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Datum Date 89-04-11	Antal sidor No. of Pages 4	Vår ref Our Ref UP/HENRIK SUNDÉN
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Till To	<u>CURRAGH RESOURCES</u> <u>LEE C. PIGAGE</u> <u>WHITEHORSE</u>
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Meddelande:**Message:**

THREE PAGES CONCERNING BOREHOLE MEASUREMENTS FOLLOW.

PLEASE, NOTE THAT THE RESISTIVITY CALCULATIONS I COULD MAKE FROM THE MEASURED SAMPLES ARE VERY APPROXIMATE AND I WOULD PREFER MAKING MEASUREMENTS ON CUT SAMPLES 25 MM X 25 MM X 50 MM WITH BOLIDEN'S SAMPLE TESTOR.

REGARDS,

Henrik Sundén



To:
Durragh Resources Inc
Lee C. Pigage
117 Industrial Road
Whitehorse, Yukon Y1A 2T8
Canada

1989-04-11

TENDER

BOREHOLE MEASUREMENTS

Referring to Your letter to Nils-Erik Marinder concerning possible drillhole measurements in Faro and Vangorda and subsequent information about measurements on rock samples, we would like to give You the following tender for Borehole measurements in the Faro - Vangorda District.

METHOD OF GEOPHYSICAL MEASUREMENT

We propose that the Boliden BHEM system is used for the measurement. This instrument has two frequencies, 223 Hz and 2230 Hz. Three conditions must be met if this method is to be effective:

1. The overlying rocks must be penetrable for 223 Hz EM field down to the target depth and a little beyond. We think they are, since the Vangorda formation rock submitted has a resistivity of approx 700 ohmm, giving a penetration depth (skin depth) of 900 meter, and the host rocks 30-300 ohmm, giving skin depths of 200 - 600 meter. The interpretation of rock resistivities from the submitted measurements are, however, rather uncertain.
2. The target must be conductive and reasonably thick. The Faro ore type has an approximate resistivity of 3 ohmmeter and a thickness of 3 - 20 meter of this would be possible to indicate.
3. The target does not have any competitors in conductivity-thickness product in the vicinity. Out of the submitted measurements, the sericite schist and carbonaceous phyllite are closest to be in the dangerous zone with resistivity 30 - 100 ohmmeter.

Boliden's BHEM system utilizes a large transmitter loop on the ground and a three-component sonde in the borehole. The curvature of the borehole must be known before interpretation can be performed. The principle is to induce currents along the target's edges and measure primary plus secondary (= total) field. The primary field is calculated from essentially geometrical factors and can be subtracted to obtain the secondary field.

The system has under favourable conditions detected ore 100 meters from the drillhole. Conducting overburden, conducting host rock and disturbing non-ore conductors decrease the sensed distance considerably and makes the interpretation more difficult.

If the nearest edge of the target conductor is straight and well defined, its position and orientation can be estimated. Boliden is routinely using this to define ore edges in its exploration programme. The diameter of the sonde is 32 mm to accommodate 46 mm and wider drillholes.

ROCK SAMPLES

To make a good estimation of rock resistivities and to decide if Boliden's BHEM is efficient enough in the Faro-Vangorda environment, we believe it is necessary to prepare cut rock samples with dimensions 25 mm by 25 mm by 50 mm approximately and send them to Boliden, for the following rock types:

1. Calc silicate of Vangorda formation
2. Sericite schist of the altered host rock type of Faro
3. Graphitic schist of the carbonaceous ore type
4. Graphitic phyllite of the carbonaceous host rock type
5. Faro sulphide ore.

QUANTITY OF MEASUREMENTS

The proposed price is based on five days of field work for a two man staff. This would be sufficient for logging 4 - 10 boreholes with four different cable loops. The logging cable comes in three lengths: 300, 500 and 1000 meters. Since the 1000 meter cable is of considerable weight, it must be explicitly stated that boreholes longer than 500 meters are to be logged.

COORDINATE SYSTEM

It is assumed that Curragh performs a land survey to define the xyz coordinates of the borehole casing tops. It is also assumed that there is a field coordinate system that is visible and can be used when the cables are laid out. It is advisable to determine the xyz coordinate of each cable corner.

PRE-SURVEY INFORMATION

It is very cost-effective to make a pre-survey estimation of suitable cable loop locations out of geometrical and logistical considerations. It is therefore suitable that Curragh submits a good topographic map with unaccessible areas roughly indicated, as well as a map set showing the geology in three dimensions. This information should be in Boliden in June.

TIME OF MEASUREMENT

Boliden's proposal is that the borehole measurement takes place starting at 15th August. This is because the BHEM equipment is much in use and a large job is performed in Spain, ending in June. The instruments must then be shipped from Spain to Sweden for service, then to Canada. July is usually holiday month in Sweden, but a measurement in July can be performed at an extra cost.

AVAILABILITY OF BOREHOLES

It is advisable that Curragh controls the availability of the boreholes by logging them with a dummy sonde before the BHEM equipment is shipped from Sweden.

CABLE AND MOTOR GENERATOR

It is little economy in transporting standard copper wire by airfreight over the Atlantic, so we recommend that Curragh purchases the cable. The following cable is recommended: Single conductor, multifilament copper, area 1.5 square millimeters, insulated (flexible plastic insulation). Length 4000 - 6000 meters in sections of about 500 - 1000 meters. Each section on a spool

with center hole for easy laying out. It is possible to utilize a used cable where several sections are tied together and insulated, if the insulation is undamaged and the ties well done.

If Curragh has a motor generator available, capable of producing 220 volts, 1500 - 2000 watts at 50 (fifty) hertz frequency and with good stability, the transport cost and instrument rental fare will be diminished quite much.

INTERPRETATION

The results are interpreted at Boliden's office in Sweden, since considerable computing is involved. The interpretation method is briefly described in "Directional Measurements in Boreholes" by Pantze, Malmqvist and Kristensson, earlier mailed to You.

The interpretation will take two to three weeks. The result is presented as maps, showing detected targets with positions in three dimensions, the direction of target edges if interpretable, and the conductivity-thickness estimation for the targets if interpretable. The conductivity-thickness product can only be calculated if the 2230 Hz response is good, which is doubted due to the lesser depth of penetration and greater sensitivity to host rock conductivity of this frequency. A short text describing the results and the methods are included in the report.

The report will be mailed or faxed to You approximately 4 weeks after the finish of the borehole logging.

PRICE

Measurement and interpretation, report. Includes one week of field work and five days of transport	CAN\$ 27000
Instrument rental fare incl insurance (Reduced to 5500 if a good 220V 1500-2000W 50Hz motor generator is available)	CAN\$ 6000
Airfare for personnel, 2 persons	CAN\$ 5600 approx
Airfreight of equipment, approx 250 kg	CAN\$ 1400 approx
Extra field days with borehole logging	CAN\$ 3100
Extra idle days (weather, transport)	CAN\$ 1550

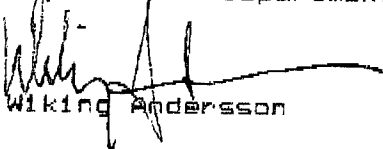
It is assumed that Curragh is invoiced for the actually paid airfares for personnel and instruments.

It is also assumed that Curragh supplies at own cost accomodation for Boliden personnel at or near the logging site, as well as local transport from the nearest airfield to the survey site and daily transports to and within the survey area.

Curragh will not be invoiced for field time during periods when field work is stopped due to instrument failure or personal illness.

This tender is valid until May 31st, 1989.

Boliden Mineral AB
Exploration Department


Wiking Andersson

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CURRAGH W FARO

65078 BOLIDBO S

1989-02-22

TO: CURRAGH RESOURCES, INC, FARO, YUKON
ATTN: LEE C PIGAGE

FROM: BOLIDEN MINERAL AB

REGARDING: BOREHOLE MEASUREMENTS IN THE VANGORDA AND FARO DISTRICTS.

IN MIDDLE JANUARY WE HAD COMMUNICATIONS REGARDING BOREHOLE MEASUREMENTS.

ARE YOU INTERESTED IN A DETAILED PROPOSAL FROM US?

IF SO, WE WOULD LIKE TO HAVE SUPPLEMENTARY INFORMATION REGARDING

- 1) THE DISTRIBUTION OF THE BOREHOLES
- 2) THE RESISTIVITY OF TARGET ROCKS AND HOST ROCKS (OR SAMPLES TO MEASURE)

HENRIK SUNDEN AND NILS-ERIK MARINDER
BOLIDEN MINERAL AB
S-936 00 BOLIDEN
SWEDEN

FAX NO +#6 910 60796

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CURRAGH W FARO

65078 BOLIDBO S

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Curragh
Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1989 02 15

Dr. Henrik Sunden
Senior Geophysicist
Boliden Mineral AB
93600 Boliden
Sweden

Dear Dr. Sunden:

Thank you for your letter concerning Boliden's BHEM system. I will attempt to answer some of your questions concerning the geology and electrical response of Anvil District rocks.

The disseminated and massive sulphide ore lenses commonly occur in association with carbonaceous metasediments. Some of the carbonaceous horizons, however, do not have associated ore lenses. Therefore, it would be advantageous to be able to differentiate between ore and carbonaceous metasediments.

Some experimental measurements of resistivity for Anvil rocks were completed in the early 1970's. No report summarizing the measurements was ever written. I am enclosing copies of the results. I am not sure if these are useful to you or not. If necessary we can collect core samples of the different rock types and forward them to your attention

We envision a borehole logging program consisting of up to 4 drill holes. These holes are widely scattered and would generally not be measured using the same cable loop. Approximate drill hole locations are indicated on the enclosed map.

Please let me know if the enclosed information is inadequate and you require representative samples.

Sincerely,

CURRAGH RESOURCES INC.

Lee Pigage
Senior Geologist

1989-01-13

Lee C. Pigage
Curragh Resources Inc
117 Industrial Road
Whitehorse, Yukon Y1A 2T8
Canada

BOREHOLE MEASUREMENTS

Referring to Your letter to Nils-Erik Marinder concerning possible drillhole measurements in Faro and Vangorda, I would like to supply some information about Boliden's BHEM system and ask some questions regarding facts on drillholes and rocks.

I understand that carbonaceous phyllites and pelites as well as mineable ore are electrical conductors and the surrounding rock of other types are essentially poor conductors.

The drillhole diameter is sufficient for borehole sondes of various types that might be relevant, such as
electromagnetic low frequency (harmonic or transient)
electromagnetic high frequency (22-50 MHz radar)
electric resistivity and IP
magnetic.

Boliden has competence to perform harmonic EM logging, magnetic logging and electric resistivity and IP logging. A Swedish contracting company (SGAB of Luleå and Malå) has competence for radar logging (with an instrument which is a development of a Boliden radar system no longer in operation).

Radar logging is relatively expensive and requires a pre-survey study to determine the high frequency response of representative rock samples. This study is inexpensive. Radar has shown good capability of detecting waterfilled cracks and crush zones and conductive ores. Maximum range is 50 - 100 meters under excellent conditions, much less if the host rock is conductive at high frequencies.

Boliden's BHEM system utilizes a large transmitter loop on the ground and a three-component sonde in the borehole. The curvature of the borehole must be known before interpretation can be performed. The principle is to induce currents along the target's edges and measure primary plus secondary (= total) field. The primary field is calculated from essentially geometrical factors and can be subtracted to obtain the secondary field. The system has under favourable conditions detected ore 100 meters from the drillhole. Conducting overburden, conducting host rock and disturbing non-ore conductors decrease the sensed distance considerably and makes the interpretation more difficult. If the nearest edge of the target conductor is straight and well defined, its position and orientation can be estimated. Boliden is routinely using this to define ore edges in its exploration programme. The diameter of the sonde is 32 mm to accommodate 46 mm and wider drillholes.

Bolidenkongcernens affärsområden: Gruvor och metaller • Kemikalier • Entreprenad • Grosshandel • Handel och industri

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Information about Boliden's BHEM system can be found in a reprint, "Directional EM measurements in boreholes" by R Pantze et al. Mr Marinder has handed over a copy to Greg Jilson. Anyway I will send another copy by mail to You.

I have some questions to be answered before it definitely can be decided if BHEM is an effective tool in this case and before I can give a cost estimate.

- First: How many drillholes are to be logged? How are they scattered? If several holes are within a few hundred meters from each other, they can be measured with the same cable loop.
- Second: Can You give conductivity (or resistivity) values for different rock types, including carbonaceous phyllites and the like, representative ore types? Can You send core samples of about 75 mm length if You don't have figures or easily can measure samples? The resistivities relevant for BHEM should be measured at DC or a low AC frequency (below 10 kHz).
- Third: Can You estimate the resistivity of the rocks between the ground and the ore zone? (More than 5000 ohm-meters is no problem at all.)
- Fourth: Is it essential to differentiate carbonaceous sediments from ore? Is the target sediments and ore in combination or ore alone?

Best regards,

Henrik Sundén

Henrik Sundén
Senior Geophysicist



Curragh
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1989 01 10

Nils-Erik Marinder
Boliden Mineral A.B.
Exploration Department
5 - 936 00
Boliden, Sweden

Dear Mr. Marinder:

This letter relates to your discussions with Mr. Gregg Jilson concerning possible borehole geophysical surveys as part of the Boliden-Curragh Technical Services Agreement.

We are considering the use of borehole geophysics in our exploration program near Faro, Yukon, during Summer 1989. The target is unexposed stratiform Pb-Zn deposits similar to those previously discovered in the Anvil District.


The deposits typically occur as tabular lenses hosted by pelites which have been metamorphosed to phyllites or schists. Locally the pelites are carbonaceous. Metabasite sills and dykes are also scattered through the favourable stratigraphic sequence. The deposits are generally tabular subparallel to a shallowly dipping metamorphic schistosity. Ores for these deposits consist of massive pyritic sulphides and disseminated sulphides in quartzites.

Prime exploration areas are geologic along-strike extensions of the Faro and Vangorda massive sulphid deposits. Both areas currently have some NQ diamond drill holes completed in 1988 to depths of 300 meters. Additional drilling is scheduled for Summer 1989.

If you are interested in participating in this program, please forward information concerning appropriate borehole geophysical techniques, considering the exploration target. Data concerning the areal coverage possible around a drill hole and estimated costs would be appreciated.

Sincerely yours,

CURRAGH RESOURCES INC.


Lee C. Pigage
Senior Geologist

Date
1987-12-07
Yours dated

Reference

Your reference

Attending to this matter
N-E Marinder/ba

Mr. Greg Jilson
Curragh Resources
117 Industrial Blvd.
WHITEHORSE, Y.T.
Y1A 2T8
CANADA

Dear Greg,

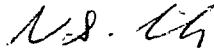
The best available information about our 3-D borehole EM seems to be this article published last year in connection with a symposium in Canada. It will give you some of the theoretical background and also some results from real exploration.

Today we use the method in reconnaissance drilling to check the rock volumes between drillholes and the surface. We also use it at target drilling to figure out geometrical features of ore bodies. I have enclosed a plot with an interpretation from one of our current exploration cases.

The visit to Faro and Whitehorse was very interesting. You certainly have the potential for many years of operation there. We also had a very nice trip the last day of the visit and saw all the beautiful sceneries between Whitehorse and Skagway.

As soon as we get the information about Vangorda and Grum we will start thinking about the design of a geogas test program.

Best regards,



Nils-Erik Marinder

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