

Boliden Summary Report

Resources and Reserves | 2018

Petiknäs Norra



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Front page: Picture showing Petiknäs mine site from 2007

1 SUMMARY

Petiknäs Norra is close to the Petiknäs mine that was mined out and closed in 2007. A drift was made to the mineralisation and 25 000 ton where test mined in 1997. In the year of 2007 a Scooping Study and a Mineral Resource estimation was made on Petiknäs Norra. The study could not present a processing method that was economically viable and no estimations or studies has been conducted on Petiknäs Norra since 2007. When reviewing the documentation on the resource estimation it is decided to downgrade some of the Mineral Resources to the figures presented in Table 1.

Table 1. Petiknäs Norra Mineral Resources. Estimated in 2007 but downgraded in 2018

		2018				
	kton	Au	Ag	Cu	Zn	Pb
Classification		(g/t)	(g/t)	(%)	(%)	(%)
Mineral Resources						
Indicated	310	8.1	73	1.8	3.1	0.3
Inferred	1 920	2.9	45	0.5	1.6	0.2

The Mineral Resources are defined with a horizontal minimum mining width of 5m and with 15 % waste dilution added.

2 COMPETENCE

The Mineral resource estimation was made in 2007 by Boliden staff according to the routines from that time. Those routines does not live up to current standard and a new Mineral Resource estimation is planned for 2019. The estimation results are reviewed by Gunnar Agmalm.

Table 2. Contributors and responsible competent persons for this report

Description	Contributors	Responsible CP
Compilation of this report	Gunnar Agmalm	Gunnar Agmalm
Geology	Roger Nordin	
Resource Estimations	Karen Wellman	

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3 GENERAL INTRODUCTION

This report is issued to inform the public (shareholders and potential investors) of the mineral assets in Petiknäs Norra held by Boliden. This report is a summary of public information and internal reports for Petiknäs Norra. Boliden is changing reporting standard from Fennoscandian Review Board (FRB) to the Pan-European Reserves and Resources Reporting Committee (PERC) "PERC Reporting Standard 2017". The PERC Reporting Standard is an international reporting standard that has been adopted by the mining

¹ Australian Institute of Mining and Metallurgy

² Fennoscandian Association for Metals and Minerals Professionals

associations in Sweden (SveMin), Finland (FinnMin) and Norway (Norsk Bergindustri), to be used for exploration and mining companies within the Nordic counties.

The previously used FRB standard will no longer be maintained. The PERC standard has more clearly defined requirements on reporting and on Competent Persons. Boliden is currently in the process of updating procedures and reports and estimations summarized here are compiled according to the previous standard (FRB). We consider this data accurate and reliable with the comments on classification later in this report. The process of creating PERC compliant estimations, studies and reports for all Projects and Mines is underway.

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. It is the European equivalent of JORC in Australasia, SAMREC in South Africa, and similar reserves standards bodies elsewhere. 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.

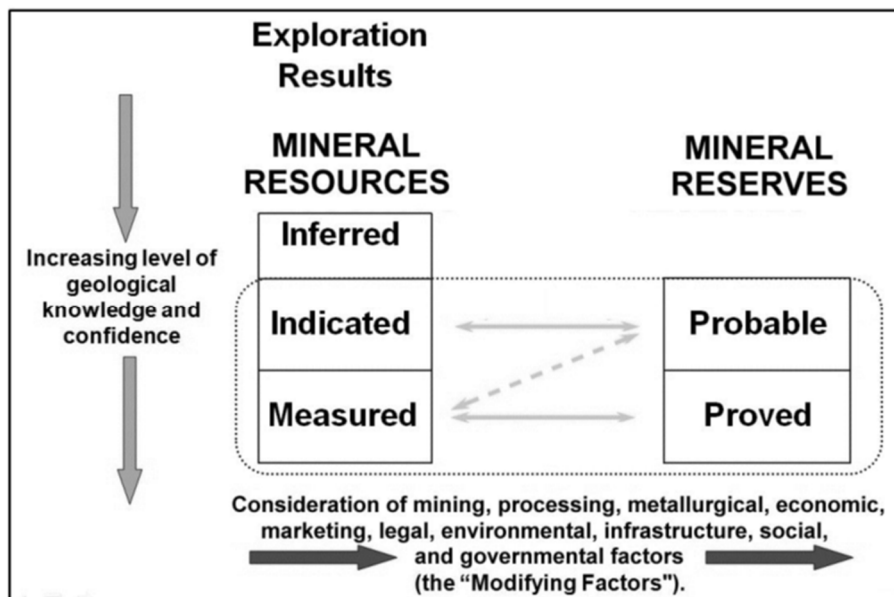


Figure 1. General relationship between Exploration Results, Mineral Resources and Mineral Reserves (PERC 2017).

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 PETIKNÄS NORRA

Petiknäs Norra is located close to the mined out Petiknäs (Södra) mine and they are connected with a ramp that reach Petiknäs Norra at 200 m level (200 m below surface). The ramp system is also connected to the operating Renström mine, which has a hoisting system from 940 m depth, with mining carried out to 1450 meters depth.

Petiknäs Norra is a massive sulphide mineralisation with values in gold, zinc, silver, copper and lead (see table 1).



Figure 2. Ramp system in Petiknäs (Södra) and Petiknäs Norra with schematic outline for mineralisation

4.1 Major changes and technical studies

No studies have been done since 2007 but a new study is planned for 2019. The study from 2007 could not show economic viability, mainly because of processing challenges that caused very high processing costs.

4.2 Location

The Petiknäs mine and Petiknäs Norra mineralisation are located in Norsjö municipality in Västerbotten, approximately 20 km west of the Boliden Area mill, and some 2-3 km west of the operating Renström mine. The distance between Petiknäs (Södra) and Petiknäs Norra deposits is 800 m.



Figure 3. Location for Petiknäs and Petiknäs Norra

4.3 History

Systematic exploration started in the Petiknäs area in 1983. Several drill programs were completed and Petiknäs Norra was intersected with the 19th hole. In 1989 ramp construction started towards Petiknäs Norra, but due to the discovery of the Petiknäs (Södra) deposit all activities were focused there. Mining in Petiknäs commenced in 1992 and ended in 2007. In total, 5.4 Mt ore was mined in Petiknäs.

A ramp was made from Petiknäs to Petiknäs Norra and in 1997 test mining and processing of 25 000 t was made at 200 m level, see Table 3.

Table 3. Tonnes and grades from test mining in Petiknäs Norra

Tonnes	Au (g/t)	Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	S (%)
24666	3.86	64	0.70	2.09	0.34	13.60

Exploration at Petiknäs Norra re-commenced in 2006, about 1 year before the Petiknäs Södra mine was scheduled to close. An exploration drift was made at 600 m level. Drilling targeting the deeper parts was made from this level and the results were evaluated in 2007. A new Mineral Resource estimation was made but the Scooping Study could not show economic viability.

4.4 Ownership and permits

Boliden has 100 % ownership of Petiknäs Norra. The valid mining lease Petiknäs K nr 1 was approved 2001-10-22. This mining lease is valid for 25 years.

4.5 Geology overview

The Paleoproterozoic Svecofennian, 1.87– 1.9 Ga, Skellefte field is situated in shield, Northern Sweden, covering an area of 120 km length and 30 km wide. The region hosts more than 85 pyritic Zn-Cu-Pb-Au-Ag massive sulfide deposits and also epigenetic gold deposits, being one of the most significant and richest mining districts within Sweden and Europe. The Skellefte field is one of the gold richest massive sulphide districts in the world.

4.5.1 Regional geology

The Skellefte field is a felsic dominated volcanic-magmatic area, hydrothermally and diagenetically altered. It is also metamorphosed, ranging from greenschist to amphibolite facies. From a structural point of view, the region is strongly deformed, characterized by tight vertical and sub vertical folds, affected by a complex system of shear zones and brittle faults. The stratigraphy is composed of a thick volcanic succession (named the Skellefte Group) overlain by sedimentary formations (named the Vargfors Group) and intruded by late granitoid intrusions.

4.5.2 Local Property Geology

The volcanic massive sulphide deposit, Petiknäs North, is located in the eastern part of Skellefte district. In the eastern part, the Petiknäs North structural block is separated from the Petiknäs South deposit by Petiknäs Main Fault Zone (PMFZ). The PMFZ represent a large regional scale shear zone with a northeast – southwest strike direction, which dips moderately southward. The Petiknäs North deposit is located directly underneath this fault zone. The upper part of the deposit was truncated by this fault.

The deposit is hosted by the felsic volcanic rhyolitic rocks. The stratigraphic footwall is composed of a large felsic volcanic complex, over 5 km in length, and more than 800 meters in thickness and in excess of 1 km in depth. This immediate host sequence is overlain by finer grained volcanic rocks. The hanging wall consists of mass flow breccias and black graphitic shales. The Petiknäs North area is intruded by barren dacite and andesite sills.

4.5.3 Mineralization

The Petiknäs North deposit is a 2 – 8 m thick sheet like deposit, with associated stringer mineralization below and above the ore horizon. The deposit is composed of a main A – lens, stratigraphically overlain by a secondary B – lens, occurring within a few 10's of meters from each other. The deposit has a vertical dip of 80 ° to north and a plunge angle of 70 ° to the east. The economic mineralization can be followed about 100 m on a north east – south west strike direction. The lenses are characterized by fine and medium grained mineralization, dominated by pyrite with sphalerite ZnS, chalcopyrite CuFeS₂, pyrrhotite FeS, arsenopyrite FeAsS and minor amounts of galena PbS and Ag-Sb-As-S minerals rich in silver and antimony. The deposit is very rich in gold, which mostly occur as electrum, i.e. a Au-Ag mineral. The highest gold grades are related to the copper rich parts of the ore body. The area with the highest amount of copper were found around the fault which separates the two A and B lenses.

4.6 Mining methods, mineral processing and infrastructure

4.6.1 Mining methods

There is no planned mining in Petiknäs Norra and the only mining assumptions used in the Mineral Resource estimation is a minimum horizontal mining width of 5 m and a waste dilution of 15 % added. The dilution is without grades and is based on experience from other mining operations.

4.6.2 Mineral processing

There are several processing tests done in Petiknäs Norra between 1987 and 2011 but high content of arsenic and antimony causes problems in concentrate quality and low metal recovery. There are technical solutions for the problems and those results are used for the Mineral Resource definition. The costs for these solutions have so far been too high for economic viability.

4.6.3 Infrastructure

All infrastructure facilities are basically in place since the previous mining at the Petiknäs mine. The nearby Renström mine has been in continuous operation since the 1950's. There is also a drift between Renström and Petiknäs and ore from Renström can be transported to surface using the existing Petiknäs ramp. Ore can be transported by truck approximately 25 km to the Boliden mill.

4.7 Prices, terms and costs

The present Mineral Resource Estimation and Scooping Study was made in 2007 and in Table 4 are prices used for that study.

Table 4. Long term planning prices used in Conceptual Study 2007

	Planning prices, 2007
Copper	USD 2 200/tonne
Zinc	USD 1 250/tonne
Lead	USD 650/tonne
Gold	USD 400/tr.oz
Silver	USD 5.5/tr.oz
USD/SEK	8.50

No strict cut-off is used for the resource estimation. It is based on the geological interpretation of the mineralization, although some low grade parts are excluded.

4.8 Mineral resources

The Mineral Resource estimation is done in Datamine Studio 3 in 2007. When reviewing the documentation on the resource estimation it was decided to downgrade some of the Mineral Resources presented in Table 5. Figure 4 show a longitudinal section of the interpreted mineralisation and the resource classification.

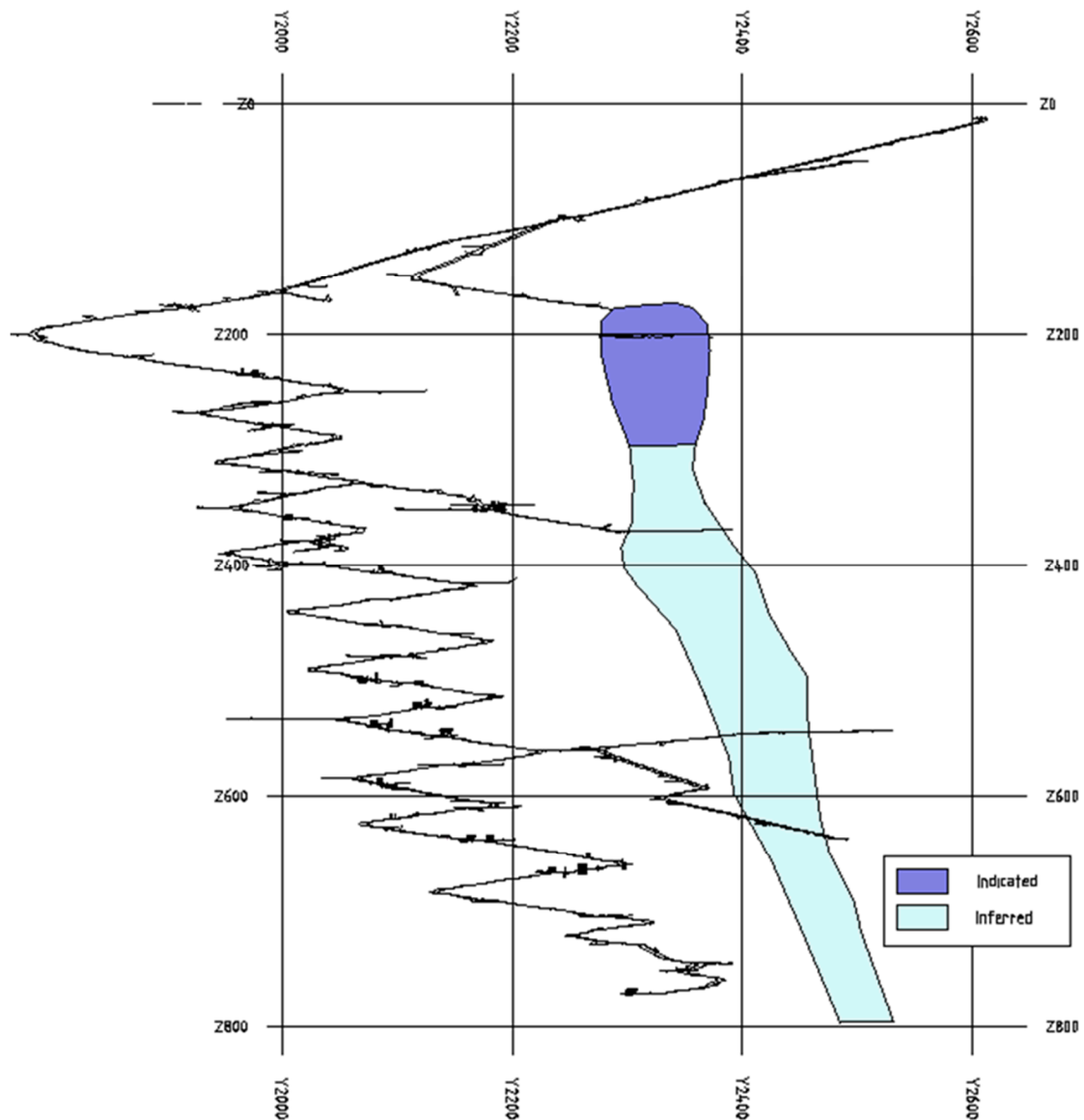


Figure 4. Longitudinal section looking north in Petiknäs local mine system. Ramp to the left is in Petiknäs (South) approximately 800 m from Petiknäs North

Table 5. Mineral Resources for Petiknäs Norra as of 2018-12-31. Figures with 15 % waste dilution added

Mineral Resource Classification	kton	Au (g/t)	2018 Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	kton	Au (g/t)	2007 Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	Comments
Measured							310	8.1	73	1.8	3.1	0.3	
Indicated	310	8.1	73	1.8	3.1	0.3	1 200	2.7	52	0.6	1.8	0.3	Measured downgraded to indicated
Sum M and I	310	8.1	73	1.8	3.1	0.3	1 510	3.8	56	0.8	2.1	0.3	
Inferred	1 920	2.9	45	0.5	1.6	0.2	720	3.3	33	0.5	1.2	0.2	Indicated downgraded to inferred

The documentation on the resource estimation from 2007 is poor and thus the classification was downgraded, although the total figures stay the same.

4.9 Mineral Reserves

There is no Mineral Reserve defined in Petiknäs Norra.

4.10 Comparison with previous estimation

The previous Mineral Resource estimation was made in 1999 before the last drill campaign. The total figures presented 2018 are the same as year 2007 total figures in Table 7.

Table 6. Results from previous Mineral Resource Estimation from 1999

Mineral Resource Classification	Kton	Au (g/t)	1999 Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	Sb	As (%)	S (%)	Dilution (%)
Measured	311	8.1	73	1.8	3.1	0.3	0.15	6.8	19	15
Indicated	757	5.8	67	1.3	3.2	0.3	0.14	6.2	17	15
Sum M and I	1 068	6.5	69	1.4	3.2	0.3	0.14	6.4	18	
Inferred	1 600	3.0	40	1.5	2.5	0.2	0.2	3.5	11	20

Table 7. Comparison between estimations total tonnes and grades for all resource classes

Mineral Resource Classification	kton	Au (g/t)	1999 Ag (g/t)	Cu (%)	Zn (%)	Pb (%)	Dilution (%)
1999	2668	4.0	52	1.5	2.8	0.2	15 - 20
2007	2230	3.7	49	0.7	1.8	0.2	15

5 REFERENCES

Pan-European Standard for reporting of Exploration results, Mineral Resources and Mineral Reserves (The PERC Reporting standard 2017). www.percstandard.eu