SVERIGES GEOLOGISKA UNDERSÖKNING

SER C NR 652 AVHANDLINGAR OCH UPPSATSER ÅRSBOK 64 NR 9

UNO SVENSSON

GEOCHEMICAL INVESTIGATION OF THE PRINCIPAL PRE-CAMBRIAN ROCKS OF VÄSTERBOTTEN COUNTY, SWEDEN

STOCKHOLM 1970

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C. DAVIDSONS BOKTRYCKERI AB, VÄXJÖ

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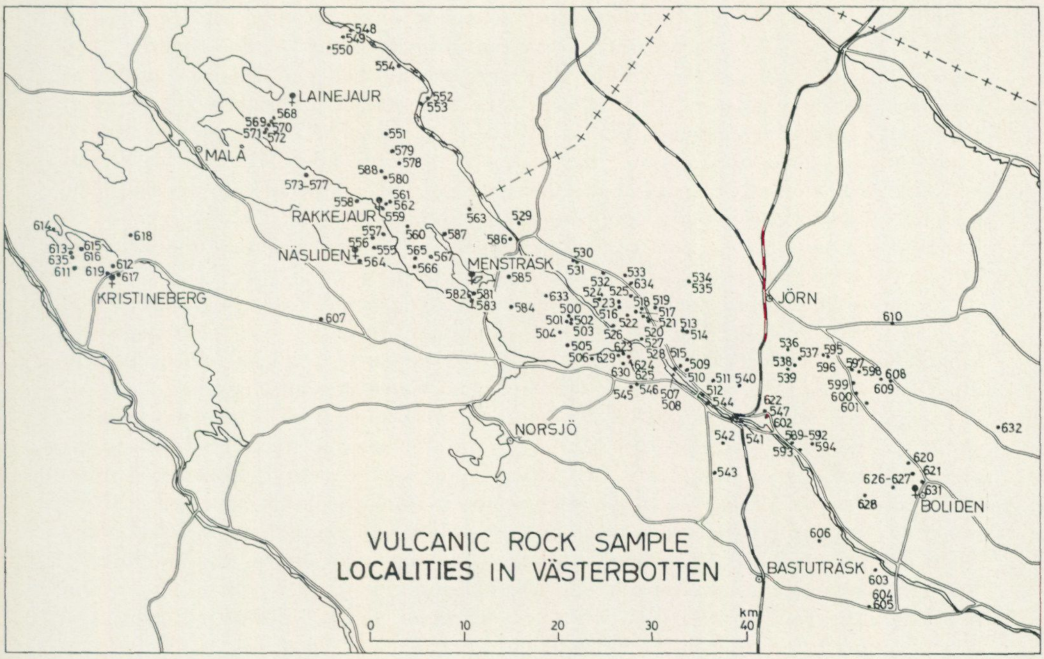

VULCANIC ROCK SAMPLE
LOCALITIES IN VÄSTERBOTTEN
LAINEJAUR
MALÅ
RAKKEJAUR
NÄSLIDEN
KRISTINEBERG
MENSTRÄSK
JÖRN
NORSJÖ
BOLIDEN
BASTUTRÄSK
km
0
10
20
30
40

SUMMARY

This geochemical investigation deals with the rocks of the volcanic series, the phyllite series, the gneisses and also with the Revsund granite in Västerbotten county in northern Sweden.

It has been established by previous geological, stratigraphical and tectonical investigations that the phyllites, gneisses and Revsund granites belong to the same metamorphic series. One of the original purposes of the present investigation was to verify this and to elucidate the redistribution of the elements caused by metamorphism and granitization. The rocks of the volcanic series are included in the investigation partly to give a perspective to the relations in the metamorphic series phyllite, gneiss and Revsund granite and partly to form a background to the recently started investigations of the minor elements of the Pre-Cambrian rocks of Västerbotten.

This later investigation is to form the basis on which geochemical prospecting for ores is intended to continue. The present investigation comprises 123 samples of the phyllite series, 170 of gneiss, 153 of Revsund granite and 136 of the volcanic series. The analyses of these samples have been carried out by the research laboratory of the Boliden Company at Rönnskär, Sweden.

The mineral calculation is made according to a simple system published by Tom F. W. Barth 1955. Thus, the elements are taken together in three groups denoted by Q, Px and Fl. The calculated values are plotted in triangular diagrams (Fig. 6–9). From the diagram of the volcanic series it can be seen that the series consists of two main groups – one group with basic and the other one with acid rocks. In the diagrams for the metamorphic series a successive development of the distribution of the mineral groups can be seen. The rocks of the phyllite series have many maxima indicating different types that have appeared on account of sedimentary differentiation. The Q–Px–Fl values of the gneiss series in Västerbotten mainly cover the same area in the diagram as the phyllite series but the many minor maxima are levelled out and a single one is developed near the preponderance of that of the phyllites. The sedimentary character in the phyllite diagram has vanished and the rock mass has become more homogeneous in the gneiss stage. A new characteristic in the diagram is an outbreaking against the area of Revsund granite. The centre of the mineral composition for Revsund granite has changed its place radically owing to a considerable expulsion of Px-forming elements and the addition of Fl-forming ones. The manner in which the mineral composition has moved from phyllite over gneiss to Revsund granite forms a pattern that is considered as evidence that the Revsund granite is formed from the phyllite rocks by granitization.

The feldspar composition is calculated from the chemical analyses and plotted in a An-Ab-Or diagram (Fig. 10–13). In the diagram of the volcanic rocks there is a long maximum with its centre at An = 50, Ab = 45, Or = 5. These rocks represent the basic group of the volcanic series and are mainly andesites and basalts.

A trend for the distribution of the acid volcanics appears. The feldspar composition moves towards a more An-rich composition when the rocks go from quartz porphyry towards dacite. This is the real meaning of the definition of these rocks and it also has been observed in the microscopic examinations that have been carried out. Yet the picture is not quite clear because of the sediments that are interbedded in the volcanic rocks. These sediments could not be separated during the sampling.

In the metamorphic series phyllite–gneiss–Revsund granite the feldspar composition becomes more and more Or-rich when the degree of metamorphism increases. The crystallization of feldspar in the Revsund granite has taken place close to the eutectic

line between the fields of plagioclase and potash feldspar. This eutectic crystallization occurs at the same time as a crystallization of an An-rich feldspar in a rock in contact with it. The remaining solutions or melts in the different crystallization centres are enriched in potassium and calcium respectively. Through metasomatism an equalization takes place and potassium goes to the centre of granitization and calcium goes in the opposite direction.

Further, other elements such as iron and magnesium are thought to have taken part in similar transports of material between the two crystallization centres, because a larger quantity than is to be found in the ores and altered rocks in the neighbourhood of the granites has separated from the granitized part of the rock masses. Consequently the granitization processes are going on at the same time as dioritic or gabbroid rocks are formed in the neighbourhood. Presumably the two centres of crystallization have been situated in the former phyllite complex, the thickness of which may have reached many thousands of meters. On the other hand the granitization processes are not thought to have touched the basement rocks. These must have had a varying composition which must have been reflected in the products of granitization. However, the Revsund granite is a rock which over extensive areas has the same characteristic appearance of a gray coarse-grained microcline granite and only locally are small deviations in the appearance to be seen. This agrees with the uniform facies development shown by the rocks of the phyllite series in all the diverse localities where they are represented in Västerbotten.

The distribution of the different elements of the rock series has been studied and it gives further information about the geochemical conditions (Fig. 16–30). The primary pattern of the distribution of the percentage is the normal distribution. Silicon and aluminium follow normally distributed curves. Other principal elements do not follow this rule but follow lognormal distributions. The reason for this is the fact that the distribution is either truncated or has a limiting value. The most common limit is zero. When the limit is zero one should not talk of a law of geochemistry but rather of a limit of mathematical nature. In other cases, however, the limit is determined by purely geochemical properties. Potassium in the Revsund granite has an upper limit at 7 % and the function $(7\text{-}K^{+})$ follows a lognormal distribution. This is explained by the crystallization of feldspar in the Revsund granite that takes place at the eutectic line between the fields of crystallization of plagioclase and potash feldspar in the system An-Ab-Or.

Usually the cumulative distribution curves of the different elements are not single straight lines but combinations of straight lines in such a way that several segments are formed. These segments arise when the rock series consists of more than one stock. The volcanic series can be divided in this manner in a basic and an acid group. The basic group usually forms an ideal distribution without segments while the curve of the acid group still has segments, which indicates that it contains at least two sub-groups. These are supposed to correspond partly to sedimentary rocks and partly to rocks of the differentiation series quartz porphyry-quartz keratophyre-keratophyre-dacite.

In the metamorphic series the curves will move from complex ones with many segments in the phyllites to simple or sometimes almost ideal distributions in the Revsund granite. The complicated pattern of distribution in the phyllite series depends on the sedimentary differentiation which has given rise to many different rock types. The simple pattern of distribution in the Revsund granite is due to the radical homogenization which is the essence of granitization. The gneisses take an intermediate position.

The distribution of the density of the different rocks shows the same pattern as the elements (Fig. 32). The volcanic rocks have three segments on the cumulative distribution curve and these correspond to two groups of rocks. The phyllite series has a complicated distribution which is simplified in the case of the Revsund granite owing to its alteration by metamorphism.

PREFACE

This work is a part of a geochemical investigation of the Pre-Cambrian rocks of Västerbotten and the altered rocks in the Skellefte district, N. Sweden. It was started at the suggestion of Professor S. Gavelin of Stockholm University and Fil. Dr. E. Grip, Chief Geologist of the Boliden Company Mining Division. The author wishes to express his thanks for their guidance during the work.

In great part this investigation has been possible thanks to the development in analytical techniques that has taken place at the research laboratory of the Boliden Company Works at Rönnskär, and the author wishes to express his thanks for the good collaboration given by their investigators Fil. lic. A. Danielsson, Chem. Engineer Å. Olofsson, Chem. Engineer and Fil. lic. G. Sundkvist.

To his colleagues in the Boliden Company's Prospecting Department Fil. lic. C. A. Nilsson, Fil. Dr. H. Helfrich, Fil. Dr. D. S. Parasnis and Phys. Engineer B. Tornqvist the author wishes to convey his thanks for valuable suggestions. Thanks are also due to Fil. Dr. D. S. Parasnis who kindly revised the English of the manuscript. Further I sincerely thank O. Theolin, H. Lindström, B. Persson and C. Burlin for valuable assistance in the work.

The expenses of this investigation were covered by grants from the State Technical Research Council in Sweden and from the Boliden Company for which also my thanks are due to these two bodies.

For the permission to publish this paper the author wishes to convey his sincere thanks to the management of the Boliden Company.

STATEMENT OF THE PROBLEM

It has been settled through the geological investigations made in Västerbotten principally by Gavelin and Grip, 1946, and Gavelin, 1955, that phyllites, gneisses and Revsund granites belong to one and the same metamorphic series. In many places successive transitions among these three rock groups can be seen.

One of the original purpose of this investigation was to verify the common relationship in a geochemical way. It has been assumed that the rocks of the phyllite series have a composition similar to the Revsund granite and accordingly they could be easily granitized. The object of the geochemical investigation was to test this hypothesis by analysing the distribution of the elements among the different members of the metamorphic series. It was also expected that the investigation would give an answer to the question about the source of the new pattern in the alteration and ore zones in the rocks of the volcanic series.

The rocks of the volcanic series are included in the investigation partly to give a perspective to the relations in the metamorphic series and partly to give a background to the planned investigations of trace elements of the Pre-Cambrian rocks in Västerbotten. This investigation should form a basis for geochemical prospecting for industrial mineral concentrations.

SAMPLING

Following different authors the following incontrovertible strata scheme of the Pre-Cambrian rocks in Västerbotten has been constructed:

Revsund granite
Migmatite
Phyllite series
Hiatus
Volcanic series

The present geochemical investigation only deals with these incontrovertible members. The rocks are divided in four groups namely, phyllites, gneisses, Revsund granites and volcanics. Among the volcanics there are no samples from the Arvidsjaur porphyry and in the phyllite group there are no samples from the Vargfors series. The granite group includes the coarse-grained Revsund granite and the fine-grained Skellefte granite but not the controversial Adak granite. In many districts, of which the largest is situated south of the lower reaches of the Skellefte river, there are Jörn granite massifs transformed to veined gneisses. These gneisses are not taken into the investigation.

Sampling is an important phase in all chemical investigations of inhomogeneous substances. Inhomogeneous substances are mixtures of different materials and a rock is such a mixture of different mineral grains. Then it is clear that the sampling must be suited to the grain size in the rocks. Larger samples must be taken from coarse-grained rocks than from fine-grained ones. L. R. Wagner and E. M. Brown recommend in their work "Methods in Geochemistry" samples of 5 kg for a grain size bigger than 30 mm and 2 kg for a grain size of 10–30 mm. Considering the coarse-grained Revsund granite, samples of 10 kg were taken to be on the safer side. We shall now see how the grain size affects the analyses of a 10 kg sample. In the granite samples the microcline grains are the largest and they will determine the precision of the analyses. The content of microcline is SiO_2, Al_2O_3 and K_2O. The whole content of

K_2O is calculated to go into the feldspars so the content of it is more critical than SiO_2 and Al_2O_3 which enter other minerals and do not influence the analyses so much. We shall now test how much the analyses of K_2O will vary with the grain size of microcline. The standard deviation is calculated from equation 1, which is derived from the equation of binomial distribution.

$$\text{Eqn. 1: } s = \sqrt{npq}$$

s = standard deviation
n = numbers of grains
p and q = proportions of components

According to the definition of probability $p + q = 1$.

The mean size of the microcline grains in a granite sample of 10 kg is assumed to be 10 mm corresponding to a mass of about 3 g. Certainly there are grains larger than 10 mm but it must be remembered that the grains can split apart into smaller pieces during sampling. A grain size of 10 mm corresponds to 3,000 grains in the sample so that $n = 3{,}000$.

In the Revsund granite there is about 30 % of microcline so that $p = 0.3$; $q = 0.7$. According to equation 1 the standard deviation will be

$$s = \sqrt{3{,}000 \cdot 0.3 \cdot 0.7} = \pm 25.1$$

This means that in 68 % of the samples the number of microcline grains lies in the interval 900 ± 25.1 or that the number will deviate by 2.8 % from the arithmetic mean. With 30 % microcline in the rock the content of K_2O is 6 %. A variation of ± 2.8 % in this 6 % means a variation of ± 0.17 in the content of K_2O. This variation shows that samples of 10 kg are the smallest that can be contemplated.

We can assume that the same risk of error in the sampling will also be present in the veined gneisses though the grain sizes are much smaller. The statistical calculation of the standard deviation however, is much more uncertain in these inhomogeneous rocks so that I will not give any account of it.

A statistical calculation on rock series must be made on the basis of a sufficiently large number of analyses. According to S. Gavelin, 1955, Revsund granites occupy 47.4 % of the Pre-Cambrian district in Västerbotten, the gneisses take 26 %, the phyllites 9.6 % and the volcanic series 1.7 % so the sampling must be much closer in volcanic and phyllite districts and still closer in the gneiss districts than in the Revsund granite district. On an average one sample of gneiss was taken per 100 square kilometers while the interval was much closer for the volcanics and phyllites. The samples of Revsund granite were taken more sparsely. A car was used for transport and the sampling was carried out in roadcuts where outcrops can be easily detected and where it is easy to break loose the material needed for the samples. A good collection rate is 10 samples per day and the transport distance will then be about 20 kilometers per sample. Some of the samples were taken from drillcores, especially those of phyllites of which there are few good outcrops.

ANALYTICAL TECHNIQUES

The analyses have been made at the research laboratory of the Boliden Company Works. The method has been devised there. The pulverized and homogenized rock is melted together with a boron flux and an internal standard. When the melt is cool it is ground, distributed on a tape and analyzed by the spectral analysis method for the elements Si, Al, Fe, Ca, Mg, Mn and Ti. As the tape used for the analyses has some content of alkali, Na and K must be analysed by some other method and this is done with a flame spectroscope. To separate Fe^{+2} from Fe^{+3} the sample are wet-analysed for the Fe^{+2} ion. On account of the cost involved, the samples are dissolved in hydrochlorid acid without previous treatment with hydrofluoric acid. Hence, all the Fe^{+2} will not dissolve and the percentage of Fe^{+2} will be too low. Samples with a high percentage of iron, however, have been treated with hydrofluoric acid so that the error is acceptably low for all analyses. Further, most of the statistical calculations are made on the total content of iron.

The samples are melted at a temperature of 1,000° C and the ignition loss is calculated. The ignition loss is the amount of the volatile and combustible constituents in the rock. The greatest ignition loss takes place in the phyllite series and it is principally carbonate-carbon, sulphur and water which cause the decrease. Oxidation processes have an opposite effect, chiefly the oxidation of Fe^{+2} to Fe^{+3} which takes up oxygen and causes an increase of weight.

STATISTICAL METHODS

Means and ranges

To get an idea of the large number of analyses and the calculations made therefrom some statistical calculations must be done. It is convenient to calculate the arithmetic mean:

$$\overline{X} = \frac{\Sigma X}{n}$$

$\overline{X}$ = arithmetic mean
X = analysis value
n = number of analyses

The arithmetic mean expresses a mean quantity per unit mass of the analysed matter and it must be used for calculations of total amounts. The arithmetic mean is sensitive to extreme values so that it will not express the typical composition of a rock series sufficiently well.

Another statistical method which expresses the character of the rock better than the arithmetic mean is the median. The median is a value such that half the number of analyses fall below and the other half above it. The determination of the median can be made in different ways. In this work it is read off from the cumulative diagrams which are dealt with in a later section. In what follows the median will be indicated by M.

It should be observed that the sum of the median values of two elements will not be the same as the median of the sum of these two elements as is the case for the arithmetic mean. The difference between the arithmetic mean and median is seen in the effect that the extreme values have on them. An extremely high or low analysis value will influence the arithmetic mean more than the median. The median is not influenced by the actual values of the extreme analyses as such.

Dispersion is another statistical value which can be calculated from the analyses. From it we can obtain a good idea of the homogeneity of the population. The most common measure of the dispersion is the standard deviation (s) defined by the formula

$$s^2 = \Sigma(X-\overline{X})^2/n$$

The standard deviation is a quantity such that approximately 68 % of the analyses lie in the interval $\overline{X} \pm s$. It should be observed that the formula for the standard deviation is theoretically correct only for normally distributed populations. However, it is very common and of great practical value to use the standard deviation for skew distributions also, as in this work. In making the calculations it is convenient to transform the equation as

$$s = \sqrt{\frac{\Sigma(X-\overline{X})^2}{n}} = \frac{1}{n}\sqrt{n\,\Sigma X^2 - (\Sigma X)^2}$$

The calculations can be easily carried out from this formula on a calculating machine with two tabulators. At the same time the arithmetic mean is also calculated.

A measure of the dispersion or homogeneity which is directly comparable between different rock groups as well as between different elements is the relative standard deviation (C) which is calculated from the formula

$$C = \frac{100\ s}{\overline{X}}$$

C expresses the standard deviation in percent of the arithmetic mean. A low value indicates that the rock group has a homogeneous composition.

Distribution types

It is often better to illustrate distributions in diagrams than in tables. The mineral groups Q/Px/Fl p. 14 and the feldspar composition An/Ab/Or p. 19 are illustrated in triangular diagrams. In order to obtain a better grasp of the diagram, appropriate intensity lines are also drawn. In practice this is done by counting the points in every area and then drawing the isogrades. The alterations in the metamorphic series often appear clearly in these ternary diagrams.

The distribution of single elements will be illustrated in binary diagrams. A simple one is the histogram. A histogram (Fig. 1) is obtained by grouping the analyses in several classes. For SiO_2 it is appropriate to take every full percent as a class. The number of analyses is normalized to 100 to make the different histograms comparable. The classes are plotted as abscissas and the frequency as ordinates. This pile diagram or histogram will be more or less symmetrical around the arithmetic mean. In some cases the distribution is sufficiently symmetrical to be considered as a normal distribution and can be drawn with the help of the formula

$$Y = \frac{X_f - \overline{X}}{s}$$

X_f = required point on the abscissa scale

The value of the ordinate (Y) can be found from tables in Fisher, R. A. and Yates, F., 1949, Table II. The curve is fitted to the histogram by multiplying the table values by a constant that is dependent on the width of the classes. By comparing the histogram and the curve for the normal distribution in the

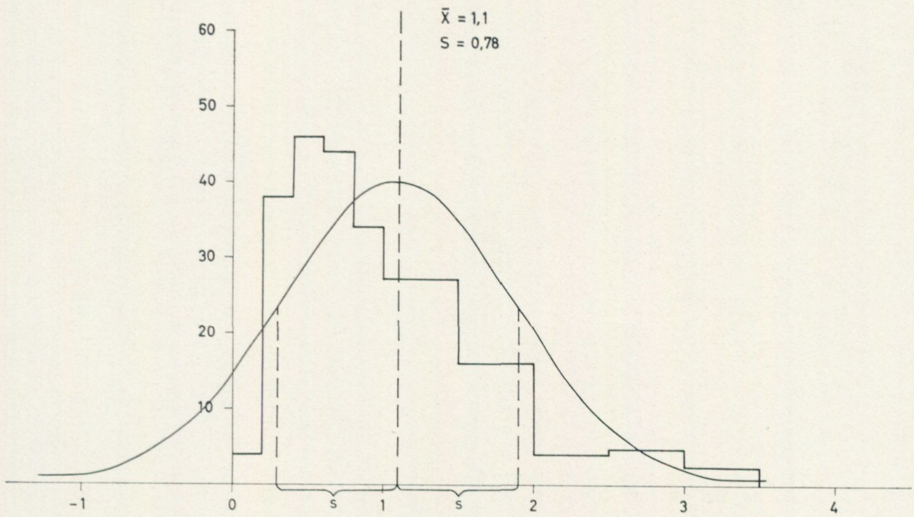

Fig. 1. Histogram of Mg^{+2} in Revsund granites.

same diagram the fit of the population to the normal distribution can be estimated. In Fig. 1 the fit is not good.

The distribution can also be illustrated in a cumulative diagram (Fig. 2). A cumulative diagram is obtained by adding the classes and plotting the sums in a co-ordinate system. A curve drawn through the upper class limit in such a diagram has the form of an inclined S. If this S is symmetrical around the mean, the curve fits the normal distribution. It can be difficult to decide if the curve is symmetrical so that it is more convenient to use a diagram with the ordinates graduated on the normal scale (Fig. 3). Paper for such diagrams can be bought or can be made with help of tables of the normal distribution. A

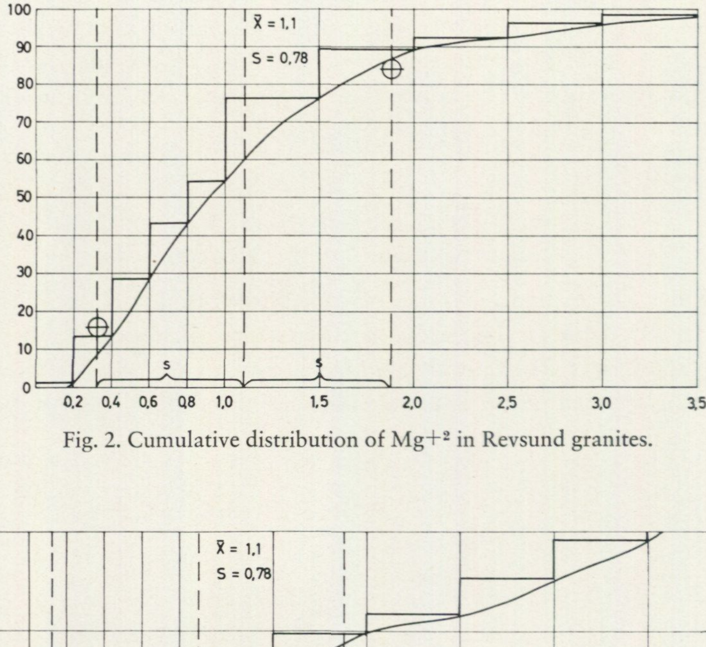

Fig. 2. Cumulative distribution of Mg^{+2} in Revsund granites.

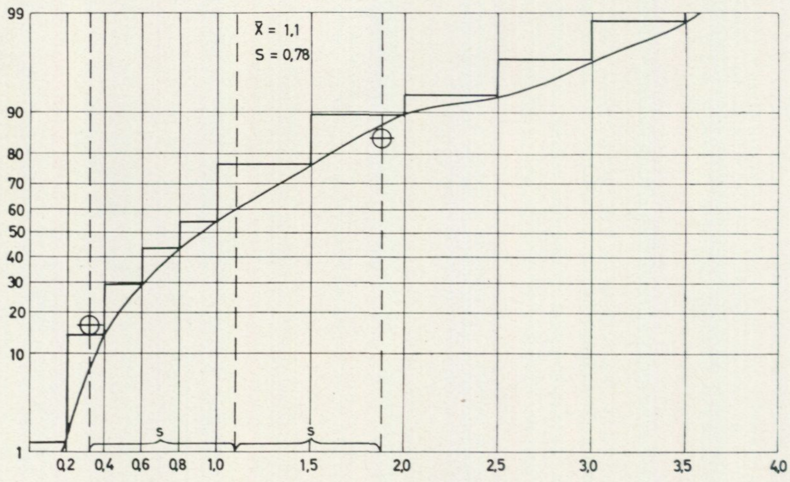

Fig. 3. Cumulative normal distribution of Mg^{+2} in Revsund granites.

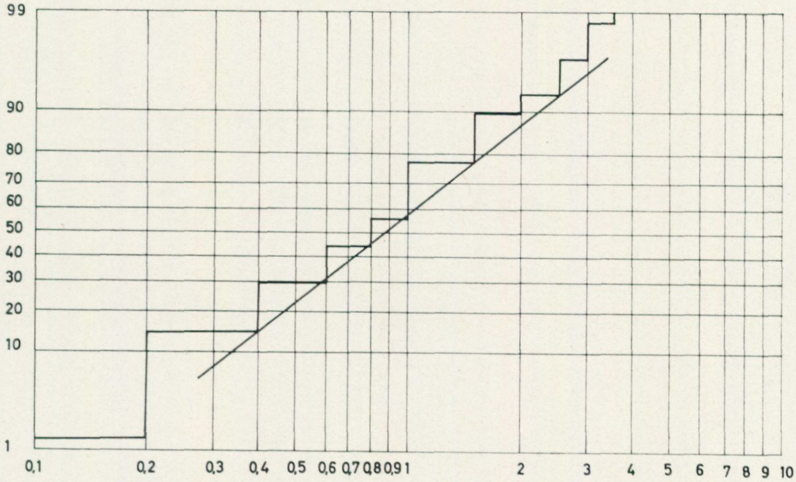

Fig. 4. Cumulative lognormal distribution of Mg^{+2} in Revsund granite.

normally distributed population in such a diagram will form a straight line but other distributions will yield curves. The data in the present paper do not always fit the normal distribution but do often fit the lognormal distribution. In a diagram with cumulative lognormal distribution (Fig. 4) the ordinates are graduated on the normal scale as in the normaldistribution paper, but the abscissas are graduated on a logarithmic scale. A lognormally distributed population in such diagram forms a straight line.

Not even in such diagrams will all the elements in the rocks be represented by straight lines. Often, the distributions will form two or more straight lines. Such combinations appear if two different populations are mixed (Fig. 5 A–D). In these diagrams the populations I and II are mixed in equal shares. If the two populations are mixed in unequal shares the diagram will alter its appearance. This makes it impossible to calculate the distributions of the primary populations. It must be observed that the lines in these diagrams are theoretically not straight but bent particularly at the transitions. The combinations A–D in Fig. 5 are drawn for lognormal distributions but the same principles apply to normally distributed populations.

Mineral grouping

Tom F. W. Barth 1955 has devised a simple system for petrochemical calculations. It constitutes a combination of elements into groups of minerals named Q, Px and Fl. These groups represent quartz in the Q-group, micas, pyroxenes and amphiboles in the Px-group and feldspar in the Fl-group. The advantage

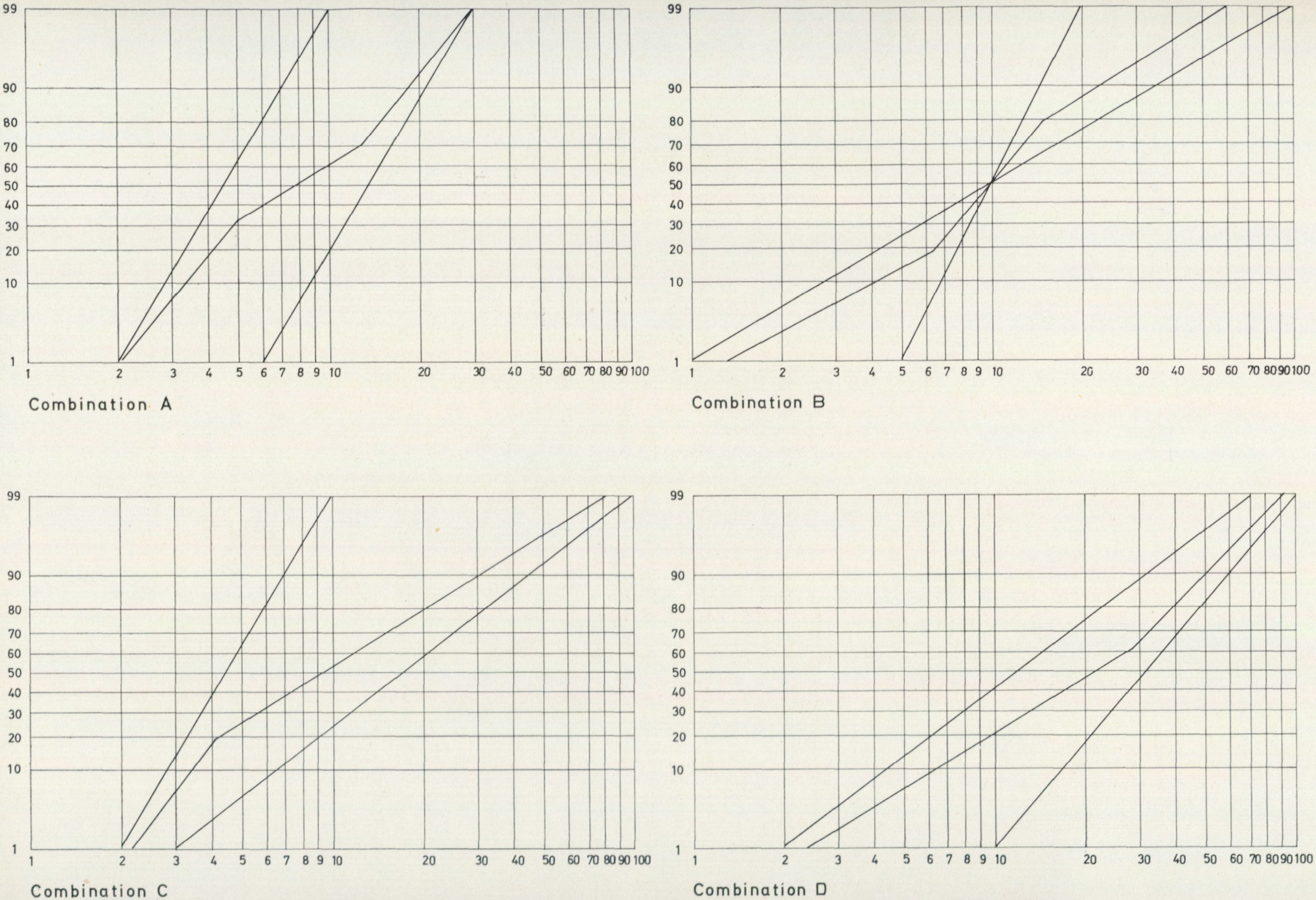

Fig. 5. Combination of populations.

of the system is that it makes it possible to illustrate the composition in a triangular diagram. The diagram is constructed for cases when Q<0, that is, when olivine and nepheline are present. Another advantage of the system is the rapidity of calculations which permits investigations on a large material.

Table 1. Average and dispersions for the mineral groups Q/Px/Fl

Element group	Function	Volcanic rocks	Basic	Acid	Phyllites	Gneisses	Granites
Q	$\overline{X}$	23.5	4.2	32.1	22.0	26.1	27.4
	s	16.4	6.3	11.5	11.4	8.7	6.7
	C	70		36	52	33	24
Px	$\overline{X}$	20.5	38.0	12.7	24.9	20.1	9.4
	s	14.6	11.7	6.9	9.2	7.7	3.5
	C	71	31	54	37	38	37
Fl	$\overline{X}$	55.7	57.8	54.8	53.0	54.0	63.3
	s	10.5	9.0	11.0	8.7	9.1	5.8
	C	19	15	20	16	17	9

Phyllites, gneisses and Revsund granites

The phyllite series consists of quartzites, arkoses, slates and phyllites interbedded with greenstones of different compositions. A number of maxima can be seen in the Q/Px/Fl diagram (Fig. 6). These correspond to different rock types which have arisen by sedimentary differentiation. The maxima at 33/15/52 and 37/17/46 represent two types of quartzites. Both of them are gray and fine-grained. The first one is most common in the southern phyllite regions and the second is common in the regions from Boliden to the north. A maximum around 24/24/52 represents the composition of gray phyllite and a maximum at 18/28/54 is the normal composition of the graphite phyllites. The maximum around 25/34/41 is the composition of a dark very fine-grained phyllite.

The Q/Px/Fl values of the gneisses in Västerbotten generally cover the same area of the diagram as the phyllites (Fig. 7). However, the characteristics of sedimentary differentiation are reduced and a single maximum has arisen at 39/19/52. This point is only slightly displaced from the centre of the composition of the phyllites.

A new characteristic of the gneisses is the extension which appears in the diagram against the area of the Revsund granite. These gneisses with a granitic composition can be found in the marginal regions of the granite areas and they are transitional forms. (Gavelin 1955.) In this type of gneiss there are sparsely distributed large microcline crystalloblasts like the coarse rounded or rectangular microcline feldspars which are so typical for the Revsund gra-

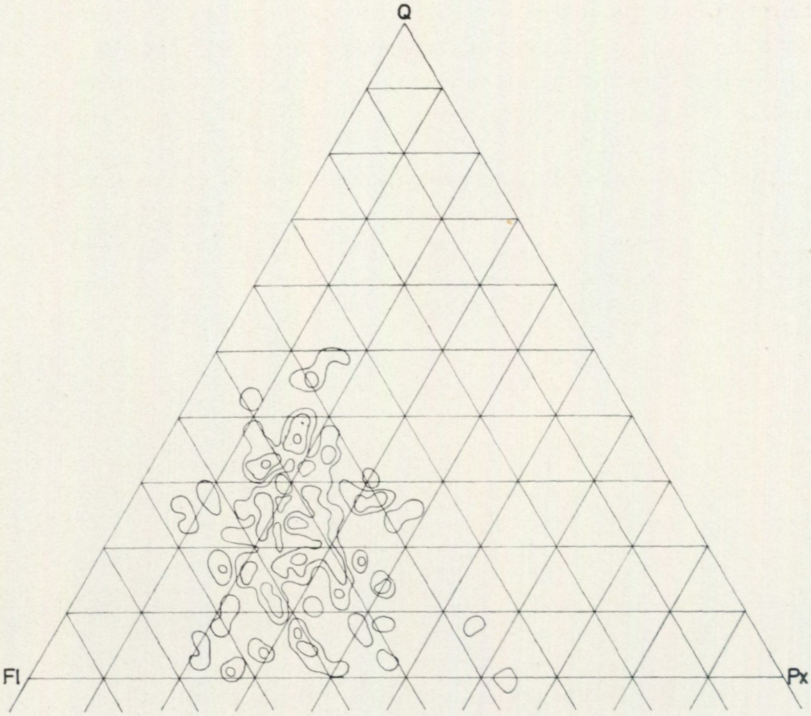

Fig. 6. Diagram of mineral composition in the Phyllite series

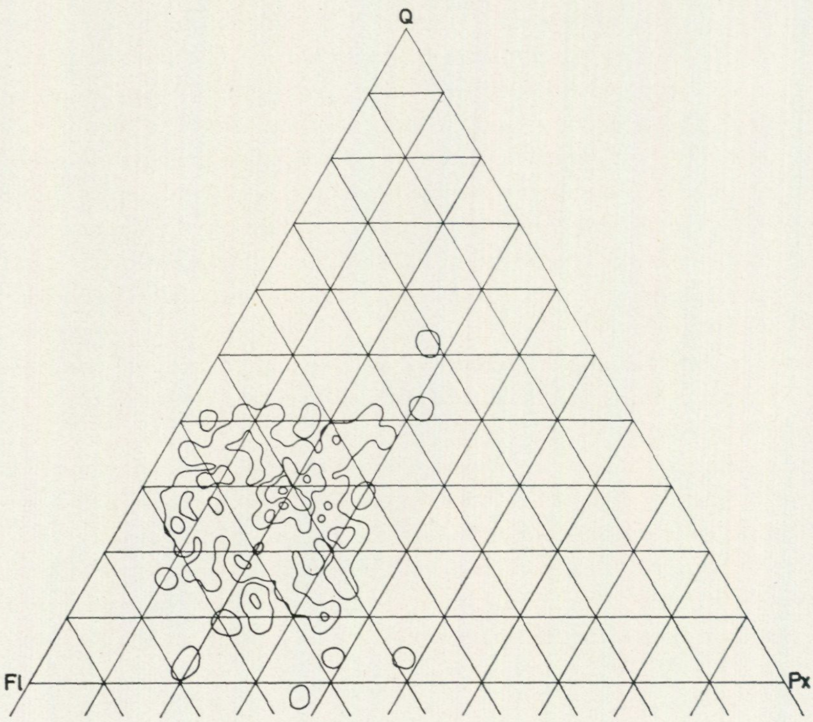

Fig. 7. Diagram of mineral composition in the Gneiss series

nite. This will be taken as an evidence that the Revsund granites have arisen from the gneisses by metamorphism. The gneisses on the other hand are metamorphic parts of the rocks of the phyllites series. This appears from geological indications and from the distribution of the mineral groups Q/Px/Fl in the diagram.

The granitization of the phyllite and gneiss series to form the Revsund granite constitutes an extensive alteration of the parent rock. An escape of a considerable quantity of Px-forming elements has occurred so that the maximum of the gneiss composition at 39/19/52 is displaced to 27/8/65 in the Revsund granite. This also means a supply of Fl-forming elements, principally potassium. The composition of the Revsund granite has also become more homogeneous. The values for the mineral groups Q, Px and Fl are lying close to the maximum point (Fig. 8).

In the metamorphic series, phyllite–gneiss–Revsund granite, there is a regular alteration which reflects the respective tendency of the different elements towards metasomatic mobility. In the first stage, the alteration of phyllite into gneiss, there is a great change in Q, the value of which increases from 22.0 to 26.1 %. In the second stage the greatest change occurs in the groups Px and Fl so that Q remains mostly constant. The variation in Q is caused by the me-

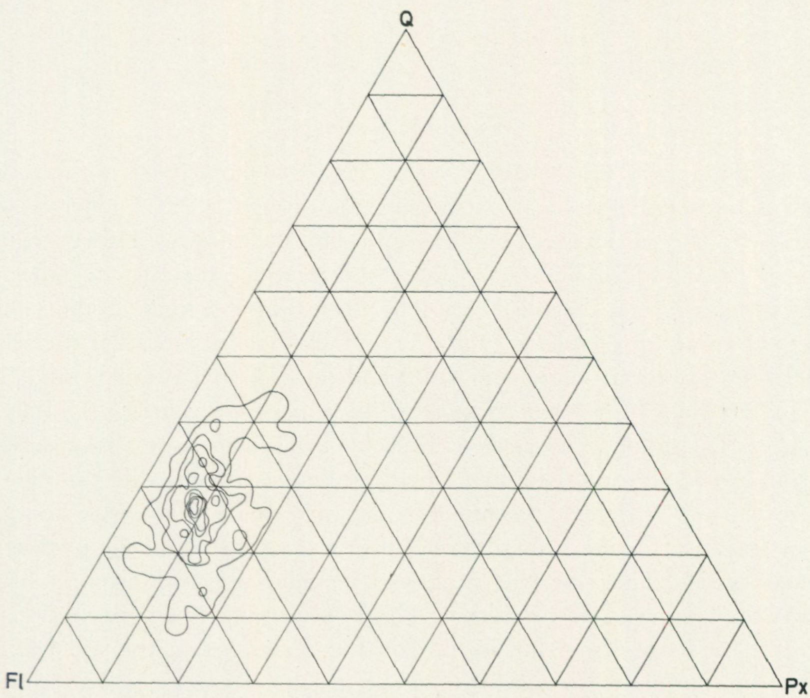

Fig. 8. Diagram of mineral composition in the Revsund granites

tasomatic mobility of other elements. The increase of Si^{+4} is uniform in the whole metamorphic series from phyllite to Revsund granite. This depends mainly on the escape of iron, magnesium and calcium. Some of the increase will cause an increase of the element group Q but this is slowed down in the second stage when Fl grows mainly in potassium feldspar, due to a large metasomatic increase of potassium, but also due to the formation of plagioclase with more albite. Potassium and sodium consume more Si^{+4} in forming feldspar than the same number of cations iron, magnesium or calcium produce when leaving the rock. The granitization of the phyllites also involves a homogenization of the rock. The relative standard deviation (C) will decrease in the element groups Q and Px in every stage of the metamorphism which means that the feature of sedimentary differentiation which was distinct in the phyllite series will vanish. The mineral group Fl has a small dispersion in the phyllite series but it increases in the gneiss series. This is due to the large alteration of the feldspar composition which is not complete in all types of gneisses. The low value of the relative standard deviation of Fl in Revsund granites means that the formation of feldspar has reached a final stage. This is not the case with Px. It has the same relative standard deviation in the granite stage as in the phyllitic and gneissic. The relative standard deviation of Q in the Revsund granite has not reached that low value which is expected for the end stage of a granite although it has decreased considerably.

Volcanic series

From the diagram of the volcanic series (Fig. 9) it appears that the series is much differentiated. The means of the element groups Q/Px/Fl generally agree with those of the sedimentary phyllite series and the gneisses. However, in the values of the standard deviation (s) or the relative standard deviation (C) certain differences can be observed. The dispersion is larger in the volcanic series than in any of the other. However, it must be observed that the relative standard deviation (C) is too high in Q and too low in Px and Fl since there are many analyses from basic rocks which give negative values of Q. The volcanic series has more analyses from basic rocks than the other rock series. In the group basic volcanics the value of the relative standard deviation is not indicated since it is affected too much by negative values. The dispersion in the element group Fl for the volcanic series is not greater than in the phyllite and the gneiss series. These narrow ranges in Fl make it possible to classify the rocks by the composition of feldspar. This is dealt with in a later section. The reason for the large dispersion in the volcanic series is that the series is composed of two different rock groups, namely the basic volcanics with andesites and basalts and the acid volcanics mainly including the series quartz porphyry-

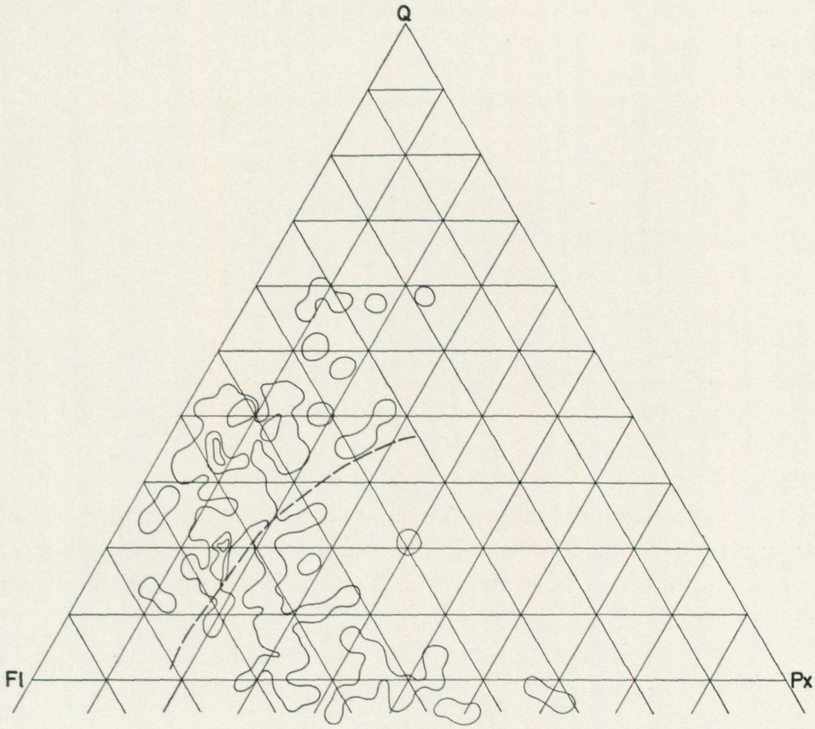

Fig. 9. Diagram of mineral composition in the Volcanic series

quartz keratophyre-keratophyre-dacite. The broken line in the Q/Px/Fl diagram (Fig. 9) is an approximate demarcation line between the two groups. Basic and acid rocks can be easily separated into two groups already during the sampling in the field. In the acid group the series quartz porphyry-quartz keratophyre-keratophyre-dacite form the spine but the group contains some sedimentary rocks too and these cannot be separated for certain. The large dispersion of Q and Px in the group indicates that there are sediments with element compositions that deviate from those of the volcanics. This admixture causes the differentiation of the volcanic group to appear indistinctly in the diagram. However, there are two maxima, one at 34/7/59 where quartz porphyry and quartz keratophyre are localized and another at 20/15/65 where dacites are common. The keratophyres are present in the area between the two maxima. Thus, the composition of the volcanic series ranges from that of an acid granite to that of a quartz diorite among the plutonic rocks.

FELDSPAR COMPOSITION

The composition of feldspars and their mutual quantitative relationship have been calculated from the analyses and only a small number of microscopic feldspar determinations have been done.

Table 2. Feldspar composition and ranges

		Volcanics			Phyllites	Gneisses	Revsund granites
		All	Basic	Acid			
An	X	30.2	47.8	22.7	23.8	22.9	15.1
	s	19.0	14.0	14.7	14.5	10.0	6.5
	C	63	29	65	61	48	43
Ab	X	51.1	42.7	54.9	44.6	45.3	42.9
	s	18.4	14.5	18.8	11.4	7.8	4.7
	C	36	34	34	26	17	11
Or	X	18.5	9.6	22.4	31.6	33.8	42.0
	s	15.7	7.5	16.7	14.1	11.3	9.4
	C	85	78	75	45	33	22

The values calculated from the analyses are entered in the triangular diagram and intensity curves are drawn. The distribution of the feldspar composition in the volcanic series is illustrated in a diagram (Fig. 10). The main part of

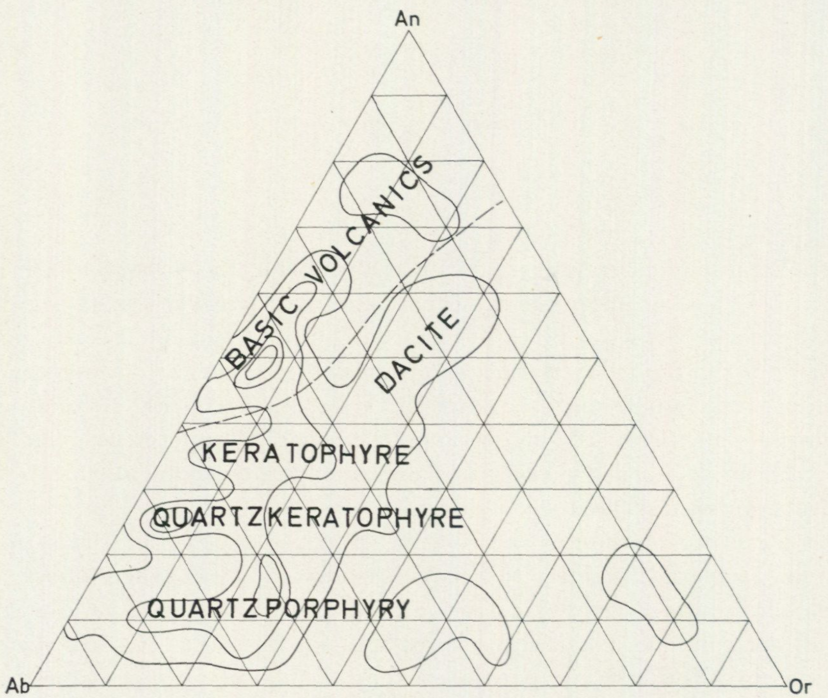

Fig. 10. Diagram of feldspar composition in the Volcanic series

the basic volcanics is localized above the broken line. There is a maximum at 50/45/5. The composition of plagioclase is consequently concentrated at the border between andesine and labradorite.

In the acid volcanics group there are many sedimentary rocks but it has been impossible to separate them with certainty so they are included in the analysis series. As an effect of this, the supposed differentiation of the series cannot be seen distinctly. However, a certain trend appears and this is illustrated in the diagram. The Or-values of the acid volcanics usually do not exceed 30 % which is remarkably low. The An-values are at 50 % for dacites, 35 % for keratophyres, 25 % for quartz keratophyres and 15 % for quartz porphyrys. The composition of plagioclase in the differentiation series runs from bytownite to oligoclase as can be seen from the diagram.

The phyllites, gneisses and Revsund granites in Västerbotten (Fig. 11–13) have a more regular feldspar composition than the rocks of the volcanic series (Table 2). The most characteristic feature of the metamorphic series is that the distribution of the composition grows more narrow with increasing metamorphism and that the supply of potassium results in a decrease of the number of analyses with low Or-values. In the An/Ab/Or diagram for phyllites there is a maximum region extending from 23/47/30 to 14/36/50. The gneisses have

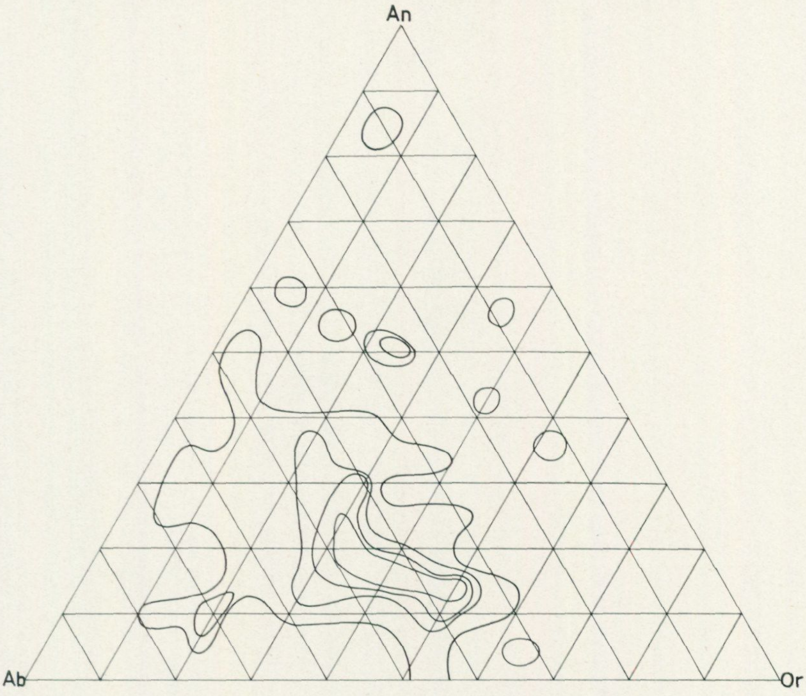

Fig. 11. Diagram of feldspar composition in the Phyllite series

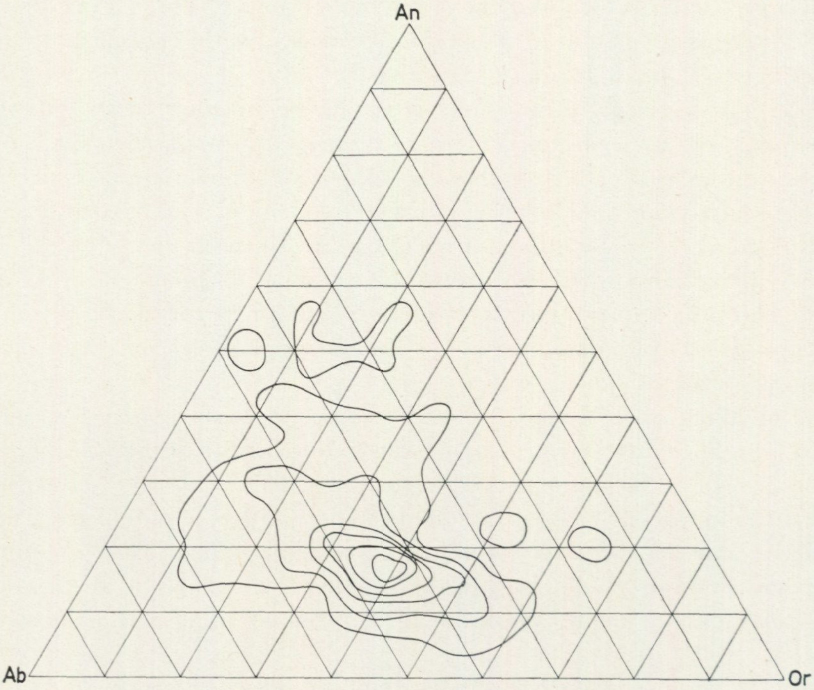

Fig. 12. Diagram of feldspar composition in the Gneiss series

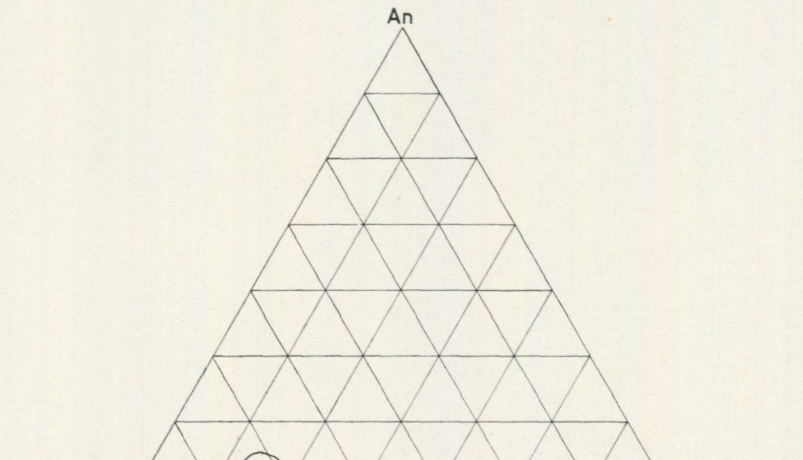

Fig. 13. Diagram of feldspar composition in the Revsund granites

developed a single maximum around 17/44/34 which is displaced to 17/38/45 by the granitization processes. Hence in the metamorphic series a migration of the feldspar composition has occurred in such a way that the crystallization in the Revsund granite mainly goes on near the eutectic line between plagioclase and potash feldspar (Fig. 14).

Quantitative measures of this process are put together in Table 2. During metamorphism the proportion of Or is increased from 31,6 % to 42.0 % and the greatest increase has occurred in the stage between gneiss and Revsund granite. This process ought to correspond to another in the reverse direction in 15.1 % in Revsund granite. Almost the whole decrease has occurred in the granite. This process ought to correspond to another in the reverse direction in some rock complex in the vicinity. In this rock, crystallization of An-rich feldspar takes place. This is part of a diorite-gabbro forming process (Marmo 1968). The remaining solutions or melts will impoverish in An and get richer in Or. During the metasomatism an adjustment takes place between the center of dioritization and the center of granitization in such a way that Or-material

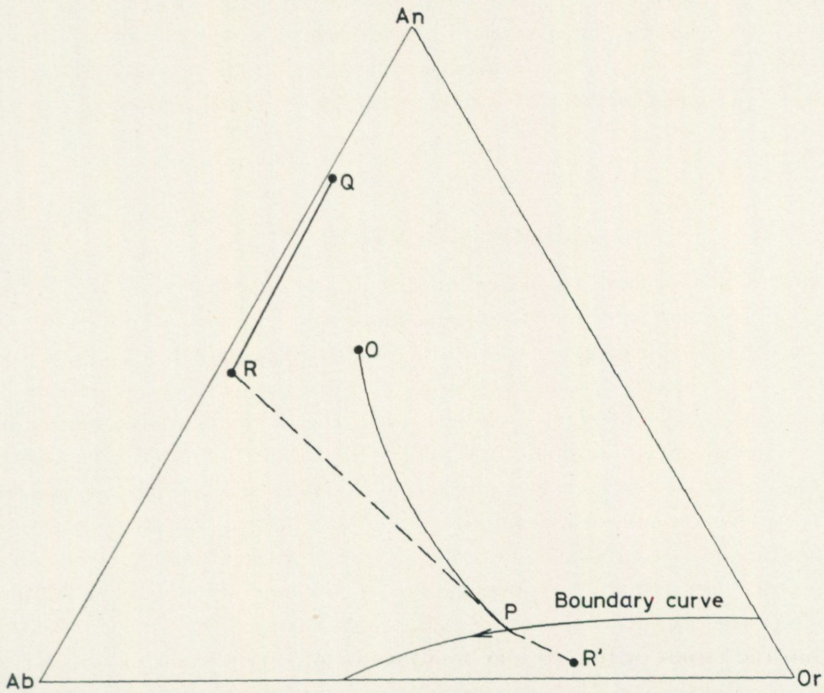

Fig. 14. Schematic illustration of fractional crystallization of feldspars from a deep-seated magma. From the initial liquid O, a plagioclase of composition Q begins to separate. In the course of crystallization the composition of the crystals changes from Q to R, while the melt migrates from O to P. At P the boundary curve is reached, and a simultaneous crystallization of plagioclase R and alkali feldspar R' begins. (From Tom F W Barth, 1962.)

goes from the center of dioritization to the center of granitization and An-material in the opposite direction. This consideration postulates that the complex where An-rich plagioclase is crystallized has another temperature than the place where Or is formed. The process cannot take place before the temperature reaches the interval where solutions or melts of feldspar material are present. Evidently this temperature is attained during the forming of the Revsund granite as it is mainly in this stage of metamorphism that the essential alterations of the feldspar composition take place. In searching for the possible rocks where these reverse rock-forming processes may have taken place, the lower part of the phyllite series appears as the alternative nearest at hand. The phyllites may have a thickness of thousands of meters. They contain so much of potassium that the quantity needed for forming the Revsund granite has been taken from them. The rest may have a potassium content enough for a diorite. The granitization and the dioritization are considered not to have affected the basement complex of the phyllites. This has probably had a variable composition which would have been reflected in the products of the granitization. However, over large areas the Revsund granite is a uniform coarse-grained microcline granite which only very locally possesses evidence of deviations in its fabric. This is comparable with the uniform facies of the phyllite series in the widespread localities where phyllites can be found. A good source of potassium is probably not to be found among the basic rocks in the deeper parts of the crust of the earth. Usually the content of potassium in basic rocks is low.

ELEMENT DISTRIBUTION

The means of the elements are calculated on the cation percent to obtain the correct proportion of the metasomatic mobility. The table of the weight percent on the other hand gives an idea of the quantities which went into play.

From the averages of the analyses of the volcanic series it is hard to form an idea about the different members since the average analyses are not an expression for the individual rock groups in the series. Both acid and basic types are present. The average analyses tell that if the series are homogenized and altered to an igneous rock it would be a quartz diorite. Rocks with this composition are not common in the volcanic series. Remarkable for the volcanic series is the low content of potassium. The volcanic series will be dealt with further in the section "Homogeneity in rock series".

From the tables of the average analyses of phyllites, gneisses and Revsund granites (Tables 3 and 4) it can be seen that some of the elements are reduced in content and other increased by the metamorphism. This alteration in the composition depends on the change of temperature and pressure. The crystallization tendency is different for different elements under different conditions. The most remarkable is the escape of a large quantity of iron and magnesium. The total escape of iron is 3.1 cation % or 4.1 weight %. This quantity would have been enough for the formation of a magnetite orebody of 25 meters thickness every kilometer, if only nature had made such a convenient arrangement for mankind. The escape of magnesium is of the same order. An amount of 3.6 cation % or 2.6 weight % of magnesium are lost by the granitization of the phyllites to the Revsund granite. The percentage of calcium is also reduced but more moderately. This escape of elements from the rock must result in an increase in the content of other elements. It will com-

Table 3. The average composition of the rock series

Weight percent
$\overline{X}$ = arithmetic mean
$\overline{X}_{100}$ = arithmetic mean corrected to 100 %

Oxide	Volcanic series		Phyllite series		Gneiss series		Revsund granite	
	$\overline{X}$	$\overline{X}_{100}$	$\overline{X}$	$\overline{X}_{100}$	$\overline{X}$	$\overline{X}_{100}$	$\overline{X}$	$\overline{X}_{100}$
SiO_2	64.2	66.3	62.0	64.9	65.5	67.4	69.7	71.2
TiO_2	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3
Al_2O_3	14.1	14.6	14.5	15.2	15.3	15.7	14.3	14.6
Fe_2O_3	2.2	2.3	1.9	2.0	1.1	1.2	0.6	0.6
FeO	3.6	3.7	5.4	5.7	4.5	4.7	3.0	3.0
MgO	3.1	3.2	3.2	3.4	2.4	2.5	0.8	0.9
CaO	4.4	4.5	3.0	3.1	2.3	2.4	2.0	2.0
Na_2O	3.1	3.2	2.5	2.6	2.7	2.7	3.0	3.0
K_2O	1.6	1.7	2.6	2.7	2.9	3.0	4.3	4.4
	96.8	100.0	95.5	100.0	97.1	100.0	98.0	100.0

Table 4. Cation percent of the rock series calculated from weight percent corrected to 100 %

$\overline{X}$ = arithmetic mean
M = median

Element	Volcanic series		Phyllite series		Gneiss series		Revsund granite	
	$\overline{X}$	M	$\overline{X}$	M	$\overline{X}$	M	$\overline{X}$	M
Si	62.0	64.9	60.7	60.9	63.1	63.9	66.7	66.6
Al	16.1	15.5	16.8	16.8	17.3	17.2	16.1	16.1
Fe+++	1.5	1.1	1.4	0.6	0.8	0.5	0.4	0.4
Fe++	2.9	2.4	4.5	4.2	3.6	3.8	2.4	2.2
Fe total	4.4	3.9	5.9	5.4	4.4	4.3	2.8	2.8
Mg	4.5	2.4	4.7	4.3	3.6	3.4	1.1	0.9
Ca	4.7	3.5	3.2	2.3	2.4	1.8	2.0	1.8
Na	5.8	5.8	4.8	4.5	4.9	4.9	5.4	5.2
K	1.9	1.8	3.3	3.3	3.6	3.6	5.3	5.6

pletely explain the increase of silicon and sodium in the granite. The content of potassium is however increased to such an extent that a substantial supply from other rocks must be evoked. The changes of the percentage in the metamorphic series phyllite-gneiss-Revsund granite can be explained to some extent by metasomatism which would have increased the content of iron, magnesium and calcium in the phyllites and reduced the content of the same elements in the granite. The present investigation has not verified this. On the contrary we find that the least metamorphosed phyllites have the highest content of these elements. Consequently the matter escaped must be deposited in some other rock and it is open to conjecture that the ores and rock alterations of Västerbotten are derived from the metamorphic series phyllite–gneiss–Revsund granite (Fig. 15).

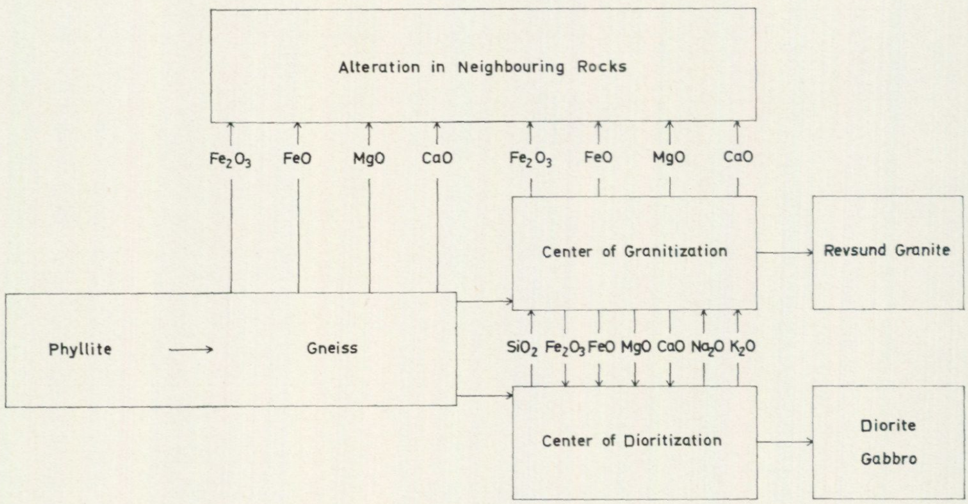

Fig. 15. Diagram of metamorphism

HOMOGENEITY IN ROCK SERIES

The standard deviation (s) and the relative standard deviation (C) are measures of the dispersion or of the homogeneity of rock series. The relative standard deviation gives a method for comparing the homogeneity of different rock series and of different elements with each other. C expresses the standard deviation in percent of the average of the rock series so that a low value of C indicates a high homogeneity of the series.

Table 5. Standard deviation and relative standard deviation of the rock series

Cation	Volcanic series		Phyllite series		Gneiss series		Revsund granite	
	s	C	s	C	s	C	s	C
Si^{+4}	10.5	17	6.6	11	4.7	7.5	3.4	5.2
Al^{+3}	2.5	15	2.3	13	1.7	9.6	1.2	7.4
Fe^{+3}	1.6	109	2.0	146	1.2	145	0.4	98
Fe^{+2}	1.8	63	2.3	51	1.4	39	1.0	41
Mg^{+2}	4.6	102	2.5	52	1.7	47	0,8	71
Ca^{+2}	3.8	80	3.0	94	1.6	68	0.9	46
Na^{+}	2.4	42	1.8	37	1.4	28	1.2	22
K^{+}	1.5	80	1.4	43	1.3	35	1.2	22

From Table 5 it seems that the volcanic series has a very inhomogeneous composition. This indicates that the series consists of many rock groups such as basic volcanics, acid volcanics and sediments. The spine of the acid group is the differentiation series quartz porphyry-quartz keratophyre-keratophyre-dacite. In the group of 94 analyses of acid volcanics there are also many sediments. The acid volcanics and the sediments have an average composition nearly agreeing with granodiorite. However, the variance of the composition is large.

Table 6. Average and dispersion of the acid volcanics

Oxide	$\bar{X}$	$\bar{X}$	M	s	C
	weight %	cation %	cation %	cation %	cation %
SiO_2	69.9	67.6	69.1	5.6	8.3
Al_2O_3	13.5	15.3	14.9	2.4	15.5
Fe_2O_3	1.1	0.8		0.7	82
FeO	2.8	2.3		1.2	54
Fe (total)	3.9	3.1	2.9	1.4	46
MgO	1.5	2.1	1.9	1.2	57
CaO	2.9	3.0	2.3	3.2	105
Na_2O	3.3	6.2	6.9	2.6	41
K_2O	1.9	2.3	2.2	1.6	69

From table 6 it appears that the widest range is that for calcium. This indicates that some calcareous sediments enter the rock group. The variances of magnesium and potassium are also large. This variance may be due to volcanic differentiation or metasomatism. The variance in Si^{+4} is not so large as in the phyllites but somewhat larger than in the gneisses in Västerbotten. The sample that is richest in silica comes from an arkose sandstone from Bjurberget. The content of SiO_2 is 81.1 % and that of quartz 60 %.

The basic group of different andesitic and basaltic rocks includes 42 out of 136 analyses on volcanic rocks. From the values of the standard deviation and the relative standard deviation it seems that the variations of the elements and the minerals are of the same order as in the gneisses.

Table 7. Average and dispersion of the basic volcanics

Oxide	$\overline{X}$	$\overline{X}$	M	s	C
	weight %	cation %	cation %	cation %	cation %
SiO_2	51.3	49.9	49.6	3.6	7.3
Al_2O_3	15.4	17.6	18.0	3.0	16.7
Fe_2O_3	4.5	3.2		1.7	53
FeO	5.1	4.3		2.1	49
Fe (total)	9.6	7.4	7.6	1.6	21
MgO	6.8	9.8	7.7	5.5	56
CaO	8.0	8.3	8.3	2.3	28
Na_2O	2.7	5.0	5.0	2.0	40
K_2O	0.9	1.1	0.8	0.8	75

The variations are largest for magnesium and potassium. The variations for Fe^{+3} and Fe^{+2} are large individually but counted together the variance is small. This behaviour indicates that the grade of oxidation is highly variable in different types of basic volcanics. Some of the variance may possibly be due to uncertainties in the analysis method. Fe^{+3} and Fe^{+2} are separated by dissolving the sample in hydrochloric acid and analysed for Fe^{+2}. However, samples with an iron content higher than 1 % are also treated with hydrofluoric acid to get all Fe^{+2} dissolved. However, the error cannot be so large as to have caused the dispersion to any significant extent.

In the metamorphic series phyllite–gneiss–Revsund granite there is an increase in the homogeneity. This is specially accentuated for the elements Si^{+4}, Al^{+3}, Ca^{+2}, Na^{+} and K^{+} which have reduced their dispersion to half by the metamorphism. The relative standard deviation of the elements Fe^{+3}, Fe^{+2} and Mg^{+2} are not reduced to any significant extent but the standard deviation is reduced for these elements also.

DISTRIBUTION OF ELEMENTS

In studying the distribution of elements in different rock series the cumulative diagrams described in the section "Statistical methods" have been used. It is easy to read the properties of a rock series from such diagrams and they give a good overall picture of the metamorphism when put together.

From the following it will appear that some elements are normally distributed and others are lognormally distributed. The ordinary distribution in nature is the normal. The height of national service men is often cited in statistical textbooks as an example of an approximately normal distribution. The number of marriages according to the age of the husband is taken as an example of a skew distribution which may be lognormal. In the first case the height of the men is normally distributed since the curve can stretch in both directions without limit. Certainly nobody has heard about infinitely short or infinitely tall men, but the limits set by nature might be at equal distance from the mean. On the other hand the number of marriages counted according to the age of the husband is not such a natural phenomenon, because the law prescribes the lowest age of the husband as 21 years so the greatest number of marriages take place shortly after 21 and the distribution becomes skew.

Similar is the situation for the distribution of the elements in rock series. The elements Si^{+4} and Al^{+3} are not limited upward or downward. The average content of Si^{+4} is far from the two limits 0 ‰ and 100 ‰ so that Si^{+4} is often normally distributed. The same is the behaviour of Al^{+3} whose average content of about 15 ‰ lies at a safe distance from the downward limit 0 ‰ so that it can fit a normal cruve, but Mg^{+2} in the Revsund granite has a different type of distribution as can be seen from an earlier section (Fig. 2–4). The arithmetic mean is close to the value 0 ‰ so that the distribution is truncated. The behaviour of many other elements with contents close to 0 ‰ is similar. They follow a skew distribution and may fit a lognormal one.

The 0-limit as the cause of a lognormal distribution is mostly a mathematical condition and is not due to natural chemical or physical laws. The skew distribution of potassium in Revsund granite on the other hand may be a geochemical law. K^{+} has an upward limit at about 7 cation ‰, which causes a negative skew distribution. The cause of this limit may be eutectic feldspar crystallization which is dealt with in another section. Other possible cases in which a skew distribution may result are small rock masses in metasomatical contact with large rock ones having diverging compositions. Such conditions may arise during the granitization of rocks in contact with basic rocks in the interior of the earth. However, such a phenomenon has not been observed in the present investigation.

Phyllite, gneiss and Revsund granite

Si^{+4}

The content of Si^{+4} is approximately normally distributed (Fig. 16). The curve of the phyllite series has many segments showing the series to be composed of many different rock groups not containing a continuous differentiation series. The phyllite series is differentiated into independent rock types.

The curve for gneisses is displaced towards higher contents of Si^{+4}. The increase of silicon has mostly influenced the basic gneisses so that the curve has become steeper. This means that the gneiss serie is more homogeneous than the phyllite one. The curve for gneisses has three segments and an appearance such that the presence of more than two rock populations must be postulated.

The distribution of the Revsund granite is quite linear and fits a normal curve very well. There are no angle points so that all the features of the sedimentary stage have been removed. This assumes that silicon is a rather mobile element in the rock.

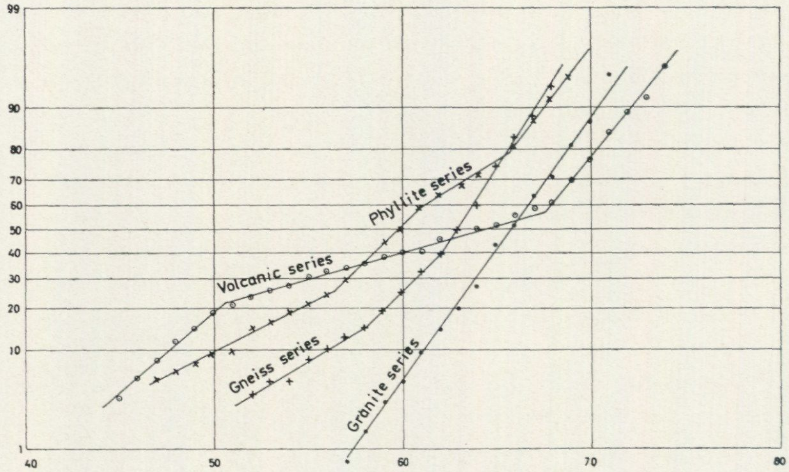

Fig. 16. Cumulative normal distribution of Si^{+4}

Al^{+3}

The distribution of Al^{+3} fits well a normal curve (Fig. 17). The curve of the phyllite series has many angle points showing the series to contain many populations which can be referred back to different types of sediments. The curves for gneiss and Revsund granite grow steeper and steeper and the metamorphism makes the rocks more homogeneous in aluminium. The curve for gneiss has two segments so that the series ought to contain two populations as far as aluminium is concerned. The curve for the Revsund granite consists of two segments so that the granitization has not been able to remove the features from the gneiss stage. Therefore, aluminium might be said to be an element with low mobility.

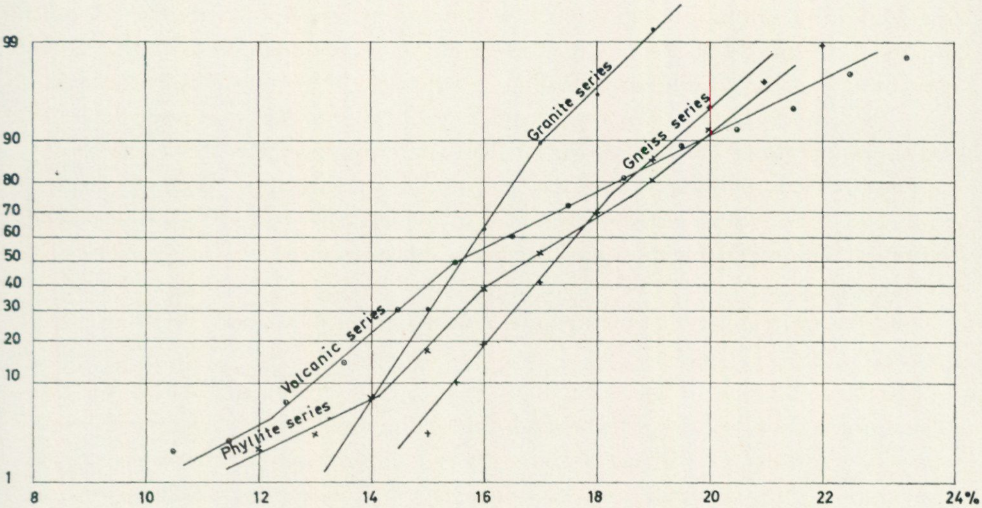

Fig. 17. Cumulative normal distribution of Al^{+3}

$Fe^{+2}+Fe^{+3}$

Fe^{+2} and Fe^{+3} individually have large dispersion and irregular curves which may, in fact, be due to errors in the analyses. Nevertheless, the large dispersion is believed to arise form interchanges in the two oxidation states being rather easy in either direction. If a comparison is to be possible with other elements in the analyses series we must study the total content of iron in the rocks.

The distribution of iron follows lognormal curves (Fig. 18). The reason for

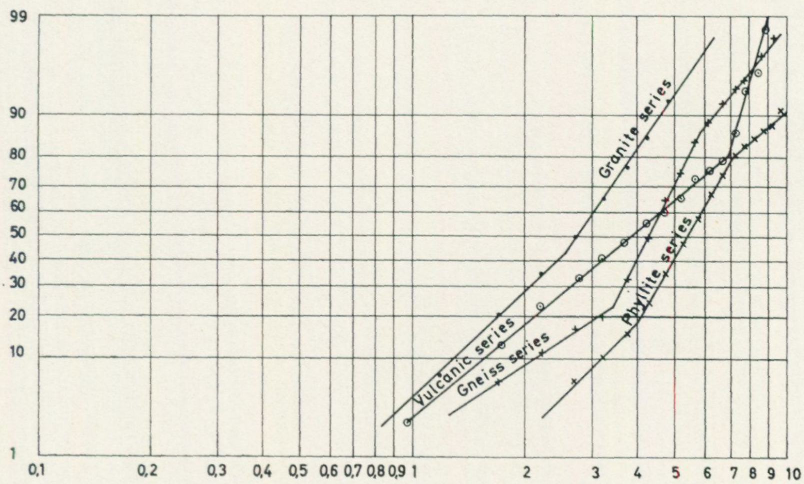

Fig. 18. Cumulative lognormal distribution of $Fe^{+2}+Fe^{+3}$

the lognormal distribution is that a 0-content limits the distribution downwards. The curve for the phyllite series has two angle points and the same appearance as the combination B (Fig. 5) indicating that the rocks of the phyllite series are divided in two types with regard to iron. Yet it is impossible to say anything about the mechanism of the differentiation from this curve.

The gneisses in Västerbotten are distributed according to a curve similar to that of the phyllites but it is displaced to the left, that is, towards lower percentages. The metasomatism has not been able to remove the feature of sedimentary rock.

The loss of iron may be due to some volatile minerals such as pyrrhotite and pyrite.

The large change in the content of iron occurs during granitization. The distribution curve is straightened and one of the angle points disappears. The curve is transformed from combination B to combination D. The large loss of iron implies that granitization is a stage in which iron generally migrates to some other rock complex. Since the iron of ore deposits and altered rocks is only a small part of the quantity coming from the rocks in the metamorphic series the rest must be looked for somewhere else. One immediately thinks of the formation of a diorite-gabbro concurrently with granitization. The formation of basic rocks may have occurred at a higher temperature than the granitization.

Mg^{+2}

Mg^{+2} follows lognormal curves in the rock series investigated. The curve for the phyllite series is almost a straight line (Fig. 19). This is interpreted as evidence that magnesium is comparatively mobile even in the low metamorphic stage of the phyllite series.

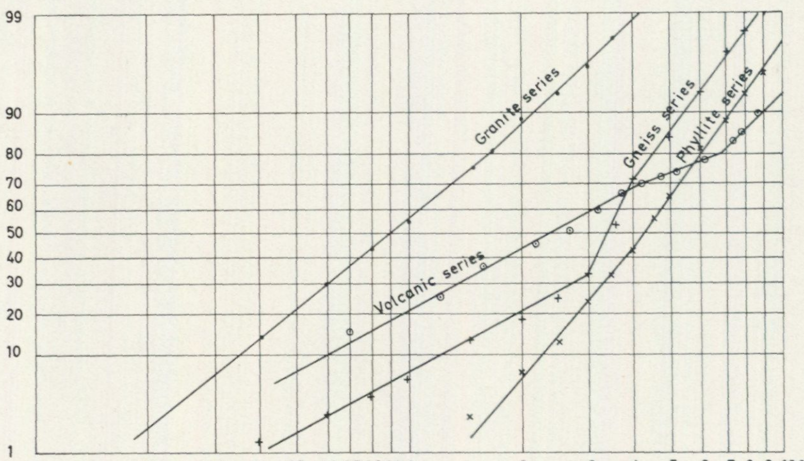

Fig. 19. Cumulative lognormal distribution of Mg^{+2}

During the formation of gneiss the curve has got at least two angle points which shows that a labile stage with the formation of different types of gneisses has begun.

The largest alteration of the content of magnesium in the metamorphic series has occurred during granitization. The distribution curve has been straightened and an almost ideal lognormal distribution has arisen. The loss of magnesium is very large in the step gneiss to granite. It cannot be accounted for by the magnesium deposited in the zones of alteration along the margins of the granites. Hence, the consumption of magnesium must be explained by the same diorite-gabbro forming process as the distribution of iron dealt with above. This rock-forming process has probably continued at pressure and temperature conditions different from those of the granitization processes forming the Revsund granite. An intimate metasomatic exchange between the two metamorphic centres must have taken place.

The conclusion is that magnesium is a highly mobile element.

Ca^{+2}

The content of Ca^{+2} follows lognormal curves (Fig. 20). This is due to the lower limit of the distribution being zero. In the curves of phyllites and gneisses there are angle points and the curves have the appearance of combination C. During the gneiss-forming processes the curve grows steeper. The distribution curve of the Revsund granite has an angle point but the curve belongs to the combination D. The change from combination C to combination D is such an alteration of the distribution type that calcium must be characterized as an easily displaceable element, at least in the more intense metamorphism.

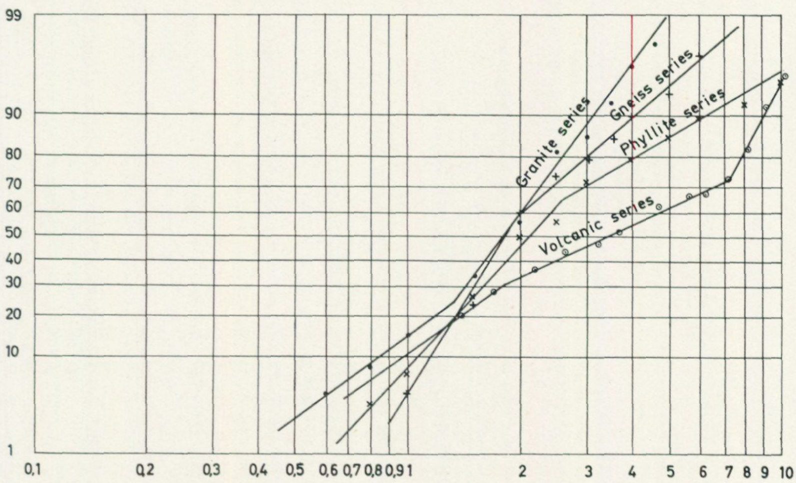

Fig. 20. Cumulative lognormal distribution of Ca^{+2}

Na^+

The contents of Na^+ in the investigated rock series are lognormally distributed. This is again due to the existence of a lower limit of zero (Fig. 21). During the metamorphism there is a slight increase in the content of Na^+. The curve for the phyllite series has two angle points but it is so irregular in other respects that it cannot be explained by only two populations. The series must consist of more than two populations which probably corresponds to the existence of many rock types arisen by sedimentary differentiation.

The distribution curve of the gneisses has a single angle point and belongs to the combination D. The homogenization of sodium has thus advanced considerably in the gneiss-forming process.

The distribution curve for the Revsund granite has a hardly discernible angle point in the upper part and the curve belongs to the combination C. The curve is parallel and close to that of gneisses which indicates that the metasomatism was able to complete the redistribution of sodium as early as the gneiss-stage. Albitic plagioclase has already been formed in the gneiss stage from low-metamorphosed sodium minerals in the phyllites.

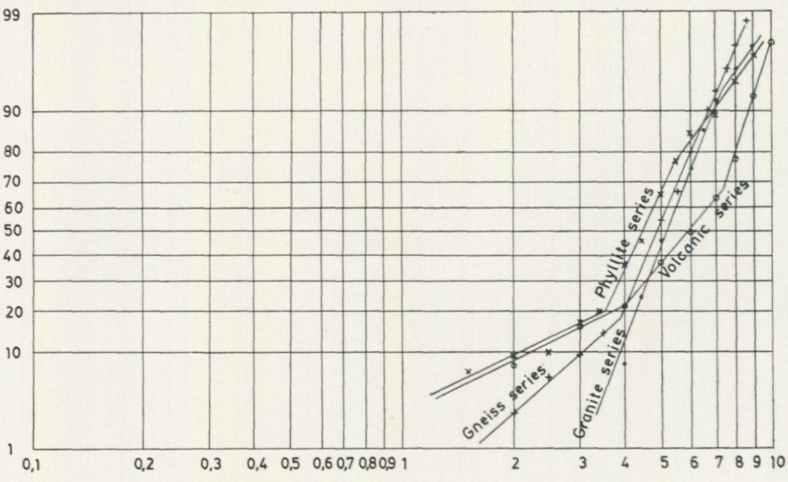

Fig. 21. Cumulative lognormal distribution of Na^+

K^+

As far as the volcanic and the phyllite series are concerned potassium follows the lognormal distribution but this is not true of potassium in the gneiss series and in the Revsund granite (Figs. 22 and 23). However, the difference between the lognormal phyllite curve and the normal gneiss curve is small. These two curves are close to each other. This means that a limited metasomatic exchange has gone on in the step from phyllite to gneiss. During the granitization on the other hand large metasomatic transports have taken place. The distribution is neither normal nor lognormal. The curve is limited upwards at a value of about 7 %. Therefore, in Fig. 24 the function ($7-K^{+}$) is constructed instead. This curve follows an almost ideal lognormal distribution. The value 7 % curtails the distribution upwards in the same way as the value 0 % curtails other distributions downwards. The reason for this limit on the content of potassium at 7 % is the crystallization of feldspar dealt with in the section "Feldspar composition". The condition that makes the value 7 cation percent to such a precise upper limit is the fact that the content of feldspar in the Revsund granite is very constant. The relative standard deviation (C) is as low as

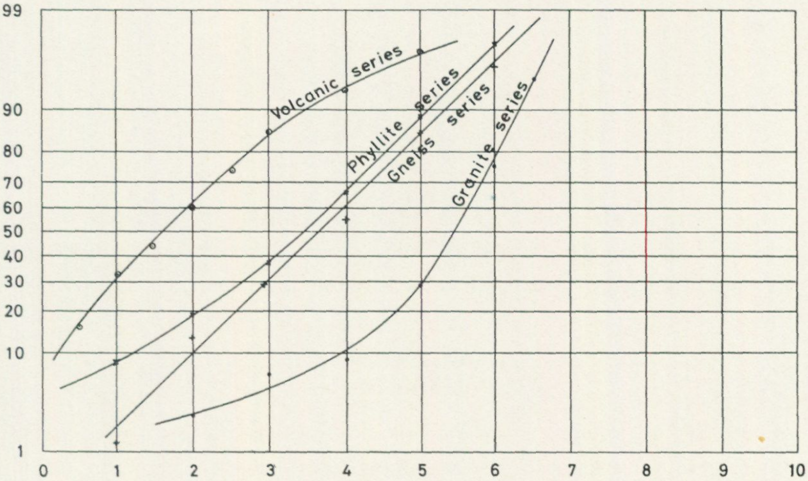

Fig. 22. Cumulative normal distribution of K^{+}

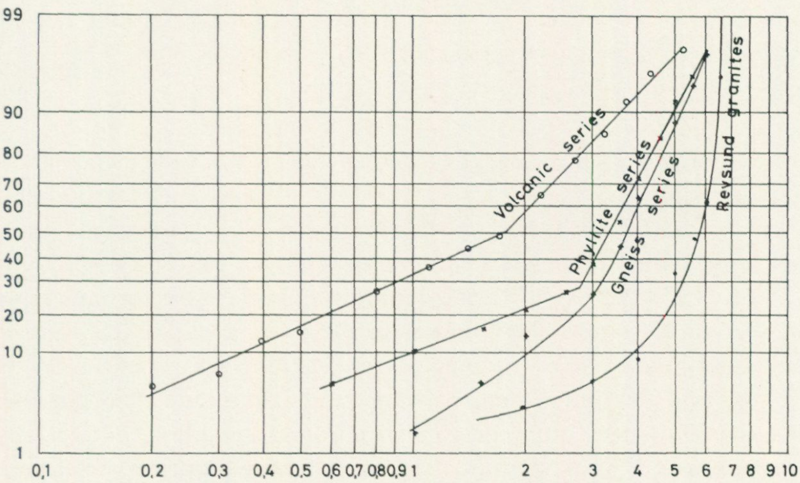

Fig. 23. Cumulative lognormal distribution of K^{+}

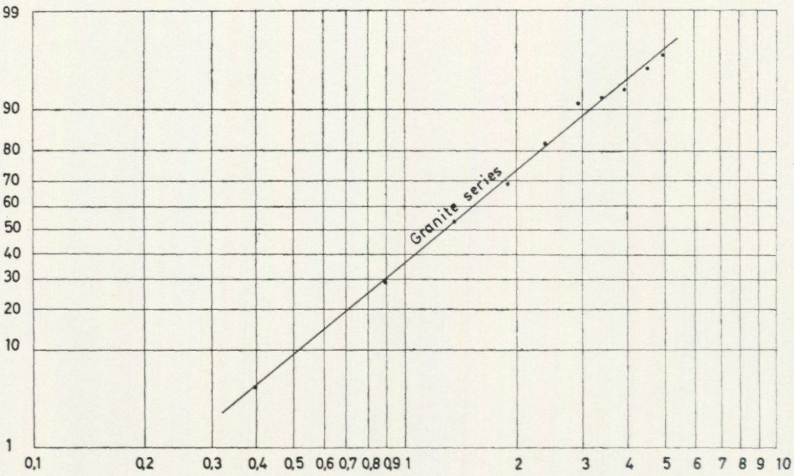

Fig. 24. Cumulative lognormal distribution of $(7\text{–}K^{+})$

9 % in the element group Fl (Table 1). If the content of feldspar in the Revsund granite had a larger dispersion the upper limit for potassium would be indistinct and the distribution curve would not get such a regular lognormal appearance.

Volcanic series

The volcanic series consists of two easily distinguishable groups of rocks. One is the basic group with andesites and basalts and the other is the acid group with the differentiation series quartz porphyry-keratophyre-dacite. In the acid group there are some sedimentary rocks too but these cannot be separated. The possibility of separating the rocks of the volcanic series into two groups has made the complex curve separable into two simpler ones.

Si^{+4}

The content of silicon in the rocks of the volcanic series follows normal distribution in the same way as the rocks of phyllites, gneisses and Revsund granites. In the curve for the volcanic series there are two angle points and the curve belongs to the combination A. The sample series consists of 94 acid volcanics and 42 basic. In Fig. 25 is shown the distribution in these two groups as well as that in the whole series. The contents in the basic group are almost ideally normally distributed. There is a single very weak angle point in the curve. The curve of the acid group has a more distinct angle point and therefore the distribution represents two different populations corresponding, in part, to sediments and in part to volcanic rocks of the series quartz porphyry-keratophyre-dacite.

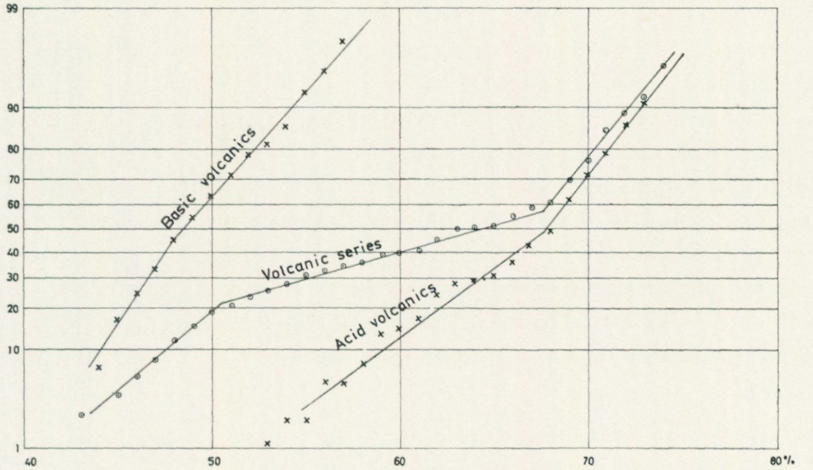

Fig. 25. Cumulative normal distribution of Si^{+4}

Al^{+3}

The content of aluminium follows a distribution which is a combination of several normal-distribution curves (Fig. 26). There are two angle points in the distribution curve and this is due to an almost ideally normal curve for the basic volcanics and a curve with angle points for the acid group. The distribution curve of the acid group may have arisen from the stratification of acid volcanics and sediments. The curve belongs to the combination B and the population corresponding to the steepest curve ought to represent the distribution of rocks of the differentiation series while the sediments must have a greater dispersion corresponding to a flat distribution curve.

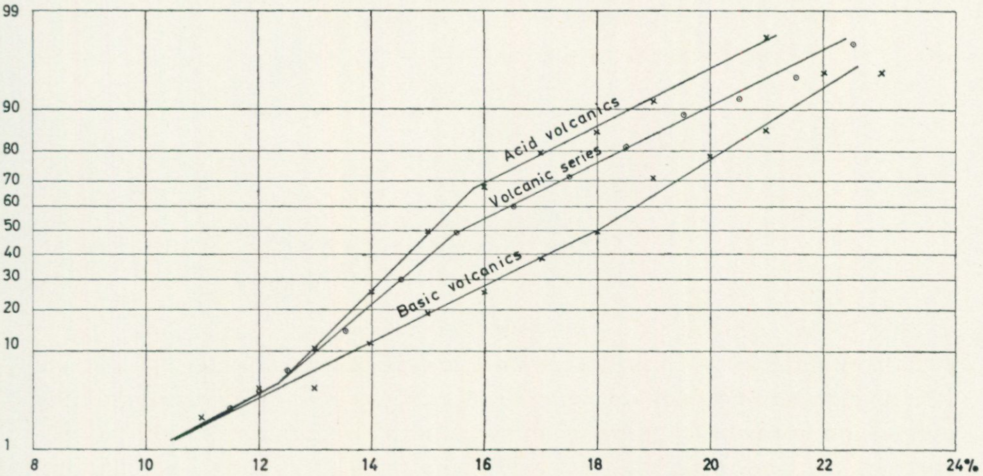

Fig. 26. Cumulative normal distribution of Al^{+3}

$Fe^{+2}+Fe^{+3}$

As in the rocks of the metamorphic series the distribution curves of the volcanic series are constructed from the total content of iron (Fig. 27). The two valences each have complicated curves owing to the extreme variability of the degree of oxidation. The distribution of iron follows well combinations of lognormal curves. It shows one distinct and one indistinct angle point. The distinct angle point is due to the two main populations, the basic group and the acid group. The curve of the basic group is steep since the content of iron has a small dispersion. The indistinct angle point in the distribution curve of the volcanic rocks arises from an angle point in the curve of acid volcanics, which in turn is due to the stratification of sediments and acid eruptive rocks.

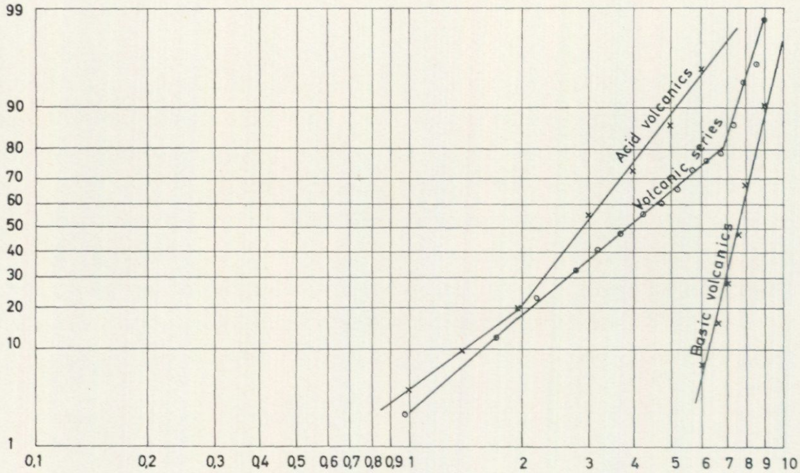

Fig. 27. Cumulative lognormal distribution of $Fe^{+2}+Fe^{+3}$

Mg^{+2}

The distribution curve of magnesium has the same appearance as that of iron. It is lognormal (Fig. 28) owing to truncation at zero. The distribution of magnesium in the basic group is almost an ideal lognormal distribution. The curve of the acid group has one angle point arising from two populations, the eruptive rocks and the sediments included in the volcanic series.

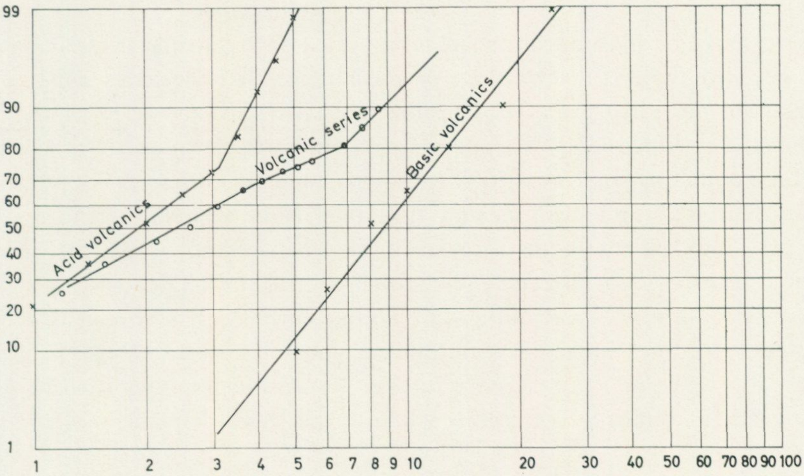

Fig. 28. Cumulative lognormal distribution of Mg^{+2}

Ca^{+2}

The distribution of calcium in the volcanic series follows a lognormal curve with angle points (Fig. 29). The curve has two angle points so it ought to be the result of two lognormal populations representing an acid and a basic rock group. However, this is not the whole case because on each of these curves there are other angle points. The angle point in the basic group can be explained by assimilation of calcium-rich rocks and that in the acid rocks by stratification of eruptive rocks and sediments.

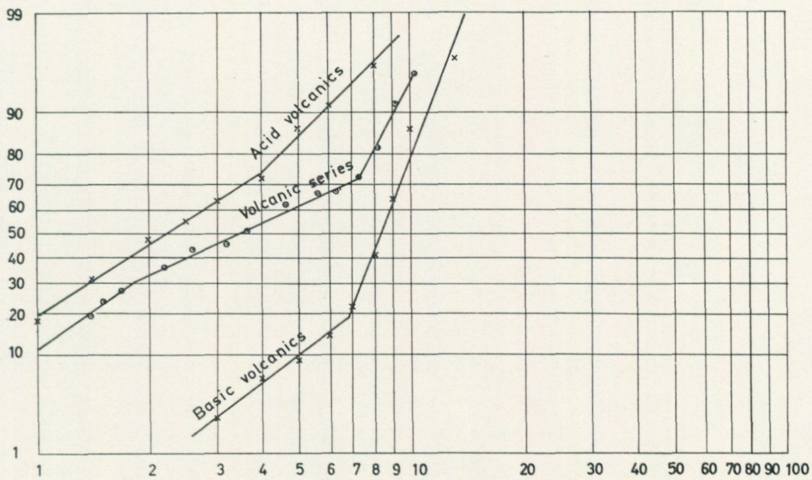

Fig. 29. Cumulative lognormal distribution of Ca^{+2}

Na+

The percentage of sodium follows combinations of lognormal curves (Fig. 30). There are two angle points on the curve so aligned that the series must be said to consist of more than one rock group. The distribution curves of the basic and the acid groups themselves confirm this. In each of these curves there are two angle points so aligned as to suggest that each group may have more than two populations. This complicated distribution of sodium in the volcanic series may indicate that a distribution in an early period of the volcanism is preserved and it is not affected by the distribution in a later eruption. How the elements – in this case sodium – are bound in the rock is obviously of great importance for the metasomatism. In the volcanics most of the sodium is deposited in feldspar and inactive while the sodium in phyllites is to be found in low grade metamorphic minerals where it is readily displaceable.

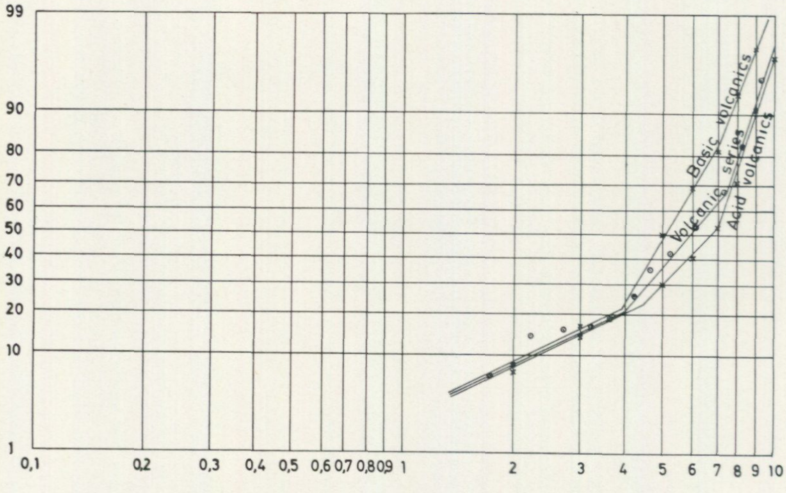

Fig. 30. Cumulative lognormal distribution of Na+

K+

Potassium in the volcanic series follows combinations of lognormal distributions (Fig. 31). The curve for the whole series is simpler than would be expected from the appearance of the curve for basic and acid volcanics. In both of these curves there are angle points which indicate that there are two subgroups in each. Fig. 31 shows that the angle point for the whole series do not depend on a combination of the distribution curve for the basic and the acid group but on a combination of the angle points in these two curves. Hence, the irregularity in the distribution of potassium in the volcanic series seems to depend on some other division of the series than a division in an acid and a basic group. Possibly the anomalous distribution of potassium may be caused by sericitization. Many of the samples are taken from sericitic rocks.

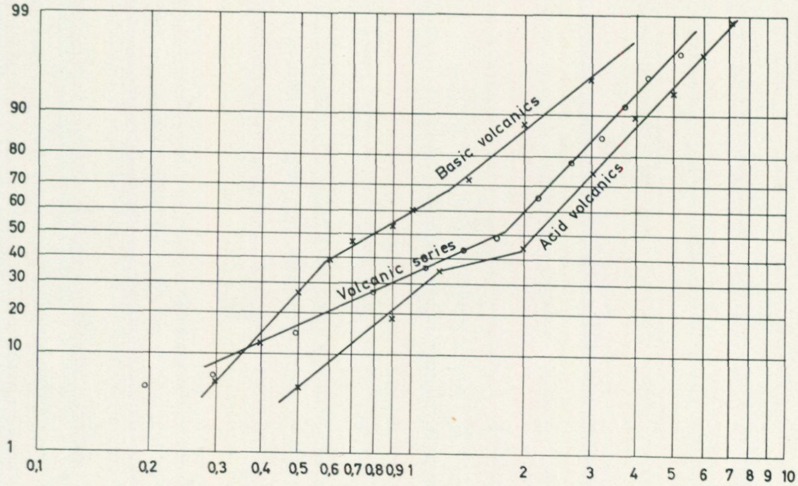

Fig. 31. Cumulative lognormal distribution of K^+

DENSITY

Density determinations have been made on almost all samples. The averages and ranges of density are summed up in Table 8.

Table 8. Averages and ranges of density

	Volcanics	Phyllites	Gneisses	Revsund granites
Density ($\overline{X}$)	2.754	2.786	2.732	2.676
Standard deviation (S)	0.091	0.089	0.065	0.044
Number (n)	122	122	170	153

In the metamorphic series phyllite–gneiss–Revsund granite there is a regular decrease of density and the dispersion decreases at the same rate as for the elements and mineralgroups.

The densities follow normal curves depending on the absence of truncating limits (Fig. 32). The curves consist of two or more straight lines which means that every group is a mixture of two or more rock populations. In each of the

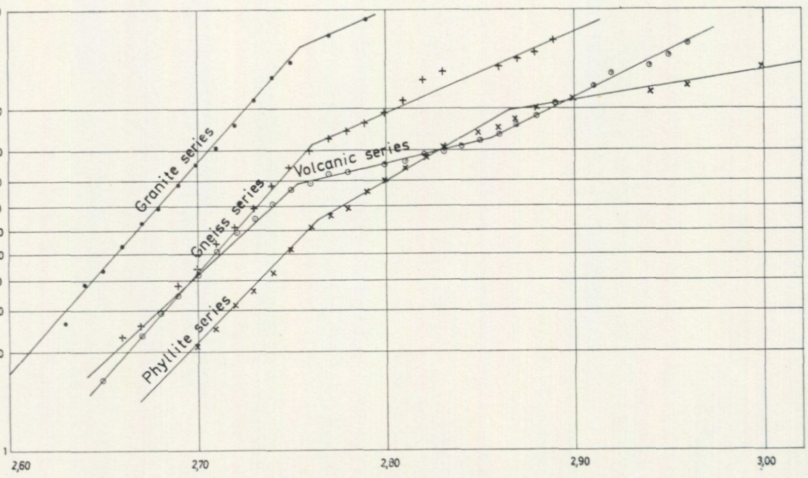

Fig. 32. Cumulative normal distribution of density

groups, volcanic series, gneiss series and Revsund granite, two populations can be discerned and in the phyllite series there are several of them. This pattern is the same as that shown by the different elements. It has been shown above how the phyllite series is separated in many different rock types owing to sedimentary differentiation.

CONCLUSIONS

The main elements of the phyllite series are classified into mineral groups and the groups are found to be distributed in several maxima. These maxima indicate different rock types formed by sedimentary differentiation. The values for the gneisses cover largely the same area of the diagram as the phyllites but the features of sedimentary differentiation are reduced and a single maximum has arisen. An intermediate form of rocks lying between gneiss and Revsund granite called granite-gneiss has appeared. In the Revsund granite the rock complex has undergone an active homogenization, a radical decrease of Px-forming elements and an increase of Fl-forming elements in comparison with the state in the phyllite and the gneiss series. The development of the distribution of the mineral groups from phyllite over gneiss to Revsund granite forms a pattern that demonstrates that the Revsund granite originates from the phyllite series by metamorphism. This process is what we call granitization.

The volcanic series consist of two main groups – basic and acid volcanics – with different patterns for the distribution of minerals. Sedimentary rocks are thought to be especially common in the group of acid volcanics but it has not been possible to distinguish them.

The calculated composition of feldspar in the metamorphic series phyllites–gneiss–Revsund granite shows a pattern of distribution where a maximum moves towards a composition with more and more potash feldspar concurrently with an increasing degree of metamorphism. Thus the crystallization of feldspar in the Revsund granite has gone on near the eutectic line between plagioclase and potash feldspar. This indicates that the crystallization of feldspar with mainly anorthite took place at the same time in a neighbouring rock complex while a metasomatical exchange went on between the two centers of crystallization. Thus the granitization continued parallel to a diorite-gabbro forming process (Marmo 1968). The granitization and the dioritization are estimated to have occurred within the primary phyllite complex.

The feldspar composition of the volcanic series is complex. The basic volcanics are poor in potash feldspar and the content of An goes from 50 to 90 % in the plagioclase. In the differentiation series quartz porphyry-keratophyre-dacite the content of anorthite grows in a regular manner. The content of potash feldspar is low.

The individual elements are distributed in different patterns. Silicon and aluminium follow normal curves and the other elements are lognormally distributed. The lognormal distribution arises owing to the truncation of the population at one limit. The most common limit in the value O but in the Revsund granite potassium has an upper limit of about 7 cation %. The function $(7-K^{+})$ is lognormally distributed. The reason for this truncation is the fact that the crystallization went on near the eutectic line between the fields of crystallization of plagioclase and potash feldspar.

Every rock series usually consists of several populations as can be seen in the distribution curves. The angle points in the diagram arise due to combinations of different populations. In the metamorphic series phyllite–gneiss–Revsund granite the distribution pattern goes from a complicated one with many populations in the phyllite series to a simple one in the Revsund granite. Thus granitization is a homogenization of the rock.

The distribution curve for the volcanic series shows that there are many populations. The basic volcanics represent a single population so that they all come from the same rock series. The acid volcanics have angle points in the distribution curves. These are due to the fact that in this group there are both eruptive rocks and sediments. The differentiation series quartz porphyry-keratophyre-dacite forms one population and the sediments the other.

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Appendix I. Sample locations

The localities are given in the co-ordinates of "Rikets nät" 2,5 °W, 1938"

1. 7270300/1556000
   E of Gittjaure
   Gray, coarse, porphyritic Revsund granite
2. 7269800/1561200
   S of Njuktjärn
   Gray, fine-grained phyllitic quartzite
3. 7267800/1567600
   E of Olsträskbäcken
   Gray, coarse, porphyritic Revsund granite
4. 7269200/1575700
   E of Stensund
   Gray, fine-grained phyllitic quartzite. It has no biotite and is non-metamorphosed
5. 7264700/1582000
   At the fork W of Grundträsk
   Fine-grained, hard graphitic quartzite with many large and small angular quartz and feldspar grains. The feldspars are grumbled by sericite.
6. 7262800/1589700
   2 km W of Aha
   Gray, coarse, porphyritic Revsund granite
7. 7257000/1582400
   N of Kvarnbrännan station
   Gray, coarse, porphyritic Revsund granite
8. 7253200/1569000
   S of Tallträsket
   Gray, coarse, porphyritic Revsund granite
9. 7252700/1595800
   Between Lilla and Stora Gubbträsket
   Gray, coarse, porphyritic Revsund granite
10. 7252100/1602600
    At Näverträskbacken
    Tight red, coarse, porphyritic Revsund granite
11. 7247400/1571300
    At the dam of Storjuktan
    Gray, fine-grained, phyllite with calcite grains
12. 7249300/1577300
    S of Huftasjö
    Gray, coarse, porphyritic Revsund granite
13. 7246200/1586700
    S of the Sandsele bridge
    Gray, coarse, porphyritic Revsund granite
14. 7243600/1598700
    NW of Sappetsele
    Gray, coarse, porphyritic Revsund granite
15. 7240900/1607600
    In the brook W of Holmfors
    Gray, coarse, porphyritic Revsund granite
16. 7238400/1550600
    E of Ersmark
    Gray, coarse, porphyritic Revsund granite
17. 7235300/1557800
    W of Renberg
    Gray, coarse, porphyritic Revsund granite
18. 7234200/1575600
    S of Stångträsket
    Hard sandy graphitic phyllite with pyrrhotite
19. 7237600/1601900
    NE of Geriträsk
    Gray, coarse, porphyritic Revsund granite
20. 7246600/1714100
    At the lake SW of Nyfors
    Fine-grained phyllite with newly formed biotite
21. 7228800/1559300
    NE of Långholmen
    Gray, coarse, porphyritic Revsund granite
22. 7230500/1570400
    E of the lake Kulven
    Fine-grained phyllite with lineation
23. 7228600/1577000
    N of Åstorp
    Fine-grained phyllite with lineation
24. 7230200/1585400
    1 km S of Fredriksten
    Fine-grained phyllite with lineation
25. 7234600/1622000
    Between the tarns 3 km E of Brännäs
    Fine-grained folded graphitic phyllite. The graphite is consentrated in stripes.
26. 7237600/1719600
    At Finnliden
    Conglomerate. The matrix is a phyllite with large and small angular quartz grains and the fragments are mainly of quartzitic rocks
27. 7238700/1727300
    2 km SE of Styckfors
    Gray, phyllitic quartzite with newly formed biotite. The rock is mostly recrystallized
28. 7225100/1575900
    NW of Nedre Gunnars
    Hard, fine-grained amphibolite with quartz-veins. The content of quartz is higher than expected

29. 7224400/1579900
5 km S of Åstorp
Gray, fine-grained phyllite
30. 7255700/1583900
2 km NW of Orrträsktjärn
Dark gray even-grained Revsund granite
31. 7225400/1606500
Mutterliden
Red, coarse porphyritic Revsund granite. It has large microcline perthites and the plagioclase is sericitized
32. 7229400/1616400
At the side way 3 km S of Forsvall
Banded phyllitic quartzite. The quartz grains are anglar and have varying sizes. The rock is of low metamorphic grade
33. 7229700/1648300
E of Strömfors
Fine-grained phyllite with small light spots where recrystallization has occurred
34. 7228200/1654900
At Näsberg
Fine-grained graphitic phyllite with fragments having less graphite than the groundmass
35. 7226200/1657700
Drillcore at Skäppträskåheden
Hard, fine-grained graphitic phyllite with angular quartz grains
36. 7226400/1663300
Drillcore at Finnberg
Fine-grained banded graphitic phyllite
37. 7234600/1727500
At Gammelboliden
Fine-grained phyllite with newly formed biotite and single garnets.
38. 7234800/1733300
W of Fällfors
Gray Revsund granite
39. 7234800/1744200
1 km W of Ålund
Gray, coarse, porphyritic Revsund granite
40. 7234400/1750100
2 km SE of Båtfors
Gray, granitic gneiss with granite in veins
41. 7218300/1552900
At the top 555 at Norrberg
Red fine-grained granite
42. 7221500/1561500
S of Storuman
Gray, granitic gneiss. In the outcrop there are remains of coarse phyllite
43. 7217800/1569500
At the busstop, Långseleberget
Gray, coarse-grained biotite gneiss with remains of phyllite
44. 7220600/1578600
At Stentjärn
Graygreen diorite stratified in the phyllite series
45. 7223100/1587100
N of Orrträsket
Hard fine-grained lineated phyllite.
46. 7222200/1604800
S of Öresund
Fine-grained phyllitic quartzite with newly formed biotite fragments. The rock is partly recrystallized
47. 7223900/1613900
4 km W of Vindelgransele
Inhomogeneous graywacke quartzite with newly formed phenocrysts of quartz and feldspar
48. 7221400/1619800
At Storforsen
Very fine-grained banded phyllite.
49. 7220700/1659800
N of Gräsliden
Very fine-grained phyllite. Some of the quartz grains can be identified
50 7225700/1716900
E of Klintå
Dark gray even-grained granite
51. 7225200/1725300
W of Rörträsket
Soft and rusty graphite phyllite
52. 7228400/1762300
N of Åbytjärn
Biotite gneiss with microcline and lamilated plagioclase
53. 7216500/1574000
At the busstop, Myrträsk
Gray phyllite with graphite in bands. The matrix is fine grained and has large and small angular quartz grains
54. 7214600/1581900
At Skivträsk
Banded, hard fine-grained graphitic phyllite with large and small angular quartz grains
55. 7216200/1591600
S of Strömnäs
Slaty amphibolite. The rock is interbedded with the gneisses
56. 7214800/1605700
At Lycksaberg
Fine-grained phyllite with newly formed biotite and quartz in angular grains
57. 7216000/1602600
S of the brook at Åmliden
Fine-grained amphibolite in the phyllite series. There are many small broken amphibole phenocrysts in a matrix of quartz and feldspar
58. 7219500/1619600
At Norrbrännan
Fine-grained phyllite with some newly crystallized quartz and biotite

59. 7215700/1659900
500 m E of the side way to Gräsliden
Fine-grained graphitic phyllite with new formed biotite and quartz
60. 7217700/1672600
Drillcore from Skäggträskheden
Very fine-grained graphitic phyllite where only some of the quartz grains are large enough to be identified by the microscope
61. 7221300/1681200
Drillcore from Skogheden
Very fine grained phyllite with ore grains
62. 7221800/1686300
Drillcore SE of Petikträsk
Fine-grained graphitic phyllite with splendid banding
63. 7222300/1709000
Drillcore from Renmossaheden
Basic phyllite with chlorite. Very fine-grained and no recrystallization
64. 7222300/1709000
Drillcore from Renmossaheden
Fine-grained phyllitic quartzite with light gray spots. These spots may be fragments
65. 7218500/1714500
Drillcore from Gråliden
Fine-grained graphitic phyllite without newly formed minerals
66. 7222400/1715800
NW of Lundbacka
Conglomerate with fine-grained phyllitic matrix and pebbles from a fine-grained quartzite
67. 7223000/1719400
At Stavaträsk
Fine-grained hard graphitic phyllite
68. 7220800/1727300
At Lindbacken
Fine-grained graphitic phyllite
69. 7220200/1733000
S of Nide
Fine-grained phyllite with some newly formed large quartz grains and fragments of biotite
70. 7222800/1745300
1,5 km NW of Bjurselet
Slaty amphibolite from the phyllite series. It has lots of newly formed small green amphiboles
71. 7207700/1563600
3 km SE of Skarvsjö
Very fine-grained graphitic phyllite with fragments of a not-so-graphite-rich phyllite
72. 7207700/1563600
3 km SE of Skarvsjö
Gray fine-grained phyllite
73. 7207100/1583800
At the electrical works of Grundfors
Very fine-grained amphibolite with ray-forming minerals and mica. There are also quartz and feldspar
74. 7210000/1589000
N of Bränntjärn
Fine-grained phyllite with fragments of different quartzite
75. 7210000/1609700
At Stenträsk
Gray, coarse, porphyritic Revsund granite
76. 7210100/1665600
E of Kvammarn
Hard, fine-grained graphitic phyllite
77. 7210900/1674100
S of Tallberg
Very fine-grained phyllite
78. 7213500/1686000
At Rödbergstjärn
Gray, fine-grained phyllite
79. 7213500/1692900
Drillcore from Svanheden
Partly recrystallized fine-grained phyllite with fragments of a fine grained quartzite
80. 7215800/1718400
N of Säljedal
Fine-grained graphitic conglomerate with pebbles of fine-grained graphitic quartzite. The matrix is very graphite rich
81. 7214700/1726500
S of Storkågeträsket
Fine-grained clay quartzite
82. 7214900/1729000
2 km E of Storkågeträsket
Fine-grained phyllite with angular quartz and feldspar grains but no biotite
83. 7217500/1731200
N of Dalbäck
Fine-grained phyllite with newly formed biotite in ribbons
84. 7217700/1757700
W of Båtvik
Light gray small-grained microcline granite of the Skellefte type
85. 7205400/1545300
1.5 km NE of Gråtanliden
Gray, coarse, porphyritic Revsund granite
86. 7201500/1557800
S of Råbäcken
Porphyry of the Revsund granite series from the border of a basic massif. The porphyry has idiomorphic quartz and feldspar porphyroblasts in a fine-grained matrix of quartz, feldspar and biotite. The feldspar in the matrix is sericitized. Some of the quartz phenocrysts have cavitations

87. 7200900/1569700
The south hill S of Storträskleden
Gray, coarse, porphyritic Revsund granite
88. 7202700/1575900
At Börtingberg
Gray, coarse, porphyritic Revsund granite
89. 7201600/1591800
S of Mörtsjön
Phyllitic sandstone with quartz and feldspar in large and small angular grains and calcite in large grains
90. 7204400/1614500
W of Norberg
Gray, coarse, porhyritic Revsund granite with large microcline perthites, sericitized plagioclase, dark biotite and quartz
91. 7205200/1618800
N of Inre Tväråtjärn
Gray, coarse, porhyritic Revsund granite
92. 7204000/1645900
In Vormträsk
Light gray fine-grained microcline-granite of the Skellefte type. It has microclinperthite, sericitized plagioclase, biotite and quartz. The high percentage of potassium may come from the sericite in the plagioclase
93. 7209300/1664500
At the road S of the island in St. Kvammarn
Fine-grained amphibolite in the phyllite series. There are lots of small newly formed hornblende-grains
94. 7208600/1669300
S of Norsjövallen
Fine-grained, partly recrystallized, sandstone with ore grains. It has biotite in small fragments
95. 7210100/1681300
At Tjärnberg
Gray even-grained Revsund granite
96. 7209000/1693600
Drillcore from Åsen
Soft fine-grained graphitic phyllite
97. 7209100/1712000
Drillcore from Kankberg
Fine-grained graphitic phyllite with many large and small angular quartz grains
98. 7211600/1725300
S of Kvarnforsliden
Coarse-grained amphibolite with large hornblende-grains. The rock belongs to the phyllite series
99. 7212200/1733300
7 km S of Norra Bastuliden
Very fine-grained graphitic phyllite. The rock is unmetamorphosed and no biotite can be seen
100. 7210700/1738600
S of Stentorp
Gray, coarse, porphyritic Revsund granite
101. 7212200/1742200
W of Drängsmark
Gray, coarse, porphyritic Revsund granite
102. 7211700/1756200
S of Furögrund
Light, small-grained microcline granite of the Skellefte type
103. 7197200/1547900
N of Lövliden
Red, coarse, porphyritic Revsund granite
104. 7199600/1556400
At the parish border
Gray, small-grained granite of the Skellefte type
105. 7200300/1585900
E of Brattbäcken
Gray, coarse, porphyritic Revsund granite
106. 7198000/1598000
2 km N of the top of Tjuvberget
Very fine-grained phyllite. There are newly formed fragments of biotite
107. 7200100/1632900
1 km SE of Kronlund
Gray, coarse, porphyritic Revsund granite. The granite is soft owing to weathering
108. 7198800/1638300
At Norrforsen
Gray, coarse, porphyritic Revsund granite
109. 7201300/1644800
At Tjädermyren
Red, coarse, porphyritic Revsund granite
110. 7198500/1653400
S of Flarken
Reddish, coarse, porphyritic Revsund granite
111. 7202800/1665000
N of Långträsket
Light gray, fine-grained granite of the Skellefte type
112. 7201700/1671200
N of Avaliden
Gray, even-grained Revsund granite
113. 7200900/1686300
N of Stora Lidträsket
Gray, coarse, porphyritic Revsund granite
114. 7203600/1695400
2 km S of Holmträsk
Small-grained relatively massive granite-gneiss

115. 7205700/1705900
At Renfors
Gray, coarse, porphyritic Revsund granite
116. 7205200/1719500
At Nyholm
Fine-grained graphitic phyllite with a diffuse new crystallization of biotite
117. 7206600/1725300
N of Tarsbäckliden
Fine-grained phyllitic quartzite with some large newly formed grains of quartz and feldspar and biotite in small fragments
118. 7204000/1732500
NE of Hallbergssvedjan
Biotite-rich phyllite
119. 7207900/1746800
N of Frostkåge
Gray, coarse, porphyritic Revsund granite
120. 7188900/1545300
2 km SE of Nyliden
Reddish, coarse, porhyritic Revsund granite
121. 7195100/1591900
W of Merjasjön
Fine-grained, graphitic phyllite with pebbles or fragments of a graphitic quartzite
122. 7193100/1598100
In the brook at Stormyrheden
Fine-grained phyllite with small angular grains of quartz. Newly formed quartz has come into fissures and the biotite is also newly crystallized
123. 7193500/1606200
N of Blåvikstrand
Red, even-grained Revsund granite
124. 7191800/1639200
2 km S of Ruskträsk
Gray, coarse, porphyritic Revsund granite with microclineperthites and some grains of sericitized plagioclase quartz and biotite
125. 7193700/1656000
E of Östra Noret
Red, coarse-grained granite with some biotite but no microcline. The plagioclase has the composition An 10. The content of quartz is high
126. 7194000/1674300
NE of Ensamheten
Gray, banded granitic gneiss
127. 7197200/1695800
S of Myrberget
Gray granitic gneiss with granite in dikes. The sample is taken in pure gneiss
128. 7200100/1716700
S of Bjurlidenträsket
Gray, coarse, porphyritic Revsund granite
129. 7201500/1723100
SE of Svanström
Conglomerate with light pebbles of quartzite in a matrix of phyllitic sandstone
130. 7197800/1723000
S of Norra Grundfors
Amphibolite in the phyllite series with much hornblende
131. 7198800/1727300
1 km W of Klintforsliden
Fine-grained graphitic phyllite with some newly formed mica and single large grains of newly formed quartz
132. 7199200/1736900
E of Lövlund
Fine-grained phyllite with newly formed biotite, quartz and feldspar
133. 7199500/1745100
2 km S of Storkåge
Fine-grained quartzite with biotite and some newly formed amphiboles
134. 7202700/1750500
S of Örnänget
Coarse-grained contorted biotite gneiss with albite-twinned plagioclase, potassium feldspar and quartz with strong strain shadows
135. 7184500/1536200
At the side road to Nästansjö
Gray, coarse, porphyritic Revsund granite
136. 7188600/1554700
W of Grundsjö
Red, fine-grained microcline granite
137. 7185300/1567500
At Ulvoberg
Light gray coarse porphyritic Revsund granite
138. 7187400/1602100
SE of Hedmark
Gray phyllitic quartzite
139. 7186800/1607100
E of the hill 591,9
Fine-grained amphibolite in the phyllite series
140. 7187700/1655800
S of Forsholm
Light gray granitic gneiss
141. 7187600/1663000
SW of Ajaur
Coarse-grained gabbro in the phyllite series
142. 7189900/1674500
SW of Tvärliden
Gray, coarse-grained granitic gneiss
143. 7192700/1688600
N of Storklinten
Gray, coarse, porphyritic Revsund granite
144. 7192000/1697800
Drillcore from Stenbrånet 12.40–13.08 m
Gray, fine-grained biotite gneiss

145. 7192000/1697800
Drillcore from Stenbrånet 14.07–15.35 m
Gray, shiny fine-grained biotite gneiss
146. 7192000/1697800
Drillcore from Stenbrånet 16.58–17.40 m
Gray, fine-grained biotite gneiss
147. 7192000/1697800
Drillcore from Stenbrånet 17.40–19.01 m
Gray, shiny, fine-grained biotite gneiss
148. 7192000/1697800
Drillcore from Stenbrånet 44.47–46.30 m
Gray, fine-grained biotite gneiss
149. 7192000/1697800
Drillcore from Stenbrånet 46.30–47.31 m
Light gray, fine-grained granitic gneiss
150. 7192000/1697800
Drillcore from Stenbrånet 47.31–48.50 m
Light-gray, fine-grained, shiny, granitic gneiss
151. 7192000/1697800
Drillcore from Stenbrånet 48.50–49.64 m
Light gray granitic gneiss
152. 7192000/1697800
Drillcore from Stenbrånet 68.30–69.30 m
Gray coarse-grained biotite gneiss
153. 7192000/1697800
Drillcore from Stenbrånet 69.30–70.72 m
Gray, fine-grained biotite gneiss
154. 7192000/1697800
Drillcore from Stenbrånet 70.72–71.94 m
Gray, fine-grained biotite gneiss
155. 7192000/1697800
Drillcore from Stenbrånet 71.94–73.72 m
Gray, fine-grained biotite gneiss
156. 7192000/1697800
Drillcore from Stenbrånet 73.72–76.62 m
Gray, fine-grained biotite gneiss
157. 7192000/1697800
Drillcore from Stenbrånet 76.62–79.10 m
Gray, fine-grained biotite gneiss
158. 7192000/1697800
Drillcore from Stenbrånet 79.10–79.75 m
Light-gray fine-grained granitic gneiss
159. 7192000/1697800
Drillcore from Stenbrånet 79.75–80.35 m
Light-gray gneiss with mica
160. 7192000/1697800
Drillcore from Stenbrånet 99.30–100.10 m
Gray, fine-grained biotite gneiss
161. 7192000/1697800
Drillcore from Stenbrånet 100.10–100.50 m
Gray, fine-grained biotite gneiss
162. 7192000/1697800
Drillcore from Stenbrånet 100.50–100.80 m
Gray, shiny biotite gneiss
163. 7195200/1715500
Below Finnforsfallet
Very fine-grained phyllite with both bedding and schistosity visible in the microscope
164. 7195900/1723400
N of Holmfors
Fine-grained amphibolite from the phyllite series. It is weathered and has fragments of biotite, spots of chlorite and a mixture of quartz and feldspar
165. 7191600/1723000
Below Krångforsfallet
Hard graphitic phyllite with newly formed biotite, quartz and feldspar
166. 7196300/1729200
N of Bjurå
Fine-grained phyllitic sandstone. It is partly recrystallized with newly formed quartz, feldspar and biotite
167. 7196300/1729200
N of Gråberg N of the river
Fine-grained amphibolite with schistosity. There are very small green newly formed amphiboles and also feldspar and quartz
168. 7195300/1734300
NW of the Stöverå bridge
Fine-grained phyllitic sandstone with newly formed biotite
169. 7195900/1740400
1.5 km NW of Stensvedjan
Fine-grained phyllite. Almost the whole rock is recrystallized with biotite quartz and feldspar
170. 7193800/1744400
N of the hospital in Skellefteå
Gray sandstone which is recrystallized and has biotite, twinned plagioclase, potassium feldspar and quartz
171. 7196400/1752300
At Boviksbadet
Folded gray biotite gneiss
172. 7182500/1558400
SE of Anevare
Reddish, coarse, porphyritic Revsund granite
173. 7182300/1588300
NW of Norrbäck
Gray, coarse, porphyritic Revsund granite with small crystals of garnet
174. 7180000/1590500
E of Norrbäck
Gray, coarse, porphyritic Revsund granite
175. 7183700/1604300
NE of Arnträsk
Gray even-grained Revsund garnite
176. 7180100/1621000
S of Umeälven at Stenkulla
Gray, coarse, porphyritic Revsund granite
177. 7181600/1638000
S of Björkåsen
Gray, coarse, porphyritic Revsund granite

178. 7180000/164200
At Stensund
Gray, coarse, porphyritic Revsund granite
179. 7183900/1653200
E of Grundsund
Gray, coarse, granitic gneiss
180. 7185000/1676900
N of Klysterberg
Coarse, granitic gneiss with feldspar in veins
181. 7185500/1689900
SW of Lidträsk
Gray coarse-grained Revsund granite
182. 7186600/1698100
At Granström
Light gray fine-grained microcline granite of the Skellefte type
183. 7189300/1715200
N of Rismyrliden
Fine-grained phyllite with lots of small newly formed amphiboles
184. 7186400/1720500
N of Bergliden
Porphyritic quartzite from an outcrop on the margin of the Jörn granite-gneiss south of Skellefte river
185. 7187800/1743300
N of Kroksjö
Gray granitic gneiss
186. 7190500/1751500
At the limestone quarry of Bergsholmen
Diorite from the gneiss series
187. 7177200/1596500
At Björkberg
Gneissy sandstone with partly well developed plagioclases
188. 7175100/1636500
NE of Ulriksdal
Gray, coarse, porphyritic Revsund granite
189. 7179300/1642300
N of Rågranliden
Gray, coarse, porphyritic Revsund granite
190. 7179100/1665800
SE of Sikseltjärn
Rusty, sandy gneiss
191. 7179100/1665800
SE of Sikseltjärn
Coarse, fresh, granitic gneiss
192. 7183900/1708100
S of Ljusvattenbäcken
Even-grained biotite gneiss with weathered feldspar
193. 7182200/1725800
At Brönstjärn
Even-grained Revsund granite with some lineation
194. 7184900/1733400
At Gammelboberget
Coarse, weathered, granitic gneiss
195. 7171300/1533900
Below the dam of Malgomaj
Reddish, coarse, porphyritic Revsund granite
196. 7169900/1545100
At the road curve NW of Brännsjön
Dark gray, even-grained granite
197. 7171800/1561200
NE of Latikberg
Gray, coarse, porphyritic Revsund granite
198. At the village of Järvsjö
Gray, coarse, porphyritic Revsund granite
199. 7171300/1587700
SW of Lillgoliden
Gray, coarse, porphyritic Revsund granite
200. 7168100/1595400
1 km E of Svannäs
Gray sandstone with angular grains of quartz in a fine-grained matrix of quartz, feldspar and biotite
201. 7169900/1613900
W of Tallträsk
Gray, coarse, porphyritic Revsund granite
202. 7170500/1620600
At the village of Bäverträsk
Gray, even-grained Revsund granite
203. 7173900/1628600
E of Böjen
Gray, coarse, porphyritic Revsund granite
204. 7172200/1632700
1 km E of Stenhamn
Gray, coarse, porphyritic Revsund granite
205. 7171500/1642900
SE of Arvlidsjön
Light gray fine-grained granite of the Skellefte type
206. 7173500/1646800
1 km NW of Mellansjö
Gray, coarse, porphyritic Revsund granite
207. 7173900/1648600
SW of Övre Busjön
Gray granitic gneiss
208. 7173500/1651800
E of Yttre Busjön
Light gray granitic gneiss
209. 7172700/1692800
S of Ljusträsket
Diorite in the Revsund granite
210. 7177900/1713500
SE of Storträsk
Even-grained granitic gneiss
211. 7176000/1729300
At Järvtjärn
Gray, coarse, porphyritic Revsund granite

212. 7181900/1756300
At Tallåsen N of Bureå
Granitic gneiss

213. 7165600/1536300
S of Kristineberg
Gray, coarse, porphyritic Revsund granite

214. 7164500/1547400
1 km E of the side road to Strömåker
Gray, even-grained Revsund granite

215. 7166900/1603700
1 km S of Fäbodliden
Gray, coarse, porphyritic, weathered Revsund granite

216. 7168000/1638300
E of Umeälven between the railway- and the roadbridge
Gray, coarse, porphyritic Revsund granite

217. 7163600/1635400
N of Granarp
Gray, coarse, porphyritic Revsund granite

218. 7164200/1647500
N of Stora Tjäderbergsjön
Dark gray, coarse, porphyritic Revsund granite

219. 7164500/1653500
1 km S of Avan station
Gray, coarse, porphyritic Revsund granite

220. 7169600/1659800
SW of Malträsket
Gray granitic gneiss

221. 7170800/1679100
S of Sävsjön
Gray, coarse-grained granitic gneiss with microcline porphyroblasts like those in coarse, porphyritic Revsund granite

222. 7171600/1700500
At the bridge over Sikån
Even-grained granitic gneiss

223. 7172500/1715400
S of Riskläppen
Gray, even-grained granite believed to be a rest of Jörn granite in the Revsund granite

224. 7173900/1738400
E of Tjärnberget
Even-grained biotite gneiss

225. 7171500/1744100
At Lidtorp
Fine-grained, gray, granitic gneiss

226. 7173900/1753300
2 km N of the side road in Holmvattnet
Gray, coarse-grained, biotite gneiss

227. 7175600/1763300
W of Bergfors
Gray, even-grained granitic gneiss

228. 7157800/1533600
At Stadsås
Gray even-grained Revsund granite

229. 7157400/1546400
0.5 km on the way to Lillkullen
Coarse-grained granitic gneiss with pyrrhotite

230. 7160200/1559600
At the bridge over Vojmån
Gray, coarse, porphyritic Revsund granite

231. 7159800/1590300
1 km W of Råberg
Gray, coarse, porphyritic Revsund granite

232. 7162300/1613200
N of Gaddträsk
Diorite in the Revsund granite

233. 7157900/1620300
At the parting of the ways in Graned
Gray, coarse, porphyritic Revsund granite

234. 7160500/1626800
S of the bridge over Vårträskbäcken
Gray, coarse, porphyritic Revsund granite

235. 7160200/1654100
At Ekorrsjö
Reddish, coarse, porphyritic Revsund granite

236. 7163200/1723800
E of Dalmyrberget
Gray, fine-grained biotite gneiss

237. 7164300/1732900
S of Burträsk
Fine-grained amphibolite with lots of small green hornblende grains in a fine-grained matrix of plagioclase. The amphibolite belongs to the phyllite series

238. 7155100/1545600
N of Meselberget
Gray, even-grained Revsund granite

239. 7154400/1553700
E of Lillgård
Gray even-grained biotite gneiss

240. 7154900/1561800
0.5 km S of Norråker
Basic granitic gneiss

241. 7153700/1572500
N of Sörliden
Coarse-grained granitic gneiss

242. 7151800/1612200
At Ledningsmark
Gray, coarse, porphyritic Revsund granite

243. 7153600/1629000
NW of Rödingträsk
Fine-grained graphitic phyllite with pyrrhotite

244. 7153400/1629000
NW of Rödingträsk, 200 m S of sample 243
Fine-grained amphibolite from the phyllite series

245. 7155500/1648300
At the electric works of Tuggsele
Gray, coarse, porphyritic Revsund granite
246. 7157600/1659900
SW of Brännberget
Gray, coarse, porphyritic Revsund granite
247. 7155700/1683900
N of Blåliden
Fine-grained amphibolite with ragged and weathered amphibols. The rock belongs to the gneiss series
248. 7159100/1698200
N of Lappsjön
Light, banded, granitic gneiss
249. 7158100/1708200
SE of Mörttjärn
Coarse-grained granitic gneiss
250. 7159800/1740900
S of Svarttjärn
Coarse-grained, banded, biotite gneiss
251. 7162500/1752700
1 km S of the chapel of Vallen
Fine-grained biotite-garnet gneiss with broken and indented garnets
252. 7165700/1761400
S of Daglösen
Coarse-grained weathered biotite gneiss
253. 7164300/1768500
S of Yttersjön
Coarse-grained biotite gneiss
254. 7165000/1777300
S of the lighthouse of Bjuröklubb
Coarse-grained granitic gneiss
255. 7145800/1548900
At Råsele
Fine-grained granitic gneiss
256. 7147100/1573900
At Näversjöberget
Gray, even-grained Revsund granite
257. 7148400/1579400
S of Rosendal
Gray, coarse, porphyritic Revsund granite
258. 7145200/1589100
N of Trehörningen
Partially recrystallized sandstone with fragments of biotite and band of newly formed feldspar and quartz
259. 7146900/1624000
NW of Hornmyr
Gray phyllite. Unmetamorphosed and without biotite
260. 7147600/1646100
At the E shore of Gäddträsket
Gray, coarse, porphyritic Revsund granite
261. 7150000/1654400
In the S slope of Stornabben
Coarse-grained biotite gneiss
262. 7151600/1665000
At Nedre Ekorrselet
Reddish, coarse, porphyritic Revsund granite
263. 7151400/1684500
E of Innersjö
Gray, even- and coarse-grained granitic gneiss
264. 7154700/1744000
N of Svenmarken
Coarse-grained biotite gneiss with ore grains bands
265. 7158600/1758300
2 km NW of Rissjön
Even-grained granitic gneiss with much microcline
266. 7160600/1774100
At the side road to Bjurön
Coarse-grained garnet-gneiss with much biotite and microcline and with small garnets
267. 7139200/1530000
S of Måntorp
Coarse-grained biotite gneiss with gray, fine-grained granite in veins
268. 7141200/1541800
At the mountain chalet of Granberget
Coarse-grained Revsund granite; at times finer-grained
269. 7139400/1556900
At Abborrviken
Gray, coarse, porphyritic Revsund granite
270. 7142400/1570400
N of Torvsjö
Gray even-grained Revsund granite
271. 7140100/1597800
NW of Mjölksjön
Gray, coarse, porphyritic Revsund granite
272. 7143500/1638600
2.5 km N of Öretorp
Fine-grained amphibolite in the phyllites with a lot of small hornblende grains
273. 7147700/1686400
At Maltjärn
Coarse-grained granitic gneiss. The feldspars are in bands
274. 7149500/1702500
S of Storsävarträsket on the boundary
Coarse-grained amphibolite in the gneiss series. There is considerable pale amphibole
275. 7148200/1710300
At Floda
Gray, even-grained granitic gneiss
276. 7145600/1714100
N of Myrträsk
Fine-grained garnet-gneiss with biotite and quartz

277. 7151300/1722100
S of Bjurfors
Fine-grained biotite gneiss
278. 7146800/1725900
W of Bygdsiljum
Fine-grained gneiss with scooped garnets. The gneiss has much quartz
279. 7149200/1747400
S of Kålaboda
Coarse-grained gneiss with lots of garnets
280. 7151100/1758600
At Hogtjärn
Coarse-grained biotite gneiss
281. 7133200/1534800
S of Saxvattnet
Coarse-grained biotite gneiss
282. 7135900/1561500
W of Almsele
Gray, coarse, porphyritic Revsund granite
283. 7134200/1582600
2 km N of Yxsjön
Light gray, coarse, porphyritic Revsund granite
284. 7138800/1591600
S of Gärdsjönäs
Banded and folded sandstone with newly formed biotite, quartz and feldspar and with some small garnets
285. 7136400/1592200
W of Siksjön
Almost completely recrystallized sandstone with biotite, quartz and feldspar. There are plenty of ore grains in the sandstone
286. 7137900/1593800
At Stensnäs
Gray, coarse, porphyritic Revsund granite
287. 7139800/1602500
NW of Lögdaberg
Light gray quartzite with uneven size of the quartz grains. The grains are moreover angular
288. 7139900/1610700
At Hemsta
Gray, fine-grained quartzite partly recrystallized
289. 7139800/1628200
N of Nybytjärn
Gray, coarse, porphyritic Revsund granite
290. 7140100/1684800
N of the sanatorium of Hällnäs
Coarse, grained biotite-gneiss with feldspar in veins
291. 7142000/1700100
S of Komsjön
Coarse-grained garnet gneiss
292. 7140600/1713700
At Lillåtjelen
Coarse-grained granitic gneiss
293. 7145600/1732600
At Slyberget
Coarse-grained gneiss with large indented garnets and much microcline
294. 7145200/1751700
At Estermark on the new road to Burträsk
Banded garnet-gneiss. The garnets are large and indented and there is coarse-grained microcline
295. 7147700/1762600
In Västerbyn at the side road to Noret
Coarse-grained gneiss with large cordierites
296. 7130800/1526300
At the fork to Bellvik
Dark gray, even-grained Revsund granite
297. 7127800/1531900
At Stenberget
Gray coarse-grained granitic gneiss
298. 7130800/1554100
N of Avasjö
Fine-grained granite of the Skellefte type
299. 7133800/1594500
E of Skillingsåsen
Phyllite with large and small angular quartz grains. The phyllite is weakly metamorphosed and has no biotite
300. 7131500/1595700
NW of Stora Vallvattnet
Fine-grained phyllitic quartzite with angular quartz grains in a clay matrix. The quartzite is mostly recrystallized and has newly formed biotite and quartz
301. 7134900/1614700
N of Nordanås
Light gray, fine-grained granite of the Skellefte type
302. 7130900/1611500
S of Grundsjön
Gray, coarse, porphyritic Revsund granite
303. 7133000/1634700
E of Vajbäcken
Light gray, coarse, porphyritic Revsund granite
304. 7134400/1667300
NW of Öberget
Fine-grained mica-gneiss
305. 7136800/1694100
At the tarn 3 km N of Näverliden
Even-grained biotite gneiss
306. 7134500/1698100
S of the village of Buberget
Even-grained granitic gneiss
307. 7134600/1709500
At Kvarnsjön
Dark garnet-gneiss with stripes and much biotite

308. 7136200/1720400
W of Gravåbäcken
Coarse-grained slippery garnet-gneiss

309. 7138900/1727800
At Strandholm
Dark, coarse-grained garnet gneiss with much biotite

310. 7139800/1735900
At Brattliden
Banded coarse-grained gneiss with large but broken or idented garnets. The gneiss has much biotite and microcline

311. 7138800/1754200
S of Ånäset
Coarse-grained biotite-gneiss with small garnets

312. 7125600/1524600
At the fork to Fågelsta
Gray, even-grained Revsund granite

313. 7122500/1548400
SE of Skedsjön
Gray, coarse, porphyritic Revsund granite

314. 7122200/1561000
N of Visjön
Gray, coarse, porphyritic Revsund granite

315. 7125200/1597600
S of Tallberg
Gray, coarse, porphyritic Revsund granite

316. 7126200/1618900
2 km S of the fork to Norrfors
Reddish, coarse, porphyritic Revsund granite

317. 7129300/1644200
S of Blekmyren
Coarse-grained, veined biotite-gneiss

318. 7125500/1647100
W of Skarda
Gray, coarse, porphyritic Revsund granite

319. 7127800/1679800
0.5 km W of the fork to Kullfors
Coarse-grained biotite-gneiss with sericitized feldspar

320. 7129300/1686700
The S slope of Buberget
Weakly banded biotite-gneiss

321. 7128300/1702300
S of Kvarnlund
Coarse-grained gneiss with large phenocrysts of microcline like those of the Revsund granite

322. 7130600/1715800
S of Yttermark
Coarse-grained biotite gneiss with sericitized feldspar in veins

323. 7134100/1726700
At Ryssjön
Fine-grained garnet gneiss

324. 7131100/1736300
E of the W lake at Ytterklinten
Coarse-grained gneiss with broken garnets and much microcline. Alteration from cordierite can be seen in spots

325. 7133300/1753000
N of Klintsjön
Coarse-grained and weathered biotite gneiss with altered cordierites

326. 7118700/1541100
W of Svanabyn
Even-grained granitic gneiss

327. 7117300/1547600
2 km N of Björnberget
Gray, coarse, porphyritic Revsund granite

328. 7121200/1554800
At Lomsjö
Gray, coarse, porphyritic Revsund granite

329. 7121600/1566200
S of Fäbodsjön
Gray even-grained Revsund granite

330. 7118400/1575900
At Åsele at the church
Almost completely recrystallized phyllitic sandstone with newly formed biotite, quartz and feldspar. The sandstone has grains of graphite. These graphite grains may have been formed during the metamorphism from the ordinary very fine-grained impregnation of graphite in the lowmetamorphosed graphite phyllites

331. 7120200/1596700
E of Gigsele
Gray, coarse, porphyritic Revsund granite

332. 7117900/1601100
1.5 km E of the bridge over the Gideälv
Almost recrystallized phyllitic sandstone with newly formed biotite, quartz and feldspar

333. 7121600/1608300
W of Rensjöberget
Gray, coarse, porphyritic Revsund granite

334. 7120400/1627800
At Eaksjöliden
Gray, coarse, porphyritic Revsund granite

335. 7124700/1651400
At Hästliden
Fine-grained sandstone, almost recrystallized, with biotite, microcline plagioclase and quartz

336. 7123300/1657200
SW of Mörtsjön
Gray, coarse, porphyritic Revsund granite with some lineation

337. 7123000/1666200
2 km W of Åtmyrsjön
Fine-grained weakly banded biotite gneiss

338. 7125700/1675300
S of Ottonträsk
Quartz-rich fine-grained biotite-gneiss

339. 7123400/1687400
At Degerön
Gray, even-grained granitic-gneiss

340. 7125300/1712800
At Katasjön
Fine-grained gneiss with garnets

341. 7124900/1721900
E of Krokbäck
Coarse-grained veined biotite-gneiss

342. 7128100/1729800
At Häggnäs
Coarse-grained biotite-gneiss with broken garnets

343. 7127100/1749700
Between Sikeå and the harbour of Sikeå
Coarse-grained granitic gneiss with much microcline

344. 7112500/1556100
At Forsnäset
Gray, coarse, porphyritic Revsund granite

345. 7116000/1571100
2 km SW of Söråsel
Fine-grained folded biotite-gneiss with microcline

346. 7114000/1584400
2 km E of Bladtjärn
Gray, coarse, porphyritic Revsund granite

347. 7116700/1587800
W of Storsjön
Gray, coarse, porphyritic Revsund granite

348. 7116900/1603400
1 km W of the parish border at Skållbo
Even-grained phyllitic sandstone which is largely recrystallized with biotite, quartz and feldspar

349. 7117800/1655100
At Orträsk
Gray, coarse, porphyritic Revsund granite with single garnets

350. 7121800/1701200
In the north part of the Överrödå village
Coarse-grained gneiss with indented and broken garnets and lots of altered cordierite

351. 7119100/1730400
At Risträsk
Fine-grained biotite-gneiss with phenocrysts of microcline

352. 7123700/1732400
S of Västra Sjulsmark
Coarse-grained biotite-gneiss

353. 7122900/1747300
W of Rickleå
Coarse-grained granitic gneiss

354. 7110500/1539900
W of Svanaby
Gray, coarse, porphyritic Revsund granite

355. 7105600/1544800
S of Skalberget
Gray, coarse, porphyritic Revsund granite

356. 7110800/1567100
S of Sörnoret
Gray, coarse, porphyritic Revsund granite

357. 7109400/1574100
S of Östernoret
Gray, coarse, porphyritic Revsund granite

358. 7106900/1589900
At the fork to Svedjan
Gray, coarse, porphyritic Revsund granite

359. 7110500/1596000
W of Oxvattnet
Gray, coarse, porphyritic Revsund granite

360. 7110500/1621800
W of Lavsjön
Gray, phyllite with much newly formed biotite

361. 7112400/1628900
W of Lövlidentjärn
Fine-grained biotite gneiss

362. 7113500/1672700
S of Sunnansjö
Fine-grained granitic gneiss

363. 7115600/1689300
E of Tvärålund
Fine-grained gneiss with garnets

364. 7114300/1701600
W of Västerselet
Coarse-grained folded biotite-gneiss

365. 7114200/1708500
1 km E of Varmvattnet
Fine-grained granitic gneiss with quartz and feldspar in veins

366. 7114200/1715100
S of the tarn NW of Täfteträsket
Gray, coarse, even-grained granitic gneiss

367. 7117800/1747000
At Öndebyn
Coarse, even-grained granitic gneiss

368. 7102600/1556100
1 km NE of Tjutsjön
Gray, coarse, porphyritic Revsund granite

369. 7102900/1630200
N of the Lappland border at Godåker
Coarse-grained veined biotite gneiss

370. 7107100/1635500
At Lögdåsund
Gray, coarse, porphyritic Revsund granite

371. 7107200/1662000
At the E end of Ström village
Fine-grained and finely banded biotite gneiss

372. 7104800/1673200
S of Bastuträsk
Fine-grained and finely banded biotite gneiss

373. 7105800/1685200
N of Fällfors
Fine-grained garnet gneiss

374. 7109400/1694200
S of Tallberg
Slaty fine-grained biotite-gneiss

375. 7107600/1709200
At the fork to Långviken
Fine-grained biotite-gneiss with coarse-grained quartz and feldspar in veins

376. 7109600/1727400
N of Norrbyn
Banded biotite-gneiss

377. 7112900/1746500
At Dalkarlså
Coarse-grained granitic gneiss

378. 7098600/1552700
At the E slope of Skalberget
Gray, coarse, porphyritic Revsund granite

379. 7097100/1573300
2 km E of Holmstrand
Reddish, coarse, porphyritic Revsund granite

380. 7099800/1588200
2 km NE of Långvattnet
Gray, coarse, porphyritic Revsund granite

381. 7099700/1604300
N of Häggsjön
Gray, coarse, porphyritic Revsund granite

382. 7097900/1650300
At the fork to Nyland
Fine-grained amphibolite interbedded in the gneiss series. There are mostly small green amphiboles and much of quartz in veins and in spots

383. 7101500/1692900
N of Stensnäs
Coarse-grained granitic gneiss

384. 7103600/1706900
N of Sunnantorp
Fine-grained granitic gneiss

385. 7104000/1722200
S of Storliden
Even-grained granitic gneiss

386. 7102900/1736400
At Degerbacken
Coarse-grained granitic gneiss

387. 7108000/1742600
W of Djäkneboda
Gray granitic gneiss with single large phenocrysts of microcline like those in the coarse porphyritic Revsund granite.

388. 7093600/1597700
N of Lakasjö
Reddish, coarse, porphyritic Revsund granite

389. 7095300/1603400
1 km N of Tegelträsket
Gray, coarse, porphyritic Revsund granite with some lineation

390. 7091500/1638100
S of Holmsjön between the two small lakes
Almost wholly recrystallized phyllitic sandstone with quartz, biotite, microcline and plagioclase

391. 7095900/1661300
2 km N of the fork to Västermyrliden
Fine-grained graphitic phyllite with quartz and feldspar in veins

392. 7096500/1671500
200 m E of the tarn at Johanneslund
Coarse-grained, veined and folded biotite-gneiss

393. 7098700/1681900
1 km W of Holmsjön
Coarse-grained biotite-gneiss with lots of small garnets and idiomorph microcline

394. 7096400/1616500
S of Hökmark
Coarse-grained biotite-gneiss with large microcline phenocrysts like those in Revsund granite

395. 7101800/1744300
N of Brednoret
Fine-grained and finely banded granitic gneiss

396. 7089500/1633400
At the fork NW of Bredträsk
Gray even-grained Revsund granite

397. 7087400/1656000
2 km S of Bjurvattnet
Gray, coarse, porphyritic Revsund granite

398. 7090500/1660200
In the curve of the road NW of Valtjärn
Red, very coarse, porphyritic Revsund granite

399. 7090400/1683900
At Österlid
Coarse-grained garnet-gneiss with quartz in narrow veins

400. 7093100/1691600
N of Västerås
Coarse-grained biotite-gneiss

401. 7093900/1707800
N of Norrfors
Coarse-grained, veined biotite-gneiss

402. 7096000/1732600
S of Sävar
Coarse-grained, veined biotite-gneiss with garnets
403. 7081000/1652400
E of Mjösjön
Coarse-grained biotite-gneiss with quartz and feldspar in veins
404. 7086400/1670500
At Aggnäs
Coarse-grained even granite-gneiss with much biotite
405. 7087600/1705700
S of Myrträsk
Coarse-grained, veined biotite-gneiss
406. 7084800/1715100
2 km W of Rödbäck
Coarse-grained granite-gneiss
407. 7090600/1724500
SW of Arnumark
Coarse-grained and veined granite-gneiss
408. 7089800/1736600
1 km SE of Ytterboda
Even-grained granitic gneiss
409. 7080600/1659000
E of Orrtjärn
Fine-grained biotite-gneiss with quartz and feldspar in small veins
410. 7079100/1661300
1 km W of Grönnas
Fine-grained biotite-gneiss
411. 7075900/1673600
S of Nyåkersjön
Coarse-grained granitic gneiss with idiomorph microcline. In the quartz grains there are inclusions which resemble folded slate
412. 7078900/1678400
At the railway bridge at Högbrännan
Even-grained granitic gneiss
413. 7081300/1684900
At the brook E of Hornsjö
Gray, even-grained Revsund granite
414. 7081500/1698500
W of Hosjö
Fine-grained granitic gneiss with remains of altered cordierite
415. 7080900/1708800
In the brook at the fork of Bjensjö
Even-grained biotite-gneiss with remains of altered cordierite and microcline
416. 7082600/1726000
At Yttertavle
Coarse-grained biotite-gneiss
417. 7070300/1662300
1 km NW of Genberg
Even-grained biotite-gneiss with quartz and feldspar in veins
418. 7073300/1685800
W of Torrböle
Coarse-grained granitic gneiss
419. 7071700/1694100
2 km E of Mullsjö
Coarse-grained granitic gneiss
420. 7075600/1707500
S of Högskuru
Coarse-grained gneiss with garnets and aplite in veins
421. 7076800/1716300
S of Stöcksjö
Coarse-grained granitic gneiss
422. 7074700/1726000
At Holmsund
Coarse-grained, veined biotite-gneiss
423. 7067900/1668600
At Storfall
Gray, coarse, porphyritic Revsund granite
424. 7068800/1676800
At Östanå
Coarse-grained gneiss with large but broken garnets and well crystallized microclines
425. 7067700/1705500
3.5 km S of Sörmjöle
Even-grained biotite-gneiss
426. 7070100/1714100
At the fork at Husberget
Coarse-grained gneiss with much biotite and large garnets. In the gneiss there are remains of altered cordierite
427. 7062500/1673000
1 km SE of the fork to Toböle
Coarse-grained and veined granitic gneiss with much biotite
428. 7064000/1688500
S of Brattfors
Fine-grained and finely banded biotite-gneiss
429. 7062400/1699200
S of Ängesjön
Even-grained, banded biotite-gneiss
430. 7056400/1679900
S of the airport of Olofsfors
Gray, coarse, porphyritic Revsund granite
431. 7059100/1689900
At Tjälen
Coarse-grained biotite-gneiss with large and well crystallized microcline
432. 7051300/1677000
At Aspån 3 km S of the bridge over Lögdeälv
Gray, coarse, porphyritic and gneissose Revsund granite
433. 7047600/1683500
In the bay W of Storänget
Gray, coarse, porphyritic gneissose Revsund granite
434. 7047700/1689500
Between the crofts W of Kvickudden
Inhomogeneous and veined biotite-gneiss

The following are old analyses made according to ordinary chemical methods. Most of the analyses are not published before and are made on samples taken by Dr. E. Grip and Professor O. Ödman.

435. 7197900/1729900
350 m SW of the SW bay in Varuträsket
Gray phyllite

436. 7203200/1717800
1,700 m SE of the Boliden Ore
Hard and dark phyllite with amphibole

437. 7203500/1717500
1,200 m SE of the Boliden ore
Gray phyllite

438. 7203600/1717600
1,300 m SE of the Boliden ore
Hard, dark phyllite

439. 7202900/1716600
1,370 m S of the Boliden ore
Fine-grained graphitic phyllite

440. 7202600/1716600
1,620 m SE of the Boliden ore
Gray, phyllitic quartzite

441. 7203300/1717700
1,500 m SE of the Boliden ore
Fine-grained graphitic phyllite

442. 7203100/1717900
1,800 m SE of the Boliden ore
Banded fine-grained graphitic phyllite

443. 7217300/1682900
Drillcore number 4 at Rutseleheden, 23.7–32.9 m
Fine-grained graphitic phyllite

444. 7202500/1717800
2,100 m SE of the Boliden ore
Dark and graphitic phyllite

445. 7203000/1714700
Drillcore number 46, 2,300 m SW of the Boliden ore, 29–39 m
Dark graphitic phyllite

446. 7203000/1714700
Drillcore number 46, 2,300 m SW of the Boliden ore, 70–73 m
Gray phyllitic quartzite

447. 7195400/1717800
At Forsberget 2 km E of Finnforsfallet
Dark and stiff quartzite

448. 7148700/1729900
750 m NW of Åliden
Phyllite with amphibole

449. 7241100/1647200
In the Lainejaure mine
Gray phyllite

Volcanics

500. 7219915/1678180
Rörmyrberget
Gray, fine-grained dacite with hornblende phenocrysts and some pyrite

501. 7219100/1678130
Kotjärn
Gray keratophyre

502. 7219275/1678550
Kotjärn
Gray quartz-keratophyre

503. 7219150/1678500
Kotjärn
Deformed, gray keratophyre with sericits alteration

504. 7217820/1677355
Storstenmyren
Dark-gray, fine-grained keratophyre with lots of feldspar phenocrysts up to some mm in size

505. 7216670/1677300
Spikstarrmyren
Even-grained dark-green andesite

506. 7215250/1680970
Bjurberget
Finely banded felsite with sericite alteration

507. 7215310/1689790
Storhällan at Svansele
Dark gray keratophyre

508. 7215260/1689825
Storhällan at Svansele
Light gray lineated keratophyre

509. 7215650/1690750
Svansele
Light gray green quartz-keratophyre

510. 7215500/1691450
Svansele
Schists of gray keratophyre with sericite and chlorite

511. 7214245/1694750
Rålund
Even-grained light gray lamprophyre

512. 7212710/1692890
Kedträskbron
Quartz-keratophyre with an almost compact groundmass and quartz phenocrysts up to 10 mm in size

513. 7219335/1690670
Tallbergstjärnberget
Schistose fine-grained andesite

514. 7219260/1690920
Tallbergstjärnberget
Gray compact dacite

515. 7216190/1691300
Kopladumyrberget
Gray, coarse-grained quartz-keratophyre

516. 7221080/1683650
S of the Petiknäs road
Gray keratophyre with sericitization

517. 7221100/1684795
Björkmyren
Fine-grained andesite

518. 7221280/1685710
Stormyren
Keratophyre
519. 7221300/1687340
Mossatjärn
Keratophyre
520. 7220190/1686870
Björktjärn
Andesite with hornblende phenocrysts
521. 7220220/1686050
Björktjärn
Andesite
522. 7220355/1684560
Bjurtjärnbäcken
Andesite
523. 7221580/1683690
Petikträsk
Dark gray dacite with brown dots
524. 7221745/1681230
Bjurtjärn
Light gray felsite
525. 7222590/1684670
Petikträsk
Dark gray, fine-grained dacite
526. 7219050/1683230
Vargforsen
Gray, even-grained andesite
527. 7218430/1685900
Svansele
Gray agglomeratic keratophyre with feldspar phenocrysts larger than 10 mm in size
528. 7217895/1685970
Svansele
Fine-grained andesite
529. 7229400/1671900
Gallejaure
Dark, fine-grained andesite with hornblende phenocrysts
530. 7225540/1678620
Skogheden
Gray massive andesite
531. 7225590/1678470
Skogheden
Gray, fine-grained andesite
532. 7224715/1681500
Skogtjärnheden
Green gray, grained andesite
533. 7224090/1684020
Petikträsk
Compact andesite with some pyrite
534. 7224470/1690915
Björkliden
Reddish even-grained keratophyre
535. 7224470/1690915
Björkliden
Even-grained andesite
536. 7218350/1701700
Hornträsket
Even-grained andesite
537. 7217540/1703285
Hornträsket
Gray felsite with reddish lustre
538. 7216700/1702530
Hornträsket
Fractured, gray quartz-keratophyre
539. 7216640/1702010
Hornträsket
Gray, even-grained andesite
540. 7212840/1696810
Kladdberget
Light gray, coarse-grained quartz-keratophyre
541. 7210370/1697250
Kusfors
Dark gray, fine-grained lamprophyre
542. 7207370/1695760
Braxträsk
Coarse-grained radiated andesite with some pyrite
543. 7204500/1695010
W of Holmträsk
Gray, coarse-grained gneissy keratophyre
544. 7211890/1693930
Gumboda
Felsite with some schistosity
545. 7213320/1685520
E of Bjurträsk
Gray keratophyre with lots of feldspar phenocrysts
546. 7213440/1685970
Maletjärn E of Bjurträsket
Finely banded felsite
547. 7211230/1699770
Petiknäs
Dark, compact quartz-keratophyre with lots of quartz and feldspar phenocrysts
548. 7248500/1653500
1 km downstream from the Mörttjärn bridge
Dark, coarse-grained andesite
549. 7247350/1652650
The N slope of Sappovaare
Agglomeratic andesite
550. 7246000/1651100
At the Mörttjärn village
Keratophyre with lots of feldspar phenocrysts
551. 7235700/1658400
Tallberget
Quartz-keratophyre with lots of feldspar phenocrysts and not so many quartz phenocrysts
552. 7241050/1661300
Sandfors near the discharge canal
Homogeneous gray-green dacite
553. 7241000/1660950
Sandfors at the mirror-dam
Massive, gray-green dacite
554. 7244900/1658700
1 km downstream from Grytforsen
Dark gray dacite
555. 7225500/1657350
SE of the Näsliden mine
Coarse-grained amphibolite

556. 7226650/1656910
Näsliden
Coarse-grained andesite with sericite and chlorite alteration

557. 7226940/1657950
Näsliden
Quartz-porphyry rich in phenocrysts

558. 7230390/1655170
Rakkejaure
Light gray felsite with lineation

559. 7230230/1657470
Rakkejaure
Sericite-altered gray quartz-porphyry rich in phenocrysts

560. 7228000/1660880
Rakkejaure
Compact andesite

561. 7230350/1658800
Rakkejaure
Dark green dacite

562. 7230330/1658450
Rakkejaure
Coarse-grained gabbro

563. 7230310/1666730
Maursele, at the road
Fine-grained andesite

564. 7223860/1656090
E of the Storfors cottage
Coarse-grained gabbro

565. 7226240/1661750
Finnberget
Dark gray, coarse-grained keratophyre

566. 7224100/1662000
Finnberget
Gray quartz-keratophyre

567. 7225255/1663220
Finnberget, at the top
Gray quartz-keratophyre

568. 7237600/1645370
Storliden at Skäppträsk
Dark gray felsite

569. 7237800/1645300
Skäppträsk
Dark, fine-grained andesite

570. 7237350/1645010
Skäppträsk
Even-grained quartz-keratophyre

571. 7236900/1644800
Skäppträsk
Light gray felsite

572. 7236600/1644400
Skäppträsk
Sericite-altered keratophyre

573. 7232600/1649600
Kronoborg
Sericitized schistose keratophyre

574. 7232600/1649600
Kronoborg
Schistose andesite

575. 7232600/1649600
Kronoborg
Schistose and sericite-altered felsite

576. 7232600/1649600
Kronoborg
Sericite-altered keratophyre

577. 7232600/1649600
Kronoborg
Sericite- and chlorite-altered coarse-grained andesite

578. 7234350/1659360
Storbäcken
Fine-grained keratophyre

579. 7235700/1658900
Storbäcken
Keratophyre with lots of feldspar phenocrysts

580. 7232950/1657990
N of Rakkejaureheden
Light gray homogeneous dacite

581. 7221700/1667880
Mensträskbäcken
Light gray dacite

582. 7221550/1667850
Mensträskbäcken
Banded felsite

583. 7220790/1667630
Mensträskbäcken
Limey calcareous sandstone

584. 7220170/1672250
Önnsträskberget
Quartz-porphyry with agglomerate structure

585. 7223720/1671720
Mensträsk
Gray felsite with sericite

586. 7227500/1672000
Treholmfors S of the river
Keratophyre with sericite alteration

587. 7227500/1664600
Isträsk
Compact andesite with some pyrite

588. 7233675/1657500
N of Rakkejaureheden
Light gray felsite

589. 7209500/1701960
Renström
Chlorite-altered andesite

590. 7208700/1702230
Renström
Felsite

591. 7210180/1702300
Renström
Schistose keratophyre rich in feldspar phenocrysts and sericite-altered

592. 7211350/1702150
Renström
Felsite with agglomerate structure

593. 7207800/1704050
Renström
Fine-grained lamprophyre

594. 7208840/1704950
Renström
Gray, coarse-grained keratophyre

595. 7217910/1705410
Jörnsmarken
Gray, compact granophyre

596. 7217800/1706400
Jörnsmarken
Schistose andesite

597. 7216940/1708530
Jönsmarken
Fine-grained andesite with feldspar phenocrysts

598. 7216840/1709600
Bergnäs
Keratophyre with sericitization and schistosity

599. 7215470/1708970
Bergnäs
Gray quartz-porphyry

600. 7214730/1709830
Bergnäs
Gray quartz-porphyry with lots of phenocrysts

601. 7213600/1710250
Bergnäs
Fine-grained lamprophyre

602. 7210920/1700230
Petikån
Schistose and sericitic felsite

603. 7195960/1712700
Loberg
Keratophyre with feldspar phenocrysts up to 10 mm

604. 7191500/1712300
Norsjötjärnarna
Keratophyre

605. 7191500/1712250
Norsjötjärnarna
Keratophyre

606. 7195530/1706900
Karsträsk
Fine-grained massive dacite

607. 7217200/1651000
Åmliden
Dark gray, fine-grained keratophyre

608. 7216060/1711800
Fjällboda
Compact, light gray dacite

609. 7216070/1713150
Fjällboda
Gray, schistose keratophyre with sericite and chlorite alteration

610. 7222000/1712600
Dalliden
Gray keratophyre with some small fragments another rock

611. 7220700/1626150
Rävliden
Gray, coarse-grained quartz-keratophyre

612. 7221800/1629700
Kristineberg
Light gray, sericitic granophyre with some ore grains

613. 7222500/1625600
Hornsträsket
Light gray quartz-keratophyre with large feldspar-phenocrysts and small quarts grains

614. 7224600/1623600
Ullesdal
Dark gray schists of keratophyre with sericite and chlorite alteration

615. 7223400/1627300
Hornsträsket
Gray, sericitic keratophyre with single, large feldspar phenocrysts

616. 7223400/1627300
Hornsträsket
Gray schists of keratophyre with sericite alteration

617. 7221300/1630700
Kristineberg
Gray-green homogeneous dacite

618. 7225100/1631500
Kristineberg
Light gray, gneissy keratophyre mapped as gneiss-granite

619. 7221000/1628900
Kristineberg
Fine-grained, dark gray dacite

620. 7206800/1713900
Talliden
Felsitic quart-keratophyre

621. 7206700/1713900
Talliden
Quartz-keratophyre rich in phenocrysts

622. 7211300/1699800
Petiknäs
Gray recent quartz-keratophyre with phenocrysts of albite and quartz up to 3 mm in size

623. 7215600/1685100
200 m NV of the Bjurträsk ore
Quartz-keratophyre conglomerate with light fragments in an albite groundmass. SGU, Ser. C 424.

624. 7221900/1676400
E of Maurliden
Quartz-keratophyre with large phenocrysts of quartz and albite. SGU, Ser. C 424

625. 7215400/1686100
E of the Bjurträsk ore
Quartz-porphyry with large phenocrysts of quartz and albite. SGU, Ser. C 424

626. 7203700/1713600
Gillervattnet
Dacite

627. 7203700/1713600
Gillervattnet
Dacite

628. 7204000/1709400
Skärudden
Dacite with phenocrysts of plagioclase

629. 7215100/1685200
S of the Bjurträsk ore
Agglomeratic amphibolite. SGU, Ser. C 424

630. 7215400/1684500
W of the Bjurträsk ore
Andesite with large phenocrysts of oligoclase. SGU, Ser. C 424

631. 7205500/1717500
Strömfors
Tuff-agglomerate with fragments of quartz phorphyry. SGU. Ser. C 424

632. 7212400/1725400
Kvarnforsliden
Andesite

633. 7221800/1675200
Maurliden
Quartz-keratophyre with phenocrysts of albite. The rock is altered. SGU, Ser. C 424

634. 7223700/1684800
Petikträsk
Keratophyre

635. 7222200/1625700
Hornsträsket
Quartz phorphyry with albite phenocrysts in sericitic ground mass

Appendix II. Analyses in weight %

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
1	75.5	0.20	12.7	0.6	1.5	0.04	0.20	0.90	2.7	5.0	0.4
2	58.7	0.68	18.2	1.1	5.8	0.07	3.0	1.35	2.4	3.5	3.9
3	77.5	0.17	11.9	0.1	1.8	0.02	0.25	1.10	2.6	4.0	0.5
4	65.9	0.56	9.9	2.0	3.5	0.14	4.3	3.85	1.9	1.3	3.4
5	67.7	0.70	13.5	0.1	4.8	0.07	2.50	1.50	2.4	2.6	3.5
6	70.7	0.44	13.4	0.2	3.5	0.04	0.45	1.70	2.5	4.1	0.3
7	66.6	0.68	14.3	< 0.1	5.1	0.08	0.80	2.55	2.9	4.8	0.5
8	71.0	0.36	14.6	0.6	2.1	0.04	0.93	1.90	3.7	3.9	0.5
9	73.1	0.41	12.6	0.7	2.6	0.04	0.39	1.35	2.9	4.8	0.5
10	68.5	0.48	15.1	0.1	3.6	0.07	0.60	1.90	3.9	4.7	0.6
11	50.2	3.1	13.2	0.7	12.9	0.26	4.5	9.2	4.3	0.6	0.9
12	67.4	0.52	14.1	0.2	4.3	0.07	0.55	2.15	2.8	4.5	0.5
13	69.5	0.60	14.6	< 0.1	4.4	0.06	0.48	2.05	2.9	5.2	0.3
14	65.2	0.88	14.7	1.4	5.0	0.09	0.78	2.80	2.9	4.7	0.3
15	68.9	0.61	13.2	0.7	4.1	0.08	0.56	2.10	2.9	4.4	0.4
16	73.0	0.32	13.1	0.4	2.2	0.03	0.75	0.40	2.1	3.8	1.0
17	68.7	0.49	14.7	0.3	3.2	0.06	1.00	1.45	3.0	4.9	1.2
18	59.2	0.63	15.5	0.7	6.8	0.07	2.80	1.50	4.5	3.3	3.7
19	74.2	0.28	12.3	0.5	2.1	0.04	0.17	1.00	5.0	3.6	0.3
20	60.5	0.70	16.1	0.1	7.1	0.12	2.65	3.60	3.1	2.5	1.4
21	72.5	0.24	13.2	0.1	1.9	0.04	0.45	1.10	3.2	5.1	0.6
22	69.9	0.53	13.2	0.3	3.6	0.02	1.70	1.10	2.7	2.3	1.2
23	56.8	0.76	18.5	1.3	7.4	0.08	4.3	1.15	2.1	4.3	1.7
24	64.3	0.71	15.5	0.7	5.5	0.07	2.35	1.15	4.0	1.5	2.2
25	57.2	0.68	17.3	0.9	7.5	0.04	4.2	1.65	2.1	3.5	2.8
26	78.0	0.36	6.6	< 0.1	3.5	0.09	1.80	5.0	2.5	1.0	1.2
27	62.9	0.88	15.5	0.7	6.3	0.11	3.1	3.00	3.2	2.3	0.7
28	54.3	0.79	19.1	0.9	8.1	0.09	4.3	1.30	2.5	5.0	2.5
29	71.0	0.60	13.8	0.3	3.9	0.07	1.85	1.70	3.0	2.4	1.0
30	62.2	0.70	15.4	0.4	4.0	0.07	2.95	4.1	4.3	2.5	0.8
31	73.0	0.28	13.2	0.6	1.9	0.04	0.55	1.15	2.8	5.0	0.7
32	70.7	0.59	12.8	0.3	4.6	0.09	2.25	2.80	2.0	2.2	0.8
33	59.7	0.80	16.2	1.1	7.7	0.05	4.4	0.70	1.4	3.0	2.3
34	66.7	0.42	13.6	0.7	6.2	0.14	1.80	1.00	4.7	1.1	2.1
35	49.0	0.40	11.6	4.9	11.7	0.16	1.70	3.30	0.7	2.6	8.1
36	64.7	0.45	13.5	0.3	5.1	0.10	2.30	2.70	0.5	3.3	3.7
37	60.5	0.72	15.9	0.6	6.8	0.07	4.0	2.80	2.5	2.8	1.4
38	76.0	0.09	13.2	0.1	0.9	0.02	0.27	0.70	2.8	4.2	0.5
39	75.5	0.10	12.9	< 0.1	1.0	0.02	0.25	0.65	2.5	6.0	0.4
40	73.2	0.27	15.8	0.1	1.7	0.02	0.63	1.75	3.2	3.8	0.5
41	71.7	0.25	14.3	0.6	1.5	0.05	0.52	1.05	3.6	3.3	0.8
42	68.5	0.45	14.5	0.3	2.8	0.05	1.35	2.05	4.6	2.4	0.6
43	66.9	0.67	13.5	0.3	5.4	0.05	2.50	1.50	1.9	3.7	1.0
44	59.5	1.1	14.4	0.8	5.1	0.10	4.1	5.4	5.8	2.3	1.9
45	64.4	0.56	14.7	2.7	2.7	0.06	3.6	2.50	2.9	3.1	0.8
46	62.8	0.80	16.7	2.3	4.8	0.09	3.7	1.70	1.6	2.5	1.7
47	62.7	0.74	15.6	1.3	5.7	0.06	3.8	1.40	4.6	2.0	1.5
48	58.8	0.92	16.9	1.7	6.4	0.08	4.1	1.00	2.4	3.8	2.7
49	58.8	0.74	17.1	2.9	5.1	0.04	3.3	0.75	2.3	3.8	3.5
50	60.7	0.70	17.3	0.4	4.3	0.08	2.25	5.2	5.0	1.8	0.6
51	54.6	0.72	16.1	3.7	2.3	0.13	2.85	4.2	3.0	1.8	10.8
52	63.7	0.81	16.0	0.4	5.7	0.07	2.70	1.60	2.3	3.5	1.4
53	68.4	0.70	14.5	0.7	4.5	0.06	2.45	1.95	2.7	2.7	1.3
54	60.3	0.72	17.0	0.6	5.4	0.02	2.80	2.05	1.9	2.1	4.5
55	50.8	0.47	17.4	1.5	6.3	0.14	7.0	10.4	3.5	1.1	1.9
56	64.3	0.63	14.8	0.9	5.4	0.07	3.0	1.70	2.7	3.0	1.2
57	53.5	0.80	17.8	0.9	6.2	0.14	2.25	14.1	2.4	0.6	0.4

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
58	66.8	0.70	14.3	0.7	4.9	0.08	2.70	3.35	2.7	2.1	0.9
59	59.9	0.80	15.9	2.6	4.9	0.07	3.8	1.70	2.3	2.9	3.8
60	57.7	0.50	13.7	<0.1	12.5	0.13	1.45	1.80	2.0	3.0	4.9
61	59.1	0.50	14.8	0.1	8.4	0.07	2.75	2.10	1.9	3.7	3.6
62	57.5	0.35	11.8	2.3	10.7	0.13	1.65	2.60	2.7	2.5	4.9
63	51.0	0.63	15.5	<0.1	10.1	0.28	5.5	7.2	1.5	2.4	5.0
64	64.4	0.68	14.8	0.9	5.3	0.20	3.00	1.30	3.9	3.5	1.1
65	58.8	0.77	15.5	0.3	6.8	0.05	4.0	1.95	2.7	3.1	3.6
66	66.6	0.78	12.5	1.0	5.7	0.07	3.2	1.40	3.0	2.0	1.3
67	57.0	0.88	16.6	0.4	8.1	0.12	3.4	4.2	2.9	1.8	3.7
68	59.4	1.1	16.1	2.6	5.8	0.13	3.7	4.2	2.8	1.3	2.5
69	64.4	0.37	13.4	1.0	6.0	0.11	3.7	2.30	2.3	2.3	0.6
70	49.7	1.75	13.8	0.9	12.4	0.21	5.8	10.6	2.6	0.5	0.8
71	57.8	0.66	15.8	1.0	6.2	0.10	2.85	1.60	2.4	3.6	5.7
72	61.1	0.80	15.9	0.9	6.8	0.08	3.7	1.05	1.5	3.0	3.3
73	49.5	1.7	19.6	3.9	7.4	0.15	5.1	8.1	3.9	0.3	0.7
74	65.6	0.52	13.8	0.7	4.9	0.12	2.15	2.60	3.2	3.0	1.3
75	72.5	0.47	13.3	0.3	3.1	0.06	0.55	1.60	2.7	4.7	0.5
76	74.3	0.60	10.7	<0.1	4.4	0.11	1.80	3.50	1.0	1.3	1.2
77	54.6	1.0	18.1	0.7	8.2	0.06	3.8	1.95	3.5	2.8	3.0
78	70.3	0.26	13.3	0.6	3.0	0.07	1.60	1.35	4.0	3.0	0.6
79	63.0	0.33	13.3	0.1	8.0	0.13	1.85	2.75	1.3	2.5	3.2
80	55.7	0.77	13.6	1.7	8.6	0.15	3.2	2.30	2.0	2.7	5.4
81	71.5	0.65	13.6	0.7	4.0	0.07	2.00	1.75	3.1	2.2	0.5
82	62.7	0.80	15.4	1.0	5.8	0.09	3.2	1.40	2.5	3.3	1.3
83	59.8	0.68	15.2	1.1	5.8	0.07	4.1	2.35	3.2	3.3	0.8
84	73.4	0.15	14.4	<0.1	1.3	0.02	0.50	1.40	2.4	3.4	0.5
85	67.3	0.40	14.9	1.3	1.9	0.07	1.05	1.90	4.8	4.8	0.9
86	67.8	0.45	16.2	0.7	2.2	0.07	0.65	2.15	2.9	4.3	0.6
87	75.8	0.20	12.6	0.6	1.4	0.03	0.18	1.05	2.4	5.0	0.6
88	75.5	0.17	12.6	0.4	1.4	0.03	0.18	1.05	2.8	4.9	0.6
89	70.2	0.56	13.0	0.1	4.4	0.06	1.85	3.50	2.6	1.7	1.0
90	73.7	0.37	13.0	0.1	2.4	0.05	0.40	1.45	2.0	4.1	0.6
91	73.7	0.29	12.5	0.3	2.2	0.04	0.35	1.30	2.3	5.2	0.5
92	73.0	0.10	13.8	0.4	1.3	0.03	0.35	0.95	3.3	4.5	0.6
93	47.4	0.70	8.9	0.9	4.6	0.22	4.5	16.1	0.3	1.8	11.5
94	69.2	0.48	12.7	0.6	3.5	0.08	2.75	3.75	2.1	2.4	2.0
95	69.0	0.58	12.8	1.0	4.3	0.05	0.35	2.25	2.8	4.2	0.2
96	62.8	0.50	12.7	0.7	5.2	0.11	5.2	4.0	2.5	2.4	2.0
97	52.0	0.50	14.0	1.7	14.4	0.18	2.55	1.75	1.8	3.6	6.1
98	54.8	0.83	14.4	1.6	8.8	0.17	6.5	7.9	1.8	1.2	0.6
99	60.9	0.73	16.3	0.4	7.1	0.05	3.6	1.10	1.4	3.2	2.4
100	64.1	1.1	15.0	0.4	5.1	0.08	2.05	3.15	2.5	3.5	0.6
101	64.9	1.0	15.8	0.4	4.6	0.08	1.75	2.90	2.9	4.1	0.6
102	74.8	0.05	13.9	0.1	0.8	0.02	0.20	1.00	3.1	4.5	0.3
103	70.3	0.35	14.6	0.4	2.1	0.06	0.90	2.00	4.8	4.5	0.5
104	64.9	0.38	17.4	0.9	2.1	0.07	2.20	4.4	4.2	1.6	0.9
105	73.7	0.20	13.1	0.1	2.2	0.04	0.27	1.30	3.2	5.0	0.7
106	61.6	0.76	15.8	0.9	6.3	0.07	3.40	2.10	2.6	3.8	1.5
107	74.8	0.20	13.5	0.3	1.2	0.03	0.20	0.95	2.4	5.3	0.5
108	72.2	0.54	13.1	0.1	3.1	0.05	0.60	1.80	1.8	3.5	0.3
109	72.0	0.62	13.0	<0.1	3.5	0.06	0.83	1.55	2.0	3.5	0.6
110	67.7	0.70	14.3	0.4	3.5	0.07	1.00	2.25	2.8	4.5	0.6
111	76.0	0.08	13.0	0.6	0.5	0.11	0.18	0.52	3.3	3.9	0.7
112	72.1	0.55	13.1	0.1	3.3	0.05	0.68	1.50	3.3	4.3	0.5
113	63.7	1.0	14.8	0.6	4.9	0.08	1.70	3.35	3.8	4.1	0.5
114	73.8	0.27	13.4	1.1	1.4	0.03	0.60	2.00	3.3	2.4	0.4
115	70.4	0.60	14.0	0.3	3.3	0.05	0.90	2.00	2.6	4.6	0.5
116	62.2	0.70	15.7	<0.1	6.0	0.19	2.55	2.75	3.2	2.8	2.3
117	71.0	0.44	12.9	0.6	3.7	0.12	1.45	2.50	1.9	3.2	0.7
118	58.8	1.0	15.2	0.7	8.2	0.12	4.6	3.5	3.2	1.0	0.8
119	62.3	1.2	15.2	0.4	5.8	0.08	1.95	3.80	3.2	3.7	1.1
120	67.2	0.52	15.6	1.3	2.4	0.07	1.25	2.65	3.5	4.1	1.2

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
121	62.2	0.45	12.8	4.3	1.5	0.14	0.90	2.25	2.3	5.0	5.9
122	68.5	0.25	16.0	1.1	1.7	0.05	2.60	0.20	2.6	4.4	2.5
123	74.3	0.26	13.5	0.6	1.2	0.04	0.72	0.85	4.2	4.1	0.6
124	74.0	0.42	13.8	0.1	2.1	0.05	0.45	1.25	2.6	5.1	0.6
125	78.1	0.10	11.8	0.6	0.6	0.01	0.53	0.35	5.6	0.3	0.6
126	74.3	0.27	13.7	0.3	2.1	0.02	0.80	2.80	3.5	2.2	0.5
127	70.6	0.57	14.1	0.3	3.0	0.04	0.70	1.25	2.2	5.1	0.5
128	70.0	0.40	15.5	0.6	1.9	0.05	1.00	2.40	2.6	2.1	0.6
129	57.0	1.0	14.2	1.0	8.8	0.17	5.0	7.9	3.2	0.9	0.9
130	55.1	1.3	16.4	0.9	11.0	0.09	5.4	2.70	2.0	2.1	1.6
131	56.4	0.86	12.6	0.6	9.1	0.21	5.3	11.2	0.4	0.3	1.6
132	70.6	0.60	14.0	0.6	4.2	0.06	2.05	1.65	2.4	2.5	0.9
133	68.4	0.60	13.1	0.7	4.8	0.07	3.4	2.90	2.1	2.0	0.8
134	62.3	0.78	16.3	0.4	6.8	0.05	2.50	2.70	2.6	2.2	2.4
135	65.8	0.50	15.7	1.0	3.2	0.07	1.25	2.20	3.4	4.8	0.6
136	75.0	0.16	13.4	0.6	1.2	0.04	0.18	0.75	2.8	5.2	0.5
137	75.3	0.19	12.4	0.4	1.4	0.04	0.15	0.85	2.4	5.1	0.4
138	73.7	0.26	12.2	0.9	2.2	0.06	1.10	0.85	2.1	4.4	1.1
139	48.7	1.1	13.3	2.9	10.5	0.21	7.0	10.6	2.7	0.4	0.7
140	67.0	0.36	15.5	0.5	3.4	0.09	1.00	3.70	4.3	1.4	0.4
141	54.0	1.15	15.1	1.1	8.8	0.15	5.1	7.6	5.1	2.3	0.7
142	76.0	0.16	13.2	0.4	0.9	0.03	0.20	1.20	2.8	5.0	0.3
143	70.8	0.55	14.5	0.3	2.8	0.04	0.70	2.15	2.9	5.0	0.3
144	55.5	1.1	17.0	4.1	7.2		5.1	3.0	2.7	2.4	1.3
145	58.3	0.8	16.9	3.0	6.8		4.3	2.6	3.1	2.7	1.0
146	61.1	0.9	16.0	2.9	5.8		3.7	3.0	2.8	1.9	0.4
147	59.9	1.0	16.1	2.6	6.4		4.1	3.3	3.1	2.3	0.8
148	55.8	0.7	17.0	3.1	7.2		3.8	6.0	2.6	1.4	1.7
149	71.2	0.4	14.5	1.7	3.0		1.9	2.5	2.5	0.9	1.4
150	75.1	0.4	13.4	1.0	1.0		1.2	2.1	3.6	1.2	0.9
151	71.2	0.6	16.3	0.9	0.9		0.9	2.1	4.7	1.5	0.9
152	68.0	0.6	15.3	0.9	3.7		3.6	3.6	1.8	1.7	0.7
153	67.7	0.4	15.4	1.0	3.9		4.3	3.9	1.3	1.6	0.7
154	68.0	0.5	14.8	2.3	3.3		4.4	3.9	0.9	1.3	0.5
155	68.5	0.6	14.9	0.9	3.9		3.7	2.8	1.4	1.7	0.8
156	69.7	0.3	15.1	0.7	4.0		3.6	2.4	1.5	1.2	1.0
157	67.1	0.3	14.4	0.4	5.4		3.8	3.9	1.0	1.3	1.6
158	69.6	0.3	14.7	0.4	2.7		3.2	4.3	1.6	1.1	1.0
159	68.8	0.3	11.5	0.3	11.3		1.8	1.7	1.3	0.8	2.2
160	73.0	0.3	12.6	1.0	4.2		3.7	1.1	0.8	1.3	0.9
161	54.0	0.6	22.2	1.0	5.1		2.7	5.8	4.1	2.3	0.8
162	66.5	0.7	15.0	1.1	5.3		4.4	2.0	1.1	1.7	0.9
163	63.8	0.67	15.4	0.1	6.0	0.05	3.2	1.40	2.3	3.3	2.1
164	54.9	1.6	13.7	1.1	10.9	0.13	6.8	3.25	4.3	1.4	0.5
165	63.6	0.75	14.4	<0.1	6.4	0.10	3.2	2.80	2.2	2.7	1.5
166	68.4	0.63	13.7	0.3	4.8	0.06	2.30	1.90	2.8	3.3	0.7
167	54.5	1.05	15.1	1.6	8.3	0.12	4.4	5.4	2.3	4.7	1.7
168	67.0	0.75	14.2	0.7	5.3	0.06	3.2	1.95	2.5	2.7	0.8
169	66.4	0.68	13.3	<0.1	6.0	0.09	3.5	2.15	2.3	2.5	1.6
170	66.3	0.66	14.5	<0.1	5.7	0.07	3.1	2.50	2.7	2.4	0.8
171	64.4	0.60	14.8	0.1	5.7	0.07	2.45	1.65	2.3	3.0	1.4
172	66.9	0.50	15.6	1.1	3.0	0.10	1.30	2.75	3.3	3.8	0.5
173	68.3	0.60	14.9	0.3	3.5	0.07	0.90	2.20	3.4	3.5	0.4
174	71.6	0.34	14.2	0.1	2.8	0.04	0.38	1.35	3.2	5.2	0.3
175	61.0	0.75	16.5	0.9	5.1	0.11	1.45	3.45	3.2	4.3	1.3
176	67.5	0.82	15.0	0.9	3.7	0.06	1.10	2.50	2.6	5.0	0.4
177	68.8	0.65	13.6	0.9	3.0	0.07	0.76	1.70	3.4	4.7	0.4
178	74.2	0.62	12.4	0.6	2.6	0.05	0.62	1.80	2.0	4.2	0.6
179	70.5	0.40	15.0	0.6	3.3	0.07	1.10	3.60	3.6	1.1	0.4
180	65.4	1.05	14.4	1.0	4.5	0.06	1.25	2.35	3.2	4.4	0.7
181	69.0	0.61	14.4	0.4	4.9	0.07	0.73	2.15	2.7	3.4	0.5
182	74.5	0.25	13.6	0.1	1.3	0.06	0.30	0.80	2.9	5.3	0.6
183	56.7	1.1	15.8	0.4	8.4	0.12	5.0	4.7	2.3	2.6	1.4

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign. loos
184	71.5	0.25	13.6	< 0.1	2.7	0.09	1.20	1.95	2.8	4.3	0.6
185	71.9	0.28	14.3	0.7	1.9	0.05	1.40	3.00	2.8	1.2	0.7
186	55.5	0.80	16.3	6.1	3.7	0.18	4.0	7.3	3.2	1.6	0.4
187	68.0	0.58	14.3	0.4	4.2	0.07	2.05	2.05	3.1	3.2	0.6
188	70.2	0.60	15.4	0.4	2.8	0.06	0.65	2.35	2.8	4.9	0.4
189	70.5	0.64	14.6	0.7	2.7	0.05	0.70	2.00	2.5	5.0	0.4
190	58.5	0.90	15.9	1.6	6.2	0.09	4.1	4.9	2.9	1.8	2.3
191	73.0	0.29	14.8	0.1	1.1	0.03	0.55	1.65	3.5	4.6	0.4
192	61.2	0.97	15.6	1.4	6.6	0.11	4.0	1.75	1.1	3.3	1.1
193	63.4	1.7	14.7	1.0	5.8	0.09	1.90	3.90	2.6	3.5	0.4
194	69.5	0.34	14.2	1.4	2.7	0.02	1.34	2.70	3.7	1.7	0.5
195	67.1	0.46	15.6	0.9	2.8	0.08	1.20	2.80	3.7	3.7	0.5
196	62.6	0.75	17.2	0.3	5.5	0.08	1.90	4.0	3.3	1.5	0.6
197	67.5	0.52	15.0	0.4	3.8	0.08	1.85	2.75	2.7	4.6	0.5
198	68.6	0.65	14.3	0.4	4.1	0.07	0.70	2.10	3.0	4.3	0.5
199	70.3	0.37	14.0	0.6	2.7	0.05	0.56	1.05	3.0	5.1	0.6
200	67.4	0.63	13.9	0.3	4.4	0.04	2.25	2.05	3.1	2.6	1.1
201	68.2	0.65	13.9	0.9	3.0	0.06	0.72	2.30	3.1	5.2	0.5
202	62.7	0.89	14.9	1.4	5.1	0.09	2.10	4.50	3.1	4.0	0.5
203	70.2	0.75	13.5	0.7	3.4	0.04	0.80	2.30	2.6	4.7	0.4
204	68.6	0.61	14.8	0.7	3.0	0.04	0.74	2.40	2.4	4.7	0.4
205	73.0	0.23	14.9	0.4	1.5	0.05	0.80	2.00	3.5	3.4	0.6
206	70.4	0.54	13.5	0.4	2.3	0.06	0.70	1.50	2.7	5.1	0.6
207	59.2	2.2	14.1	2.6	8.0	0.13	2.25	5.2	3.0	3.2	0.5
208	69.5	0.35	15.6	0.7	1.9	0.04	1.10	3.55	5.0	1.3	0.6
209	56.4	1.9	14.6	1.9	8.2	0.12	3.7	5.8	3.3	3.0	0.3
210	77.0	0.01	12.0	0.1	0.8	0.02	0.08	0.60	2.5	4.9	0.3
211	64.9	1.30	14.5	0.9	4.9	0.08	1.60	3.30	2.6	3.8	0.4
212	72.6	0.18	14.0	0.7	1.9	0.05	0.70	2.40	3.1	1.9	0.3
213	74.0	0.27	14.4	0.4	1.7	0.04	0.35	1.10	2.5	5.4	0.5
214	69.3	0.43	16.4	0.1	2.8	0.06	1.30	3.65	3.4	1.8	0.5
215	72.2	0.48	14.0	0.6	2.8	0.04	0.58	1.85	2.9	4.8	0.4
216	70.3	0.43	14.2	0.3	2.6	0.05	0.57	1.95	2.4	5.3	0.5
217	69.8	0.55	13.4	0.7	3.2	0.05	0.65	2.25	2.1	4.9	0.3
218	64.8	1.2	15.3	0.4	5.7	0.08	1.35	3.7	2.8	4.0	0.2
219	69.0	0.75	13.9	0.4	4.0	0.05	0.80	2.75	2.7	4.1	0.3
220	70.0	0.79	13.9	0.3	4.0	0.04	1.15	1.70	2.2	4.4	0.6
221	70.2	0.46	14.0	0.4	2.2	0.04	0.95	2.05	3.4	4.5	0.7
222	70.0	0.31	16.1	0.1	2.1	0.03	1.10	2.55	4.4	2.8	0.4
223	65.8	0.49	17.2	0.4	3.1	0.06	1.35	3.50	4.3	2.2	0.5
224	58.5	2.3	14.7	1.0	7.5	0.12	2.90	5.5	3.5	2.3	0.5
225	66.7	0.48	15.2	1.3	3.3	0.09	1.45	2.00	3.3	4.0	0.8
226	62.0	0.64	16.3	0.6	5.7	0.07	3.2	2.65	5.1	3.4	0.9
227	72.6	0.35	15.2	0.6	1.8	0.08	0.60	1.70	3.1	3.3	0.4
228	70.6	0.30	14.4	0.1	2.4	0.04	0.88	2.00	3.3	3.6	0.7
229	66.1	0.47	14.2	0.3	5.0	0.04	1.60	1.35	2.7	3.0	3.0
230	72.9	0.35	13.8	<0.1	2.2	0.04	0.43	1.10	2.2	5.2	0.8
231	72.0	0.30	13.0	<0.1	2.3	0.03	0.40	1.10	2.7	5.1	0.4
232	47.2	2.1	15.8	1.0	12.0	0.19	8.3	9.0	2.0	0.8	- 0.6
233	71.5	0.42	13.2	0.3	2.4	0.04	0.50	1.65	3.0	4.7	0.4
234	69.5	0.66	14.2	0.4	3.6	0.06	0.85	2.15	2.3	4.6	0.5
235	64.2	0.95	14.5	0.3	5.7	0.07	1.25	2.70	2.7	4.5	0.9
236	67.8	0.73	13.8	0.4	5.1	0.08	2.70	1.95	2.4	3.0	0.7
237	49.7	1.4	13.1	1.1	2.8	0.25	6.6	9.8	2.3	0.2	0.1
238	69.0	0.50	16.6	0.4	4.0	0.06	1.20	3.10	3.5	1.7	0.9
239	65.8	0.55	14.8	0.4	4.8	0.05	2.40	1.60	2.5	3.0	1.7
240	58.8	0.90	16.0	0.5	5.8	0.10	3.3	5.5	3.8	2.5	1.0
241	63.4	0.95	16.2	0.1	5.7	0.08	2.3	4.4	3.1	3.3	0.7
242	74.1	0.31	13.0	0.1	2.2	0.04	0.35	1.10	3.0	5.1	0.3
243	54.0	0.55	12.3	0.4	15.6	0.10	2.60	1.75	0.7	4.3	5.3
244	44.5	1.9	12.1	1.2	11.8	0.15	14.4	9.6	0.4	0.3	2.7
245	70.8	0.55	13.8	0.6	3.0	0.03	0.90	1.65	2.9	4.8	0.4
246	67.9	0.83	14.5	1.0	4.4	0.07	1.10	3.10	2.4	3.5	0.8

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
247	59.1	1.6	16.1	0.7	6.3	0.12	2.90	5.0	3.3	3.3	0.9
248	71.6	0.23	15.4	0.7	2.1	0.05	0.75	3.05	4.1	1.5	0.4
249	68.6	0.60	14.3	0.3	4.2	0.04	2.20	2.15	2.4	2.6	0.9
250	64.3	0.65	14.3	0.1	6.0	0.05	2.30	2.35	3.5	2.9	1.8
251	69.0	0.60	14.6	1.0	4.2	0.06	2.4	1.75	2.8	2.8	1.1
252	68.6	0.63	13.6	0.1	4.9	0.05	2.30	2.20	3.0	2.5	0.7
253	63.7	0.84	15.5	0.9	5.9	0.07	3.7	2.25	2.3	2.9	1.1
254	71.5	0.30	16.3	0.3	2.4	0.05	1.00	3.35	3.7	1.4	0.5
255	65.0	0.72	15.5	0.9	4.9	0.07	2.65	2.00	3.4	3.0	1.2
256	72.0	0.30	14.0	<0.1	1.7	0.05	0.75	1.40	4.0	4.1	0.9
257	73.9	0.25	13.8	0.4	1.9	0.05	0.30	0.80	2.7	5.1	0.8
258	74.6	0.36	12.0	<0.1	3.1	0.02	1.25	0.80	2.1	2.7	1.4
259	59.8	0.88	17.1	1.1	6.4	0.06	3.5	1.25	1.9	4.3	2.1
260	65.4	1.00	14.8	0.7	5.6	0.09	1.00	3.10	3.2	4.6	0.4
261	69.4	0.70	13.7	0.7	4.6	0.05	2.15	1.70	2.5	2.8	1.2
262	63.8	1.25	14.8	0.7	6.3	0.09	1.40	3.20	2.4	4.1	1.0
263	71.2	0.43	15.3	0.3	2.8	0.05	1.10	3.10	3.3	1.5	0.8
264	54.2	0.67	15.8	<0.1	10.7	0.05	2.90	1.75	2.3	3.7	5.2
265	69.5	0.50	14.6	<0.1	2.2	0.02	0.97	0.95	2.6	5.7	0.5
266	64.4	0.73	15.6	0.9	5.3	0.07	2.50	1.75	2.1	3.5	1.2
267	66.3	0.46	15.8	0.3	4.9	0.05	2.05	1.75	2.8	2.7	0.8
268	73.2	0.23	13.7	<0.1	1.4	0.04	0.42	0.60	2.1	4.1	0.4
269	65.4	0.79	15.0	0.4	5.5	0.09	1.35	1.70	2.4	3.8	1.2
270	72.7	0.26	14.0	0.1	1.5	0.04	0.48	1.90	3.3	3.8	0.4
271	68.4	0.65	14.4	0.1	4.2	0.05	1.20	1.70	2.7	5.0	0.7
272	49.4	0.92	14.6	1.1	9.9	0.18	8.0	10.1	4.0	0.6	1.8
273	68.2	0.52	14.4	<0.1	5.0	0.06	2.45	2.15	2.8	2.6	0.7
274	49.8	1.6	15.6	1.1	9.6	0.18	8.4	8.0	3.0	0.3	1.0
275	63.7	0.64	16.0	0.4	4.0	0.06	1.80	3.35	3.6	3.1	0.4
276	63.0	0.80	16.2	0.6	6.2	0.08	2.75	2.15	2.6	3.3	1.4
277	68.3	0.60	13.7	0.1	5.1	0.05	2.35	1.50	2.3	3.5	1.0
278	64.8	0.67	15.7	0.3	5.4	0.12	2.45	5.0	1.7	1.8	0.8
279	67.8	0.60	15.0	0.4	4.4	0.04	2.45	1.70	2.6	2.3	1.8
280	64.1	0.72	14.9	0.3	5.9	0.03	2.45	1.85	2.5	2.9	2.3
281	65.6	0.70	15.3	0.7	5.5	0.05	2.20	1.30	2.3	3.3	1.2
282	66.0	0.77	14.9	0.7	5.0	0.07	1.15	2.30	2.1	4.4	0.6
283	74.0	0.01	14.6	0.1	0.6	0.01	0.20	0.95	4.1	2.7	0.5
284	61.5	0.72	16.4	1.4	6.0	0.07	3.4	1.35	1.8	2.9	2.3
285	69.5	0.42	14.0	0.1	3.7	0.05	1.85	1.20	1.9	3.9	1.5
286	68.7	0.55	14.6	0.9	3.1	0.06	1.05	1.30	2.6	5.0	0.7
287	77.0	0.17	11.9	0.1	2.3	0.04	0.72	0.35	1.7	5.1	0.6
288	69.9	0.35	13.4	0.1	4.9	0.05	1.15	1.65	2.5	3.5	1.4
289	75.3	0.22	13.8	0.3	1.9	0.03	0.30	0.95	2.1	5.1	0.6
290	60.2	0.85	15.4	0.4	7.3	0.08	3.55	1.80	2.5	3.2	2.6
291	68.9	0.65	13.9	0.9	4.4	0.06	2.50	1.75	2.5	2.7	1.0
292	67.0	0.82	13.8	0.9	5.4	0.07	2.70	1.95	2.3	2.5	1.0
293	54.7	1.05	20.9	3.1	6.4	0.09	4.0	1.10	1.6	5.0	1.0
294	67.4	0.55	14.5	0.7	3.7	0.05	2.25	1.65	2.7	3.3	0.8
295	63.1	0.70	16.2	1.6	5.3	0.11	2.75	1.65	2.3	3.2	1.5
296	64.8	0.58	17.3	0.6	3.3	0.09	1.80	3.60	3.4	3.2	0.5
297	66.8	0.56	14.9	1.4	2.3	0.06	1.10	2.45	4.4	4.5	1.0
298	72.6	0.31	14.9	0.6	1.7	0.05	0.75	2.15	2.8	1.4	0.5
299	61.0	0.73	17.1	0.7	5.9	0.05	3.1	1.30	2.1	3.7	2.0
300	67.6	0.55	14.7	0.4	4.8	0.04	2.30	1.15	1.9	3.1	2.1
301	68.6	0.29	16.3	0.3	1.7	0.03	0.65	2.50	5.5	2.3	0.4
302	64.8	0.92	13.8	1.4	5.1	0.10	1.00	2.30	3.5	4.9	1.1
303	74.7	0.33	13.3	<0.1	2.1	0.04	0.40	1.00	2.4	5.2	0.5
304	62.5	0.69	15.3	0.7	6.7	0.09	4.3	1.35	3.2	1.6	3.3
305	64.5	0.67	15.6	1.9	4.8	0.08	2.70	1.50	2.4	3.0	2.0
306	69.8	0.40	13.1	0.1	3.7	0.02	1.60	1.70	2.6	2.5	1.3
307	63.0	0.62	17.0	1.3	6.0	0.07	3.3	1.35	1.8	2.9	1.3
308	65.6	0.67	16.0	0.8	4.9	0.06	2.80	2.10	2.4	2.8	0.9
309	54.4	0.92	18.1	3.6	7.6	0.08	4.7	1.65	2.5	4.2	1.1

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign. loos
310	65.7	0.72	15.7	1.7	4.5	0.06	2.65	1.70	2.2	2.7	0.9
311	66.1	0.47	16.3	0.4	4.6	0.06	2.40	1.15	2.4	3.6	1.9
312	65.4	0.61	14.7	1.3	4.6	0.09	0.43	1.55	3.3	4.5	0.5
313	70.0	0.28	15.6	0.1	2.3	0.04	0.24	1.80	3.7	5.6	0.5
314	64.1	0.63	15.8	0.1	5.9	0.07	0.90	3.50	2.1	3.8	0.4
315	70.3	0.32	13.3	0.3	3.0	0.05	0.44	1.10	3.6	5.7	0.7
316	72.5	0.08	14.3	0.1	1.2	0.02	0.38	0.75	4.5	4.2	0.8
317	68.2	0.67	14.6	1.0	4.9	0.06	2.50	1.45	2.2	3.1	1.1
318	67.0	0.77	13.7	0.1	4.6	0.05	1.30	2.15	2.5	4.4	0.6
319	69.8	0.60	13.7	0.3	4.6	0.06	2.15	1.90	2.7	1.7	0.9
320	68.5	0.67	14.6	0.1	5.0	0.05	2.45	1.45	2.0	2.5	1.2
321	68.7	0.63	14.8	0.1	5.0	0.05	2.25	1.95	2.2	3.3	0.9
322	66.0	0.60	14.6	0.1	4.5	0.04	2.20	1.45	2.7	4.6	0.9
323	63.8	0.90	16.8	1.5	5.8	0.07	2.95	1.80	2.2	2.7	1.5
324	68.4	0.62	13.7	0.4	4.5	0.07	2.20	1.75	3.0	3.2	0.8
325	61.1	0.85	16.7	0.3	6.3	0.15	3.1	1.70	2.7	3.6	1.5
326	71.0	0.41	13.7	<0.1	3.3	0.05	0.40	1.95	2.2	5.0	0.6
327	68.8	0.48	14.5	0.3	4.1	0.04	0.50	1.95	2.3	4.7	0.7
328	69.1	0.42	15.1	0.3	3.6	0.06	0.50	2.30	2.4	4.5	0.5
329	74.8	0.13	14.5	0.1	1.3	0.01	0.32	0.62	3.2	4.0	0.5
330	69.1	0.48	13.3	1.4	3.6	0.05	1.30	1.25	2.2	2.4	3.4
331	68.0	0.67	14.0	0.2	4.3	0.06	0.70	2.05	2.5	4.9	0.5
332	70.1	0.52	14.1	<0.1	4.2	0.05	1.70	1.35	2.5	2.7	0.9
333	70.6	0.48	13.9	0.9	3.3	0.05	0.37	1.60	2.6	5.4	0.5
334	67.8	0.54	14.9	0.6	2.7	0.03	1.00	1.65	2.9	5.1	0.5
335	58.4	0.63	15.6	0.9	5.3	0.06	2.90	1.90	3.3	4.2	4.6
336	69.3	0.70	14.6	0.7	3.7	0.04	1.15	2.05	2.9	4.1	0.7
337	61.8	0.65	17.0	0.3	5.5	0.07	2.95	1.35	2.6	4.5	1.3
338	67.2	0.65	13.4	0.1	5.8	0.06	2.70	1.95	2.9	2.3	1.8
339	66.2	0.44	15.8	0.4	4.0	0.05	1.85	1.40	2.9	4.0	1.5
340	70.6	0.60	13.8	0.3	4.2	0.04	1.95	1.60	2.3	3.1	1.1
341	73.6	0.54	12.0	0.1	3.1	0.01	1.50	1.65	2.2	2.8	1.0
342	60.5	0.85	18.1	0.8	7.2	0.07	3.5	1.05	1.6	4.0	1.0
343	67.3	0.67	14.5	0.9	4.0	0.06	2.00	1.25	2.4	4.2	1.0
344	67.8	0.44	14.7	0.6	3.1	0.04	0.45	2.00	3.1	5.0	0.5
345	70.6	0.66	14.0	0.4	4.2	0.05	1.95	1.45	2.5	2.9	0.5
346	70.5	0.37	14.2	0.1	3.1	0.03	0.40	1.50	2.2	4.8	0.4
347	70.5	0.33	13.9	1.0	2.2	0.05	0.30	1.10	2.6	5.6	0.5
348	64.5	0.63	15.4	0.6	5.8	0.05	2.95	1.05	3.2	3.1	1.3
349	67.0	0.84	14.8	1.0	3.5	0.06	1.20	2.10	2.9	4.8	0.7
350	63.7	0.68	16.4	0.1	5.4	0.06	2.40	1.40	3.2	3.6	1.7
351	58.5	0.90	18.6	0.9	6.8	0.08	3.5	1.60	2.0	3.2	1.8
352	67.2	0.52	14.3	0.1	6.0	0.05	2.60	1.45	2.0	3.2	1.8
353	64.9	0.60	16.5	0.3	5.4	0.05	2.40	1.15	2.0	3.5	1.8
354	68.6	0.32	15.0	0.6	2.8	0.05	0.40	2.15	3.0	5.3	0.6
355	67.4	0.50	14.4	0.9	4.0	0.06	0.60	2.40	2.7	4.5	0.6
356	68.6	0.48	14.6	0.4	3.5	0.05	0.45	1.80	2.3	5.5	0.5
357	69.3	0.62	14.8	0.6	4.0	0.07	0.50	2.30	2.7	4.6	0.5
358	69.1	0.32	15.6	0.1	2.2	0.04	0.35	1.90	3.0	4.9	0.6
359	73.5	0.27	13.2	0.7	2.1	0.04	0.25	0.90	2.6	5.1	0.5
360	63.4	0.66	15.2	<0.1	6.3	0.08	3.0	1.90	2.8	2.6	3.3
361	62.6	0.65	16.2	<0.1	6.3	0.06	2.75	1.65	2.6	2.3	3.6
362	70.9	0.54	12.7	0.4	4.0	0.05	1.90	1.50	2.6	3.0	1.3
363	61.9	0.46	12.9	5.7	9.7	0.11	2.45	2.50	0.9	1.8	0.8
364	58.8	0.55	15.6	1.9	6.6	0.06	2.65	1.55	2.5	2.5	6.4
365	72.5	0.15	14.1	0.4	1.2	0.03	0.40	1.15	3.3	4.5	0.6
366	68.1	0.43	15.2	0.3	4.1	0.04	1.85	1.30	2.6	3.5	1.1
367	66.9	0.60	15.1	0.4	4.9	0.04	2.30	1.30	2.2	3.3	1.5
368	63.8	0.75	14.4	0.7	6.2	0.08	1.00	1.85	2.4	4.6	0.8
369	64.4	0.66	16.8	1.5	4.9	0.07	2.55	1.05	1.5	2.2	2.3
370	67.0	0.75	14.3	0.2	4.3	0.05	1.25	2.30	2.4	4.5	0.6
371	59.4	0.78	18.5	0.6	6.4	0.06	3.6	1.40	1.8	3.9	1.8
372	67.8	0.59	13.5	<0.1	5.5	0.04	2.85	2.25	3.1	2.8	0.9

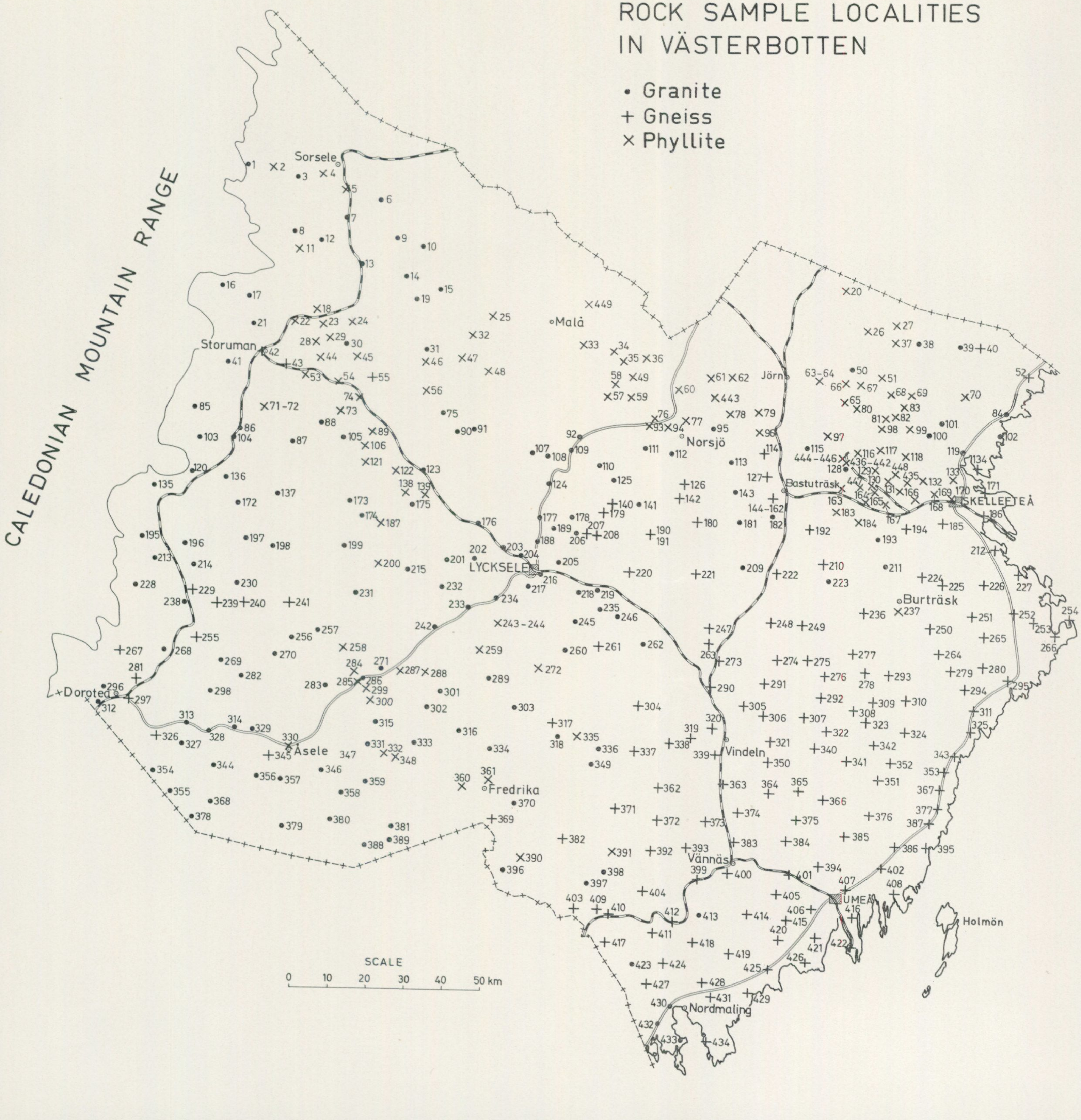
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
373	64.5	0.70	16.3	0.3	5.6	0.07	2.85	1.20	1.9	4.0	2.0
374	63.9	0.71	15.9	0.4	5.1	0.06	2.70	2.55	3.1	3.5	0.7
375	64.6	0.53	15.7	0.6	5.1	0.04	2.20	1.40	2.6	3.4	1.4
376	66.8	0.64	15.3	0.4	4.6	0.05	2.50	2.45	3.3	2.3	0.4
377	63.7	0.73	16.0	0.3	4.8	0.06	2.60	2.95	2.3	2.9	1.0
378	71.9	0.22	13.5	0.4	1.7	0.05	0.40	0.80	3.5	4.8	0.8
379	69.0	0.60	13.1	0.3	5.0	0.07	0.55	1.95	2.1	5.0	1.0
380	68.3	0.57	14.1	0.1	5.0	0.06	0.88	2.05	2.6	4.6	0.7
381	68.2	0.75	14.3	0.1	5.0	0.07	0.95	1.85	2.3	4.6	0.5
382	48.0	1.8	13.2	2.0	11.3	0.29	6.1	12.7	1.8	0.7	0.7
383	66.9	0.58	15.7	0.3	4.6	0.06	2.10	1.65	2.7	3.4	1.1
384	74.5	0.41	13.7	0.1	2.8	0.04	1.30	1.35	2.5	3.4	0.8
385	67.6	0.98	14.6	0.6	3.7	0.04	1.40	1.90	2.5	5.3	0.8
386	67.3	0.50	15.0	0.6	4.2	0.05	2.15	1.40	2.8	3.3	1.2
387	67.0	0.50	14.1	0.7	3.5	0.05	1.70	1.40	3.3	3.6	1.0
388	68.6	0.67	14.7	0.3	4.8	0.05	0.90	1.75	2.3	4.5	0.8
389	69.1	0.66	13.8	0.4	4.6	0.07	0.90	1.90	2.4	4.5	0.5
390	64.3	0.65	16.1	0.3	5.8	0.06	2.60	1.50	2.4	3.4	1.6
391	61.3	0.59	16.1	0.3	6.4	0.07	2.60	1.30	2.0	3.5	3.8
392	64.4	0.78	16.9	0.3	5.5	0.07	2.80	0.70	1.8	4.5	1.5
393	65.4	0.67	15.3	0.7	4.8	0.06	2.45	1.50	2.8	3.0	1.6
394	66.7	0.52	15.4	0.3	4.8	0.06	2.45	1.50	2.5	3.3	1.0
395	69.6	0.47	13.8	<0.1	4.0	0.04	1.60	1.85	4.0	2.8	0.8
396	72.0	0.30	14.3	0.4	1.8	0.02	0.62	1.00	2.2	5.4	0.6
397	71.8	0.40	13.4	0.4	3.0	0.04	0.45	1.45	2.8	4.8	0.7
398	70.2	0.40	14.3	0.1	3.7	0.06	0.53	1.70	2.7	5.1	0.7
399	65.9	0.67	14.3	1.0	5.0	0.05	2.60	1.00	3.1	3.9	1.5
400	66.1	0.77	14.5	0.4	4.9	0.03	2.35	1.65	2.1	3.4	1.3
401	60.7	0.70	16.7	0.2	6.3	0.06	3.4	1.05	1.7	4.1	2.4
402	60.6	0.78	18.5	0.7	6.6	0.06	3.1	1.45	2.0	3.5	1.7
403	67.6	0.50	14.0	0.6	4.0	0.05	2.30	2.25	3.1	2.3	0.9
404	61.7	0.65	17.1	0.7	6.0	0.06	3.10	0.75	2.2	3.5	2.6
405	66.0	0.70	15.8	<0.1	5.3	0.05	2.45	1.55	2.1	4.0	1.0
406	67.8	0.48	15.6	0.1	3.5	0.03	1.55	1.90	2.8	3.5	0.7
407	63.0	1.90	15.4	0.4	5.1	0.09	2.05	3.70	3.5	2.9	0.7
408	65.7	0.57	15.8	0.1	4.8	0.05	2.20	1.65	2.6	3.6	1.2
409	61.9	0.64	14.1	0.7	5.2	0.08	4.8	3.5	2.6	2.9	1.2
410	57.1	0.76	19.0	0.9	7.3	0.05	3.9	1.30	2.4	3.6	1.6
411	61.8	0.70	17.7	0.5	6.6	0.05	3.4	1.00	2.3	4.2	1.2
412	64.5	0.80	16.4	0.3	4.4	0.05	1.75	3.15	4.0	2.3	0.6
413	68.8	0.90	14.5	0.9	4.0	0.06	1.20	2.10	2.6	5.1	0.8
414	68.1	0.45	15.7	0.3	3.1	0.05	1.70	2.75	3.0	2.8	1.2
415	60.8	0.75	16.7	1.0	6.7	0.12	3.2	0.90	1.8	4.2	2.1
416	65.0	0.72	16.4	0.4	5.4	0.08	2.60	1.65	2.3	3.4	1.2
417	62.5	1.50	14.9	1.0	6.0	0.09	2.25	3.35	2.6	3.5	0.8
418	66.6	0.14	17.7	<0.1	2.1	0.04	1.35	4.9	2.8	1.3	0.5
419	68.0	0.54	15.5	0.3	4.2	0.05	1.95	1.50	2.4	3.3	1.0
420	66.7	0.61	15.0	1.1	4.1	0.08	2.30	1.80	2.7	3.1	0.2
421	64.1	0.83	14.6	0.4	5.4	0.06	3.2	2.35	2.8	4.1	0.8
422	67.7	0.65	14.7	0.7	4.6	0.05	2.25	1.20	1.9	2.5	1.9
423	68.0	0.57	14.8	0.3	4.2	0.05	0.75	1.95	2.2	2.4	0.4
424	64.0	0.75	15.2	0.7	5.9	0.09	3.3	1.90	2.7	3.3	0.9
425	67.1	0.57	14.8	<0.1	5.1	0.05	2.60	2.45	3.0	2.6	0.8
426	63.2	0.70	16.0	1.1	4.9	0.07	3.0	1.25	1.6	3.5	1.3
427	62.5	0.70	17.4	0.6	5.6	0.06	2.90	1.25	2.9	4.0	1.2
428	65.2	0.59	15.2	0.9	4.6	0.05	2.25	1.75	3.3	2.6	1.8
429	63.9	0.71	16.6	0.6	5.4	0.09	2.55	2.00	3.3	3.3	1.1
430	67.8	0.80	14.5	0.4	4.9	0.08	0.90	2.20	2.7	4.8	0.7
431	66.5	0.50	16.3	<0.1	5.3	0.07	2.15	1.00	2.1	4.1	1.3
432	65.9	0.75	14.5	0.1	4.6	0.07	3.0	2.90	2.3	3.7	0.6
433	67.0	0.75	14.5	0.6	4.1	0.05	2.40	1.95	2.3	4.8	0.8
434	66.1	0.56	16.4	0.7	4.6	0.07	2.20	1.80	3.1	2.7	1.7

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
435	69.2	0.67	14.0	0.4	5.0	0.04	2.63	1.50	3.0	2.6	
436	52.5	0.70	17.9	11.0	-	0.15	3.98	5.75	5.2	0.63	
437	59.2	0.61	18.9	0.5	5.2	0.05	2.95	2.95	3.9	4.2	
438	63.9	0.53	15.9	1.0	5.1	0.05	2.68	1.68	2.3	4.6	
439	62.7	0.89	14.3	1.2	3.4	0.08	3.47	2.69	2.6	2.7	
440	67.6	0.66	13.6	6.9	-	0.04	2.11	1.74	2.9	1.3	
441	45.8	1.13	14.2	-	8.9	0.07	3.17	3.44	2.9	1.9	
442	60.9	1.10	16.3	1.0	6.2	0.05	3.52	1.27	1.5	3.3	
443	61.7	0.35	11.8	-	12.2	0.08	1.30	1.50	1.7	3.3	
444	70.5	0.53	13.9	3.6	-	0.04	1.79	1.23	1.2	3.4	
445	60.1	0.60	15.9	0.6	7.7	0.07	2.45	2.50	1.5	3.7	
446	61.9	0.59	16.3	1.1	6.2	0.17	1.50	5.52	4.1	0.4	
447	72.7	0.29	13.7	-	3.0	0.04	0.50	1.04	5.3	2.3	
448	55.8	1.25	15.8	-	11.8	0.11	4.95	3.85	3.8	1.3	
449	72.5	0.90	11.7	0.4	4.6	0.06	1.79	4.17	1.0	1.3	
500	57.7	0.75	20.7	1.0	4.1	0.06	0.9	8.6	3.6	0.7	3.1
501	72.7	0.3	13.0	0.1	2.3	0.06	0.8	5.65	2.5	0.5	2.3
502	72.6	0.3	12.8	0.6	2.4	0.05	0.6	2.4	3.7	1.5	2.8
503	67.7	0.35	12.2	0.4	4.9	0.09	1.25	4.25	1.4	1.4	4.6
504	77.7	0.15	11.0	0.5	2.2	0.07	0.75	0.75	4.1	1.6	0.5
505	50.5	0.75	20.1	7.0	3.4	0.15	4.8	9.85	3.6	0.3	0.7
506	81.0	0.2	8.8	0.2	2.3	0.03	0.7	1.2	1.8	1.3	1.0
507	69.9	0.4	13.5	0.6	4.3	0.11	2.3	1.55	4.9	2.1	1.1
508	74.8	0.25	12.3	0.7	1.9	0.04	0.75	1.1	4.3	2.1	1.4
509	74.3	0.3	12.0	0.4	2.8	0.03	1.45	0.65	4.7	0.6	1.2
510	62.8	0.5	12.2	1.7	5.8	0.16	2.3	4.3	4.0	0.5	5.1
511	50.2	0.65	12.9	5.3	3.3	0.13	12.2	7.7	2.3	1.5	3.0
512	72.4	0.35	15.0	0.3	0.7	0.04	0.5	2.1	5.1	3.0	0.7
513	46.3	0.5	10.2	5.0	4.1	0.12	17.2	8.2	0.5	0.6	4.6
514	68.9	0.4	15.2	1.6	2.2	0.04	1.5	0.85	6.8	2.2	0.9
515	58.0	0.45	14.9	0.8	3.6	0.10	1.45	6.5	2.5	2.9	7.0
516	67.3	0.25	13.2	1.8	1.3	0.05	1.2	4.1	2.8	1.8	4.4
517	48.6	1.75	14.5	3.5	6.8	0.13	4.8	6.4	2.4	2.5	7.0
518	70.6	0.3	13.7	3.5	0.9	0.07	1.25	0.6	2.4	3.6	1.7
519	71.9	0.3	13.2	2.1	2.0	0.05	2.6	0.55	2.2	2.9	2.2
520	50.0	0.6	13.0	6.6	3.5	0.15	11.2	8.0	2.8	1.5	3.0
521	48.0	0.8	17.5	5.9	4.9	0.15	8.3	7.6	3.0	0.6	4.0
522	51.6	0.8	18.1	4.6	5.2	0.13	5.3	8.2	2.2	1.1	3.3
523	61.2	0.55	15.4	4.7	0.6	0.08	1.5	5.3	3.8	1.1	5.1
524	78.2	0.25	10.8	0.0	1.5	0.04	0.55	1.25	4.4	0.8	1.2
525	70.0	0.35	13.1	1.2	3.3	0.07	1.25	1.35	4.7	2.2	1.7
526	48.4	0.6	16.0	4.5	2.4	0.14	4.3	12.2	3.9	0.5	8.1
527	72.9	0.5	11.3	4.0	2.4	0.05	2.2	0.55	0.2	2.0	2.4
528	46.1	1.7	15.2	1.4	9.4	0.14	7.3	7.0	2.8	0.3	8.7
529	50.1	0.7	14.2	7.2	3.0	0.14	11.1	9.9	2.6	0.7	0.9
530	53.8	0.65	14.8	1.3	6.8	0.17	3.6	6.25	2.3	1.6	8.1
531	53.4	0.75	14.5	1.4	7.2	0.16	4.8	6.8	2.5	0.7	7.7
532	60.1	0.45	15.4	1.1	6.1	0.09	2.7	4.0	5.4	0.0	3.6
533	57.0	0.9	15.1	1.2	8.3	0.09	4.4	3.45	4.8	0.3	4.6
534	73.6	0.25	13.3	0.9	1.8	0.05	0.3	1.15	4.9	3.4	0.6
535	52.5	1.45	16.6	5.3	4.5	0.13	5.3	7.95	3.5	1.6	0.6
536	54.4	0.7	16.5	3.8	3.1	0.10	5.2	8.7	3.7	0.2	3.0
537	78.7	0.15	11.3	0.7	1.0	0.04	0.25	2.55	5.1	0.0	0.4
538	76.5	0.35	11.3	1.1	2.0	0.04	0.4	2.1	5.4	0.1	0.4
539	56.1	0.5	17.5	4.5	3.4	0.11	5.3	8.4	3.2	0.3	1.8
540	74.1	0.2	13.3	0.4	0.6	0.02	1.55	1.6	4.4	0.5	3.3
541	54.6	0.6	16.6	7.5	2.6	0.16	6.0	8.1	3.7	0.7	0.9
542	52.1	0.7	16.2	10.3	1.7	0.22	6.1	11.5	1.2	0.3	0.5
543	74.4	0.25	13.3	1.0	1.5	0.04	0.55	2.25	4.2	2.6	0.7
544	71.2	0.5	11.9	1.0	4.5	0.10	2.5	3.55	1.6	2.1	1.1
545	73.3	0.3	13.4	0.8	1.4	0.04	1.0	3.2	3.5	1.5	1.6
546	74.4	0.25	12.8	0.4	2.9	0.05	1.4	1.8	3.9	2.2	1.0
547	77.0	0.15	12.4	0.3	1.8	0.05	0.55	0.45	3.9	2.4	0.5

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
548	46.6	1.0	19.0	7.7	3.8	0.20	4.2	14.0	2.9	0.4	1.7
549	52.1	0.75	18.5	7.0	1.5	0.14	2.8	13.4	2.3	0.4	1.1
550	70.7	0.4	13.0	2.6	3.1	0.08	1.3	2.6	4.0	0.8	0.6
551	71.7	0.3	13.5	0.9	3.1	0.06	0.75	2.0	3.7	1.6	1.9
552	62.5	0.45	16.4	1.9	3.6	0.07	3.2	4.85	4.0	1.0	3.0
553	60.1	0.45	16.3	1.1	4.1	0.07	2.8	4.65	3.7	1.1	4.7
554	58.0	0.75	16.5	1.6	6.3	0.09	2.7	3.85	4.4	1.6	4.5
555	49.3	0.7	14.5	5.6	4.6	0.15	8.3	9.4	2.3	0.9	3.7
556	46.7	0.5	9.1	8.0	2.9	0.16	18.0	8.9	1.1	0.3	3.5
557	75.2	0.1	13.0	0.3	0.9	0.03	0.5	1.25	2.7	4.8	1.2
558	73.3	0.1	13.6	1.0	0.5	0.05	0.35	1.7	2.3	5.5	1.9
559	73.1	0.2	14.5	0.6	1.6	0.04	0.75	1.5	3.7	1.9	2.3
560	60.4	1.0	16.2	1.5	7.8	0.08	3.0	1.6	3.9	1.5	3.1
561	63.6	0.55	16.8	3.4	0.7	0.06	2.6	7.7	4.6	0.8	0.7
562	47.6	0.6	12.1	6.6	3.4	0.14	13.8	7.7	2.7	0.2	5.1
563	57.1	0.85	14.3	5.2	2.9	0.11	5.7	8.0	2.9	1.6	1.5
564	46.5	0.7	11.9	6.5	3.3	0.12	14.4	8.9	2.0	0.6	4.2
565	68.8	0.4	13.1	1.3	3.3	0.05	1.65	1.65	3.5	2.6	2.5
566	62.5	0.4	12.7	0.6	3.0	0.06	2.1	7.25	0.8	2.2	7.8
567	72.3	0.25	10.5	0.6	2.8	0.10	2.2	2.05	2.1	1.9	3.8
568	67.4	0.6	13.9	0.9	5.0	0.08	1.15	4.0	1.0	3.2	1.7
569	54.2	1.1	18.2	7.0	3.5	0.13	3.7	8.95	2.0	0.9	0.7
570	73.7	0.4	13.1	0.3	2.4	0.05	1.05	3.25	2.3	1.9	0.8
571	73.2	0.4	13.9	0.6	1.1	0.04	0.55	1.15	5.6	1.8	0.5
572	69.1	0.45	14.3	0.7	4.2	0.07	1.4	1.65	4.4	2.5	0.6
573	55.1	0.8	18.3	2.6	6.6	0.11	2.4	6.7	1.0	0.5	3.3
574	42.6	1.1	19.0	2.0	10.2	0.16	5.6	6.75	0.5	1.3	8.3
575	53.8	0.65	16.3	1.0	8.4	0.15	5.4	3.75	0.7	1.9	5.2
576	62.2	0.75	16.2	1.4	5.8	0.12	2.1	3.8	0.9	1.6	4.1
577	48.4	0.8	19.1	0.5	8.7	0.13	3.8	6.2	1.1	1.6	6.8
578	52.7	0.65	17.5	1.4	6.3	0.11	2.6	8.25	1.0	0.4	5.9
579	62.4	0.5	16.9	1.2	4.4	0.07	2.8	3.0	1.1	1.6	3.8
580	58.4	0.65	18.3	2.0	4.0	0.09	2.0	7.8	3.7	0.3	3.3
581	62.5	0.4	15.1	1.1	2.4	0.08	2.2	7.65	1.6	1.9	5.1
582	63.5	0.7	17.5	1.5	3.8	0.04	2.3	4.2	3.7	1.7	1.2
583	47.9	0.35	8.9	0.4	1.6	0.11	0.45	22.1	2.5	0.6	16.7
584	77.4	0.25	7.3	0.4	3.0	0.06	0.6	4.75	1.2	0.6	2.3
585	68.2	0.4	11.4	1.2	3.2	0.08	0.9	4.25	1.1	1.8	4.8
586	65.6	0.35	12.9	1.2	2.1	0.07	1.45	5.3	2.4	1.2	5.7
587	49.5	0.9	11.8	6.3	3.6	0.14	12.6	7.45	2.3	0.7	3.3
588	64.7	0.6	16.1	1.5	1.8	0.08	0.7	6.95	5.4	0.3	1.9
589	45.6	0.7	13.1	2.4	7.1	0.16	7.7	7.95	2.1	0.4	10.0
590	75.8	0.25	12.3	0.7	1.3	0.04	0.7	1.2	3.7	2.0	1.4
591	66.1	0.25	17.1	1.2	1.7	0.05	2.3	0.45	2.1	5.5	2.5
592	56.4	0.75	14.1	2.0	7.0	0.13	2.4	5.2	4.0	0.8	4.8
593	56.1	1.0	14.6	7.8	3.1	0.14	5.3	5.6	4.5	0.2	0.4
594	72.3	0.35	12.8	1.3	2.5	0.06	0.85	2.75	4.0	1.1	1.1
595	72.1	0.4	13.4	0.1	2.8	0.06	1.4	1.8	5.1	0.2	1.3
596	52.2	1.1	14.8	3.5	7.9	0.28	4.5	6.1	4.2	0.2	2.6
597	50.9	1.35	15.5	4.1	5.4	0.12	4.8	7.8	3.4	0.2	4.4
598	73.4	0.3	13.1	0.4	2.8	0.07	0.9	1.8	4.5	1.6	1.1
599	71.7	0.3	12.9	0.6	3.0	0.06	0.55	2.6	4.0	1.6	2.9
600	71.9	0.25	12.9	0.8	1.7	0.04	0.45	2.45	2.8	2.2	2.9
601	51.4	0.8	13.2	6.3	2.8	0.14	8.8	9.05	2.5	2.7	1.8
602	75.4	0.25	11.5	2.2	0.5	0.03	0.6	0.6	3.9	1.9	1.9
603	80.1	0.25	11.5	0.0	0.6	0.02	0.2	1.6	4.9	0.9	0.5
604	74.8	0.3	12.3	0.7	2.0	0.06	1.1	1.45	4.0	2.3	0.6
605	73.0	0.25	12.4	0.7	2.0	0.06	0.9	1.2	2.8	4.2	0.4
606	64.0	0.75	14.5	2.3	4.2	0.11	1.75	3.9	4.4	1.1	0.7
607	64.4	0.75	14.8	0.7	6.1	0.04	3.15	1.95	2.8	2.8	1.6
608	70.6	0.3	12.7	0.8	4.0	0.08	2.55	3.0	4.4	0.4	1.4
609	61.6	0.55	16.9	0.6	5.8	0.09	3.2	2.25	4.5	0.9	3.3
610	73.1	0.6	12.0	0.8	4.5	0.03	2.2	1.5	3.4	1.6	1.0

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Ign loos
611	77.2	0.35	12.3	0.5	1.4	0.05	1.3	1.05	1.6	2.7	0.6
612	73.8	0.4	13.2	2.5	1.1	0.07	1.1	0.65	0.4	2.8	2.5
613	73.8	0.45	12.3	2.2	2.8	0.09	1.75	0.7	0.4	4.3	1.5
614	68.8	0.45	12.9	2.2	3.2	0.06	4.0	0.5	1.5	2.5	2.5
615	74.8	0.4	12.9	1.4	2.0	0.04	1.05	0.55	5.0	1.6	0.6
616	74.2	0.45	15.1	1.3	1.4	0.04	1.05	0.75	3.3	2.3	1.6
617	65.1	0.55	14.8	3.9	3.5	0.04	2.2	3.25	4.8	0.5	1.0
618	78.0	0.25	11.6	0.8	1.0	0.04	1.85	0.4	3.4	1.9	1.3
619	73.1	0.3	12.3	0.3	1.8	0.05	2.1	1.4	0.5	8.5	0.5
620	73.54	0.31	12.35	0.38	3.73	0.08	1.17	1.78	2.85	2.24	
621	72.86	0.24	12.42	0.30	4.07	0.13	1.60	2.40	2.83	1.72	
622	76.46	0.14	11.88	0.29	2.45	0.07	0.33	0.47	4.90	2.10	
623	74.08	0.32	11.35	0.80	3.11	0.10	1.46	2.34	2.03	2.41	
624	79.84	0.17	9.60	0.20	1.60	0.04	1.16	1.94	1.78	1.13	
625	69.46	0.30	15.41	0.96	2.50	0.10	1.57	0.92	4.41	2.60	
626	65.30	0.53	15.46	0.97	4.50	0.08	2.49	4.51	3.49	1.17	
627	64.27	0.50	14.62	1.18	5.13	0.07	2.13	4.15	2.22	2.78	
628	69.40	0.42	14.40	0.55	3.98	0.05	1.28	2.74	2.69	3.32	
629	51.34	0.85	15.14	1.97	9.02	0.25	7.47	5.72	4.27	0.45	
630	51.08	0.38	19.43	2.99	7.17	0.19	3.83	10.08	2.48	0.78	
631	52.37	0.75	15.04	1.86	5.78	0.20	3.20	9.40	4.08	1.53	
632	54.88	0.79	13.92	2.76	7.94	0.18	6.14	8.11	2.78	1.00	
633	76.10	0.26	12.39	0.16	2.52	0.03		1.63	4.67	0.99	
634	64.53	0.50	14.58	1.04	5.22	0.07	1.92	3.19	4.72	0.85	
635	70.20	0.70	13.52	1.95	3.79	0.10	2.44	0.78	4.04	0.92	

ROCK SAMPLE LOCALITIES IN VÄSTERBOTTEN



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