0,3	0,3	97,7
Leucoxene	77,3	5,2	0,3	0,2	6,9	3,9	0,3	0,8	1,1	96,1
Rutile	92,7	1,6	0,3	0,1	1,7	0,9	0,1	0,1	0,4	97,9
Ti magnetite	39,3	42,6	1,5	0,2	10,1	2,7	0,3	1,0	0,3	98,1
Magnetite	0,3	80,5	0,8	0,2	7,8	1,9	1,6	2,1	0,6	95,7
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	1,0	30,9	0,2	0,1	2,4	0,9	0,0	0,2	0,4	36,2
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	11,9	0,0	0,0	10,2	5,0	2,2	2,1	0,0	31,3
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	37,4	1,3	0,2	0,0	29,5	1,4	0,1	26,8	0,5	97,2
Garnet	0,6	28,6	3,0	0,1	37,7	19,5	3,2	4,0	0,3	97,1
Sillimanite	0,3	0,6	0,2	0,4	42,9	53,6	0,0	0,0	0,1	98,1
Staurolite	0,8	13,7	0,2	0,1	33,8	48,2	1,2	0,1	0,4	98,4
Zircon	0,3	0,7	0,1	0,1	29,5	0,1	0,1	0,3	64,4	95,6
Silicate	0,8	10,1	0,3	0,2	53,6	15,6	3,8	11,9	0,3	96,5
Unclassified	7,6	16,4	0,6	0,4	33,7	3,9	1,7	8,3	16,4	88,9

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	51,2	5,6	13,7	7,8	6,0	12,9	2,9	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	54,3	80,5	94,6	40,1
Fe_2O_3 wt%	37,9	5,5	1,6	43,5
MnO wt%	2,0	0,3	0,3	1,5
Cr_2O_3 wt%	0,2	0,2	0,1	0,2
SiO_2 wt%	3,4	7,2	1,7	10,3
Al_2O_3 wt%	1,3	4,1	1,0	2,7
MgO wt%	0,3	0,3	0,1	0,3
CaO wt%	0,3	0,9	0,1	1,0
ZrO_2 wt%	0,3	1,2	0,4	0,3
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	61,8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	54,9
Valuable heavy minerals in raw sand:	0,64

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	14,2	0,3
Leucoxene	1,5	0,0
Rutile	3,8	0,1
Ti magnetite	2,2	0,0
Magnetite	9,4	0,2
Chromite	0,0	0,0
Pyrite	1,1	0,0
Phosphate	0,0	0,0
Monazite	0,1	0,0
Y-phosphate	0,0	0,0
Sphene	0,3	0,0
Garnet	1,7	0,0
Sillimanite	0,8	0,0
Staurolite	1,0	0,0
Zircon	3,6	0,1
Silicate	57,6	99,0
Unclassified	2,8	0,1
Total	100,0	100,0

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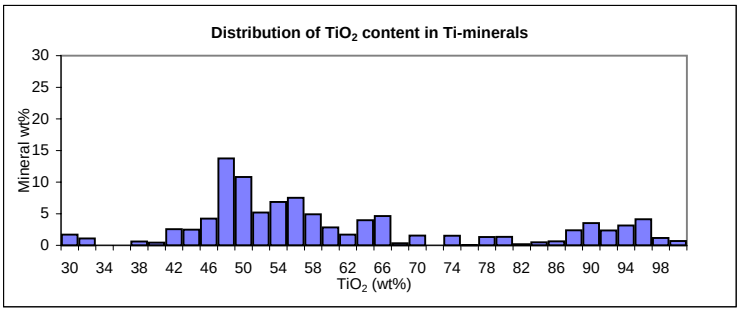
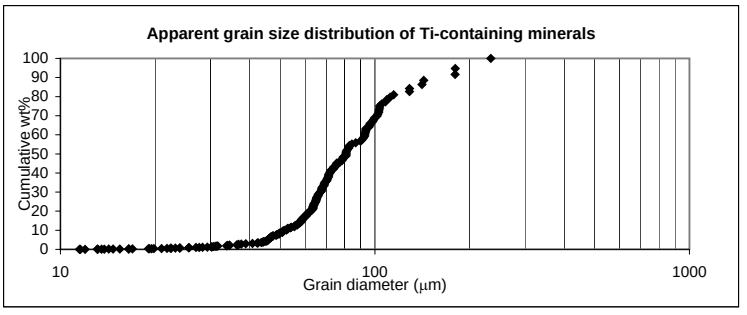
GEUS

Sample Name:	SL1 240-257m	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	19-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,8	272	105	135
Leucoxene	1,5	1,8	232	90	20
Rutile	1,6	1,8	254	97	40
Ti magnetite	1,6	2,3	344	143	16
Magnetite	1,8	2,2	360	154	48
Chromite	0,0	0,0	0	0	0
Pyrite	1,4	1,8	203	79	14
Phosphate	0,0	0,0	0	0	0
Monazite	1,2	1,8	245	95	1
Y-phosphate	0,0	0,0	0	0	0
Sphene	1,4	1,6	239	91	4
Garnet	1,7	1,9	254	99	21
Sillimanite	2,0	2,3	387	157	7
Staurolite	2,1	2,5	483	210	5
Zircon	1,4	1,6	275	98	31
Silicate	1,6	2,0	362	148	471
Unclassified	1,6	2,5	454	195	22

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Sample Name:	AB1190-95m
Date:	19-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	200 μm
Sieve	100 μm^2

No. of analysed frames:	64
No. analysed of particles	705
Heavy minerals in raw sand (%):	0,53
comments:	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53,9	35,9	2,6	0,2	2,3	1,4	0,3	0,3	0,5	97,4
Leucoxene	77,6	7,8	0,5	0,2	3,3	3,6	0,2	1,2	1,4	95,7
Rutile	92,0	1,6	0,2	0,3	1,0	0,9	0,2	0,1	0,5	96,8
Ti magnetite	41,3	40,2	1,8	0,2	8,4	1,2	0,4	0,1	0,6	94,1
Magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,2	31,4	0,1	0,2	1,4	0,5	0,1	0,1	0,4	34,3
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	1,4	1,3	0,8	2,5	1,1	7,1
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	35,0	0,0	0,0	0,3	30,3	2,5	0,0	27,8	0,0	95,9
Garnet	0,5	28,1	2,1	0,1	37,8	19,9	4,4	3,3	0,2	96,5
Sillimanite	0,3	0,8	0,1	0,2	42,3	54,2	0,0	0,0	0,3	98,4
Staurolite	0,5	14,2	0,3	0,1	32,2	47,2	1,2	0,2	1,0	97,0
Zircon	0,1	0,5	0,3	0,1	29,4	0,1	0,2	0,2	64,8	95,7
Silicate	0,6	10,4	0,3	0,2	47,2	18,0	5,2	14,2	0,3	96,4
Unclassified	3,4	22,2	0,8	0,0	33,4	7,7	7,4	7,4	1,4	83,6

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	59,0	10,4	9,1	7,8	3,8	3,4	6,4	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55,3	81,0	95,0	43,9
Fe_2O_3 wt%	36,8	8,1	1,7	42,7
MnO wt%	2,7	0,5	0,2	1,9
Cr_2O_3 wt%	0,2	0,2	0,3	0,2
SiO_2 wt%	2,4	3,4	1,0	8,9
Al_2O_3 wt%	1,5	3,8	0,9	1,3
MgO wt%	0,4	0,2	0,2	0,4
CaO wt%	0,3	1,2	0,1	0,1
ZrO_2 wt%	0,5	1,5	0,6	0,6
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	61,6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	57,6
Valuable heavy minerals in raw sand:	0,21

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	23,1	0,1
Leucoxene	4,1	0,0
Rutile	3,6	0,0
Ti magnetite	3,1	0,0
Magnetite	0,0	0,0
Chromite	0,0	0,0
Pyrite	5,0	0,0
Phosphate	0,0	0,0
Monazite	0,2	0,0
Y-phosphate	0,0	0,0
Sphene	0,2	0,0
Garnet	1,5	0,0
Sillimanite	2,5	0,0
Staurolite	0,7	0,0
Zircon	1,3	0,0
Silicate	53,9	99,8
Unclassified	0,9	0,0
Total	100,0	100,0

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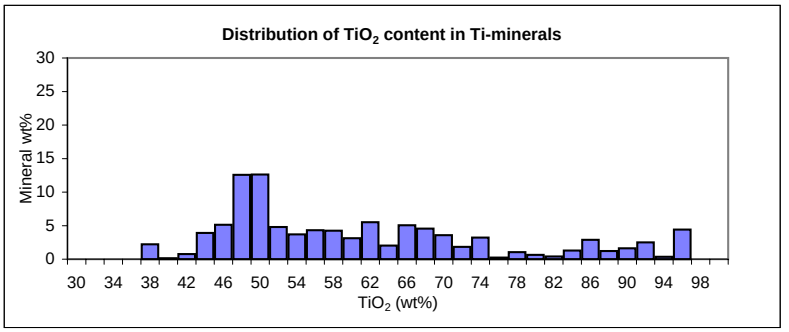
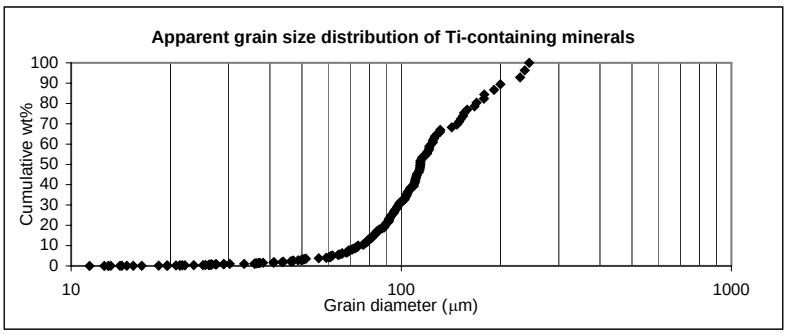
Sample Name:	AB1190-95m	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	19-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	2	2	389	155	118
Leucoxene	2	2	414	167	18
Rutile	2	2	288	119	27
Ti magnetite	2	2	373	155	15
Magnetite	0	0	0	0	0
Chromite	0	0	0	0	0
Pyrite	2	2	517	231	14
Phosphate	0	0	0	0	0
Monazite	2	2	370	131	1
Y-phosphate	0	0	0	0	0
Sphene	2	4	689	312	1
Garnet	2	3	466	200	8
Sillimanite	1	2	565	232	10
Staurolite	2	2	246	105	9
Zircon	2	2	287	110	10
Silicate	2	2	386	160	465
Unclassified	2	2	369	156	9

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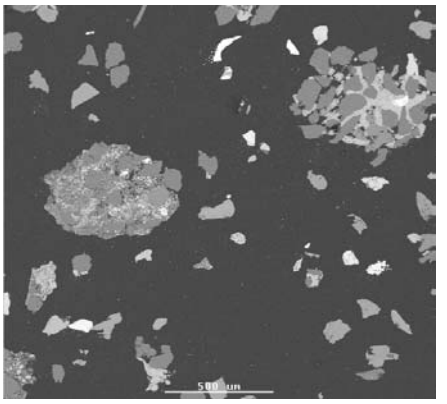

Sample Name:	BH15 102.0-117.0	No. of analysed frames:	24
Date:	20-10-00	No. analysed of particles	616
Submitter:	Dupont	Heavy minerals in raw sand (%):	3,46
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	80x		
Guard region	300 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	52,1	37,1	2,0	0,1	4,0	1,4	0,3	0,2	0,4	97,6
Leucoxene	76,2	7,5	0,5	0,3	4,8	3,2	0,4	0,8	1,7	95,6
Rutile	91,5	2,2	0,1	0,2	2,2	0,8	0,1	0,1	0,4	97,5
Ti magnetite	35,8	36,5	1,3	0,3	11,8	4,4	1,2	0,8	0,5	92,6
Magnetite	0,6	79,0	0,8	0,2	7,9	2,7	1,0	2,1	1,0	95,3
Chromite	0,3	29,8	1,4	52,5	0,8	6,5	5,7	0,2	0,4	97,4
Pyrite	0,1	32,3	0,1	0,1	2,9	1,7	0,1	0,1	0,2	37,5
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,1	29,4	2,0	0,1	38,1	19,7	3,6	4,3	0,4	97,8
Sillimanite	0,1	0,5	0,1	0,1	42,9	53,4	0,0	0,0	0,3	97,4
Staurolite	0,6	13,0	0,5	0,1	32,6	48,2	1,4	0,1	0,9	97,2
Zircon	0,2	1,2	0,3	0,1	28,2	0,3	0,4	0,6	63,0	94,4
Silicate	1,3	10,4	0,3	0,2	55,8	14,3	2,9	10,6	0,3	96,0
Unclassified	6,0	28,5	0,9	0,4	31,3	4,9	0,6	4,7	7,9	85,1

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	54,0	8,0	10,4	13,5	4,4	6,3	3,5	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	53,4	79,8	93,9	38,7
Fe_2O_3 wt%	38,0	7,8	2,2	39,4
MnO wt%	2,1	0,6	0,1	1,4
Cr_2O_3 wt%	0,1	0,3	0,2	0,3
SiO_2 wt%	4,1	5,0	2,2	12,8
Al_2O_3 wt%	1,4	3,4	0,8	4,7
MgO wt%	0,3	0,4	0,1	1,3
CaO wt%	0,2	0,9	0,1	0,8
ZrO_2 wt%	0,4	1,8	0,4	0,5
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	58,4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	53,5
Valuable heavy minerals in raw sand:	0,56

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	8,7	0,3
Leucoxene	1,3	0,0
Rutile	1,7	0,1
Ti magnetite	2,2	0,1
Magnetite	6,6	0,2
Chromite	0,2	0,0
Pyrite	3,6	0,1
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,7	0,0
Sillimanite	0,6	0,0
Staurolite	0,1	0,0
Zircon	1,0	0,0
Silicate	60,7	98,6
Unclassified	12,7	0,4
Total	100,0	100,0

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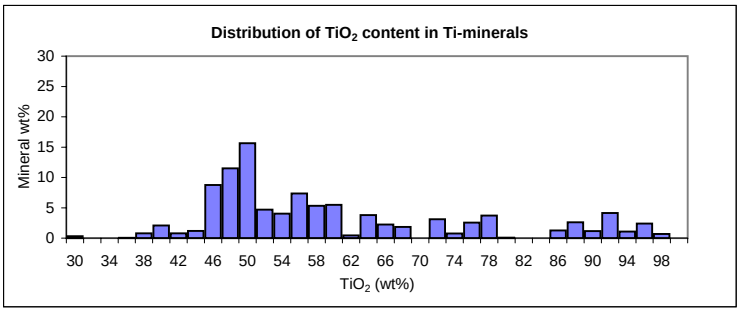
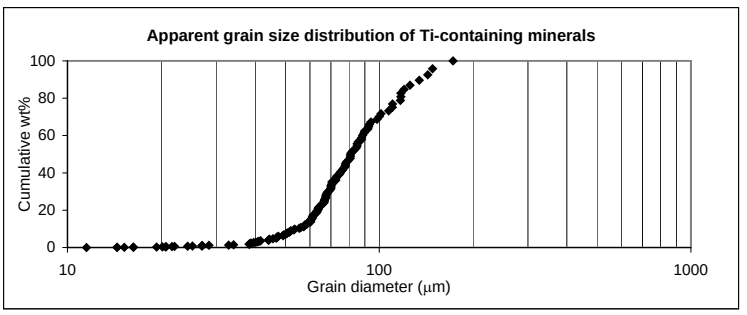
GEUS

Sample Name:	3H15 102.0-117.0	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	20-10-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,7	1,6	272	100	85
Leucoxene	1,5	1,7	266	102	14
Rutile	1,4	1,6	241	88	19
Ti magnetite	1,6	1,8	277	111	20
Magnetite	1,5	1,7	284	111	44
Chromite	1,3	1,4	275	90	2
Pyrite	1,4	2,9	827	356	6
Phosphate	0,0	0,0	0	0	0
Monazite	0,0	0,0	0	0	0
Y-phosphate	0,0	0,0	0	0	0
Sphene	0,0	0,0	0	0	0
Garnet	1,4	1,7	297	112	7
Sillimanite	1,4	1,6	392	144	4
Staurolite	1,4	1,5	146	50	3
Zircon	1,4	1,5	277	100	9
Silicate	1,6	1,9	433	178	370
Unclassified	1,4	1,6	447	192	33

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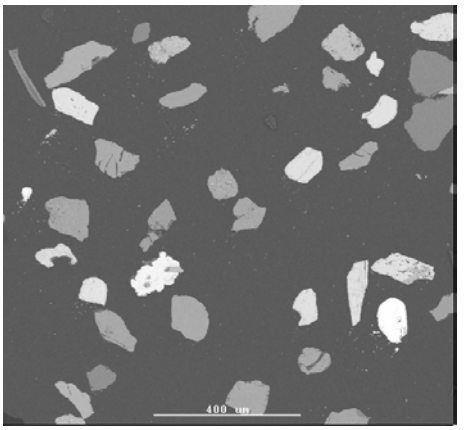

Sample Name:	BH 17 276-282	No. of analysed frames:	81
Date:	04-11-00	No. analysed of particles	958
Submitter:	Dupont	Heavy minerals in raw sand (%):	2,46
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	100X		
Guard region	120 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	52,6	39,1	2,1	0,1	2,6	1,1	0,4	0,1	0,3	98,3
Leucoxene	75,2	10,5	0,5	0,2	5,3	3,6	0,3	0,8	0,9	97,3
Rutile	92,6	1,8	0,1	0,1	1,6	0,9	0,1	0,2	0,4	97,8
Ti magnetite	41,0	44,9	1,9	0,1	7,1	2,0	0,4	0,3	0,3	98,1
Magnetite	0,5	79,8	0,6	0,1	8,3	3,8	1,5	2,0	0,5	97,1
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,0	31,1	0,2	0,0	5,9	1,5	0,1	0,1	0,1	39,0
Phosphate	0,2	0,7	0,1	0,1	0,4	0,0	0,0	57,5	0,8	59,8
Monazite	0,0	3,2	0,0	0,0	3,0	2,5	0,7	0,1	3,6	13,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	38,0	0,5	0,4	0,1	29,7	1,2	0,1	28,3	0,2	98,5
Garnet	0,3	28,8	1,9	0,1	38,5	19,9	4,2	3,7	0,2	97,6
Sillimanite	0,1	0,8	0,1	0,2	43,0	53,9	0,0	0,0	0,1	98,2
Staurolite	0,6	14,4	0,3	0,1	32,5	49,3	1,4	0,1	0,1	98,8
Zircon	0,3	0,6	0,1	0,2	29,6	0,2	0,1	0,2	64,4	95,6
Silicate	0,8	12,5	0,3	0,1	46,7	17,9	4,2	14,4	0,2	97,1
Unclassified	6,6	21,6	1,7	0,6	31,3	9,4	1,1	6,3	7,4	86,2

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	56,0	12,0	9,5	5,9	2,8	12,6	1,2	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	53,5	77,3	94,6	41,8
Fe_2O_3 wt%	39,7	10,8	1,8	45,8
MnO wt%	2,1	0,5	0,1	2,0
Cr_2O_3 wt%	0,1	0,2	0,1	0,2
SiO_2 wt%	2,6	5,4	1,7	7,2
Al_2O_3 wt%	1,1	3,7	0,9	2,0
MgO wt%	0,4	0,3	0,1	0,5
CaO wt%	0,1	0,8	0,2	0,3
ZrO_2 wt%	0,3	0,9	0,4	0,3
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	60,8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56,4
Valuable heavy minerals in raw sand:	0,91

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	20,8	0,5
Leucoxene	4,5	0,1
Rutile	3,5	0,1
Ti magnetite	2,2	0,1
Magnetite	10,1	0,2
Chromite	0,0	0,0
Pyrite	8,8	0,2
Phosphate	0,3	0,0
Monazite	0,1	0,0
Y-phosphate	0,0	0,0
Sphene	0,2	0,0
Garnet	1,1	0,0
Sillimanite	0,4	0,0
Staurolite	0,4	0,0
Zircon	4,7	0,1
Silicate	37,0	98,5
Unclassified	5,9	0,1
Total	100,0	100,0

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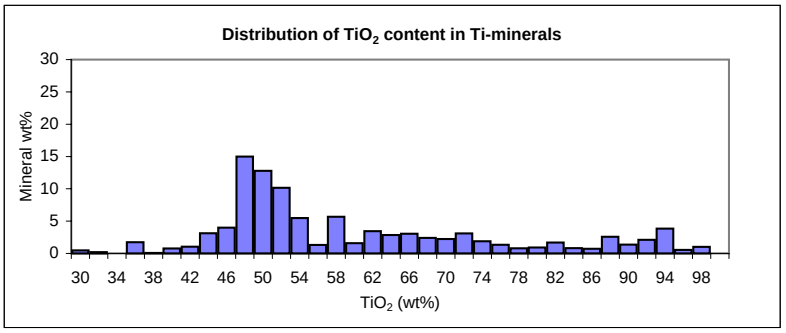
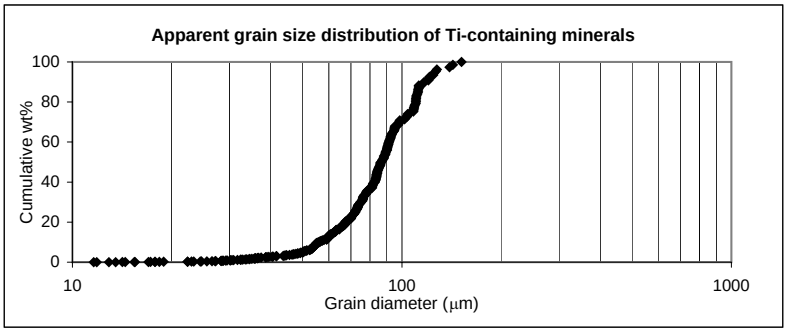
GEUS

Sample Name:	BH 17 276-282	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	04-11-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,7	1,9	296	116	219
Leucoxene	1,6	2,0	322	128	39
Rutile	1,7	1,9	306	122	32
Ti magnetite	1,5	2,0	313	124	20
Magnetite	1,5	2,3	392	166	52
Chromite	0,0	0,0	0	0	0
Pyrite	1,6	2,4	827	356	11
Phosphate	1,2	1,3	275	84	2
Monazite	1,3	1,8	319	123	1
Y-phosphate	0,0	0,0	0	0	0
Sphene	2,4	1,8	314	119	3
Garnet	1,7	1,9	270	106	15
Sillimanite	1,3	1,8	339	129	5
Staurolite	1,5	2,2	378	153	4
Zircon	1,4	1,7	294	107	44
Silicate	1,7	2,0	336	135	483
Unclassified	1,6	2,2	485	200	28

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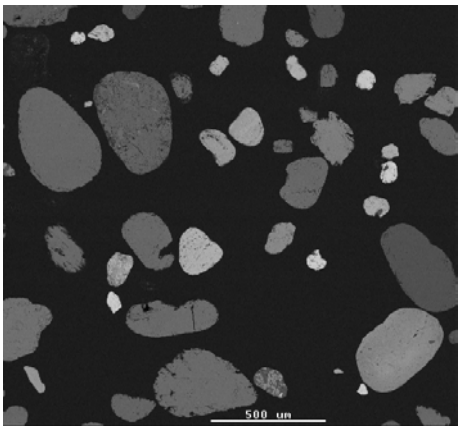

Sample Name:	Roadcut Hoyerswerda-Burg	No. of frames analysed:	35
Lab. Name:	2000116	No. of particles analysed:	543
Date:	21-11-02	Heavy minerals in raw sand (%):	0,00
Submitter:	DuPont/GEUS		
Country:	Germany	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	325 μm		
Sieve:	100 μm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54,8	37,9	2,2	0,1	1,7	1,2	0,3	0,1	0,2	98,4
Leucoxene	78,0	11,1	0,4	0,1	4,9	2,7	0,1	0,1	0,5	97,8
Rutile	94,0	1,3	0,1	0,1	1,4	1,0	0,1	0,1	0,4	98,4
Ti magnetite	31,7	48,8	1,3	0,2	6,4	4,6	3,9	0,6	0,3	97,9
Magnetite	6,5	81,4	0,4	0,1	3,0	4,0	2,4	0,1	0,2	98,1
Chromite	0,4	21,5	0,7	38,9	1,9	22,5	11,7	0,1	0,4	98,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	1,3	18,0	1,6	0,1	41,7	14,1	6,4	14,4	0,2	98,0
Kya/Sill	0,7	0,8	0,2	0,1	42,7	53,5	0,0	0,1	0,3	98,5
Staurolite	0,6	14,9	0,2	0,2	34,3	45,9	1,1	0,2	0,4	97,8
Zircon	0,2	0,6	0,2	0,1	29,9	0,5	0,1	0,2	63,5	95,1
Silicate	1,7	10,2	0,3	0,5	47,5	20,0	7,3	8,1	0,3	96,0
Unclassified	9,0	17,4	1,5	4,9	23,7	18,1	4,9	2,3	6,5	88,2

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	16,3	2,4	3,6	1,8	67,5	4,4	2,0	2,1	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55,7	79,8	95,6	32,4
Fe_2O_3 wt%	38,5	11,3	1,3	49,9
MnO wt%	2,2	0,4	0,1	1,3
Cr_2O_3 wt%	0,1	0,1	0,1	0,2
SiO_2 wt%	1,7	5,0	1,4	6,6
Al_2O_3 wt%	1,2	2,7	1,0	4,7
MgO wt%	0,3	0,1	0,1	4,0
CaO wt%	0,1	0,1	0,1	0,6
ZrO_2 wt%	0,2	0,5	0,4	0,3
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	62,3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56,5
Valuable heavy minerals in raw sand:	0,00

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	11,2	0,0
Leucoxene	1,7	0,0
Rutile	2,5	0,0
Ti magnetite	1,2	0,0
Magnetite	8,9	0,0
Chromite	0,4	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	46,4	0,0
Kya/Sill	1,3	0,0
Staurolite	1,5	0,0
Zircon	3,0	0,0
Silicate	19,4	100,0
Unclassified	2,4	0,0
Total	100,0	100,0

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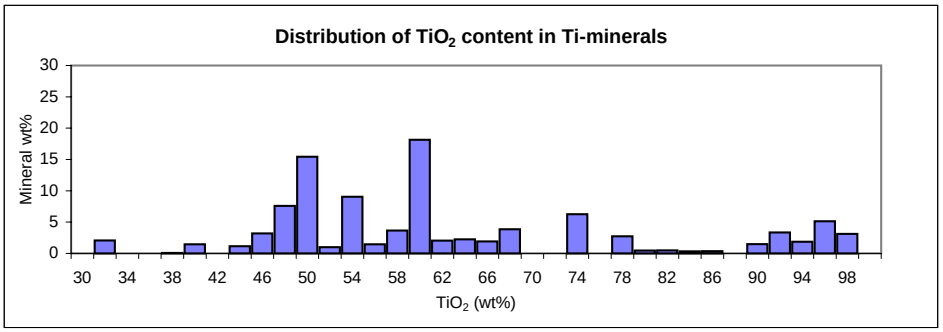
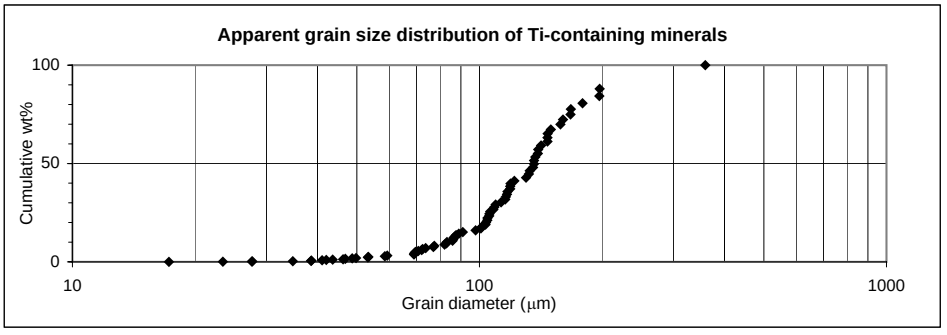
GEUS

Lab. Name:	2000116	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	21-11-02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,4	1,5	401	145	10296	55
Leucoxene	1,4	1,6	432	153	10462	8
Rutile	1,7	1,5	429	149	10205	11
Ti magnetite	1,5	1,9	383	154	7302	8
Magnetite	1,4	1,5	453	162	14495	27
Chromite	1,4	1,5	334	116	6029	3
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,5	1,8	457	176	11428	231
Kya/Sill	1,8	1,8	571	215	15740	6
Staurolite	1,5	1,8	384	150	7924	11
Zircon	1,3	1,5	318	108	6198	24
Silicate	1,5	1,7	424	163	12170	137
Unclassified	1,7	1,8	448	187	11257	18

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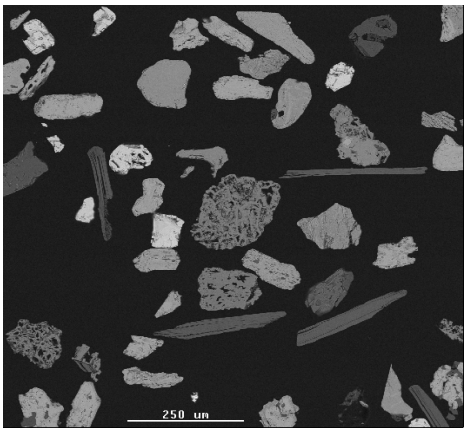

Sample Name:	Mölliner Schichten	No. of frames analysed:	49
Lab. Name:	2000108	No. of particles analysed:	652
Date:	20-11-02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	1,20
Country:	Germany	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/100x		
Guard region:	200 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55,4	35,7	2,2	0,1	2,5	1,6	0,2	0,1	0,3	98,1
Leucoxene	75,8	7,7	0,3	0,3	5,2	5,9	0,2	0,4	0,6	96,4
Rutile	93,9	1,8	0,1	0,2	1,3	0,7	0,1	0,0	0,2	98,3
Ti magnetite	40,8	33,3	1,2	0,2	18,5	3,0	0,3	0,1	0,3	97,7
Magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chromite	0,9	27,9	1,8	43,9	0,3	17,3	6,3	0,1	0,5	98,9
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	3,5	0,7	0,0	0,8	5,6	10,6
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,6	7,2	1,4	0,1	39,9	23,3	0,1	25,2	0,1	97,9
Kya/Sill	0,4	0,0	0,2	0,4	43,0	54,0	0,1	0,0	0,0	98,1
Staurolite	1,0	16,9	0,1	0,0	30,4	47,4	1,5	0,0	0,3	97,5
Zircon	0,5	0,4	0,1	0,1	29,4	0,3	0,1	0,2	64,1	95,2
Silicate	1,5	4,8	0,2	0,1	53,6	29,5	1,5	0,8	0,3	92,2
Unclassified	27,6	8,4	0,7	0,1	34,4	7,5	0,2	0,3	13,8	93,0

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	60,4	16,6	8,0	1,1	1,0	12,4	0,1	0,5	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56,4	78,7	95,5	41,8
Fe_2O_3 wt%	36,4	8,0	1,8	34,1
MnO wt%	2,2	0,3	0,1	1,3
Cr_2O_3 wt%	0,1	0,3	0,2	0,2
SiO_2 wt%	2,5	5,4	1,3	19,0
Al_2O_3 wt%	1,7	6,1	0,7	3,0
MgO wt%	0,2	0,2	0,1	0,3
CaO wt%	0,1	0,5	0,0	0,1
ZrO_2 wt%	0,3	0,6	0,3	0,3
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	64,1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	60,9
Valuable heavy minerals in raw sand:	1,05

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	52,9	0,6
Leucoxene	14,5	0,2
Rutile	7,0	0,1
Ti magnetite	0,9	0,0
Magnetite	0,0	0,0
Chromite	0,4	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,3	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,9	0,0
Kya/Sill	0,1	0,0
Staurolite	0,4	0,0
Zircon	10,8	0,1
Silicate	10,4	98,9
Unclassified	1,4	0,0
Total	100,0	100,0

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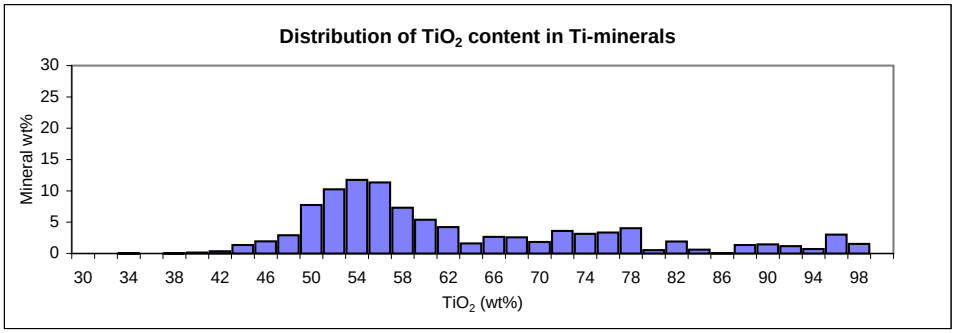
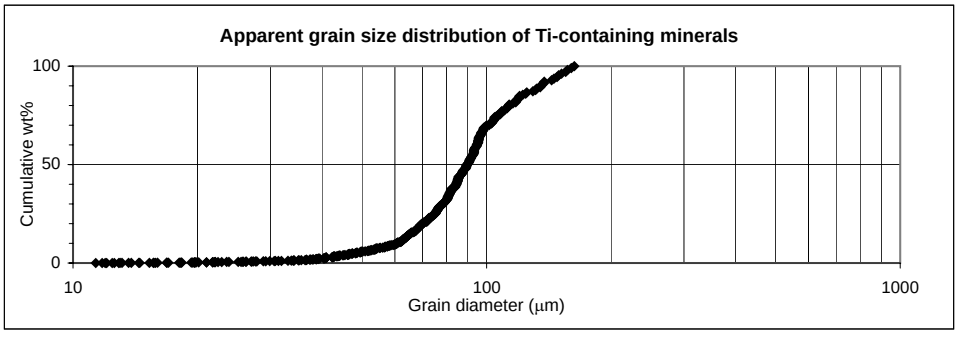
Lab. Name:	2000108	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	20-11-02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,7	2,1	313	126	4204	349
Leucoxene	1,5	2,5	382	163	5752	70
Rutile	1,8	2,2	340	140	4844	36
Ti magnetite	1,7	2,0	232	90	3430	7
Magnetite	0,0	0,0	0	0	0	0
Chromite	1,1	1,9	328	128	4642	2
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	1,3	2,3	467	195	7569	1
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,5	2,3	254	105	2522	11
Kya/Sill	2,1	2,8	325	141	3034	1
Staurolite	1,5	2,8	471	204	6835	2
Zircon	1,5	1,8	292	112	4151	70
Silicate	3,6	3,4	418	185	5257	93
Unclassified	1,8	2,6	418	180	6273	10

Denmark

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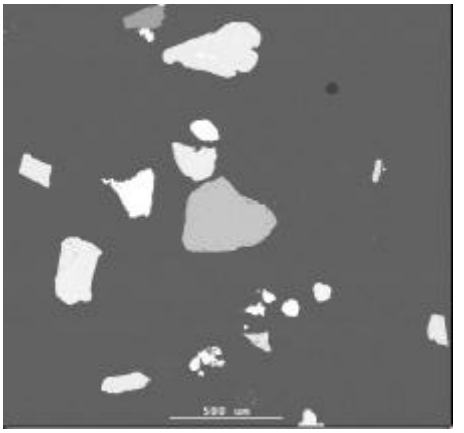

Sample Name:	D Klintegrund	No. of analysed frames:	49
Lab. Name:	TS01-3	No. analysed of particles	691
Date:	4/18/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.24
Country:	Denmark/Bornholm	comments:	
Analyzed by:	MJ		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	150 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63.1	27.8	2.0	0.1	2.2	0.8	0.3	0.2	0.3	96.8
Leucoxene	73.8	17.6	1.8	0.2	1.9	1.4	0.2	0.3	0.3	97.6
Rutile	91.6	2.4	0.2	0.2	1.7	1.2	0.1	0.2	0.2	97.7
Ti magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	0.2	78.6	1.2	0.1	6.8	1.6	2.7	5.4	0.5	97.3
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.2	31.0	0.1	0.1	3.8	0.9	0.1	0.1	0.3	36.7
Phosphate	0.0	0.6	0.1	0.0	2.3	0.3	0.1	56.5	0.9	60.9
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.1	33.2	1.1	0.1	36.3	19.1	3.6	1.4	0.4	95.3
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.4	0.4	0.2	0.2	29.4	0.2	0.1	0.3	63.3	94.5
Silicate	0.7	8.6	0.2	0.1	63.7	10.5	2.1	6.7	0.4	93.1
Unclassified	3.4	7.8	0.3	1.3	15.7	6.5	3.8	27.6	9.2	75.6

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	42.6	41.5	4.5	0.0	1.0	10.4	0.0	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	65.2	75.7	93.7	0
Fe_2O_3 wt%	28.7	18.0	2.5	0
MnO wt%	2.1	1.9	0.2	0
Cr_2O_3 wt%	0.1	0.2	0.2	0
SiO_2 wt%	2.3	2.0	1.8	0
Al_2O_3 wt%	0.9	1.5	1.2	0
MgO wt%	0.3	0.2	0.1	0
CaO wt%	0.2	0.3	0.2	0
ZrO_2 wt%	0.3	0.3	0.2	0
Total	100.0	100.0	100.0	0

Average TiO_2 content of all the TiO_2 minerals:	71.5
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	70.4
Valuable heavy minerals in raw sand:	0.15

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	27.0	0.1
Leucoxene	26.3	0.1
Rutile	2.8	0.0
Ti magnetite	0.0	0.0
Magnetite	1.3	0.0
Chromite	0.0	0.0
Pyrite	13.2	0.0
Phosphate	0.1	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	0.6	0.0
Kya/Sill	0.0	0.0
Staurolite	0.0	0.0
Zircon	6.6	0.0
Silicate	13.0	99.8
Unclassified	8.9	0.0
Total	100.0	100.0

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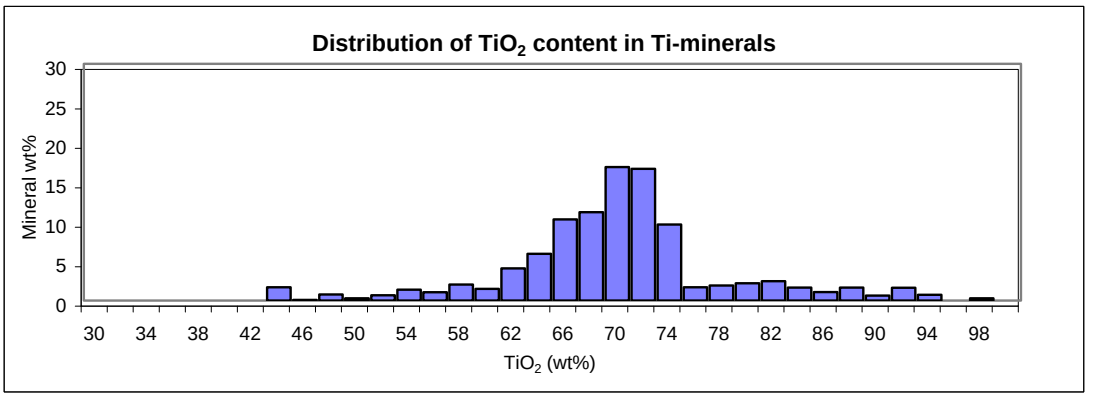
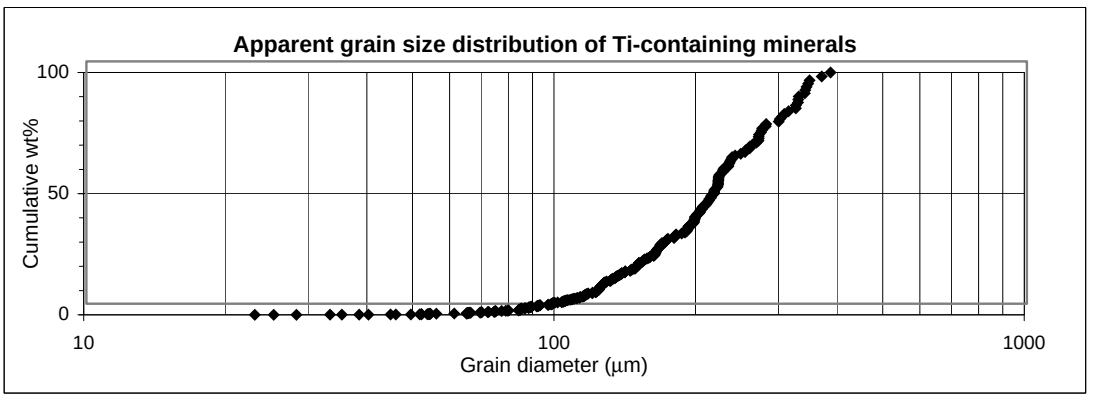
Lab. Name:	TS01-3	Analyzed by:	MJ
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/18/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	2.0	710	279	24734	136
Leucoxene	1.6	2.0	706	281	23435	140
Rutile	1.5	2.0	562	223	14465	22
Ti magnetite	0.0	0.0	0	0	0	0
Magnetite	1.5	1.9	394	157	7471	19
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.4	1.9	545	219	16689	89
Phosphate	1.1	1.5	367	129	7215	2
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.4	1.7	460	169	12891	7
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.4	1.6	437	157	11397	70
Silicate	1.5	1.9	636	256	23581	117
Unclassified	1.5	1.9	632	254	20772	89

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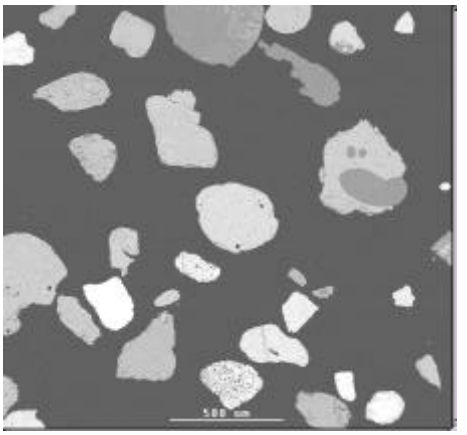

Sample Name:	E Glatføre	No. of analysed frames:	49
Lab. Name:	TS01-2	No. analysed of particles	533
Date:	4/11/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.21
Country:	Denmark/Bornholm	comments: Amount of unclassified is	
Analyzed by:	MJ	high. Grains with high contents of Ca, P	
Acc. Voltage/Magnification:	17kV/50x	and Si have been categorized as	
Guard region:	150 µm	unclassified	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	61.7	29.6	2.8	0.1	1.6	0.9	0.3	0.2	0.2	97.3
Leucoxene	75.2	14.4	1.3	0.2	3.8	1.7	0.2	0.3	0.3	97.4
Rutile	92.8	3.0	0.2	0.1	1.1	0.4	0.1	0.2	0.2	98.2
Ti magnetite	34.2	41.4	1.1	0.8	9.5	3.4	0.9	2.6	0.9	94.8
Magnetite	0.2	75.2	0.7	0.1	8.0	2.4	3.5	6.4	0.4	96.9
Chromite	0.1	14.5	0.5	52.2	0.8	19.1	10.7	0.2	0.4	98.4
Pyrite	0.1	29.7	0.1	0.1	7.9	0.5	0.1	0.1	0.2	38.7
Phosphate	0.0	2.9	0.0	0.1	20.2	39.2	0.0	5.0	0.0	67.4
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	34.8	2.9	0.3	0.2	29.8	1.8	0.0	27.2	0.0	97.0
Garnet	0.6	24.9	1.2	0.2	37.8	20.2	5.4	2.9	0.2	93.3
Kya/Sill	0.3	0.4	0.0	0.2	43.1	54.2	0.0	0.0	0.0	98.3
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.1	0.5	0.1	0.2	29.9	0.0	0.1	0.1	64.7	95.8
Silicate	0.8	9.9	0.2	0.1	61.3	8.0	2.2	7.9	0.4	90.9
Unclassified	1.9	10.2	0.4	0.3	16.5	3.3	2.9	33.0	2.1	70.4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	51.7	31.0	4.3	1.4	5.5	5.1	1.1	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	63.4	77.2	94.6	36.1
Fe_2O_3 wt%	30.4	14.8	3.0	43.7
MnO wt%	2.8	1.3	0.2	1.1
Cr_2O_3 wt%	0.1	0.2	0.1	0.8
SiO_2 wt%	1.7	3.9	1.1	10.0
Al_2O_3 wt%	0.9	1.7	0.4	3.6
MgO wt%	0.3	0.2	0.1	1.0
CaO wt%	0.2	0.3	0.2	2.8
ZrO_2 wt%	0.3	0.3	0.2	0.9
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	69.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	68.0
Valuable heavy minerals in raw sand:	0.05

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	13.4	0.0
Leucoxene	8.0	0.0
Rutile	1.1	0.0
Ti magnetite	0.4	0.0
Magnetite	13.3	0.0
Chromite	0.1	0.0
Pyrite	17.2	0.0
Phosphate	0.1	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.2	0.0
Garnet	1.4	0.0
Kya/Sill	0.3	0.0
Staurolite	0.0	0.0
Zircon	1.3	0.0
Silicate	28.8	99.9
Unclassified	14.3	0.0
Total	100.0	100.0

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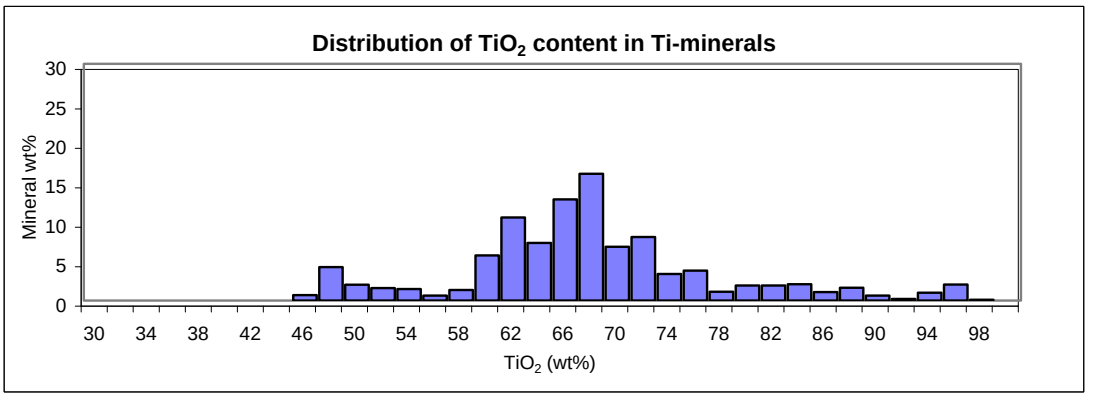
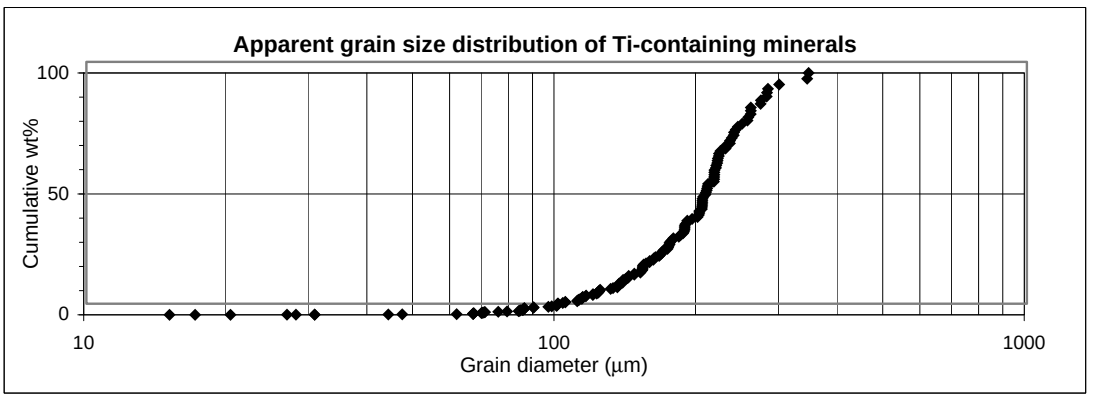
Lab. Name:	TS01-2	Analyzed by:	MJ
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/11/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	711	275	24549	95
Leucoxene	1.5	1.9	731	285	25865	54
Rutile	1.6	1.6	393	142	9604	18
Ti magnetite	1.2	1.5	564	215	20363	3
Magnetite	1.4	2.1	1035	430	57076	35
Chromite	1.5	1.7	476	179	10602	2
Pyrite	1.4	2.1	1317	538	89851	30
Phosphate	3.2	4.7	771	357	10062	2
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.6	1.8	758	285	25909	2
Garnet	2.2	2.1	690	290	21617	13
Kya/Sill	1.7	1.8	866	333	33289	2
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.4	1.6	528	185	14758	15
Silicate	1.5	2.0	1005	405	52638	162
Unclassified	1.5	1.9	856	340	41448	100

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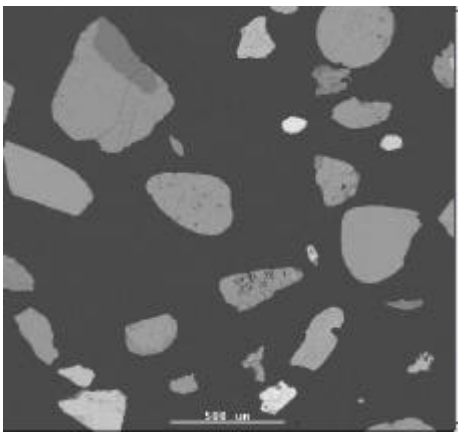

Sample Name:	I Beton	No. of analysed frames:	49
Lab. Name:	TS01-1	No. analysed of particles	861
Date:	4/10/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.49
Country:	Denmark/Bornholm	comments: Amount of unclassified is	
Analyzed by:	MJ	high. Grains with high contents of Ca, P	
Acc. Voltage/Magnification:	17kV/50x	and Si have been categorized as	
Guard region:	150 µm	unclassified	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	58.0	35.0	2.4	0.1	1.2	0.6	0.2	0.2	0.3	98.1
Leucoxene	75.7	15.3	0.9	0.1	3.3	1.1	0.2	0.5	0.3	97.5
Rutile	94.0	1.5	0.1	0.1	1.3	0.7	0.1	0.2	0.3	98.5
Ti magnetite	41.8	43.8	0.9	0.2	4.5	1.1	0.7	0.9	0.5	94.4
Magnetite	4.0	85.3	0.2	0.2	4.4	1.6	0.7	0.7	0.3	97.4
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.1	32.5	0.1	0.0	0.7	0.2	0.1	0.2	0.2	34.1
Phosphate	0.0	0.7	0.0	0.0	0.4	0.0	0.1	56.4	0.0	57.7
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	36.0	2.5	0.4	0.3	29.0	1.7	0.3	27.0	0.0	97.2
Garnet	0.2	32.6	3.3	0.1	37.2	19.6	3.3	1.6	0.2	98.1
Kya/Sill	0.0	1.2	0.2	0.2	42.8	53.7	0.0	0.0	0.1	98.3
Staurolite	0.7	16.3	0.3	0.2	30.7	48.3	1.2	0.0	0.0	97.8
Zircon	0.2	0.4	0.2	0.2	29.7	0.1	0.1	0.2	64.5	95.5
Silicate	0.9	12.6	0.4	0.1	49.1	14.9	5.4	11.7	0.2	95.4
Unclassified	0.8	5.2	0.2	0.1	8.4	1.3	1.1	47.5	2.6	67.1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	47.5	9.5	7.7	2.7	23.1	6.8	1.6	1.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	59.2	77.6	95.5	44.2
Fe_2O_3 wt%	35.7	15.7	1.6	46.4
MnO wt%	2.5	0.9	0.1	1.0
Cr_2O_3 wt%	0.1	0.1	0.1	0.2
SiO_2 wt%	1.2	3.4	1.3	4.8
Al_2O_3 wt%	0.6	1.1	0.7	1.2
MgO wt%	0.2	0.2	0.1	0.8
CaO wt%	0.2	0.5	0.2	0.9
ZrO_2 wt%	0.3	0.4	0.3	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	65.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	61.4
Valuable heavy minerals in raw sand:	0.21

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	20.1	0.1
Leucoxene	4.0	0.0
Rutile	3.3	0.0
Ti magnetite	1.2	0.0
Magnetite	1.9	0.0
Chromite	0.0	0.0
Pyrite	0.1	0.0
Phosphate	0.3	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	9.8	0.0
Kya/Sill	0.7	0.0
Staurolite	0.4	0.0
Zircon	2.9	0.0
Silicate	25.8	99.6
Unclassified	29.5	0.1
Total	100.0	100.0

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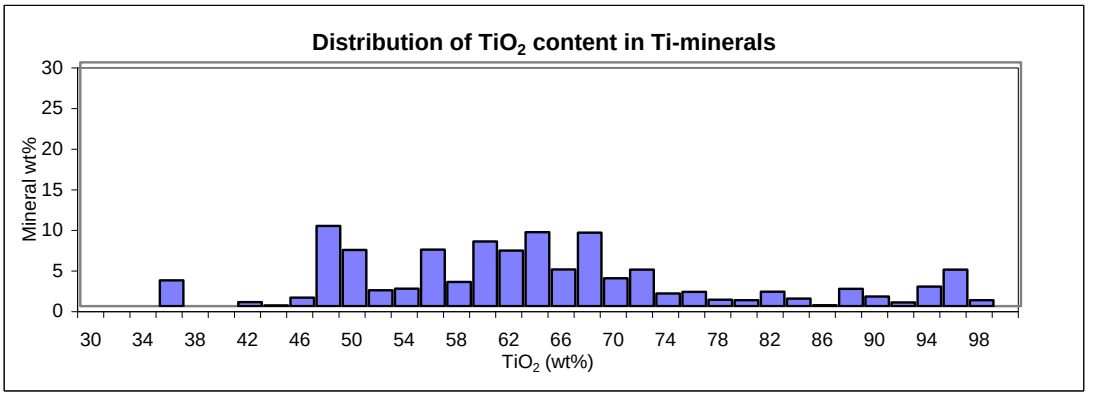
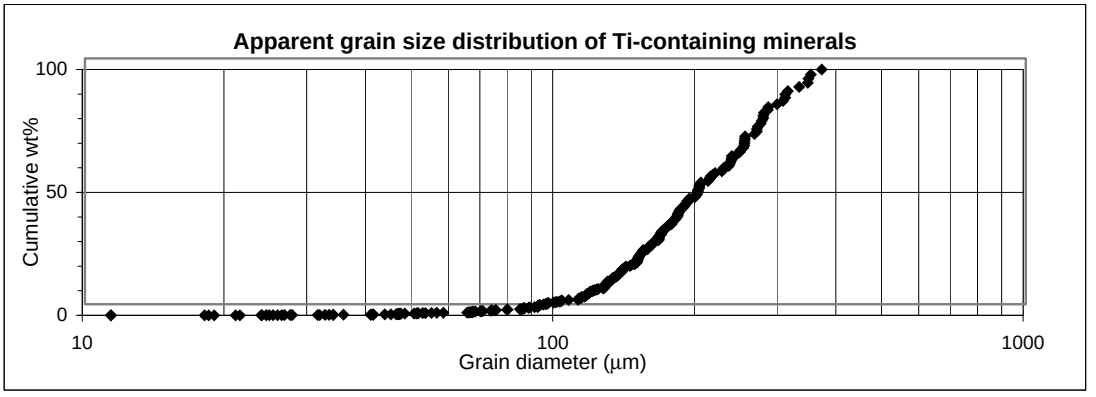
Lab. Name:	TS01-1	Analyzed by:	MJ
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/10/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	581	219	19635	206
Leucoxene	1.5	1.8	601	230	19791	41
Rutile	1.6	1.8	623	234	21813	27
Ti magnetite	1.5	1.8	606	242	21880	10
Magnetite	1.5	1.6	508	188	14498	23
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.4	2.1	388	155	5863	3
Phosphate	1.8	2.1	1149	470	49231	1
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.3	1.1	111	37	872	2
Garnet	1.6	1.9	710	278	26716	83
Kya/Sill	2.2	2.6	1186	495	46751	4
Staurolite	1.6	2.2	837	344	25650	4
Zircon	1.6	1.7	490	178	12801	44
Silicate	1.6	1.9	786	308	37622	234
Unclassified	1.5	1.8	997	382	55167	179

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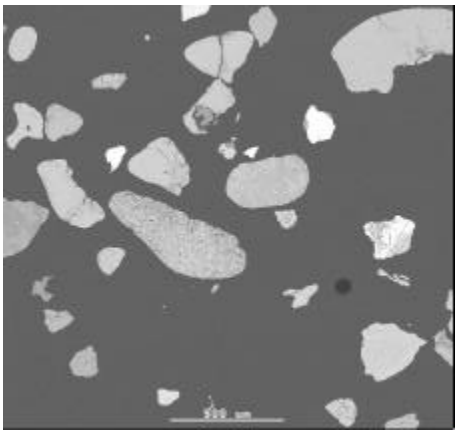

Sample Name:	G Fyld	No. of analysed frames:	64
Lab. Name:	TS01-4	No. analysed of particles	1046
Date:	4/18/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.50
Country:	Denmark/Bornholm	comments: Amount of unclassified is	
Analyzed by:	MJ	high. Grains with high content of Ca, P, Fe	
Acc. Voltage/Magnification:	17kV/100x	and Si have been catagorized as	
Guard region:	250 µm	unclassified.	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	57.8	33.8	2.5	0.2	2.2	0.6	0.3	0.2	0.3	97.9
Leucoxene	78.0	12.1	1.0	0.2	3.8	1.3	0.3	0.5	0.4	97.6
Rutile	91.4	2.0	0.1	0.2	1.9	0.9	0.1	0.4	0.4	97.5
Ti magnetite	34.7	43.8	1.6	0.3	7.6	1.2	0.7	1.8	0.6	92.3
Magnetite	0.7	77.3	1.3	0.2	6.1	1.3	3.9	6.0	0.4	97.0
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.1	30.5	0.1	0.0	3.8	1.0	0.1	0.3	0.2	36.3
Phosphate	0.0	0.8	0.3	0.1	1.1	0.1	0.3	56.8	0.8	60.4
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	40.8	2.1	0.5	0.0	27.3	2.9	0.2	23.2	0.4	97.3
Garnet	0.4	31.5	2.4	0.1	37.2	19.6	4.0	2.1	0.2	97.5
Kya/Sill	0.2	0.0	0.0	0.0	42.3	54.2	0.2	0.0	0.0	96.9
Staurolite	0.2	15.3	0.3	0.0	30.6	47.7	1.5	0.2	0.2	95.9
Zircon	0.3	0.6	0.2	0.1	29.6	0.2	0.1	0.2	63.6	94.9
Silicate	0.8	13.0	0.4	0.1	49.3	11.4	4.6	12.1	0.3	92.0
Unclassified	1.2	7.1	0.5	0.2	10.2	1.7	5.3	44.4	1.8	72.3

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	50.5	26.8	6.3	3.9	8.7	3.7	0.1	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	59.0	80.0	93.8	37.6
Fe_2O_3 wt%	34.5	12.4	2.1	47.5
MnO wt%	2.6	1.1	0.1	1.7
Cr_2O_3 wt%	0.2	0.2	0.2	0.3
SiO_2 wt%	2.3	3.9	2.0	8.3
Al_2O_3 wt%	0.6	1.3	0.9	1.3
MgO wt%	0.3	0.3	0.1	0.8
CaO wt%	0.2	0.5	0.4	1.9
ZrO_2 wt%	0.3	0.4	0.4	0.7
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	67.0
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	64.9
Valuable heavy minerals in raw sand:	0.16

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	16.0	0.1
Leucoxene	8.5	0.0
Rutile	2.0	0.0
Ti magnetite	1.2	0.0
Magnetite	4.3	0.0
Chromite	0.0	0.0
Pyrite	0.9	0.0
Phosphate	0.3	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.1	0.0
Garnet	2.7	0.0
Kya/Sill	0.0	0.0
Staurolite	0.0	0.0
Zircon	1.2	0.0
Silicate	26.9	99.6
Unclassified	35.7	0.2
Total	100.0	100.0

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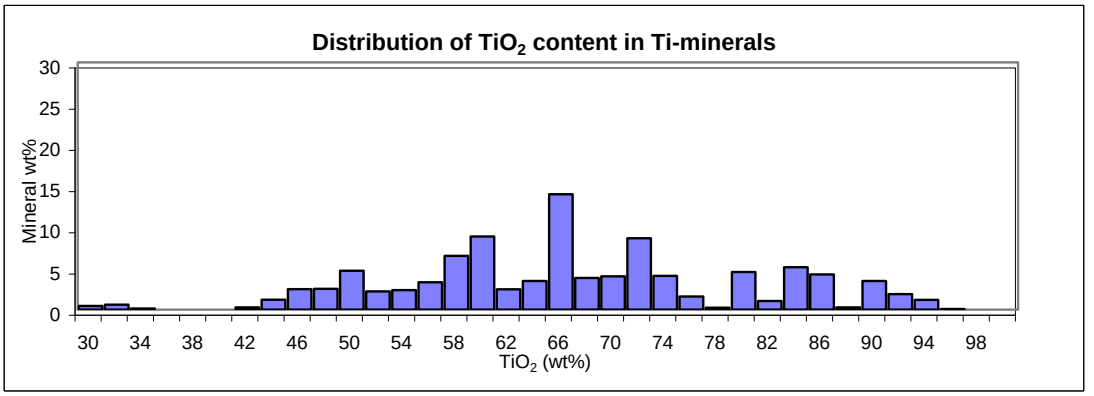
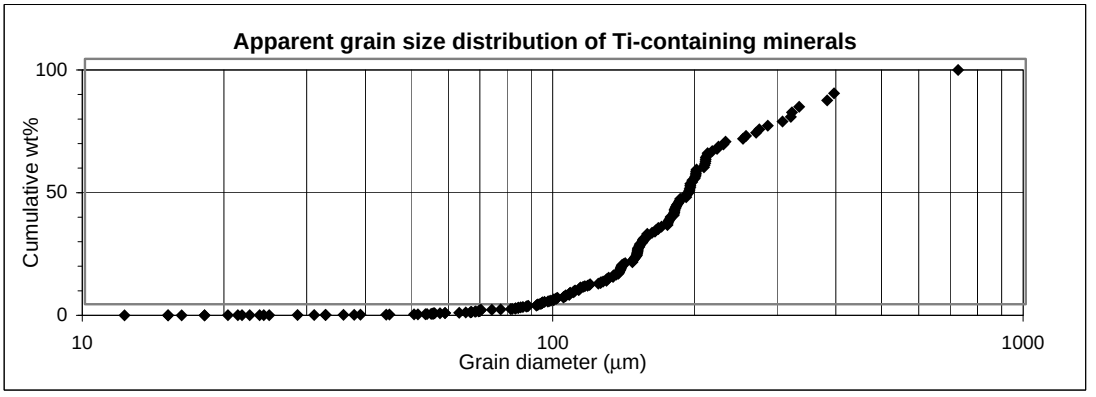
Lab. Name:	TS01-4	Analyzed by:	MJ
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/18/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	558	213	18089	139
Leucoxene	1.7	2.0	733	296	25145	53
Rutile	1.5	1.8	507	203	15691	18
Ti magnetite	1.4	1.9	498	194	12280	15
Magnetite	1.5	1.8	363	143	6788	87
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.2	1.8	419	167	9473	14
Phosphate	1.5	1.6	430	151	9864	5
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.3	1.6	604	219	18130	1
Garnet	1.6	1.8	466	179	11299	43
Kya/Sill	1.6	2.0	404	162	6429	1
Staurolite	1.3	1.5	130	45	880	1
Zircon	1.5	1.7	443	171	10510	17
Silicate	1.6	1.9	632	251	22061	326
Unclassified	1.5	1.8	703	275	28742	326

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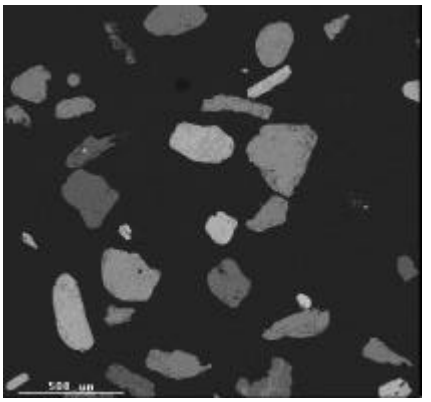

Sample Name:	010796 Vestkysten	No. of analysed frames:	67
Lab. Name:	TS01-5	No. of analysed particles:	580
Date:	10/15/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.43
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	350 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.5	36.6	2.1	0.1	2.4	0.7	0.3	0.1	0.3	98.1
Leucoxene	74.9	10.1	0.6	0.2	9.6	1.3	0.2	0.1	0.3	97.2
Rutile	94.4	1.7	0.1	0.2	0.6	0.4	0.2	0.2	0.1	97.9
Ti magnetite	38.1	47.3	2.0	0.2	5.8	1.5	0.8	1.5	0.2	97.5
Magnetite	3.8	74.2	0.8	0.2	9.5	2.0	1.2	1.4	0.5	93.7
Chromite	0.0	27.5	0.8	48.0	0.3	14.0	7.1	0.0	0.0	97.7
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.1	0.2	0.1	0.3	0.5	0.0	0.1	56.5	1.1	58.8
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	38.0	1.5	0.1	0.0	29.1	1.5	0.1	27.3	0.2	97.7
Garnet	0.2	30.6	2.3	0.1	37.0	19.3	3.7	4.0	0.3	97.6
Kya/Sill	0.1	0.9	0.1	0.2	42.6	53.8	0.0	0.1	0.2	98.0
Staurolite	0.9	15.0	0.3	0.2	33.1	46.2	1.6	0.2	0.2	97.5
Zircon	0.2	0.7	0.1	0.0	29.9	0.1	0.1	0.1	64.9	96.1
Silicate	1.0	13.6	0.5	0.1	48.6	16.4	4.3	11.7	0.3	96.3
Unclassified	10.6	16.2	2.5	1.0	19.2	5.1	2.8	16.2	8.5	81.9

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	46.4	6.7	3.8	7.0	16.1	2.5	5.5	11.9	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.6	77.0	96.4	39.1
Fe_2O_3 wt%	37.3	10.3	1.8	48.5
MnO wt%	2.1	0.6	0.1	2.1
Cr_2O_3 wt%	0.1	0.2	0.2	0.2
SiO_2 wt%	2.5	9.9	0.6	5.9
Al_2O_3 wt%	0.7	1.3	0.4	1.6
MgO wt%	0.3	0.2	0.2	0.8
CaO wt%	0.1	0.1	0.2	1.6
ZrO_2 wt%	0.3	0.3	0.1	0.2
Total	100.0	100.0	100.0	100.0

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	21.5	0.1
Leucoxene	3.1	0.0
Rutile	1.8	0.0
Ti magnetite	3.3	0.0
Magnetite	11.1	0.0
Chromite	0.6	0.0
Pyrite	0.0	0.0
Phosphate	0.4	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.6	0.0
Garnet	7.4	0.0
Kya/Sill	2.6	0.0
Staurolite	5.5	0.0
Zircon	1.2	0.0
Silicate	38.7	99.7
Unclassified	2.3	0.0
Total	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	59.2
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56.8
Valuable heavy minerals in raw sand:	0.20

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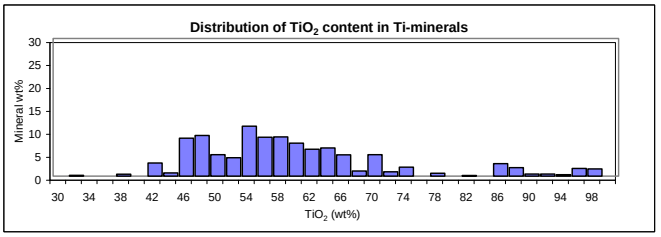
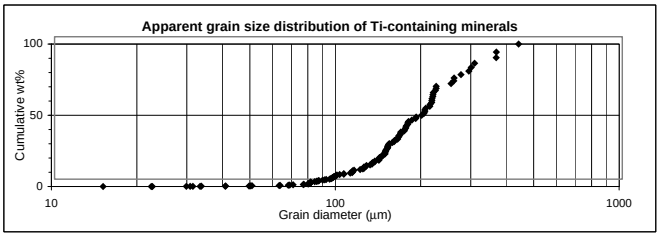
Lab. Name:	TS01-5	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/15/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	609	229	20665	96
Leucoxene	1.7	2.1	828	328	31940	9
Rutile	1.5	1.6	410	152	9800	15
Ti magnetite	1.6	2.0	600	235	18911	15
Magnetite	1.7	1.9	609	231	21093	42
Chromite	2.6	1.9	1111	441	50638	1
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.3	1.5	315	109	5540	6
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.8	1.8	550	210	13466	5
Garnet	1.5	1.8	542	210	17167	45
Kya/Sill	1.8	2.0	960	382	40870	8
Staurolite	1.5	2.2	1312	552	75131	8
Zircon	1.5	1.6	463	166	11574	9
Silicate	1.6	1.9	624	246	20277	299
Unclassified	1.3	1.4	400	148	16110	22

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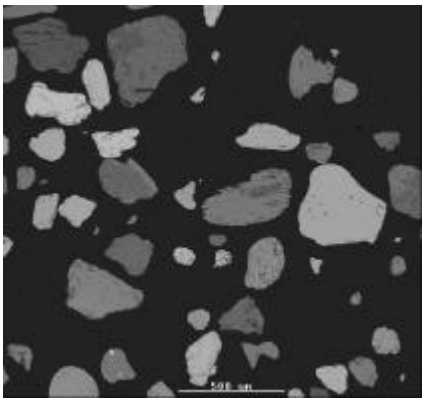

Sample Name:	010797 Vestkysten	No. of analysed frames:	83
Lab. Name:	TS01-6	No. of analysed particles:	1491
Date:	10/15/01	Heavy minerals in raw sand (%):	0.70
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	350 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.6	37.2	2.3	0.1	2.2	0.9	0.3	0.2	0.2	98.1
Leucoxene	75.8	7.6	0.6	0.1	9.4	2.2	0.4	0.7	0.4	97.3
Rutile	94.5	1.4	0.1	0.2	1.1	0.5	0.1	0.1	0.2	98.2
Ti magnetite	34.4	53.3	2.2	0.2	4.3	1.4	0.5	0.7	0.2	97.2
Magnetite	3.2	81.4	0.8	0.1	6.7	2.1	0.9	0.6	0.3	96.1
Chromite	3.3	30.6	0.6	45.3	0.4	10.6	7.4	0.1	0.2	98.4
Pyrite	0.0	33.4	0.0	0.0	0.5	0.5	0.3	0.0	0.3	35.1
Phosphate	0.1	0.5	0.1	0.2	0.5	0.0	0.1	57.3	1.2	60.0
Monazite	0.0	0.7	0.0	0.0	2.8	0.2	0.1	2.5	2.1	8.4
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	36.8	2.1	0.1	0.2	28.9	2.0	0.1	26.9	0.1	97.3
Garnet	0.3	31.1	2.8	0.1	37.0	19.4	3.5	4.1	0.2	98.4
Kya/Sill	0.3	1.4	0.1	0.0	42.8	53.5	0.0	0.1	0.2	98.4
Staurolite	0.6	15.5	0.3	0.1	32.8	46.5	1.6	0.1	0.1	97.6
Zircon	0.2	0.7	0.1	0.2	29.5	0.1	0.1	0.2	63.8	95.0
Silicate	1.0	12.8	0.5	0.1	48.9	17.4	4.0	11.0	0.2	96.0
Unclassified	6.2	21.5	2.3	0.2	21.3	5.3	3.0	26.5	3.3	89.7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	48.7	5.9	3.9	8.4	16.8	9.8	4.1	2.2	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.6	77.9	96.3	35.4
Fe_2O_3 wt%	37.9	7.9	1.4	54.9
MnO wt%	2.4	0.7	0.1	2.2
Cr_2O_3 wt%	0.1	0.1	0.2	0.2
SiO_2 wt%	2.3	9.7	1.1	4.4
Al_2O_3 wt%	0.9	2.3	0.5	1.4
MgO wt%	0.3	0.4	0.1	0.6
CaO wt%	0.2	0.7	0.1	0.7
ZrO_2 wt%	0.2	0.4	0.2	0.2
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	57.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	55.0
Valuable heavy minerals in raw sand:	0.29

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	20.0	0.1
Leucoxene	2.4	0.0
Rutile	1.6	0.0
Ti magnetite	3.5	0.0
Magnetite	13.3	0.1
Chromite	0.5	0.0
Pyrite	0.0	0.0
Phosphate	0.2	0.0
Monazite	0.2	0.0
Y-phosphate	0.0	0.0
Sphene	0.4	0.0
Garnet	6.9	0.0
Kya/Sill	1.7	0.0
Staurolite	0.9	0.0
Zircon	4.0	0.0
Silicate	40.3	99.6
Unclassified	4.1	0.0
Total	100.0	100.0

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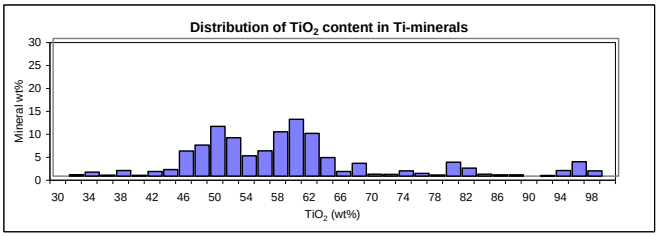
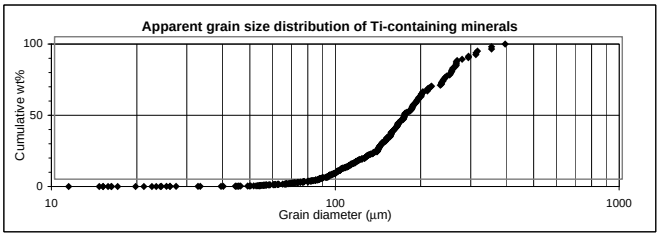
Lab. Name:	TS01-6	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/15/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	535	204	15898	297
Leucoxene	1.5	1.8	608	231	19052	30
Rutile	1.5	1.7	484	180	12310	28
Ti magnetite	1.5	1.8	578	226	17091	45
Magnetite	1.5	1.7	588	223	26355	103
Chromite	1.4	1.8	585	221	16400	6
Pyrite	2.0	2.8	529	230	7989	1
Phosphate	1.3	1.3	398	119	9897	5
Monazite	1.8	1.7	552	205	14564	3
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.5	1.7	508	191	14931	9
Garnet	1.6	2.0	656	259	21116	87
Kya/Sill	1.7	2.0	1034	418	55552	10
Staurolite	1.7	2.4	732	306	21220	12
Zircon	1.3	1.6	502	186	14424	64
Silicate	1.6	1.9	609	240	22142	731
Unclassified	1.4	1.6	575	220	26718	60

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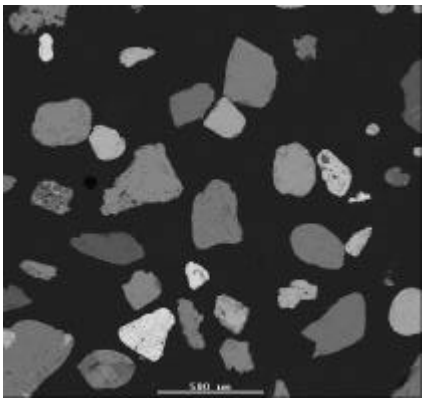

Sample Name:	010798 Vestkysten	No. of analysed frames:	117
Lab. Name:	TS01-7	No. of analysed particles:	1444
Date:	10/16/01	Heavy minerals in raw sand (%):	0.88
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	350 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.9	36.2	2.0	0.1	2.1	0.8	0.4	0.1	0.4	98.0
Leucoxene	75.2	10.2	0.9	0.2	6.8	2.6	0.4	0.3	0.4	96.9
Rutile	92.3	1.8	0.2	0.1	1.7	0.6	0.1	0.3	0.4	97.5
Ti magnetite	32.1	52.6	1.7	0.2	6.1	1.9	0.7	1.5	0.8	97.5
Magnetite	3.0	83.5	0.6	0.1	5.6	1.6	0.9	0.5	0.3	96.1
Chromite	0.2	22.9	0.4	47.7	0.3	16.7	10.8	0.0	0.1	99.1
Pyrite	0.0	40.0	0.7	0.0	1.3	0.1	0.4	0.1	0.0	42.7
Phosphate	0.0	1.2	0.1	0.0	0.3	0.0	0.0	55.1	2.4	59.1
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.0	1.9	0.1	0.2	29.0	1.9	0.1	26.9	0.2	97.4
Garnet	0.1	30.1	3.5	0.1	36.8	19.4	3.9	3.9	0.2	98.1
Kya/Sill	0.1	0.8	0.1	0.1	42.8	53.9	0.0	0.0	0.4	98.3
Staurolite	0.8	15.0	0.2	0.1	34.3	46.0	1.4	0.1	0.3	98.3
Zircon	0.2	0.6	0.1	0.2	29.6	0.1	0.1	0.2	64.1	95.2
Silicate	1.3	13.5	0.7	0.1	47.3	18.8	3.5	10.9	0.3	96.4
Unclassified	10.3	17.7	2.1	0.5	27.5	8.5	1.8	12.3	8.0	88.8

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	46.3	4.5	4.2	10.4	21.6	8.0	0.8	4.2	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.1	77.6	94.7	32.9
Fe_2O_3 wt%	36.9	10.5	1.9	53.9
MnO wt%	2.1	0.9	0.2	1.7
Cr_2O_3 wt%	0.1	0.2	0.1	0.2
SiO_2 wt%	2.2	7.0	1.7	6.2
Al_2O_3 wt%	0.8	2.7	0.6	2.0
MgO wt%	0.4	0.4	0.1	0.7
CaO wt%	0.1	0.3	0.3	1.5
ZrO_2 wt%	0.4	0.4	0.4	0.8
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	57.1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	54.5
Valuable heavy minerals in raw sand:	0.44

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	23.1	0.2
Leucoxene	2.3	0.0
Rutile	2.1	0.0
Ti magnetite	5.2	0.0
Magnetite	12.3	0.1
Chromite	0.2	0.0
Pyrite	0.0	0.0
Phosphate	0.3	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	1.0	0.0
Garnet	10.8	0.1
Kya/Sill	0.4	0.0
Staurolite	2.1	0.0
Zircon	4.0	0.0
Silicate	33.1	99.4
Unclassified	3.2	0.0
Total	100.0	100.0

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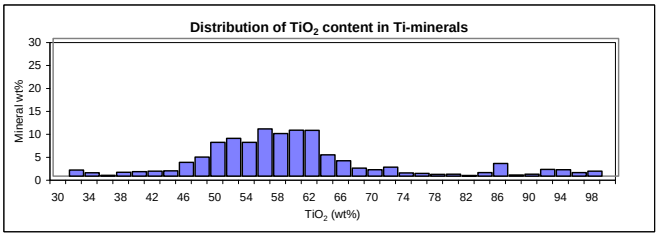
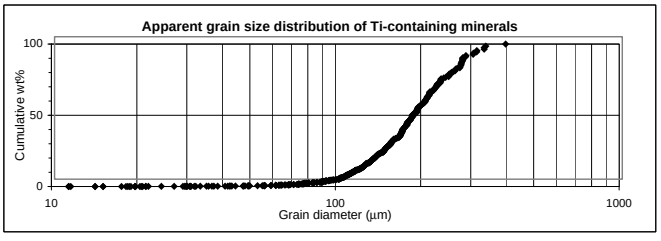
Lab. Name:	TS01-7	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/16/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	589	223	18751	332
Leucoxene	1.5	1.8	529	206	15183	40
Rutile	1.5	1.8	503	192	14581	35
Ti magnetite	1.5	2.0	675	274	21835	60
Magnetite	1.5	1.9	659	259	21994	130
Chromite	1.5	1.8	705	270	22162	2
Pyrite	1.9	2.2	289	119	3081	1
Phosphate	1.6	2.7	1610	693	77440	1
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.5	1.8	889	342	37194	9
Garnet	1.5	2.0	693	276	24322	134
Kya/Sill	2.3	2.7	772	328	19588	8
Staurolite	1.4	2.1	705	281	26505	25
Zircon	1.4	1.6	525	189	15954	65
Silicate	1.6	1.9	702	278	27207	556
Unclassified	1.5	2.0	733	295	31075	46

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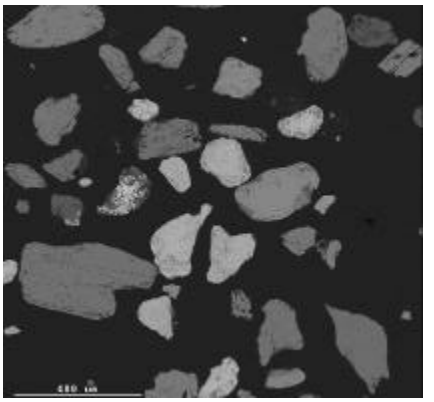

Sample Name:	010799 Vestkysten	No. of analysed frames:	73
Lab. Name:	TS01-8	No. of analysed particles:	552
Date:	10/17/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.84
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/75x		
Guard region:	350 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.8	35.8	2.1	0.1	3.1	1.1	0.3	0.2	0.3	97.8
Leucoxene	76.0	11.6	0.8	0.1	5.6	2.1	0.2	0.4	0.2	97.1
Rutile	92.4	2.2	0.3	0.1	1.3	0.4	0.1	0.0	0.4	97.1
Ti magnetite	37.2	39.1	1.8	0.2	9.5	3.7	0.8	1.3	0.3	93.8
Magnetite	8.3	73.5	0.7	0.2	6.9	3.2	0.6	0.3	0.3	93.9
Chromite	0.3	20.3	0.0	60.5	0.3	10.2	7.2	0.2	0.1	99.1
Pyrite	0.2	29.8	0.2	0.0	3.7	1.3	0.1	0.2	0.4	35.9
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.3	1.3	0.1	0.1	29.8	1.6	0.0	26.8	0.2	97.4
Garnet	0.2	30.6	2.7	0.1	36.9	19.4	3.8	4.2	0.2	98.2
Kya/Sill	0.2	0.5	0.1	0.0	42.6	53.9	0.0	0.1	0.1	97.6
Staurolite	0.9	16.9	0.5	0.3	31.6	46.6	1.5	0.1	0.0	98.3
Zircon	0.4	0.8	0.1	0.1	29.4	0.1	0.1	0.2	64.2	95.4
Silicate	1.6	13.6	0.5	0.2	46.2	16.2	4.8	12.4	0.3	95.8
Unclassified	9.6	16.9	1.8	0.2	27.4	6.1	0.5	4.3	4.6	71.5

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	52.3	14.1	4.6	6.3	10.9	7.5	2.8	1.4	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.0	78.3	95.1	39.7
Fe_2O_3 wt%	36.6	12.0	2.3	41.6
MnO wt%	2.1	0.9	0.3	1.9
Cr_2O_3 wt%	0.1	0.1	0.2	0.2
SiO_2 wt%	3.2	5.7	1.3	10.1
Al_2O_3 wt%	1.2	2.1	0.4	4.0
MgO wt%	0.4	0.2	0.1	0.8
CaO wt%	0.2	0.5	0.0	1.4
ZrO_2 wt%	0.3	0.3	0.4	0.3
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	61.1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	58.9
Valuable heavy minerals in raw sand:	0.38

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	23.8	0.2
Leucoxene	6.4	0.1
Rutile	2.1	0.0
Ti magnetite	2.9	0.0
Magnetite	0.5	0.0
Chromite	0.3	0.0
Pyrite	4.1	0.0
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	1.5	0.0
Garnet	5.0	0.0
Kya/Sill	1.3	0.0
Staurolite	0.6	0.0
Zircon	3.4	0.0
Silicate	46.8	99.6
Unclassified	1.2	0.0
Total	100.0	100.0

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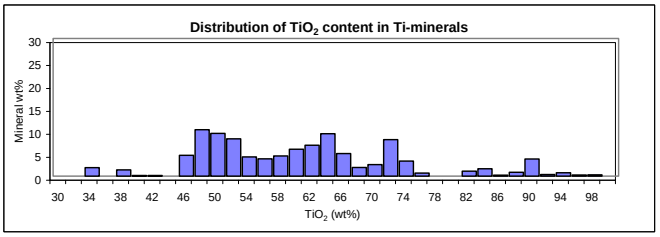
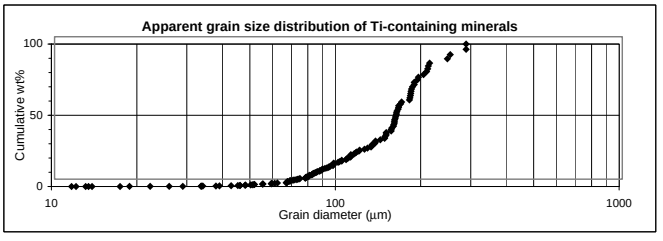
Lab. Name:	TS01-8	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/17/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	499	195	12088	99
Leucoxene	1.6	1.9	477	190	14027	23
Rutile	1.6	2.4	540	230	10623	9
Ti magnetite	1.6	2.2	453	192	10382	13
Magnetite	1.4	1.7	256	100	4425	5
Chromite	1.5	2.3	660	276	14897	1
Pyrite	1.5	2.0	395	162	8055	23
Phosphate	0.0	0.0	0	0	0	0
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	2.0	2.1	463	188	9476	10
Garnet	1.6	2.0	413	167	9707	29
Kya/Sill	1.8	2.1	622	247	18039	5
Staurolite	1.8	2.4	735	309	18605	2
Zircon	1.5	1.7	410	154	9742	17
Silicate	1.6	2.1	497	203	13290	300
Unclassified	1.4	2.1	350	149	6515	16

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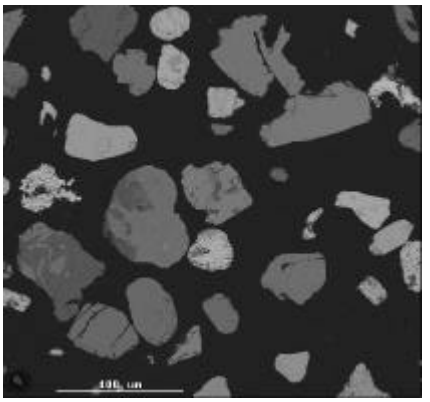

Sample Name:	010800 Vestkysten	No. of analysed frames:	80
Lab. Name:	TS01-9	No. of analysed particles:	821
Date:	10/18/01	Heavy minerals in raw sand (%):	0.78
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/75x		
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.1	36.6	1.9	0.1	1.9	1.1	0.4	0.3	0.3	97.7
Leucoxene	75.8	10.4	0.4	0.1	5.9	3.0	0.4	0.3	0.2	96.5
Rutile	92.4	1.1	0.2	0.1	2.5	0.9	0.1	0.1	0.3	97.6
Ti magnetite	34.9	49.3	1.4	0.2	6.6	2.1	0.2	0.8	0.3	95.9
Magnetite	0.7	53.6	1.0	0.0	23.7	11.9	1.4	1.5	0.1	94.0
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.1	31.7	0.2	0.1	2.8	0.8	0.1	0.1	0.3	36.1
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.0	0.0	0.0	4.2	0.1	0.0	1.8	2.8	8.9
Y-phosphate	0.0	1.4	0.0	0.0	0.0	1.8	0.0	0.0	1.5	4.8
Sphene	38.0	1.5	0.1	0.1	29.1	2.4	0.1	26.4	0.0	97.7
Garnet	1.3	30.9	1.7	0.1	36.4	19.0	4.4	3.7	0.2	97.7
Kya/Sill	0.1	0.8	0.0	0.4	42.7	53.5	0.0	0.1	0.1	97.8
Staurolite	0.6	16.9	0.1	0.0	30.3	49.0	1.5	0.0	0.3	98.7
Zircon	0.2	0.4	0.3	0.3	29.6	0.1	0.1	0.2	64.4	95.5
Silicate	0.9	12.6	0.4	0.1	48.8	16.5	4.0	11.7	0.2	95.4
Unclassified	3.7	21.1	1.3	0.2	18.4	11.9	1.1	12.7	2.7	73.2

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	50.7	17.8	4.5	6.5	13.2	4.0	2.4	0.9	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.4	78.6	94.7	36.4
Fe_2O_3 wt%	37.4	10.8	1.1	51.4
MnO wt%	1.9	0.4	0.2	1.5
Cr_2O_3 wt%	0.1	0.1	0.1	0.2
SiO_2 wt%	1.9	6.2	2.5	6.9
Al_2O_3 wt%	1.2	3.1	1.0	2.2
MgO wt%	0.4	0.4	0.1	0.2
CaO wt%	0.3	0.3	0.1	0.9
ZrO_2 wt%	0.3	0.2	0.3	0.3
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	61.9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	59.9
Valuable heavy minerals in raw sand:	0.30

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	19.7	0.2
Leucoxene	6.9	0.1
Rutile	1.7	0.0
Ti magnetite	2.5	0.0
Magnetite	0.0	0.0
Chromite	0.0	0.0
Pyrite	8.0	0.1
Phosphate	0.0	0.0
Monazite	0.2	0.0
Y-phosphate	0.3	0.0
Sphene	2.1	0.0
Garnet	5.1	0.0
Kya/Sill	0.9	0.0
Staurolite	0.3	0.0
Zircon	1.5	0.0
Silicate	49.5	99.6
Unclassified	1.0	0.0
Total	100.0	100.0

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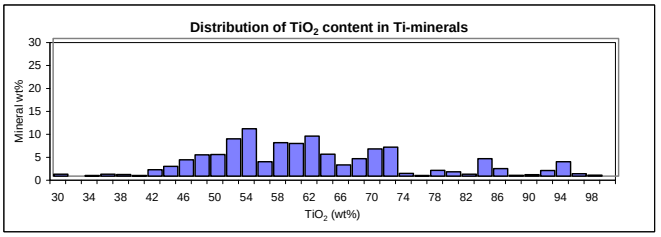
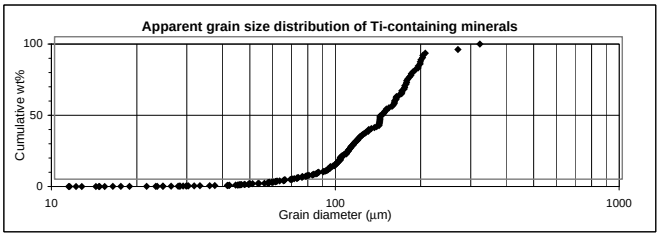
Lab. Name:	TS01-9	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/18/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	433	169	9918	139
Leucoxene	1.5	1.9	529	204	14258	34
Rutile	1.5	1.9	374	147	7316	15
Ti magnetite	1.5	1.9	375	147	7598	22
Magnetite	1.8	1.7	102	38	487	1
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.6	2.4	518	218	10928	46
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.4	1.6	553	198	15601	1
Y-phosphate	1.5	1.7	596	224	16558	1
Sphene	1.7	2.3	790	330	23331	8
Garnet	1.5	2.2	596	247	15549	26
Kya/Sill	1.6	1.9	667	262	22248	4
Staurolite	1.4	2.1	600	244	14456	2
Zircon	1.3	1.6	360	132	8709	12
Silicate	1.6	2.1	483	199	12435	473
Unclassified	1.4	1.8	209	87	3191	37

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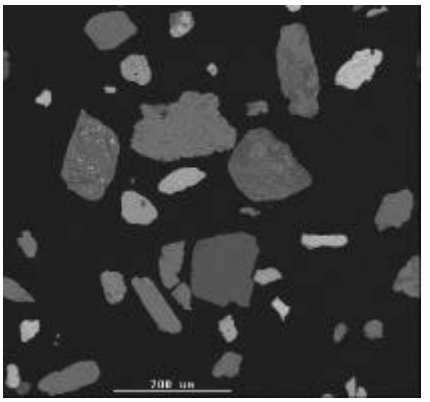

Sample Name:	010801 Jyske rev	No. of analysed frames:	82
Lab. Name:	TS01-10	No. of analysed particles:	1496
Date:	10/18/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	1.21
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/40x			
Guard region:	375 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.9	36.8	2.3	0.1	1.9	1.0	0.4	0.2	0.2	97.9
Leucoxene	77.9	7.6	0.3	0.1	6.3	3.0	0.8	0.5	0.5	97.1
Rutile	94.0	1.0	0.0	0.0	0.5	0.3	0.0	0.0	0.3	96.1
Ti magnetite	30.2	58.5	1.6	0.2	3.2	1.4	0.7	1.1	0.3	97.1
Magnetite	2.8	88.5	0.2	0.2	2.8	1.6	0.5	0.4	0.4	97.4
Chromite	1.7	50.4	1.2	22.7	4.2	8.5	0.6	0.3	0.6	90.2
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.4	0.1	0.3	0.7	0.0	0.1	55.3	1.5	58.4
Monazite	0.0	0.6	0.0	0.0	3.1	0.4	0.3	0.8	2.4	7.6
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	36.7	1.5	0.2	0.1	29.5	2.1	0.1	27.4	0.3	97.8
Garnet	0.2	30.2	3.9	0.1	36.5	19.3	3.9	3.3	0.2	97.7
Kya/Sill	0.5	0.8	0.0	0.0	43.2	54.4	0.3	0.0	0.5	99.7
Staurolite	0.8	14.5	0.3	0.1	33.7	46.9	1.6	0.1	0.1	98.1
Zircon	0.3	0.4	0.2	0.2	29.8	0.1	0.1	0.2	63.9	95.0
Silicate	1.6	13.1	0.5	0.2	49.6	13.7	5.0	11.3	0.3	95.1
Unclassified	7.0	15.8	1.0	0.6	24.3	5.9	3.8	20.0	3.6	82.0

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	51.5	7.8	0.1	11.9	16.1	4.4	0.4	8.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.1	80.2	97.8	31.1
Fe_2O_3 wt%	37.6	7.8	1.0	60.2
MnO wt%	2.3	0.3	0.0	1.6
Cr_2O_3 wt%	0.1	0.1	0.0	0.2
SiO_2 wt%	2.0	6.5	0.5	3.3
Al_2O_3 wt%	1.0	3.0	0.3	1.5
MgO wt%	0.4	0.8	0.0	0.7
CaO wt%	0.2	0.6	0.0	1.1
ZrO_2 wt%	0.3	0.6	0.3	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	54.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	54.5
Valuable heavy minerals in raw sand:	0.27

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	11.3	0.1
Leucoxene	1.7	0.0
Rutile	0.0	0.0
Ti magnetite	2.6	0.0
Magnetite	6.3	0.1
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.2	0.0
Monazite	0.4	0.0
Y-phosphate	0.0	0.0
Sphene	0.8	0.0
Garnet	3.5	0.0
Kya/Sill	0.1	0.0
Staurolite	1.7	0.0
Zircon	1.0	0.0
Silicate	67.4	99.6
Unclassified	3.1	0.0
Total	100.0	100.0

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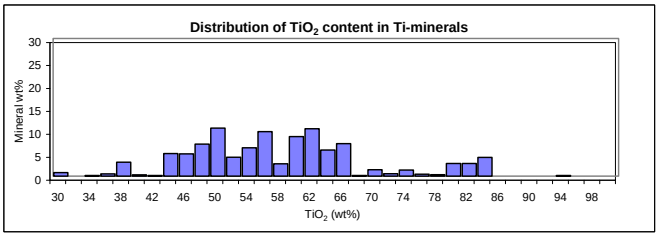
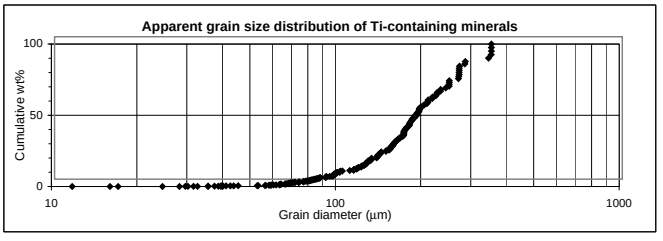
Lab. Name:	TS01-10	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/18/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	559	207	18617	155
Leucoxene	1.4	2.1	765	314	27354	16
Rutile	1.3	1.2	209	65	2889	1
Ti magnetite	1.6	1.7	480	181	12821	49
Magnetite	1.5	1.8	605	231	18327	76
Chromite	1.4	1.1	106	35	780	4
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.6	1.5	421	151	11155	4
Monazite	1.8	1.6	599	216	17950	5
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.6	1.7	587	222	21090	12
Garnet	1.6	1.8	516	201	14097	72
Kya/Sill	1.4	1.8	801	309	28149	1
Staurolite	1.3	1.9	1048	409	52947	10
Zircon	1.4	1.6	409	145	9469	25
Silicate	1.7	1.9	725	285	29473	993
Unclassified	1.4	1.5	472	177	17819	73

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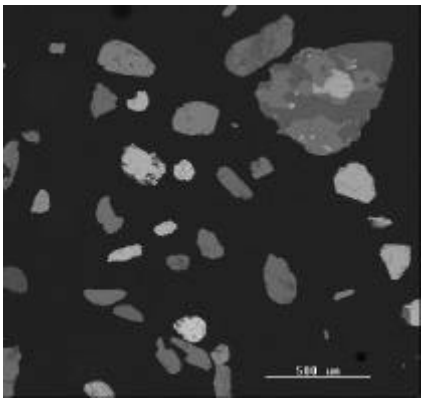

Sample Name:	010802 Jyske rev	No. of analysed frames:	46
Lab. Name:	TS01-11	No. of analysed particles:	658
Date:	10/19/01	Heavy minerals in raw sand (%):	1.13
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	325 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.3	37.8	1.9	0.1	1.4	0.6	0.4	0.4	0.4	98.2
Leucoxene	73.2	14.7	0.7	0.4	4.5	2.0	0.4	0.4	0.2	96.6
Rutile	93.9	1.7	0.1	0.3	1.6	0.6	0.2	0.1	0.1	98.6
Ti magnetite	36.5	47.1	2.2	0.2	7.5	1.8	1.0	1.4	0.1	97.8
Magnetite	3.4	87.3	0.4	0.1	3.4	1.3	0.7	0.4	0.5	97.7
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.3	0.2	0.0	0.3	0.0	0.0	57.4	0.9	59.2
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.9	0.0	0.0	2.5	0.0	0.1	2.3	0.6	6.4
Sphene	36.4	1.6	0.1	0.2	29.6	2.5	0.2	27.1	0.2	97.9
Garnet	0.4	29.9	2.2	0.1	37.3	19.7	3.5	3.9	0.3	97.4
Kya/Sill	0.1	1.2	0.1	0.2	42.9	54.0	0.0	0.0	0.2	98.7
Staurolite	0.5	15.6	0.2	0.2	33.0	46.8	1.4	0.0	0.4	98.1
Zircon	0.2	1.1	0.1	0.1	29.6	0.1	0.1	0.1	63.9	95.3
Silicate	1.6	14.5	0.4	0.1	45.5	14.6	5.1	14.1	0.2	96.2
Unclassified	9.1	14.9	1.0	0.3	16.9	3.1	4.6	23.3	6.6	80.0

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	40.4	5.2	4.3	16.0	16.3	6.6	5.4	5.7	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.3	75.8	95.3	37.3
Fe_2O_3 wt%	38.5	15.2	1.8	48.2
MnO wt%	1.9	0.8	0.1	2.3
Cr_2O_3 wt%	0.1	0.4	0.3	0.2
SiO_2 wt%	1.4	4.7	1.6	7.6
Al_2O_3 wt%	0.6	2.1	0.6	1.8
MgO wt%	0.4	0.4	0.2	1.0
CaO wt%	0.5	0.4	0.1	1.4
ZrO_2 wt%	0.4	0.2	0.1	0.1
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	55.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	53.0
Valuable heavy minerals in raw sand:	0.28

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	10.0	0.1
Leucoxene	1.3	0.0
Rutile	1.1	0.0
Ti magnetite	3.9	0.0
Magnetite	11.3	0.1
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	2.2	0.0
Monazite	0.0	0.0
Y-phosphate	0.4	0.0
Sphene	1.4	0.0
Garnet	4.0	0.0
Kya/Sill	1.3	0.0
Staurolite	1.4	0.0
Zircon	1.6	0.0
Silicate	58.0	99.5
Unclassified	2.1	0.0
Total	100.0	100.0

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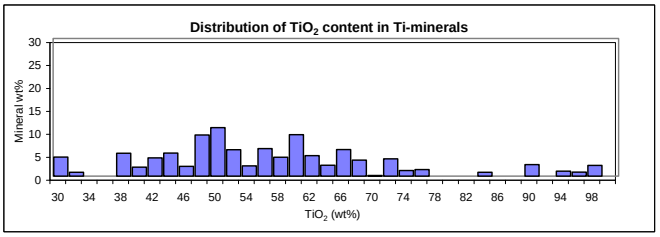
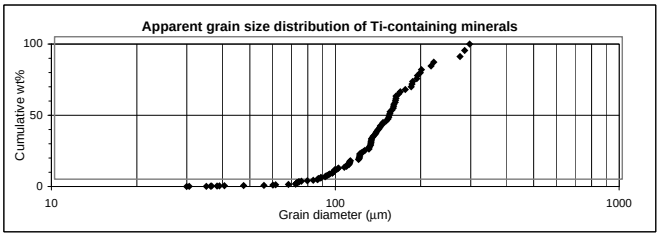
Lab. Name:	TS01-11	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/19/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	500	189	13165	71
Leucoxene	1.6	1.6	501	183	13485	9
Rutile	1.7	1.8	527	201	12883	7
Ti magnetite	1.6	2.1	635	256	17395	20
Magnetite	1.4	1.7	482	181	12612	73
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.2	1.6	696	251	26354	7
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	1.3	1.4	533	174	16050	2
Sphene	1.4	1.7	582	219	18160	9
Garnet	1.5	1.8	493	193	12474	34
Kya/Sill	1.9	2.1	722	293	21619	8
Staurolite	1.8	2.3	855	353	25911	6
Zircon	1.3	1.6	407	144	9280	16
Silicate	1.6	1.9	688	272	24730	374
Unclassified	1.5	1.6	477	190	15069	22

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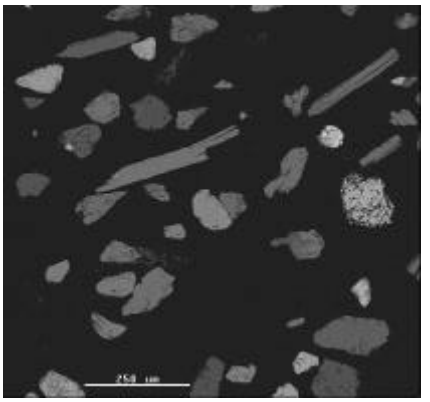

Sample Name:	010803 Jyske rev	No. of analysed frames:	76
Lab. Name:	TS01-12	No. of analysed particles:	851
Date:	10/22/01	Heavy minerals in raw sand (%):	1.69
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments: Relative high amount of unclassified. Grains categorized as unclassified have high content of Si, Mg, Fe, Ca and/or Zr. Remains of animals and fragments of shells are present.	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/100x		
Guard region:	225 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53.3	36.8	2.2	0.1	3.3	1.2	0.5	0.4	0.3	98.2
Leucoxene	74.5	8.8	0.7	0.2	8.2	2.8	0.4	0.5	0.9	97.0
Rutile	93.2	1.2	0.2	0.2	2.2	0.9	0.1	0.1	0.3	98.3
Ti magnetite	34.8	50.6	1.6	0.2	6.5	2.5	0.9	0.6	0.2	97.9
Magnetite	3.1	84.4	0.4	0.2	5.3	2.0	0.9	0.9	0.3	97.6
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.2	34.9	0.2	0.1	1.4	0.5	0.1	0.2	0.3	37.9
Phosphate	0.2	0.2	0.2	0.1	0.7	0.0	0.1	57.2	1.4	60.1
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.2	1.4	0.3	0.1	29.0	2.3	0.0	27.0	0.1	97.5
Garnet	0.2	31.4	3.7	0.1	36.6	19.2	3.2	3.3	0.2	97.9
Kya/Sill	0.3	0.2	0.0	0.4	42.4	53.7	0.0	0.2	0.0	97.2
Staurolite	0.5	14.6	0.1	0.1	35.4	46.3	1.2	0.1	0.1	98.4
Zircon	0.2	0.8	0.1	0.2	29.8	0.2	0.2	0.2	63.9	95.6
Silicate	1.7	13.7	0.4	0.1	48.4	13.8	4.6	13.4	0.2	96.5
Unclassified	2.6	14.1	0.3	0.1	14.5	3.3	7.7	31.8	10.3	84.8

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	46.9	12.0	9.1	9.2	9.2	12.4	0.4	0.9	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	54.3	76.8	94.8	35.6
Fe_2O_3 wt%	37.5	9.1	1.2	51.7
MnO wt%	2.3	0.7	0.2	1.7
Cr_2O_3 wt%	0.1	0.2	0.2	0.2
SiO_2 wt%	3.4	8.4	2.2	6.6
Al_2O_3 wt%	1.2	2.9	0.9	2.5
MgO wt%	0.5	0.4	0.1	0.9
CaO wt%	0.4	0.5	0.1	0.6
ZrO_2 wt%	0.3	0.9	0.3	0.2
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	60.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	55.8
Valuable heavy minerals in raw sand:	0.59

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	16.5	0.3
Leucoxene	4.2	0.1
Rutile	3.2	0.1
Ti magnetite	3.2	0.1
Magnetite	5.0	0.1
Chromite	0.0	0.0
Pyrite	0.5	0.0
Phosphate	1.9	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	2.1	0.0
Garnet	3.2	0.1
Kya/Sill	0.1	0.0
Staurolite	0.3	0.0
Zircon	4.4	0.1
Silicate	49.3	99.1
Unclassified	5.9	0.1
Total	100.0	100.0

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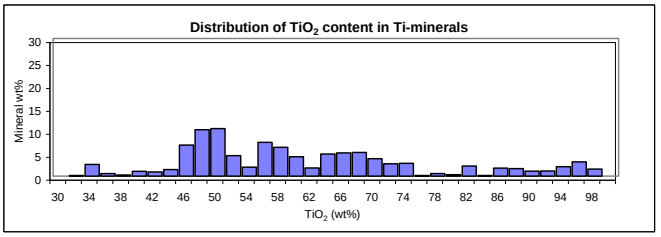
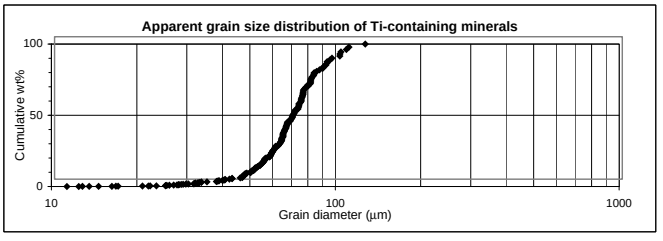
Lab. Name:	TS01-12	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/22/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.7	1.8	247	93	3038	117
Leucoxene	1.5	1.9	305	120	4319	21
Rutile	1.5	1.8	254	98	2957	21
Ti magnetite	1.7	1.8	215	84	2332	28
Magnetite	1.6	1.9	210	82	2116	44
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.5	1.8	164	62	1457	7
Phosphate	1.5	1.6	297	108	4696	8
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.5	1.8	251	96	3059	19
Garnet	1.6	1.9	213	83	2111	37
Kya/Sill	1.2	2.8	380	165	4169	1
Staurolite	1.5	1.7	201	78	2666	3
Zircon	1.4	1.6	201	72	2210	41
Silicate	1.6	2.0	293	117	3907	461
Unclassified	1.4	2.0	295	117	4960	43

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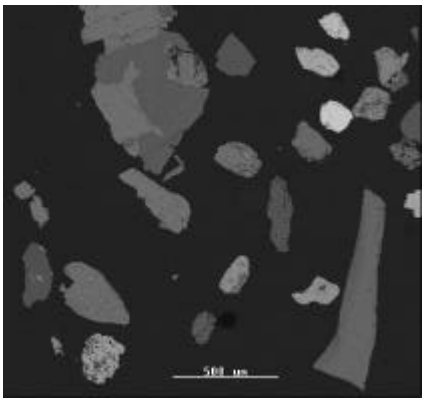

Sample Name:	010804 Horns rev	No. of analysed frames:	74
Lab. Name:	TS01-13	No. of analysed particles:	867
Date:	10/23/01	Heavy minerals in raw sand (%):	0.17
Submitter:	DuPont/GEUS		
Country:	Denmark	Comments: Relative high amount of unclassified. Grains categorized as unclassified have high content of Si and Ca. Remains of animals and fragments of shells are present.	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	350 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.0	38.4	2.2	0.1	1.8	0.8	0.4	0.1	0.2	98.2
Leucoxene	74.8	10.3	0.9	0.2	6.9	3.0	0.5	0.4	0.3	97.2
Rutile	93.3	1.1	0.3	0.1	1.4	1.0	0.1	0.1	0.2	97.6
Ti magnetite	37.4	44.8	1.9	0.1	9.1	1.7	0.4	0.8	0.5	96.7
Magnetite	4.3	75.9	0.4	0.2	8.9	4.0	0.9	0.7	0.5	95.7
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.3	0.0	0.0	0.3	0.3	0.0	0.3	55.3	1.1	57.7
Monazite	0.0	0.0	0.0	0.0	0.1	0.0	0.0	2.9	1.0	4.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	38.3	1.1	0.2	0.4	28.0	1.2	0.1	27.9	0.4	97.6
Garnet	0.2	30.1	4.4	0.1	36.8	19.3	3.0	3.8	0.2	98.1
Kya/Sill	0.2	0.8	0.3	0.1	42.6	53.7	0.0	0.0	0.4	98.1
Staurolite	0.7	14.8	0.4	0.2	32.6	46.9	1.8	0.1	0.3	97.7
Zircon	0.2	0.7	0.2	0.2	29.1	0.1	0.1	0.2	64.2	94.9
Silicate	1.2	10.2	0.5	0.2	51.3	19.1	3.4	10.0	0.3	96.1
Unclassified	6.3	4.7	0.4	0.5	11.0	3.2	1.3	63.0	1.0	91.4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	59.6	12.6	4.0	5.1	11.1	3.2	1.5	2.8	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.0	77.0	95.6	38.7
Fe_2O_3 wt%	39.2	10.6	1.1	46.4
MnO wt%	2.3	0.9	0.3	1.9
Cr_2O_3 wt%	0.1	0.2	0.2	0.1
SiO_2 wt%	1.8	7.1	1.4	9.4
Al_2O_3 wt%	0.8	3.0	1.0	1.7
MgO wt%	0.4	0.5	0.1	0.5
CaO wt%	0.2	0.4	0.1	0.9
ZrO_2 wt%	0.3	0.3	0.2	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	59.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	57.5
Valuable heavy minerals in raw sand:	0.08

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	29.7	0.1
Leucoxene	6.3	0.0
Rutile	2.0	0.0
Ti magnetite	2.6	0.0
Magnetite	4.2	0.0
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.2	0.0
Garnet	5.6	0.0
Kya/Sill	0.7	0.0
Staurolite	1.4	0.0
Zircon	1.6	0.0
Silicate	39.5	99.9
Unclassified	6.2	0.0
Total	100.0	100.0

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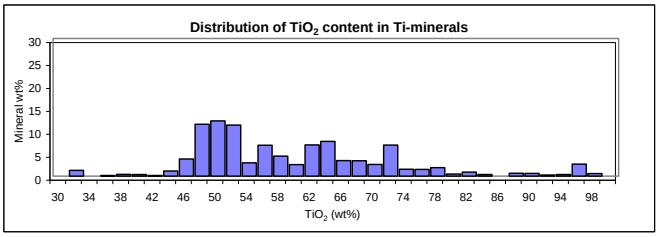
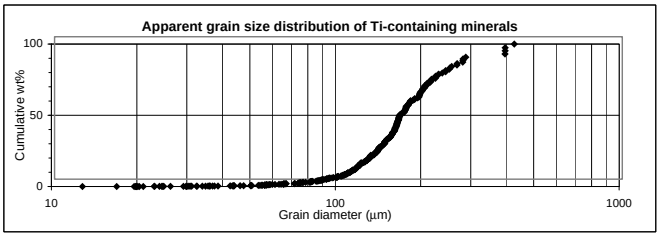
Lab. Name:	TS01-13	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/23/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.8	552	210	16149	254
Leucoxene	1.4	1.8	687	265	27174	32
Rutile	1.6	1.8	412	155	9809	25
Ti magnetite	1.4	1.7	435	169	11465	29
Magnetite	1.4	1.7	565	214	22673	22
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.1	1.2	183	55	2190	1
Monazite	2.0	1.9	282	111	3356	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.7	2.1	652	264	16438	2
Garnet	1.5	2.1	743	299	23293	37
Kya/Sill	1.7	2.1	513	208	11829	12
Staurolite	1.7	2.0	515	207	12766	18
Zircon	1.4	1.6	437	158	11048	19
Silicate	1.6	2.0	689	276	25508	363
Unclassified	2.0	2.2	696	300	27432	52

Sweden

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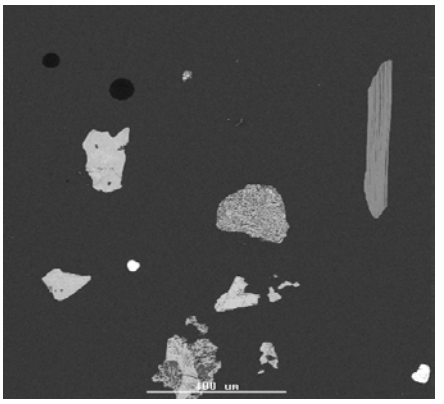

Sample Name:	Ferrogenus Sandst. 0.045-0.71
Date:	20-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	200 µm
Sieve	100 µm^2

No. of analysed frames:	46
No. analysed of particles	527
Heavy minerals in raw sand (%):	0,33
comments:	Sample from Eriksdal

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	64,7	22,2	1,1	0,4	4,7	2,8	0,3	0,1	0,6	96,8
Leucoxene	74,8	15,5	1,0	0,2	2,8	2,6	0,1	0,1	0,4	97,5
Rutile	90,6	2,3	0,2	0,1	2,2	1,9	0,1	0,1	0,3	97,8
Ti magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Magnetite	1,4	80,8	0,0	0,3	5,0	1,6	0,5	0,7	0,0	0,0
Chromite	0,6	24,0	0,4	48,3	1,5	14,4	8,2	0,1	0,1	0,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,4	1,5	0,2	0,0	0,0	3,0	0,0	0,9	0,4	6,5
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	3,2	6,0	0,0	0,0	48,7	28,1	1,0	0,2	0,2	87,5
Sillimanite	0,0	2,5	0,1	0,0	43,3	53,4	0,0	0,0	0,0	99,3
Staurolite	0,9	14,1	0,2	0,3	32,8	48,3	1,5	0,1	0,0	98,2
Zircon	0,4	0,4	0,1	0,1	29,9	0,3	0,1	0,1	63,6	95,0
Silicate	2,5	3,1	0,2	0,1	68,0	19,0	1,2	0,4	0,5	94,9
Unclassified	28,6	5,9	0,8	0,4	22,1	12,0	0,9	0,8	13,3	84,9

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	16,7	64,5	12,9	0,0	0,6	5,0	0,3	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	66,8	76,7	92,6	0
Fe_2O_3 wt%	23,0	15,9	2,4	---
MnO wt%	1,1	1,0	0,2	---
Cr_2O_3 wt%	0,4	0,2	0,1	---
SiO_2 wt%	4,8	2,9	2,3	---
Al_2O_3 wt%	2,9	2,6	1,9	---
MgO wt%	0,3	0,1	0,1	---
CaO wt%	0,1	0,1	0,1	---
ZrO_2 wt%	0,6	0,4	0,3	---
Total	100,0	100,0	100,0	---

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	15,4	0,1
Leucoxene	59,6	0,2
Rutile	11,9	0,0
Ti magnetite	0,0	0,0
Magnetite	0,3	0,0
Chromite	2,1	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,2	0,0
Sphene	0,0	0,0
Garnet	0,5	0,0
Sillimanite	0,3	0,0
Staurolite	0,2	0,0
Zircon	4,6	0,0
Silicate	3,6	99,7
Unclassified	1,3	0,0
Total	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	77,1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	74,6
Valuable heavy minerals in raw sand:	0,30

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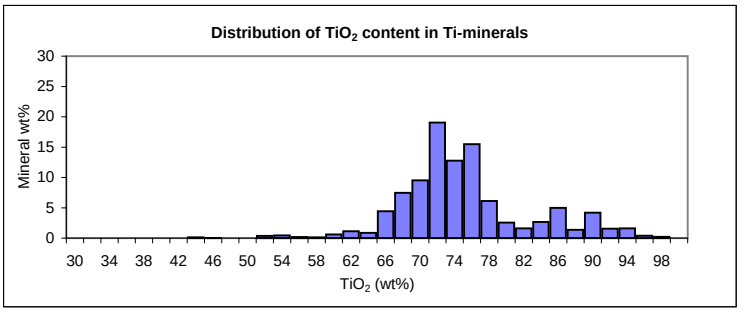
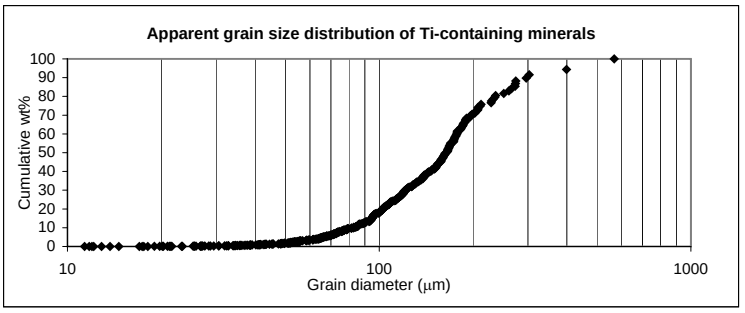
Sample Name:	Ferrogenus Sandst. 0.045-0.71	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	20-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,9	381	151	100
Leucoxene	1,6	2,0	465	184	258
Rutile	1,5	1,9	450	178	52
Ti magnetite	0,0	0,0	0	0	0
Magnetite	1,7	2,2	364	156	2
Chromite	1,4	1,8	458	177	8
Pyrite	0,0	0,0	0	0	0
Phosphate	0,0	0,0	0	0	0
Monazite	0,0	0,0	0	0	0
Y-phosphate	1,8	2,0	464	186	1
Sphene	0,0	0,0	0	0	0
Garnet	2,8	5,0	1411	657	1
Sillimanite	1,9	3,0	836	368	1
Staurolite	1,7	2,0	315	130	3
Zircon	1,4	1,6	319	114	37
Silicate	2,4	2,3	335	136	51
Unclassified	1,5	2,2	420	184	13

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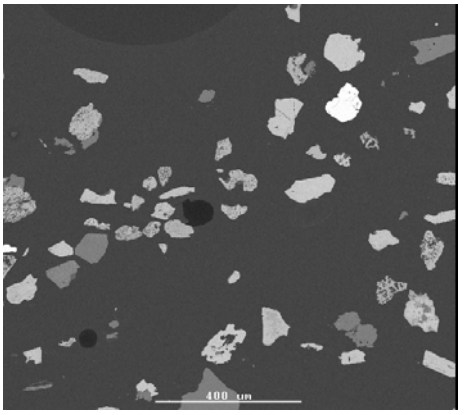

Sample Name:	Lower 4m 0.045-0.71mm
Date:	20-09-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	80x
Guard region	200 µm
Sieve	100 µm^2

No. of analysed frames:	21
No. analysed of particles	614
Heavy minerals in raw sand (%):	0,58
comments:	Eriksdal , lower 4 m (below major clay) 0.045-0.71m

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63,8	22,5	1,2	0,2	6,5	2,0	0,3	0,2	0,5	97,3
Leucoxene	75,9	11,1	0,8	0,3	4,7	3,1	0,2	0,4	0,6	97,1
Rutile	90,6	2,3	0,2	0,2	1,9	1,6	0,1	0,2	0,4	97,6
Ti magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Magnetite	0,3	97,2	0,0	0,0	0,8	0,9	0,0	0,0	0,0	99,3
Chromite	1,3	22,4	0,7	47,2	1,0	16,4	7,7	0,2	0,4	97,2
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	4,3	0,0	0,0	0,0	43,1	0,9	2,6	0,0	50,8
Monazite	0,0	0,2	0,0	0,0	4,7	1,6	0,8	3,5	7,5	18,3
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,8	19,6	1,8	0,2	41,3	21,4	3,1	3,8	0,6	92,7
Sillimanite	0,2	1,5	0,0	0,5	41,7	54,1	0,0	0,1	0,3	98,5
Staurolite	3,1	11,6	0,2	0,0	37,3	43,4	1,1	0,0	0,0	96,7
Zircon	0,9	0,4	0,2	0,2	29,7	0,1	0,1	0,3	63,6	95,6
Silicate	4,5	4,4	0,4	0,2	68,5	13,2	1,3	0,4	0,5	93,4
Unclassified	31,7	3,1	0,2	0,3	36,1	8,3	0,3	0,4	11,9	92,4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	25,3	48,0	22,0	0,0	1,2	3,1	0,3	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	65,5	78,2	92,9	0
Fe_2O_3 wt%	23,2	11,5	2,3	0
MnO wt%	1,2	0,9	0,2	0
Cr_2O_3 wt%	0,2	0,3	0,2	0
SiO_2 wt%	6,7	4,9	2,0	0
Al_2O_3 wt%	2,1	3,2	1,6	0
MgO wt%	0,4	0,2	0,1	0
CaO wt%	0,2	0,4	0,2	0
ZrO_2 wt%	0,5	0,6	0,5	0
Total	100,0	100,0	100,0	0,0

Average TiO_2 content of all the TiO_2 minerals:	78,2
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	73,8
Valuable heavy minerals in raw sand:	0,47

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	20,7	0,1
Leucoxene	39,3	0,2
Rutile	18,0	0,1
Ti magnetite	0,0	0,0
Magnetite	0,9	0,0
Chromite	0,8	0,0
Pyrite	0,0	0,0
Phosphate	0,2	0,0
Monazite	0,2	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	1,0	0,0
Sillimanite	0,2	0,0
Staurolite	0,0	0,0
Zircon	2,6	0,0
Silicate	13,4	99,5
Unclassified	2,8	0,0
Total	100,0	100,0

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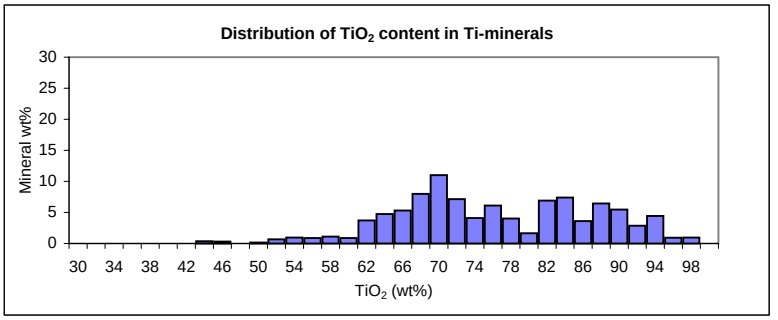
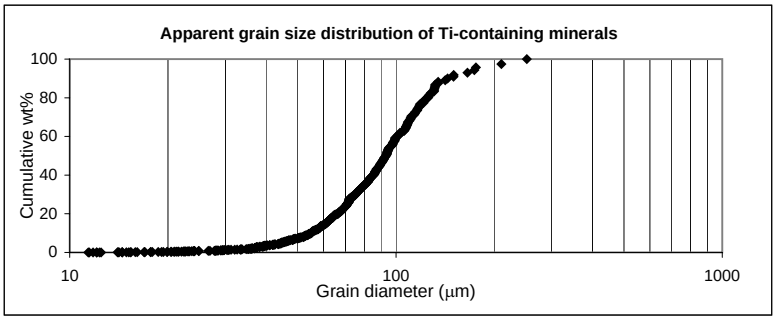
GEUS

Sample Name:	Lower 4m 0.045-0.71mm	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	20-09-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,9	277	110	140
Leucoxene	1,7	2,2	327	135	212
Rutile	1,7	2,0	306	123	93
Ti magnetite	0,0	0,0	0	0	0
Magnetite	1,7	1,6	630	229	1
Chromite	1,8	1,7	184	69	9
Pyrite	0,0	0,0	0	0	0
Phosphate	1,2	1,6	284	102	1
Monazite	1,2	1,4	169	63	2
Y-phosphate	0,0	0,0	0	0	0
Sphene	0,0	0,0	0	0	0
Garnet	1,9	1,9	253	105	9
Sillimanite	2,3	2,6	328	139	2
Staurolite	1,1	1,0	38	14	1
Zircon	1,4	1,6	251	89	18
Silicate	2,1	2,4	366	156	106
Unclassified	1,5	2,5	397	171	20

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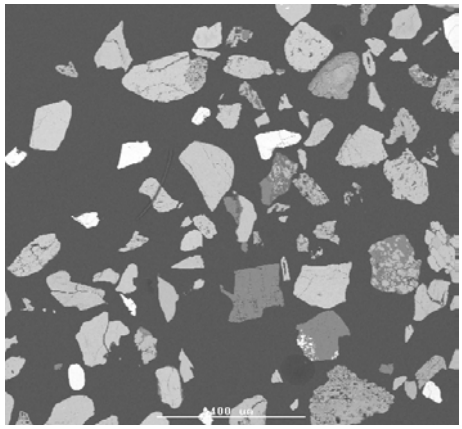

Sample Name:	Lower Sand
Date:	04-11-00
Submitter:	Dupont
Analyzed by:	CCA
Acc. Voltage	17 kV
Magnification	50
Guard region	300 μm
Sieve	100 μm^2

No. of analysed frames:	67
No. analysed of particles	2149
Heavy minerals in raw sand (%):	0,28
comments:	Sample from Eriksdal Lower sand 0.045-0.71

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	62,7	23,4	1,1	0,3	5,8	2,8	0,3	0,2	0,8	97,2
Leucoxene	75,7	13,9	0,7	0,3	3,4	2,5	0,2	0,3	0,5	97,6
Rutile	91,2	2,5	0,1	0,2	1,9	1,3	0,1	0,2	0,4	97,8
Ti magnetite	37,7	28,1	1,3	3,3	10,0	7,9	0,8	0,7	1,4	91,2
Magnetite	0,8	77,8	0,2	0,2	11,9	3,6	1,1	0,8	0,1	96,5
Chromite	0,8	23,3	0,7	48,3	0,9	16,5	7,4	0,2	0,2	98,3
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	6,1	2,0	0,0	0,0	2,8	0,8	0,2	0,9	3,0	15,8
Y-phosphate	0,0	0,5	0,0	0,0	1,4	0,1	0,1	0,8	2,2	5,1
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	2,3	7,5	3,6	0,6	42,7	22,8	1,6	0,8	1,5	83,2
Sillimanite	0,3	1,3	0,1	0,2	42,9	53,6	0,0	0,0	0,2	98,7
Staurolite	0,9	12,9	0,3	0,6	33,7	47,1	1,6	0,1	0,4	97,7
Zircon	0,7	0,4	0,1	0,2	29,4	0,2	0,1	0,2	63,5	94,8
Silicate	4,4	3,4	0,3	0,2	66,2	18,8	1,1	0,4	0,4	95,1
Unclassified	24,1	6,4	0,5	1,8	21,9	4,7	0,9	2,1	17,3	79,7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	44,1	38,4	9,6	0,4	0,2	7,1	0,2	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64,5	77,6	93,2	41,4
Fe_2O_3 wt%	24,0	14,2	2,6	30,8
MnO wt%	1,1	0,7	0,1	1,4
Cr_2O_3 wt%	0,3	0,3	0,2	3,6
SiO_2 wt%	5,9	3,5	2,0	10,9
Al_2O_3 wt%	2,9	2,6	1,3	8,6
MgO wt%	0,3	0,2	0,1	0,9
CaO wt%	0,2	0,3	0,2	0,8
ZrO_2 wt%	0,8	0,6	0,4	1,5
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	72,8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	70,5
Valuable heavy minerals in raw sand:	0,25

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	39,5	0,1
Leucoxene	34,3	0,1
Rutile	8,6	0,0
Ti magnetite	0,4	0,0
Magnetite	0,1	0,0
Chromite	1,6	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,4	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,2	0,0
Sillimanite	0,2	0,0
Staurolite	0,3	0,0
Zircon	6,3	0,0
Silicate	4,9	99,7
Unclassified	3,4	0,0
Total	100,0	100,0

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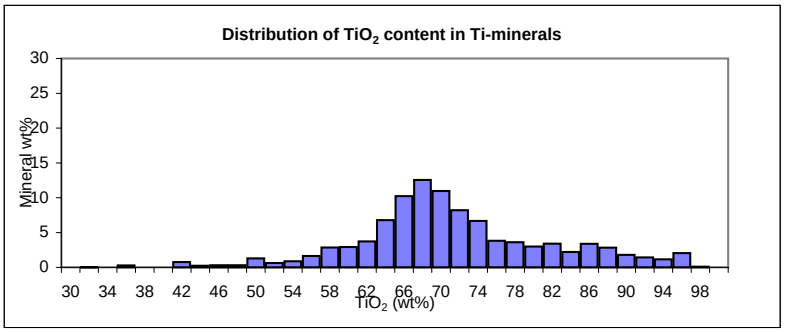
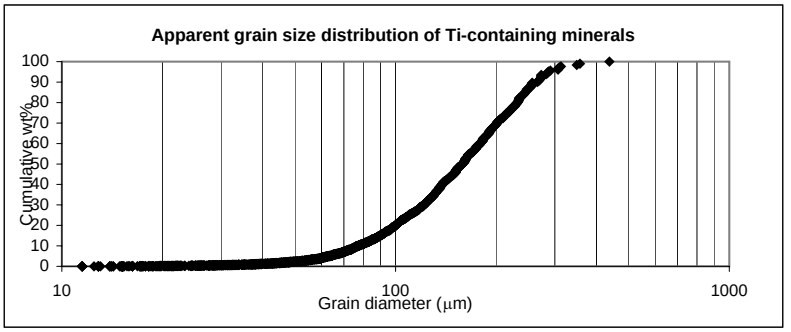
GEUS

Sample Name:	Lower Sand	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	04-11-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,9	418	167	693
Leucoxene	1,5	1,9	428	170	601
Rutile	1,6	1,7	356	136	170
Ti magnetite	1,4	1,6	255	111	13
Magnetite	1,9	1,7	254	96	6
Chromite	1,5	1,7	358	135	36
Pyrite	0,0	0,0	0	0	0
Phosphate	0,0	0,0	0	0	0
Monazite	1,5	1,9	397	154	5
Y-phosphate	1,5	1,9	422	167	1
Sphene	0,0	0,0	0	0	0
Garnet	1,7	1,5	194	82	9
Sillimanite	1,6	1,8	366	142	5
Staurolite	1,3	1,3	153	55	16
Zircon	1,4	1,5	319	114	168
Silicate	1,7	1,9	390	158	146
Unclassified	1,4	1,8	359	151	114

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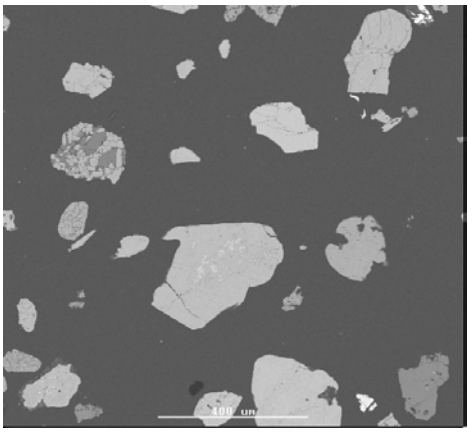

Sample Name:	Upper Sand 0.045-0.71	No. of analysed frames:	59
Date:	06-11-00	No. analysed of particles	650
Submitter:	Dupont	Heavy minerals in raw sand (%):	0,28
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	80x		
Guard region	200 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	64,9	25,0	1,1	0,2	3,1	2,1	0,3	0,2	0,6	97,6
Leucoxene	74,9	16,0	1,1	0,2	2,5	2,2	0,2	0,3	0,4	97,8
Rutile	91,0	2,3	0,2	0,2	1,9	1,3	0,1	0,2	0,4	97,6
Ti magnetite	40,1	20,1	1,1	0,4	18,1	16,6	0,6	0,4	0,0	97,4
Magnetite	0,5	67,9	0,8	0,2	17,9	6,6	0,9	1,3	0,9	96,9
Chromite	0,5	19,0	0,3	50,4	0,2	18,4	8,8	0,2	0,1	97,8
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,7	1,5	0,0	0,3	0,0	47,0	0,3	7,8	0,0	57,5
Monazite	0,0	0,6	0,0	0,0	5,3	4,5	0,5	7,8	2,1	20,8
Y-phosphate	0,0	0,0	0,0	0,0	5,9	3,7	0,4	3,1	4,1	17,4
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	42,9	1,6	0,0	0,0	32,0	18,2	0,6	0,2	0,0	95,5
Sillimanite	0,1	0,8	0,2	0,1	42,9	53,2	0,0	0,2	0,5	98,0
Staurolite	1,0	13,6	0,4	0,1	32,6	48,1	1,8	0,1	0,5	98,2
Zircon	0,4	0,5	0,2	0,2	29,2	0,2	0,1	0,1	63,7	94,5
Silicate	2,1	3,6	0,2	0,1	69,5	17,8	1,2	0,9	0,5	95,8
Unclassified	15,5	5,8	0,8	0,2	23,4	10,1	0,8	4,5	19,8	80,8

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	28,9	48,8	14,4	0,0	0,1	7,7	0,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	66,5	76,5	93,2	41,2
Fe_2O_3 wt%	25,7	16,4	2,3	20,6
MnO wt%	1,1	1,1	0,2	1,2
Cr_2O_3 wt%	0,2	0,2	0,2	0,4
SiO_2 wt%	3,2	2,6	2,0	18,6
Al_2O_3 wt%	2,2	2,2	1,4	17,0
MgO wt%	0,3	0,2	0,1	0,6
CaO wt%	0,2	0,4	0,2	0,4
ZrO_2 wt%	0,6	0,4	0,4	0,0
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	76,0
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	72,8
Valuable heavy minerals in raw sand:	0,25

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	26,1	0,1
Leucoxene	44,1	0,1
Rutile	13,0	0,0
Ti magnetite	0,0	0,0
Magnetite	1,3	0,0
Chromite	1,7	0,0
Pyrite	0,0	0,0
Phosphate	0,6	0,0
Monazite	0,4	0,0
Y-phosphate	0,2	0,0
Sphene	0,0	0,0
Garnet	0,1	0,0
Sillimanite	0,0	0,0
Staurolite	0,1	0,0
Zircon	7,0	0,0
Silicate	4,9	99,7
Unclassified	0,5	0,0
Total	100,0	100,0

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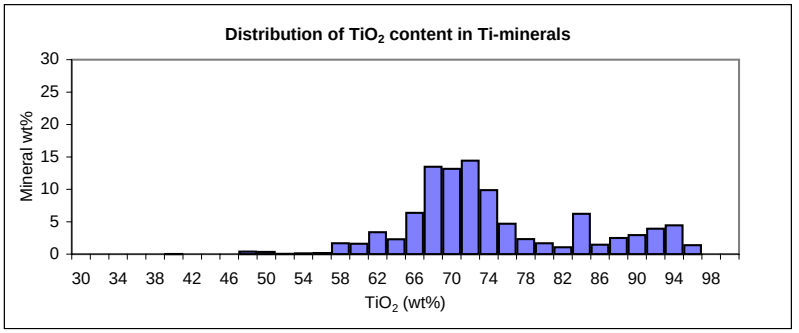
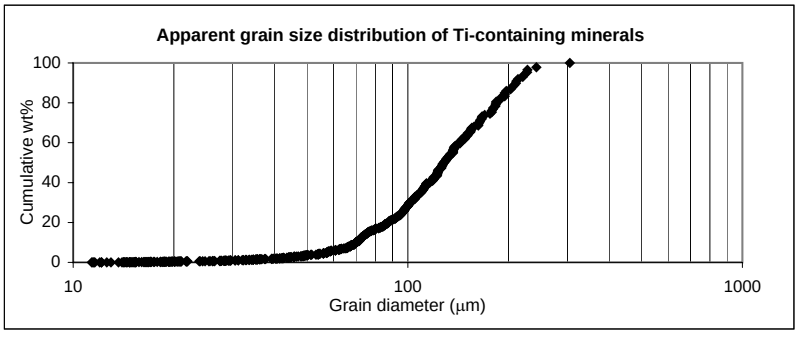
Sample Name:	Upper Sand 0.045-0.71	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	06-11-00		





Average grain parameters					
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Total grains
Ilmenite	1,6	1,9	344	138	162
Leucoxene	1,6	2,1	373	151	256
Rutile	1,5	2,0	338	136	81
Ti magnetite	1,2	1,5	134	48	1
Magnetite	1,4	2,7	533	233	5
Chromite	1,4	1,9	439	169	7
Pyrite	0,0	0,0	0	0	0
Phosphate	1,2	2,2	527	222	2
Monazite	1,8	1,6	138	51	12
Y-phosphate	1,3	1,6	380	139	1
Sphene	0,0	0,0	0	0	0
Garnet	1,8	2,9	379	166	1
Sillimanite	1,7	1,7	146	54	2
Staurolite	1,3	1,7	128	52	6
Zircon	1,4	1,8	327	127	46
Silicate	1,9	2,2	328	138	54
Unclassified	1,4	1,7	201	82	14

Poland

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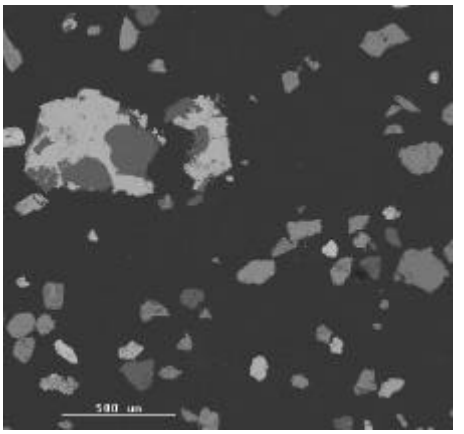

Sample Name:	R 00/73	No. of analysed frames:	40
Lab. Name:	2000092	No. analysed of particles	1282
Date:	7/30/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.00
Country:	Poland	Comments: Several grains are composed	
Analyzed by:	BV	of more than one mineral.	
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	325 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.6	34.6	1.8	0.1	4.3	1.6	0.4	0.1	0.2	97.7
Leucoxene	76.0	7.4	0.2	0.1	9.0	3.4	0.6	0.2	0.4	97.4
Rutile	93.6	1.1	0.2	0.2	1.6	0.7	0.2	0.1	0.3	97.9
Ti magnetite	40.3	40.7	1.3	0.6	4.9	1.1	0.8	0.1	0.7	90.4
Magnetite	0.2	75.4	2.3	0.1	9.9	3.0	0.6	3.8	0.4	95.7
Chromite	0.0	16.9	1.1	38.7	0.7	29.5	10.3	0.0	0.1	97.3
Pyrite	0.1	31.6	0.1	0.1	2.4	0.5	0.1	0.1	0.3	35.2
Phosphate	1.2	0.6	0.3	0.2	2.2	0.6	0.0	48.6	0.4	54.1
Monazite	0.0	0.7	0.0	0.0	8.2	1.4	0.1	1.0	1.1	12.5
Y-phosphate	0.0	0.8	0.2	0.0	1.5	0.7	0.0	1.0	1.9	6.1
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.2	31.8	2.0	0.1	37.1	19.5	4.1	2.9	0.2	97.9
Kya/Sill	0.5	0.7	0.2	0.1	41.8	53.5	0.0	0.0	0.0	96.7
Staurolite	0.7	15.8	0.3	0.1	32.3	47.1	1.2	0.0	0.4	98.1
Zircon	0.3	0.5	0.2	0.2	29.9	0.1	0.1	0.1	63.2	94.4
Silicate	0.8	7.6	0.6	0.2	77.2	6.9	0.9	1.5	0.5	96.0
Unclassified	3.7	20.1	1.7	2.5	20.8	7.9	2.0	1.2	13.6	73.4

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	16.5	3.2	9.4	4.8	46.6	16.2	0.2	3.1	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.9	78.0	95.6	44.5
Fe_2O_3 wt%	35.4	7.6	1.1	45.0
MnO wt%	1.9	0.2	0.2	1.4
Cr_2O_3 wt%	0.1	0.2	0.2	0.6
SiO_2 wt%	4.4	9.3	1.7	5.4
Al_2O_3 wt%	1.6	3.5	0.7	1.3
MgO wt%	0.4	0.6	0.2	0.9
CaO wt%	0.1	0.2	0.1	0.1
ZrO_2 wt%	0.2	0.4	0.3	0.7
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	67.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56.6
Valuable heavy minerals in raw sand:	0.00

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	8.7	
Leucoxene	1.7	
Rutile	5.0	
Ti magnetite	2.5	
Magnetite	2.5	
Chromite	0.0	
Pyrite	29.9	
Phosphate	0.0	
Monazite	0.9	
Y-phosphate	0.2	
Sphene	0.0	
Garnet	24.5	
Kya/Sill	0.1	
Staurolite	1.6	
Zircon	8.6	
Silicate	11.2	
Unclassified	2.5	
Total	100.0	

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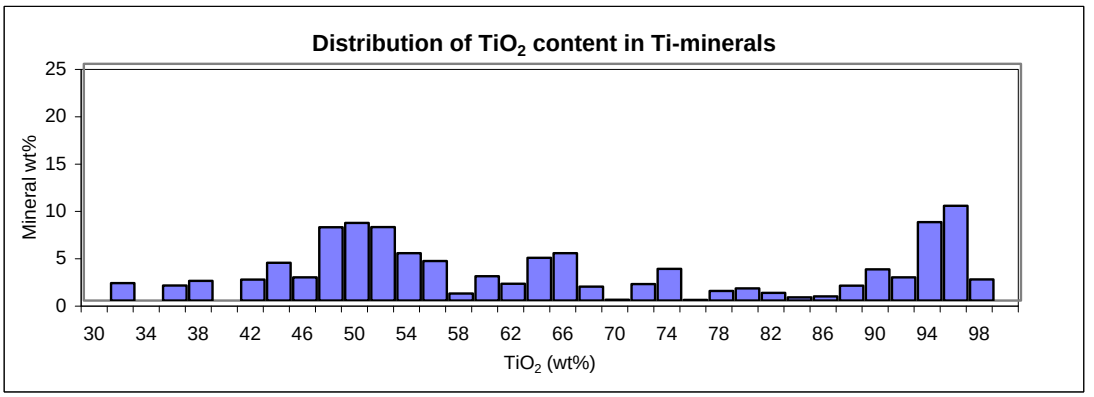
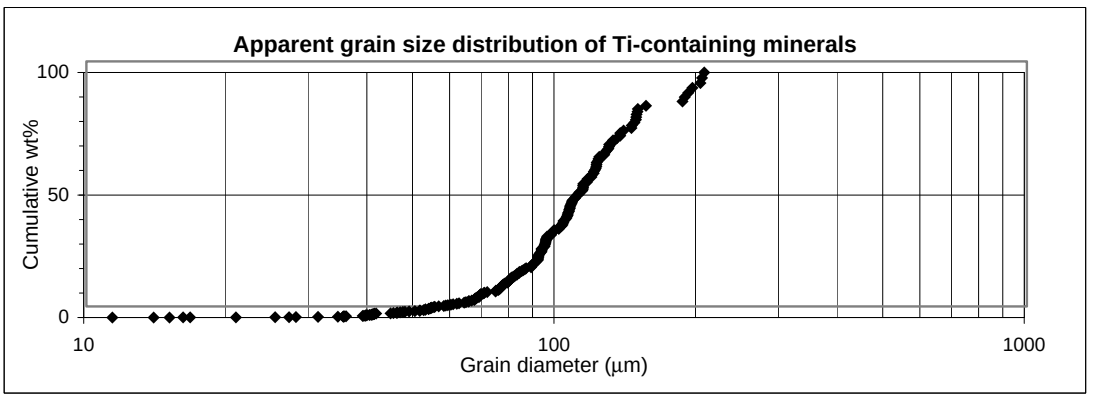
Lab. Name:	2000092	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	7/30/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	388	150	7434	107
Leucoxene	1.5	1.8	373	144	6758	23
Rutile	1.5	1.7	338	127	6078	67
Ti magnetite	1.5	2.1	506	206	11327	19
Magnetite	1.3	1.5	308	110	5951	33
Chromite	1.5	1.4	268	89	3994	1
Pyrite	1.3	1.7	373	141	8053	305
Phosphate	1.4	1.3	133	46	1318	3
Monazite	1.4	1.6	337	120	6297	12
Y-phosphate	1.7	1.6	302	109	4660	4
Sphene	0.0	0.0	0	0	0	0
Garnet	1.5	1.8	432	166	9729	259
Kya/Sill	1.5	1.8	514	199	11519	1
Staurolite	1.3	1.9	536	211	13591	13
Zircon	1.4	1.5	326	115	6296	120
Silicate	1.4	1.7	350	135	6985	249
Unclassified	1.4	1.6	277	113	5724	66

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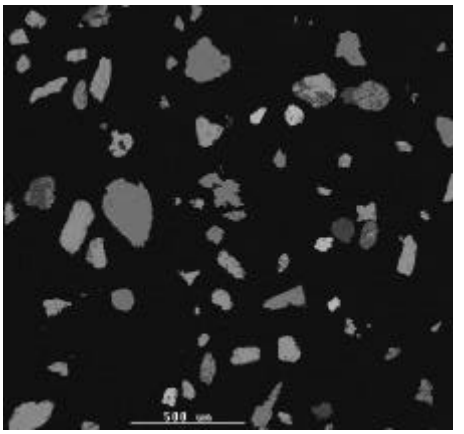

Sample Name:	R 96/71	No. of analysed frames:	54
Lab. Name:	2000093	No. analysed of particles	1482
Date:	7/30/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.00
Country:	Poland	Comments: Several grains are composed	
Analyzed by:	BV	of more than one mineral.	
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	400 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53.1	36.9	2.9	0.1	3.2	1.2	0.1	0.1	0.3	97.9
Leucoxene	75.7	6.4	0.4	0.2	10.2	3.6	0.2	0.1	0.5	97.2
Rutile	92.9	0.7	0.1	0.1	2.8	1.2	0.1	0.1	0.2	98.2
Ti magnetite	38.5	35.5	2.3	0.5	13.9	3.0	0.6	0.1	0.9	95.4
Magnetite	0.7	83.5	3.0	0.2	6.5	1.7	0.4	0.5	0.5	96.8
Chromite	1.4	32.4	0.9	31.8	1.2	24.6	5.3	0.1	0.1	97.8
Pyrite	0.3	29.8	0.1	0.1	5.4	0.6	0.1	0.1	0.3	36.8
Phosphate	0.1	4.9	0.8	0.0	1.4	15.7	0.4	28.4	0.6	52.2
Monazite	2.2	2.3	0.0	0.0	3.5	1.3	0.1	0.6	2.9	12.6
Y-phosphate	0.5	0.3	0.4	0.1	0.7	1.6	0.0	0.0	2.3	5.9
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.2	32.0	2.2	0.2	36.7	19.4	3.9	3.5	0.3	98.4
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.2	0.5	0.2	0.1	30.1	0.2	0.1	0.2	63.1	94.6
Silicate	5.2	2.6	0.2	0.2	82.3	3.1	0.2	0.7	0.4	94.9
Unclassified	16.8	13.2	1.3	0.7	29.4	4.5	0.6	3.0	12.3	81.8

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	70.9	6.2	10.2	3.5	0.6	8.6	0.0	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	54.2	77.9	94.6	40.3
Fe_2O_3 wt%	37.7	6.5	0.7	37.2
MnO wt%	3.0	0.4	0.1	2.4
Cr_2O_3 wt%	0.1	0.2	0.1	0.6
SiO_2 wt%	3.3	10.5	2.8	14.6
Al_2O_3 wt%	1.2	3.7	1.2	3.1
MgO wt%	0.1	0.2	0.1	0.6
CaO wt%	0.1	0.1	0.1	0.1
ZrO_2 wt%	0.3	0.5	0.2	1.0
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	59.9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	55.5
Valuable heavy minerals in raw sand:	0.00

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	48.6	
Leucoxene	4.3	
Rutile	7.0	
Ti magnetite	2.4	
Magnetite	19.9	
Chromite	0.3	
Pyrite	3.8	
Phosphate	0.1	
Monazite	0.5	
Y-phosphate	0.1	
Sphene	0.0	
Garnet	0.4	
Kya/Sill	0.0	
Staurolite	0.0	
Zircon	5.9	
Silicate	4.5	
Unclassified	2.2	
Total	100.0	

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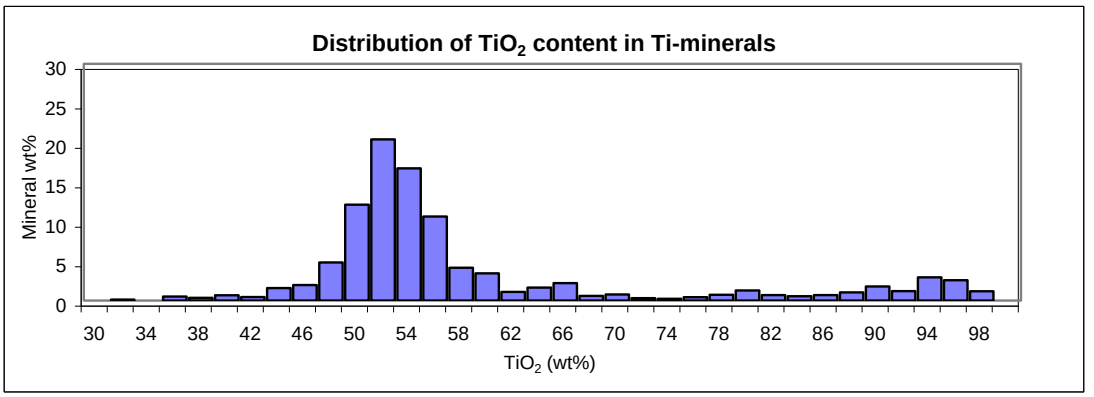
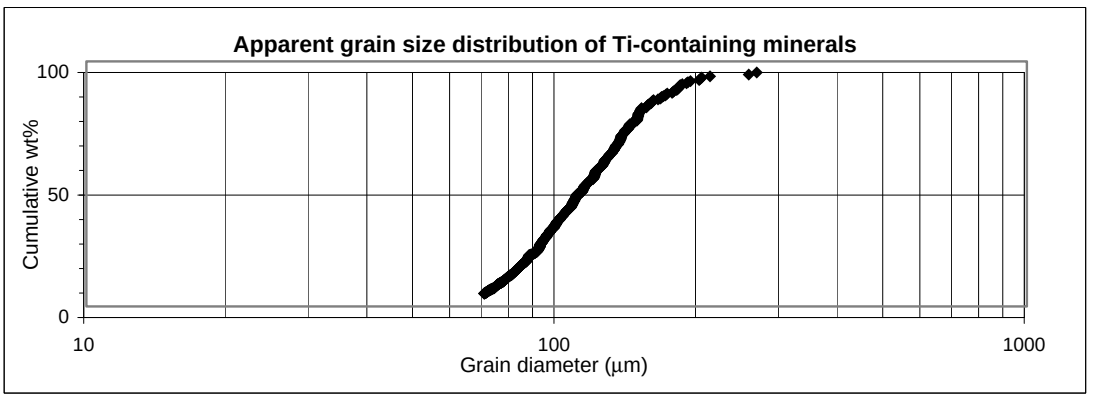
Lab. Name:	2000093	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	7/30/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	370	140	7082	766
Leucoxene	1.6	1.9	383	153	7350	65
Rutile	1.5	1.8	390	152	7387	95
Ti magnetite	1.5	1.8	348	138	6538	39
Magnetite	1.5	1.8	468	182	12986	148
Chromite	1.3	1.4	298	97	5391	6
Pyrite	1.4	1.7	358	140	8403	46
Phosphate	1.7	1.7	296	113	4005	2
Monazite	1.5	1.9	385	151	6608	7
Y-phosphate	1.3	1.3	249	70	3790	2
Sphene	0.0	0.0	0	0	0	0
Garnet	1.7	1.9	446	174	9628	5
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.3	1.5	294	103	5032	127
Silicate	1.5	1.8	389	152	8333	103
Unclassified	1.4	1.7	303	122	5797	71

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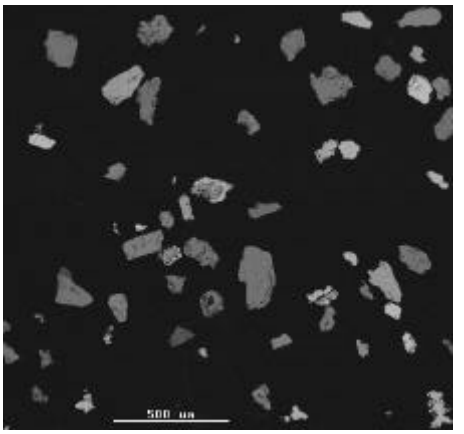

Sample Name:	R 98/71	No. of analysed frames:	36
Lab. Name:	2000094	No. analysed of particles	924
Date:	8/1/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.00
Country:	Poland	Comments: Several graind are composed	
Analyzed by:	BV	of more than one mineral.	
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	325 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	51.5	38.0	1.7	0.1	4.2	1.1	0.3	0.2	0.4	97.4
Leucoxene	75.9	5.6	0.3	0.3	11.0	2.6	0.3	0.1	0.6	96.7
Rutile	93.7	1.0	0.2	0.1	1.7	0.5	0.1	0.0	0.3	97.7
Ti magnetite	34.9	36.3	1.4	0.1	8.9	1.3	0.4	0.3	0.7	84.3
Magnetite	0.5	76.1	4.4	0.2	10.0	2.5	0.5	1.5	0.2	96.0
Chromite	0.4	25.4	0.4	41.1	2.0	20.3	8.3	0.1	0.2	98.2
Pyrite	0.1	30.7	0.1	0.1	3.3	1.0	0.1	0.1	0.3	35.8
Phosphate	0.3	0.6	0.2	0.3	1.7	0.7	0.2	52.7	0.5	57.1
Monazite	8.9	4.1	0.0	0.0	6.5	2.4	0.5	1.1	1.1	24.5
Y-phosphate	0.2	0.8	0.0	0.2	2.7	1.4	0.4	1.5	0.2	7.4
Sphene	38.0	0.3	0.4	0.2	30.0	1.3	0.1	26.9	0.7	97.9
Garnet	0.3	31.5	2.2	0.1	37.4	19.4	3.4	3.3	0.3	97.8
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	0.4	14.5	0.4	0.1	34.9	46.8	1.1	0.0	0.2	98.4
Zircon	0.1	0.6	0.1	0.2	29.7	0.1	0.1	0.2	63.4	94.6
Silicate	1.2	17.0	1.5	0.1	56.5	13.8	1.8	3.3	0.3	95.6
Unclassified	5.6	18.5	1.0	1.8	23.2	7.2	1.3	2.0	6.0	66.8

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	18.2	3.8	8.6	9.9	44.4	12.5	0.0	2.6	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	52.9	78.5	96.0	41.4
Fe_2O_3 wt%	39.0	5.7	1.0	43.1
MnO wt%	1.7	0.3	0.2	1.7
Cr_2O_3 wt%	0.1	0.3	0.1	0.1
SiO_2 wt%	4.3	11.4	1.7	10.5
Al_2O_3 wt%	1.1	2.7	0.5	1.5
MgO wt%	0.3	0.3	0.1	0.5
CaO wt%	0.2	0.1	0.0	0.3
ZrO_2 wt%	0.4	0.6	0.3	0.8
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	61.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	52.4
Valuable heavy minerals in raw sand:	0.00

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	8.3	
Leucoxene	1.7	
Rutile	3.9	
Ti magnetite	4.5	
Magnetite	4.2	
Chromite	0.7	
Pyrite	32.7	
Phosphate	0.5	
Monazite	0.4	
Y-phosphate	0.5	
Sphene	0.0	
Garnet	20.2	
Kya/Sill	0.0	
Staurolite	1.2	
Zircon	5.7	
Silicate	11.2	
Unclassified	4.2	
Total	100.0	

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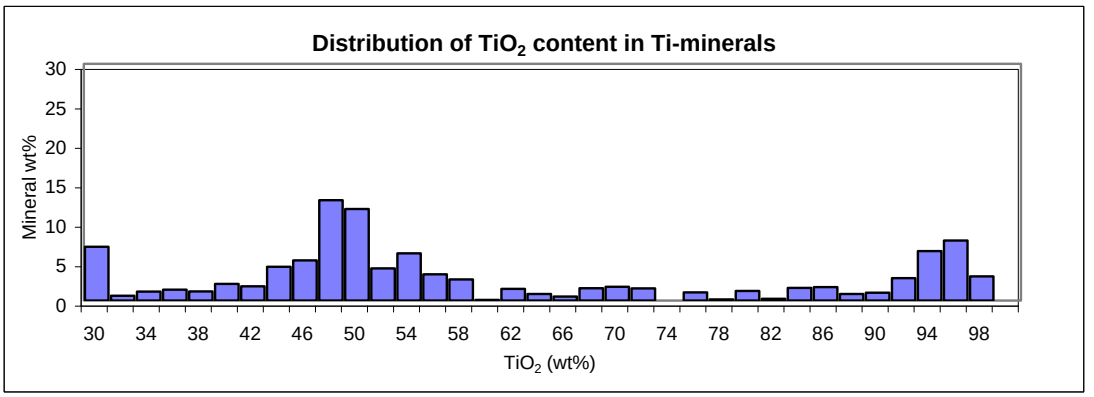
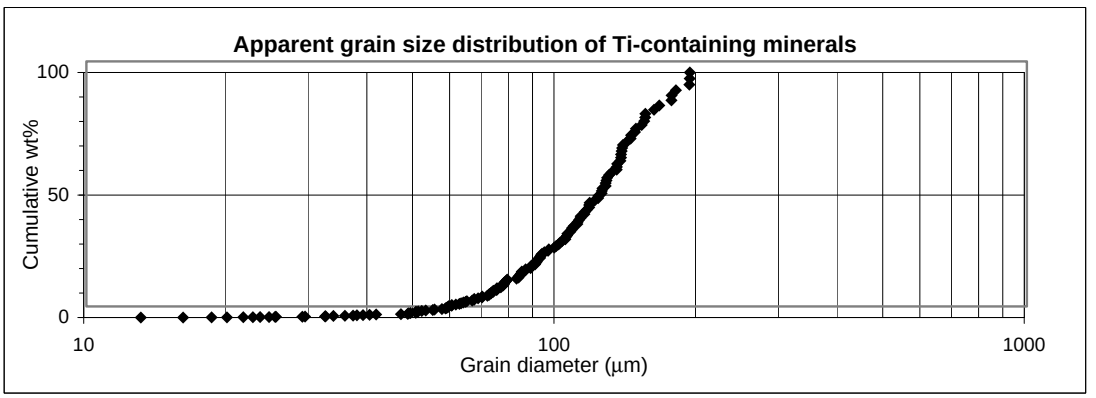
Lab. Name:	2000094	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	8/1/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	398	155	7950	72
Leucoxene	1.4	1.7	373	142	7509	16
Rutile	1.5	1.7	354	133	6545	37
Ti magnetite	1.5	2.1	441	181	8885	33
Magnetite	1.3	1.6	384	145	9747	26
Chromite	1.5	1.7	339	128	6036	7
Pyrite	1.4	1.8	354	141	7659	265
Phosphate	1.4	1.3	259	96	7439	4
Monazite	1.5	1.8	313	120	4954	5
Y-phosphate	1.5	1.8	396	151	7675	4
Sphene	2.3	1.7	174	66	1381	1
Garnet	1.5	1.8	415	161	9182	171
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	1.3	1.9	640	253	19239	5
Zircon	1.4	1.6	325	116	5928	64
Silicate	1.5	1.8	396	156	9336	141
Unclassified	1.4	1.6	279	113	6593	73

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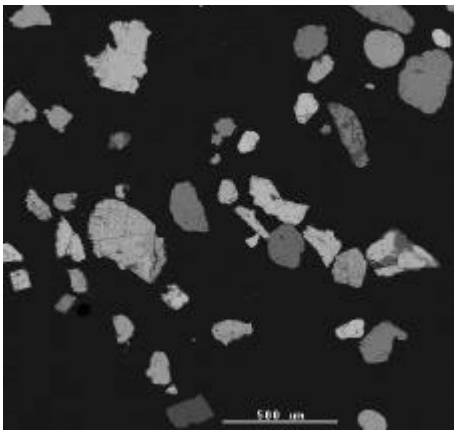

Sample Name:	1 W/31	No. of analysed frames:	81
Lab. Name:	2000095	No. analysed of particles	1407
Date:	7/31/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.00
Country:	Poland	Comments: Several grains are composed	
Analyzed by:	BV	of more than one mineral.	
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.0	35.5	3.8	0.1	2.6	1.3	0.3	0.1	0.4	98.0
Leucoxene	74.2	5.2	0.3	0.1	14.0	3.0	0.3	0.1	0.3	97.5
Rutile	91.4	1.2	0.2	0.1	3.3	1.3	0.1	0.1	0.3	98.1
Ti magnetite	38.7	46.7	4.2	0.2	3.8	2.1	0.8	0.2	0.5	97.1
Magnetite	1.8	88.8	0.7	0.2	3.0	1.2	0.4	0.8	0.3	97.3
Chromite	2.3	30.3	0.5	35.3	1.6	18.7	8.3	0.2	0.4	97.6
Pyrite	0.1	31.5	0.1	0.1	3.1	0.5	0.1	0.1	0.1	35.6
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	1.9	2.7	0.1	0.0	6.0	2.6	0.4	0.9	1.9	16.4
Y-phosphate	0.1	1.7	0.0	0.0	4.3	2.2	0.3	1.2	2.7	12.4
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.8	32.1	2.9	0.1	36.8	19.3	3.6	1.7	0.4	97.7
Kya/Sill	0.1	1.0	0.0	0.1	42.9	53.9	0.0	0.1	0.0	98.0
Staurolite	0.9	15.3	0.1	0.2	31.8	47.6	1.7	0.2	0.2	98.1
Zircon	0.2	0.6	0.1	0.2	29.5	0.4	0.1	0.2	63.1	94.5
Silicate	2.2	7.7	0.5	0.2	58.2	17.4	1.8	7.1	0.3	95.4
Unclassified	15.0	12.6	1.1	1.0	22.9	8.1	1.0	1.0	14.0	76.7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	42.4	8.8	8.0	8.7	18.1	12.6	0.4	1.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.1	76.1	93.3	39.8
Fe_2O_3 wt%	36.2	5.3	1.2	48.1
MnO wt%	3.9	0.3	0.2	4.3
Cr_2O_3 wt%	0.1	0.1	0.1	0.2
SiO_2 wt%	2.6	14.3	3.4	3.9
Al_2O_3 wt%	1.3	3.0	1.4	2.2
MgO wt%	0.3	0.3	0.1	0.8
CaO wt%	0.1	0.1	0.1	0.2
ZrO_2 wt%	0.4	0.3	0.3	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	60.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56.0
Valuable heavy minerals in raw sand:	0.00

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	23.3	
Leucoxene	4.9	
Rutile	4.4	
Ti magnetite	4.7	
Magnetite	27.6	
Chromite	0.6	
Pyrite	4.7	
Phosphate	0.0	
Monazite	1.0	
Y-phosphate	0.4	
Sphene	0.0	
Garnet	9.9	
Kya/Sill	0.2	
Staurolite	0.5	
Zircon	6.9	
Silicate	9.1	
Unclassified	1.8	
Total	100.0	

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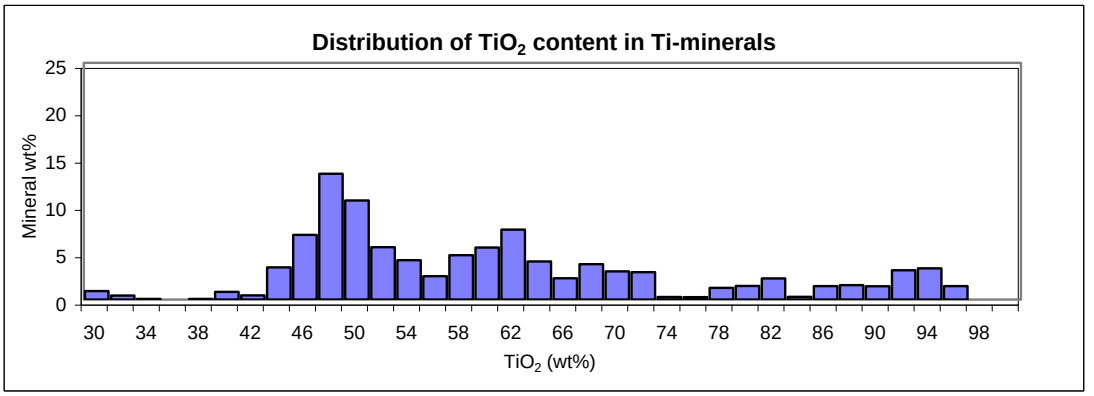
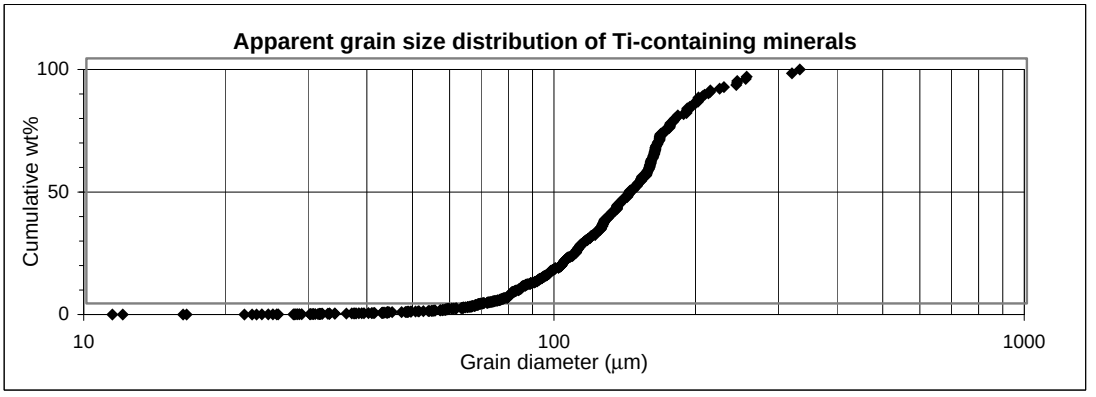
Lab. Name:	2000095	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	7/31/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.7	440	165	10234	367
Leucoxene	1.5	1.9	488	191	12235	64
Rutile	1.5	1.8	455	173	10670	60
Ti magnetite	1.5	1.8	451	177	11638	62
Magnetite	1.5	1.9	541	215	16123	239
Chromite	1.4	1.6	325	122	5686	15
Pyrite	1.4	1.7	507	189	16287	42
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.5	1.6	304	114	5051	28
Y-phosphate	1.6	1.6	277	102	4355	14
Sphene	0.0	0.0	0	0	0	0
Garnet	1.5	1.8	632	249	22283	81
Kya/Sill	1.6	2.1	547	222	11778	4
Staurolite	1.5	1.8	520	201	14242	7
Zircon	1.4	1.6	332	118	6339	170
Silicate	1.5	1.8	491	189	13578	184
Unclassified	1.4	1.5	299	119	6734	70

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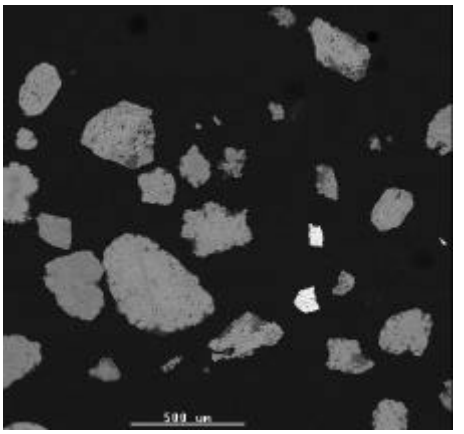

Sample Name:	55/65	No. of analysed frames:	81
Lab. Name:	2000096	No. analysed of particles	801
Date:	7/31/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.00
Country:	Poland	Comments: Many grains are composed of	
Analyzed by:	BV	more than one mineral. Amount of	
Acc. Voltage/Magnification: 17kV/50x		unclassified is high. Grains with high	
Guard region:	375 µm	content of Ti, Fe, Si and Al have been	
Sieve:	100 µm^2	categorized as unclassified.	

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	59.2	29.2	3.4	0.3	1.4	1.0	0.4	0.4	1.0	96.3
Leucoxene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rutile	88.6	0.2	0.4	0.5	7.0	0.9	0.0	0.0	0.9	98.5
Ti magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	0.3	72.4	0.8	0.1	16.0	5.9	0.7	0.4	0.4	96.9
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.1	32.8	0.1	0.1	1.9	0.4	0.0	0.0	0.1	35.6
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	49.1	1.0	0.0	0.0	7.2	5.0	0.0	0.7	0.0	63.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.1	35.0	0.4	0.1	38.7	20.1	1.2	0.2	0.4	96.1
Kya/Sill	0.4	1.8	0.0	0.0	42.9	53.2	0.0	0.0	0.8	99.1
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.3	0.9	0.0	0.3	27.8	0.4	0.1	1.0	61.0	91.7
Silicate	0.5	15.5	0.1	0.1	63.7	14.1	0.4	0.2	0.4	95.0
Unclassified	10.6	34.0	0.5	0.8	25.4	7.8	0.7	0.5	0.9	81.1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	49.8	0.0	14.6	0.0	11.2	21.4	3.0	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	61.5	0	90.0	0
Fe_2O_3 wt%	30.3	0	0.2	0
MnO wt%	3.5	0	0.4	0
Cr_2O_3 wt%	0.4	0	0.5	0
SiO_2 wt%	1.5	0	7.1	0
Al_2O_3 wt%	1.0	0	0.9	0
MgO wt%	0.4	0	0.0	0
CaO wt%	0.4	0	0.0	0
ZrO_2 wt%	1.0	0	0.9	0
Total	100.0	0	100.0	0

Average TiO_2 content of all the TiO_2 minerals:	68.0
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	61.5
Valuable heavy minerals in raw sand:	0.00

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	0.3	
Leucoxene	0.0	
Rutile	0.1	
Ti magnetite	0.0	
Magnetite	89.6	
Chromite	0.0	
Pyrite	1.1	
Phosphate	0.0	
Monazite	0.1	
Y-phosphate	0.0	
Sphene	0.0	
Garnet	0.1	
Kya/Sill	0.0	
Staurolite	0.0	
Zircon	0.1	
Silicate	1.4	
Unclassified	7.1	
Total	100.0	

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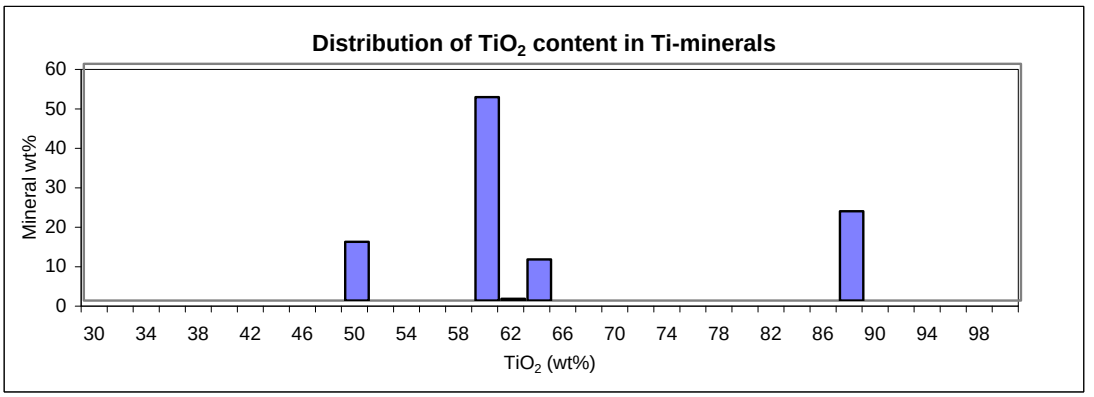
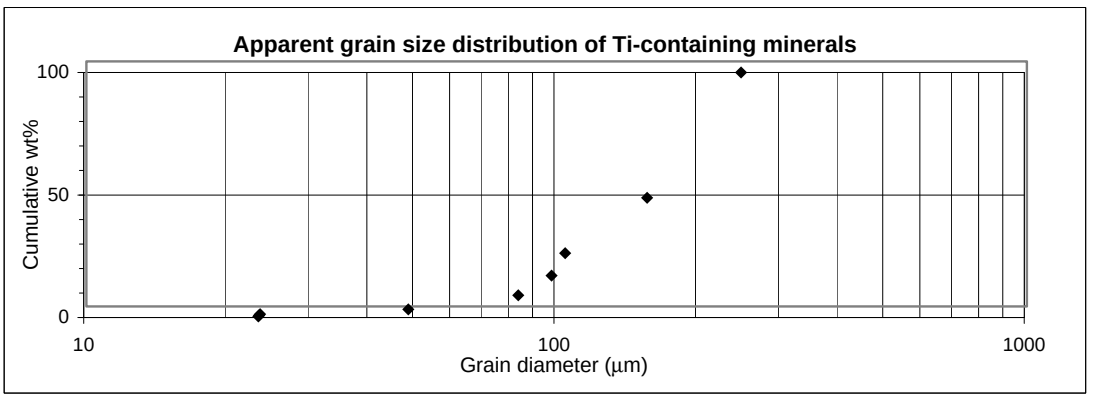
Lab. Name:	2000096	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	7/31/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.3	1.5	332	123	9278	8
Leucoxene	0.0	0.0	0	0	0	0
Rutile	1.5	1.8	657	250	19552	1
Ti magnetite	0.0	0.0	0	0	0	0
Magnetite	1.4	1.9	713	284	27513	599
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.5	2.2	651	270	17757	12
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.4	2.0	492	197	9655	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	1.9	248	101	3136	6
Kya/Sill	1.9	1.9	386	153	6159	1
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.3	1.7	558	207	15406	2
Silicate	1.4	1.7	408	160	12967	40
Unclassified	1.5	1.9	569	232	19162	131

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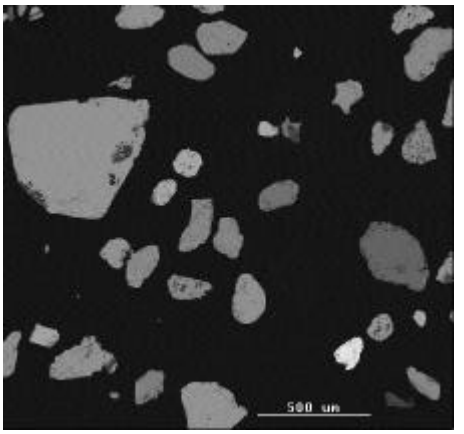

Sample Name:	1. Rakowice	No. of analysed frames:	47
Lab. Name:	2000097	No. analysed of particles	697
Date:	10/8/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	94.34
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	325 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	50.3	40.7	3.2	0.1	2.4	0.7	0.3	0.4	0.2	98.3
Leucoxene	72.1	10.5	0.6	0.3	11.5	2.9	0.4	0.1	0.0	98.3
Rutile	94.4	0.9	0.1	0.1	1.5	0.8	0.1	0.1	0.2	98.2
Ti magnetite	35.0	51.7	2.7	0.1	5.0	1.5	0.7	0.9	0.4	98.0
Magnetite	2.2	85.3	0.4	0.4	4.7	1.6	0.5	0.3	0.6	96.0
Chromite	1.6	56.7	1.3	20.0	4.5	0.5	3.1	0.0	0.0	87.8
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	1.0	2.8	0.0	0.0	3.2	1.1	0.2	1.1	3.0	12.4
Y-phosphate	0.1	1.0	0.0	0.0	6.4	1.7	0.2	0.0	1.4	10.9
Sphene	36.5	0.0	0.0	0.5	30.2	2.2	0.1	26.5	0.4	96.5
Garnet	0.2	28.9	5.9	0.1	36.7	19.6	2.9	2.7	0.2	97.2
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.1	0.9	0.1	0.2	29.6	0.2	0.1	0.2	63.5	94.9
Silicate	2.6	11.8	0.3	0.2	48.5	15.1	3.1	11.7	0.4	93.8
Unclassified	4.5	30.8	2.3	1.6	13.0	3.3	1.5	10.0	4.7	71.7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	49.0	1.0	3.5	17.9	17.6	11.0	0.0	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	51.2	73.3	96.1	35.8
Fe_2O_3 wt%	41.4	10.7	0.9	52.8
MnO wt%	3.2	0.6	0.1	2.8
Cr_2O_3 wt%	0.1	0.3	0.1	0.1
SiO_2 wt%	2.5	11.7	1.6	5.1
Al_2O_3 wt%	0.7	3.0	0.9	1.5
MgO wt%	0.3	0.4	0.1	0.7
CaO wt%	0.5	0.1	0.1	0.9
ZrO_2 wt%	0.2	0.0	0.2	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	49.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	47.4
Valuable heavy minerals in raw sand:	36.66

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	19.0	18.0
Leucoxene	0.4	0.4
Rutile	1.3	1.3
Ti magnetite	7.0	6.6
Magnetite	53.1	50.1
Chromite	0.4	0.4
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	1.5	1.4
Y-phosphate	0.3	0.3
Sphene	0.0	0.0
Garnet	6.9	6.5
Kya/Sill	0.0	0.0
Staurolite	0.0	0.0
Zircon	4.3	4.0
Silicate	2.6	8.1
Unclassified	3.2	3.0
Total	100.0	100.0

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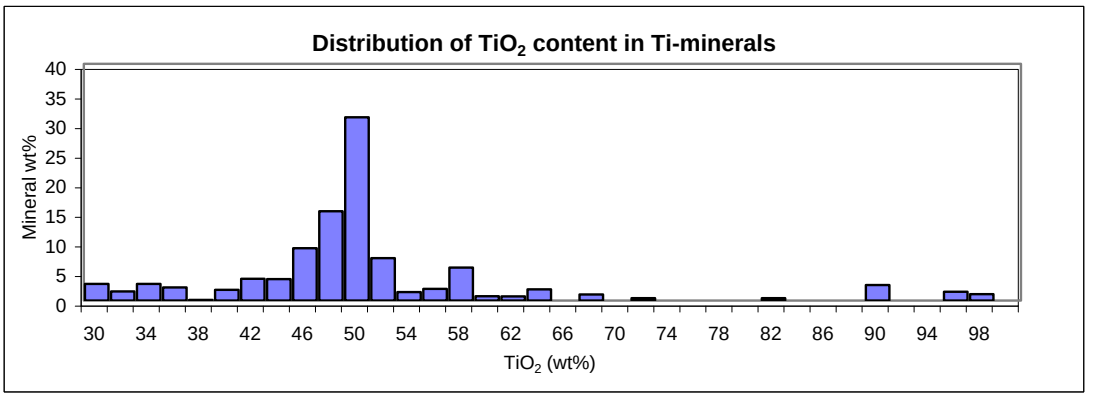
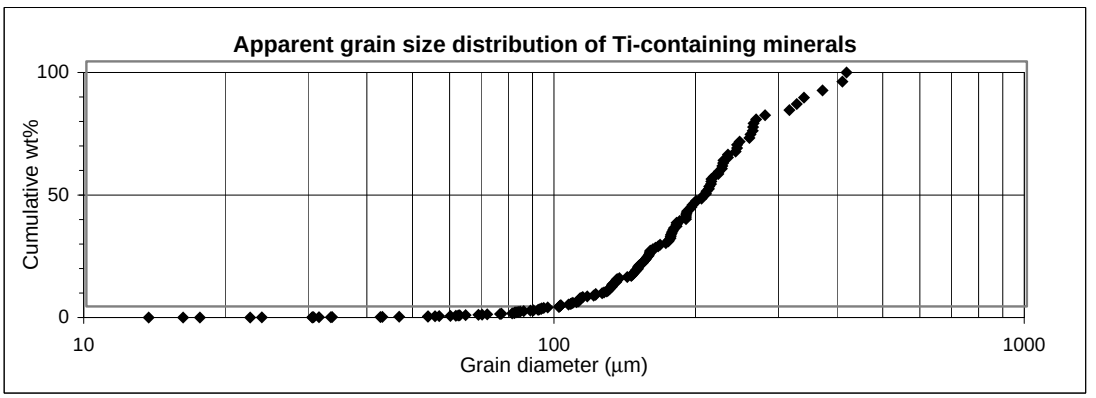
Lab. Name:	2000097	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/8/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	656	253	23046	110
Leucoxene	1.3	1.9	526	205	12616	4
Rutile	1.6	1.8	690	264	22996	7
Ti magnetite	1.5	1.8	604	235	19874	44
Magnetite	1.5	1.7	542	208	19558	313
Chromite	1.8	2.7	840	383	23819	2
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.6	1.8	499	197	13760	13
Y-phosphate	1.5	1.6	579	214	18076	2
Sphene	1.4	2.0	421	167	7216	1
Garnet	1.7	2.0	840	337	44639	23
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.4	1.7	506	183	13151	42
Silicate	1.4	1.6	504	197	17715	33
Unclassified	1.4	1.7	303	128	6900	103

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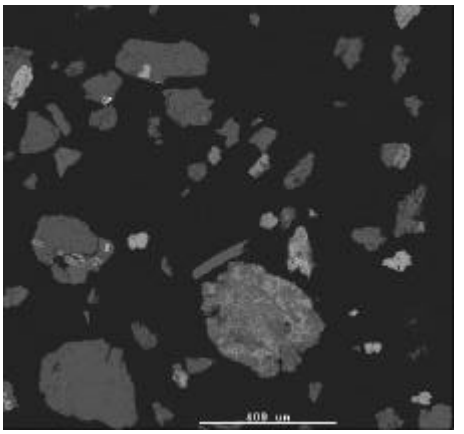

Sample Name:	6. Pliocene	No. of analysed frames:	44
Lab. Name:	2000102	No. analysed of particles	720
Date:	10/11/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.15
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.2	28.4	4.1	0.1	7.8	2.3	0.2	0.1	0.3	97.6
Leucoxene	76.2	5.2	0.6	0.2	10.2	3.9	0.6	0.1	0.4	97.4
Rutile	90.8	1.2	0.2	0.1	3.4	1.8	0.1	0.1	0.2	97.9
Ti magnetite	40.2	26.9	6.2	0.0	14.0	9.3	0.2	0.2	0.0	97.1
Magnetite	0.3	72.6	0.2	0.2	6.7	1.6	8.2	0.3	0.4	90.5
Chromite	0.1	22.8	0.9	59.5	1.1	7.5	5.5	0.3	0.4	98.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	4.0	0.0	0.0	16.0	35.7	0.5	0.5	0.0	56.6
Monazite	0.0	0.0	0.0	0.0	3.1	0.0	1.0	0.8	1.2	6.1
Y-phosphate	1.6	0.0	0.0	0.3	3.9	2.0	0.0	0.4	0.0	8.2
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	10.0	11.1	3.4	0.1	42.3	23.4	0.9	0.6	0.7	92.5
Kya/Sill	0.2	0.6	0.2	0.2	42.4	53.9	0.0	0.1	0.2	97.9
Staurolite	9.6	10.5	0.6	0.0	35.8	42.1	0.2	0.0	0.0	98.7
Zircon	0.2	0.3	0.3	0.2	29.5	0.5	0.2	0.0	64.0	95.2
Silicate	1.6	2.0	0.2	0.2	54.0	34.8	0.4	0.2	0.3	93.6
Unclassified	30.0	9.4	3.9	0.3	29.1	13.8	1.2	0.9	3.3	91.9

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	47.7	6.7	12.3	1.6	9.0	2.9	19.6	0.2	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.5	78.3	92.8	41.4
Fe_2O_3 wt%	29.1	5.4	1.2	27.7
MnO wt%	4.2	0.6	0.3	6.4
Cr_2O_3 wt%	0.1	0.2	0.1	0.0
SiO_2 wt%	8.0	10.5	3.5	14.4
Al_2O_3 wt%	2.4	4.0	1.9	9.5
MgO wt%	0.2	0.6	0.1	0.3
CaO wt%	0.1	0.1	0.1	0.2
ZrO_2 wt%	0.4	0.4	0.2	0.0
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	64.2
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	57.9
Valuable heavy minerals in raw sand:	0.04

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	12.9	0.0
Leucoxene	1.8	0.0
Rutile	3.3	0.0
Ti magnetite	0.4	0.0
Magnetite	17.9	0.0
Chromite	0.6	0.0
Pyrite	0.0	0.0
Phosphate	0.2	0.0
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	2.5	0.0
Kya/Sill	5.3	0.0
Staurolite	0.1	0.0
Zircon	0.8	0.0
Silicate	51.7	99.9
Unclassified	2.2	0.0
Total	100.0	100.0

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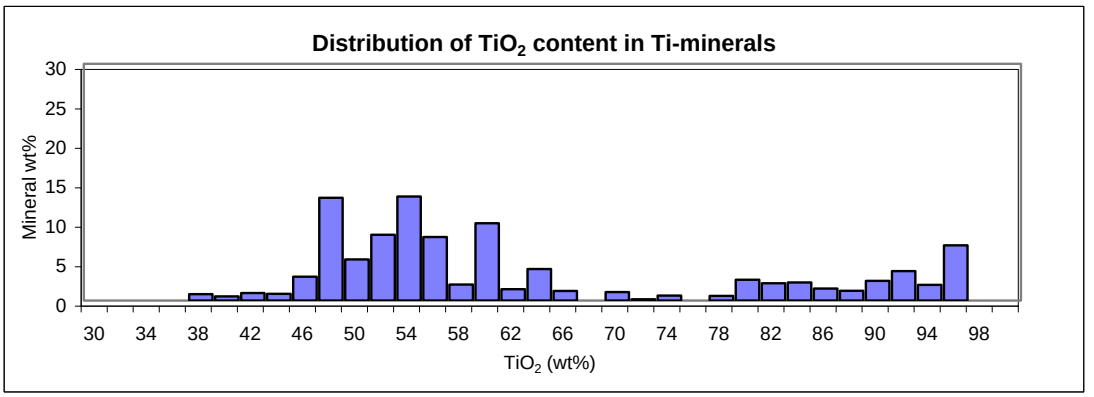
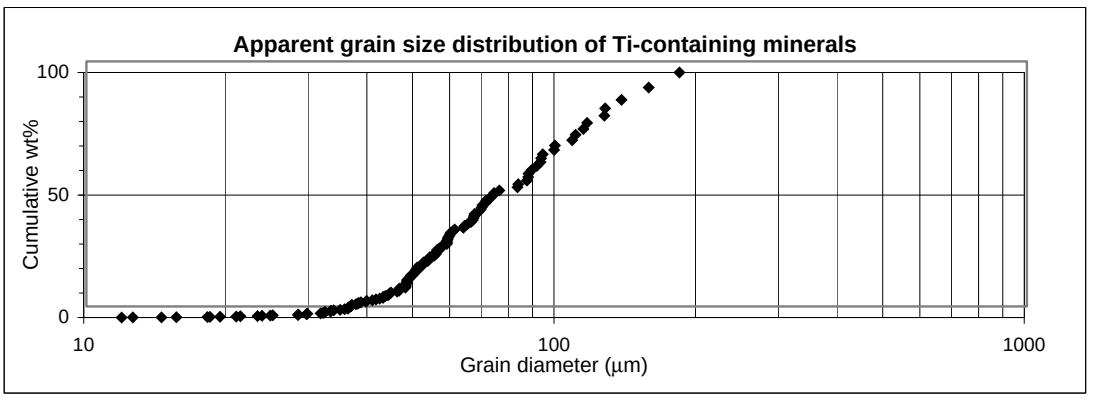
Lab. Name:	2000102	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/11/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.7	1.9	261	104	3327	92
Leucoxene	1.8	2.0	227	91	2274	19
Rutile	1.7	2.1	279	113	3544	20
Ti magnetite	1.7	2.0	195	77	1570	6
Magnetite	1.4	1.8	671	284	52451	7
Chromite	1.2	1.6	506	184	12722	1
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.6	1.8	325	125	4719	1
Monazite	1.5	2.1	272	110	2820	1
Y-phosphate	1.5	1.6	146	53	1039	1
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	2.3	372	157	6516	10
Kya/Sill	1.5	1.9	232	97	3791	46
Staurolite	1.3	2.9	242	105	1628	1
Zircon	1.3	1.5	203	69	2575	7
Silicate	1.6	2.2	279	119	4415	470
Unclassified	1.6	2.3	321	140	4518	19

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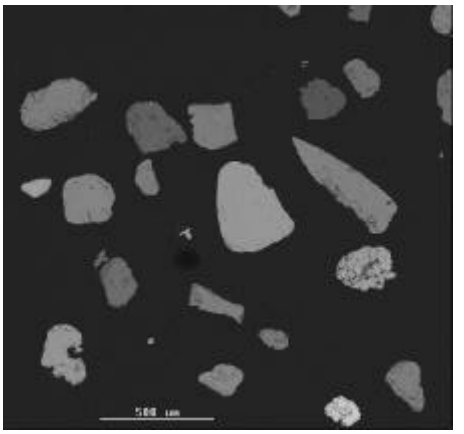

Sample Name:	7. Hel Peninsula	No. of analysed frames:	51
Lab. Name:	2000103	No. analysed of particles	628
Date:	10/9/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	36.84
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	275 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	57.0	35.5	2.2	0.1	1.6	0.9	0.4	0.4	0.3	98.3
Leucoxene	75.3	19.3	1.0	0.2	0.8	0.9	0.1	0.1	0.2	97.9
Rutile	94.4	1.0	0.2	0.2	1.6	0.4	0.0	0.1	0.2	98.2
Ti magnetite	36.4	43.9	2.7	0.1	8.8	3.8	0.7	0.4	0.3	97.0
Magnetite	1.4	80.2	2.3	0.3	4.9	2.5	0.4	2.5	0.5	95.0
Chromite	0.9	41.0	0.4	41.6	0.0	11.1	3.6	0.0	0.2	98.9
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.3	1.4	0.0	0.0	0.3	0.3	0.5	58.6	0.0	61.4
Monazite	0.0	0.0	0.0	0.0	1.9	0.0	0.3	2.5	2.4	7.1
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	36.4	2.8	0.0	0.0	28.6	2.1	0.0	27.1	0.0	97.0
Garnet	0.1	34.5	2.4	0.1	36.1	19.3	3.3	2.0	0.2	98.1
Kya/Sill	0.0	1.9	0.0	0.4	41.7	53.9	0.1	0.0	0.0	98.1
Staurolite	0.7	14.7	0.4	0.1	34.3	46.2	1.4	0.1	0.2	98.0
Zircon	0.2	0.5	0.2	0.1	29.9	0.1	0.1	0.2	63.7	95.0
Silicate	0.7	19.2	1.4	0.2	43.1	17.6	3.1	12.2	0.2	97.6
Unclassified	5.0	23.0	1.2	0.8	23.3	10.7	1.6	8.8	3.8	78.3

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	31.3	2.7	1.6	3.8	53.7	2.9	0.3	3.8	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58.0	76.9	96.1	37.5
Fe_2O_3 wt%	36.1	19.7	1.0	45.2
MnO wt%	2.3	1.1	0.2	2.7
Cr_2O_3 wt%	0.1	0.2	0.2	0.1
SiO_2 wt%	1.6	0.8	1.7	9.1
Al_2O_3 wt%	0.9	0.9	0.4	3.9
MgO wt%	0.4	0.1	0.0	0.7
CaO wt%	0.4	0.1	0.1	0.5
ZrO_2 wt%	0.3	0.2	0.2	0.3
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	58.9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	57.3
Valuable heavy minerals in raw sand:	29.54

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	25.1	9.2
Leucoxene	2.2	0.8
Rutile	1.3	0.5
Ti magnetite	3.0	1.1
Magnetite	2.7	1.0
Chromite	0.1	0.1
Pyrite	0.0	0.0
Phosphate	0.2	0.1
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	0.2	0.1
Garnet	43.0	15.9
Kya/Sill	0.2	0.1
Staurolite	3.0	1.1
Zircon	2.3	0.9
Silicate	14.8	68.6
Unclassified	1.7	0.6
Total	100.0	100.0

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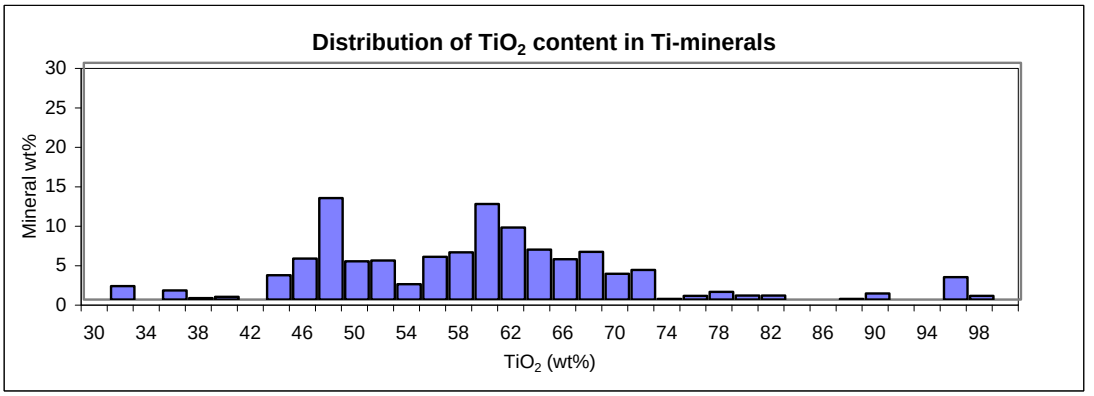
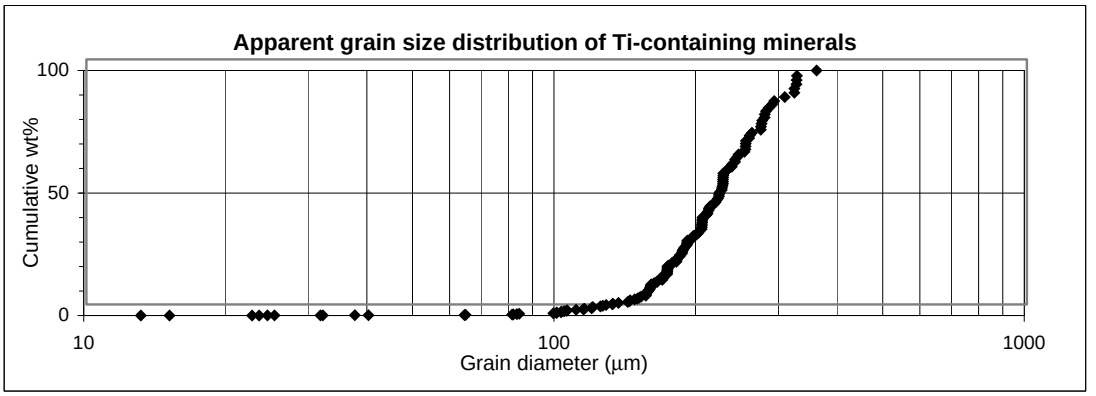
Lab. Name:	2000103	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/9/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.8	774	294	30197	127
Leucoxene	1.3	1.6	755	276	30344	11
Rutile	1.5	1.8	686	260	24818	7
Ti magnetite	1.4	2.0	855	344	33593	13
Magnetite	1.5	1.6	450	167	16825	21
Chromite	2.0	1.7	399	144	9455	2
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.4	1.5	749	255	30425	1
Monazite	1.6	1.3	517	159	15858	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.4	1.8	830	321	30084	1
Garnet	1.6	2.0	758	302	27418	270
Kya/Sill	1.6	2.1	1106	451	45986	1
Staurolite	1.4	1.7	724	273	30356	18
Zircon	1.4	1.7	717	264	26525	13
Silicate	1.4	1.8	786	302	33078	116
Unclassified	1.4	1.3	355	131	17046	26

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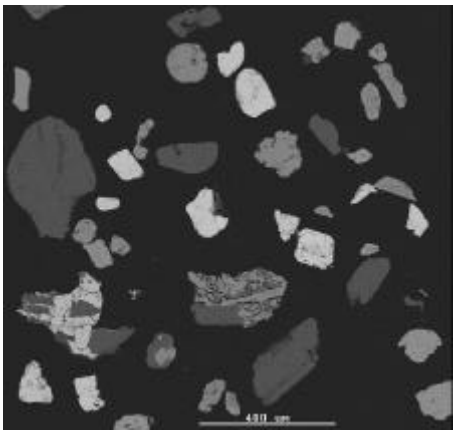

Sample Name:	1. Belchatów	No. of analysed frames:	121
Lab. Name:	2000104	No. analysed of particles	1214
Date:	10/8/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.17
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	275 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63.8	26.4	1.2	0.1	4.6	1.6	0.3	0.1	0.3	98.4
Leucoxene	76.1	12.6	0.5	0.2	5.7	2.3	0.2	0.1	0.3	98.0
Rutile	93.1	1.3	0.1	0.2	2.1	1.1	0.1	0.1	0.3	98.3
Ti magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	2.5	77.6	0.0	0.3	11.2	2.6	1.2	1.5	0.1	97.1
Chromite	0.4	20.2	0.6	52.5	1.7	15.7	6.5	0.1	0.3	98.0
Pyrite	0.2	29.9	0.1	0.1	5.8	0.4	0.0	0.1	0.4	37.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	1.9	0.0	0.4	4.9	2.1	0.5	1.1	2.9	13.9
Y-phosphate	0.7	1.7	0.0	0.0	0.6	1.6	0.0	0.3	1.4	6.3
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.3	24.6	0.8	3.8	40.7	21.0	5.6	1.0	0.1	97.9
Kya/Sill	0.3	1.0	0.1	0.1	42.7	53.4	0.0	0.1	0.2	98.0
Staurolite	0.8	14.7	0.3	0.1	33.4	47.0	1.5	0.1	0.2	98.1
Zircon	0.3	0.3	0.2	0.1	29.7	0.3	0.1	0.2	64.1	95.2
Silicate	1.4	5.0	0.1	0.2	54.5	32.5	2.1	0.7	0.3	96.8
Unclassified	15.0	4.7	0.3	2.0	32.2	5.7	0.7	0.4	26.5	87.6

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	20.8	21.8	28.7	0.0	0.4	19.8	1.8	6.8	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64.8	77.7	94.7	0
Fe_2O_3 wt%	26.8	12.9	1.3	0
MnO wt%	1.2	0.5	0.1	0
Cr_2O_3 wt%	0.1	0.2	0.2	0
SiO_2 wt%	4.7	5.9	2.1	0
Al_2O_3 wt%	1.6	2.3	1.1	0
MgO wt%	0.3	0.2	0.1	0
CaO wt%	0.1	0.1	0.1	0
ZrO_2 wt%	0.3	0.3	0.3	0
Total	100.0	100.0	100.0	0

Average TiO_2 content of all the TiO_2 minerals:	80.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	71.4
Valuable heavy minerals in raw sand:	0.12

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	15.0	0.0
Leucoxene	15.7	0.0
Rutile	20.7	0.0
Ti magnetite	0.0	0.0
Magnetite	0.3	0.0
Chromite	0.5	0.0
Pyrite	3.5	0.0
Phosphate	0.0	0.0
Monazite	0.2	0.0
Y-phosphate	0.1	0.0
Sphene	0.0	0.0
Garnet	0.3	0.0
Kya/Sill	1.3	0.0
Staurolite	4.9	0.0
Zircon	14.3	0.0
Silicate	21.7	99.9
Unclassified	1.6	0.0
Total	100.0	100.0

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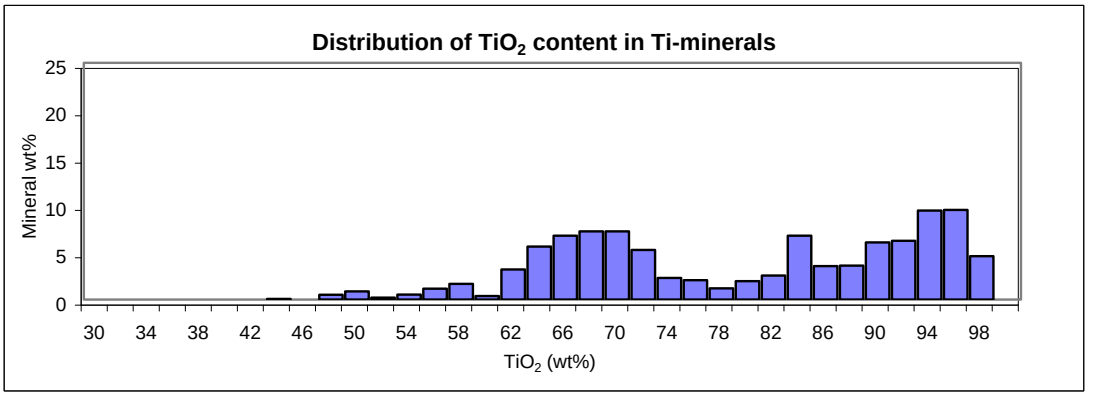
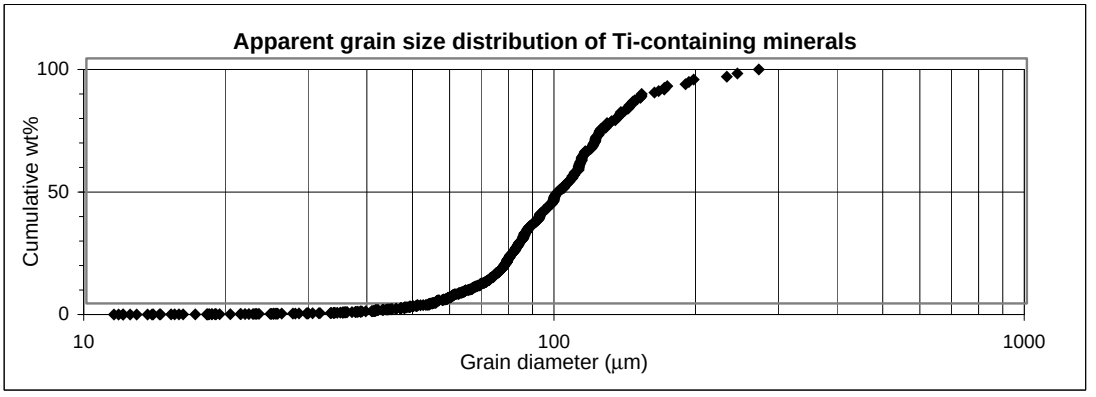
Lab. Name:	2000104	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/8/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	332	126	5824	180
Leucoxene	1.6	1.9	364	143	6712	164
Rutile	1.6	1.9	336	131	5450	239
Ti magnetite	0.0	0.0	0	0	0	0
Magnetite	1.4	2.0	281	111	3800	5
Chromite	1.6	1.6	186	66	1939	15
Pyrite	1.5	2.1	378	157	9633	23
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.5	1.7	151	60	1230	8
Y-phosphate	1.4	1.3	263	80	4125	1
Sphene	0.0	0.0	0	0	0	0
Garnet	1.5	2.2	354	145	5104	4
Kya/Sill	2.2	2.6	480	203	7862	16
Staurolite	1.7	2.4	431	181	7994	51
Zircon	1.5	1.6	297	108	4844	200
Silicate	1.5	2.1	431	177	9832	263
Unclassified	1.4	1.9	296	123	4820	39

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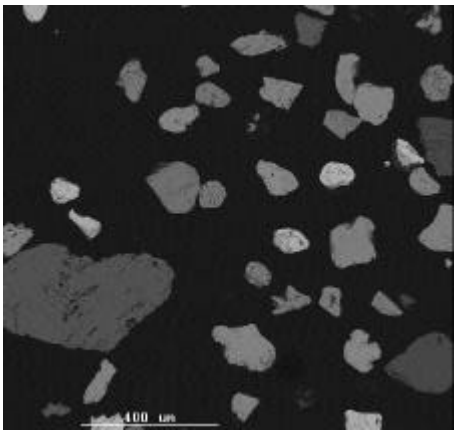

Sample Name:	2. Belchatów	No. of analysed frames:	117
Lab. Name:	2000105	No. analysed of particles	1346
Date:	10/8/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.17
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	275 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	62.4	25.7	1.3	0.1	5.9	2.2	0.3	0.1	0.4	98.4
Leucoxene	75.8	12.9	0.5	0.2	6.0	2.1	0.1	0.1	0.3	98.1
Rutile	93.1	1.3	0.1	0.1	2.2	1.1	0.1	0.1	0.3	98.3
Ti magnetite	43.2	39.9	0.5	0.1	8.0	3.9	1.9	0.4	0.2	98.1
Magnetite	0.4	92.7	0.2	0.1	1.1	0.6	0.7	0.1	0.5	96.5
Chromite	0.4	19.6	0.9	50.6	1.5	18.2	6.9	0.1	0.1	98.4
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.0	0.0	0.0	5.1	1.7	1.0	1.7	1.0	10.5
Y-phosphate	0.1	0.1	0.0	0.0	2.2	2.9	0.1	1.2	2.3	9.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	4.4	19.0	0.4	0.2	39.9	21.6	3.7	1.0	0.0	90.3
Kya/Sill	0.3	0.8	0.2	0.3	42.6	53.7	0.0	0.0	0.1	97.9
Staurolite	0.9	15.1	0.2	0.2	33.6	46.5	1.4	0.0	0.2	98.1
Zircon	0.3	0.4	0.1	0.1	29.8	0.3	0.1	0.1	64.1	95.5
Silicate	1.7	5.5	0.2	0.1	57.2	29.0	2.0	0.5	0.3	96.5
Unclassified	22.9	6.6	0.4	1.7	30.8	7.3	0.5	0.3	20.4	90.9

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	22.7	24.1	26.2	0.3	0.1	23.4	0.5	2.8	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	63.5	77.3	94.6	44.1
Fe_2O_3 wt%	26.1	13.1	1.3	40.6
MnO wt%	1.3	0.5	0.1	0.5
Cr_2O_3 wt%	0.1	0.2	0.1	0.1
SiO_2 wt%	6.0	6.1	2.2	8.2
Al_2O_3 wt%	2.2	2.1	1.1	4.0
MgO wt%	0.3	0.1	0.1	1.9
CaO wt%	0.1	0.1	0.1	0.4
ZrO_2 wt%	0.4	0.3	0.3	0.2
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	79.1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	70.4
Valuable heavy minerals in raw sand:	0.13

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	17.6	0.0
Leucoxene	18.6	0.0
Rutile	20.3	0.0
Ti magnetite	0.2	0.0
Magnetite	1.9	0.0
Chromite	2.5	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.1	0.0
Sphene	0.0	0.0
Garnet	0.1	0.0
Kya/Sill	0.4	0.0
Staurolite	2.1	0.0
Zircon	18.1	0.0
Silicate	15.9	99.9
Unclassified	2.0	0.0
Total	100.0	100.0

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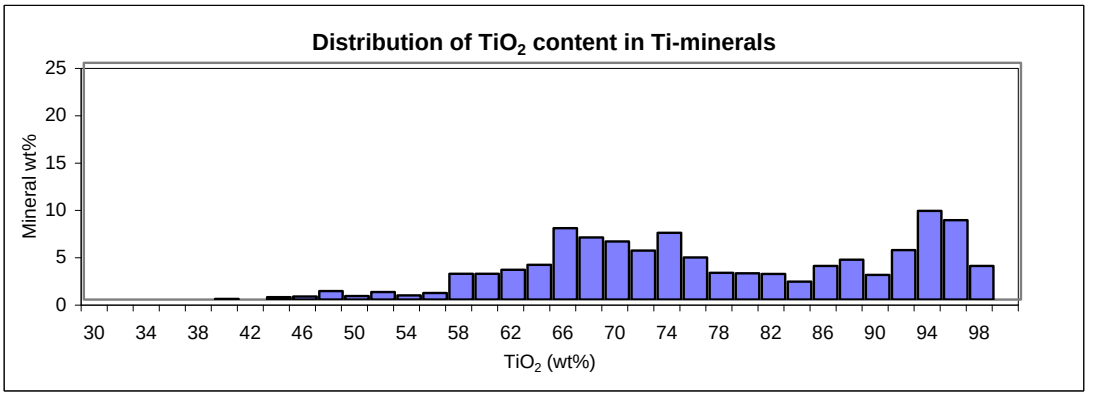
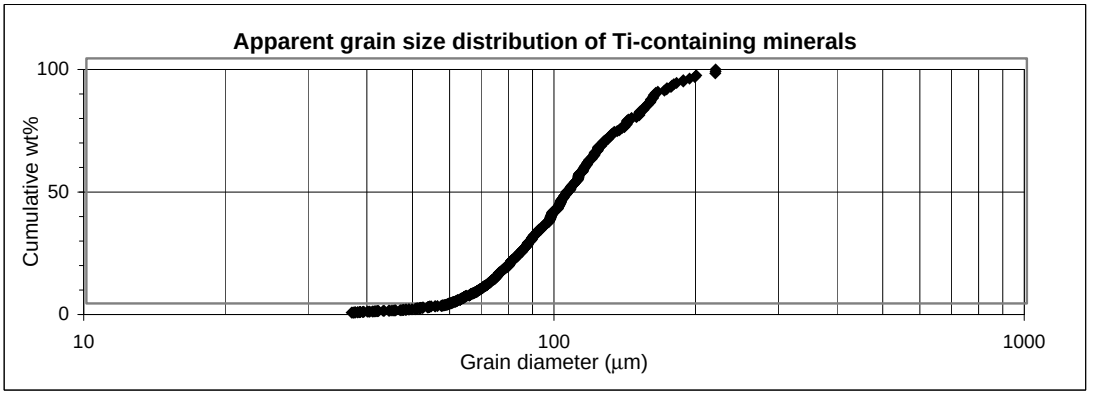
Lab. Name:	2000105	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/8/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.8	344	132	6136	245
Leucoxene	1.5	1.8	401	155	8103	197
Rutile	1.5	1.8	351	136	6022	260
Ti magnetite	1.5	1.6	284	103	4689	4
Magnetite	1.3	1.7	1037	367	71604	2
Chromite	1.5	1.7	313	116	4933	38
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.2	1.5	203	70	2209	1
Y-phosphate	1.5	1.8	349	135	5433	2
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	1.6	204	78	2618	3
Kya/Sill	1.5	1.8	436	172	9640	5
Staurolite	1.7	2.2	435	180	7732	28
Zircon	1.5	1.6	304	109	5036	298
Silicate	1.6	1.9	365	146	10734	216
Unclassified	1.4	2.1	351	146	6051	47

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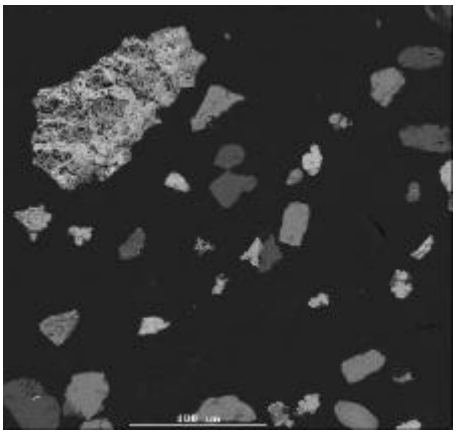

Sample Name:	3. Belchatów	No. of analysed frames:	144
Lab. Name:	2000106	No. analysed of particles	1217
Date:	10/11/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.24
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	62.7	27.6	1.3	0.1	3.8	1.3	0.3	0.1	0.3	97.6
Leucoxene	75.8	12.3	0.5	0.1	6.2	2.0	0.2	0.2	0.4	97.6
Rutile	93.5	1.3	0.1	0.2	1.6	1.0	0.1	0.1	0.3	98.1
Ti magnetite	28.6	29.6	1.7	0.0	23.3	4.6	3.6	5.1	0.1	96.7
Magnetite	0.9	69.6	1.3	0.2	4.9	1.4	0.7	0.9	0.3	80.2
Chromite	0.4	20.4	0.5	53.0	0.5	16.6	6.8	0.1	0.0	98.2
Pyrite	0.2	33.5	0.1	0.1	1.8	0.4	0.0	0.1	0.2	36.5
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	1.0	0.0	0.0	15.4	1.0	0.0	1.4	0.0	18.8
Y-phosphate	0.0	1.3	0.2	0.0	0.0	1.1	0.0	0.0	0.0	2.6
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.2	33.0	2.9	0.1	36.8	19.1	3.7	2.7	0.2	98.7
Kya/Sill	0.5	0.5	0.1	0.1	43.0	53.8	0.0	0.1	0.1	98.2
Staurolite	0.8	15.6	0.4	0.1	32.7	47.2	1.3	0.0	0.2	98.4
Zircon	0.2	0.5	0.1	0.2	29.6	0.2	0.1	0.1	63.8	95.0
Silicate	1.2	5.4	0.2	0.1	64.5	20.9	1.9	0.8	0.3	95.4
Unclassified	4.0	25.9	0.2	0.6	20.6	6.0	1.8	3.4	4.1	66.5

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	22.4	22.3	23.8	0.1	1.6	22.5	2.0	5.3	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64.2	77.7	95.3	29.6
Fe_2O_3 wt%	28.3	12.6	1.3	30.6
MnO wt%	1.3	0.5	0.1	1.8
Cr_2O_3 wt%	0.2	0.1	0.2	0.0
SiO_2 wt%	3.9	6.3	1.6	24.1
Al_2O_3 wt%	1.3	2.0	1.0	4.8
MgO wt%	0.3	0.2	0.1	3.7
CaO wt%	0.1	0.2	0.1	5.2
ZrO_2 wt%	0.3	0.4	0.3	0.1
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	79.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	70.8
Valuable heavy minerals in raw sand:	0.11

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	10.5	0.0
Leucoxene	10.4	0.0
Rutile	11.2	0.0
Ti magnetite	0.1	0.0
Magnetite	2.4	0.0
Chromite	0.8	0.0
Pyrite	27.4	0.1
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.1	0.0
Sphene	0.0	0.0
Garnet	0.7	0.0
Kya/Sill	0.9	0.0
Staurolite	2.5	0.0
Zircon	10.5	0.0
Silicate	19.8	99.8
Unclassified	2.6	0.0
Total	100.0	100.0

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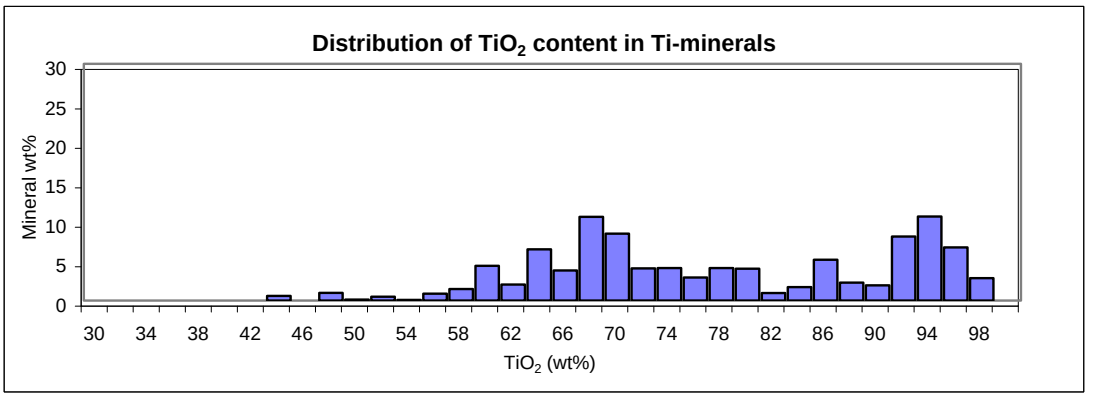
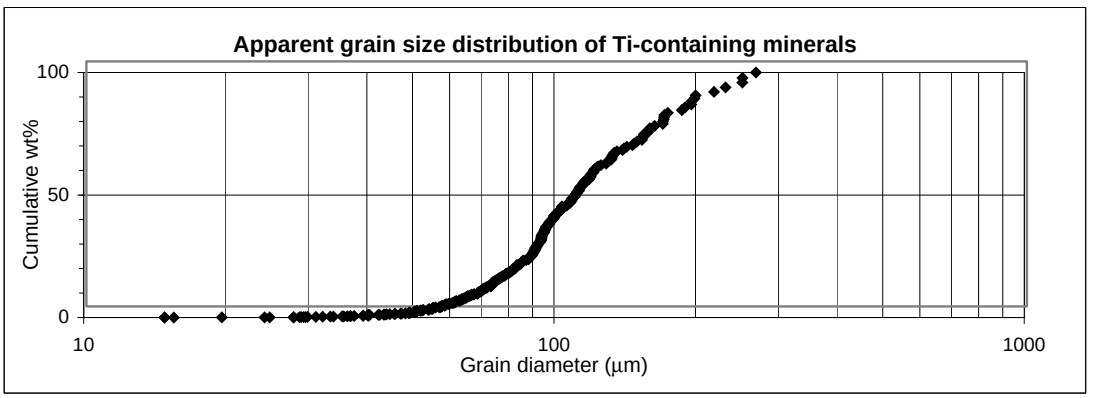
Lab. Name:	2000106	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/11/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.8	368	140	6926	121
Leucoxene	1.6	1.9	412	160	8991	93
Rutile	1.6	1.8	348	134	6285	128
Ti magnetite	1.6	1.6	318	115	5055	1
Magnetite	1.4	1.5	293	111	8430	20
Chromite	1.5	1.8	425	164	8503	7
Pyrite	1.4	1.9	296	119	5075	390
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.4	1.3	77	23	364	2
Y-phosphate	1.7	1.5	260	88	3701	1
Sphene	0.0	0.0	0	0	0	0
Garnet	1.7	1.9	426	166	8246	8
Kya/Sill	1.9	2.6	662	286	14666	7
Staurolite	1.6	2.3	543	225	12337	19
Zircon	1.4	1.6	314	114	5753	142
Silicate	1.5	2.0	460	190	12959	208
Unclassified	1.4	1.7	243	100	5009	70

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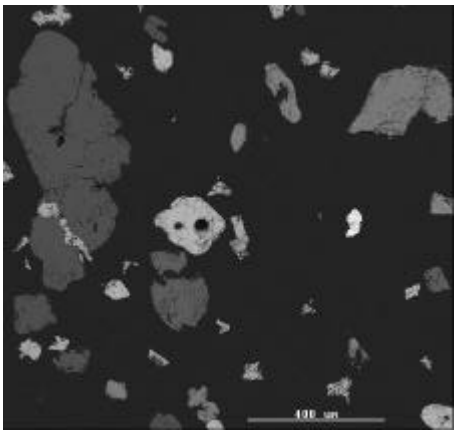

Sample Name:	4. Konin	No. of analysed frames:	125
Lab. Name:	2000107	No. analysed of particles	1421
Date:	10/11/01	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.10
Country:	Poland	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	61.9	9.0	0.1	0.5	11.5	1.9	0.4	0.1	2.5	88.0
Leucoxene	78.3	4.2	0.2	0.3	7.0	0.9	0.2	0.3	1.9	93.3
Rutile	95.1	0.9	0.2	0.1	0.8	0.4	0.1	0.1	0.2	97.8
Ti magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	0.0	89.7	0.0	0.1	3.2	0.5	0.1	0.1	0.0	93.7
Chromite	1.4	24.6	1.0	48.9	0.3	14.8	7.4	0.1	0.1	98.6
Pyrite	0.2	31.3	0.1	0.1	1.1	0.1	0.0	0.1	0.2	33.3
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	1.2	0.0	0.0	1.1	0.2	0.2	1.5	1.1	5.3
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.1	33.1	4.6	0.1	35.8	18.7	1.4	4.4	0.5	98.7
Kya/Sill	0.2	0.9	0.1	0.1	42.8	53.7	0.0	0.1	0.3	98.1
Staurolite	0.6	15.0	0.3	0.2	32.1	47.9	1.5	0.1	0.2	98.0
Zircon	0.2	0.4	0.2	0.2	29.4	0.1	0.1	0.2	64.2	94.9
Silicate	0.8	3.9	0.2	0.2	59.8	27.9	1.9	0.5	0.3	95.4
Unclassified	8.1	9.8	1.0	2.4	22.6	4.1	3.0	8.7	13.1	72.8

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	1.0	3.0	44.2	0.0	2.3	22.1	17.2	10.2	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	70.4	83.9	97.2	0
Fe_2O_3 wt%	10.3	4.5	0.9	0
MnO wt%	0.1	0.2	0.2	0
Cr_2O_3 wt%	0.6	0.3	0.1	0
SiO_2 wt%	13.1	7.5	0.8	0
Al_2O_3 wt%	2.1	0.9	0.4	0
MgO wt%	0.5	0.3	0.1	0
CaO wt%	0.1	0.3	0.1	0
ZrO_2 wt%	2.9	2.0	0.2	0
Total	100.0	100.0	100.0	0

Average TiO_2 content of all the TiO_2 minerals:	95.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	80.5
Valuable heavy minerals in raw sand:	0.05

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	0.5	0.0
Leucoxene	1.6	0.0
Rutile	23.7	0.0
Ti magnetite	0.0	0.0
Magnetite	0.1	0.0
Chromite	0.3	0.0
Pyrite	15.4	0.0
Phosphate	0.0	0.0
Monazite	0.4	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	1.2	0.0
Kya/Sill	9.3	0.0
Staurolite	5.5	0.0
Zircon	11.8	0.0
Silicate	29.0	99.9
Unclassified	1.2	0.0
Total	100.0	100.0

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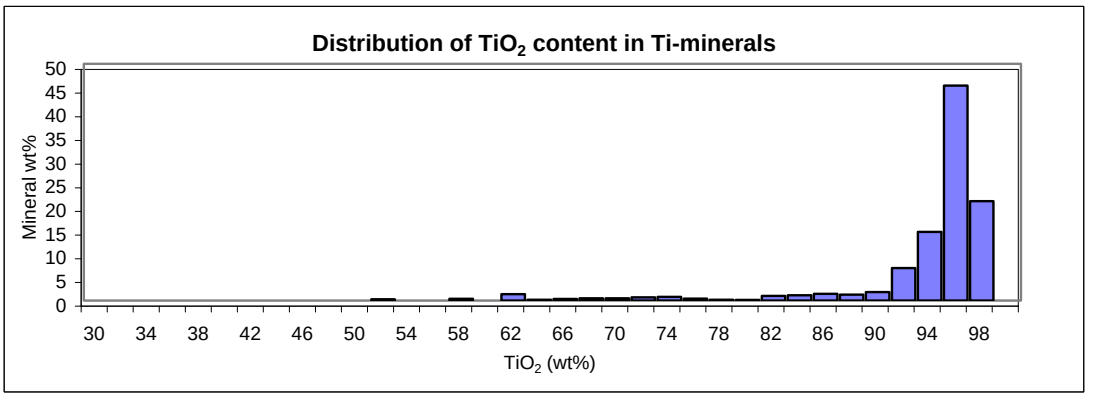
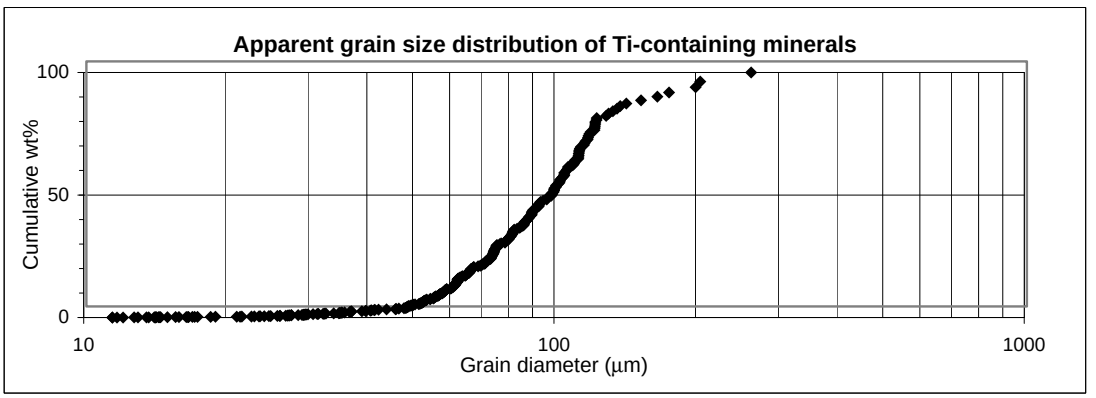
Lab. Name:	2000107	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	10/11/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.3	2.5	339	144	4171	8
Leucoxene	1.6	2.3	292	123	3439	29
Rutile	1.6	2.0	313	125	4754	279
Ti magnetite	0.0	0.0	0	0	0	0
Magnetite	2.3	3.3	341	152	2805	1
Chromite	1.4	1.6	257	95	3404	5
Pyrite	1.4	1.9	204	82	2100	409
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.7	1.7	658	248	20113	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.7	2.4	490	210	10855	8
Kya/Sill	1.8	2.6	580	251	13030	61
Staurolite	1.6	2.1	348	146	6178	65
Zircon	1.5	1.7	273	102	3865	184
Silicate	1.6	2.2	374	157	9083	337
Unclassified	1.5	1.9	246	101	3509	34

Lithuania

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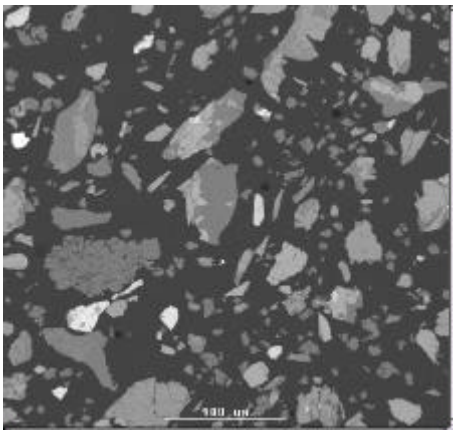

Sample Name:	2.Pananga	No. of analysed frames:	8
Lab. Name:	2000025	No. analysed of particles	1253
Date:	19-04-01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.81
Country:	Lithuania	comments: Amount of unclassified is	
Analyzed by:	CCA	high. Grains with high content of Ca and	
Acc. Voltage/Magnification: 17kV/30x		Mg have been categorized as	
Guard region:	340 µm	unclassified.	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	50.6	41.7	2.1	0.1	1.4	0.5	0.7	0.4	0.3	97.7
Leucoxene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti magnetite	34.0	51.6	1.3	0.1	4.7	2.1	1.5	1.6	0.4	97.3
Magnetite	2.5	80.2	0.6	0.1	6.6	2.1	0.7	2.0	0.6	95.4
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.1	0.4	0.2	0.1	0.6	0.1	0.2	57.5	1.2	60.4
Monazite	0.0	1.2	0.0	0.0	4.0	1.6	0.0	2.8	3.8	13.3
Y-phosphate	0.0	0.2	1.1	0.1	2.8	2.2	0.3	0.0	2.1	8.8
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.3	32.9	1.5	0.1	36.8	19.4	4.1	1.8	0.3	97.2
Kya/Sill	0.2	1.4	0.1	0.0	43.1	53.0	0.1	0.1	0.3	98.3
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.1	0.4	0.6	0.1	29.6	0.2	0.2	0.8	64.7	96.7
Silicate	1.9	16.8	0.4	0.1	46.0	13.2	5.7	10.1	0.3	94.5
Unclassified	0.4	2.8	0.4	0.2	4.0	1.3	31.0	54.4	0.4	94.9

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	19.6	0.0	0.0	14.3	60.7	1.9	3.6	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	51.8	0	0	35.0
Fe_2O_3 wt%	42.6	0	0	53.0
MnO wt%	2.1	0	0	1.4
Cr_2O_3 wt%	0.1	0	0	0.1
SiO_2 wt%	1.5	0	0	4.9
Al_2O_3 wt%	0.5	0	0	2.2
MgO wt%	0.7	0	0	1.6
CaO wt%	0.4	0	0	1.6
ZrO_2 wt%	0.3	0	0	0.4
Total	100.0	0	0	100.0

Average TiO_2 content of all the TiO_2 minerals:	44.7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	44.7
Valuable heavy minerals in raw sand:	0.11

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	2.6	0.0
Leucoxene	0.0	0.0
Rutile	0.0	0.0
Ti magnetite	1.9	0.0
Magnetite	3.6	0.0
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.8	0.0
Monazite	0.3	0.0
Y-phosphate	0.2	0.0
Sphene	0.0	0.0
Garnet	8.2	0.1
Kya/Sill	0.5	0.0
Staurolite	0.0	0.0
Zircon	0.3	0.0
Silicate	60.0	99.7
Unclassified	21.6	0.2
Total	100.0	100.0

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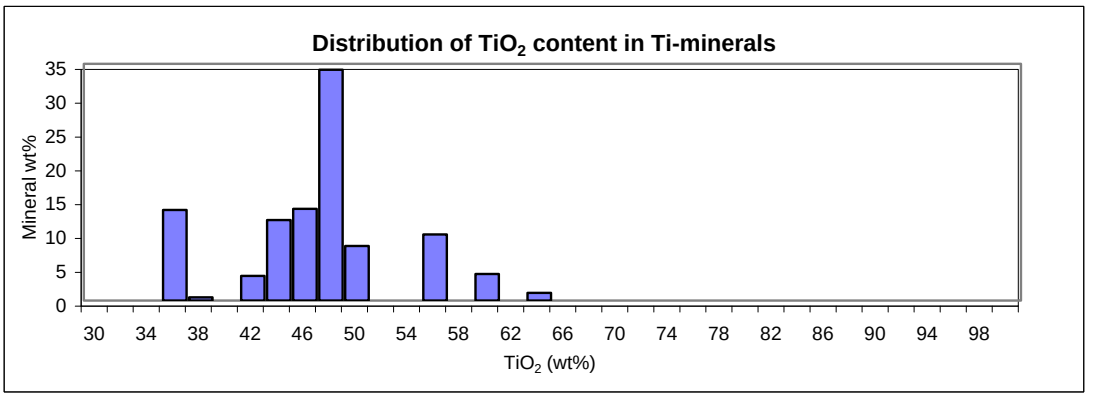
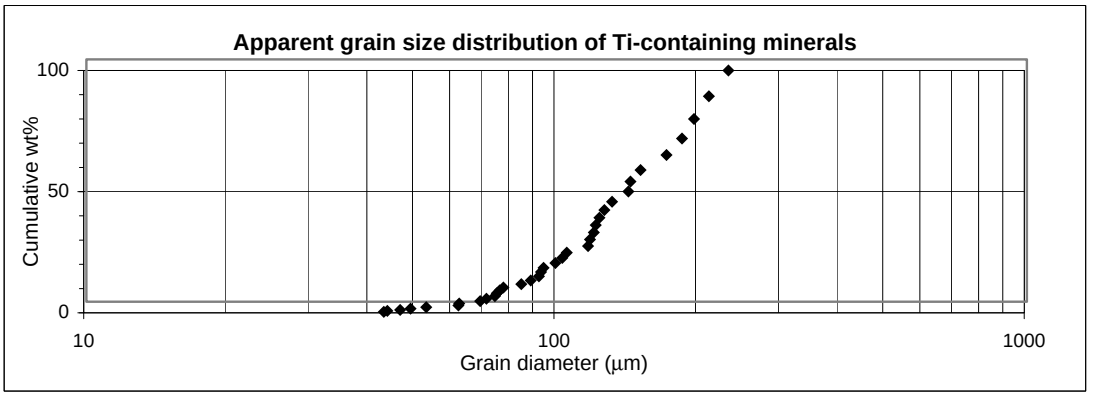
Lab. Name:	2000025	Analyzed by:	CCA
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/19/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.6	423	151	10221	23
Leucoxene	0.0	0.0	0	0	0	0
Rutile	0.0	0.0	0	0	0	0
Ti magnetite	1.5	1.7	473	179	12417	13
Magnetite	1.5	1.5	412	152	12156	23
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.5	1.5	306	107	5423	12
Monazite	1.2	1.3	583	175	20365	1
Y-phosphate	1.1	1.5	495	170	13178	1
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	1.7	560	214	19092	43
Kya/Sill	1.3	1.8	1164	447	60292	1
Staurolite	0.0	0.0	0	0	0	0
Zircon	1.2	1.4	311	108	5403	4
Silicate	1.7	1.8	619	249	25159	359
Unclassified	1.3	1.4	225	83	4415	724

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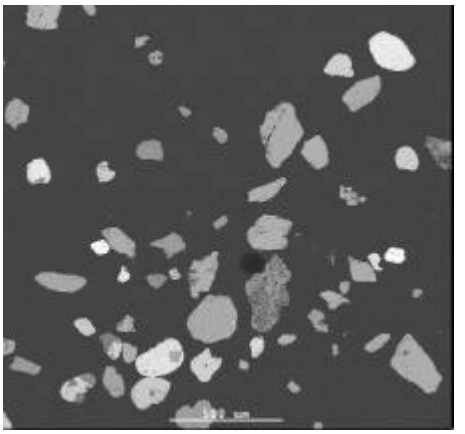

Sample Name:	5.Varenia	No. of analysed frames:	22
Lab. Name:	2000028	No. analysed of particles	712
Date:	4/20/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	1.14
Country:	Lithuania	comments:	
Analyzed by:	MJ		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	150 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.6	35.3	2.3	0.1	3.3	1.4	0.4	0.1	0.3	97.9
Leucoxene	76.0	4.6	0.6	0.3	13.3	2.0	0.1	0.1	0.2	97.1
Rutile	89.8	2.6	0.3	0.2	3.0	1.6	0.2	0.1	0.1	98.1
Ti magnetite	27.6	55.1	0.9	0.1	8.0	3.6	0.7	0.6	0.4	97.1
Magnetite	2.3	83.7	0.3	0.1	6.2	3.6	0.4	0.4	0.3	97.5
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.2	0.4	0.3	0.1	0.7	0.1	0.1	56.2	0.3	58.5
Monazite	0.0	1.5	0.0	0.0	3.1	0.9	0.1	2.4	2.3	10.4
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	35.5	1.2	0.0	0.0	29.3	2.9	0.1	28.6	0.4	98.0
Garnet	0.2	32.3	2.6	0.1	37.1	19.7	3.3	2.2	0.4	97.7
Kya/Sill	0.0	0.7	0.0	0.3	42.3	53.4	0.0	0.0	0.0	96.6
Staurolite	0.4	15.4	0.2	0.0	31.6	48.6	1.4	0.1	0.1	97.8
Zircon	0.2	0.8	0.2	0.2	29.6	0.4	0.1	0.1	63.2	94.7
Silicate	1.3	16.3	0.8	0.1	46.6	13.1	6.4	11.2	0.3	96.1
Unclassified	8.0	15.4	1.5	0.8	23.4	9.6	7.4	18.7	3.3	88.1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	32.7	0.4	1.0	8.3	52.0	3.7	0.1	1.7	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.8	78.2	91.6	28.5
Fe_2O_3 wt%	36.1	4.7	2.7	56.7
MnO wt%	2.4	0.6	0.3	0.9
Cr_2O_3 wt%	0.2	0.3	0.3	0.1
SiO_2 wt%	3.3	13.6	3.1	8.3
Al_2O_3 wt%	1.4	2.0	1.7	3.7
MgO wt%	0.4	0.1	0.2	0.7
CaO wt%	0.1	0.1	0.1	0.6
ZrO_2 wt%	0.3	0.3	0.1	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	51.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	50.6
Valuable heavy minerals in raw sand:	0.57

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	16.4	0.2
Leucoxene	0.2	0.0
Rutile	0.5	0.0
Ti magnetite	4.2	0.0
Magnetite	9.2	0.1
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	1.2	0.0
Monazite	0.4	0.0
Y-phosphate	0.0	0.0
Sphene	0.2	0.0
Garnet	26.1	0.3
Kya/Sill	0.0	0.0
Staurolite	0.8	0.0
Zircon	1.9	0.0
Silicate	36.7	99.3
Unclassified	2.1	0.0
Total	100.0	100.0

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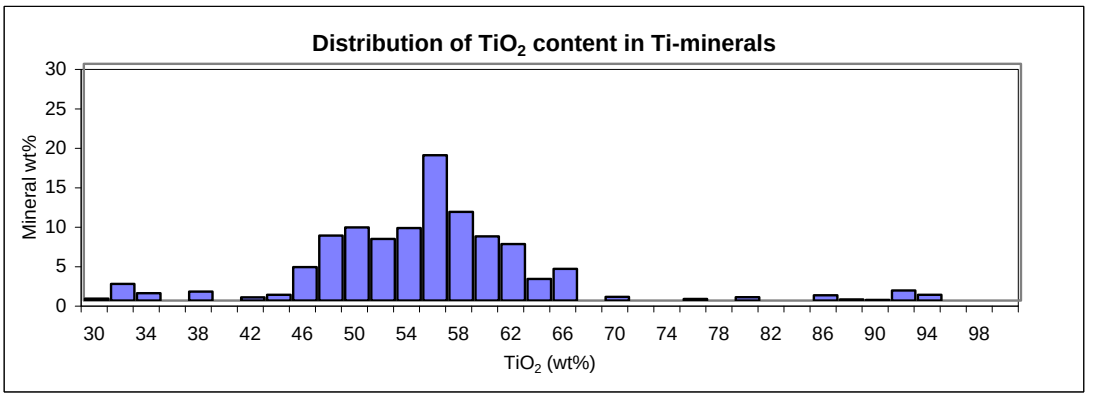
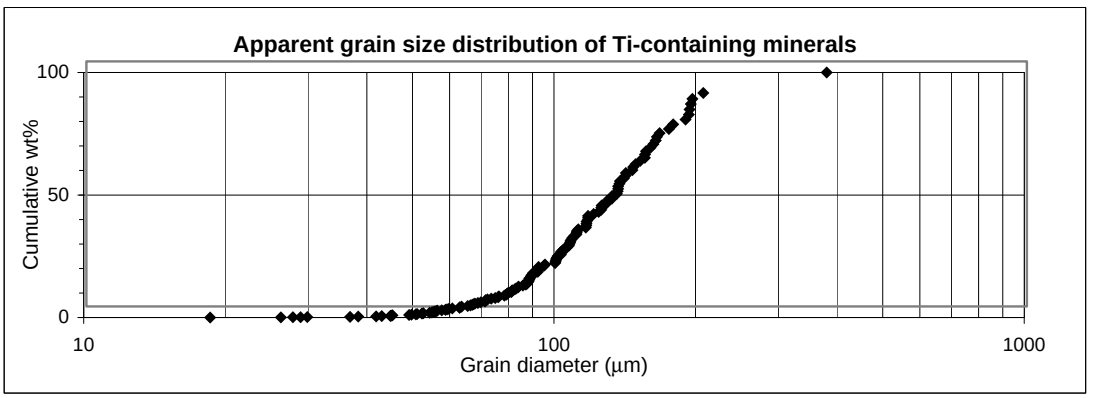
Lab. Name:	11/20/75	Analyzed by:	MJ
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/20/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.4	1.6	401	144	9307	119
Leucoxene	1.2	1.4	274	85	4497	3
Rutile	1.6	1.6	280	102	4497	7
Ti magnetite	1.5	1.7	466	175	14650	18
Magnetite	1.5	1.6	467	170	12489	43
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.4	1.4	545	172	18811	4
Monazite	1.5	1.4	313	102	6143	4
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.5	1.7	323	120	5435	3
Garnet	1.5	1.7	472	180	13197	150
Kya/Sill	1.6	1.8	321	124	4495	1
Staurolite	1.5	1.7	486	179	11236	6
Zircon	1.3	1.4	291	99	5098	24
Silicate	1.6	1.8	501	190	14276	294
Unclassified	1.6	1.7	322	127	6567	36

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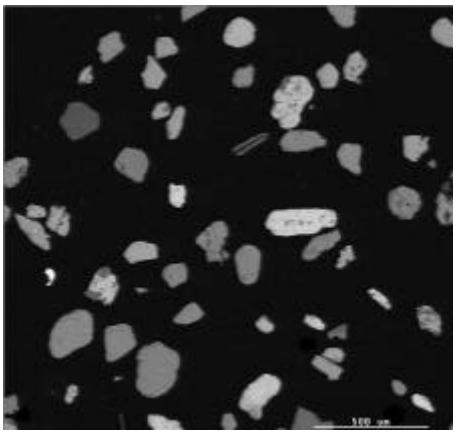

Sample Name:	7.Rudininkai	No. of analysed frames:	36
Lab. Name:	2000030	No. analysed of particles	1428
Date:	4/25/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.78
Country:	Lithuania	comments:	
Analyzed by:	DO		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	160 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.4	32.8	2.5	0.1	5.1	1.4	0.4	0.1	0.4	98.1
Leucoxene	76.3	3.7	0.2	0.2	11.2	4.0	0.6	0.3	0.6	97.0
Rutile	92.5	1.5	0.2	0.3	1.7	1.0	0.1	0.0	0.3	97.6
Ti magnetite	31.6	57.0	1.4	0.2	3.6	2.1	0.7	0.2	0.4	97.2
Magnetite	2.4	78.3	0.7	0.2	8.5	4.7	0.5	0.3	0.6	96.3
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.1	0.5	0.2	0.0	0.8	0.1	0.1	57.0	1.2	60.0
Monazite	0.0	0.0	0.0	0.0	3.9	1.5	0.2	1.9	0.0	7.6
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.6	1.9	0.2	0.1	28.1	3.6	0.1	26.3	0.1	98.0
Garnet	0.2	32.3	2.6	0.1	37.5	19.6	3.0	2.4	0.3	98.1
Kya/Sill	0.4	1.7	0.0	0.5	43.2	53.1	0.1	0.0	0.5	99.4
Staurolite	0.5	14.5	0.6	0.1	34.5	46.2	1.5	0.1	0.2	98.2
Zircon	0.2	0.7	0.2	0.1	29.7	0.1	0.1	0.2	63.3	94.7
Silicate	1.7	15.7	0.6	0.1	47.8	13.5	6.6	10.1	0.2	96.3
Unclassified	6.5	19.5	1.1	0.5	24.3	9.9	3.3	10.0	8.0	83.2

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	30.6	1.1	1.0	5.6	51.9	6.0	0.2	3.7	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.5	78.6	94.8	32.5
Fe_2O_3 wt%	33.4	3.8	1.6	58.6
MnO wt%	2.6	0.2	0.2	1.5
Cr_2O_3 wt%	0.1	0.2	0.3	0.2
SiO_2 wt%	5.2	11.6	1.8	3.7
Al_2O_3 wt%	1.4	4.1	1.0	2.1
MgO wt%	0.4	0.6	0.1	0.7
CaO wt%	0.1	0.3	0.0	0.2
ZrO_2 wt%	0.4	0.6	0.3	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	54.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	53.5
Valuable heavy minerals in raw sand:	0.31

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	12.3	0.1
Leucoxene	0.4	0.0
Rutile	0.4	0.0
Ti magnetite	2.3	0.0
Magnetite	10.0	0.1
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.5	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.4	0.0
Garnet	20.8	0.2
Kya/Sill	0.1	0.0
Staurolite	1.5	0.0
Zircon	2.4	0.0
Silicate	46.8	99.6
Unclassified	2.1	0.0
Total	100.0	100.0

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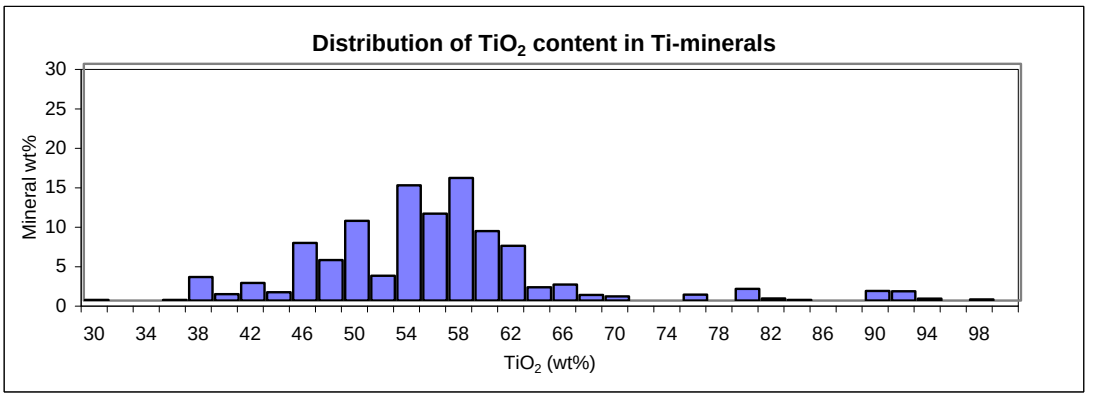
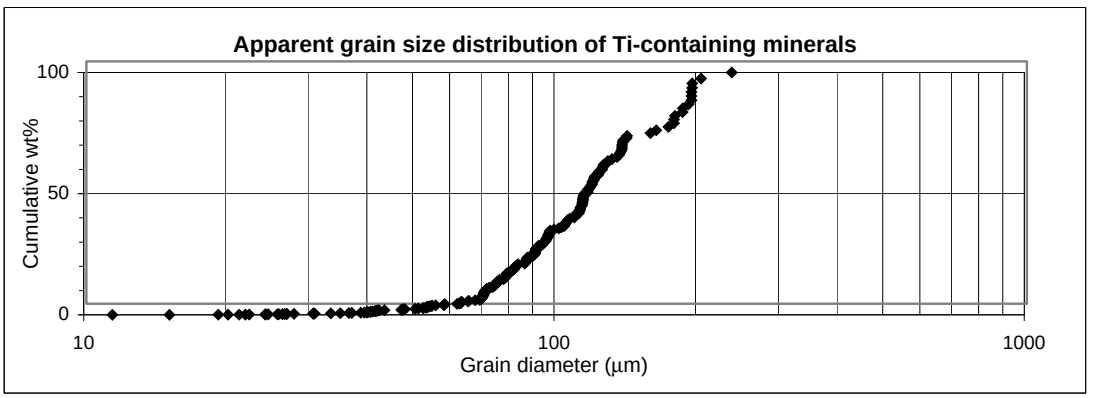
Lab. Name:	2000030	Analyzed by:	DO
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/25/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	370	137	7465	190
Leucoxene	1.4	1.5	291	100	6371	8
Rutile	1.5	1.5	255	92	4121	10
Ti magnetite	1.6	1.8	405	163	8484	29
Magnetite	1.6	1.7	446	169	11265	89
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.3	1.6	336	123	6131	9
Monazite	1.6	1.1	110	39	880	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.3	1.4	399	137	11837	5
Garnet	1.6	1.8	455	177	11872	228
Kya/Sill	1.2	1.5	452	161	10502	1
Staurolite	1.6	2.2	559	230	14462	14
Zircon	1.4	1.5	322	113	6143	44
Silicate	1.6	1.9	478	188	12806	717
Unclassified	1.5	1.7	314	127	6789	60

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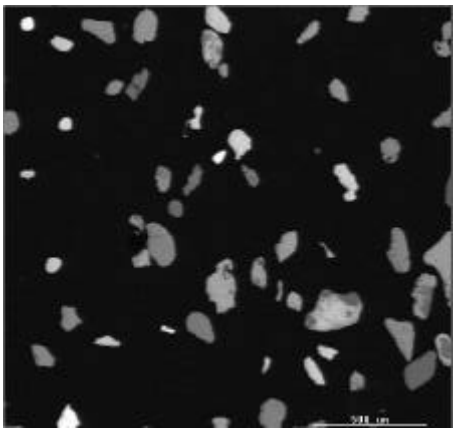

Sample Name:	8.Bezdonys	No. of analysed frames:	36
Lab. Name:	2000031	No. analysed of particles	1384
Date:	4/25/01	Heavy minerals in raw	
Submitter:	Dupont/GEUS	sand (%):	0.55
Country:	Lithuania	comments:	
Analyzed by:	DO		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	200 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.6	32.3	2.6	0.1	5.0	1.7	0.4	0.1	0.2	98.0
Leucoxene	75.1	6.5	0.3	0.1	11.0	3.2	0.3	0.2	0.4	97.0
Rutile	91.0	1.5	0.2	0.1	2.9	1.2	0.2	0.2	0.3	97.5
Ti magnetite	32.5	45.8	1.3	0.2	10.9	4.0	0.6	1.3	0.6	97.2
Magnetite	1.5	77.4	0.6	0.1	10.2	5.2	0.6	0.3	0.4	96.3
Chromite	0.2	43.5	1.1	45.4	2.2	3.0	3.1	0.1	0.0	98.7
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.1	0.3	0.4	0.0	0.9	0.0	0.0	55.7	1.2	58.7
Monazite	0.0	0.7	0.0	0.0	19.0	0.8	0.0	0.9	3.3	24.7
Y-phosphate	0.0	1.7	0.0	0.0	0.0	1.2	0.0	0.0	3.0	5.9
Sphene	36.6	0.2	0.0	0.2	30.5	2.0	0.1	28.7	0.5	98.7
Garnet	0.3	32.6	2.4	0.1	37.2	19.7	3.2	2.1	0.3	97.9
Kya/Sill	0.3	0.7	0.1	0.2	43.0	54.1	0.2	0.0	0.2	98.8
Staurolite	0.6	15.2	0.4	0.1	32.8	47.3	1.5	0.1	0.2	98.2
Zircon	0.2	0.9	0.2	0.1	29.8	0.3	0.1	0.2	63.4	95.2
Silicate	1.2	15.4	0.7	0.2	48.9	13.5	6.2	9.9	0.3	96.2
Unclassified	9.7	21.3	1.0	0.7	28.6	8.7	2.8	7.1	5.2	85.2

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	35.8	2.5	3.2	6.2	40.5	7.3	0.4	4.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.7	77.4	93.3	33.4
Fe_2O_3 wt%	32.9	6.7	1.6	47.2
MnO wt%	2.6	0.3	0.2	1.4
Cr_2O_3 wt%	0.1	0.1	0.2	0.2
SiO_2 wt%	5.1	11.3	2.9	11.2
Al_2O_3 wt%	1.7	3.3	1.2	4.1
MgO wt%	0.4	0.3	0.2	0.6
CaO wt%	0.1	0.2	0.2	1.4
ZrO_2 wt%	0.2	0.4	0.3	0.6
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	57.2
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	54.6
Valuable heavy minerals in raw sand:	0.23

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	15.1	0.1
Leucoxene	1.1	0.0
Rutile	1.4	0.0
Ti magnetite	2.6	0.0
Magnetite	10.8	0.1
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.2	0.0
Monazite	0.5	0.0
Y-phosphate	0.1	0.0
Sphene	0.2	0.0
Garnet	17.0	0.1
Kya/Sill	0.2	0.0
Staurolite	1.7	0.0
Zircon	3.1	0.0
Silicate	43.3	99.7
Unclassified	2.8	0.0
Total	100.0	100.0

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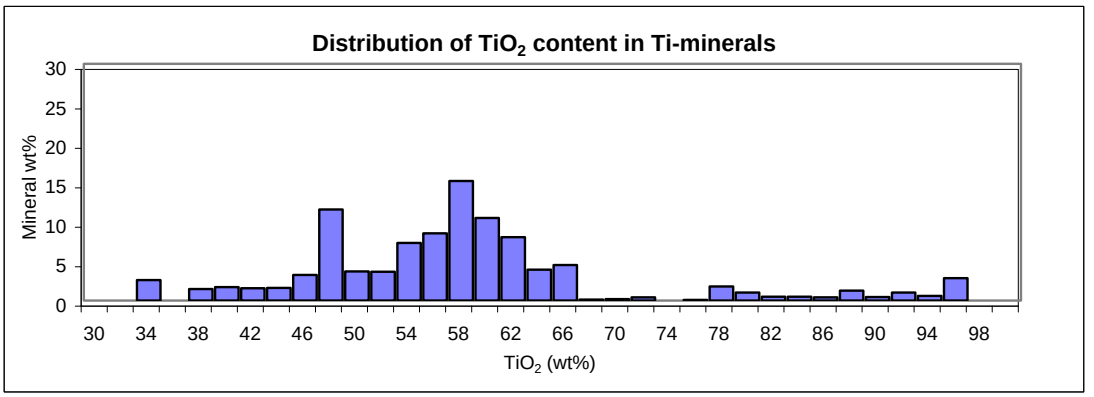
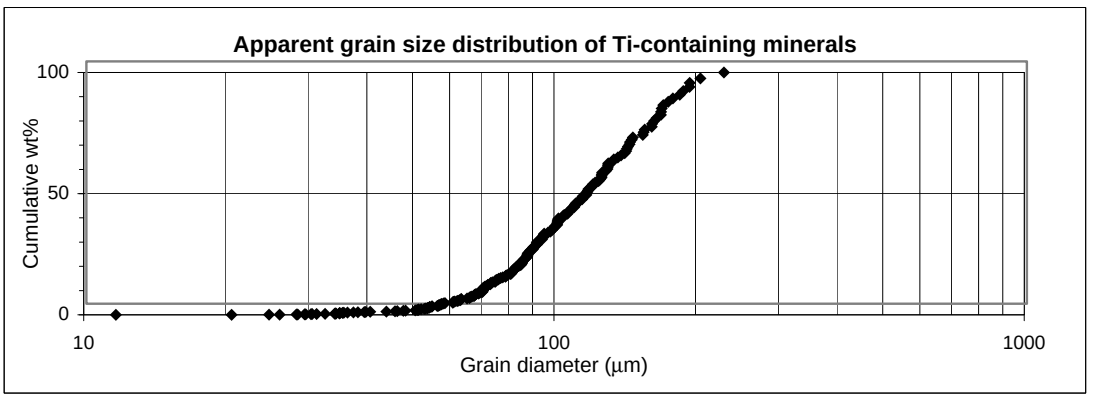
Lab. Name:	2000031	Analyzed by:	DO
Submitter:	Dupont/GEUS	Acc. Voltage	17kV
Date:	4/25/01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	367	136	7356	182
Leucoxene	1.4	1.6	316	113	5846	16
Rutile	1.7	1.8	342	128	6009	18
Ti magnetite	1.4	1.7	420	159	9923	22
Magnetite	1.5	1.6	392	146	10118	82
Chromite	1.5	2.1	313	127	3768	1
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.4	1.9	369	153	6285	3
Monazite	1.5	1.6	352	126	6525	6
Y-phosphate	1.3	1.2	343	104	7703	1
Sphene	1.4	1.5	451	160	11138	2
Garnet	1.6	1.9	420	164	9256	184
Kya/Sill	2.6	3.5	683	302	11415	2
Staurolite	1.6	1.9	411	161	8536	21
Zircon	1.4	1.5	304	105	5640	47
Silicate	1.6	1.8	408	159	9050	722
Unclassified	1.5	1.6	285	115	5581	75

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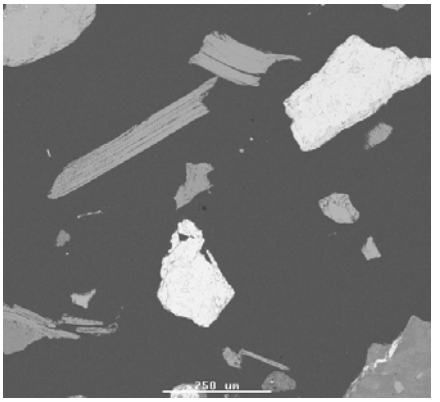

Sample Name:	5 Tauragnai Q3bl	No. of analysed frames:	81
Date:	12-01-01	No. analysed of particles	948
Country:	Lituania	Heavy minerals in raw	
Submitter:	Dupont	sand (%):	2,56
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	50x		
Guard region	300 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	52,3	34,2	2,1	0,1	6,3	1,7	0,4	0,4	0,4	97,9
Leucoxene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rutile	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ti magnetite	34,4	46,0	2,0	0,2	8,2	2,2	1,0	2,1	0,6	96,7
Magnetite	1,1	81,6	0,5	0,2	8,0	2,7	1,1	1,7	0,2	97,2
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,1	0,6	0,4	0,2	1,3	0,2	0,3	55,6	1,1	59,8
Monazite	0,0	0,9	0,0	0,0	4,1	0,5	0,3	3,0	1,5	10,2
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,2	33,2	2,1	0,1	36,6	19,3	3,4	2,1	0,3	97,3
Sillimanite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Staurolite	0,8	15,5	1,1	0,2	31,8	45,9	2,1	0,2	0,3	97,9
Zircon	0,1	0,5	0,2	0,1	29,8	0,1	0,1	0,2	63,5	94,6
Silicate	1,2	17,1	0,5	0,2	48,7	11,9	6,4	8,8	0,3	95,1
Unclassified	1,2	12,2	1,8	0,4	14,4	3,9	16,7	33,9	1,6	86,2

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	2,9	0,0	0,0	17,8	77,3	2,0	0,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	53,5	0	0	35,5
Fe_2O_3 wt%	34,9	0	0	47,6
MnO wt%	2,1	0	0	2,1
Cr_2O_3 wt%	0,1	0	0	0,2
SiO_2 wt%	6,4	0	0	8,4
Al_2O_3 wt%	1,7	0	0	2,3
MgO wt%	0,4	0	0	1,1
CaO wt%	0,4	0	0	2,2
ZrO_2 wt%	0,5	0	0	0,7
Total	100,0	0	0	100,0

Average TiO_2 content of all the TiO_2 minerals:	38,0
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	38,0
Valuable heavy minerals in raw sand:	0,57

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	0,6	0,0
Leucoxene	0,0	0,0
Rutile	0,0	0,0
Ti magnetite	4,0	0,1
Magnetite	14,3	0,4
Chromite	0,0	0,0
Pyrite	0,0	0,0
Phosphate	0,4	0,0
Monazite	1,1	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	17,2	0,4
Sillimanite	0,0	0,0
Staurolite	0,6	0,0
Zircon	0,4	0,0
Silicate	51,7	98,8
Unclassified	9,7	0,2
Total	100,0	100,0

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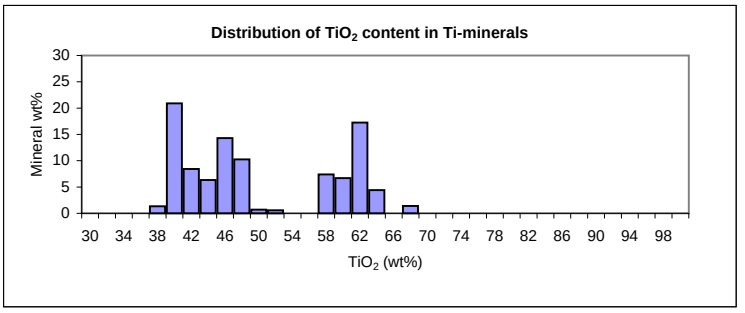
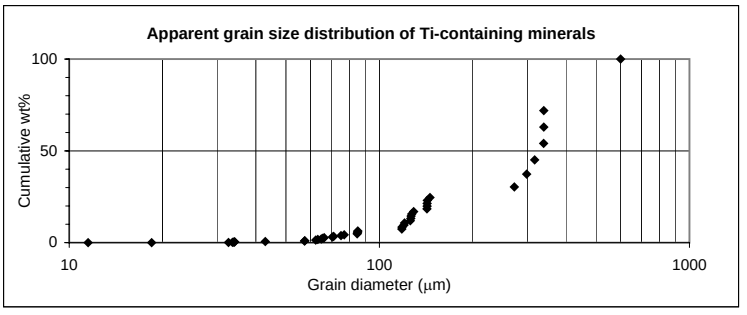
Sample Name:	5 Tauragnai Q3bl	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	12-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,5	1,7	363	135	7150	21
Leucoxene	0,0	0,0	0	0	0	0
Rutile	0,0	0,0	0	0	0	0
Ti magnetite	1,5	1,8	731	290	37669	23
Magnetite	1,5	1,9	820	332	43515	66
Chromite	0,0	0,0	0	0	0	0
Pyrite	0,0	0,0	0	0	0	0
Phosphate	1,5	1,7	439	163	12614	6
Monazite	2,0	1,6	1232	446	75825	3
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,6	2,3	869	363	40978	110
Sillimanite	0,0	0,0	0	0	0	0
Staurolite	1,4	2,3	1543	643	81798	2
Zircon	1,4	1,5	368	123	7720	13
Silicate	1,8	2,0	742	303	36105	565
Unclassified	1,5	1,8	521	207	27009	139

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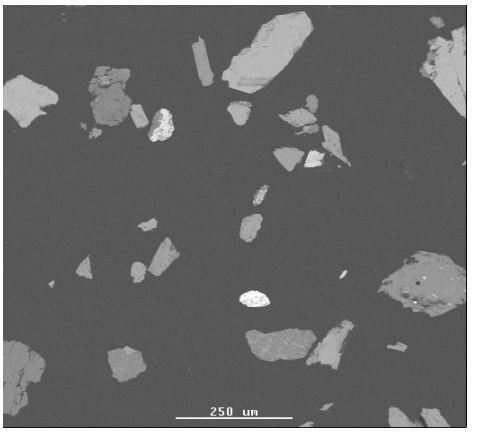

Sample Name:	1 Didzasalias Q3bl	No. of analysed frames:	81
Date:	12-01-01	No. analysed of particles	872
Country:	Lituania	Heavy minerals in raw sand (%):	2,83
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	50x		
Guard region	300 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	53,4	37,8	2,1	0,1	3,0	0,8	0,4	0,2	0,3	98,1
Leucoxene	70,3	25,0	0,2	0,0	1,4	0,3	0,2	0,1	0,0	97,6
Rutile	94,3	1,4	0,5	0,3	0,8	0,4	0,1	0,0	0,0	97,8
Ti magnetite	31,0	57,0	1,3	0,4	3,9	2,2	0,6	1,1	0,3	97,7
Magnetite	1,7	78,3	0,6	0,2	9,4	3,4	1,1	1,0	0,4	96,0
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,1	0,6	0,1	0,7	4,0	1,5	0,6	52,6	1,0	61,3
Monazite	0,0	1,7	0,0	0,0	4,1	1,5	0,5	4,7	4,5	16,9
Y-phosphate	0,0	3,4	0,0	0,0	2,1	2,1	0,2	0,8	5,8	14,4
Sphene	35,1	1,2	0,0	0,2	30,3	1,7	0,3	27,7	0,6	97,0
Garnet	0,3	32,8	2,8	0,2	36,4	19,2	2,9	2,1	0,4	97,1
Sillimanite	0,6	1,4	0,9	0,0	41,1	53,8	0,0	0,0	1,5	99,4
Staurolite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Zircon	0,2	1,0	0,3	0,2	30,0	0,2	0,1	0,1	62,9	95,0
Silicate	1,2	16,8	0,6	0,2	47,5	12,9	6,6	8,0	0,5	94,4
Unclassified	0,9	13,4	0,9	0,4	15,0	5,9	16,4	33,6	1,7	88,1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	15,0	0,2	0,2	22,3	60,8	1,1	0,4	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	54,4	72,1	96,4	31,8
Fe_2O_3 wt%	38,5	25,6	1,4	58,3
MnO wt%	2,1	0,2	0,5	1,3
Cr_2O_3 wt%	0,1	0,0	0,3	0,4
SiO_2 wt%	3,1	1,4	0,9	4,0
Al_2O_3 wt%	0,9	0,3	0,4	2,2
MgO wt%	0,4	0,2	0,1	0,6
CaO wt%	0,2	0,1	0,0	1,2
ZrO_2 wt%	0,3	0,0	0,0	0,3
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	41,3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	41,0
Valuable heavy minerals in raw sand:	0,75

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	4,0	0,1
Leucoxene	0,0	0,0
Rutile	0,1	0,0
Ti magnetite	6,0	0,2
Magnetite	26,0	0,7
Chromite	0,0	0,0
Pyrite	0,0	0,0
Phosphate	0,1	0,0
Monazite	0,2	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	16,2	0,5
Sillimanite	0,1	0,0
Staurolite	0,0	0,0
Zircon	0,3	0,0
Silicate	34,5	98,1
Unclassified	12,5	0,4
Total	100,0	100,0

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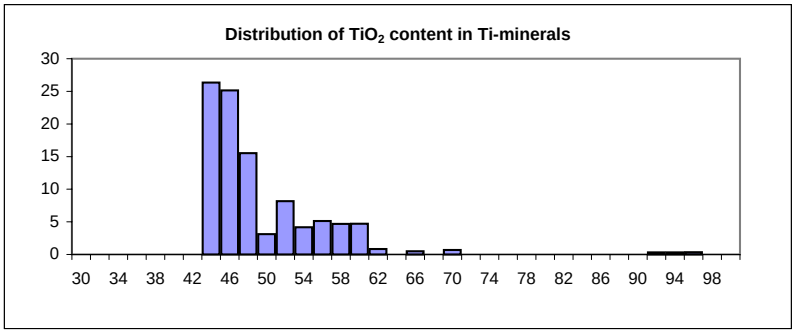
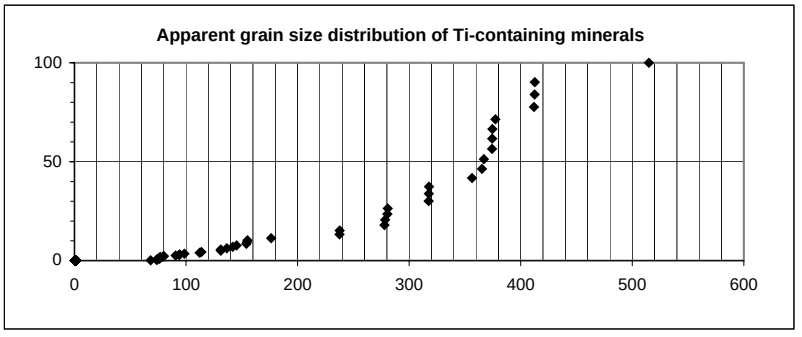
Sample Name:	1 Didzasalias Q3bl	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	12-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,5	1,7	744	282	33279	27
Leucoxene	2,3	2,2	525	215	10171	1
Rutile	1,2	1,2	260	76	4309	3
Ti magnetite	1,4	1,7	1256	475	84259	15
Magnetite	1,5	2,0	838	337	42235	120
Chromite	0,0	0,0	0	0	0	0
Pyrite	0,0	0,0	0	0	0	0
Phosphate	1,3	1,3	245	88	5315	3
Monazite	1,3	1,7	675	259	23043	2
Y-phosphate	1,2	1,5	378	129	7710	1
Sphene	1,6	1,7	201	76	1987	4
Garnet	1,6	2,0	704	286	34827	118
Sillimanite	1,5	2,0	893	361	30971	1
Staurolite	0,0	0,0	0	0	0	0
Zircon	1,3	1,5	458	151	12845	5
Silicate	1,8	2,1	704	291	33502	394
Unclassified	1,5	1,7	475	190	26434	178

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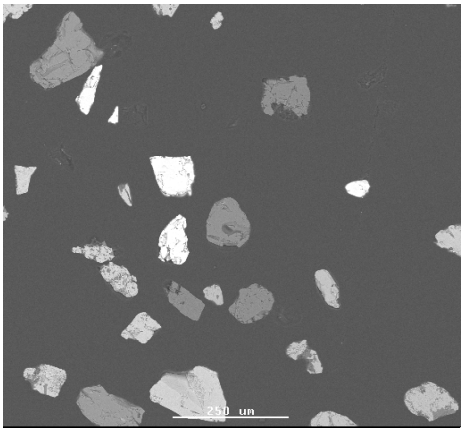

Sample Name:	6 Vetygala Q1vl upper part	No. of analysed frames:	81
Date:	13-01-01	No. analysed of particles	638
Country:	Lituania	Heavy minerals in raw sand (%):	0,53
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	60,7	26,5	1,4	0,2	5,9	2,2	0,3	0,2	0,6	97,9
Leucoxene	76,5	9,5	0,3	0,2	6,9	3,2	0,2	0,2	0,4	97,4
Rutile	91,2	1,8	0,2	0,1	2,5	1,5	0,1	0,1	0,3	97,9
Ti magnetite	41,4	29,3	0,7	0,1	18,3	6,7	1,3	0,3	0,0	98,1
Magnetite	0,9	75,7	1,8	0,8	5,0	2,7	0,9	0,7	3,4	91,9
Chromite	1,3	35,7	0,4	31,8	3,7	21,2	4,1	0,0	0,5	98,7
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	2,0	24,5	1,4	0,2	39,0	20,8	3,5	3,5	0,5	95,6
Sillimanite	0,2	0,6	0,2	0,1	42,4	54,0	0,0	0,1	0,3	97,9
Staurolite	0,9	14,4	0,3	0,1	33,2	46,9	1,3	0,1	0,3	97,4
Zircon	0,4	0,5	0,1	0,2	29,9	0,8	0,1	0,2	63,5	95,6
Silicate	2,2	5,7	0,4	0,2	56,6	28,0	1,9	0,9	0,5	96,3
Unclassified	15,2	6,6	0,9	3,5	28,7	8,8	1,3	0,6	17,5	83,0

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	52,1	22,2	14,9	3,1	0,8	5,6	1,3	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	62,0	78,6	93,2	42,2
Fe_2O_3 wt%	27,1	9,7	1,8	29,9
MnO wt%	1,5	0,3	0,2	0,7
Cr_2O_3 wt%	0,2	0,2	0,1	0,1
SiO_2 wt%	6,1	7,0	2,6	18,6
Al_2O_3 wt%	2,3	3,3	1,5	6,8
MgO wt%	0,3	0,2	0,1	1,3
CaO wt%	0,2	0,3	0,1	0,3
ZrO_2 wt%	0,6	0,4	0,3	0,0
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	70,3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	66,0
Valuable heavy minerals in raw sand:	0,43

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	42,3	0,2
Leucoxene	18,0	0,1
Rutile	12,1	0,1
Ti magnetite	2,5	0,0
Magnetite	0,6	0,0
Chromite	0,2	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,6	0,0
Sillimanite	1,0	0,0
Staurolite	2,3	0,0
Zircon	4,6	0,0
Silicate	12,5	99,5
Unclassified	3,2	0,0
Total	100,0	100,0

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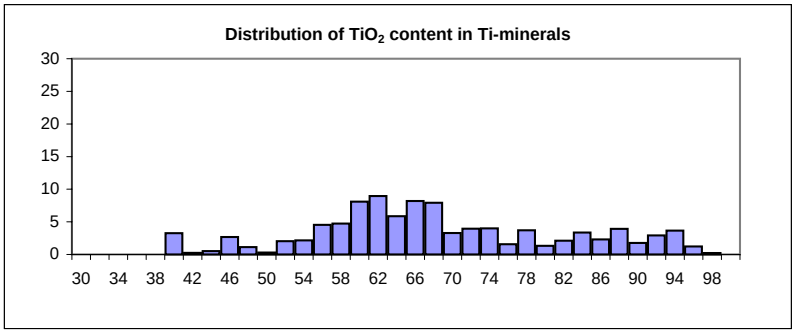
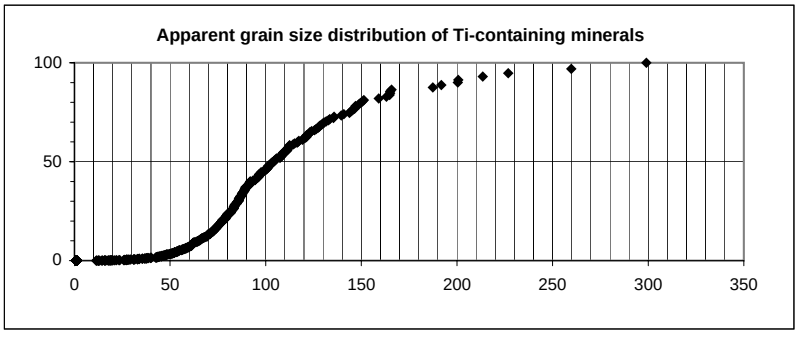
Sample Name:	6 Vetygala Q1vl upper part	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	13-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	2,0	368	148	6151	221
Leucoxene	1,6	2,0	356	142	5858	99
Rutile	1,8	2,0	337	134	5066	69
Ti magnetite	1,4	2,6	788	346	25668	3
Magnetite	1,6	2,2	348	150	5561	3
Chromite	1,8	2,0	345	139	4677	1
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,6	2,0	230	95	2894	8
Sillimanite	1,9	2,3	397	161	5799	8
Staurolite	1,5	1,9	252	101	3172	28
Zircon	1,5	1,7	257	95	3458	41
Silicate	1,7	2,1	324	132	5010	136
Unclassified	1,6	2,1	401	165	8167	21

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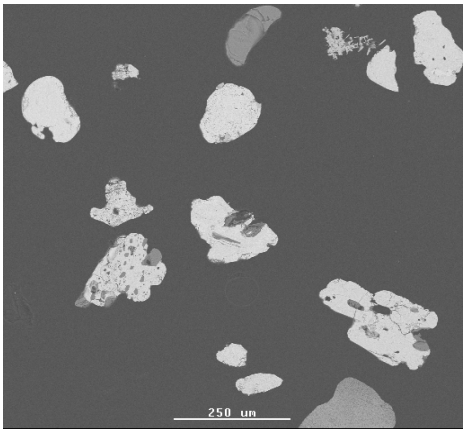

Sample Name:	2 Vetygala Q1vl	No. of analysed frames:	81
Date:	13-01-01	No. analysed of particles	519
Country:	Lituania	Heavy minerals in raw sand (%):	1,81
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	58,1	29,5	3,4	0,1	5,2	1,0	0,2	0,1	0,3	97,9
Leucoxene	73,7	12,0	1,1	0,1	8,5	1,5	0,2	0,2	0,3	97,8
Rutile	93,5	0,8	0,1	0,0	2,5	0,7	0,1	0,1	0,1	97,9
Ti magnetite	39,3	20,5	4,6	0,1	24,6	5,2	0,2	0,2	0,8	95,5
Magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,4	0,8	0,0	0,0	16,8	2,1	0,2	1,3	2,0	23,6
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,3	26,9	7,3	0,1	36,6	19,5	2,4	4,2	0,2	97,6
Sillimanite	0,4	0,9	0,0	0,1	42,2	54,3	0,0	0,0	0,2	98,2
Staurolite	1,0	15,9	0,4	0,1	32,2	47,0	1,4	0,1	0,2	98,2
Zircon	0,2	0,4	0,2	0,2	29,6	0,1	0,1	0,1	64,2	95,2
Silicate	1,2	7,5	1,0	0,2	64,7	19,3	1,3	1,4	0,4	96,9
Unclassified	9,1	11,7	1,8	0,2	33,9	8,7	0,9	0,9	26,3	93,4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	71,8	3,3	2,1	1,4	8,2	12,7	0,5	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	59,3	75,4	95,5	41,2
Fe_2O_3 wt%	30,1	12,3	0,9	21,5
MnO wt%	3,5	1,2	0,1	4,8
Cr_2O_3 wt%	0,1	0,1	0,0	0,1
SiO_2 wt%	5,3	8,7	2,5	25,7
Al_2O_3 wt%	1,0	1,6	0,7	5,4
MgO wt%	0,3	0,2	0,1	0,2
CaO wt%	0,1	0,2	0,1	0,2
ZrO_2 wt%	0,3	0,3	0,1	0,8
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	60,7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	59,7
Valuable heavy minerals in raw sand:	1,45

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	57,3	1,0
Leucoxene	2,6	0,0
Rutile	1,7	0,0
Ti magnetite	1,1	0,0
Magnetite	0,0	0,0
Chromite	0,0	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,7	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	6,6	0,1
Sillimanite	0,4	0,0
Staurolite	4,5	0,1
Zircon	10,2	0,2
Silicate	13,9	98,4
Unclassified	1,1	0,0
Total	100,0	100,0

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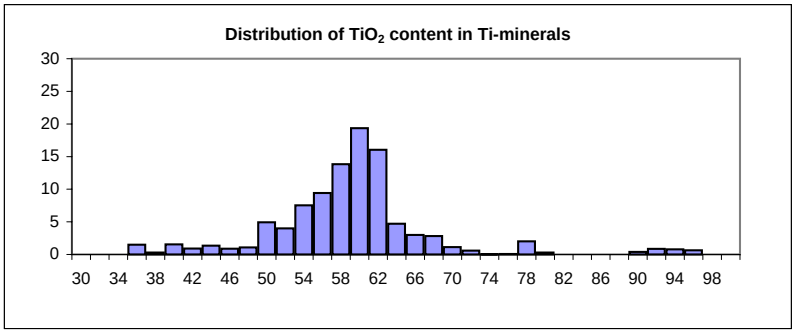
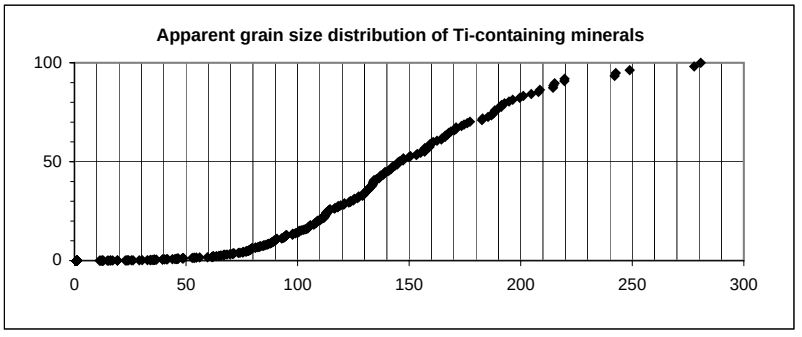
Sample Name:	2 Vetygala Q1vl	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	13-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,7	2,1	497	201	11310	266
Leucoxene	1,5	2,0	436	175	10563	13
Rutile	1,5	1,8	397	153	7969	10
Ti magnetite	1,7	2,0	582	243	18395	3
Magnetite	0,0	0,0	0	0	0	0
Chromite	0,0	0,0	0	0	0	0
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	1,8	2,1	472	191	8697	4
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,7	2,4	619	261	17648	22
Sillimanite	1,6	2,4	376	171	6811	4
Staurolite	1,6	2,8	651	282	15702	18
Zircon	1,5	1,7	379	141	8201	63
Silicate	1,5	2,4	510	216	12751	97
Unclassified	1,8	2,2	292	119	4847	19

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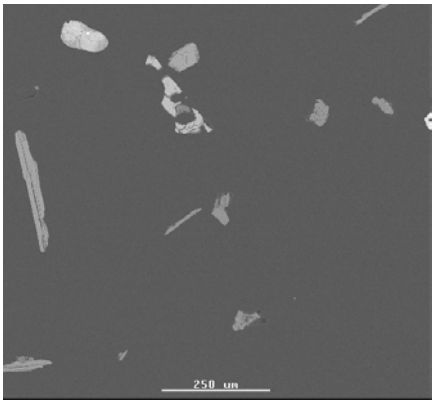

Sample Name:	7 Vetygala D3sv	No. of analysed frames:	100
Date:	14-01-01	No. analysed of particles	596
Country:	Lituania	Heavy minerals in raw	
Submitter:	Dupont	sand (%):	0,57
Analyzed by:	CCA	comments:	
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	57,0	31,3	2,3	0,1	5,0	1,4	0,3	0,1	0,3	97,9
Leucoxene	75,3	9,2	0,5	0,1	9,5	2,2	0,1	0,2	0,3	97,5
Rutile	91,0	2,4	0,2	0,2	2,2	1,1	0,2	0,2	0,5	98,1
Ti magnetite	40,0	21,7	1,3	0,1	29,8	3,1	0,2	0,3	0,6	97,2
Magnetite	0,3	76,3	0,5	0,2	10,1	4,1	1,0	2,7	0,4	95,6
Chromite	0,3	23,0	1,3	53,5	0,8	13,7	5,3	0,2	0,0	98,1
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,4	20,6	2,8	0,2	41,6	21,6	1,3	3,4	0,6	92,6
Sillimanite	0,3	0,7	0,1	0,2	42,2	53,9	0,0	0,1	0,4	98,0
Staurolite	0,9	15,2	0,4	0,2	33,5	47,0	1,2	0,1	0,3	98,8
Zircon	0,2	0,6	0,3	0,1	29,9	0,1	0,1	0,3	63,2	94,8
Silicate	0,5	1,9	0,3	0,1	83,2	7,3	0,4	0,5	0,5	94,6
Unclassified	12,4	11,7	1,9	0,6	35,4	7,1	0,4	0,6	11,6	81,6

Valuable heavy minerals							
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	61,9	10,8	9,8	2,1	1,4	11,1	2,8	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58,2	77,2	92,7	41,1
Fe_2O_3 wt%	32,0	9,4	2,5	22,3
MnO wt%	2,4	0,6	0,2	1,3
Cr_2O_3 wt%	0,2	0,1	0,2	0,2
SiO_2 wt%	5,1	9,8	2,3	30,7
Al_2O_3 wt%	1,5	2,2	1,1	3,2
MgO wt%	0,3	0,1	0,2	0,3
CaO wt%	0,1	0,2	0,2	0,3
ZrO_2 wt%	0,3	0,4	0,5	0,7
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	64,2
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	60,5
Valuable heavy minerals in raw sand:	0,25

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	27,3	0,2
Leucoxene	4,8	0,0
Rutile	4,3	0,0
Ti magnetite	0,9	0,0
Magnetite	7,6	0,0
Chromite	0,3	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,6	0,0
Sillimanite	1,2	0,0
Staurolite	0,9	0,0
Zircon	4,9	0,0
Silicate	44,2	99,7
Unclassified	2,9	0,0
Total	100,0	100,0

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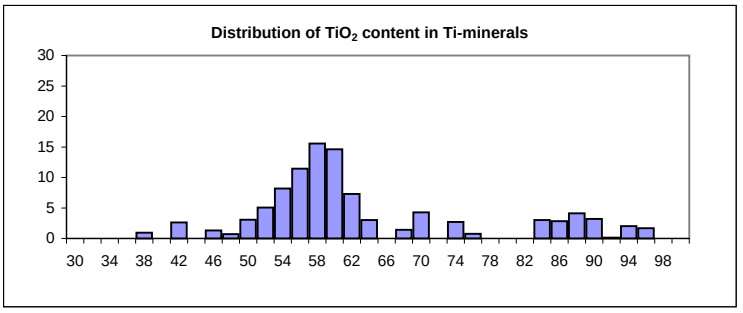
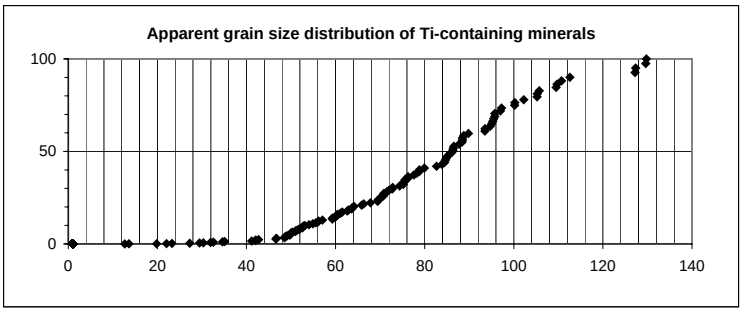
Sample Name:	7 Vetygala D3sv	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	14-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,8	2,1	318	129	4240	92
Leucoxene	1,6	2,4	378	153	5685	12
Rutile	1,7	2,2	299	122	3723	15
Ti magnetite	1,3	2,1	324	131	4146	3
Magnetite	1,5	2,3	367	156	5850	16
Chromite	1,4	1,7	307	116	4334	1
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	1,6	1,5	142	49	1659	6
Sillimanite	1,5	2,2	341	142	4899	5
Staurolite	1,8	2,1	233	97	2494	6
Zircon	1,4	1,6	272	97	3982	17
Silicate	2,3	2,5	264	111	2661	403
Unclassified	1,7	2,3	262	110	3413	20

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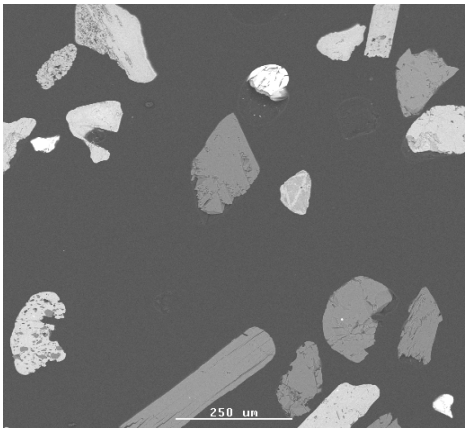

Sample Name:	4 Anykschchiai-7 middel part	No. of analysed frames:	81
Date:	14-01-01	No. analysed of particles	486
Country:	Lituania	Heavy minerals in raw sand (%):	0,43
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63,5	26,9	1,5	0,2	4,1	1,0	0,3	0,2	0,3	98,1
Leucoxene	77,4	13,3	0,8	0,3	3,6	1,2	0,2	0,3	0,3	97,4
Rutile	92,5	1,6	0,2	0,2	1,9	0,8	0,1	0,1	0,3	97,8
Ti magnetite	45,5	24,6	23,0	0,0	0,7	0,4	0,0	0,0	0,0	94,2
Magnetite	1,9	90,8	0,8	0,1	2,6	1,4	0,3	0,1	0,3	98,4
Chromite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sillimanite	0,0	1,2	0,0	0,2	42,6	53,2	0,0	0,0	0,6	97,9
Staurolite	0,8	13,8	0,4	0,1	33,1	47,6	1,5	0,1	0,2	97,6
Zircon	0,3	0,4	0,3	0,1	29,6	0,4	0,1	0,1	64,3	95,6
Silicate	2,5	4,4	0,2	0,2	54,9	31,6	2,3	0,8	0,3	97,0
Unclassified	27,2	4,1	0,2	1,6	30,7	1,6	0,7	0,6	14,3	80,9

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	45,0	19,1	25,3	2,2	0,0	5,9	2,5	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64,8	79,5	94,6	48,3
Fe_2O_3 wt%	27,4	13,7	1,6	26,1
MnO wt%	1,6	0,8	0,2	24,5
Cr_2O_3 wt%	0,2	0,3	0,2	0,0
SiO_2 wt%	4,2	3,7	1,9	0,7
Al_2O_3 wt%	1,0	1,2	0,8	0,4
MgO wt%	0,3	0,2	0,1	0,0
CaO wt%	0,2	0,3	0,1	0,0
ZrO_2 wt%	0,3	0,3	0,3	0,0
Total	100,0	100,0	100,0	100,0

Average TiO_2 content of all the TiO_2 minerals:	75,7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	68,5
Valuable heavy minerals in raw sand:	0,32

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	33,6	0,1
Leucoxene	14,2	0,1
Rutile	18,9	0,1
Ti magnetite	1,7	0,0
Magnetite	4,0	0,0
Chromite	0,0	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,0	0,0
Sillimanite	1,9	0,0
Staurolite	2,7	0,0
Zircon	4,4	0,0
Silicate	17,1	99,6
Unclassified	1,6	0,0
Total	100,0	100,0

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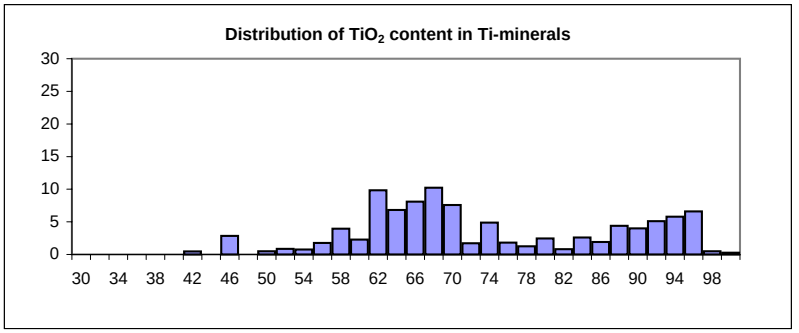
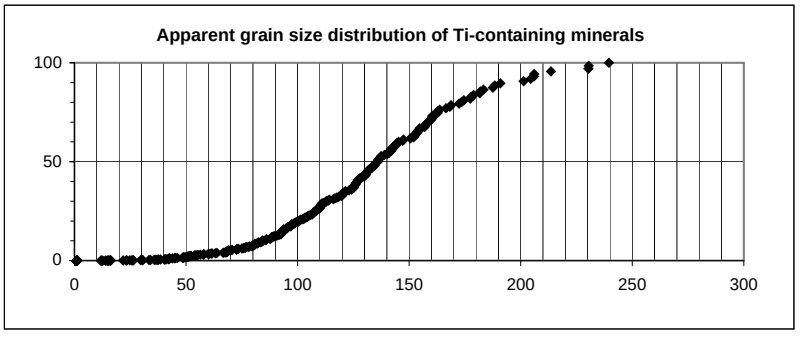
Sample Name:	4 Anykschchiai-7 middel part	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	14-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	2,1	473	191	10097	142
Leucoxene	1,5	2,0	425	171	8556	71
Rutile	1,7	2,3	451	185	8638	84
Ti magnetite	1,1	2,1	938	382	33327	2
Magnetite	1,6	2,0	466	184	9787	15
Chromite	0,0	0,0	0	0	0	0
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	0,0	0,0	0	0	0	0
Sillimanite	2,1	2,4	742	312	27843	4
Staurolite	1,5	2,3	468	199	11307	12
Zircon	1,5	1,8	360	138	6451	28
Silicate	1,7	2,5	520	221	10713	116
Unclassified	1,7	2,2	481	201	9697	12

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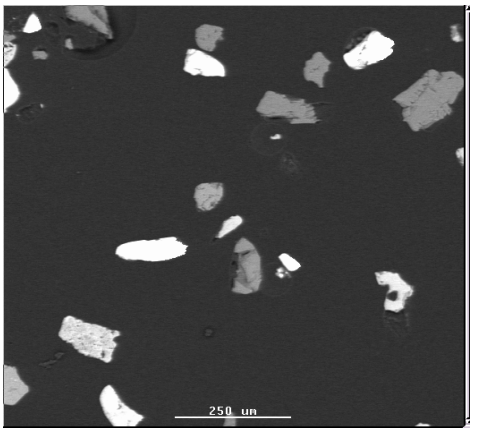

Sample Name:	3 Anykschchiai - 7 delta layer	No. of analysed frames:	116
Date:	14-01-01	No. analysed of particles	558
Country:	Lituania	Heavy minerals in raw sand (%):	0,53
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63,5	27,8	1,7	0,2	3,2	1,4	0,2	0,2	0,3	98,3
Leucoxene	77,1	11,9	0,6	0,3	5,3	1,6	0,2	0,3	0,3	97,7
Rutile	92,5	1,6	0,2	0,2	2,2	0,9	0,1	0,2	0,3	98,2
Ti magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Magnetite	2,9	73,9	0,7	0,2	5,9	0,7	0,0	11,9	0,7	96,9
Chromite	0,8	26,5	0,6	56,0	1,5	8,6	3,4	0,2	0,4	97,9
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	38,4	1,9	0,5	0,0	26,7	0,8	0,1	29,3	0,2	98,0
Garnet	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sillimanite	0,4	0,9	0,2	0,2	42,2	54,0	0,0	0,2	0,1	98,2
Staurolite	0,8	15,1	0,4	0,3	32,4	47,3	1,5	0,1	0,3	98,1
Zircon	0,3	0,3	0,2	0,2	30,0	0,3	0,1	0,2	64,1	95,7
Silicate	1,3	5,4	0,2	0,1	53,0	32,1	2,8	1,9	0,3	97,1
Unclassified	9,3	13,3	1,9	2,3	12,9	2,3	0,6	3,1	25,5	71,1

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	31,6	25,5	26,6	0,0	0,0	15,7	0,7	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64,5	79,0	94,3	0
Fe_2O_3 wt%	28,2	12,2	1,6	0
MnO wt%	1,7	0,6	0,2	0
Cr_2O_3 wt%	0,2	0,3	0,2	0
SiO_2 wt%	3,3	5,5	2,3	0
Al_2O_3 wt%	1,4	1,6	0,9	0
MgO wt%	0,2	0,2	0,1	0
CaO wt%	0,2	0,3	0,2	0
ZrO_2 wt%	0,3	0,3	0,3	0
Total	100,0	100,0	100,0	0

Average TiO_2 content of all the TiO_2 minerals:	78,4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	71,0
Valuable heavy minerals in raw sand:	0,44

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	26,6	0,1
Leucoxene	21,5	0,1
Rutile	22,4	0,1
Ti magnetite	0,0	0,0
Magnetite	0,4	0,0
Chromite	0,4	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,0	0,0
Sillimanite	0,6	0,0
Staurolite	3,8	0,0
Zircon	13,2	0,1
Silicate	10,3	99,5
Unclassified	0,8	0,0
Total	100,0	100,0

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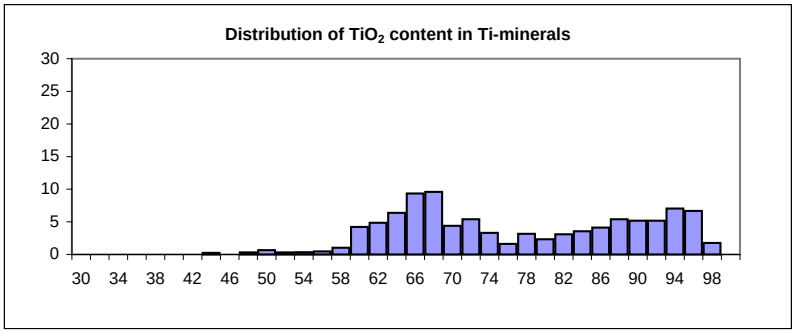
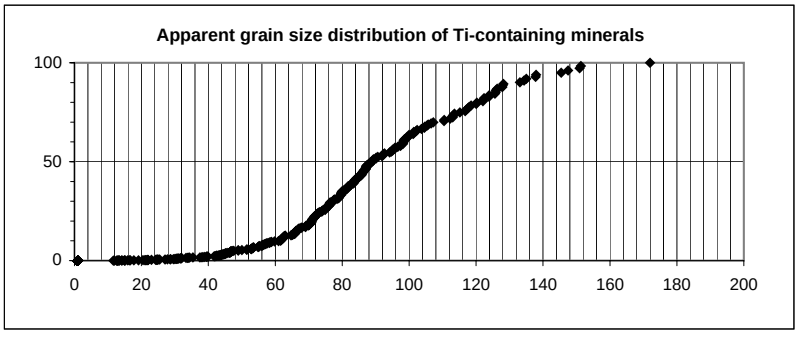
Sample Name:	3 Anykschchiai - 7 delta layer	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	14-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (μm)	Length (μm)	Area (μm^2)	Total grains
Ilmenite	1,6	1,8	300	116	4644	130
Leucoxene	1,6	2,0	325	128	5020	97
Rutile	1,6	2,0	305	121	4274	107
Ti magnetite	0,0	0,0	0	0	0	0
Magnetite	1,4	1,9	254	101	3442	2
Chromite	1,5	1,7	184	70	1744	5
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	1,7	1,9	178	70	1321	1
Garnet	0,0	0,0	0	0	0	0
Sillimanite	1,4	2,0	358	145	5822	3
Staurolite	2,0	2,5	352	149	5032	20
Zircon	1,5	1,7	263	98	3665	79
Silicate	1,7	2,1	306	124	4176	95
Unclassified	1,3	1,4	129	48	1561	19

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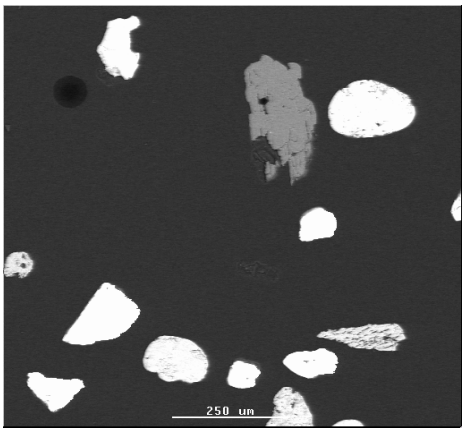

Sample Name:	8 Anykschchiai - 7	No. of analysed frames:	100
Date:	14-01-01	No. analysed of particles	381
Country:	Lituania	Heavy minerals in raw sand (%):	0,39
Submitter:	Dupont	comments:	
Analyzed by:	CCA		
Acc. Voltage	17 kV		
Magnification	100x		
Guard region	150 µm		
Sieve	100 µm²		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	63,0	26,7	1,9	0,2	4,7	0,9	0,2	0,2	0,3	98,0
Leucoxene	75,6	12,1	0,8	0,3	6,5	1,3	0,2	0,3	0,3	97,4
Rutile	93,2	1,2	0,2	0,2	2,1	0,6	0,1	0,1	0,2	98,0
Ti magnetite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Magnetite	4,0	65,6	0,0	0,3	10,6	8,4	0,3	0,0	0,0	89,2
Chromite	0,7	18,3	0,5	58,2	1,8	11,5	7,3	0,2	0,2	98,6
Pyrite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Monazite	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Y-phosphate	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphene	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Garnet	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sillimanite	0,0	0,5	0,0	0,3	42,8	53,7	0,1	0,1	0,5	98,0
Staurolite	0,6	14,8	0,3	0,1	34,1	46,4	1,3	0,1	0,2	98,0
Zircon	0,3	0,4	0,2	0,2	29,8	0,1	0,1	0,2	64,3	95,5
Silicate	0,7	3,7	0,2	0,2	65,7	23,9	1,2	0,7	0,4	96,7
Unclassified	18,4	1,6	0,2	0,1	65,5	0,8	0,0	0,1	8,6	95,3

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Sillimanite	Total
wt %	35,2	20,5	22,3	0,0	0,0	21,0	1,0	100,0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	64,3	77,7	95,1	0
Fe_2O_3 wt%	27,2	12,4	1,2	0
MnO wt%	2,0	0,8	0,2	0
Cr_2O_3 wt%	0,2	0,3	0,2	0
SiO_2 wt%	4,8	6,7	2,2	0
Al_2O_3 wt%	0,9	1,4	0,6	0
MgO wt%	0,2	0,2	0,1	0
CaO wt%	0,2	0,3	0,1	0
ZrO_2 wt%	0,3	0,3	0,2	0
Total	100,0	100,0	100,0	0

Average TiO_2 content of all the TiO_2 minerals:	76,6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	69,2
Valuable heavy minerals in raw sand:	0,32

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	28,8	0,1
Leucoxene	16,8	0,1
Rutile	18,3	0,1
Ti magnetite	0,0	0,0
Magnetite	0,0	0,0
Chromite	1,3	0,0
Pyrite	0,0	0,0
Phosphate	0,0	0,0
Monazite	0,0	0,0
Y-phosphate	0,0	0,0
Sphene	0,0	0,0
Garnet	0,0	0,0
Sillimanite	0,8	0,0
Staurolite	5,5	0,0
Zircon	17,2	0,1
Silicate	10,1	99,6
Unclassified	1,1	0,0
Total	100,0	100,0

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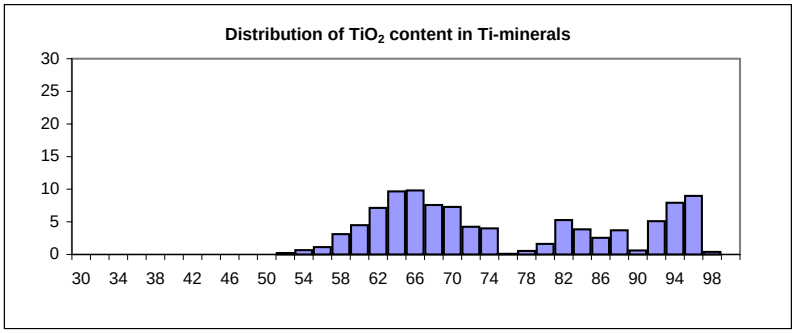
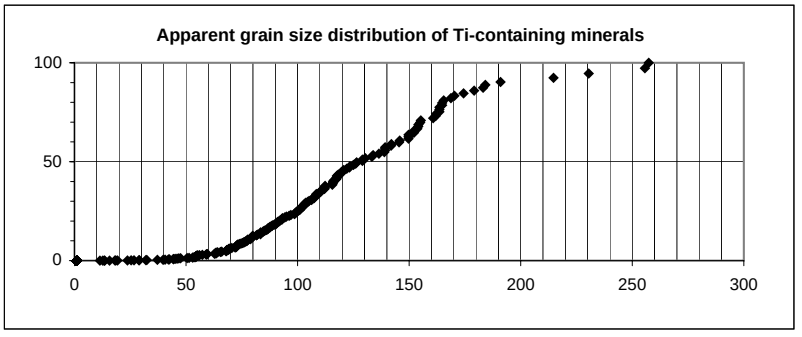
Sample Name:	8 Anykschchiai - 7	Analyzed by:	CCA
Submitter:	Dupont	Acc. Voltage	17kV
Date:	14-01-01		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1,6	1,9	423	165	8798	98
Leucoxene	1,7	2,1	441	178	9300	54
Rutile	1,6	2,1	447	182	8501	58
Ti magnetite	0,0	0,0	0	0	0	0
Magnetite	1,9	1,9	71	28	213	1
Chromite	1,3	1,6	380	135	8669	4
Pyrite	0,0	0,0	0	0	0	0
Phosphate	0,0	0,0	0	0	0	0
Monazite	0,0	0,0	0	0	0	0
Y-phosphate	0,0	0,0	0	0	0	0
Sphene	0,0	0,0	0	0	0	0
Garnet	0,0	0,0	0	0	0	0
Sillimanite	2,0	3,0	554	243	8301	4
Staurolite	1,6	2,5	565	239	13946	14
Zircon	1,5	1,8	391	148	7789	64
Silicate	1,7	2,2	370	153	6607	78
Unclassified	1,7	2,2	344	143	8945	6

Belarus

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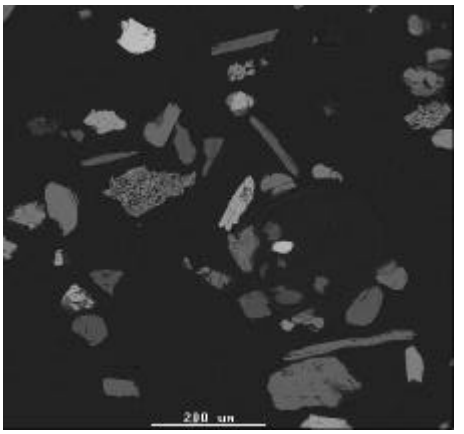

Sample Name:	8 km south of Gomel, 1	No. of frames analysed:	86
Lab. Name:	2000120	No. of particles analysed:	1064
Date:	4/2/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.59
Country:	Belarus	Comments: The single grain of magnetite	
Analyzed by:	BV	has low average content due to high con-	
Acc. Voltage/Magnification: 17kV/125x		tent of cupper.	
Guard region:	125 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.8	31.1	2.0	0.1	6.2	1.7	0.4	0.3	0.3	97.9
Leucoxene	76.8	6.6	0.3	0.2	8.1	3.3	0.4	0.7	0.5	96.8
Rutile	90.9	2.1	0.1	0.2	2.6	1.2	0.2	0.3	0.3	97.9
Ti magnetite	38.5	39.4	1.8	0.2	13.0	3.3	0.5	0.2	0.2	97.2
Magnetite	0.7	59.9	0.0	0.7	12.3	0.0	0.0	0.9	0.6	75.1
Chromite	0.8	30.4	1.0	27.5	2.9	30.6	6.0	0.1	0.0	99.4
Pyrite	0.1	32.3	0.2	0.1	0.9	0.4	0.0	0.1	0.3	34.4
Phosphate	0.5	1.1	0.0	0.2	3.4	0.9	0.1	53.6	1.4	61.2
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.4	0.0	0.0	3.8	0.6	0.0	2.6	6.0	13.4
Sphene	37.2	1.7	0.1	0.1	29.9	2.2	0.1	26.7	0.1	98.2
Garnet	0.3	30.0	2.3	0.1	38.7	20.4	3.3	2.1	0.2	97.4
Kya/Sill	0.2	0.9	0.1	0.1	42.9	53.1	0.0	0.0	0.2	97.5
Staurolite	0.7	14.8	0.3	0.3	34.1	45.5	1.7	0.1	0.5	98.0
Zircon	0.3	0.6	0.3	0.1	29.2	0.2	0.1	0.5	63.2	94.5
Silicate	0.8	8.1	0.3	0.1	59.9	16.0	2.5	7.1	0.3	95.1
Unclassified	16.7	15.5	0.9	0.2	21.7	5.6	0.5	17.7	8.0	86.8

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	37.7	27.5	14.4	2.3	11.1	5.0	0.5	1.5	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.0	79.4	92.8	39.7
Fe_2O_3 wt%	31.7	6.8	2.2	40.5
MnO wt%	2.1	0.3	0.2	1.9
Cr_2O_3 wt%	0.1	0.2	0.2	0.2
SiO_2 wt%	6.4	8.3	2.6	13.4
Al_2O_3 wt%	1.7	3.4	1.3	3.4
MgO wt%	0.4	0.4	0.2	0.5
CaO wt%	0.3	0.7	0.3	0.2
ZrO_2 wt%	0.3	0.5	0.3	0.2
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	70.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	65.5
Valuable heavy minerals in raw sand:	0.26

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	16.8	0.1
Leucoxene	12.3	0.1
Rutile	6.4	0.0
Ti magnetite	1.0	0.0
Magnetite	0.0	0.0
Chromite	0.1	0.0
Pyrite	0.6	0.0
Phosphate	0.4	0.0
Monazite	0.0	0.0
Y-phosphate	0.1	0.0
Sphene	1.1	0.0
Garnet	5.0	0.0
Kya/Sill	0.2	0.0
Staurolite	0.7	0.0
Zircon	2.2	0.0
Silicate	52.3	99.7
Unclassified	0.9	0.0
Total	100.0	100.0

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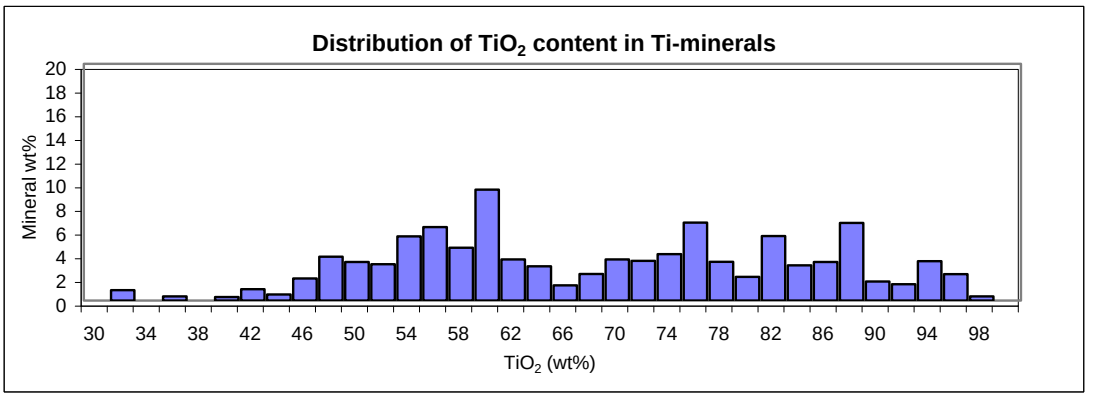
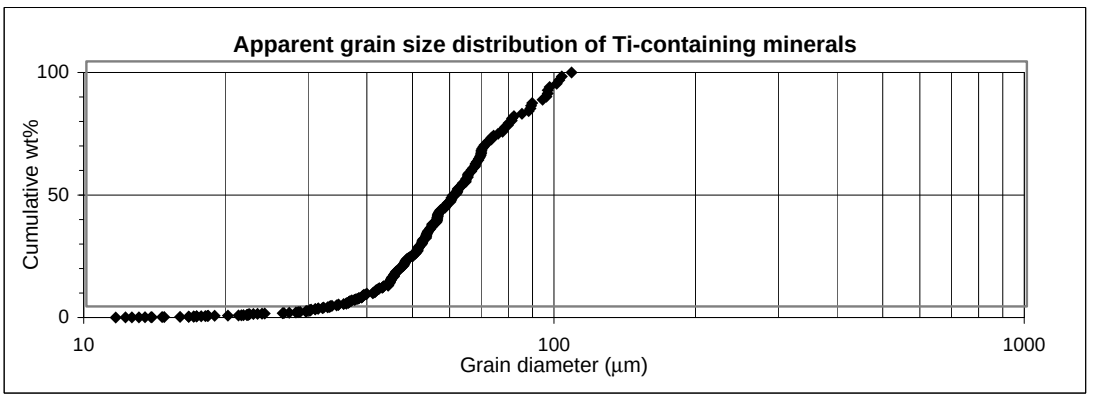
Lab. Name:	2000120	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/2/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.8	2.0	208	81	2031	130
Leucoxene	1.7	2.4	263	110	2639	73
Rutile	1.6	2.0	225	89	2266	40
Ti magnetite	1.8	2.2	177	71	1289	12
Magnetite	1.7	1.2	39	13	105	1
Chromite	1.7	1.8	153	58	1062	1
Pyrite	2.1	4.1	463	214	4336	2
Phosphate	1.4	1.9	187	73	1908	3
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	1.3	1.4	118	38	786	1
Sphene	1.7	2.0	255	102	3173	7
Garnet	1.9	2.1	207	83	1951	45
Kya/Sill	1.7	2.4	190	80	1313	4
Staurolite	1.5	1.9	178	71	1519	8
Zircon	1.3	1.7	194	71	1982	17
Silicate	2.1	2.4	221	91	1982	704
Unclassified	1.4	1.8	162	63	1472	16

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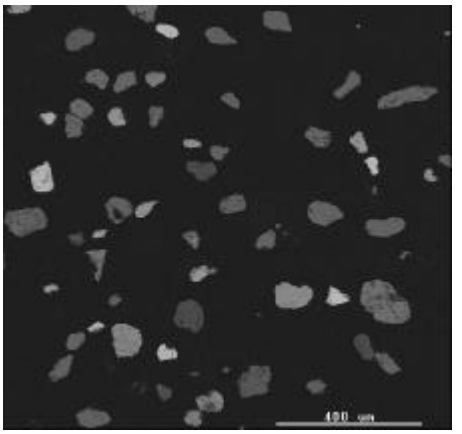

Sample Name:	Yourkovitchi, 4-1	No. of frames analysed:	61
Lab. Name:	2000123	No. of particles analysed:	1498
Date:	4/3/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.59
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/80x		
Guard region:	135 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56.6	34.5	2.0	0.1	3.4	0.9	0.2	0.1	0.2	98.2
Leucoxene	74.3	10.2	0.6	0.1	10.1	1.8	0.2	0.2	0.4	97.8
Rutile	93.8	1.4	0.1	0.1	1.7	0.6	0.1	0.1	0.3	98.2
Ti magnetite	35.5	46.0	1.6	0.1	8.5	2.5	1.1	0.8	0.5	96.6
Magnetite	1.4	80.9	1.1	0.2	6.2	2.4	0.7	3.7	0.1	96.9
Chromite	0.0	18.1	0.9	65.6	3.1	6.4	2.2	0.2	0.1	96.5
Pyrite	0.1	32.6	0.0	0.2	0.4	0.1	0.0	0.0	0.3	33.7
Phosphate	0.3	0.9	0.1	0.2	0.9	0.1	0.1	55.9	1.0	59.5
Monazite	0.0	0.5	0.0	0.0	3.5	0.2	0.0	2.1	0.2	6.5
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.0	1.4	0.1	0.1	29.6	2.1	0.1	27.5	0.1	98.1
Garnet	0.3	33.1	2.2	0.1	37.2	19.5	3.3	1.9	0.2	97.8
Kya/Sill	0.0	0.9	0.0	0.4	43.1	53.3	0.0	0.1	0.1	97.8
Staurolite	0.6	14.9	0.4	0.1	32.9	46.9	1.3	0.1	0.3	97.6
Zircon	0.2	0.7	0.1	0.1	29.6	0.1	0.1	0.2	64.0	95.1
Silicate	0.9	15.6	0.5	0.1	49.3	13.3	5.7	10.8	0.3	96.7
Unclassified	3.2	15.8	2.7	0.2	14.6	4.4	10.9	30.5	4.0	86.1

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	40.9	8.9	8.5	3.0	17.6	17.9	0.5	2.6	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.7	76.0	95.5	36.8
Fe_2O_3 wt%	35.2	10.4	1.4	47.6
MnO wt%	2.1	0.6	0.1	1.7
Cr_2O_3 wt%	0.1	0.1	0.1	0.1
SiO_2 wt%	3.5	10.3	1.7	8.8
Al_2O_3 wt%	0.9	1.8	0.6	2.6
MgO wt%	0.2	0.2	0.1	1.1
CaO wt%	0.1	0.2	0.1	0.9
ZrO_2 wt%	0.2	0.4	0.3	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	64.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	59.6
Valuable heavy minerals in raw sand:	0.26

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	17.8	0.1
Leucoxene	3.9	0.0
Rutile	3.7	0.0
Ti magnetite	1.3	0.0
Magnetite	0.6	0.0
Chromite	0.0	0.0
Pyrite	0.2	0.0
Phosphate	1.3	0.0
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	1.4	0.0
Garnet	7.7	0.0
Kya/Sill	0.2	0.0
Staurolite	1.1	0.0
Zircon	7.8	0.0
Silicate	45.3	99.7
Unclassified	7.6	0.0
Total	100.0	100.0

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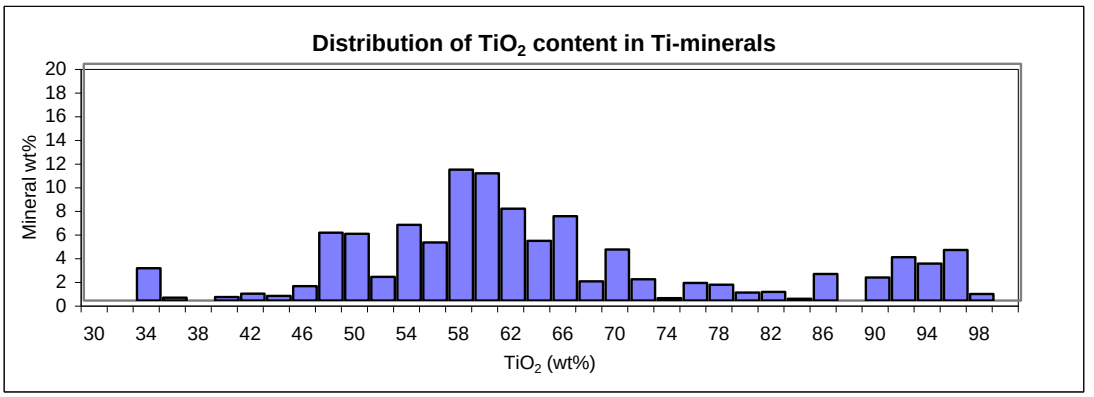
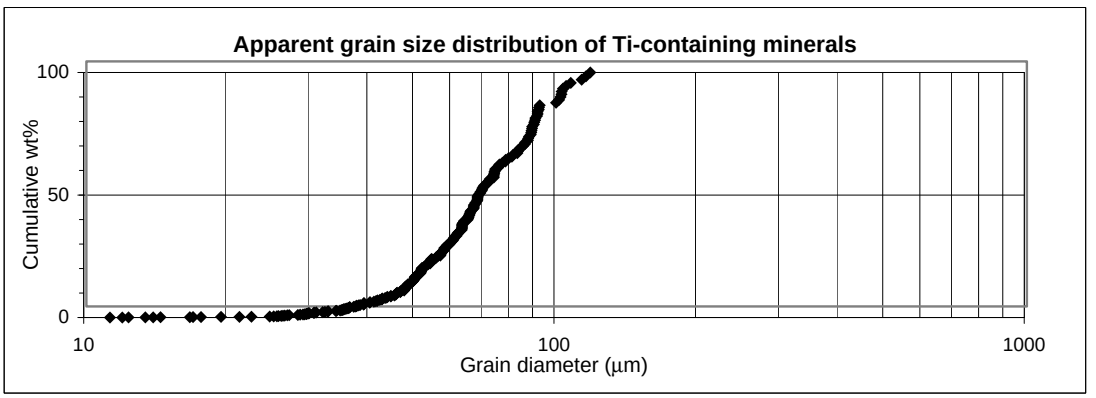
Lab. Name:	2000123	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/3/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.6	225	82	2791	185
Leucoxene	1.7	1.8	279	106	3869	29
Rutile	1.6	1.7	238	90	2758	35
Ti magnetite	1.6	1.7	227	90	2977	12
Magnetite	1.5	1.7	146	57	1381	11
Chromite	1.3	1.1	46	16	158	1
Pyrite	1.3	1.6	244	86	2975	2
Phosphate	1.6	1.7	249	93	3144	11
Monazite	1.3	1.2	140	42	1810	2
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.7	1.6	242	88	3028	17
Garnet	1.6	1.8	211	82	2213	113
Kya/Sill	1.5	1.9	291	112	4506	2
Staurolite	1.8	2.0	262	105	3295	12
Zircon	1.5	1.5	206	73	2425	90
Silicate	1.6	1.8	233	89	2738	815
Unclassified	1.6	1.9	231	91	2774	133

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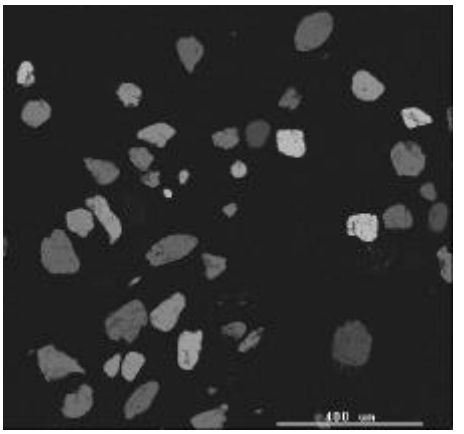

Sample Name:	Yourkovitchi, 4-2	No. of frames analysed:	72
Lab. Name:	2000124	No. of particles analysed:	1268
Date:	4/3/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	3.40
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/80x			
Guard region:	135 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.5	35.8	2.1	0.1	2.9	1.2	0.3	0.2	0.3	98.4
Leucoxene	74.1	12.0	0.4	0.2	8.6	1.9	0.2	0.2	0.6	98.1
Rutile	92.1	1.1	0.2	0.2	3.5	0.7	0.1	0.1	0.3	98.2
Ti magnetite	31.6	57.2	1.3	0.1	4.8	2.2	0.5	0.2	0.3	98.3
Magnetite	10.5	82.2	0.4	0.2	2.9	1.3	0.2	0.5	0.2	98.3
Chromite	1.4	30.3	0.4	41.4	0.8	16.7	7.4	0.1	0.0	98.6
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.3	0.6	0.2	0.1	1.1	0.3	0.1	55.7	0.8	59.1
Monazite	6.1	3.1	0.0	0.0	3.6	0.9	0.6	1.1	3.2	18.4
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	36.2	1.5	0.3	0.1	29.8	2.6	0.2	27.3	0.1	97.9
Garnet	0.2	34.2	2.1	0.1	36.9	19.5	3.4	1.7	0.3	98.3
Kya/Sill	0.0	0.5	0.0	0.0	42.8	54.3	0.0	0.0	0.1	97.8
Staurolite	0.7	15.7	0.4	0.2	32.8	46.9	1.4	0.1	0.3	98.3
Zircon	0.2	0.6	0.2	0.1	29.8	0.3	0.1	0.2	63.8	95.2
Silicate	0.9	16.5	0.9	0.1	47.2	15.0	5.1	10.8	0.3	96.9
Unclassified	5.7	24.9	1.7	1.0	24.4	10.0	1.9	8.4	12.7	90.7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	35.6	3.7	4.1	4.4	28.2	19.1	0.1	4.9	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.4	75.5	93.8	32.1
Fe_2O_3 wt%	36.4	12.2	1.1	58.2
MnO wt%	2.1	0.4	0.2	1.4
Cr_2O_3 wt%	0.1	0.2	0.2	0.1
SiO_2 wt%	3.0	8.8	3.6	4.9
Al_2O_3 wt%	1.2	1.9	0.7	2.3
MgO wt%	0.3	0.2	0.1	0.5
CaO wt%	0.2	0.2	0.1	0.3
ZrO_2 wt%	0.3	0.6	0.3	0.3
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	58.9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	55.6
Valuable heavy minerals in raw sand:	2.21

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	23.1	0.8
Leucoxene	2.4	0.1
Rutile	2.6	0.1
Ti magnetite	2.8	0.1
Magnetite	2.0	0.1
Chromite	0.1	0.0
Pyrite	0.0	0.0
Phosphate	1.5	0.1
Monazite	0.3	0.0
Y-phosphate	0.0	0.0
Sphene	0.8	0.0
Garnet	18.3	0.6
Kya/Sill	0.1	0.0
Staurolite	3.2	0.1
Zircon	12.4	0.4
Silicate	27.6	97.5
Unclassified	2.7	0.1
Total	100.0	100.0

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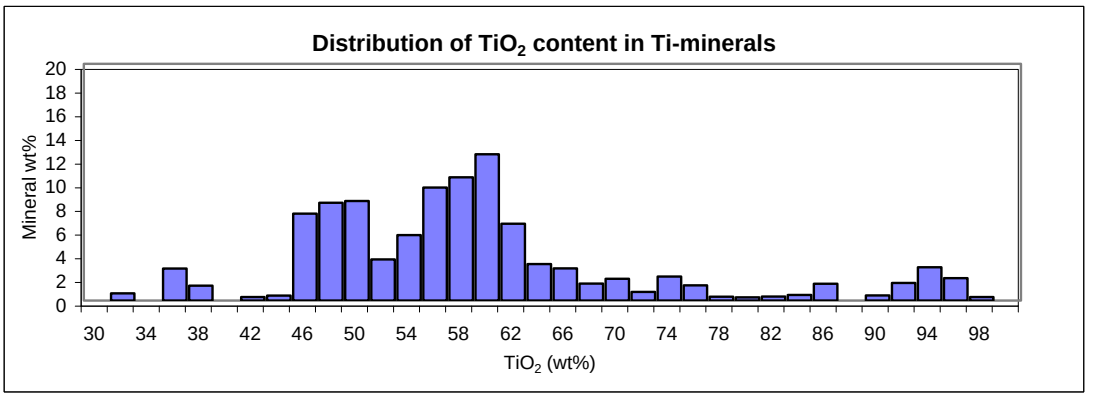
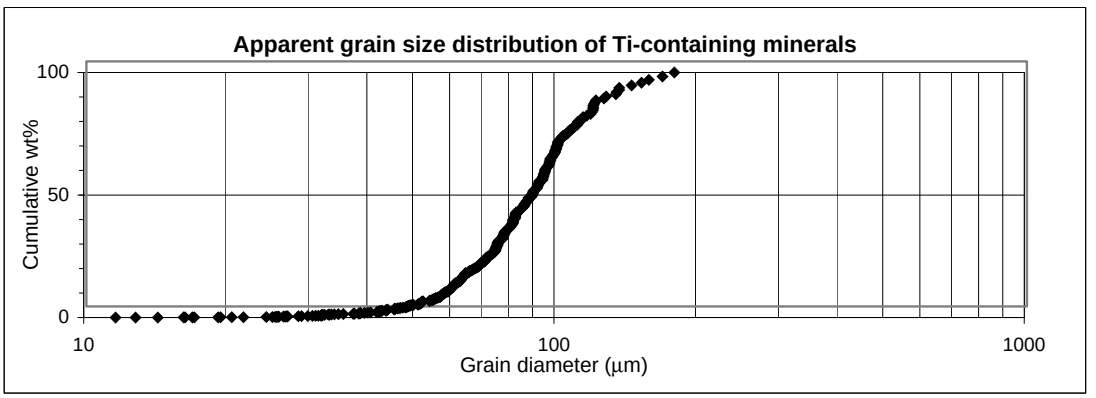
Lab. Name:	2000124	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/3/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.6	291	106	4659	268
Leucoxene	1.6	1.6	316	115	5407	24
Rutile	1.6	1.7	267	99	3679	35
Ti magnetite	1.4	1.8	313	121	4966	29
Magnetite	1.4	1.6	246	89	3415	27
Chromite	1.2	1.4	246	82	3429	2
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.5	1.6	337	120	6526	11
Monazite	1.4	2.0	361	141	5295	3
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.6	1.6	298	109	4371	12
Garnet	1.6	1.8	306	119	4551	245
Kya/Sill	2.0	3.1	468	207	5697	1
Staurolite	1.6	2.2	430	174	7812	26
Zircon	1.4	1.5	262	92	3882	167
Silicate	1.6	1.8	354	135	6696	379
Unclassified	1.5	2.0	348	144	6330	39

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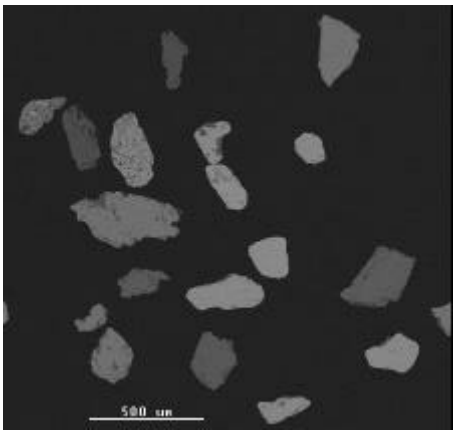

Sample Name:	Peredelka 5-1	No. of frames analysed:	100
Lab. Name:	2000125	No. of particles analysed:	1011
Date:	3/11/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.48
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	250 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	60.4	29.7	1.8	0.1	4.2	1.1	0.5	0.1	0.2	98.1
Leucoxene	77.6	9.9	0.3	0.2	6.6	1.7	0.4	0.2	0.3	97.3
Rutile	94.6	1.1	0.1	0.2	1.2	0.5	0.1	0.1	0.3	98.2
Ti magnetite	34.7	29.2	1.9	0.3	13.1	16.6	0.8	0.2	0.1	96.9
Magnetite	0.9	67.2	1.6	0.3	15.3	6.5	1.2	3.6	0.0	96.6
Chromite	1.0	39.6	0.6	40.0	1.7	11.4	2.6	0.1	0.0	96.9
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.8	0.0	0.0	3.4	0.0	0.0	3.1	0.0	7.2
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.3	31.7	2.5	0.1	37.2	19.3	3.5	3.4	0.2	98.2
Kya/Sill	0.1	1.0	0.0	0.2	42.7	53.7	0.0	0.0	0.3	98.2
Staurolite	0.6	15.4	0.3	0.1	32.7	47.2	1.4	0.1	0.2	98.1
Zircon	0.3	1.1	0.3	0.1	29.8	0.3	0.1	0.1	62.8	94.9
Silicate	0.6	12.8	1.0	0.1	50.5	27.3	1.4	2.6	0.3	96.8
Unclassified	13.4	20.4	0.5	0.4	29.8	17.3	1.7	0.7	5.2	89.4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	53.6	4.3	7.7	1.2	19.7	1.8	3.1	8.7	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	61.6	79.8	96.3	35.8
Fe_2O_3 wt%	30.3	10.2	1.1	30.1
MnO wt%	1.8	0.4	0.1	2.0
Cr_2O_3 wt%	0.1	0.2	0.2	0.3
SiO_2 wt%	4.3	6.8	1.3	13.5
Al_2O_3 wt%	1.1	1.7	0.5	17.1
MgO wt%	0.5	0.4	0.1	0.9
CaO wt%	0.1	0.2	0.1	0.2
ZrO_2 wt%	0.2	0.3	0.3	0.1
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	66.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	62.4
Valuable heavy minerals in raw sand:	0.38

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	42.3	0.2
Leucoxene	3.4	0.0
Rutile	6.1	0.0
Ti magnetite	0.9	0.0
Magnetite	0.1	0.0
Chromite	0.1	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	15.5	0.1
Kya/Sill	2.4	0.0
Staurolite	6.9	0.0
Zircon	1.4	0.0
Silicate	20.4	99.6
Unclassified	0.5	0.0
Total	100.0	100.0

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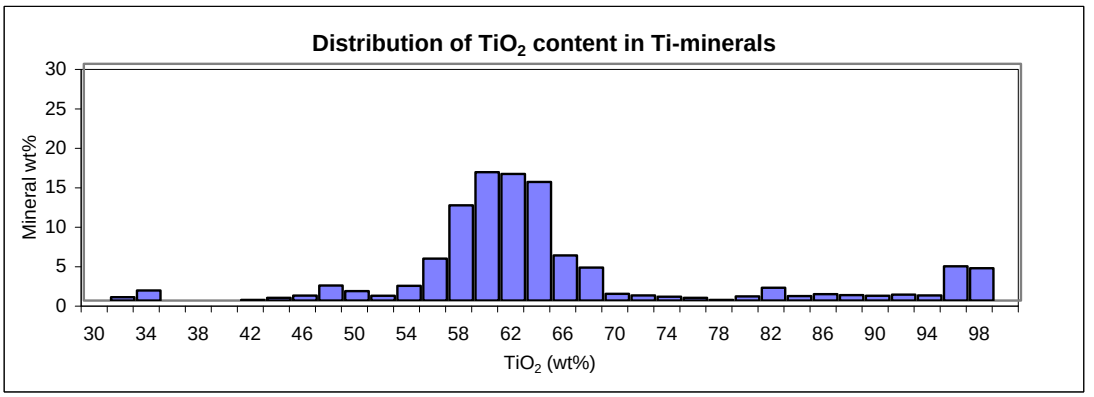
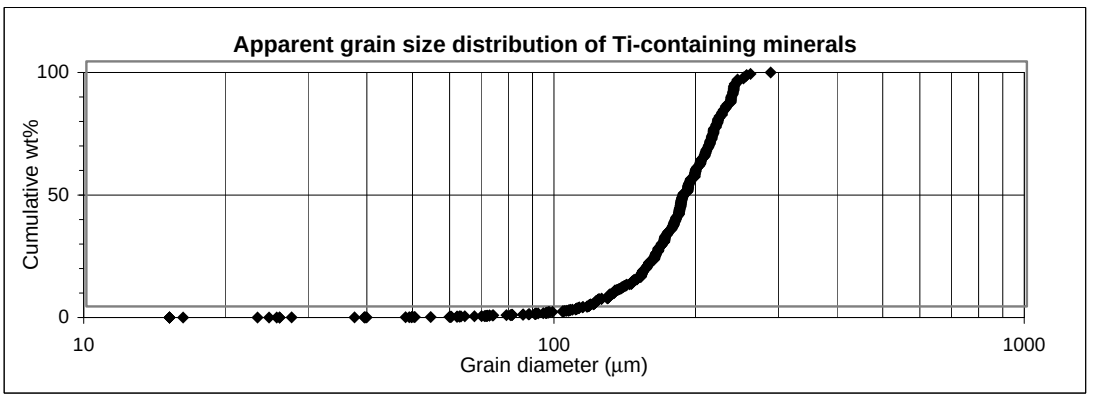
Lab. Name:	2000125	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/11/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	664	245	22764	393
Leucoxene	1.6	1.6	583	214	19595	37
Rutile	1.5	1.7	603	225	19541	59
Ti magnetite	1.7	2.1	967	399	36511	5
Magnetite	1.5	1.5	173	65	2060	6
Chromite	1.2	2.0	769	307	23851	1
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.7	1.8	402	156	7005	2
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	2.0	748	300	25860	143
Kya/Sill	1.9	2.2	1089	449	44378	16
Staurolite	1.5	1.9	729	284	27779	62
Zircon	1.4	1.6	517	185	14176	20
Silicate	1.6	2.0	779	315	30583	240
Unclassified	1.4	1.3	237	91	5993	27

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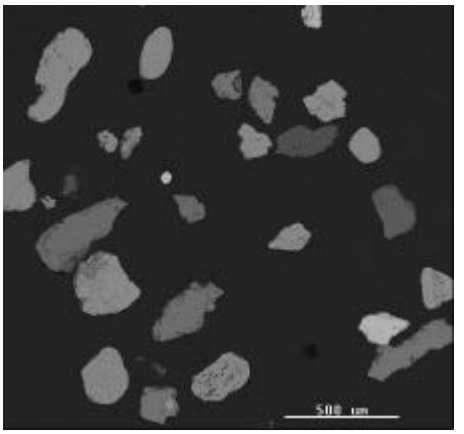

Sample Name:	Peredelka 5-2	No. of frames analysed:	109
Lab. Name:	2000126	No. of particles analysed:	732
Date:	3/15/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.45
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/50x			
Guard region:	325 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	59.9	27.1	1.5	0.2	6.7	1.5	0.6	0.1	0.3	97.9
Leucoxene	74.9	13.7	0.7	0.2	5.5	1.6	0.4	0.2	0.5	97.6
Rutile	94.2	1.2	0.1	0.2	1.4	0.5	0.2	0.1	0.2	98.0
Ti magnetite	40.3	25.7	1.1	0.1	19.3	9.5	1.4	0.1	0.5	98.0
Magnetite	0.1	84.8	0.3	1.2	0.4	0.6	0.0	0.4	0.5	88.3
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	1.8	32.0	0.1	0.0	0.9	0.5	0.1	0.0	0.5	35.9
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.0	0.0	0.0	2.4	0.7	0.0	0.4	0.0	3.4
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.2	31.1	3.1	0.1	37.2	19.5	3.7	3.1	0.3	98.3
Kya/Sill	0.2	0.9	0.1	0.1	42.8	53.5	0.0	0.1	0.3	98.0
Staurolite	0.7	15.2	0.3	0.1	32.5	47.1	1.7	0.1	0.3	98.2
Zircon	0.2	0.8	0.1	0.2	29.8	0.2	0.1	0.2	63.3	94.8
Silicate	0.6	11.0	0.9	0.1	49.3	31.8	1.3	1.5	0.4	97.0
Unclassified	6.9	15.9	4.4	0.4	30.2	15.1	1.0	3.6	10.9	88.5

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	46.0	5.5	4.3	5.8	20.5	3.0	1.8	13.1	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	61.2	76.8	96.2	41.1
Fe_2O_3 wt%	27.7	14.0	1.2	26.2
MnO wt%	1.5	0.8	0.1	1.1
Cr_2O_3 wt%	0.2	0.2	0.2	0.1
SiO_2 wt%	6.8	5.6	1.4	19.7
Al_2O_3 wt%	1.5	1.6	0.5	9.7
MgO wt%	0.6	0.4	0.2	1.4
CaO wt%	0.1	0.2	0.1	0.1
ZrO_2 wt%	0.3	0.5	0.2	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	63.1
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	60.6
Valuable heavy minerals in raw sand:	0.36

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	36.8	0.2
Leucoxene	4.4	0.0
Rutile	3.4	0.0
Ti magnetite	4.7	0.0
Magnetite	0.4	0.0
Chromite	0.0	0.0
Pyrite	0.4	0.0
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	16.4	0.1
Kya/Sill	1.4	0.0
Staurolite	10.4	0.0
Zircon	2.4	0.0
Silicate	16.1	99.6
Unclassified	3.2	0.0
Total	100.0	100.0

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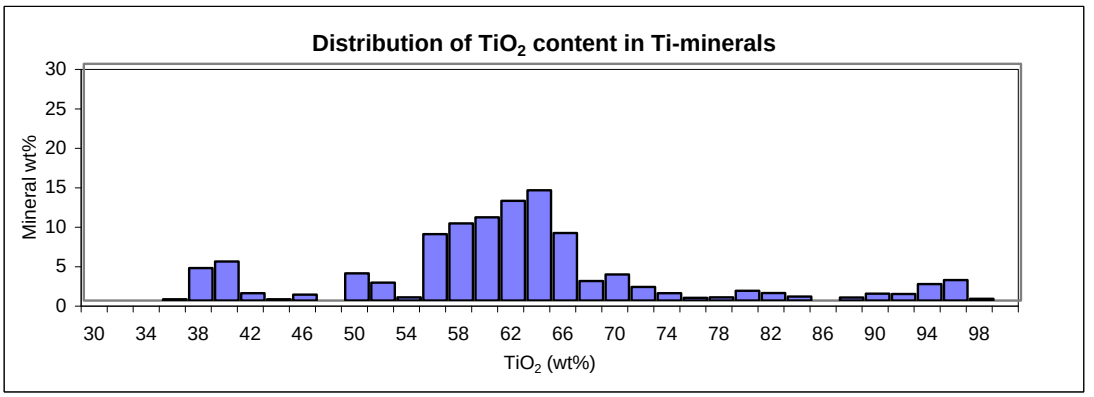
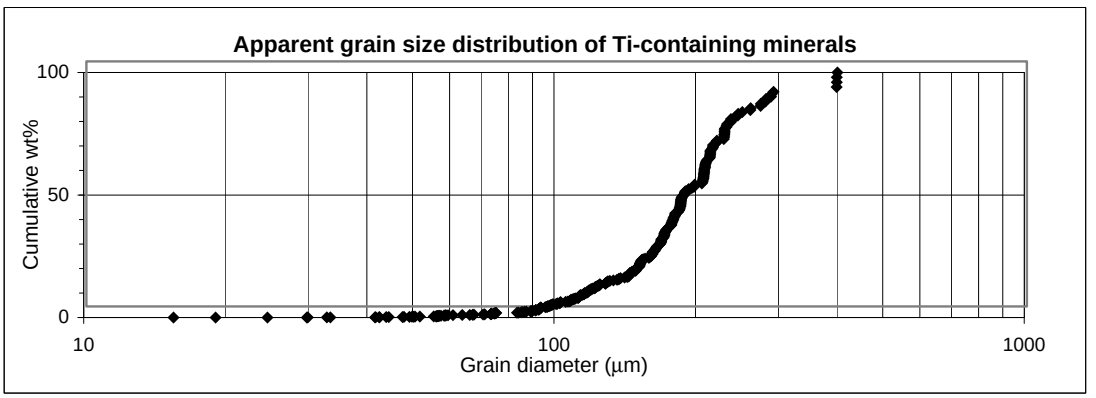
Lab. Name:	2000126	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/15/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.7	591	218	19362	260
Leucoxene	1.5	1.6	625	227	21333	28
Rutile	1.6	1.7	537	202	14583	29
Ti magnetite	2.0	2.5	1345	580	66773	9
Magnetite	1.3	2.4	627	270	14200	3
Chromite	0.0	0.0	0	0	0	0
Pyrite	1.5	2.1	540	223	11527	4
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.1	1.3	302	93	5416	1
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	2.0	762	305	25797	98
Kya/Sill	1.5	2.1	825	334	27231	10
Staurolite	1.7	2.3	867	357	29161	58
Zircon	1.5	1.7	570	209	16481	19
Silicate	1.6	2.0	655	266	22617	165
Unclassified	1.4	1.9	527	222	16403	44

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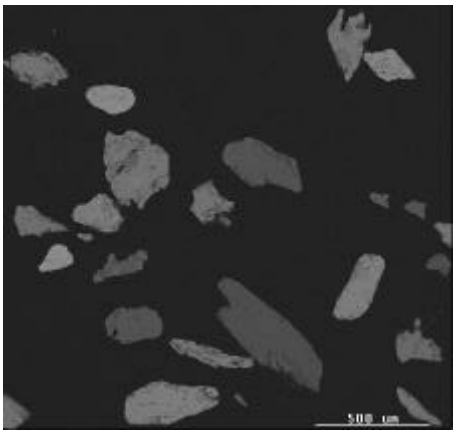

Sample Name:	Krupeiki 8-1	No. of frames analysed:	100
Lab. Name:	2000137	No. of particles analysed:	991
Date:	3/14/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.47
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification:	17kV/50x		
Guard region:	250 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	60.1	30.1	2.0	0.1	3.8	1.0	0.4	0.1	0.3	97.9
Leucoxene	75.2	11.4	1.2	0.2	5.4	1.9	0.4	0.2	0.4	96.3
Rutile	94.4	1.1	0.3	0.2	1.3	0.4	0.1	0.2	0.3	98.1
Ti magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	1.0	75.3	3.1	0.7	9.7	2.8	0.8	1.3	0.0	94.7
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	38.7	0.3	0.2	0.4	29.0	1.8	0.0	28.0	0.2	98.7
Garnet	0.2	30.9	2.5	0.1	37.1	19.4	4.0	3.4	0.3	97.9
Kya/Sill	0.2	0.8	0.1	0.3	42.6	53.8	0.0	0.1	0.2	98.1
Staurolite	0.7	15.0	0.3	0.2	32.4	47.2	1.7	0.1	0.2	97.8
Zircon	0.2	0.4	0.1	0.2	29.5	0.0	0.1	0.1	63.8	94.5
Silicate	0.7	10.9	1.1	0.2	44.4	31.9	1.4	5.6	0.3	96.7
Unclassified	3.8	18.4	3.0	1.2	29.2	11.5	1.8	1.9	5.9	76.8

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	35.4	6.2	5.7	0.0	27.4	0.7	4.0	20.6	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	61.4	78.1	96.2	0
Fe_2O_3 wt%	30.7	11.9	1.1	0
MnO wt%	2.1	1.2	0.3	0
Cr_2O_3 wt%	0.1	0.2	0.2	0
SiO_2 wt%	3.9	5.6	1.3	0
Al_2O_3 wt%	1.0	2.0	0.4	0
MgO wt%	0.4	0.4	0.1	0
CaO wt%	0.1	0.2	0.2	0
ZrO_2 wt%	0.3	0.4	0.3	0
Total	100.0	100.0	100.0	0

Average TiO_2 content of all the TiO_2 minerals:	67.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	63.9
Valuable heavy minerals in raw sand:	0.34

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	25.4	0.1
Leucoxene	4.4	0.0
Rutile	4.1	0.0
Ti magnetite	0.0	0.0
Magnetite	0.4	0.0
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.3	0.0
Garnet	19.7	0.1
Kya/Sill	2.9	0.0
Staurolite	14.8	0.1
Zircon	0.5	0.0
Silicate	27.1	99.7
Unclassified	0.5	0.0
Total	100.0	100.0

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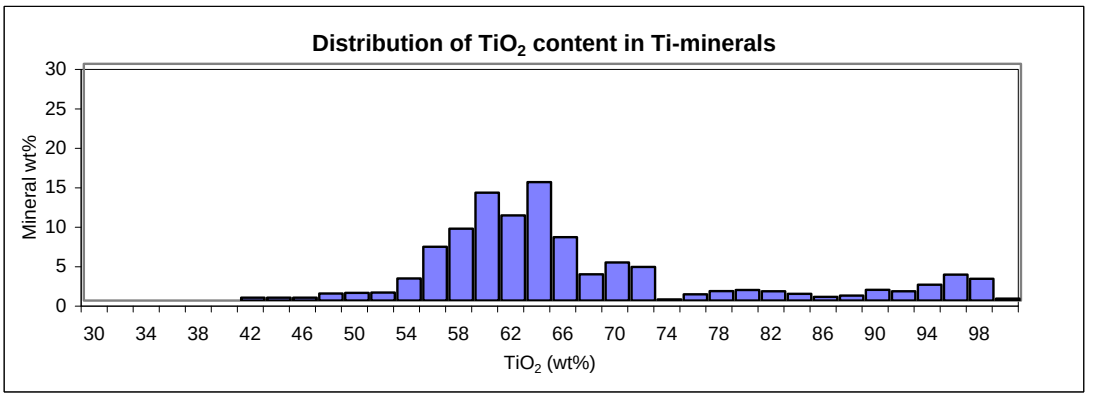
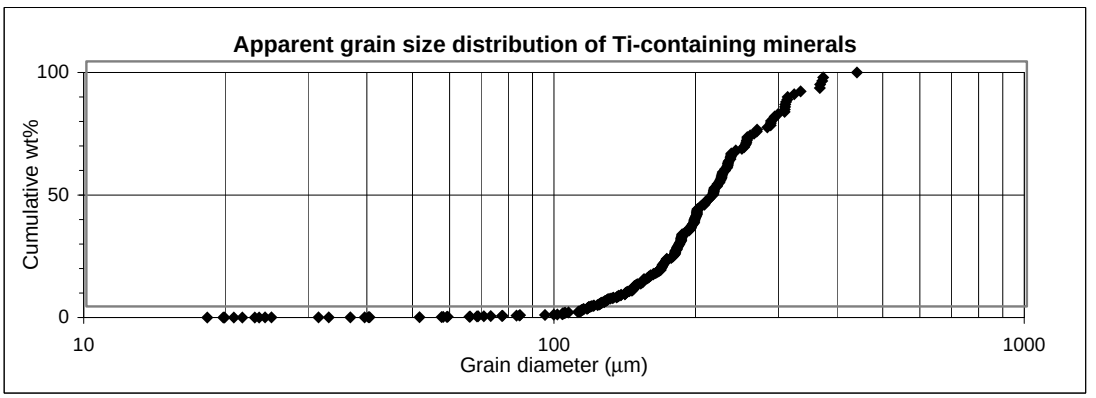
Lab. Name:	2000137	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/14/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.5	1.8	744	288	27431	206
Leucoxene	1.4	1.7	764	290	31770	31
Rutile	1.6	1.8	715	276	23988	34
Ti magnetite	0.0	0.0	0	0	0	0
Magnetite	1.5	2.1	616	257	17315	4
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.7	2.0	990	396	39243	2
Garnet	1.6	2.1	811	333	29602	166
Kya/Sill	1.8	2.1	871	353	30549	29
Staurolite	1.7	2.3	882	366	34462	113
Zircon	1.3	1.7	416	157	9338	11
Silicate	1.6	2.2	801	331	29353	349
Unclassified	1.3	1.2	148	57	3864	46

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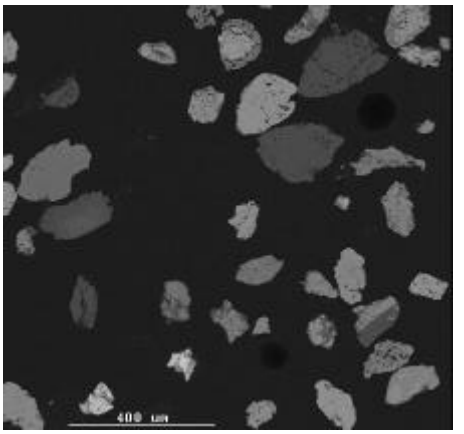

Sample Name:	Kabaki (Northern wall), 9a-1	No. of frames analysed:	66
Lab. Name:	2000141	No. of particles analysed:	1048
Date:	3/20/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.76
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/80x			
Guard region:	200 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	59.6	29.6	1.9	0.1	4.6	1.4	0.3	0.2	0.3	98.0
Leucoxene	76.4	9.1	0.5	0.2	7.7	2.4	0.3	0.3	0.3	97.2
Rutile	91.4	1.6	0.3	0.2	2.8	1.1	0.2	0.1	0.3	98.0
Ti magnetite	39.5	31.2	1.5	0.2	16.8	3.8	0.9	0.1	3.3	97.4
Magnetite	1.3	68.2	5.8	0.0	6.4	1.3	0.3	10.3	0.5	94.2
Chromite	1.6	35.3	2.6	40.6	0.5	11.4	6.1	0.0	0.0	98.2
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	1.8	0.0	0.0	5.7	1.5	0.0	1.2	2.3	12.5
Y-phosphate	0.0	0.0	0.0	0.0	1.0	0.0	0.4	1.8	3.4	6.7
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	0.4	29.0	5.0	0.1	37.4	19.2	2.5	4.5	0.1	98.2
Kya/Sill	0.6	0.9	0.2	0.1	42.5	53.3	0.0	0.1	0.3	98.0
Staurolite	1.7	13.4	0.3	0.2	33.5	47.1	1.4	0.1	0.2	97.9
Zircon	0.5	0.7	0.1	0.1	29.6	0.3	0.1	0.3	62.8	94.5
Silicate	2.3	9.7	1.1	0.1	55.6	22.7	1.9	2.3	0.4	96.0
Unclassified	23.7	6.4	3.8	0.2	29.7	6.4	0.8	3.9	13.3	88.3

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	55.4	21.1	12.4	0.5	2.9	5.5	0.6	1.6	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	60.8	78.6	93.2	40.6
Fe_2O_3 wt%	30.2	9.3	1.6	32.0
MnO wt%	2.0	0.5	0.3	1.5
Cr_2O_3 wt%	0.1	0.2	0.2	0.2
SiO_2 wt%	4.7	7.9	2.9	17.3
Al_2O_3 wt%	1.5	2.5	1.2	3.9
MgO wt%	0.3	0.3	0.2	1.0
CaO wt%	0.2	0.3	0.1	0.1
ZrO_2 wt%	0.3	0.4	0.3	3.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	69.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	65.5
Valuable heavy minerals in raw sand:	0.69

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	50.0	0.4
Leucoxene	19.0	0.1
Rutile	11.2	0.1
Ti magnetite	0.5	0.0
Magnetite	0.0	0.0
Chromite	0.2	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.2	0.0
Y-phosphate	0.1	0.0
Sphene	0.0	0.0
Garnet	2.6	0.0
Kya/Sill	0.5	0.0
Staurolite	1.4	0.0
Zircon	4.9	0.0
Silicate	7.9	99.3
Unclassified	1.5	0.0
Total	100.0	100.0

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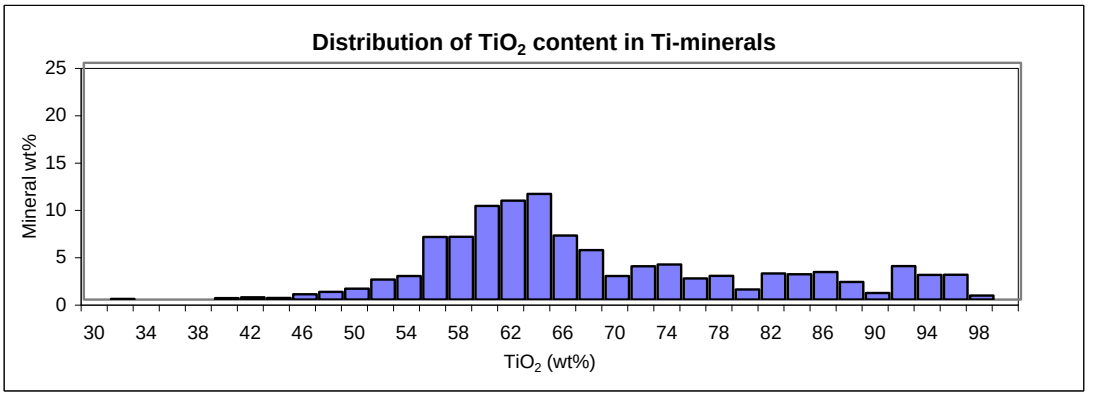
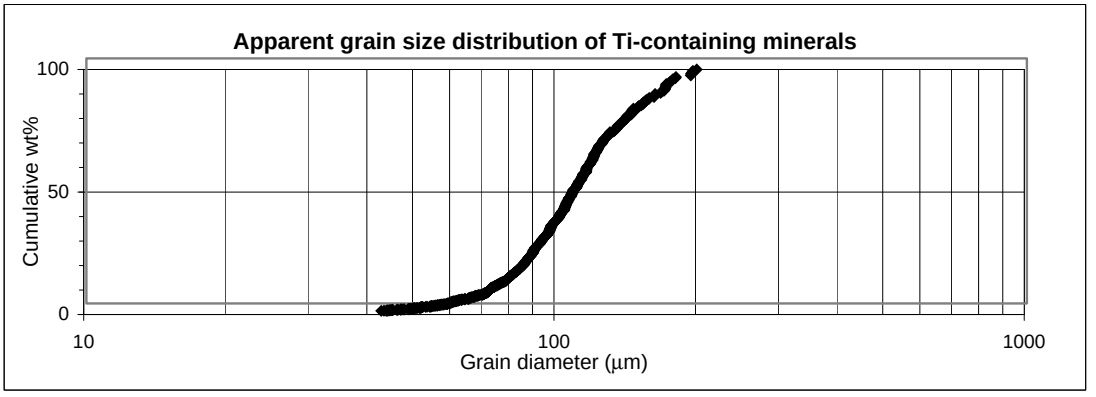
Lab. Name:	2000141	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/20/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	370	146	6420	503
Leucoxene	1.6	2.1	441	177	8485	145
Rutile	1.6	1.9	357	141	6272	104
Ti magnetite	1.8	1.9	293	118	4137	7
Magnetite	1.6	1.4	179	56	1882	1
Chromite	1.8	1.7	339	129	5370	2
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.7	1.6	256	94	3227	3
Y-phosphate	1.8	1.5	282	99	4109	1
Sphene	0.0	0.0	0	0	0	0
Garnet	1.6	2.0	325	130	4690	40
Kya/Sill	1.8	2.0	465	184	9429	5
Staurolite	2.0	2.6	483	205	8274	13
Zircon	1.5	1.8	335	127	5523	56
Silicate	1.6	1.9	335	134	6207	139
Unclassified	1.5	2.0	325	136	5700	29

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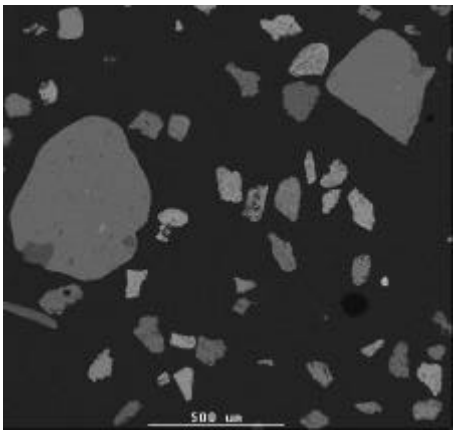

Sample Name:	12-1	No. of frames analysed:	84
Lab. Name:	2000147	No. of particles analysed:	1495
Date:	3/12/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.51
Country:	Belarus	Comments: Large amount of unclassified.	
Analyzed by:	BV	Many grains,mostly large, are composed	
Acc. Voltage/Magnification:	17kV/60x	of several minerals. These grains are often	
Guard region:	300 µm	rich in P + Ca and/or Si, Al, Ti, Fe.	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.7	33.8	2.1	0.1	3.9	1.1	0.3	0.3	0.3	97.7
Leucoxene	76.6	9.6	0.7	0.2	6.5	2.0	0.4	0.5	0.4	96.9
Rutile	91.7	1.9	0.2	0.2	2.1	0.7	0.2	0.2	0.3	97.4
Ti magnetite	41.6	35.7	1.7	0.1	14.5	1.9	0.6	0.2	0.3	96.8
Magnetite	1.8	79.6	0.9	0.3	6.6	1.2	0.6	2.2	0.6	93.7
Chromite	0.7	31.3	0.8	45.5	1.9	12.0	5.3	0.2	0.2	98.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.3	1.0	0.0	0.1	0.6	0.1	0.2	55.8	0.6	58.5
Monazite	0.0	0.0	0.0	0.0	9.8	1.3	0.0	0.1	3.2	14.3
Y-phosphate	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	2.6
Sphene	36.4	1.1	0.0	0.2	29.8	1.9	0.0	27.4	0.1	97.0
Garnet	0.3	28.5	4.0	0.2	37.0	19.5	3.0	4.3	0.4	97.2
Kya/Sill	0.4	1.0	0.0	0.1	42.8	53.2	0.1	0.1	0.1	97.9
Staurolite	1.9	13.8	0.2	0.2	32.2	47.3	1.4	0.1	0.2	97.3
Zircon	0.3	0.7	0.1	0.1	29.4	0.2	0.1	0.2	63.5	94.7
Silicate	2.2	10.8	0.4	0.2	45.5	20.5	0.5	16.3	0.3	96.6
Unclassified	7.9	5.7	0.4	0.5	13.8	4.9	0.6	33.2	3.7	70.7

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	62.1	19.8	9.0	2.2	3.1	3.2	0.3	0.4	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.1	79.1	94.2	42.9
Fe_2O_3 wt%	34.6	9.9	2.0	36.9
MnO wt%	2.1	0.7	0.2	1.8
Cr_2O_3 wt%	0.2	0.2	0.2	0.1
SiO_2 wt%	4.0	6.7	2.1	15.0
Al_2O_3 wt%	1.1	2.1	0.7	2.0
MgO wt%	0.3	0.4	0.2	0.7
CaO wt%	0.3	0.5	0.2	0.2
ZrO_2 wt%	0.3	0.4	0.3	0.3
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	65.0
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	61.9
Valuable heavy minerals in raw sand:	0.24

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	29.3	0.1
Leucoxene	9.3	0.0
Rutile	4.2	0.0
Ti magnetite	1.0	0.0
Magnetite	1.7	0.0
Chromite	0.2	0.0
Pyrite	0.0	0.0
Phosphate	3.2	0.0
Monazite	0.0	0.0
Y-phosphate	0.1	0.0
Sphene	0.2	0.0
Garnet	1.4	0.0
Kya/Sill	0.2	0.0
Staurolite	0.2	0.0
Zircon	1.5	0.0
Silicate	10.5	99.5
Unclassified	37.0	0.2
Total	100.0	100.0

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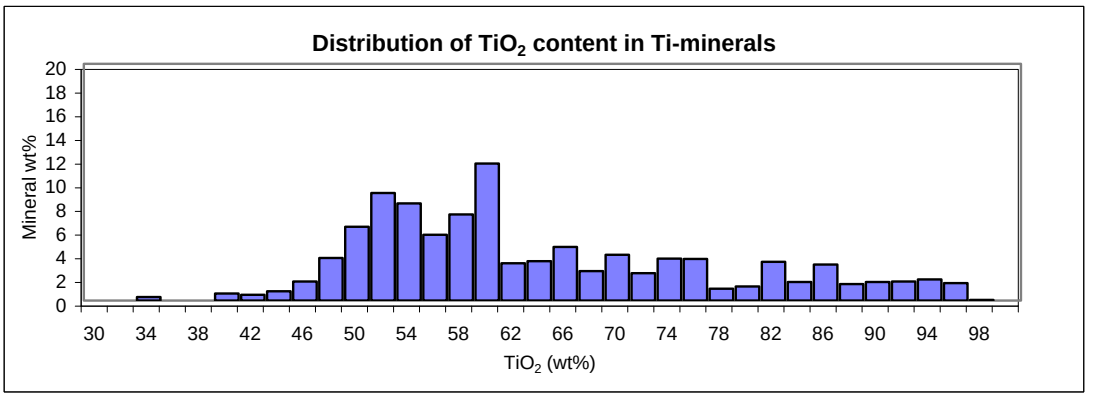
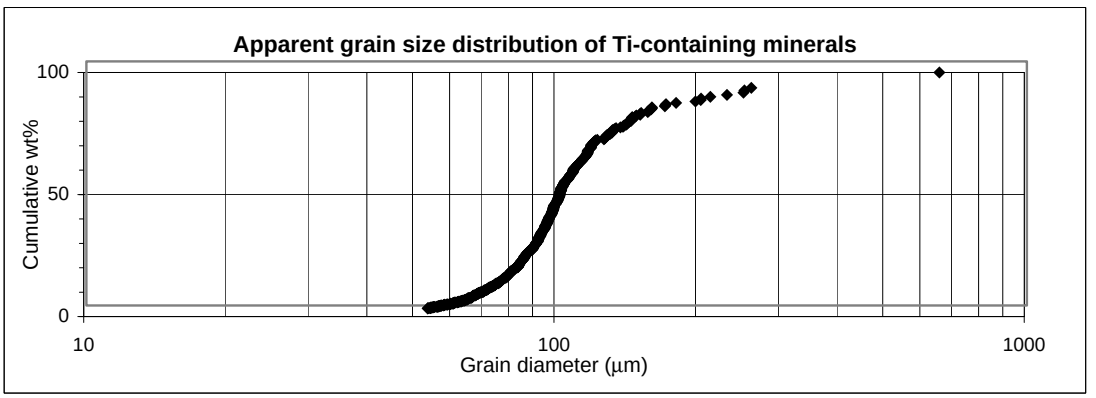
Lab. Name:	2000147	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/12/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	353	135	6695	539
Leucoxene	1.5	1.8	404	155	8346	138
Rutile	1.6	1.8	303	117	4832	97
Ti magnetite	1.7	2.0	339	134	5164	23
Magnetite	1.4	1.9	422	168	8462	21
Chromite	1.3	1.6	299	110	4568	5
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.5	1.9	658	268	27129	13
Monazite	2.3	2.0	162	65	1067	1
Y-phosphate	1.2	2.2	425	175	6553	1
Sphene	1.6	1.6	225	82	2856	10
Garnet	1.7	1.8	293	113	4366	46
Kya/Sill	1.5	2.3	425	176	6474	4
Staurolite	1.3	1.9	300	118	4012	7
Zircon	1.4	1.5	259	91	3911	46
Silicate	1.6	1.9	349	138	5840	378
Unclassified	1.5	1.8	680	263	45852	166

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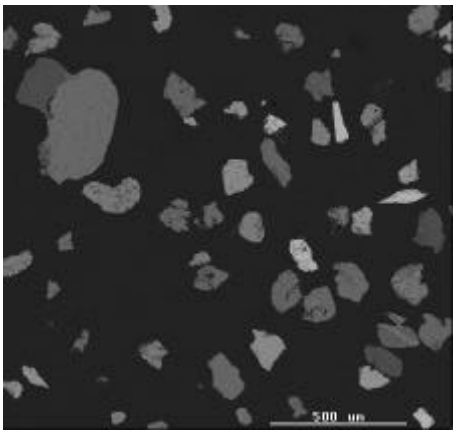

Sample Name:	12-2	No. of frames analysed:	58
Lab. Name:	2000148	No. of particles analysed:	1384
Date:	3/12/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	1.12
Country:	Belarus	Comments: High amount of unclassified.	
Analyzed by:	BV	Many unclassified grains are composed of	
Acc. Voltage/Magnification:	17kV/60x	several minerals. These grains are often	
Guard region:	300 µm	rich in P+Ca and/or Si, Al, Ti, Fe and Zr.	
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.0	34.7	2.1	0.1	3.8	1.1	0.3	0.3	0.4	97.9
Leucoxene	77.0	7.6	0.5	0.3	8.4	2.0	0.3	0.6	0.5	97.2
Rutile	92.8	1.6	0.2	0.2	1.8	0.8	0.1	0.1	0.3	97.9
Ti magnetite	38.7	32.2	1.6	0.8	14.3	4.2	0.6	2.4	0.6	95.3
Magnetite	0.6	69.3	0.3	0.2	15.7	3.7	0.7	2.4	0.3	93.2
Chromite	0.6	20.3	0.6	40.0	4.6	22.3	8.6	0.1	0.0	97.1
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.1	1.2	0.0	0.1	1.4	0.6	0.5	54.7	0.6	59.2
Monazite	0.0	1.4	0.4	0.0	2.9	1.2	0.5	2.3	0.6	9.3
Y-phosphate	0.0	0.3	0.0	0.3	2.3	0.6	0.2	2.0	4.0	9.7
Sphene	38.3	1.3	0.2	0.1	28.0	2.3	0.3	26.4	0.2	97.0
Garnet	0.2	30.4	4.4	0.1	36.8	19.1	2.7	4.2	0.3	98.3
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	1.0	15.8	0.2	0.0	32.8	46.9	1.4	0.1	0.3	98.3
Zircon	0.3	0.7	0.2	0.1	29.2	0.3	0.1	0.2	63.8	95.0
Silicate	1.4	10.0	0.3	0.2	46.7	20.0	0.5	17.1	0.3	96.6
Unclassified	6.8	7.5	0.8	0.9	15.0	17.0	1.5	21.4	6.9	77.8

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	57.3	12.8	7.3	14.9	2.0	5.2	0.0	0.5	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.2	79.3	94.9	40.6
Fe_2O_3 wt%	35.4	7.8	1.6	33.8
MnO wt%	2.1	0.5	0.2	1.7
Cr_2O_3 wt%	0.2	0.3	0.2	0.8
SiO_2 wt%	3.9	8.7	1.8	15.0
Al_2O_3 wt%	1.2	2.1	0.8	4.4
MgO wt%	0.3	0.3	0.1	0.7
CaO wt%	0.4	0.6	0.1	2.5
ZrO_2 wt%	0.4	0.5	0.3	0.6
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	59.9
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	56.9
Valuable heavy minerals in raw sand:	0.67

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	34.2	0.4
Leucoxene	7.6	0.1
Rutile	4.4	0.0
Ti magnetite	8.9	0.1
Magnetite	4.1	0.0
Chromite	0.1	0.0
Pyrite	0.0	0.0
Phosphate	0.5	0.0
Monazite	0.1	0.0
Y-phosphate	0.1	0.0
Sphene	0.1	0.0
Garnet	1.2	0.0
Kya/Sill	0.0	0.0
Staurolite	0.3	0.0
Zircon	3.1	0.0
Silicate	24.0	99.1
Unclassified	11.4	0.1
Total	100.0	100.0

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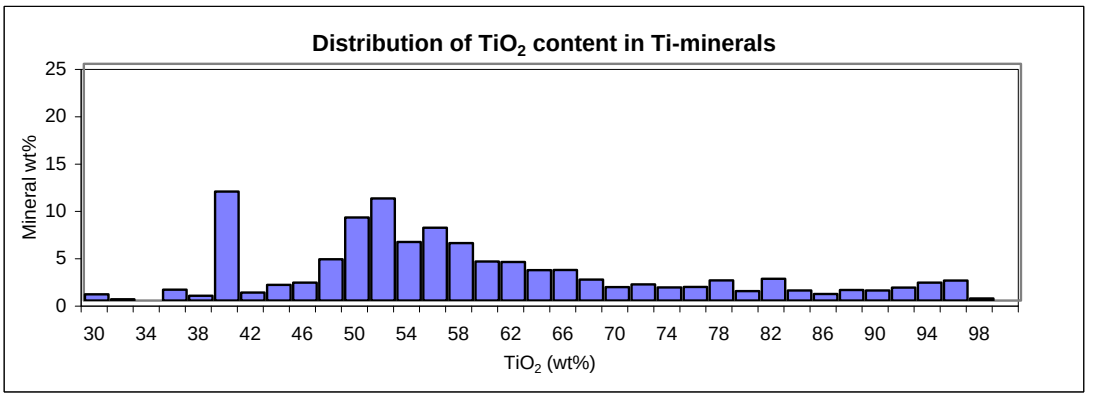
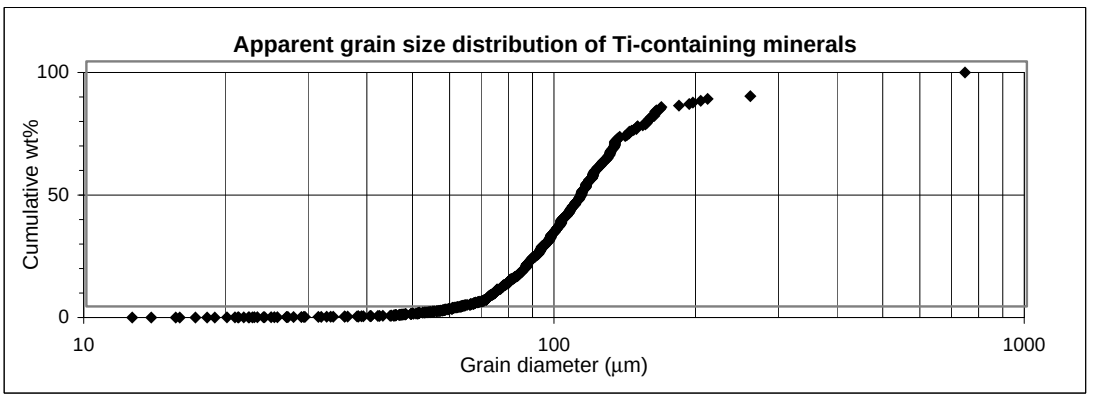
Lab. Name:	2000148	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/12/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	384	150	6789	441
Leucoxene	1.5	1.9	450	178	9159	73
Rutile	1.5	1.8	357	136	6271	55
Ti magnetite	1.5	2.3	599	253	23610	31
Magnetite	1.3	2.3	633	264	23699	13
Chromite	1.9	2.3	347	142	4978	2
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.7	2.1	472	195	9791	4
Monazite	1.7	1.6	171	61	1610	3
Y-phosphate	1.3	1.4	196	65	2367	3
Sphene	1.4	1.9	347	137	5391	3
Garnet	1.6	1.9	332	129	4977	24
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	1.9	2.0	367	148	5775	5
Zircon	1.5	1.6	277	98	4296	61
Silicate	1.5	1.9	378	150	7146	499
Unclassified	1.5	1.8	381	153	9986	167

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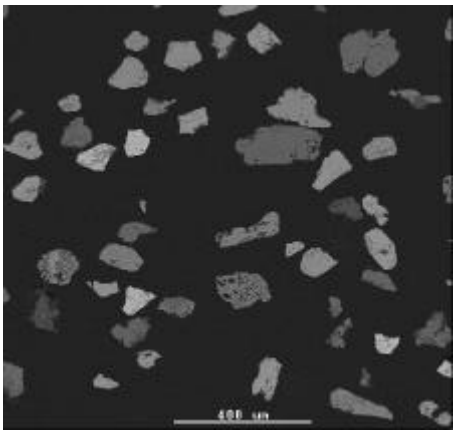

Sample Name:	Koliadichi lens 2, 14-1	No. of frames analysed:	89
Lab. Name:	2000149	No. of particles analysed:	1483
Date:	3/13/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.74
Country:	Belarus	Comments: High amount of unclassified.	
Analyzed by:	BV	Unclassified grains are mostly large and	
Acc. Voltage/Magnification: 17kV/75x		composed of several minerals.	
Guard region:	225 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	55.5	33.3	1.9	0.1	4.9	1.3	0.3	0.2	0.3	97.9
Leucoxene	75.8	9.5	0.5	0.2	7.6	2.1	0.3	0.5	0.5	97.1
Rutile	92.0	2.2	0.2	0.2	2.1	0.7	0.2	0.2	0.2	97.9
Ti magnetite	40.4	37.6	1.3	0.2	12.3	3.3	0.6	0.1	0.7	96.5
Magnetite	0.8	70.9	4.9	0.3	8.1	2.1	0.1	8.5	0.0	95.6
Chromite	0.2	23.6	0.7	53.4	0.8	12.3	6.9	0.2	0.0	98.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.2	1.6	0.1	0.1	1.5	2.6	0.2	52.5	1.0	59.8
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.9	1.0	0.1	0.1	28.6	1.8	0.0	27.3	0.2	97.0
Garnet	0.6	27.8	2.3	0.1	38.4	19.9	4.1	4.0	0.2	97.5
Kya/Sill	0.0	0.6	0.1	0.2	43.0	54.3	0.0	0.1	0.0	98.3
Staurolite	0.7	14.7	0.2	0.1	33.7	46.3	1.5	0.1	0.3	97.7
Zircon	0.4	0.7	0.1	0.2	29.4	0.2	0.1	0.2	63.4	94.7
Silicate	1.8	11.7	0.5	0.2	44.0	21.1	0.8	16.9	0.3	97.1
Unclassified	18.0	8.1	1.2	1.0	26.8	5.2	0.7	15.9	5.1	82.0

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	59.3	20.1	9.5	2.9	3.6	3.7	0.4	0.5	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	56.7	78.1	93.9	41.9
Fe_2O_3 wt%	34.0	9.8	2.3	39.0
MnO wt%	2.0	0.5	0.2	1.3
Cr_2O_3 wt%	0.1	0.2	0.2	0.2
SiO_2 wt%	5.0	7.8	2.1	12.8
Al_2O_3 wt%	1.3	2.1	0.7	3.4
MgO wt%	0.3	0.4	0.2	0.6
CaO wt%	0.2	0.5	0.2	0.1
ZrO_2 wt%	0.3	0.5	0.2	0.7
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	64.7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	61.4
Valuable heavy minerals in raw sand:	0.46

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	36.5	0.3
Leucoxene	12.3	0.1
Rutile	5.8	0.0
Ti magnetite	1.8	0.0
Magnetite	0.2	0.0
Chromite	0.5	0.0
Pyrite	0.0	0.0
Phosphate	0.9	0.0
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.7	0.0
Garnet	2.2	0.0
Kya/Sill	0.2	0.0
Staurolite	0.3	0.0
Zircon	2.3	0.0
Silicate	28.5	99.5
Unclassified	7.6	0.1
Total	100.0	100.0

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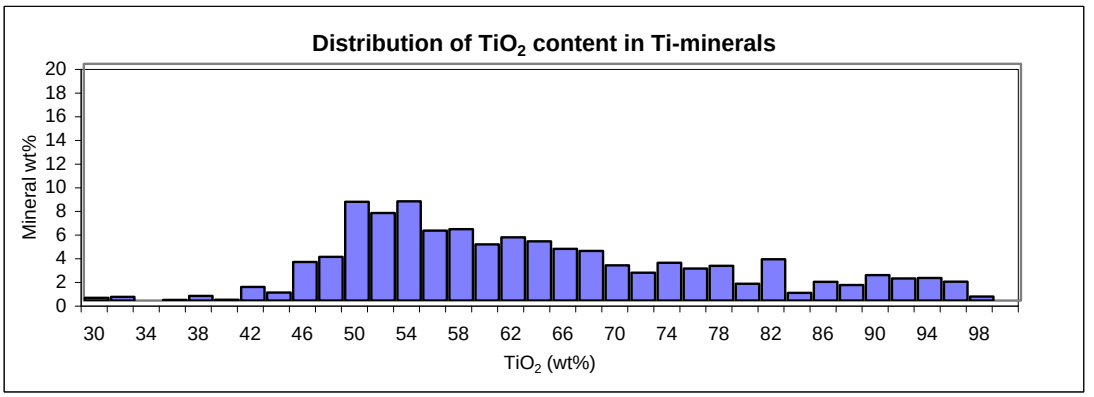
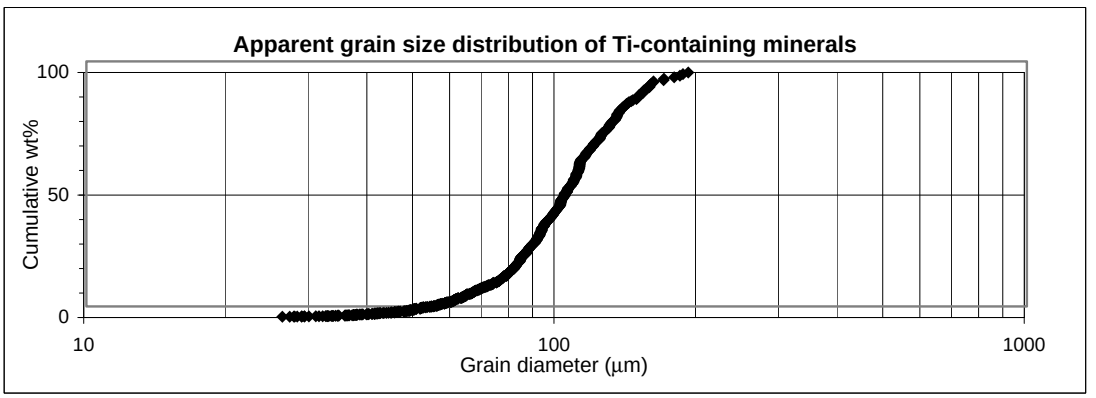
Lab. Name:	2000149	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/13/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	2.0	363	144	6018	459
Leucoxene	1.6	1.9	395	155	7528	124
Rutile	1.6	1.8	315	123	4833	82
Ti magnetite	1.7	1.9	337	135	5598	23
Magnetite	1.7	1.5	213	73	2957	5
Chromite	1.6	1.9	375	146	6053	5
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.8	1.8	287	108	4431	14
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.7	1.9	340	131	5388	13
Garnet	1.8	2.0	308	122	4241	44
Kya/Sill	1.6	1.9	387	152	6328	4
Staurolite	1.6	1.9	311	122	4742	6
Zircon	1.4	1.6	263	94	3900	43
Silicate	1.6	2.1	373	152	6180	593
Unclassified	1.5	2.0	469	189	14969	64

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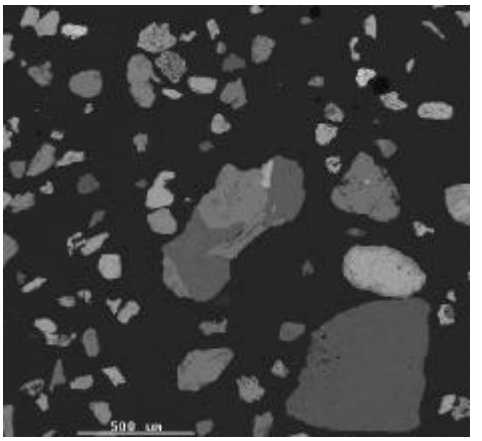

Sample Name:	Koliadichi (S. wall) 14-2/1	No. of frames analysed:	63
Lab. Name:	2000151	No. of particles analysed:	1479
Date:	21/03/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.43
Country:	Belarus	Comments: High amount of unclassified.	
Analyzed by:	BV	Many grains are composed of more than	
Acc. Voltage/Magnification:	17kV/50x	one mineral.	
Guard region:	400 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56.7	31.2	1.9	0.2	4.8	1.2	0.4	0.5	0.4	97.2
Leucoxene	76.0	7.8	0.5	0.2	8.0	2.5	0.3	0.8	0.5	96.6
Rutile	91.4	1.8	0.1	0.1	2.7	0.9	0.2	0.1	0.3	97.6
Ti magnetite	37.0	40.0	1.3	0.1	12.5	2.8	0.9	0.9	0.8	96.3
Magnetite	2.2	75.1	0.1	0.1	8.1	2.2	0.5	0.4	0.6	89.3
Chromite	0.0	26.2	1.7	42.1	1.4	16.8	9.6	0.0	0.6	98.3
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.2	0.7	0.2	0.1	0.9	6.7	0.2	48.8	1.0	58.7
Monazite	7.2	2.4	0.0	0.0	3.7	1.5	0.2	0.8	2.1	17.9
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	37.2	0.7	0.0	0.2	29.8	2.2	0.2	26.6	0.4	97.4
Garnet	0.4	32.9	2.2	0.1	36.8	19.4	4.0	2.3	0.2	98.3
Kya/Sill	0.0	1.1	0.0	0.3	43.0	53.1	0.0	0.1	0.6	98.2
Staurolite	1.1	14.1	0.4	0.0	34.5	46.2	1.3	0.0	0.3	97.8
Zircon	0.3	0.6	0.2	0.2	29.8	0.2	0.2	0.3	62.6	94.4
Silicate	1.6	9.6	0.4	0.1	55.9	15.9	2.9	8.6	0.4	95.4
Unclassified	10.4	13.8	1.1	0.2	20.9	4.1	4.0	17.9	5.8	78.3

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	53.0	20.8	7.1	5.6	9.4	4.0	0.1	0.1	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	58.3	78.7	93.6	38.4
Fe_2O_3 wt%	32.1	8.1	1.8	41.6
MnO wt%	1.9	0.5	0.1	1.4
Cr_2O_3 wt%	0.2	0.2	0.2	0.1
SiO_2 wt%	4.9	8.3	2.8	13.0
Al_2O_3 wt%	1.2	2.6	0.9	2.9
MgO wt%	0.4	0.3	0.2	1.0
CaO wt%	0.5	0.8	0.1	0.9
ZrO_2 wt%	0.4	0.5	0.3	0.8
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	64.8
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	62.2
Valuable heavy minerals in raw sand:	0.23

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	28.6	0.1
Leucoxene	11.2	0.0
Rutile	3.8	0.0
Ti magnetite	3.0	0.0
Magnetite	5.6	0.0
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	1.3	0.0
Monazite	0.2	0.0
Y-phosphate	0.0	0.0
Sphene	0.1	0.0
Garnet	5.1	0.0
Kya/Sill	0.0	0.0
Staurolite	0.1	0.0
Zircon	2.2	0.0
Silicate	28.0	99.7
Unclassified	10.8	0.0
Total	100.0	100.0

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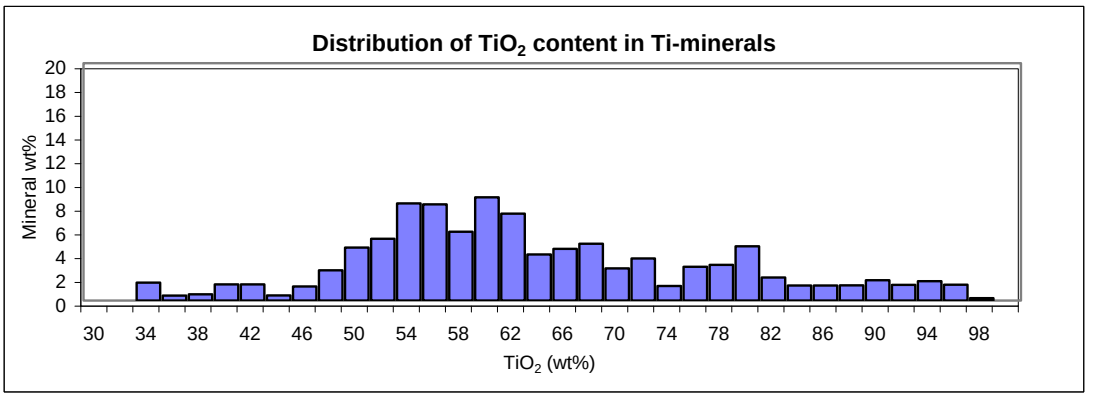
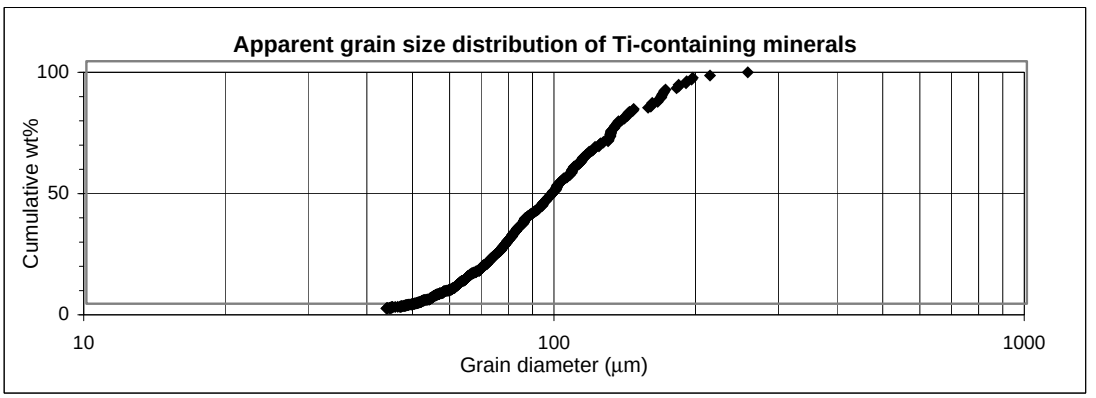
Lab. Name:	2000151	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	21/03/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.7	298	111	4896	519
Leucoxene	1.5	1.8	347	134	6196	161
Rutile	1.6	1.7	274	103	4042	76
Ti magnetite	1.6	2.2	448	188	8717	29
Magnetite	1.5	1.9	712	278	26979	16
Chromite	2.0	1.7	177	67	1455	1
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.6	1.7	376	142	7851	13
Monazite	1.5	1.6	200	75	2122	6
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.6	1.4	307	111	7126	2
Garnet	1.7	1.9	444	176	10109	50
Kya/Sill	1.8	1.8	309	120	4150	1
Staurolite	1.9	1.8	255	98	3443	2
Zircon	1.4	1.5	260	91	4035	46
Silicate	1.6	1.8	394	153	10012	422
Unclassified	1.4	1.7	382	149	11881	135

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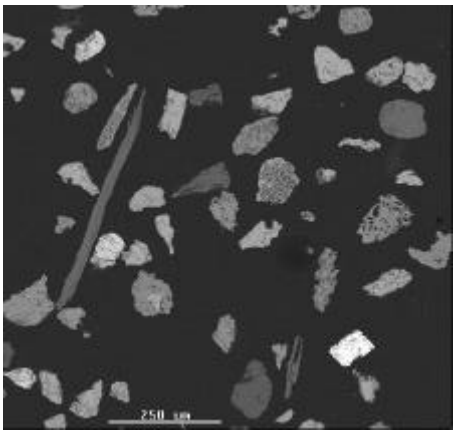

Sample Name:	Koliadichi, lens 4, 14-4/1	No. of frames analysed:	121
Lab. Name:	2000152	No. of particles analysed:	1416
Date:	3/25/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.44
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/100x			
Guard region:	200 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56.1	33.4	1.8	0.1	4.5	1.2	0.4	0.1	0.3	98.0
Leucoxene	77.2	9.2	0.5	0.2	6.4	2.3	0.3	0.6	0.6	97.3
Rutile	92.1	2.0	0.1	0.2	2.3	0.8	0.1	0.1	0.3	98.1
Ti magnetite	38.1	29.7	1.4	0.1	21.7	4.5	1.0	0.1	0.4	97.1
Magnetite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.5	0.4	0.0	0.4	1.0	0.2	0.4	56.0	0.5	59.4
Monazite	0.0	3.4	0.0	0.0	14.1	3.6	1.4	1.5	1.7	25.8
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	12.8	5.8	6.3	0.2	40.0	21.2	1.2	1.7	1.0	90.3
Kya/Sill	0.3	1.0	0.2	0.1	42.9	53.5	0.0	0.1	0.4	98.3
Staurolite	1.2	15.4	0.3	0.1	33.5	45.6	1.5	0.1	0.2	97.9
Zircon	0.4	0.6	0.2	0.2	28.9	0.2	0.2	0.4	62.7	93.7
Silicate	2.0	4.9	0.1	0.1	62.6	21.1	1.6	0.9	0.4	93.7
Unclassified	20.0	17.3	0.3	0.2	25.3	4.4	0.6	0.5	13.3	81.9

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	45.9	34.2	14.2	1.2	0.4	3.3	0.5	0.4	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.3	79.3	94.0	39.3
Fe_2O_3 wt%	34.1	9.5	2.0	30.6
MnO wt%	1.9	0.5	0.1	1.4
Cr_2O_3 wt%	0.1	0.2	0.2	0.1
SiO_2 wt%	4.6	6.6	2.3	22.4
Al_2O_3 wt%	1.3	2.4	0.8	4.7
MgO wt%	0.4	0.3	0.2	1.0
CaO wt%	0.1	0.6	0.1	0.1
ZrO_2 wt%	0.3	0.6	0.3	0.5
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	70.4
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	66.3
Valuable heavy minerals in raw sand:	0.37

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	38.4	0.2
Leucoxene	28.7	0.1
Rutile	11.9	0.1
Ti magnetite	1.0	0.0
Magnetite	0.0	0.0
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.2	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	0.3	0.0
Kya/Sill	0.4	0.0
Staurolite	0.4	0.0
Zircon	2.8	0.0
Silicate	12.9	99.6
Unclassified	3.0	0.0
Total	100.0	100.0

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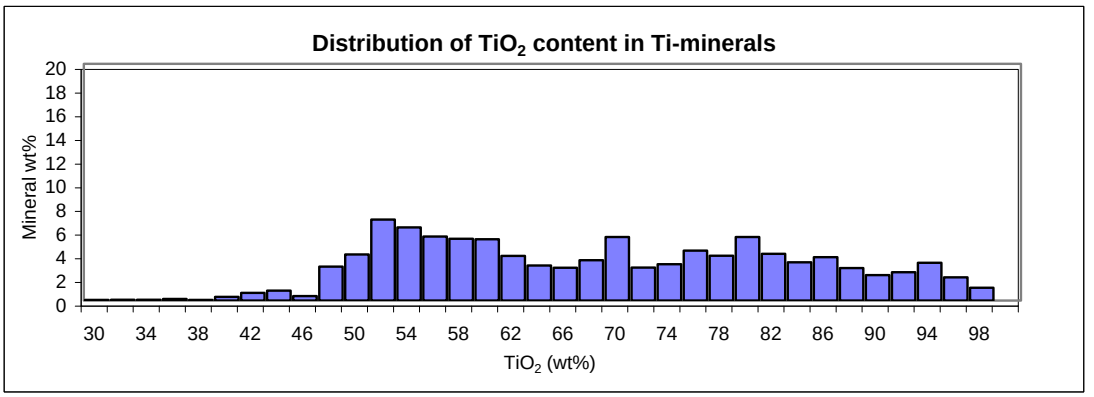
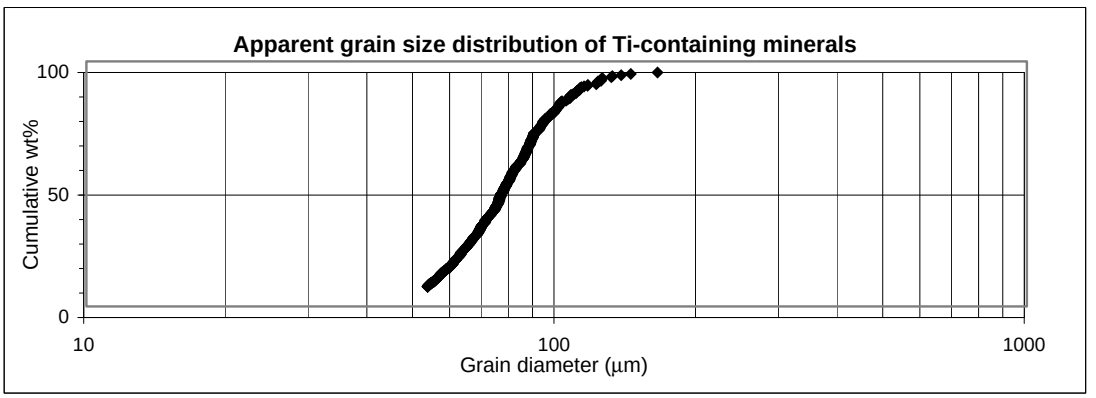
Lab. Name:	2000152	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	3/25/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	259	102	3045	556
Leucoxene	1.6	2.3	344	142	4661	271
Rutile	1.6	2.0	249	99	2766	170
Ti magnetite	1.7	2.0	208	84	2017	20
Magnetite	0.0	0.0	0	0	0	0
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.7	1.4	141	44	1162	1
Monazite	1.4	1.6	208	75	2293	3
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.5	2.3	270	115	3009	5
Kya/Sill	1.4	1.9	255	99	2950	9
Staurolite	1.4	1.9	225	89	2145	9
Zircon	1.5	1.7	227	85	2665	44
Silicate	2.7	2.8	323	138	3543	273
Unclassified	1.6	2.2	313	129	4060	55

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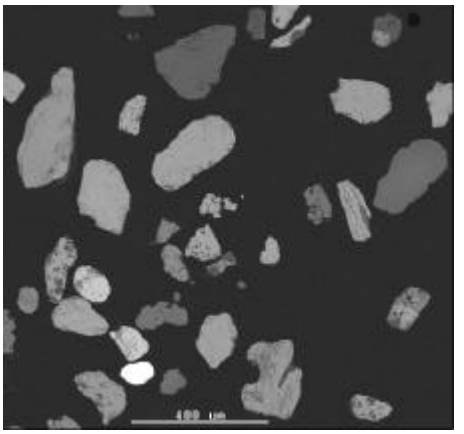

Sample Name:	Pishki, 15-1	No. of frames analysed:	100
Lab. Name:	2000154	No. of particles analysed:	1444
Date:	4/2/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.40
Country:	Belarus	Comments: The single grain of magnetite	
Analyzed by:	BV	has low average content due to high con-	
Acc. Voltage/Magnification: 17kV/75x		tent of S and K.	
Guard region:	200 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.9	36.6	2.0	0.1	3.0	0.8	0.3	0.1	0.3	98.1
Leucoxene	75.9	10.2	0.7	0.2	7.2	2.0	0.3	0.3	0.3	96.9
Rutile	91.4	1.7	0.1	0.1	3.2	0.8	0.2	0.1	0.2	97.9
Ti magnetite	39.0	35.3	1.5	0.1	14.5	3.2	0.5	0.3	1.0	95.4
Magnetite	0.1	51.5	0.0	0.0	0.5	0.7	0.0	0.4	0.0	53.2
Chromite	0.4	23.6	1.6	52.2	1.0	12.7	6.2	0.2	0.3	98.1
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.4	0.9	0.0	0.2	2.7	0.6	0.1	53.5	1.4	59.8
Monazite	0.0	0.7	0.0	0.0	2.8	0.6	0.0	0.9	2.5	7.5
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	40.2	1.8	0.2	0.0	26.9	2.2	0.1	25.9	0.1	97.4
Garnet	0.5	26.2	1.9	0.2	38.7	20.5	4.1	3.3	1.3	96.7
Kya/Sill	0.1	0.5	0.1	0.1	43.0	53.6	0.0	0.1	0.1	97.7
Staurolite	0.4	13.7	0.2	0.1	33.5	48.4	1.4	0.0	0.3	98.0
Zircon	0.3	0.5	0.2	0.1	29.6	0.2	0.1	0.2	64.0	95.1
Silicate	1.0	11.0	0.4	0.2	47.0	20.6	0.7	15.8	0.2	96.8
Unclassified	5.0	35.2	0.4	0.3	9.8	2.7	1.0	4.8	3.2	62.5

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	65.6	15.2	6.8	4.7	1.4	5.7	0.5	0.1	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.9	78.2	93.3	40.9
Fe_2O_3 wt%	37.3	10.6	1.8	37.0
MnO wt%	2.1	0.7	0.1	1.6
Cr_2O_3 wt%	0.1	0.2	0.1	0.1
SiO_2 wt%	3.1	7.4	3.3	15.2
Al_2O_3 wt%	0.8	2.0	0.8	3.3
MgO wt%	0.3	0.3	0.2	0.5
CaO wt%	0.1	0.3	0.1	0.3
ZrO_2 wt%	0.3	0.3	0.2	1.0
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	61.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	59.0
Valuable heavy minerals in raw sand:	0.29

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	47.9	0.2
Leucoxene	11.1	0.0
Rutile	5.0	0.0
Ti magnetite	3.5	0.0
Magnetite	0.2	0.0
Chromite	0.6	0.0
Pyrite	0.0	0.0
Phosphate	0.2	0.0
Monazite	0.2	0.0
Y-phosphate	0.0	0.0
Sphene	0.3	0.0
Garnet	1.0	0.0
Kya/Sill	0.4	0.0
Staurolite	0.1	0.0
Zircon	4.2	0.0
Silicate	18.1	99.7
Unclassified	7.2	0.0
Total	100.0	100.0

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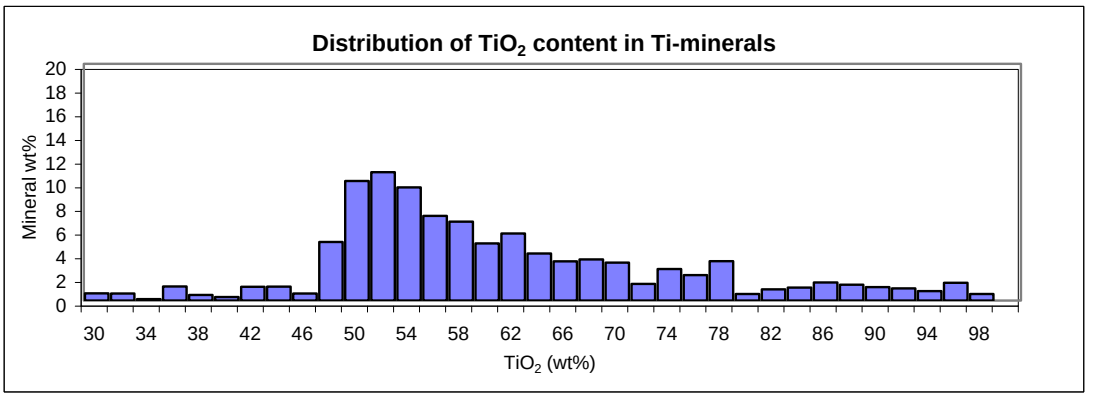
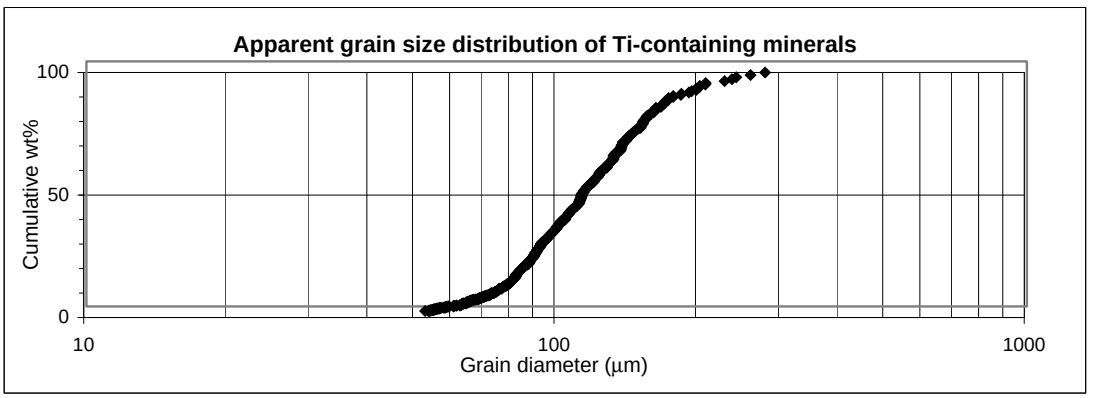
Lab. Name:	2000154	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/2/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.9	391	153	7451	561
Leucoxene	1.6	2.0	410	163	8144	119
Rutile	1.5	1.9	371	145	6503	60
Ti magnetite	1.7	2.4	467	198	8104	35
Magnetite	1.5	1.8	640	244	18553	1
Chromite	1.6	1.9	347	138	6214	8
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.7	2.5	326	138	4047	3
Monazite	1.6	1.7	326	118	5350	3
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.6	2.5	404	170	6478	5
Garnet	1.7	1.9	278	117	4529	22
Kya/Sill	1.6	2.1	430	175	7108	6
Staurolite	1.6	1.7	212	79	2303	3
Zircon	1.4	1.7	332	124	5675	62
Silicate	1.5	2.1	350	143	5972	450
Unclassified	1.5	1.7	360	141	9897	106

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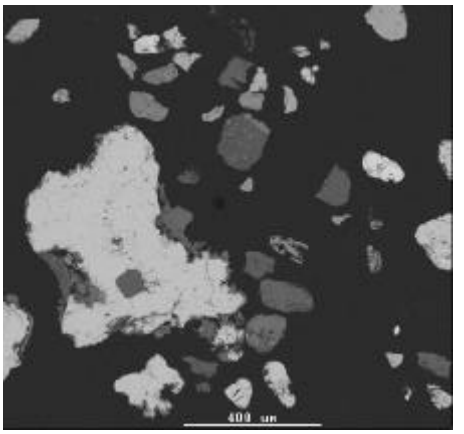

Sample Name:	Pinsk, borehole 35, 16-1	No. of frames analysed:	115
Lab. Name:	2000155	No. of particles analysed:	1185
Date:	4/2/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.86
Country:	Belarus	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/75x			
Guard region:	300 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	54.0	33.0	1.9	0.1	5.7	1.6	0.4	0.1	0.4	97.3
Leucoxene	76.8	6.8	0.4	0.3	7.6	2.9	0.4	0.3	0.4	96.0
Rutile	91.5	1.9	0.1	0.2	2.5	0.9	0.2	0.1	0.3	97.7
Ti magnetite	40.0	32.2	1.5	0.1	15.7	4.4	0.8	0.4	0.3	95.4
Magnetite	1.1	70.6	1.4	0.9	5.7	2.8	0.8	0.8	0.1	84.1
Chromite	0.3	19.8	0.2	40.5	1.4	24.3	11.1	0.0	0.4	98.1
Pyrite	0.1	31.7	0.1	0.1	4.0	0.8	0.1	0.1	0.2	37.1
Phosphate	0.1	0.2	0.0	0.0	0.9	0.0	0.1	55.7	0.4	57.3
Monazite	0.0	1.3	0.0	0.0	3.8	2.2	0.5	1.4	1.8	11.1
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	1.0	29.2	1.9	0.0	38.3	20.4	2.8	2.2	0.3	96.2
Kya/Sill	0.2	0.9	0.0	0.2	42.6	53.7	0.0	0.0	0.2	97.8
Staurolite	0.8	10.1	0.3	0.6	34.5	45.3	1.3	0.0	2.1	95.0
Zircon	0.1	1.3	0.1	0.1	29.6	0.5	0.2	0.4	61.7	94.1
Silicate	1.1	9.7	0.3	0.2	59.6	16.5	2.0	3.7	0.4	93.4
Unclassified	8.0	20.5	0.7	0.4	22.4	5.0	1.5	7.1	5.9	71.4

Valuable heavy minerals								
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	48.6	25.2	11.8	5.0	3.1	5.0	1.3	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average	Category			
content	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	55.5	80.0	93.7	42.0
Fe_2O_3 wt%	33.9	7.1	1.9	33.8
MnO wt%	2.0	0.4	0.1	1.5
Cr_2O_3 wt%	0.1	0.3	0.2	0.2
SiO_2 wt%	5.9	8.0	2.5	16.4
Al_2O_3 wt%	1.6	3.0	1.0	4.6
MgO wt%	0.4	0.4	0.2	0.8
CaO wt%	0.1	0.3	0.1	0.4
ZrO_2 wt%	0.4	0.5	0.3	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	66.6
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	62.5
Valuable heavy minerals in raw sand:	0.24

Weight percent on a mineral basis:		
	Heavy mineral concentrate	Raw sand
Category	wt %	wt %
Ilmenite	13.3	0.1
Leucoxene	6.9	0.1
Rutile	3.2	0.0
Ti magnetite	1.4	0.0
Magnetite	0.1	0.0
Chromite	0.3	0.0
Pyrite	51.9	0.4
Phosphate	0.1	0.0
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	0.8	0.0
Kya/Sill	0.4	0.0
Staurolite	0.0	0.0
Zircon	1.4	0.0
Silicate	16.8	99.3
Unclassified	3.4	0.0
Total	100.0	100.0

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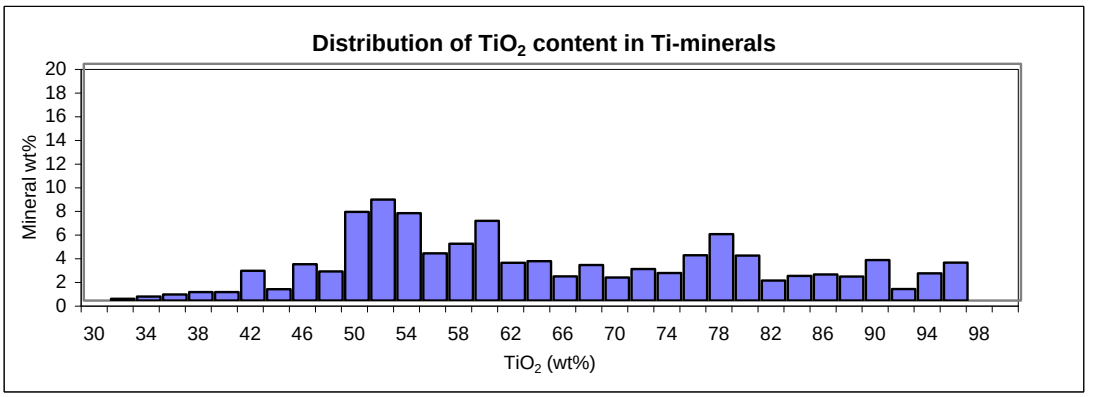
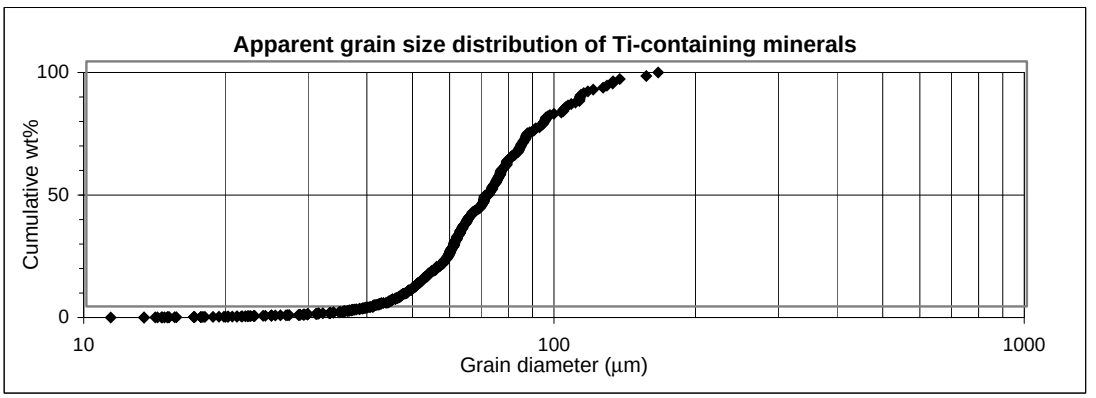
Lab. Name:	2000155	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/2/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.8	241	92	2872	297
Leucoxene	1.7	2.0	306	122	4260	104
Rutile	1.7	1.8	237	92	2657	70
Ti magnetite	1.7	1.9	246	100	2945	28
Magnetite	1.5	1.4	126	44	1189	7
Chromite	1.2	1.6	379	137	7213	2
Pyrite	1.5	2.1	467	189	11932	251
Phosphate	1.7	1.7	286	108	3747	1
Monazite	1.6	1.6	253	92	3208	2
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.9	2.2	284	115	3406	18
Kya/Sill	1.2	1.8	351	137	6374	5
Staurolite	1.2	1.0	37	14	109	1
Zircon	1.3	1.6	273	100	4072	21
Silicate	1.7	2.0	314	128	5928	308
Unclassified	1.4	1.7	238	97	5246	70

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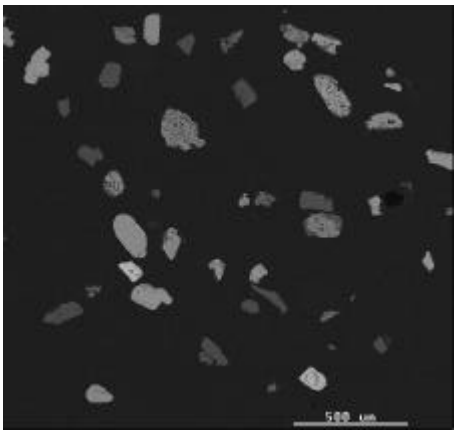

Sample Name:	Loe'v, 17-3	No. of frames analysed:	62
Lab. Name:	2000158	No. of particles analysed:	1491
Date:	4/4/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	0.80
Country:	Belarus	Comments: The two grains of magnetite	
Analyzed by:	BV	have low average content due to high	
Acc. Voltage/Magnification: 17kV/50x		content of respectively Ca+Ti+Nb and	
Guard region:	200 µm	S+K.	
Sieve:	100 μm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	56.2	32.9	1.8	0.1	4.7	1.2	0.4	0.1	0.3	97.8
Leucoxene	76.3	10.4	0.6	0.3	6.4	2.0	0.2	0.3	0.4	96.9
Rutile	93.5	1.2	0.1	0.2	1.8	0.6	0.1	0.1	0.3	97.8
Ti magnetite	39.7	28.7	1.1	0.1	17.8	5.9	0.9	0.6	0.4	95.2
Magnetite	4.4	59.9	0.0	0.0	1.0	0.5	0.0	2.6	0.0	68.3
Chromite	3.6	40.4	0.7	40.8	0.8	10.4	1.6	0.1	0.2	98.6
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monazite	0.0	2.9	0.0	0.0	9.9	2.0	0.5	1.1	2.5	18.9
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garnet	1.1	28.7	1.2	0.1	38.0	20.0	5.8	2.5	0.4	97.8
Kya/Sill	0.1	0.9	0.1	0.2	42.7	53.5	0.0	0.0	0.2	97.9
Staurolite	0.6	15.1	0.4	0.2	33.6	46.1	1.5	0.1	0.3	98.0
Zircon	0.3	0.7	0.2	0.2	29.3	0.1	0.1	0.3	63.5	94.8
Silicate	0.6	7.6	0.4	0.2	47.6	31.3	1.0	7.5	0.3	96.3
Unclassified	10.5	17.7	0.9	1.4	23.5	12.2	2.0	2.3	7.4	77.8

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	59.9	10.6	9.5	1.9	5.6	4.2	5.6	2.8	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	57.5	78.7	95.6	41.7
Fe_2O_3 wt%	33.6	10.7	1.3	30.2
MnO wt%	1.8	0.6	0.1	1.2
Cr_2O_3 wt%	0.1	0.3	0.2	0.1
SiO_2 wt%	4.8	6.6	1.9	18.7
Al_2O_3 wt%	1.3	2.1	0.6	6.1
MgO wt%	0.5	0.3	0.1	0.9
CaO wt%	0.1	0.3	0.1	0.6
ZrO_2 wt%	0.3	0.4	0.3	0.4
Total	100.0	100.0	100.0	100.0

Average TiO_2 content of all the TiO_2 minerals:	64.3
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	60.2
Valuable heavy minerals in raw sand:	0.59

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	43.9	0.4
Leucoxene	7.8	0.1
Rutile	7.0	0.1
Ti magnetite	1.4	0.0
Magnetite	0.1	0.0
Chromite	0.4	0.0
Pyrite	0.0	0.0
Phosphate	0.0	0.0
Monazite	0.1	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	4.1	0.0
Kya/Sill	4.1	0.0
Staurolite	2.0	0.0
Zircon	3.1	0.0
Silicate	25.3	99.4
Unclassified	0.8	0.0
Total	100.0	100.0

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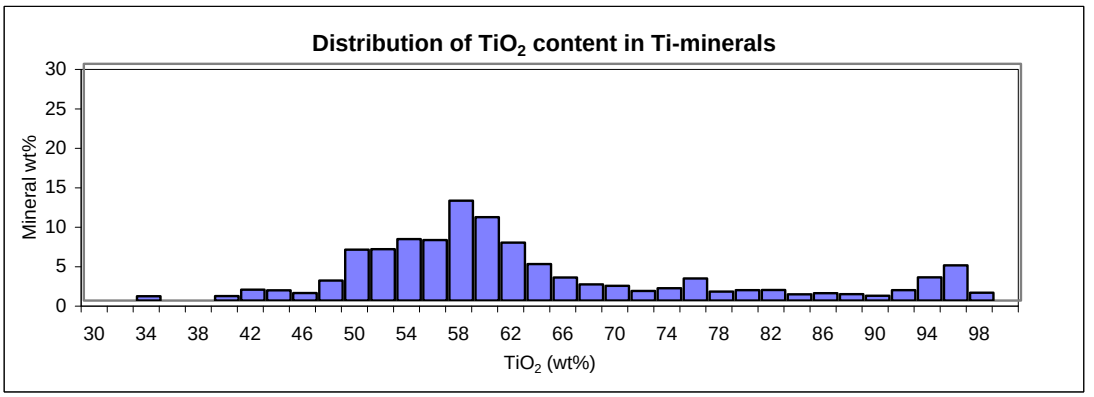
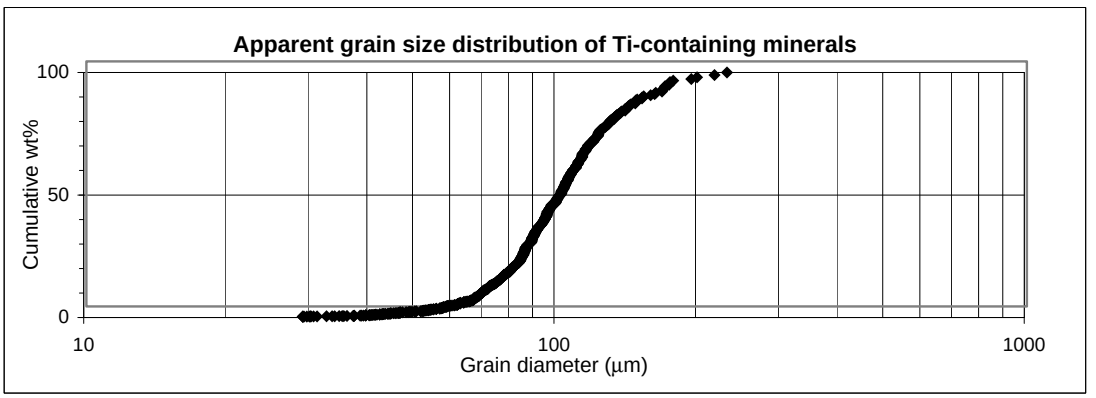
Lab. Name:	2000158	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/4/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	1.6	1.7	352	132	6391	505
Leucoxene	1.6	1.9	388	153	7259	79
Rutile	1.6	1.8	325	125	5628	82
Ti magnetite	1.6	1.9	338	138	5527	17
Magnetite	1.4	1.5	257	92	4059	2
Chromite	1.4	1.5	283	102	4419	6
Pyrite	0.0	0.0	0	0	0	0
Phosphate	0.0	0.0	0	0	0	0
Monazite	1.8	1.4	138	43	1127	3
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	0.0	0.0	0	0	0	0
Garnet	1.7	2.0	330	132	5193	65
Kya/Sill	1.7	1.9	400	158	7410	56
Staurolite	1.6	2.2	403	167	6775	26
Zircon	1.4	1.5	287	99	4789	46
Silicate	1.5	1.8	330	131	5741	551
Unclassified	1.4	1.3	145	55	1787	53

Italy

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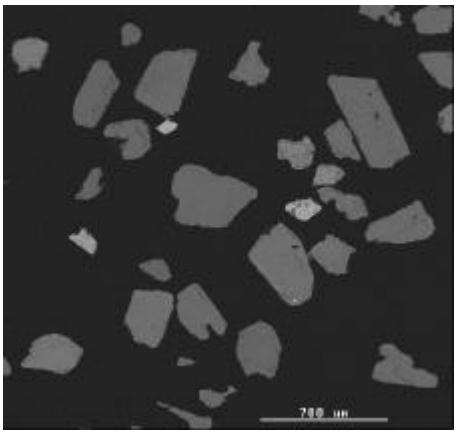

Sample Name:	Agropoli, 93 km s. of Amalfi	No. of frames analysed:	90
Lab. Name:	2000180	No. of particles analysed:	1094
Date:	4/3/02	Heavy minerals in raw	
Submitter:	DuPont/GEUS	sand (%):	66.24
Country:	Italy	Comments:	
Analyzed by:	BV		
Acc. Voltage/Magnification: 17kV/40x			
Guard region:	375 µm		
Sieve:	100 µm^2		

	Average content									
Category	TiO_2 wt%	Fe_2O_3 wt%	MnO wt%	Cr_2O_3 wt%	SiO_2 wt%	Al_2O_3 wt%	MgO wt%	CaO wt%	ZrO_2 wt%	Total
Ilmenite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leucoxene	69.5	6.3	0.0	0.1	11.2	5.3	1.9	0.2	0.0	94.5
Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti magnetite	42.5	46.9	0.9	0.1	0.4	0.3	5.7	0.5	0.2	97.7
Magnetite	5.4	81.6	1.1	0.1	3.1	3.6	1.9	1.0	0.2	98.0
Chromite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phosphate	0.2	0.6	0.0	0.1	0.5	0.0	0.1	57.0	0.9	59.4
Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y-phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	35.0	2.5	0.0	0.4	29.6	1.7	0.0	27.5	0.3	97.0
Garnet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kya/Sill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staurolite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Silicate	1.1	9.7	0.3	0.2	47.0	5.1	11.2	22.4	0.2	97.3
Unclassified	1.3	7.1	0.9	0.6	10.1	4.1	15.4	43.1	3.5	86.1

Valuable heavy minerals									
Category	Ilmenite	Leucoxene	Rutile	Ti magnetite	Garnet	Zircon	Kya/Sill	Staurolite	Total
wt %	0.0	37.1	0.0	62.9	0.0	0.0	0.0	0.0	100.0

Normalised average contents of the valuable Ti-containing minerals:				
Average content	Category			
	Ilmenite	Leucoxene	Rutile	Ti magnetite
TiO_2 wt%	0	73.5	0	43.5
Fe_2O_3 wt%	0	6.6	0	48.0
MnO wt%	0	0.0	0	1.0
Cr_2O_3 wt%	0	0.2	0	0.2
SiO_2 wt%	0	11.9	0	0.4
Al_2O_3 wt%	0	5.6	0	0.3
MgO wt%	0	2.1	0	5.9
CaO wt%	0	0.2	0	0.5
ZrO_2 wt%	0	0.0	0	0.2
Total	0	100.0	0	100.0

Average TiO_2 content of all the TiO_2 minerals:	54.7
Average TiO_2 content of all the TiO_2 minerals excl. rutile:	54.7
Valuable heavy minerals in raw sand:	0.12

Weight percent on a mineral basis:		
Category	Heavy mineral concentrate wt %	Raw sand wt %
Ilmenite	0.0	0.0
Leucoxene	0.1	0.0
Rutile	0.0	0.0
Ti magnetite	0.1	0.1
Magnetite	2.7	1.8
Chromite	0.0	0.0
Pyrite	0.0	0.0
Phosphate	0.7	0.5
Monazite	0.0	0.0
Y-phosphate	0.0	0.0
Sphene	0.0	0.0
Garnet	0.0	0.0
Kya/Sill	0.0	0.0
Staurolite	0.0	0.0
Zircon	0.0	0.0
Silicate	95.1	96.7
Unclassified	1.4	0.9
Total	100.0	100.0

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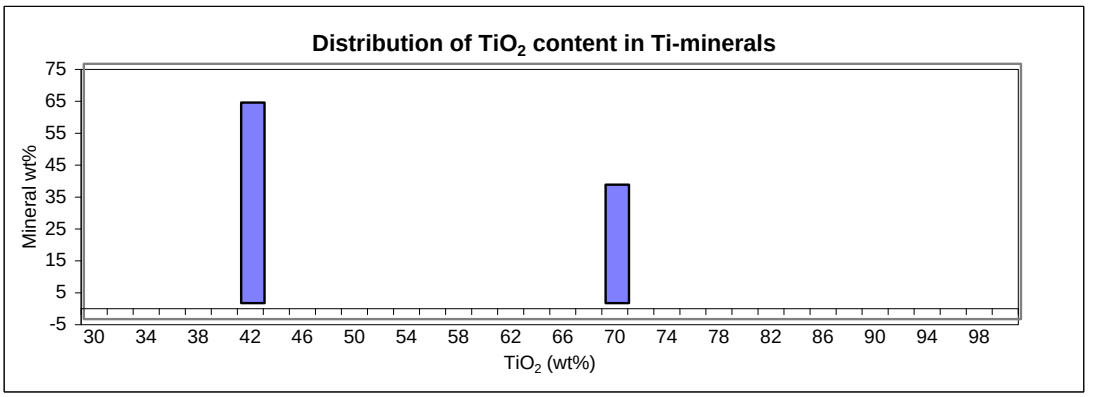
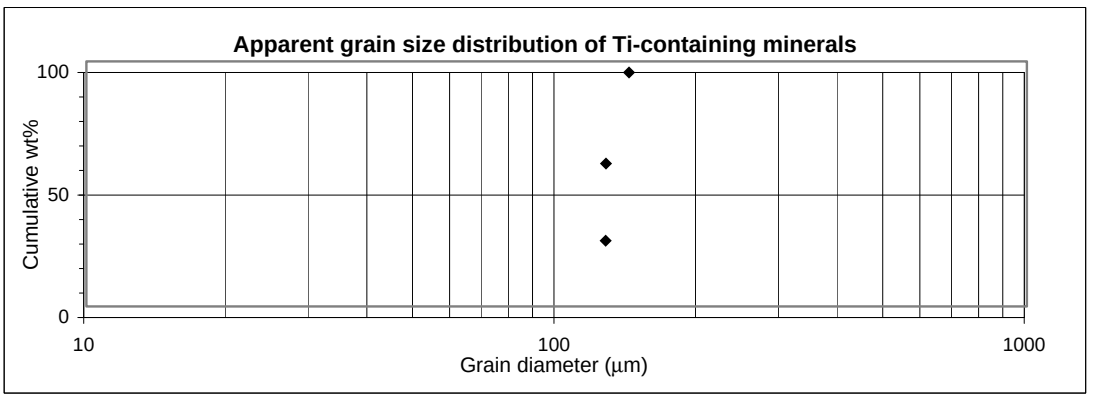
Lab. Name:	2000180	Analyzed by:	BV
Submitter:	DuPont/GEUS	Acc. Voltage	17kV
Date:	4/3/02		





Average grain parameters						
Category	Aspect ratio	Circularity	Perimeter (µm)	Length (µm)	Area (µm^2)	Total grains
Ilmenite	0.0	0.0	0	0	0	0
Leucoxene	1.3	1.4	541	179	16386	1
Rutile	0.0	0.0	0	0	0	0
Ti magnetite	1.7	2.0	573	229	13054	2
Magnetite	1.5	1.7	439	167	10610	52
Chromite	0.0	0.0	0	0	0	0
Pyrite	0.0	0.0	0	0	0	0
Phosphate	1.3	1.8	896	345	36772	4
Monazite	0.0	0.0	0	0	0	0
Y-phosphate	0.0	0.0	0	0	0	0
Sphene	1.3	1.5	200	69	2132	2
Garnet	0.0	0.0	0	0	0	0
Kya/Sill	0.0	0.0	0	0	0	0
Staurolite	0.0	0.0	0	0	0	0
Zircon	0.0	0.0	0	0	0	0
Silicate	1.6	1.9	878	348	38549	1001
Unclassified	1.5	1.5	467	179	17287	32