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Tittel

Report on orientation flotation tests on ore from the Skiftesmyr Deposit, Grong Gruber A/S

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Geologi Malmberegning		Sanddølaområdet Skiftesmyr Godejord
Råstoffgruppe	**Råstofftype**	
Malm/metall	Cu, Zn, Pb,Ag, Au	

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

This report is an English translation of Odd Eidsmos report of February 1977 (BV 2388). The report goes through flotation tests, mainly to clarifie how the Ag content in the raw ore is distributed.
The tests show that 50% of the Ag goes to the tailings, while 30 % goes to the cu-conc an 20 % to the Zn-conc.

Report on orientation flotation tests on ore from the Skiftesmyr Deposit, Grong Gruber A/S

By Odd Eidsmo
NTH, Feb., 1977.

Translated by Arne Reinsbakken
Trondheim, 1st Feb., 1997.

SUMMARY:
The intention with these tests was primarily to investigate how the silver content in the crushed raw-ore feed is distributed in the different flotation concentrates. The listing of assays, Appendix 1, shows that the Cu-concentrate will contain 50-60 g/t Ag while the Zn-concentrate contains 40-50 g/t.
From the silver content in the feed, 30% is found in the Cu-concentrate while 20% is found in the Zn - concentrate. Hence, about half of the silver from the zinc flotation will be lost in the tailings.

Otherwise, these tests indicate that the Skiftesmyr ore is easy to mill and that it will be possible to make a high class concentrate with good recovery for both Copper and pyrite.

Providing that the sphalerite does not contain too much iron, it should also be possible to make a high class Zn - concentrate.

The minerals show a satisfactory liberation on grinding down to 50-60% -325 mesh which for this type of ore would require 10-12 kW/t for grinding in a conventional mill.

Feed.
The tests were performed on drill cores selected by Arve Haugen. Haugen's sample descriptions are found in Appendix 2.

The samples recieved had a weight of 2.2 kg and was marked: Ddh 1-2-3-4, sample 1.

The ability of the ore mineral liberation has been investigated by Terje Malvik and presented in a report dated January 1977.

Malvik's investigation has been made on two samples.

Sample 1: This represents a section down the dip of the ore zone (surface exposure?)and includes drill holes 4-1-2-3. This sample is virtually identical with the above sample used for the flotation tests.

Sample 2: This represents a section that more or less follows the strike of the ore zone, at approximately the same depth, and includes drill holes 5-16-1-10.

From Malvik's report, one can see that sample 2 obtained mineral liberation in a coarser fraction than that in sample 1.

Malvik's report is found in Appendix no. 3.

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Flotation tests and Analyses

Tests are run in batch scale with 0.5 kg charges.

screen (mesh) analyses for ground goods:

Mesh	65	150	200	270	325	-325
weght %	0.1	6.0	12.8	13.0	10.1	58.0

Copper flotation is run in four steps with 10 g/t KAX in each step -pH 11.5.

Zinc flotation is run in three steps + schawenger. Copper sulphate addition (tilsats) 400 g/t and 20 g/t KAX in each step - pH 12.0.

In order to get an orientation of the Cu- and Zn- contents in a pyrite concentrate, ca. 50 g/t KAX was added after the zincschawenger and the amount that was 'willing' to come over with the collectors (samlertilsatsen) was floated out.

Results from the best tests are shown in appendix 1.

The elements in the different products are analysed by atomic absorption at Grong Gruber A/S.

There is a very good aggreement in Cu, Zn and Fe between the analysed feed (pågang) and the feed calculated out from the analysed values and the weight -% in the products. Silver, on the other hand, shows much less aggreement, 10 ppm in the analysed feed and only 7 ppm in the sum of the products (calculated pg.).

Silver is also controll analysed at NGU using atomic absorption.

Appendix 1 shows that NGU analysed the raw ore feed to 13 ppm and the calculated feed was 12 ppm, thus a very good aggreement between the analysed and calculated feed.

It is interesting to notice that for Cu-concentrate 1, which has 25.44 %(?) Cu, Grong Gruber A/S and NGU have recieved exactly the same value.

For the pyrite concentrate and pyrite mp./tailings, NGU got 2 and 6 times higher values, respectively, than Grong Gruber.

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Appendix 1. **Skiftesmyr**

Results from flotation tests on ore samples (rågods) marked BhHull 1-2-3-4, sample 1.

1 Ag - analyses done by Grong Gruber A/S.

2 Ag - analyses done by NGU (Dept. Eng. Knut Solem).

Utv. = extraction, gain

Vekt % = weight %

Rå-kons. = raw concentrate

pyritmp./Avgang = pyrite ? /tailings

Pågang beregnet = ore feed calculated

Pågang analysert = ore feed analysed

Appendix 2. 2 pages

Grong Grubere A/S
Exploration div.

to: O. Eidsmo
From: A. Haugen
Date: 1 Nov., 1976.

Samples for Microscopic Investigations - T. Malvik.

1. The ore zone at Skiftesmyr (appendix) is to be investigated microscopically for mineral dressing parameters, for eg., liberation grinding. In order to obtain representative samples based on diamond drill hole - samples, two vertical sections were set out through the deposit, at roughly right angles to each other. Two samples were taken from these two sections:

Sample 1: represents a section along the plunge of the orebody and contains drill holes 4-1-2-3.

Sample 2: represents a section more or less along the strike of the orebody, in a somewhat even depth and contains drill holes 5-16-1-10.

These two samples represent therefore 7 of the 12 drill hole that we have in the field.

2. The drill core was split at Joma. Part of the sample is stored in the core boxes. The other part was coarse-crushed with a relative fine adjusted jaw crusher. The coarse-crushed material was split and half of this was stored at Joma. The other half was fine crushed and further split and sent to analyses.

3. Selection of samples was as follows: The orebody's thickness in each drill-holes is calculated. Pure silicate host-rock fragments and bands that occur in the orebody are not included in the samples (these contain in order 0.05% Cu and 0.1% Zn). A new sample is split out from the stored sample of each analysis sample from each drill hole. Each split has a weight that corresponds to it's core length, m, and it's specific weight (density):

m x sp. wt. x 10 = weight of split.

This procedure was followed for each core length from the ore zone in the drill hole that was sent to analyses. All the samples for each drill hole was then added together to make one sample. After this, all the samples from the drill holes in the chosen vertical section were then combined to form a composite.

4. Sample 1 weighs ca. 1100 gram and sample 2 weighs ca. 600 gram. Most of the material has a grain size in the order of 1-6 mm and very little will be over 10 mm. Sample 2, which contains drill hole 16, contains, for the most + 10 mm, because this drill-hole was crushed using a plate crushers and a coarser jaw-crusher.

5. Parallel samples to the two samples refered to above were sent from Joma to O. Eidsmo on Fri., 29 Oct., 1976.

Appendix 3: An evaluation of the grinding liberation factors for chalcopyrite and sphalerite from the Skiftesmyr Deposit.

- by Terje Malvik, Geological Institute- NTH., Jan., 1977.

1. Summary.

1.1 Sample Material. was composed of two drill-core samples. The sample material is described in more detail in the Appendix.

1.2 Method of investigation. An empirical model, described in Teknisk Rapport (Technical Report) 28/2 (BVLI), is used to evaluate the grinding free liberation properties.

1.3 Conclusion. Chalcopyrite and sphalerite are relatively coarse-grained in the ore from Skiftesmyr. Much coarser-grained than at Skorovass, and also more coarse-grained than the same minerals in ore from the Tverrfjellet deposit.

Fine grinding to give ca. 55% liberation at - 45 microns for chalcopyrite and sphalerite is regarded as a reasonable starting point, and it is assumed that this corresponds to a total fine grind liberation in the area 40-45% -45 microns.

2. Description of Investigation.

2.1 Fine Grinding. Preliminary grinding tests were carried out in order to choose the necessay grinding time to obtain a reference fine grind 50% -45 microns for chalcopyrite and sphalerite. The fractions + 45 and - 45 microns were analysed for Cu and Zn at Grong Gruber A/S. The results of these analyses are found in the appendix.

Appendix 1 shows the fine grind (partical size) as a function of grinding time for the two ore samples.

The curves show that a grinding time of 21 min. for sample 1 and 13 min. for sample 2 gives the reference fine grind liberation (?) 50% -45 microns for chalcopyrite and sphalerite.

The fraction -125+90 microns of the grind product was taken out for preparation of polished sections and a grain analyses was conducted on these sections.

2.2 Grain Analyses. Table, appendix 2, shows results of grain analyses.

This investigation is concerned only with the study of the grinding liberation factors for chalcopyrite and sphalerite and, therefore, only grains with these minerals are registered in the traverses across the polished sections. The distance between the traverse lines is 0.5 mm.

There is a distinction made here between whole grains (100% of mineral), half grain (ca. 20-80% of mineral), contaminated grain 5-20% (minority mineral represents ca. 20% of grain), contaminated grain < 5% (minority mineral represents < 5% of grain) and multiphase grain which is a grain with three minerals in approx. equal amounts.

The following terms are used in the Table:

b = (bergart) = rock
sl = sinkblende = sphalerite
cp = kobberkis = chalcopyrite
py = svovelkis = pyrite
po = magnetkis = pyrrhotite
gn = blyglans = galena
fahl = fahlerts = tetrahedrite - tennantite solid solution

In regards to the ore microscopic work, it was noted that mixed grains were generally of a simple type, and that chalcopyrite and sphalerite also occur as inclusions mostly in pyrite. Such grains are divided out as separate types.

Fahlerts (possible silver bearing) is registered in a half grain associated with chalcopyrite in sample no. 2.

On the basis of this grain analyses, the degree of liberation in the fraction -125+90 microns is calculated to:

	chalcopyrite	sphalerite
sample no. 1	73.7 ± 2.3	72.6± 2.7
sample no. 2	78.9 ± 2.1	81.4 ± 2.5

The degree of liberation is given ± standard deviation.

2.3 Liberation curves. When one constructs the developement of the total degree of liberation as a function of the grinding down of a mineral, it is important to keep in mind that a mineral distribution curve for the grinding product of the ore will have an influence on the development of the curve for total liberation.

In Appendix 3 and 4 the developement of the total degree of liberation for chalcopyrite and sphalerite is constructed on the basis of the model described in T.R. 28/2, and with the mineral distribution curve nearly parallels the curve for chalcopyrite and sphalerite in the feed to the mineral dressing plant at Tverrfjellet (Folldal A/S).

The curve for Tverrfjellet is chosen because the ore types here, to a certain degree, can be compared with the ore types at Skiftesmyr.

The total degree of liberation is marked by a field with hatched lines, because the degree of liberation in the fraction ± standard deviation is used in the model.

The corresponding curves for chalcopyrite and sphalerite in the feed to the flotation plant at the Tverrfjellet and Skorovas mines are also shown in order to illustrate the relative liberation relationships between the three deposits.

Chalcopyrite and sphalerite is a slightly coarser grained in sample 2 than in sample 1 (the curve for sample 2 is a little higher in the diagram).

Within the individual samples, both chalcopyrite and sphalerite show nearly identical liberation relations.

2.4 Evaluation of the actual grade of liberation. The actual grade of liberation will be given by the wished grade of liberation for the minerals.

An investigation of the flotation feed (23-26/03-76), for the Skorovas mine, gives a grade of liberation for chalcopyrite to be 78%.

If one chooses this value of the liberation grade as a starting point, this corresponds to the grinding down of chalcopyrite and sphalerite in sample 1 to ca. 45 - 48% -45 micron, and in sample 2, ca. 40 - 44 % -45 micron.

In all likelihood, a total liberation grade in the order of ca. 85 % would be better for chalcopyrite and sphalerite in a relatively coarse-grained ore type as Skiftesmyr.

This can be obtained for sample 1 by grinding chalcopyrite and sphalerite to the order of 54 - 58 % - 45 micron, and 50 - 54 % - 45 micron for sample 2.

A reasonable middle grade of grinding could therefore be suggested to be ca. 55 % - 45 micron for chalcopyrite and sphalerite.

What this means in the total grinding of the sample will depend on to which degree chalcopyrite and sphalerite grind down selectively.

In the laboratory grinding done for this investigation, chalcopyrite and sphalerite is to a large degree ground down selectively.

On comparing the grinding curves on Appendix 1 with similar curves for raw flotation feed from Tverrfjellet (T.R. 28/02 p. 245), the selective grinding appears to be comparable, and one can say that with grinding the Skiftesmyr ore in a large scale drift one will get approximately the same relationship as that found for Tverrfjellet.

This will mean that at a total grinding of the ore in the order of 40 - 45 % - 45 micron will give ca. 55 % - 45 micron for chalcopyrite and sphalerite.

Appendix 1: Graph which shows axes with 'grinding time in min.' versus 'mineral particle size as a function of grinding time % -45 micron'.

Appendix 2: Table with 'Grain analyses of fraction -125+90 micron of two grind products from the Skiftesmyr ore'.

Antall registrerte korn med kobberkis og sinkblende = no. of grains registered with chalcopyrite and sphalerite

helkorn = whole grain
halvkorn = half grain
smittede korn 5-20% = contaminated grain 5-20%
smitted korn 5% = contaminated grain 5%
multifase korn = multi-phase grain

Beregnete frimalingsgrader = calculated grade of liberation.
prove = sample

Appendix 3:
Graph 1 - most likely developement of the total grade of liberation for chalcopyrite in sample no. 1 from Skiftesmyr on the basis of mineral distribution curve approximately parallel to the curves for chalcopyrite and sphalerite in flotation feed from the Tverrfjellet mine.

Graph 2 - most likely developement of the total grade of liberation for sphalerite in sample no. 1 from Skiftesmyr on the basis of mineral distribution curve approximately parallel to the curves for chalcopyrite and sphalerite in flotation feed from the Tverrfjellet mine.

Appendix 4:

Graph 1 - most likely developement of the total grade of liberation for chalcopyrite in sample no. 2 from Skiftesmyr on the basis of mineral distribution curve approximately parallel to the curves for chalcopyrite and sphalerite in flotation feed from the Tverrfjellet mine.

Graph 2 - most likely developement of the total grade of liberation for sphalerite in sample no. 2 from Skiftesmyr on the basis of mineral distribution curve approximately parallel to the curves for chalcopyrite and sphalerite in flotation feed from the Tverrfjellet mine.
