Boliden Summary Report

Resources and Reserves | 2020

Rockliden

Prepared by
Lina Åberg

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1 SUMMARY

The Rockliden mineralization is situated in Västernorrland, in Örnsköldsvid municipality, about 200 km SW of Boliden. The mineralization is interpreted as a typical Volcanic Massive Sulphide (VMS) deposit and shows a complex geometry of faulting and folding. The deposit has probably formed as one single lens, which has been subjected to deformation after deposition, which resulted in at least seven massive sulphide lenses over a ca 400 m strike extension.

The reported figures summarized in the Table 1 below were originally reported in 2013 and remain unchanged from the previous year´s disclosure. Boliden changed reporting standards in 2018 from Fennoscandian Review Board (FRB) to the Pan-European Reserves and Resources Reporting Committee "PERC Reporting Standard 2017" (PERC). The reports and estimations summarized here are compiled according to the previous standard (FRB) but intends to comply with PERC. Boliden consider this data accurate and reliable. There are currently not and have not previously been reported any mineral reserves for Rockliden. Rockliden mineral resources are reported with additional 15% waste dilution.

Table 1.Rockliden mineral resources with additional 15% waste dilution.

	2020								2019							
Classi-fication	**kton**	**Au (g/t)**	**Ag (g/t)**	**Cu (%)**	**Zn (%)**	**Pb (%)**	**As (%)**	**Sb (g/t)**	kton	Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	As (%)	Sb (g/t)
Mineral Resources																
Measured																
Indicated	**800**	**0.08**	**102**	**2.1**	**4.4**	**0.9**	**0.9**	**1800**	**800**	**0.08**	**102**	**2.1**	**4.4**	**0.9**	**0.9**	**1800**
Inferred	**9 190**	**0.05**	**47**	**1.7**	**3.9**	**0.4**	**0.6**	**670**	**9 190**	**0.05**	**47**	**1.7**	**3.9**	**0.4**	**0.6**	**670**

2 COMPETENCE

The Mineral Resource estimation for Rockliden is made by Boliden in 2013-14. The data from these estimations are compiled into this report by Lina Åberg. Multiple participants have been involved and contributed to this summary report. Roles and responsibilities are listed in Table 2

Table 2. Contributors and responsible competent persons for this report.

Description	Contributors	Responsible CP
Compilation of this report	Lina Åberg	Hans Årebäck
Geology	Jonas Lasskogen	Hans Årebäck
Resource estimations	Lina Åberg	Hans Årebäck
Mineral Processing	Stig Markström	Hans Årebäck
Mining	Per-Olov Andersson	Hans Årebäck

Hans Årebäck works for Boliden as a Senior Project Manager at Business Development and is a member FAMMP[1]. Hans Årebäck has over 20 years of experience in the Exploration and Mining industry.

[1] Fennoscandian Association for Metals and Minerals Professionals

3 GENERAL INTRODUCTION

This report is issued annually to inform the public (shareholders and potential investors) of the mineral assets in Rockliden held by Boliden. The report is a summary of internal reports for Rockliden. Boliden method of reporting Mineral Resources and Mineral Reserves intends to comply with the Pan-European Standard for reporting of Exploration results, Mineral Resources and Mineral Reserves (The PERC Reporting standard 2017). It is an international reporting standard that has been adopted by the mining associations in Sweden (SveMin), Finland (FinnMin) and Norway (Norsk Bergindustri), to be used for exploration and mining companies within the Nordic counties.

3.1 Pan-European Standard for Reporting of Exploration Results, Mineral Resources and Mineral Reserves – The PERC Reporting Standard

PERC is the organisation responsible for setting standards for public reporting of Exploration Results, Mineral Resources and Mineral Reserves by companies listed on markets in Europe. PERC is a member of CRIRSCO, the Committee for Mineral Reserves International Reporting Standards, and the PERC Reporting Standard is fully aligned with the CRIRSCO Reporting Template.

The PERC standard sets out minimum standards, recommendations and guidelines for Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves in Europe.

3.2 Definitions

Public Reports on Exploration Results, Mineral Resources and/or Mineral Reserves must only use terms set out in the PERC standard.

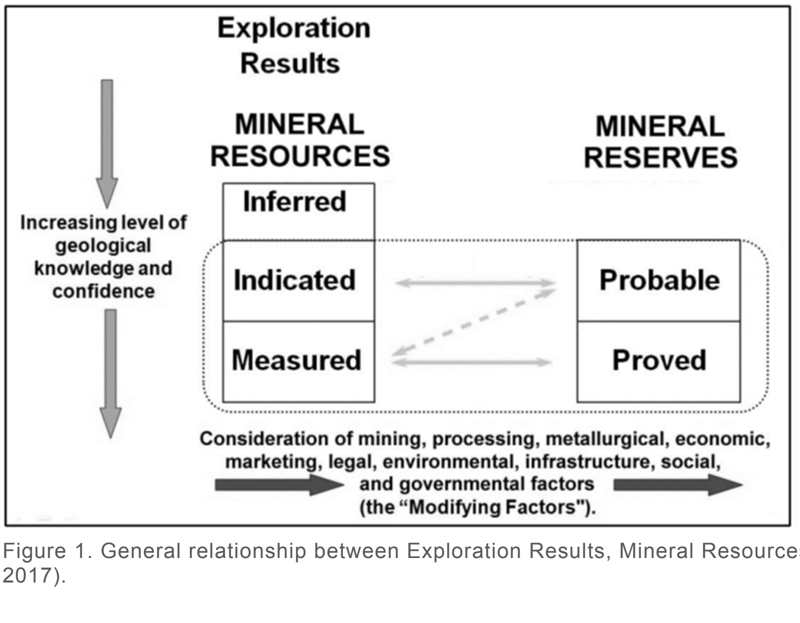

Figure 1. General relationship between Exploration Results, Mineral Resources and Mineral Reserves (PERC 2017).

3.2.1 Mineral Resource

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

3.2.2 Mineral Reserve

A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

4 ROCKLIDEN

The Rockliden mineralization is interpreted as a typical Volcanic Massive Sulphide (VMS) deposit.). It was discovered in 1982 by Boliden staff after a period of geological field mapping in combination with geophysical surveys and diamond drilling. The main economic minerals of interest are sphalerite (ZnS), chalcopyrite ($CuFeS_2$) and galena (PbS). The deposit has probably formed as one single lens, which has been subjected to deformation after deposition.

4.1 Location

The Rockliden mineralization is situated in Västernorrland, in Örnsköldsviks municipality, about 200 km SW of Boliden (Figure 2). In general, road conditions are of high standard and quality. The nearest railway station is in Mellansel about 50 km SE of Solberg. The today nearest processing plant to Rockliden is that in Boliden.

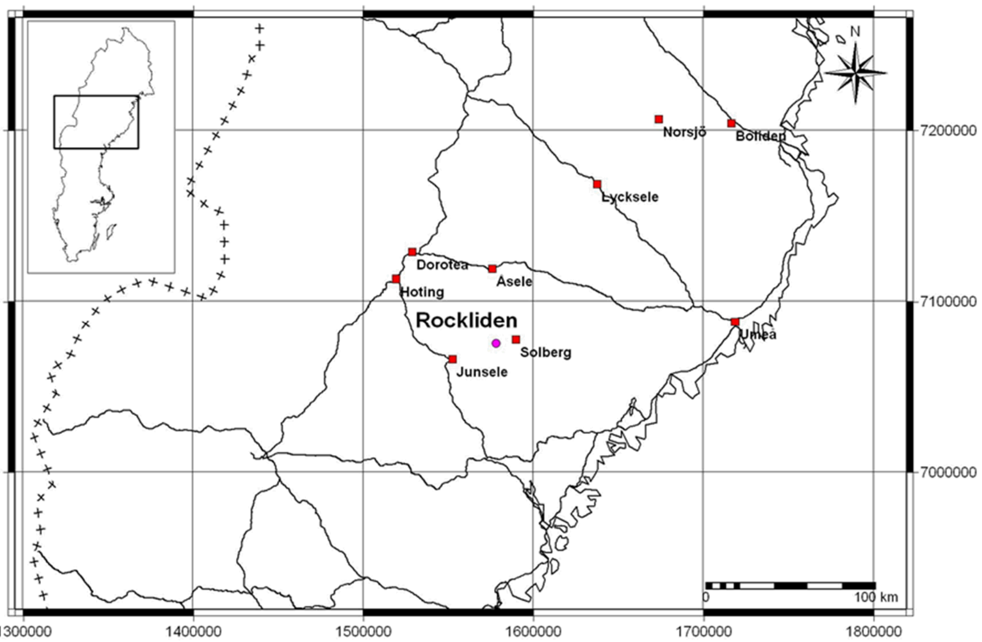

Figure 2.Overview of the north central part of Sweden and ints main roads. Location of the Rockliden deposit is indicated as a pink dot (RT90 7072250N/1578230E).

4.2 History

Boliden started exploration in the Rockliden area around 1930. Boulder hunting resulted in the discovery of a copper mineralization at Solberg, however grades were not of any economic interest.

During the 1940's exploration focused on nickel, related to a major gabbroic intrusion (the Kläppsjö gabbro), which is situated 10km southwest of Rockliden. No mineralization of economic interest was encountered.

The annual mineral hunt of 1975 came up with an interesting copper-nickel mineralized boulder 20km SE of Solberg. Boliden performed both airborne- and ground geophysical surveys. Traces of copper-nickel mineralization were discovered (25km east of Rockliden) but noting of economic interest.

In 1981 exploration started again with boulder tracing, mapping followed by geophysical. The first hole was drilled in 1982. Massive sulphides of significant width were first identified in trenches followed by the first drillhole (ROE14) intercepting mineralization in 1983.

In 1984 the first resource estimation resulted in 1 Mt massive sulphide mineralization. The overburden/glacial till was removed in 1985, uncovering the Rockliden mineralization at surface. Metallurgical tests were made in 1985 and showed significant metallurgical problems. The copper concentrate was not sellable due to high antimony content.

Exploration started again in 2007 and continued up to 2015. In 2010 a resource estimation and a conceptual study was conducted. After exploration drilling in 2012 -2013, with the main focus to increases the mineral resource, a new ore interpretation and estimation was made, followed by study.

The Scoping study was completed in 2014.

The high content of deleterious elements (Hg, Sb and As) in the concentrates is one of the challenges to be further investigated if advancing this project.

4.3 Ownership

The land where the Rockliden mineralization is located is owned by Holmen skog.

4.4 Permits

Boliden holds an exploitation concession, Rockliden K nr 1, which covers the deposit (Figure 3). The concession was granted 2002-04-25 with a validity period of 25 years. The concession area is relatively small, covering an area of 36.01 hectares.

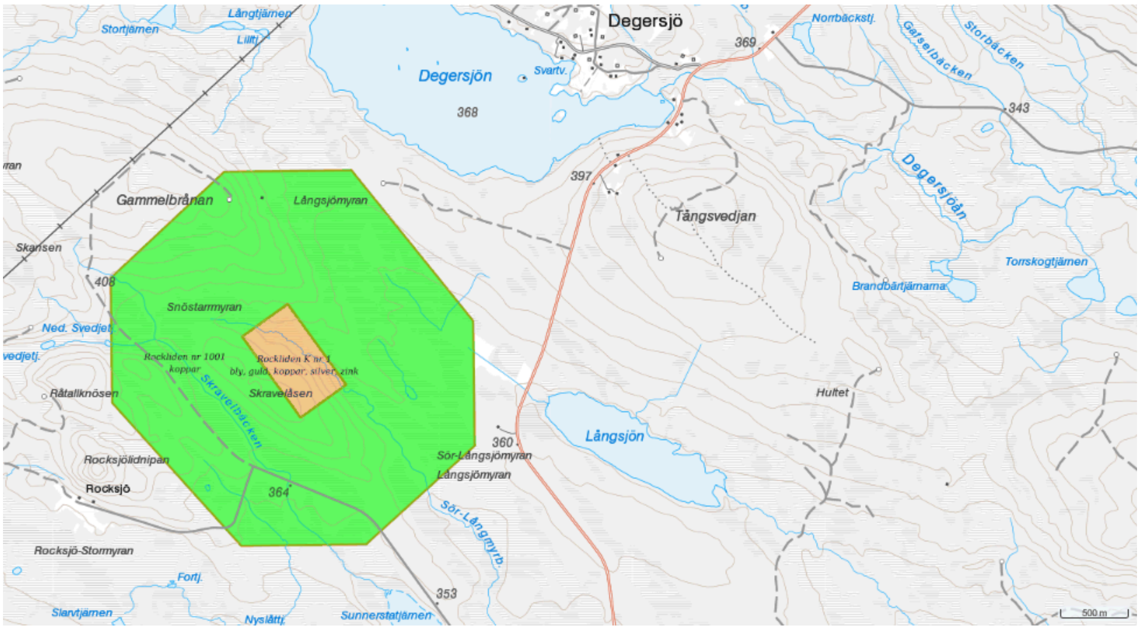

Figure 3. Exploitation concession (Rockliden K nr1 in orange) and exploration permit (Rockliden 1001) in green) in Rockliden.

Boliden holds today one exploration permit (Rockliden 1001) around Rockliden (figure 3 and table 3).

Table 3. Boliden's exploration permits around Rockliden.

Exploration permit	Expiration date	Comment
Rockliden 1001	2020-07-14	

4.5 Geology

4.5.1 Regional geology

The following background is extracted from Raat (2009).

Rockliden is part of the Bothnian Basin (Figure 4). The Bothnian Basin is formed during the Svecokarelian orogeny (1.87-1.82 Ga) (Kousa & Lundqvist, 2000) and represents a major part of the Fennoscandian Shield. The Bothnian Basin is limited to the north and to the south respectively by the Skellefte and the Bergslagen Proterozoic volcanic arc, which coincide with ancient subduction zones.

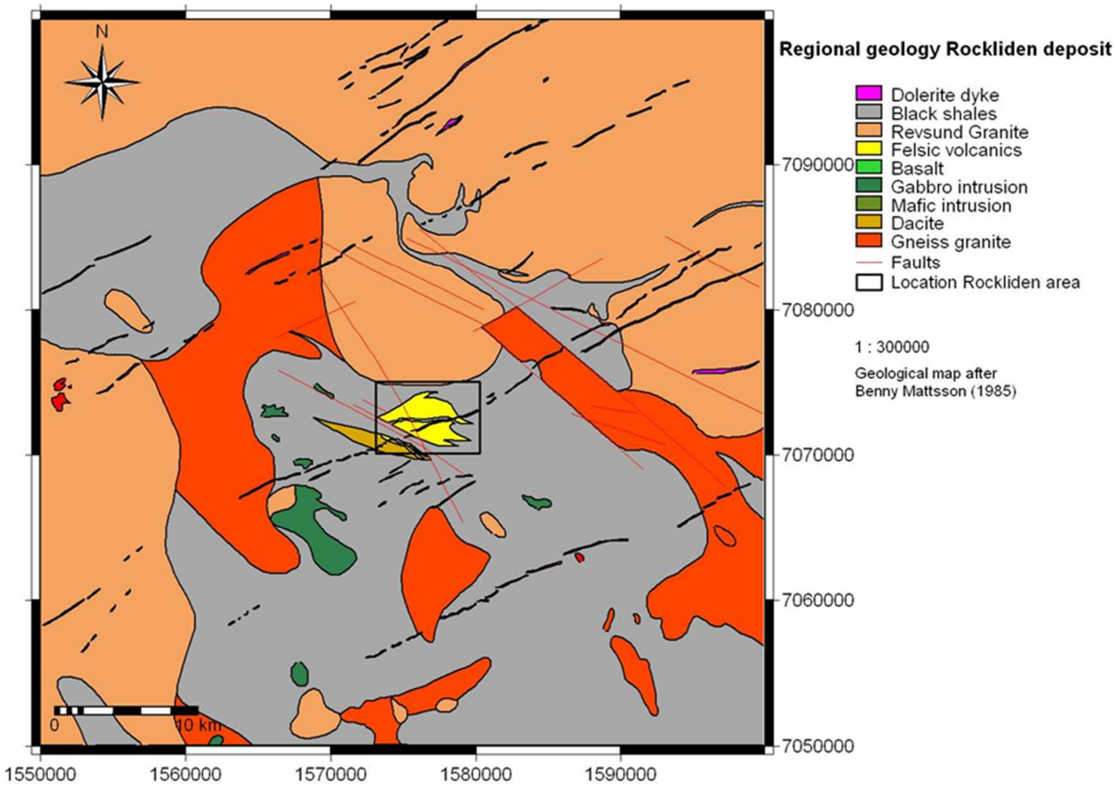

Figure 4. Overview of the regional geology after Mattsson & Heeroma (1985). A square box in the middle indicates the location of Rockliden. A zoom-in on the local geology can be seen in Figure 5.

The supracrustal rocks of the Bothnian Basin are defined as the Härnö Group (2,0-1,87 Ga) by Kousa & Lundqvist (2000). The Härnö Group is mainly composed of turbiditic greywackes and argillitic sedimentary rocks with minor intercalations of mainly mafic but also felsic volcanic rocks. Several granitoid intrusions, belonging to the Svecokarelian orogeny (1,87-1,82 Ga), are noticed and spread over the Bothnian Basin. Late intruding dolerite dykes (1,27-1,22 Ga) occur in a NE-SW trending direction crosscutting the basin.

4.5.2 Local Geology

The Rockliden area is dominated by sedimentary rocks of greywackes and shales surrounded by the later magmatic intrusions and with a number of enclaves of coherent and volcaniclastic rhyolites and dacites, of which two are some size - the main volcanic area spans 5x4 km and the southern 1x10km.

4.5.3 Property geology

The main area hosts the known mineralizations of Rockliden and Skravelåsen South and is composed of a volcanic stratigraphy of intervening coherent dacites (orange) and volcaniclastic rhyolites (yellow) striking east-west to southwest-northeast, and dipping 70º to 80º(Figure 5). Several smaller volcanic lenses are found east and north of the main area and numerous mafic dykes in the entire area.

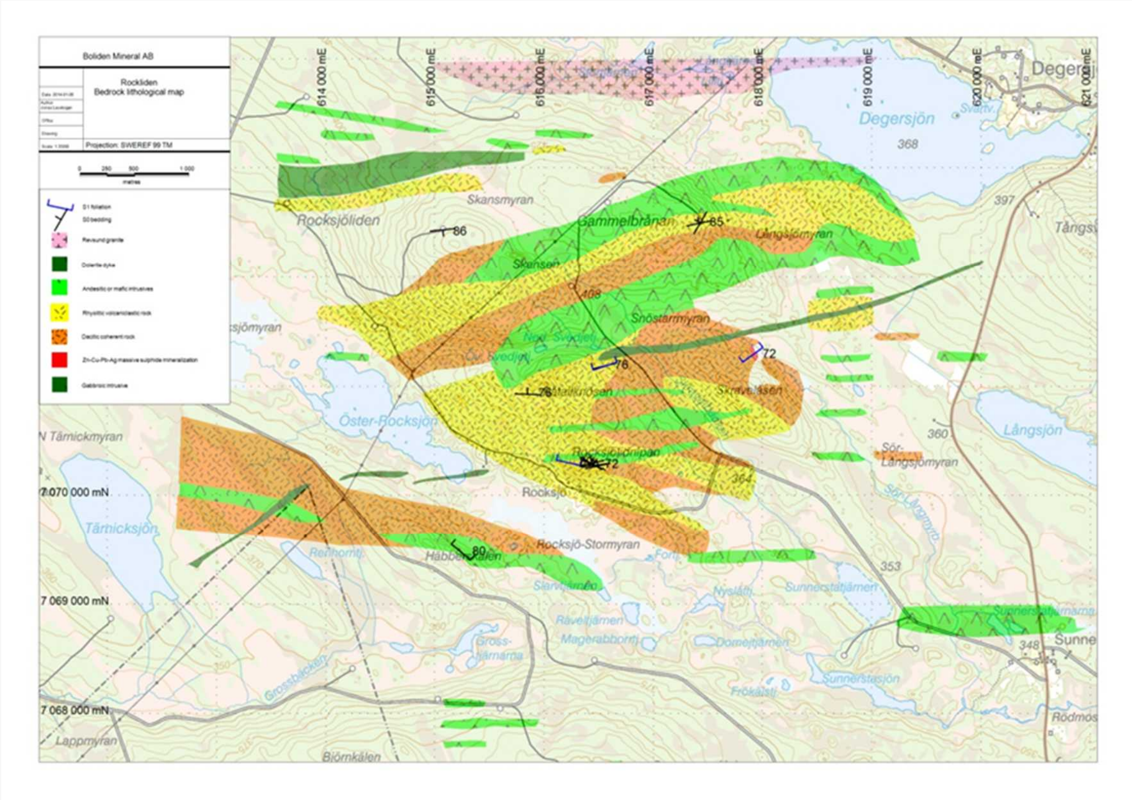

Figure 5. 2013 geological map of the Rockliden area volcanic rocks based on outcrop data and bedrock rock chip geochemistry.

4.5.4 Mineralization

The Rockliden mineralization is interpreted as a typical Volcanic Massive Sulphide (VMS) deposit. The main economic minerals of interest are sphalerite (ZnS), chalcopyrite (CuFeS2) and galena (PbS). The Rockliden mineralization shows a complex geometry of faulting and folding. The deposit has probably formed as one single lens, which has been subjected to deformation after deposition. Deformation has resulted in at least seven massive sulphide lenses over a 400 m strike extension. Later remobilization along fault planes has been transporting mainly chalcopyrite and pyrrhotite, forming secondary, but significant, lenses.

The Rockliden deposit can be divided into three different parts.

1. massive sulphides in the main mineralization (sphalerite, chalcopyrite, silver/tetrahedrite, pyrrhotite, pyrite)
2. weak to strong impregnation and stringer mineralization below the massive sulphides (chalcopyrite, pyrrhotite, pyrite)
3. remobilized ore shoots along fault planes (chalcopyrite and pyrrhotite)

The massive sulphide intersections are dominated by pyrite, pyrrhotite, chalcopyrite, sphalerite, galena, tetrahedrite and bournonite. Antimony (Sb) occurs in tetrahedrite and bournonite. The lenses pinch and swell substantially and true thicknesses varies from 5 to 20 m. Zonation occurs repeatedly in all massive sulphide lenses. In the primary lenses, the lower part of the stratigraphy, close to the footwall, is in general richer in copper impregnation and stringer mineralization. The middle part of the lenses is generally richest in zinc. The part closest to the hanging wall is commonly rich in pyrrhotite and copper. Zinc grades increase and copper decrease towards the central part of the deposit. Copper, zinc and silver grades are consistent towards the deeper part of the mineralization whereas antimony grades decrease. Smaller intervals of strong impregnation to semi-massive arsenopyrite are common in most massive sulphide intersections, and generally correlate with increased values of arsenic, antimony and lesser quicksilver. Sulphosalts occur around wall rock fragments and in fractures in some lenses.

The thickness of the impregnation zone just below the massive sulphides is irregular. It can vary from one meter up to 30 meters or more and consists of mainly pyrite and pyrrhotite. Chalcopyrite impregnations vary from weak to strong and increase towards the massive mineralization. Arsenopyrite is noticed here and there and increase towards the massive mineralization.

4.6 Exploration procedures and data

4.6.1 Drilling techniques

Boliden has explored the area in campaigns using diamond drilling since the discovery in 1982. A total of 161 diamond drill holes have been drilled towards the Rockliden mineralization and in its vicinity. Different drill entrepreneurs have performed the drilling, see Table 4.

Table 4.Diamond drilling performed in Rockliden area.

Contractor	Period	Hole no. (ROD-ROE)	Total length	Dimension
Boliden Mineral AB	1982-1984	1-67	12 343 m	46 mm
Boliden Mineral AB	1984-1986	68-102	10 786 m	56 and 58 mm
RATE/Bergteamet	2007-2009	103-114	8 474 m	56 mm
Drillcon/Smoy	2010	115-119 (not 118)	3 168 m	?
Protek	2011	120-131	5 046 m	?
Styrud	2012	132-142	10 426 m	60 and 75.7 mm
Styrud/Devico	2013	143-163	10 426 m	60 and 75.7 mm
		Total 158 holes	**56 170 m**	

In the early 80's, it was normal to use 46mm rods (ROE 1 –67), especially for drilling short holes. However, the deviation of the slightly deeper holes (+300m) was sometimes problematic. Therefore, when drilling deeper holes, 58mm rods and a stronger engine resulted in straighter holes (ROE 68-102). During the drill campaign (2007-2009) 56mm rods were used (ROE 103-114). No information about used rod dimensions during drill campaigns 2010-2011 are to be found in reports or database. During drill campaign 2012-2013 two different kinds of drill rods were used; normal drilling NQ=60 mm and directional drilling BQ=75,7 mm. These give a drill core of 36,5 mm and 47,6 mm respectively.

4.6.2 Downhole surveying

All holes from the first drill campaign (except ROE 102) have been measured for deviation. Around 90% of the holes have been measured by BHEM (down hole electromagnetics). During the last major drill campaigns all holes have been measured for deviation and down hole EM. This information is valuable for interpretation and decision making statements, concerning when to finish the hole.

4.6.3 Sampling

The majority of the sampled material deals with drilled core with an average diameter of around 42mm with 56mm rods. Assay samples follow geological boundaries and try to cover mineralized section in a homogenous way (separating (strong) impregnations from semi-massive from massive). Drill core sections vary between 0.10 and 7.40m, with an average length of 2 meter (1.96m). After logging and indicating sections for analysis, the core was splitted lengthwise with a hydraulic splitter. A water driven rock saw was used during the last drill campaign (Raat, 2009).
Samples were prepared according to international standards by the representative laboratories. This includes weighting, drying, crushing, splitting and pulverizing to 75 microns before starting analysis (Raat, 2009).

4.6.4 Density

Density measurements have been done on drill core from the mineralized parts of the deposit. In 2010 (Wiik, 2009) the measurements from 2009 and 1985 were compared to the standard density formula for massive sulphides used by Boliden:

Density = 2.7 + 0.0043Cu + 0.004Zn + 0.02Pb + 0.027As + 0.0375S
(Larsson & Agmalm, 1994)

The results show weak linear relations between measured density and theoretical density. In general measurements give higher density compared to formula. Especially measured massive sulphides give higher density (about 10%). This goes for both 1985 and 2009 measurements (Figure 6).

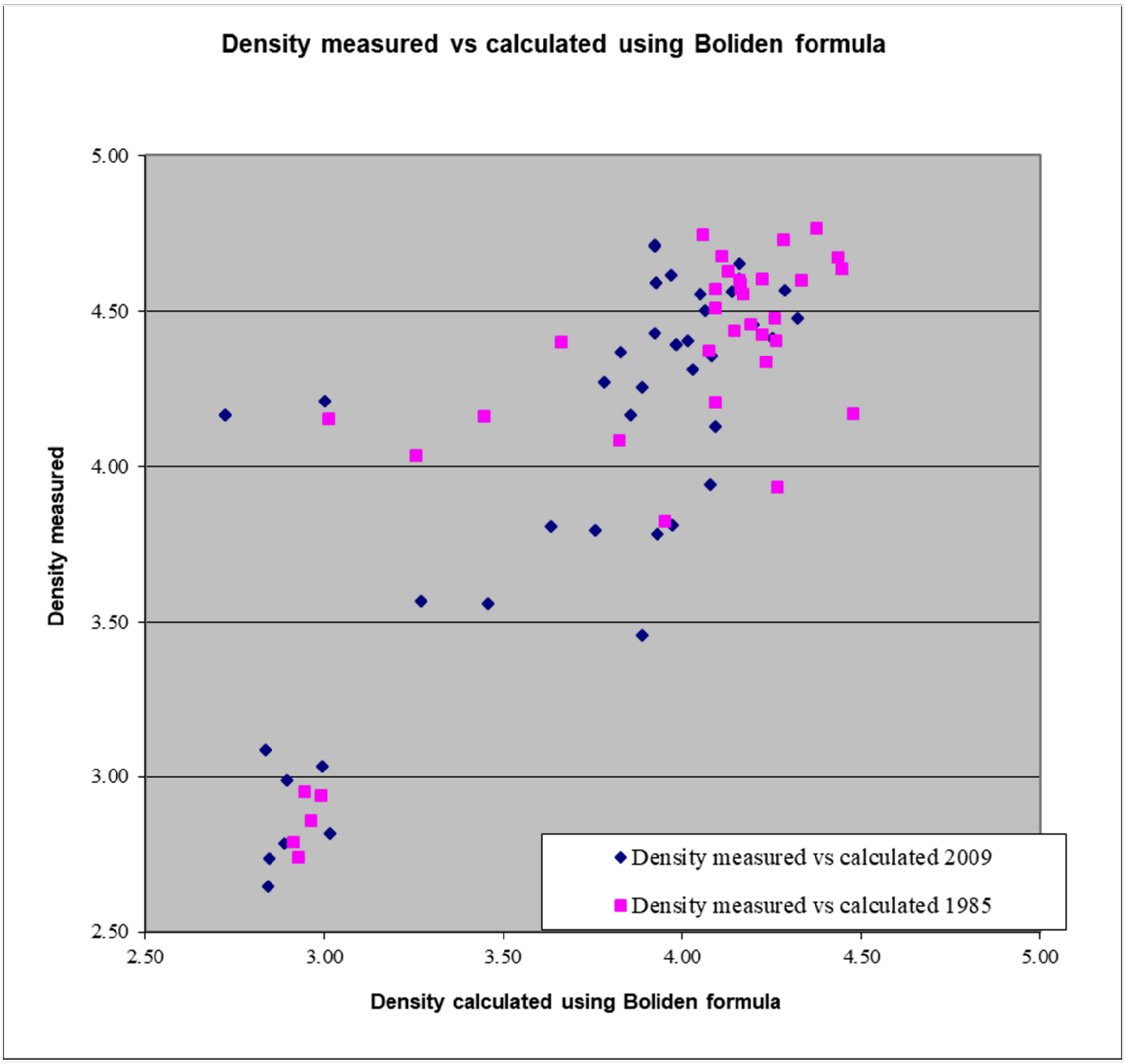

Figure 6.Weak linear relations between measured density and theoretical density.

After raising the S factor in the standard formula from 0.0375 to 0.047 by "trial-and-error method" the relation seems more linear (Figure 7). This could be due to the presence of pyrrhotite in the deposit and not in the formula.

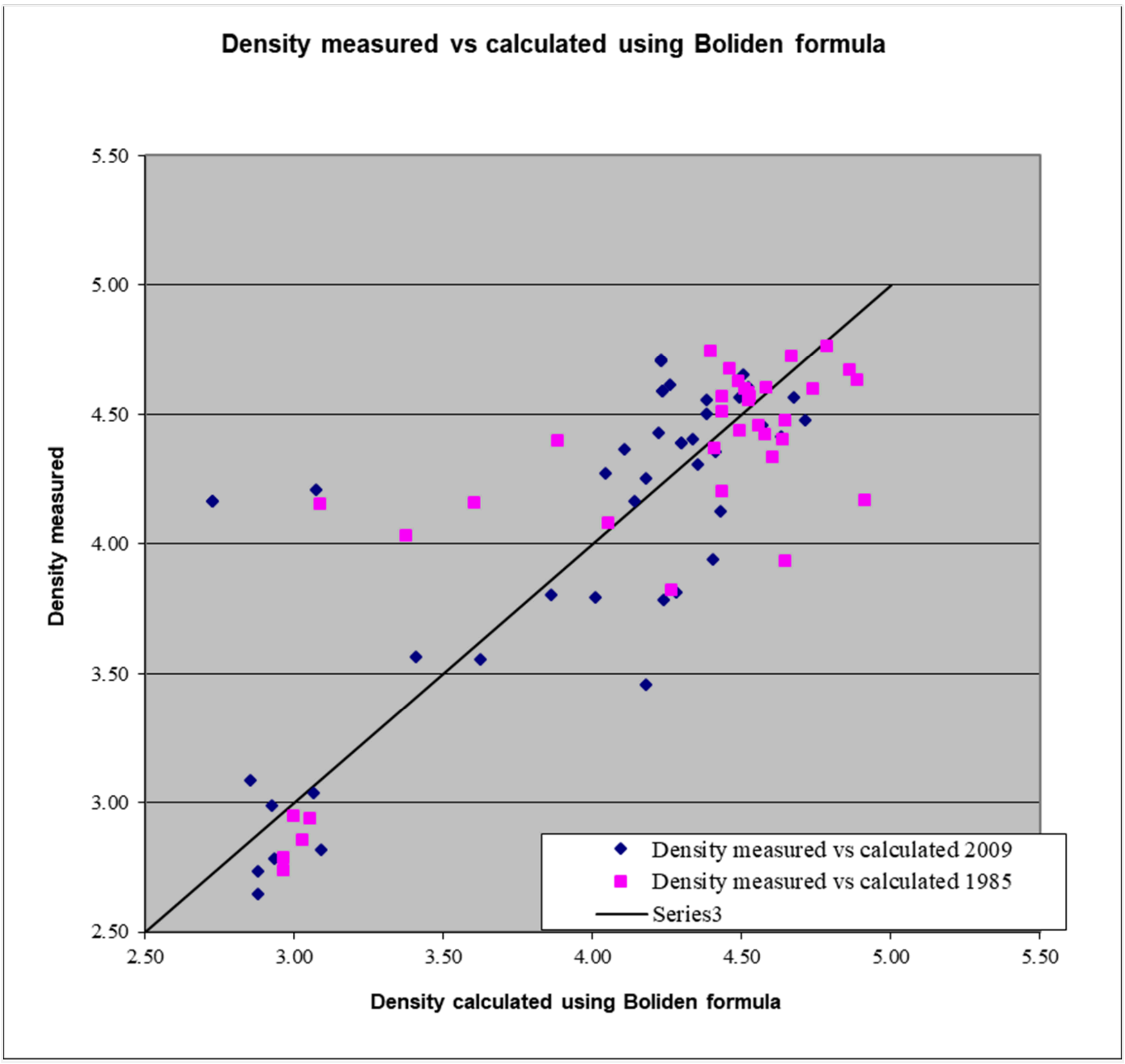

Figure 7.More linear relations after raising the S factor in the formula.

Formula used in this estimation is the same as the one used in 2009:

Density = 2.7 + 0.0043Cu + 0.004Zn + 0.02Pb + 0.027As + 0.047S

4.6.5 QAQC

No information can be given on the quality control of assay samples during the drill campaign in the 1980's (Raat, 2009).

During the drill campaign 2007-2009, around every 20th sample has been duplicated. Several samples from ROE 107, 108, 111 and 114 were sent to Rönnskär for quality control. Results are generally good. Au and Sb do not show linear relations probably due to element detection limits (Raat, 2009). Apart from duplicates no reference samples, blanks, randomisation or other types of controls have been used.

No information is found regarding the QAQC system and results from drill campaign 2010.

In 2011 international standards were sent with the batches, 1-1.5% standards in one batch according to internal recommendations by Boliden Mineral.

During drill campaign 2012-2013 standards, blanks and check assays has been sampled as described in the company QAQC policy. Standards and check assays are used to monitor the accuracy in analysis. International standards GBM308-13, GBM309-16 and GBM908-14 are added to every batch with 2-2.5% frequence. Blanks are added with a frequency of 2% ,minimum one blank per batch. Blanks are used to check the possible contamination in the lab. The blank samples are silica sand, and are placed after high grade samples. None of the blanks values are too high according to the company QAQC policy.
Check assays are added with 1% frequency or minimum one per batch. Check assays are analyzed in the Rönnskar lab to account for any errors by ALS Chemex. Most differences are within 5%. However one sample for silver in ROE 136 and one for lead in ROE 137 by far exceeds the acceptable level. Duplicates are not sampled constantly and will therefore not be report (Lasskogen, 2013).

4.7 Exploration activities

No exploration activities occurred in the Rockliden area during 2019.

4.8 Mining methods, processing and infrastructure

There is no Mineral Reserve defined in Rockliden but some mining assumptions are used in the Mineral Resource estimation. The following chapter is extracted from the Boliden internal Scoping study final report, Årebäck (2014).

4.8.1 Mining methods

Scoping study level investigations shows that the main mining alternative for Rockliden is a minor open pit, in combination with underground open stoping mining.

4.8.2 Mineral processing

Mineral processing of the Rockliden deposit aims to produce two separate concentrates (copper and zinc). According to results from laboratory tests, done on material from drill core the ore is fine grained and requires a fine grinding size in order to obtain good metal recoveries.
The upper parts of the lenses have a high concentration of lead and antimony, which pollutes the copper concentrate. Using conventional flotation will produce a copper concentrate high in Sb and a zinc concentrate high in Hg. To get the concentrates salable will require further treatment such as Cu/Pb-separation or Sb sulphide. The Boliden in house Technical department has performed several separate R & D-projects on these issues.

4.9 Prices, terms and costs

Anticipated operational costs at an underground operation in Rockliden with a small process plant is set to a minimum of 500 SEK/t. The cut-off of 500 SEK/ton was chosen as reasonable when evaluating mining- and processing costs in Boliden operations using similar mining methods. For the Mineral Resource estimate, a cut-off of 500SEK/ton was used as a guide to identify the area for the resource estimation

The present Mineral Resource Estimation was made in 2013, prices and exchange rates used for the estimation are presented in Table 5.

Table 5.Long term planning prices and exchange rates (LTP) used for the Mineral Resource estimation.

Metal/exchange rate	Long-term planning terms, 2013
Copper	USD 6 600/tonne
Zinc	USD 2 300/ton
Lead	USD 2 300/ton
Gold	USD 1 200/tr.oz
Silver	USD 20/tr.oz
USD/SEK	6.50

4.10 Mineral resources

All information about the most recent mineral resource estimation is from report Rockliden Resource Estimation 2014 by Boliden employee Lina Åberg. Boliden changed reporting standards in 2018 from Fennoscandian Review Board (FRB) to the Pan-European Reserves and Resources Reporting Committee (PERC) "PERC Reporting Standard 2017". The reports and estimations summarized here are compiled according to the previous standard (FRB) but intends to comply with PERC. Boliden consider this data accurate and reliable.

Mineralized domains were defined, using CAD program Microstation with ad-on program Propack, based on analyzed grades in drill hole sections and geological 2D interpretations (horizontal and profile). 2D ore interpretations were drawn based on the defined ore sections along drill holes.
Based on the 2D ore interpretations a three dimensional model was made and a block model was created within the domains.

Block model with block size set to 5*5*10m (x, y and z respectively) with one subdivision was used.

Gold, silver, copper, zinc, lead, arsenic, sulphur, antimony and bismuth have been continuously assayed in all newer drill holes but for older drill holes arsenic, sulphur, antimony and bismuth are not continuously assayed. These sections were left as absent values which means that the estimation is done with fewer data and the grades from the vicinity will blend in.

Non analyzed sections within the domains are made up of cross-cutting intrusive non mineralized geological units. These sections were after discussions with the project geologist set to zero grades for all elements.

Composite assay data (histograms) from the different domains showed that top capping was not necessary for any elements.

No limitation in composite length was given, which means that composite length = drill hole section length. In early stage estimations with sparse drill hole information this gives a stable estimation. The estimation does not give grade variation across the ore.

Gold, silver, copper, zinc, lead, arsenic, sulphur, antimony and bismuth were estimated for all domains in the Rockliden mineralization using Inverse Power of distance.

The Rockliden mineralization is classified as Inferred or Indicated Mineral resource (Table 6 and Figure 8). The classification is based on geological understanding and continuity together with quality and quantity of drill hole data. A drill spacing of 80x80 m is used as a guide for Inferred Resource and reasonable assumed geological continuity in combination with a 40x40 m drill pattern is used for Indicated Resource.

Table 6. Rockliden Mineral Resource statement 2020, figures are presented with 15% waste dilution.

Mineral Resources Classification	Kton	Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	As (%)	Sb (g/t)
Indicated	800	0.08	102	2.1	4.4	0.9	0.9	1800
Inferred	9 190	0.05	47	1.7	3.9	0.4	0.6	670

Generally the deposit, and the central lens in particular, is quite densely drilled down to 200m. The geological relations in this area are also consistent, hence this part of the central lens is classified as Indicated resource. The rest of the central Ore down to ca 300m are classified as Inferred Mineral resource. The two other majr lenses are classified as Inferred Mineral resource.

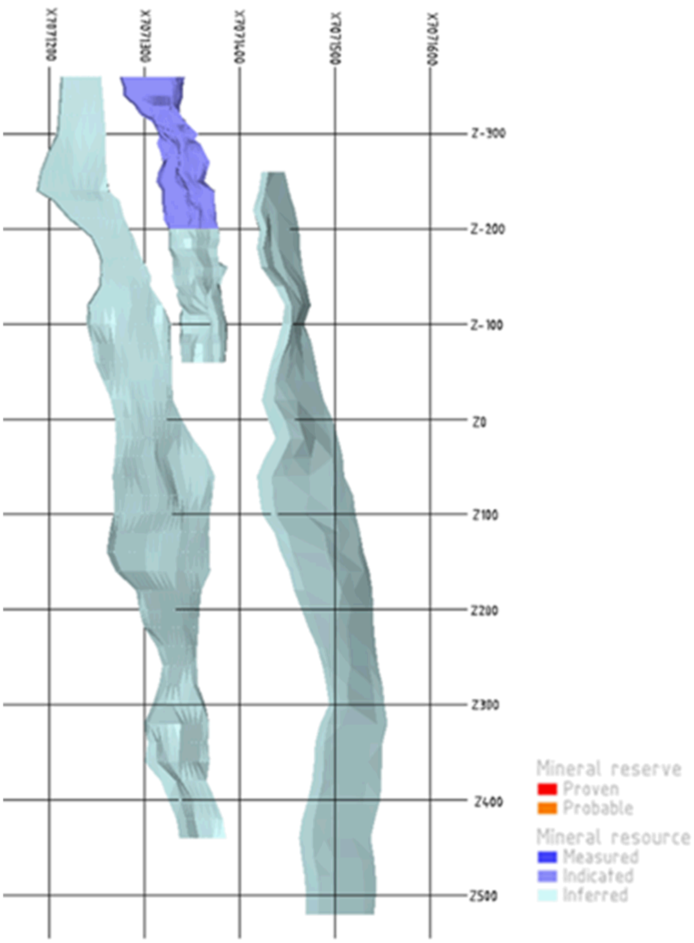

Figure 8. Overview of the Rockliden Mineral Resources (looking west in national coordinate system R90).

4.11 Mineral reserves

There are currently no mineral reserve classified for the Rockliden project.

4.12 Comparison with previous year

No changes have been made to mineral resources in the Rockliden project since 2013. The first resource estimation for Rockliden was made in 1985. At this date, three different estimations has been made for Rockliden (Table 7).

Table 7. Comparison with previous resource estimations. Figures represent total tonnage (i.e. indicated and inferred).

Estimation	Resource Mt	Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	As (%)	S (%)	Sb (g/t)
1985	2.2	-	94	2.0	5.6	0.9	0.9	27	0.18
2010	4,6	0.1	78	1.9	4.3	0.7	0.6	22	0.14
2013	10	0.1	51	1.7	3.9	0.5	0.6	24	0.08

Exploration drilling toward depth during 2012 and 2013 led to more geological knowledge and more analytical support to increase the total resource.

4.13 Reconciliation

Not applicable for this project due to no production.

5 REFERENCES

5.1 Public references

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