Boliden Summary Report

Resources and Reserves | 2018

Aitik

Prepared by
Peter Karlsson

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1 SUMMARY

Between 2018-12-31 and 2019-12-31 the mineral reserves decreased with 2% to 1 148 Mt (million metric tonnes). The mineral resources decreased with 2%. The main reason to the changes in the reserve was production.

Table 1. Summation of total Aitik operational area mineral reserves and resources per 2018-12-31. Reserves and resources from 2018-12-31 as comparison to the right

	2018				**2017**			
Classification	**kton**	**Au (g/t)**	**Ag (g/t)**	**Cu (%)**	kton	Au (g/t)	Ag (g/t)	Cu (%)
Mineral Reserve								
Proved	**787 000**	**0.15**	**1.2**	**0.22**	801 000	0.15	1.3	0.22
Probable	**361 000**	**0.13**	**1.2**	**0.23**	360 000	0.14	1.2	0.23
Total	**1 148 000**	**0.14**	**1.2**	**0.22**	**1 161 000**	**0.14**	**1.2**	**0.23**
Mineral Resource								
Measured	**204 000**	**0.08**	**0.8**	**0.15**	240 000	0.09	0.8	0.15
Indicated	**1 127 000**	**0.09**	**0.8**	**0.17**	1 116 000	0.09	0.8	0.17
Inferred	**175 000**	**0.11**	**0.5**	**0.14**	180 000	0.11	0.6	0.14
Total	**1 506 000**	**0.09**	**0.8**	**0.16**	**1 536 000**	**0.09**	**0.8**	**0.16**

2 GENERAL INTRODUCTION

This report is issued annually to inform the public (shareholders and potential investors) of the mineral assets in Aitik held by Boliden. The report is a summary of internal reports for Aitik. Boliden is changing method of reporting Mineral Resources and Mineral Reserves complies 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.

This report is the first Mineral Resources and Mineral Reserves summary report for Aitik based on the PERC Reporting standard. Until 2017 Boliden used the FRB standard (Fennoscandian Review Board) which will be no longer updated. Many of the estimations summarized in this report was made before the change from FRB to PERC. Boliden consider these estimations accurate enough to directly be reported under PERC although the process of replacing them with PERC compliant reported estimations have started. This is for Aitik confirmed with reconciliation of productions data.

2.1 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.

2.2 Definitions

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

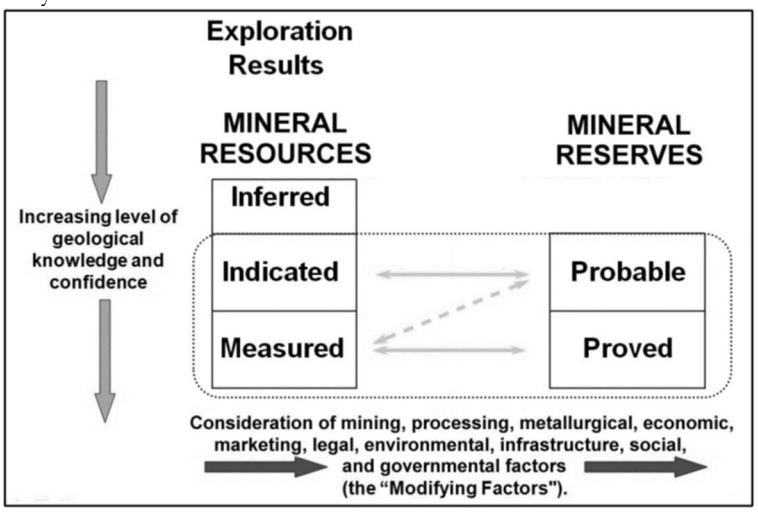

Figure 1. General relationship between Exploration Results, Mineral Resources and Mineral Reserves (PERC 2017).

2.2.1 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.

2.2.2 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.

2.3 Competence

The compilation of this report has been completed by a team of professionals who work directly for Boliden Mineral AB and are listed as contributors in Table 2 below. The report has been verified and approved by Gunnar Agmalm who is Boliden's Ore Reserves and Project Evaluation manager and a member of AusIMM[1] and FAMMP[2] .

Table 2. Contributors and responsible competent persons for this report

Description	Contributors	Responsible CP
Compilation of this report	Peter Karlsson	Gunnar Agmalm
Geology	Peter Karlsson	
Resource estimations	Ian McGimpsey	
Mineral processing	Anna Johansson	
Mining	Fredrik Thyni	
Environmental and legal permits	Åsa Sjöblom	

[1] Australian Institute of Mining and Metallurgy
[2] Fennoscandian Association for Metals and Minerals Professionals

3 AITIK

Aitik is a Cu-Au-Ag open pit mine consisting of two active pits; Salmijärvi and Aitik. Liikavaara, a satellite deposit 3km east of Aitik, is not yet in production. In Aitik, two pushbacks are active, namely S3 and N6. Salmijärvi has one pushback active; Sa2.The mined out ore tonnage in 2018 totaled 38 472 kt which is a decrease of 573 kt from last year. Copper is the most valuable commodity in Aitik, accounting for about 80 % of the revenue. The second most valuable commodity is Gold at 15 %, followed by Silver at 5%.

3.1 Major changes

In 2018 the total mineral reserves in Aitik decreased by 13.4 Mt (million metric tonnes) to 1 148 Mt. Measured and indicated resource in Aitik decreased by 25 Mt to 1 330 Mt. Inferred resource decreased by 5 Mt to 175 Mt.

3.1.1 Technical studies

During 2018 the Life of Mine Plan (LoMP) for Aitik was revised. This included some adjustments of the pushbacks design for the main pit as well as revisions on the mining sequence. One of the pushbacks was enlarged in order to make room for a future crusher, which gave a net addition of both waste rock and ore from the pushback compared to the previous design. The ore added to the pushback hence led to a transition of tonnes from the resource to reserve category. In 2018, the feasibility study for Liikavaara was completed with a positive outcome.

3.2 Location

The Aitik mine is located in Gällivare municipality, Norrbotten county, northern Sweden about 60 km north of the Arctic Circle and 15 km east of Gällivare town center (Figure 2). The Liikavaara deposit is located 3 km east of Aitik. The mining area consists of two open pits (Aitik and Salmijärvi), waste rock and overburden dumps, an industrial area hosting maintenance and office facilities, a concentrator plant, a tailings magazine, and a rail transport terminal.

Sulphide concentrate, containing payable copper, gold, and silver, is transported by rail to Boliden Mineral AB's Rönnskär smelter located about 350 km to the south of Aitik in Skelleftehamn.

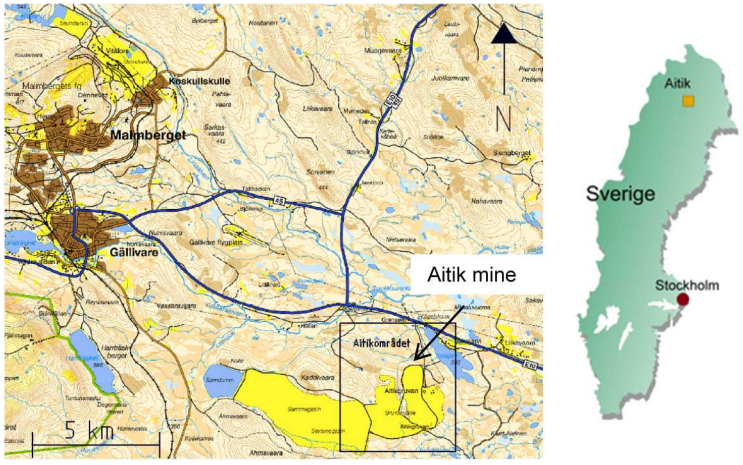

Figure 2. Location of the Aitik mine

3.3 History

The following is a short summary describing the discovery and development of the Aitik deposit:

- 1930: several boulders with significant amounts of chalcopyrite were discovered in the vicinity of Liikavaara and Aitikvaara by local prospectors
- 1948-1964: Geochemical and geophysical surveys carried out. Definition drilling of the Aitik and Liikavaara deposits.
- 1965: Feasibility study completed
- 1966: Construction of the Aitik mine and concentrator is begun
- 1968: First production at Aitik. Initial production rate is 2 Mt/yr at a head grade of 0.51% Cu.
- 1972 –2000: Continuous expansions from 2Mt/yr to 18Mt/yr: Operating grade head during this period fluctuates in the vicinity of 0.40% Cu, 0.25 g/t Au, and 4 g/t Ag.
- 2010: Construction phase of Aitik 36 expansion project complete.
- 2018: Year-end ore processing achieves 38.4 Mt at a head grade of 0.14 g/t Au, 1.8 g/t Ag, and 0.29% Cu.

Total historic ore production at the Aitik mine site from 1968 through 2018 is calculated to 821 Mton at a grade of 0.17 g/t Au, 3.1 g/t Ag, and 0.33% Cu. Total waste stripping (overburden + waste rock) during this period is calculated to 784 Mt. This gives a total historic stripping ratio (waste/ore) of 0.95.

Table 3. Annual production numbers for 2000-2018. Between 1968 and 2000 the processed ore tonnage and grades are presented with 5-year intervals. A total of 821.4 Mt of ore has been processed since mining commenced.

Year	Ore	Cu	Au	Ag	Recovery (%)		
	kton	%	g/t	g/t	Cu	Au	Ag
1968	435	0.39	-	-	90.1	-	-
1970	2285	0.50	-	-	89.4	-	-
1975	6711	0.40	0.24	3.7	90.2	46.9	68.1
1980	6436	0.39	0.24	3.6	88.5	44.0	69.7
1985	10 713	0.40	0.28	3.7	90.4	56.0	64.0
1990	12 015	0.38	0.24	3.8	89.1	56.3	69.0
1995	17 465	0.38	0.22	3.2	90.5	50.7	75.2
2000	18 219	0.42	0.17	4.1	89.3	49.5	74.9
2001	17 723	0.40	0.19	3.6	89.4	50.1	75.3
2002	18 601	0.35	0.17	3.6	88.4	48.2	70.4
2003	18 022	0.37	0.16	4.2	88.7	48.5	72.5
2004	17 663	0.41	0.23	3.8	89.0	50.6	67.6
2005	16 674	0.44	0.22	3.6	89.4	50.7	69.1
2006	18 481	0.40	0.25	2.7	89.6	50.7	70.3
2007	18 178	0.32	0.14	3.7	86.9	45.4	63.2
2008	17 813	0.30	0.14	2.8	87.9	48.5	64.9
2009	18 791	0.27	0.13	2.0	89.7	55.1	66.8
2010	27 596	0.27	0.15	2.1	90.0	53.5	64.4
2011	31 541	0.24	0.14	2.2	89.8	54.7	64.4
2012	34 321	0.22	0.11	2.5	89.9	50.7	61.0
2013	37 070	0.21	0.10	2.3	89.6	49.4	65.1
2014	39 090	0.20	0.09	2.1	88.4	49.3	66.3
2015	36 361	0.21	0.11	2.4	87.2	50.2	69.1
2016	36 051	0.22	0.11	2.1	88.3	51.2	74.3
2017	39 045	0.28	0.13	2.0	89.5	55.7	80.2
2018	38 472	0.29	0.14	1.8	90.4	57.6	78.6

3.4 Ownership

Boliden Mineral AB owns 100 % of the Aitik mine

3.5 Permits

Current processing concessions (Aitik K nr 1-5) encompass the entire area where mining in the Aitik and Salmijärvi pits is planned according to the present LOMP. Additional mining concessions over the Aitik East area will be required in the future to be able to extract the complete mineral reserves. According to the current environmental permit for the Aitik operations (partial verdict from the land- and environmental court October 3rd 2014 in case M3092-12, in all material respects established by the supreme land- and environmental court January 22nd 2016) Boliden Mineral AB is allowed to mine and concentrate up to 45 Mton ore/year. The permit is limited in time, in that the permitted amount of deposited waste rock has been calculated to be reached during year 2023. The work with the application for the next environmental permit, which is planned to be submitted to the land and environmental court in the beginning of year 2020, has started.

Table 4. Current processing concessions for Boliden Aitik; please see Figure 3 for the locations

Name	Comprises	Ref	Decicion date	Valid until
Aitik K nr 1	Cu, Ag, Au	320-669-98	1999-12-16	2024-12-31
Aitik K nr 2	Cu, Ag, Au	22-1367-2000	2001-07-12	2026-07-11
Aitik K nr 3	Cu, Ag, Au	22-122-2003	2003-05-14	2028-05-13
Aitik K nr 4	Cu, Ag, Au, Mo	22-88-2005	2007-08-29	2032-08-28
Aitik K nr 5	Cu, Ag, Au, Mo	22-36-2015	2015-08-12	2040-08-11
Fridhem K nr 1	Cu, Ag, Au	22-53-2000	2000-05-04	2025-05-03
Liikavaara K nr 1	Cu, Ag, Au	320-665-98	1999-12-28	2024-12-31
Liikavaara K nr 2	Cu, Ag, Au	applied		

In order to utilize the mineralization in the planned Liikavaara open pit in the best way possible, Boliden has, as of March 16th 2018, applied for an extension (Liikavaara K nr 2) of the existing procession concession (Liikavaara K nr 1). At present the application is being scrutinized by the authorities. The company has also applied for an environmental permit for the planned operations in Liikavaara (2018-09-28). Since the deposition of potentially acid forming waste rock and tailings, as well as handling of affected water, will take place in Aitik, the company judges that this issue can be handled as a minor change to the current permit. However, Boliden also judge that there is a high risk of a delay in the process, due to relocation of road E10, Natura 2000 considerations and potential appeals of permits from residents. This has been considered in reserve classification. Waste rock from Liikavaara is a part of the mining plan for Aitik from year 2020, ore from year 2023.

Figure 3. Map showing mining concessions at Aitik and Liikavaara. Aerial photo from summer 2018

3.6 Geology

The Aitik, Salmijärvi, and Aitik East deposits occur along a largely continuous elongate mineralized trend (the Aitik-Salmijärvi mineralization) stretching approximately 5 km along strike from north to south averaging about 500 m in width

Host rocks of the mineralization at the Aitik deposit consist mainly of paleo-proterozoic (ca. 1.89 billion years) muscovite schists, biotite gneisses, and amphibole-biotite gneisses of volcanic and volcanoclastic origin, crosscut locally by diorite intrusive units. In places the diorite intrusive make up a significant proportion of the mineralized volume, but typically at lower than average grade. Foliation is well developed in the host rocks, dipping at about 50 degrees to the west. The mineralization is mainly structurally controlled and the main mineraliszation; Aitik is delineated by a hangingwall thrust and a footwall shear, Figure 4 (Figure 5). Main sulfide minerals in the deposit are chalcopyrite, pyrite and pyrrhotite, with significant accessory minerals including magnetite, molybdenite and sulfates . The entire package has been metamorphosed to amphibolite grade resulting in significant re-crystallization and coarsening of both sulfide and silicate minerals. Late granite pegmatite dikes crosscut the mineralized host rocks and are generally weakly mineralized to barren.

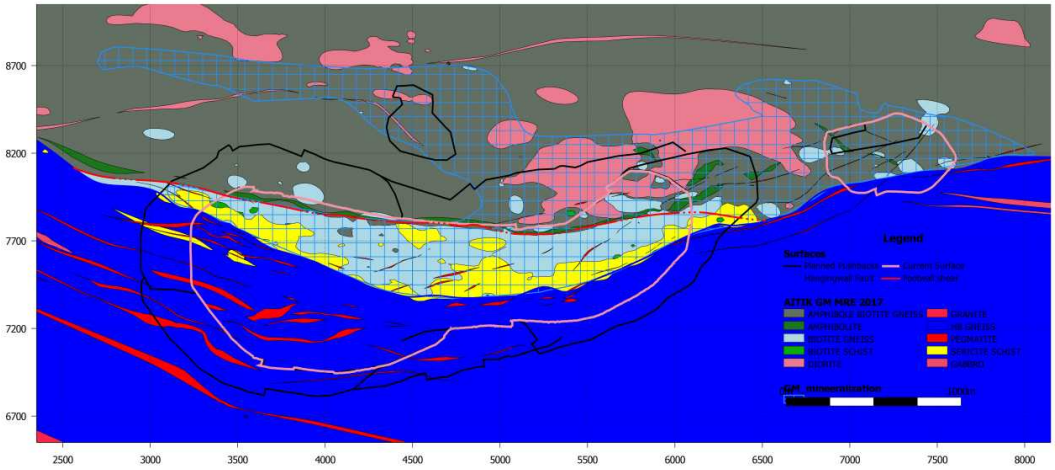

Figure 4. Plan view at -110Z, showing the geology of Aitik and the planned pushbacks. The dashed Area shows the mineralisation shell for > 0.06% Cu.

Mineralization at the Salmijärvi and Aitik East deposits is very similar in nature to the Aitik deposit, with the exception that host rocks are strongly dominated by amphibole-biotite gneisses and local diorite. Sulphide mineralization in these deposits is dominated by chalcopyrite, pyrite and pyrrhotite, although at typically lower grade than in the Aitik deposit.

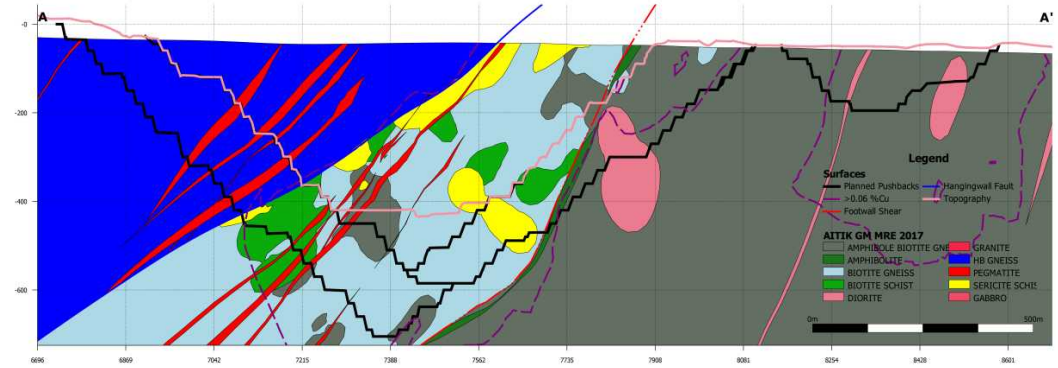

Figure 5. Crossection A-A'

About 3 km to the east, on separate and volumetrically smaller mineralized trend, sits the Liikavaara deposit (Figure 6). At Liikavaara host rocks to the mineralization are dominated by strongly foliated biotite schist, dipping steeply (ca. 80 degrees) to the west. Within the biotite schist crosscutting mineralized dioritic dikes are observed, typically showing signs of significant hydrothermal (quartz-tourmaline) alteration. Sulphides are dominated by chalcopyrite, pyrite and pyrrhotite, being typically observed occurring within millimeter to centimeter scale quartz veinlets. Significant accessory minerals at Liikavaara are molybdenite and scheelite, typically found in close association with Cu mineralization.

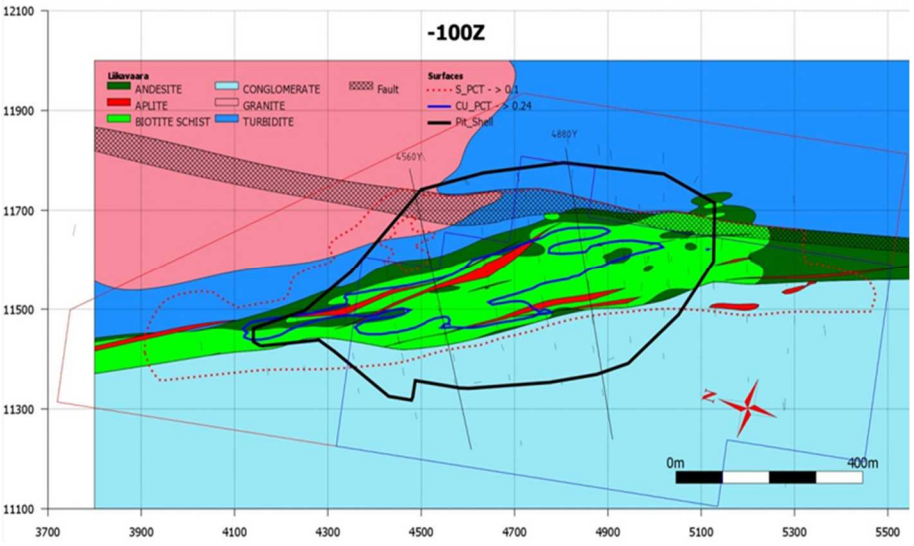

Figure 6. Plan view over Liikavaara geology at 100m depth The current concession (Liikavaara K nr1) is highlighted by the blue line and the applied (Liikavaara K nr 2) by a red line.

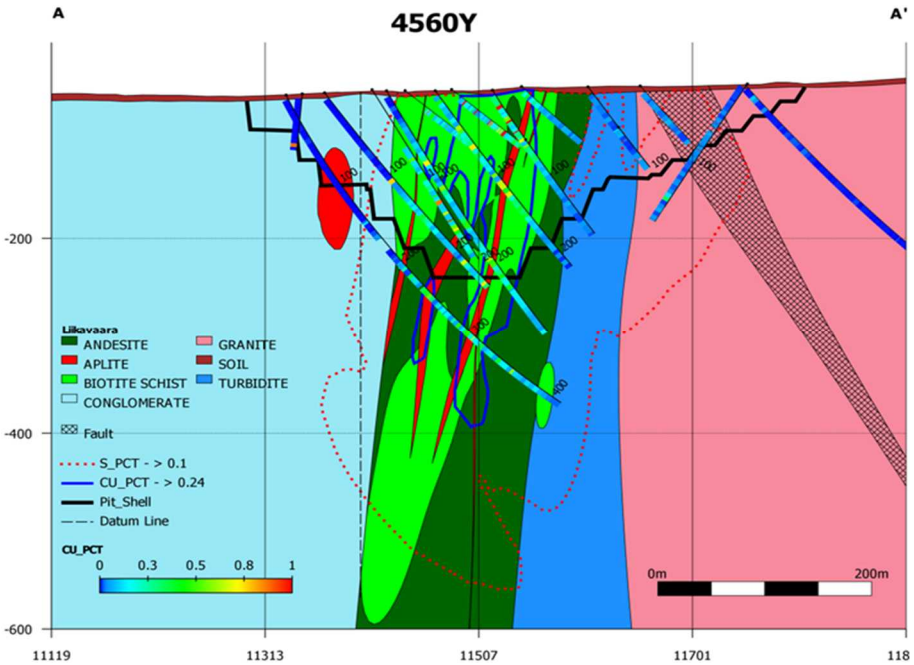

Figure 7. Oblique cross section, along 4560Y (Figure 6), looking north. Including the planned pit shell and diamond drill holes.

3.7 Exploration procedures and data

3.7.1 Drilling techniques

Diamond drilling assay data is used for mineral resource estimation. Drilling is performed by drilling contractor OY KATI AB and supervised by Boliden personnel. The current practice is to measure all diamond drillholes for deviation with Gyro. in 2018 has both SPT Gyromasterand Reflex Gyro been used by the drilling contractor.

3.7.2 Sampling, analyses, QAQC, and modelling of in-data

The drill core is logged and sampled by Boliden geologists. Standard samples, blanks and duplicates are inserted into every sample batch to ensure that the quality of the assay results is satisfactory. Sample assaying is carried out by ALS Minerals laboratories and duplicate check assays performed by BVM, both of which are independent actors. QAQC (Quality Assurance Quality Control) protocol is implemented all the way through from drilling to assaying.

Calculation of the reserves and resources estimated herein is based on the modeling of data from a total of over 1 100 drill holes in the operational area, totaling over 400000 m of drilling and dating from the late 1950's to present. From this a total of 75 000 composites have been taken and analyzed, the majority of which for Au, Ag, Cu, Mo, and S.

For the non-legacy assay data utilized in these reserve and resource estimates (that dating from year 2008 and later), half core samples were prepared at ALS Minerals laboratory in Öjebyn, Sweden and then shipped to analytical facilities in either Vancouver, Canada or Ireland. Samples were analyzed for Au using a 50 g fire assay with and ICP-AES finish. Ag, Cu and Mo were analyzed using aqua regia digestion and AAS finish, and S using the Total Sulphur (LECO) technique. A system of blanks, standards, (system introduced 2011) and pulp duplicates were added to the sample stream by Boliden to verify accuracy and precision of assay results, supplementing and verifying a variety of internal QAQC tests performed by ALS Minerals.

For legacy data (that dating pre-2008) verification has been carried out mainly by using drill hole twinning as well as grade and tonnage reconciliation from producing operational areas.

3.8 Exploration activities

In 2018, regional airborne geophysical surveys were completed and diamond drilling was conducted by Boliden Near Mine Exploration at the Liikavaara deposit, totaling 1438 m.

3.9 Mining methods, mineral processing and infrastructure

Ore is mined in two open pits along the same deposit. The main pit is called Aitik and measures roughly 4 km by 1.1 km at surface, with the deepest point currently at 450 meters from surface (Figure 8). In 2010, mining commenced in a second pit called Salmijärvi which has currently reached a depth of 165 meters below surface, with a surface foot print of roughly 0.9 by 0.6 km. The main pit will be expanded in all directions with five new pushbacks, of which mining in one of these pushbacks (S3) at the south has started in 2016. No further expansions are planned for the Salmijärvi pit after the current pushback.

The ore and waste rock is blasted in 15 meter high benches and is loaded on 300 tons capacity size trucks by large rope shovels or hydraulic excavators. Ore from the deeper parts

of the main pit is fed to one of two in-pit-crushers, while ore from pushbacks near surface and from the Salmijärvi pit is transported to a surface crusher situated between the two pits. Waste rock is separated in the loading process and hauled by trucks to dumps at the surface, where potentially acid forming waste is dumped separately from non-acid forming waste.

Ore handled by the crushers in pit is transported by a conveyor belt to an intermediate storage on surface, along with ore from the surface crusher. From the intermediate storage another conveyor belt transports the ore up to the main ore storage beside the processing plant. The main ore storage has a storage capacity corresponding to about one day's production, providing some buffer for the production.

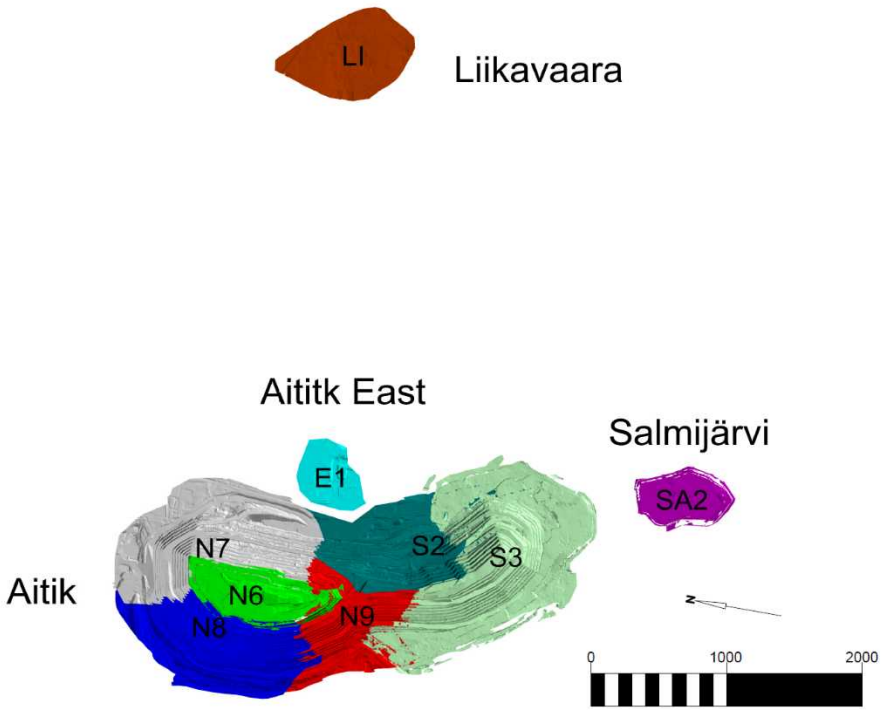

Figure 8. Overview over planned pushbacks in Aitik

3.9.1 Mineral processing

In the processing plant the ore is ground in two stages, with autogenous grinding in the primary stage and pebble mill grinding in the second. The milled ore is classified using spiral classifier. Mineral separation is done by flotation and a copper concentrate is produced. The copper concentrate is dewatered using thickeners and air pressure filters. The precious metals are reported in the copper concentrate. The copper concentrate is trucked to on-site railway terminal and reloaded for further transport by rail to the Boliden Rönnskär smelter in Skelleftehamn.

3.10 Prices, terms and costs

Boliden's planning prices, which are an expression of the anticipated future average prices for approximately 10 years, are presented in Table 5

Table 5. Long term planning prices currently used in Boliden.

	Planning prices, 2018
Copper	USD 6,600/tonne
Gold	USD 1,200/tr.oz
Silver	USD 17/tr.oz
Molybdenum	USD 8/lb
USD/SEK	7.50
EUR/SEK	8.85
EUR/USD	1.18

For Life of Mine Planning and determining Reserves, a mining cost of 15 SEK/t and a processing cost of 26 SEK/t is used for Aitik. For Resources a mining cost of 15 SEK/t and a processing cost of 25 SEK/t is used. For both Reserves and Resources a cut-off of 0.06 % Cu is used.

For the Liikavaara deposit, mining costs of 21 SEK/t and processing costs of 28 SEK/t are used for determining in the Reserve and Life of Mine Plan. For Resources a mining cost of 15 SEK/t and a processing cost of 28 SEK/t is used. At Liikavaara a cut-off of 0.08 % Cu is used for unweathered material, and 0.09 % Cu where weathered for determining both Reserves and Resources.

3.11 Mineral resources

Two separate block models are used for the Aitik Mineral Resources and Reserves. One model covers the areas of the Aitik mine "Aitik", Aitik East", and "Salmajärvi", and the other model covers the "Liikavaara" satellite deposit which is approximately 3 km from the active pit and as of yet unmined. Both mineral estimations are carried out in Datamine Studio RM after first domaining in Leapfrog Geo.

All reported elements are estimated using Ordinary Kriging. Drill holes are composited to 5m sections for both models. In the Aitik model, Cu is capped at 2.0%, Au at 2 ppm, and Ag at 20 ppm. Capping effects 0.07% of Cu assays, 0.12% of Au, and 0.10% of Ag. In the Liikavaara model Cu is left uncapped, Au is capped at 0.5 ppm, and Ag at 17 ppm. Capping in the Liikavaara model effects 0.47% of Au and 0.3% Ag composites. All lithologies in the models have been assigned a density based on specific gravity measurements. Blocks in the Aitik model are 20m (x), 20m (y), 15m (z) and no sub-blocking is used. Blocks in the Liikavaara model are 40m (x), 40m (y), 15m (z) with sub-blocking down to 10m (x), 10m (y), 15 (z).

Resource classification is based on quality of data, geological continuity and knowledge of the deposit. Support for determining the Resource class comes from geostatistics such as kriging efficiency and slope of regression, as well as drill hole spacing. As a general rule drill hole spacing for a Measured Resource is 90m x 90m at Aitik, 50m (E) x 40m (N) at

Liikavaara, and for a Indicated Resource 180m x 180m for Aitik and 100m (E) x 80m (N) for Liikavaara. Inferred Resource generally have no more than 200m to the nearest drill hole.

An initial classification is done on all blocks of the block model and then a pit optimization using Whittle software is completed for a Resource pit. All blocks within the Resource pit are then reported as the Resource as per their classification exclusive the Reserve. The blocks after final classification are shown as a long section though the main Aitik pit and the Salmijärvi pit in Figure 9, and as a cross section through the main pit and the planned Aitik east pit in Figure 10.

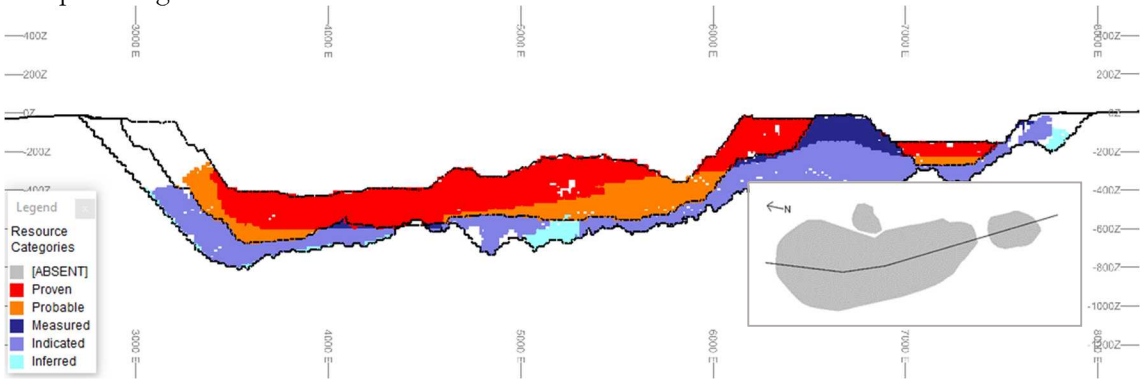

Figure 9. Long section showing the pit surface at 2018-12-31 and the pit shells for the resource and the reserve.

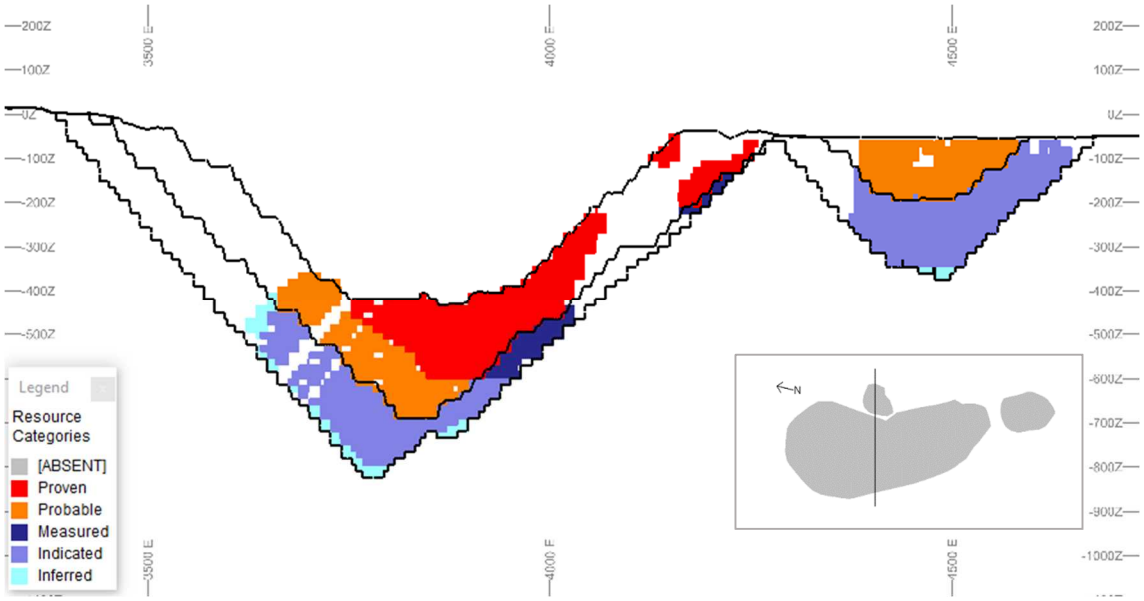

Figure 10. Cross section along 5000E

3.12 Mineral reserves

A Life of Mine Plan is created on an annual basis and the final results of this plan is used to determine the Reserves. All blocks within the Aitik Reserve pit initially classed as Measured are considered Proved, if they are initially Indicated they are then considered Probable. Any blocks initially classed as Inferred in the Reserve pit are reported as Inferred Resource. The same process was followed for the Reserve classification in the Liikavaara pit, however, material that would otherwise have been classed as a Proved Mineral Reserve has been classed as a Probable Mineral Reserve due to not as permits being in place as of yet (see 3.5 Permits). Mineral Resources and Reserves for the entire deposit are shown in Table 6.

Table 6. Mineral Resources and Mineral Reserves Aitik 2018-12-31

		2018				2017		
		Au	Ag	Cu		Au	Ag	Cu
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Total	**1 148 000**	**0.14**	**1.2**	**0.22**	**1 161 000**	**0.14**	**1.2**	**0.23**
Mineral Resource								
Measured	**204 000**	**0.08**	**0.8**	**0.15**	240 000	0.09	0.8	0.15
Indicated	**1 127 000**	**0.09**	**0.8**	**0.17**	1 116 000	0.09	0.8	0.17
Inferred	**175 000**	**0.11**	**0.5**	**0.14**	180 000	0.11	0.6	0.14
Total	**1 506 000**	**0.09**	**0.8**	**0.16**	**1 536 000**	**0.09**	**0.8**	**0.16**

3.13 Comparison with previous year

Aitik's total ore reserve per 2018-12-31 has decreased with 13 442 kt from the previous year's estimate. Explanations to the changes from the previous year can be seen in Table 7, Changes in mineral reserve per pushback can be seen in Figure 11. The main reason to the decrease of the reserve is mining. In total, 38 472 kt ore has been mined, mainly from pushback N6, Sa2 and S3. Due to redesign of the pushbacks, 21 Mt has been upgraded from resource to reserve.

Table 7. Explanation of changes to mineral reserve from 2017-2018

	Aitik	**Salmijärvi**	**Aitik East**	**Liikavaara**	**T5**	**T2**	**Mine**
	kton	kton	kton	kton	kton	kton	
Mineral reserve 2017	**1 023 559**	**46 459**	**30 011**	**61 358**	**0**	**0**	**1 161 387**
Mined (total)	-21 693	-16 779	0	0	0	0	-38 472
Mined outside reserve							0
Converted from resource	21 000						21 000
Exploration							0
Economic assumptions							0
Technical							0
Geological, infill							0
Position changed							0
Written off							0
Adjusting	5 462	2 426	0	-3 858	0	0	4 030
Mineral Reserve 2018	**1 028 328**	**32 106**	**30 011**	**57 500**	**0**	**0**	**1 147 945**

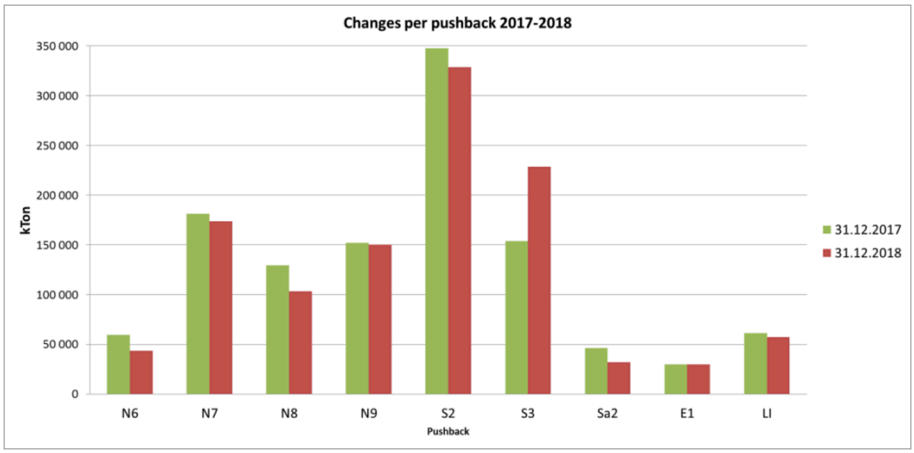

Figure 11. Changes per pushback for mineral reserve 2017-12-31 to 2018-12-31

3.14 Reconciliation

In order to confirm the precision of the geological interpretation, modelling, grade interpolation etc. the block model grades are checked against the actual measured results from the processing plant. Reconciliation is carried out every month. For the annual report of reserves and resources the reconciliation is compiled from an aggregation of 12 months.

Production reconciliation is a useful tool for checking the quality of the block model used in calculating the ore reserve and mineral resource at Aitik. Reconciliation over the period 2008-2018 is presented in Table 8.

Table 8. Reconciliation figures over ten years for Aitik

Reconciliation	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
kton concentrated Minestar [1]	17 861	18 305	27 292	30 975	35 048	38 540	37 005	35 972	35 738	39 404	38 715
kton concentrated Concentrator [2]	17 813	18 791	27 596	31 541	34 321	37 070	39 090	36 361	36 051	39 045	38 472
g/t Au block model [3]	0.14	0.13	0.16	0.15	0.11	0.11	0.11	0.13	0.12	0.14	0.14
g/t Au concentrator [4]	0.14	0.13	0.16	0.14	0.11	0.10	0.09	0.11	0.11	0.13	0.14
g/t Ag block model [3]	2.7	1.8	1.9	1.9	2.1	1.9	1.8	0.20	0.23	0.29	0.29
g/t Ag concentrator [4]	2.8	2.0	2.1	2.2	2.5	2.3	2.1	2.5	2.1	1.9	1.8
% Cu block model [3]	0.30	0.27	0.29	0.24	0.21	0.20	0.19	0.20	0.23	0.29	0.29
% Cu concentrator [4]	0.30	0.27	0.27	0.24	0.22	0.21	0.20	0.21	0.22	0.28	0.29
% S block model [3]	n/a	1.1	1.1	1.2	1.2	1.2	1.03	1.49	1.50	1.35	1.14
% S concentrator [4]	n/a	0.8	0.9	1.1	1.3	1.3	1.09	1.52	1.44	1.18	1.08

Notes:
[1] Summation of ore tonnage from Minestar using data from shovel positions and truck scales, from May 2016 Minestar replaced the bespoken Prodadmin software
[2] Official processed ore tonnage from Aitik concentrator plant based on data from belt scales
[3] Summation of modeled head grade from resource block model using polygons created from shovel scoop position and blas field type boundaries
[4] Official summation of head grade based on concentrator plant analyses

The realized/predicted values for Cu and Au are consistent with recent years of production and indicate a high level reliability to the block model for these elements (+3% and +1%, respectively). S and Ag grade deviations for 2018 are within an acceptable relative precision of ±10%, (+6% and -5%, respectively).

For grade control are samples taken from virtually all blast holes within the ore zone to update the production block model BLPR. The grades of the mined out ore are calculated from the production block model using the tonnage reported and surveyed monthly surfaces of the pit. For long term planning and resource estimation the resource block model BLPL is used. During reconciliation the result from the plant is compared to both the BLPL and BLPR. Figure 12 below shows last year's results.

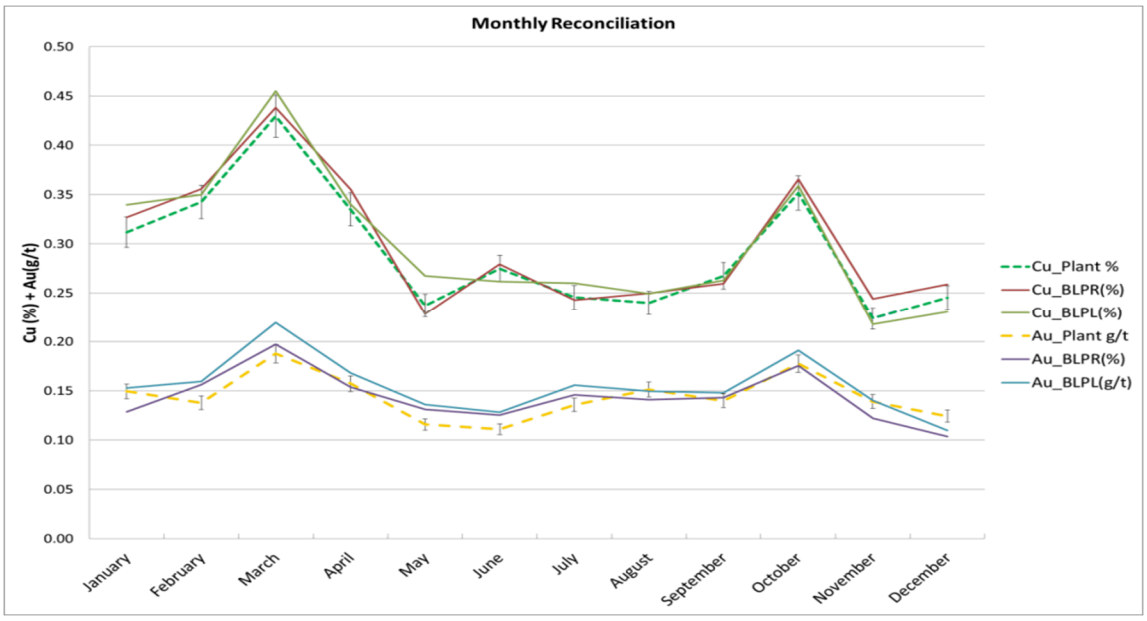

Figure 12. Comparing measured results from the processing plant with calculated results from the block models. Note that the numbers from the processing plant for December are preliminary

Table 9. Comparison of metal grades in the block model and processed ore at the end of 2018

Element	Difference in % plant/block model	Difference in grade
Gold	1.1	0.001g/t
Copper	2.9	0.008%
Silver	-6.4	-0.117%

4 REFERENCES

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