Boliden Summary Report

Resources and Reserves | 2018

Kevitsa Mine

Prepared by
Sini-Maaria Kokko

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1 SUMMARY

The Mineral Resources and Mineral Reserves for Boliden Kevitsa Ni-Cu-PGE Mine are reported in Table 1. The Mineral Reserve figures have been depleted to account for mining up to the end-of-month December 2018.

Table 1. Mineral Resources and Mineral Reserves for Boliden Kevitsa Mine as of 31-12-2018 and 31-12-2017 for comparison.

Classification	kton	NiS (%)	Cu (%)	2018 Au (g/t)	Pd (g/t)	Pt (g/t)	CoS (%)
Mineral Reserves							
Proved	**62,500**	**0.21**	**0.35**	**0.09**	**0.12**	**0.18**	**0.01**
Probable	**66,100**	**0.24**	**0.34**	**0.10**	**0.14**	**0.21**	**0.01**
Total	128,600	0.22	0.34	0.09	0.13	0.19	0.01
Mineral Resources							
Measured	**23,600**	**0.22**	**0.31**	**0.08**	**0.11**	**0.17**	**0.01**
Indicated	**114,900**	**0.23**	**0.34**	**0.08**	**0.09**	**0.14**	**0.01**
Total M&I	138,500	0.23	0.33	0.08	0.09	0.15	0.01
Inferred	**19,200**	**0.22**	**0.32**	**0.06**	**0.08**	**0.13**	**0.01**
Classification	**kton**	**NiS (%)**	**Cu (%)**	**2017 Au (g/t)**	**Pd (g/t)**	**Pt (g/t)**	**CoS (%)**
Mineral Reserves							
Proved	**71,400**	**0.21**	**0.34**	**0.10**	**0.12**	**0.19**	**0.01**
Probable	**62,400**	**0.24**	**0.34**	**0.10**	**0.14**	**0.21**	**0.01**
Total	133,800	0.22	0.34	0.10	0.13	0.20	0.01
Mineral Resources							
Measured	**19,100**	**0.21**	**0.32**	**0.08**	**0.11**	**0.16**	**0.01**
Indicated	**102,800**	**0.23**	**0.36**	**0.07**	**0.08**	**0.13**	**0.01**
Total M&I	121,900	0.23	0.36	0.07	0.08	0.13	0.01
Inferred	**56,100**	**0.22**	**0.32**	**0.06**	**0.07**	**0.12**	**0.01**

Mineral Reserves were reported from the 2016 Mineral Resource block model, using the two-stage Net Smelter Return (NSR) cut-off and the final pit design. No Inferred Mineral Resources are included in the Mineral Reserves. Kevitsa Mineral Resources are reported from the new 2018 Mineral Resource model/estimation, work done by Lion GeoConsulting (LGC), using a NiEq cut-off and constraining whittle pit shell to demonstrate Reasonable Prospects for Eventual Economic Extraction (RPEEE).

Since both 2016 and 2018 Mineral Resource models are used, this document refers to NI-43-101 compliant Technical Report by Gray et al. (2016) and the Mineral Resource estimate report by Degen & Kokko (2018).

2 GENERAL INTRODUCTION

This report is issued annually to inform the public (shareholders and potential investors) of the mineral assets in the Kevitsa mining operation ("the Kevitsa Mine") held by Boliden Mineral AB ("Boliden"). The report is a summary of internal and Competent Persons' Reports for the Kevitsa Mine. Boliden is currently changing reporting standard from the Fennoscandian Review Board's ("FRB") "Recommended Rules for Public Reporting of Exploration Results, Surveys, Feasibility Studies and Estimates of Mineral Resources and

Mineral Reserves in Sweden, Finland and Norway" ("The FRB Standard") to the Pan-European Reserves and Resources Reporting Committee's (PERC) "Pan-European Standard For Reporting Of Exploration Results, Mineral Resources And Reserves" ("The PERC Reporting Standard 2017") . The PERC Reporting Standard 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 countries.

The previously used FRB Standard will no longer be maintained. The PERC Reporting Standard has more clearly defined requirements on reporting and on Competent Persons. Boliden is currently in the process of updating procedures and many of the reports and estimations summarized here are compiled according to the FRB Standard.

The Kevitsa Mine's Mineral Resources and Mineral Reserves were previously reported under the FRB standard at the end of 2017. Prior to 2017, Mineral Resources and Mineral Reserves were reported according to National Instrument 43-101 under the previous owner First Quantum Minerals Limited (FQM).

Boliden considers that Mineral Resource and Mineral Reserve figures released in 2017 are accurate and reliable, however the process of creating PERC compliant estimations, studies and reports for all Projects and Mines is underway.

2.1 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, the Committee for Mineral Reserves International Reporting Standards (CRIRSCO), and the PERC Reporting Standard is fully aligned with the CRIRSCO Reporting Template.
The PERC Reporting 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.

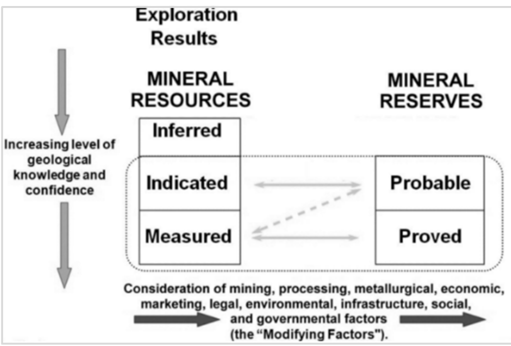

Figure 1. General relationship between Exploration Results, Mineral Resources and Mineral Reserves (PERC 2017).

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. The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

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 except for Naomi Fogden (Optiro) and Christian Degen (Lion GeoConsulting) as listed in Table 2 below. The reports has been reviewed and approved by Gunnar Agmalm. Gunnar Agmalm 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	Aarne Perälä, Sini-Maaria Kokko	Gunnar Agmalm
Mineral Resources and Mineral Reserves reporting	Naomi Fogden (Optiro)	
Mineral Resources estimation 2018	Christian Degen (Lion GeoConsulting)	
Permits and tenements	Mira Kyllästinen	

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

3 KEVITSA MINE

The Kevitsa Mine is a Ni-Cu-PGE open pit mine located at Sodankylä, Finland.

The mined out ore tonnage for 2018 was 7.93 Mt, which is a decrease from last year by 0.35 Mt. Total mined material (ore + waste) was 41.4 Mt at 2018.

Total milled material at 2018 was 7600 kt. Nickel metal annual production was 13 948 t of Ni in Nickel concentrate, which is the new annual production record. Copper recovery improved 4% -units to Copper concentrate, and total copper recovery improved 1.5% -units. Cu metal annual production was 27 498 t of Cu in concentrates. There was a new annual production records on Cobalt, Platinum and Palladium.

Cu is the most valuable commodity in the Kevitsa Mine, even though the Kevitsa Mine produces more Ni concentrate. Revenue from Cu concentrate was 57 % and 43 % from Ni concentrate. Other valuable commodities are Au, Pd and Pt, which are payable in Cu concentrates and Co in Ni concentrate (in addition to Pt and Pd). Table 3 presents the revenue per commodity at Kevitsa.

Table 3. Percentage of total revenue per element at Mineral Reserve average grades.

Commodity	Revenue (%)
Cu	45.2
Ni	33
Co	3.1
Au	4.6
Pd	6.9
Pt	7.2

3.1 Major changes

- The NiEq cut-off of NiS + (0.65*Cu) ≥ 0.25% was used at 2018 for production while the NiEq cut-off of was NiS + (0.90*Cu) ≥ 0.32% in 2017.
- New Mineral Resource Estimation/Resource model by Lion GeoConsulting (LGC) in October 2018
- Whittle pit optimisation was used to define RPEEE. Previously the Mineral Resource was defined as any block above NiEq cut-off at 0.16% outside the final pit
- Modification on pit designs stage 2, stage 3 and stage 4. Stage 2 and 3 ramps were widened for the safety reasons. Because the new hauling trucks are narrower, stage 4 design was changed by narrowing the ramps from 40 m to 33 m. The pit design was also changed due the geotechnical reasons.
- Infill drilling campaign completed during 2018

3.1.1 Technical studies

Technical studies conducted during the year were:

- The structural geology model: two major faults are informing the 2018 Resource Model
- Mineral Resource grade shells: are informing the Resource Model
- Mineral Resource Estimate/Resource model

Information on the technical studies can be found from the report of Mineral Resource Estimate for 2018 (MRE) in Degen & Kokko (2018).

3.2 Location

The Kevitsa Mine is located some 142 km north-northeast of Rovaniemi, the capital of Finnish Lapland, and approximately 140 km north of the Arctic Circle in the Municipality of Sodankylä. Sodankylä is located approximately 40 km south by road and the nearest village Petkula is located 8 km west of the property. A location map is presented in Figure 2. More detailed description in Degen & Kokko (2018).

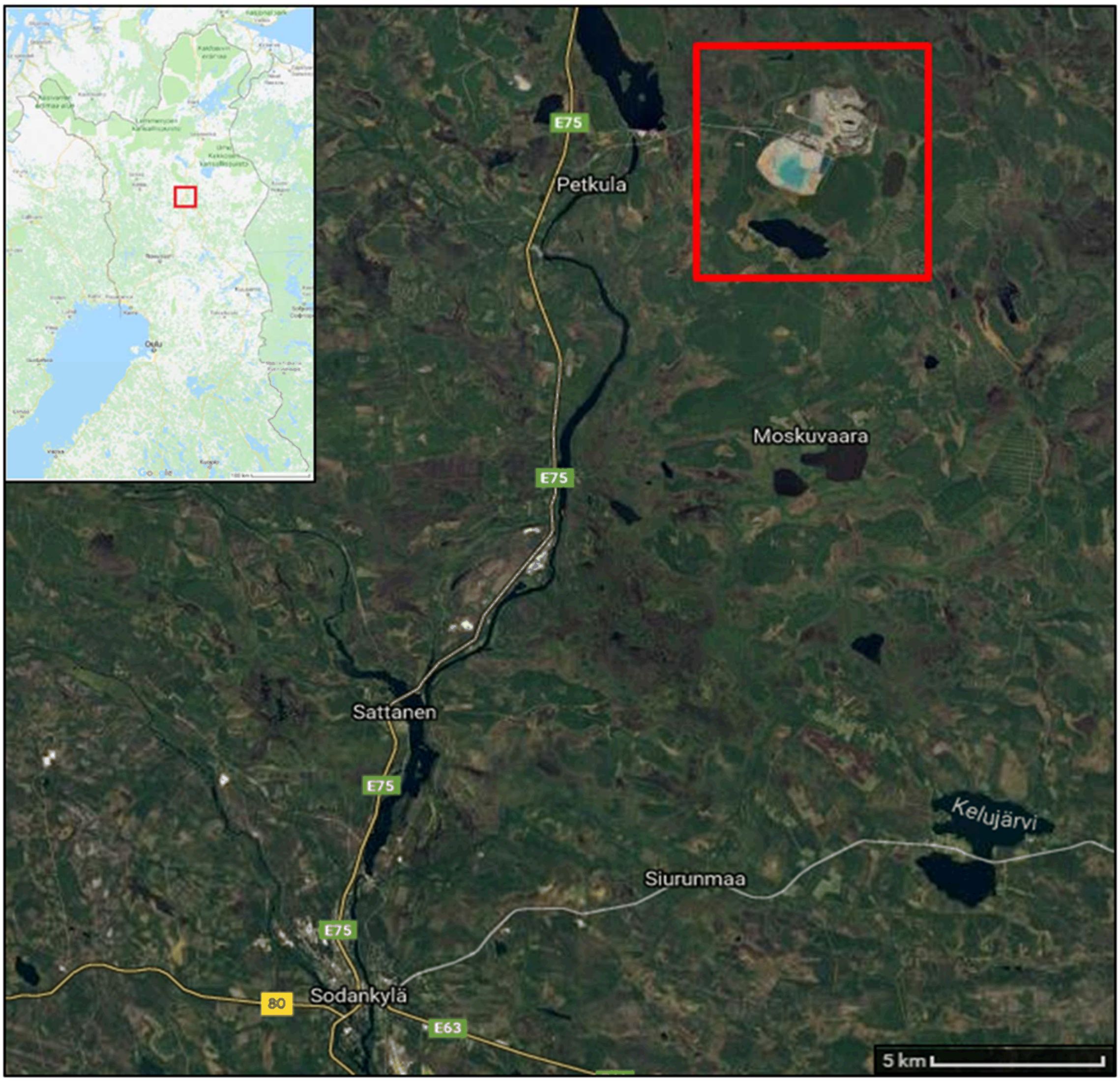

Figure 2. Map of the Kevitsa Mine property in relation to Sodankylä

3.3 History

An historical summary of the Kevitsa Mine is summarised in Table 4, production history is in Table 5 and process history in Table 6. A more detailed description of the project history from exploration to production can be found Gregory et al. (2010) and Gray et al. (2016).

Table 4. Kevitsa Project History

Kevitsa Project History	
1960s	Mapping of outcrops and river boulders
1970s	Outokumpu reconnaissance exploration work
1984	Initial diamond drilling (Geological Survey of Finland - GTK)
1984-1987	Ground geophysical surveys (magnetic, gravity, electromagnetic) and basal till sampling
1987	**Diamond drilling and discovery of Ni-Cu mineralization**
1990	Diamond drilling
1992-1995	Main diamond drilling and trenching programme
1994	Airborne Survey GTK
1996-1998	Till geochemistry and drilling and processing test work undertaken by Outokumpu Metals & Resources
2000	Project owned by Scandinavian Minerals (SGL)
2008	Project owned by FQM
2010	Construction commenced
2012	Commercial production
2016	**FQM sells the Kevitsa Mine to Boliden Mineral AB**

Table 5.Waste and ore production history of the Kevitsa Mine in Mt

Production		**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total to date**
Ore	[Mt]	3.37	5.81	6.93	6.63	7.67	8.28	7.93	46.62
Waste	[Mt]	4.23	16.01	21.21	30.39	31.9	34.2	33.5	171.4
Total		7.6	21.82	28.14	37.02	39.57	42.48	41.4	218.1

Table 6. Processed metals history of the Kevitsa plant

Production		**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total to date**
Milled, tonnes	[kt]	3,137.6	6,313.6	6,711.2	6,665.5	7,391.7	7,911.2	7,582.1	45,713
Cu metal in concentrates	[t]	8,093	14,775	17,535	17,204	20,571	29,957	27,498	135,633
Ni metal in Ni concentrate	[t]	3,874	8,963	9,434	8,805	11,100	13,777	13,948	69,901
Co metal in Ni concentrate	[t]	167	401	422	369	501	587	591	3,038
Au in concentrates	[oz]	6,914	12,875	14,110	14,110	17,143	22,822	22,223	110,196
Pt in concentrates	[oz]	15,097	33,369	37,390	35,133	41,553	50,019	55,592	268,153
Pd in concentrates	[oz]	13,298	27,020	28,501	27,761	31,782	36,015	40,812	205,189

3.4 Ownership

In accordance with Finnish regulations, Boliden Kevitsa Mining Oy ("Boliden KMOY") owns the land within the mining concession. The land was previously under the control of the Finnish State Forestry Commission, Metsähallitus, who are the principal landowner of the surrounding property of the region. Kevitsa Mine does not pay any royalties because in Finland the mining concession holder pays annual compensation (excavation fee) to the landowner.

3.5 Permits

The site operating entity is Boliden KMOY. The Ministry of Economic Affairs and Employment of Finland originally granted mining concession No. 7140 to FQM Kevitsa Mining Oy (owned by FQM) on September 2009. The company has also applied for an expansion of the mining concession for the potential requirement of building new infrastructure around the mine area. The valid and applied mining concessions and the surrounding exploration permits are shown in Figure 3Figure 3 and presented in Table 7. The environmental permit was granted in July 2009. At 2014, new environmental permit was granted for mining 10 Mt of ore per annum.

Boliden KMOY has nine valid exploration permits granted by Finnish Safety and Chemicals Agency (TUKES) around the mining concession. Two of those permits are waiting the three-year validity extension. The company has also two exploration permit applications. Boliden FinnEx Oy operates exploration in the permit areas and holds three valid exploration permits (one is waiting the three-year validity extension). Boliden FinnEx Oy have also three exploration permit applications around the near mine area.

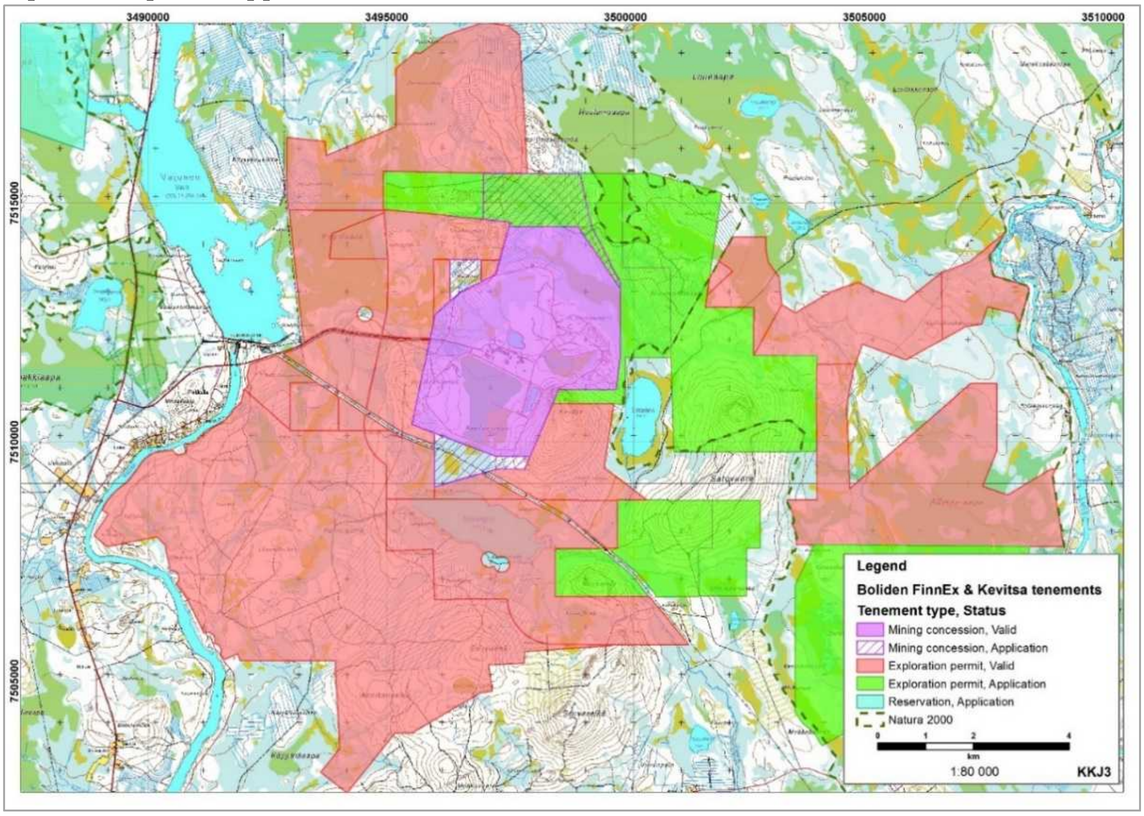

Figure 3. Boliden Kevitsa Mining Oy and Boliden FinnEx Oy tenements

Table 7. Table of tenements as per Figure 3

Tenement type	Owner	Area (km^2)	No. of blocks	Permit ID
Valid Mining Concession	Boliden KMOY	14.13	1	7140
Valid Ore Prospecting Permits	Boliden KMOY	31.25	14	ML2015:0039 ML2014:0097 ML2017:0002 ML2016:0054 ML2017:0003 ML2015:0038 ML2015:0037
Valid Ore Prospecting Permits	Boliden FinnEx Oy	20.89	5	ML2013:0080 ML2014:0106
Applied - Mining Concession, Extension	Boliden KMOY	4.01	3	7140
Applied Ore Prospecting Permits	Boliden KMOY	15.06	5	ML2014:0111 ML2014:0112
Applied - Ore Prospecting Permits	Boliden FinnEx Oy	28.5	8	ML2015:0064 ML2014:0113 ML2014:0114
Applied - Ore Prospecting Permits – Extension of the Validity	Boliden KMOY	32.89	2	ML2016:0055 ML2013:0079
Applied - Ore Prospecting Permits – Extension of the Validity	Boliden FinnEx Oy	10.69	1	ML2013:0078

3.6 Geology

More detailed description can be found from Gregory et al. (2010), Gray et al. (2016) and Degen & Kokko, (2018).

3.6.1 Regional

The Kevitsa igneous complex lies within the Central Lapland Greenstone Belt (CLGB) located within the Precambrian Fennoscandian Shield (Figure 4). CLGB is a large area that consists of volcano-sedimentary rocks of Paleoproterozoic age and it is divided to seven stratigraphical groups (Räsänen et al. 1996). Which are from oldest to youngest: Salla, Onkamo, Sodankylä, Savukoski, Kittilä, Lainio, and Kumpu Groups Savukoski group supracrustal rocks that are enveloping Kevitsa intrusion. It is representing a major marine transgression dominated by dominated by black schists, phyllites, tuffites, mafic metavolcanics and the uppermost unit of ultramafic metavolcanics. According to Räsänen et al. (1996) these rocks are polyfolded, and thrusted resulting in overturning and structural repetition of the stratigraphy. There are three major ductile deformational events (D1-D3), simultaneous and later shear zones that are related to regional structures of the CLGB and are described in detail by Hölttä et al. (2007).

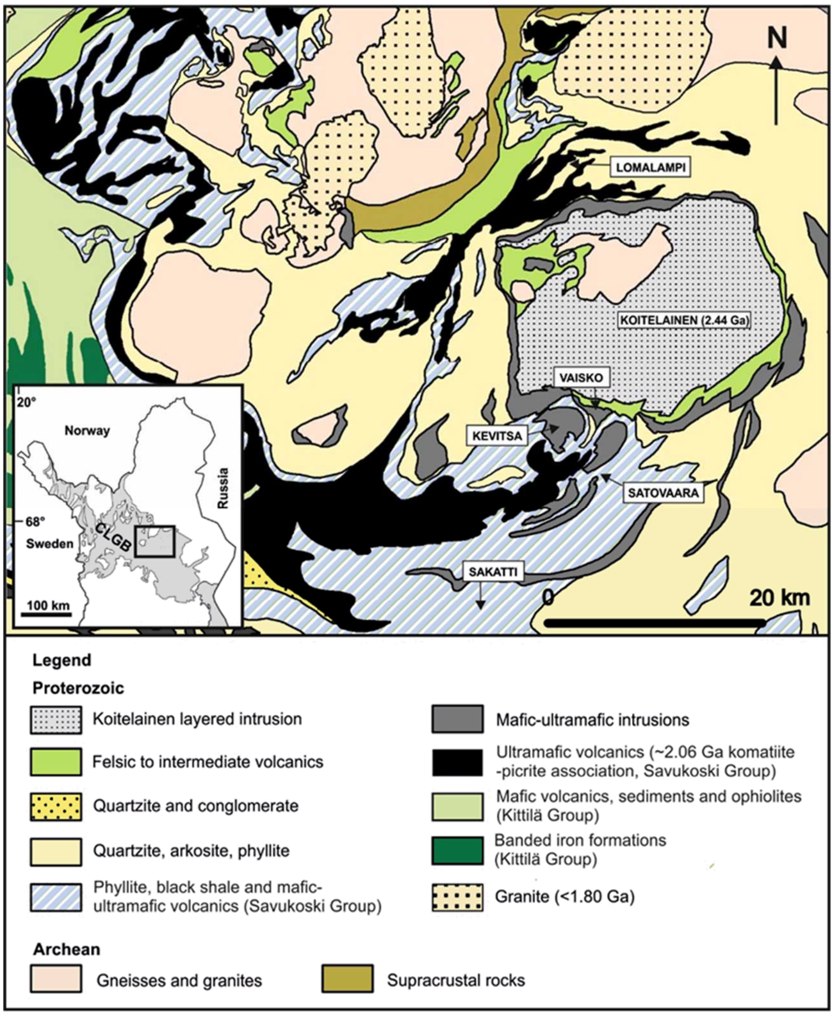

Figure 4. Regional geological map from Luolavirta et al. (2017)

3.6.2 Local

Kevitsa igneous complex layered ultramafic-mafic intrusive rocks dated at 2058 ± 4 Ma (Mutanen & Huhma, 2001). The body of the intrusion extents to 2 km. The Kevitsa intrusions ultramafic units are on lower parts of the intrusion, which is overlain by the gabbroic rocks that are located on the South-West side of the ultramafics. There is a dunite unit in the middle of the deposit, which is disconcordant to magmatic layering as well in the bottom of the intrusion. Xenoliths are common in the ultramafics and within the ore body. They are variable in sizes and by composition; they typically are sedimentary, mafic or ultramafic. There are also several mafic dykes, in the intrusion, ranging in different ages but they are not very voluminous. Geological map of Kevitsa igneous complex is presented in the Figure 5.

The Kevitsa area has undergone several tectonic and metamorphic events which are evident in the intrusion and in the country rocks (Hölttä et al. 2007). The NNE-SSW trending Satovaara fault, and other structures which are associated with it, are a structurally significant feature of the area. The Satovaara fault has deformed the eastern margin of the Kevitsa intrusion and within the deposit, there are smaller scale structures in similar trend.

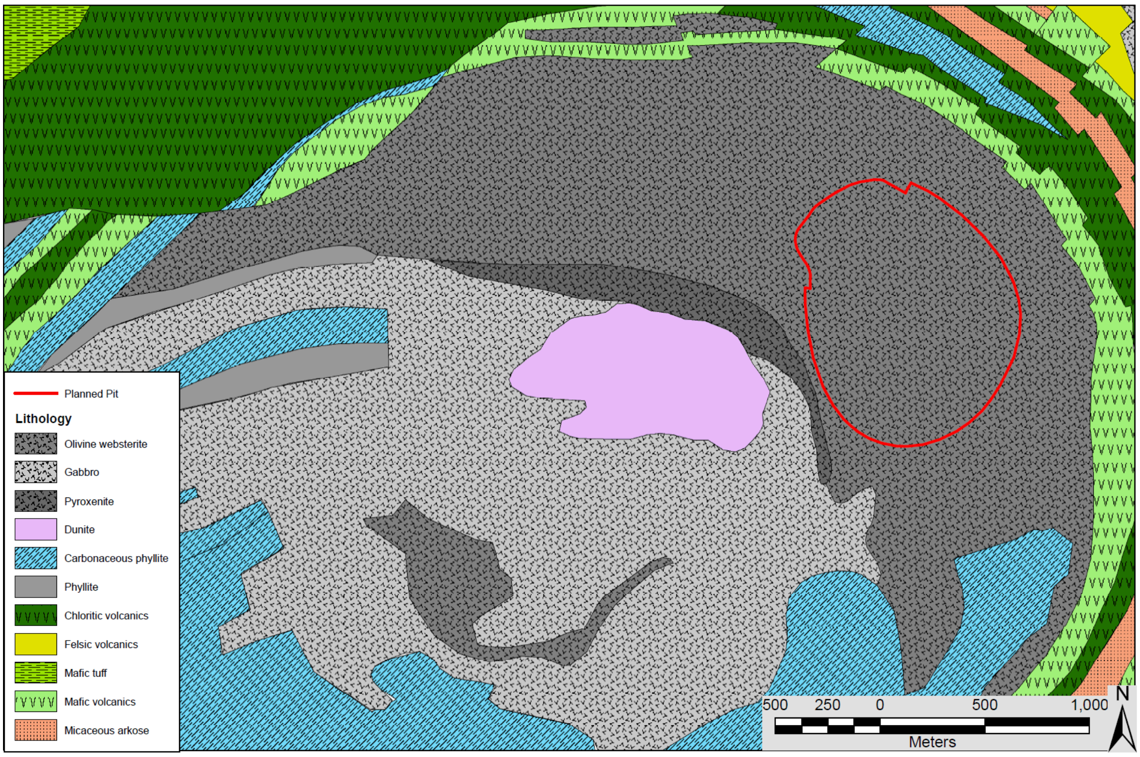

Figure 5.Geological map of the Kevitsa igneous ultramafic complex

3.6.3 Property

The Ni-Cu-(PGE) mineralization is located in the centre of the intrusions ultramafic rocks, and it is hosted typically by olivine websterite and its variants. In the broad sense, they can be described as clinopyroxene-dominated rocks with 0-30% orthopyroxene, 5-25% olivine and 0-10% plagioclase. These rocks have very subtle visual and geochemical differences. The distribution and form of observed mineralogical and geochemical patterns are interpreted to represent multiple magmatic phases. There are no internal contacts to these pulses, but in many instances the base of one pulse (olivine websterite) will grade relatively sharply into the upper part of another pulse (plagioclase bearing olivine websterite). These layers are irregular in shape. Geochemically, differentiation within these pulses is most clearly demonstrated by Al_2O_3. It is proposed by Luolavirta et al. (2017), that the Kevitsa magma chamber was initially filled by stable continuous flow ("single" input) of basaltic magma followed by differentiation in an at least nearly closed system. In the following stage, new magma pulses were repeatedly emplaced into the interior of the intrusion in a dynamic (open) system forming the sulfide ore bodies. This model would explain the contrasting intrusive stratigraphy in the different parts of the intrusion, which likely is reflecting different emplacement histories. A schematic stratigraphy column after Luolavirta (2017) is given in Figure 6.

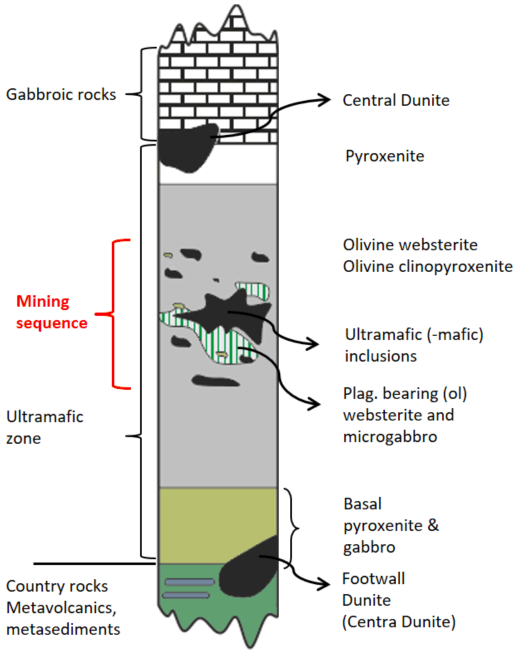

Figure 6. Schematic stratigraphy column of Kevitsa intrusion by Luolavirta, 2017

The most widespread alteration in Kevitsa resource area is amphibole alteration of ferromagnesian minerals. The alteration is typically pervasive in style and has generally "'sharp boundaries" i.e. it does not grade out. Pervasively amphibole altered rocks are often accompanied by carbonate alteration: there can be millimetre- to metre-scale carbonate or carbonate-quartz veining. The first alteration phenomenon in Kevitsa, being also common, is the serpentine alteration where the olivine is replaced by dark serpentine. Magnetite was initially primary mineral but it is also associated with other alteration styles as veins like serpentine and carbonate alteration. Epidote alteration is associated with the rodingite dykes. Actinolite-chlorite alteration seem to be associated with the structures. Narrow actinolitic selvedges are also common on carbonate ± quartz vein margins, but these wider, green actinolite features are a distinctive vein set. Talc-carbonate alteration is strongly associated with the shear zones, late fractures and veins representing CO2 bearing fluids. The style can range from selective replacement of ferromagnesian species to pervasive alteration of the rock.

3.6.4 Mineralization

The known economic Ni-Cu-PGE mineralization is disseminated in style. While having some minor semi massive sulphide veins. Overall mineralization volume is irregular in shape, and it is cut by several faults which locally are offsetting the mineralization. The predominant mineralization type is Ni-Cu, comprising 95 % of the deposit. Within it, are mineralization domains, which can be separated by the distribution of Cu and NiS grades, and as well with the amount of PGE's. The so-called Ni-PGE mineralization is in relatively small in volume.

The main economical minerals are chalcopyrite and pentlandite, but mineralogically speaking pyrrhotite is the most common sulphide. Typically, the sulphide grain size varies from fine to medium, and the grain aggregates are in the interstitial spaces of the silicates. In unaltered rocks the sulphide silicate grains are smooth and plain but in amphibole altered rocks the boundaries are irregular and serrated. Chalcopyrite generally occur as large anhedral grains, sometimes with cubanite and talnakhite, and as fine intergrowths within the gangue silicates. Pentlandite can be coarse-grained sub-euhedral, smaller intergranular grain bands between silicates and pyrrhotite, and "exolution flame" inclusions within pyrrhotite or pyrite of very fine grain size. In addition to pentlandite the nickel occurs in crystal lattice of some silicate minerals such as olivine, clinopyroxene and tremolite. The nickel in silicates is not recoverable in metallurgical process and therefore sulphide nickel is analysed by selective leach method. Pd and Pt typically occur as sulfosalts, such as arsenides and tellurides. According to Kojonen et al. (2008), over half of the PGE carrying minerals are as inclusions in amphibole, serpentine and chlorite. PGE carrying minerals which are related to sulphides occur mostly on sulphide grain boundaries, inclusions in sulphides or in late fracture fillings in pentlandite.

3.7 Drilling procedures and data

More detailed information of drilling procedures and data, as well information from previous campaigns in Kevitsa can be found from Gregory et al. (2010), Gray et al. (2016) and from Kevitsa MRE Report for 2018 (Degen & Kokko, 2018). Below is the summary from the MRE 2018 report of procedures and data.

3.7.1 Drilling techniques

Mineral Resource definition, infill and exploration drilling has been done by diamond drilling. The 2018 Kevitsa MRE includes data from 557 diamond drill holes, which incorporates 8 new infill holes. Starting in 2017, Boliden KMOY has drilled eight drill holes in the area that were logged, assayed, verified and loaded into the database before June 15, 2018. There was total of 18 holes drilled by Boliden KMOY but not assayed in 2017 and 2018.

3.7.2 Downhole surveying

The collar positions have been surveyed by the Mine Survey Department and by independent contractor, Rovamitta Oy. All drill collar locations are referenced to Finnish National Grid Coordinate System Zone 3 coordinates. The drilling contractors have conducted the downhole surveying at the Kevitsa Mine; hence, the surveying tool has changed depending on the contractor and the year. There are drill holes, which are missing deviation survey and have been used in Mineral Resource estimates in 2016 and 2018 (Degen & Kokko, 2018). 126 historic GTK drill holes which are relatively short (average 40.5 m), and nine holes with an average depth of 136 m drilled in 2011, are missing deviation surveys.

3.7.3 Sampling

Sample preparation and analysis has good evidence of being managed in a secure manner at both on and off site preparation and laboratory facilities. Drilling, logging and sampling data were collected from diamond core by reputable companies and suitably trained persons. All geological data held by the Kevitsa Mine is loaded to SQL database with a Maxwell's DataShed front end.

All of the diamond drill holes were logged and then marked for the sampling intervals, sample numbers and QC samples. Then the core was photographed as dry and wet and cut according the sample list and marks in the core by the Kevitsa Mine sample technicians.

GTK and SGL were systematically sampling in two meter intervals. Boliden and FQM were also sampling in two meter intervals, however were honouring lithological contacts - sample intervals do not cross the contacts.

The cut core was packed in sample bags with sample tags and numbers and sent to an external and independent laboratory for sample preparation and analyses. Boliden KMOY uses Labtium Oy ("Labtium") laboratory based at Sodankylä. Chain of custody forms were sent with the samples to Labtium and a copy retained on site for reference. Samples were prepared and analysed at Labtium and results are then electronically uploaded into a secure database system DataShed. Labtium is a FINAS-accredited testing laboratory T025 meeting the requirements of international standard SFS-EN ISO/IEC 17025:2005. Regular laboratory visits and audits were completed by the geological team from Kevitsa since 2009. All the analyses methods per drilling campaign and the primary laboratory are described in Table 8.

Table 8. Summary of analytical methods used by different drilling campaigns and the primary laboratory used.

Campaign	**Primary laboratory**	**Aqua Regia**[3]	**Selective Leach**	**Multi element**	**Fire Assay**[4]
		Total Ni, Cu, S etc	**Sulphidic Ni, Cu, Co**	**Ni, Cu etc**	**Au, Pt, Pd**
GTK	GTK	X			X
SGL	GTK, Labtium[5]	X	X		X
FQM KMOY	Labtium Rovaniemi	X	X		X
FQM FinnEX	ALS Loughrea			X	X
Boliden KMOY	Labtium Sodankylä	X	X		X

3.7.4 Density

A total of 254 holes within the resource area have density data collected by a conventional gravimetric (Archimedes) method. The data was collected weighting the whole core in air and in water. Density was calculated by dividing the weight in air by the difference between weight in air and weight in water. The majority of sampling for density was done on 10 cm intervals, representing a 5 m down hole length.

3.7.5 QAQC

Boliden KMOY has practised Quality Assurance and Quality Control (QAQC) for the duration of their diamond drilling. There has been QAQC programs carried out through the

[3] Full set of elements analysed; Ag, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, S

[4] The majority of samples were analysed using lead collection fire assay

[5] SGL switched from using GTK Rovaniemi to using Labtium Rovaniemi Laboratory in September 2007. Some of the drill holes were submitted for analysis by FQML after acquiring SGL in 2008.

project history. Boliden KMOY inserts blanks, commercial standards, quarter core duplicates per sample batch send out. Batch also includes details of which samples should have laboratory duplicates prepared.

3.8 Exploration activities

Boliden KMOY has drilled eight infill drill holes in the area starting from 2017 that were logged, assayed, verified and loaded into the database before June 15, 2018. These holes were informing the 2018 Resource Estimate. There was total of 18 holes drilled in 2017 and 2018 by Boliden KMOY, but not assayed and logged in time to be included in the 2018 Mineral Resource model.

Boliden conducts exploration work within the Kevitsa Mining Concession and adjacent Exploration Permit areas through Boliden FinnEx Oy, a separate entity from the mine operator. Since the release of the 2016 Kevitsa MRE (Gray et al. 2016), the exploration work done by Boliden FinnEx Oy has focused outside the Kevitsa Resource area. Apart from resource drilling, 4 exploration diamond drill holes and one extension to a resource drill hole was drilled within Kevitsa Mineral Resource area in 2018. The drill holes were not logged or assayed in time to be included in 2018 Mineral Resource estimate.

More detailed descriptions can be found in Degen & Kokko, (2018).

3.9 Mining methods, processing and infrastructure

This chapter is largely reproduced from Gray et al. (2016). More detailed description of mining methods, processing and infrastructure can be found from Gregory et al. (2010) and Gray et al. (2016).

All infrastructure required by the Mine is in place including sealed roads, power lines and substations, process plant, site offices, workshops, tailings dam, and waste storage facilities.

3.9.1 Mining methods

The Kevitsa Mine is an open pit mine operation using conventional truck and shovel operations. Boliden KMOY owns a mining fleet and uses contractor to assist mining ore and waste. The onsite technical group supervises the contractor. The Kevitsa Mine commenced mining operations in 2012. Mining has proceeded from initial excavations to stage 2 and stage 3. Stage 1 has been mined out and final pit, stage 4, waste removal will start at 2020. Currently, at the end of December 2018, the life of mine is until 2032.

The mining sequence broadly follows the sequence of events as follows:

- RC grade control drill holes will delineate the ore zones
- Blast patterns designed to reduce material throw and ore dilution - and a Blast Master planning process controls sequence of operation
- Ore and waste blasted and mined separately as fragmentation requirements vary significantly
- Waste removed on each 12 meter bench prior to the mining of ore
- The removal of waste in the successive cut-backs utilizes planned bulk systems of operation

- Trim blasts and perimeter blasting will be utilized to ensure pit wall profiles are cut to the correct angle and wall damage minimized
- Face shovels will load rock into the 225t class trucks and ore will be hauled from the pit to the finger stockpiles which are integral part of the feed sequence to ensure ore blending can be achieved, haulage efficiencies can be maximized and operational flexibility enhanced at all times
- Some of ore is loaded to the crusher directly and will be tipped directly into the crusher when the blending requires material from the pit

3.9.2 Mineral processing

The mineral processing facilities at Kevitsa have undergone several modifications and an expansion since commissioning in 2012. The current capacity of the Kevitsa process plant is 7.8Mtpa. On-going expansion project will increase the yearly throughput to 9.5Mtpa, Commissioning in 2020 and reaching full capacity in 2021.

The following unit processes comprise the Kevitsa Metallurgical facility (Figure 7):

- Primary crushing of run-of mine (ROM) ore from the open pit (delivered by dump truck)
- Screening of the primary crushed ore to produce three products -coarse lumps and fines as feed to the AG mills, and a mid-size product for the pebble mill.
- Pebble storage bin 750t live capacity
- Crushing of excess pebbles
- A single stockpile of the mixed coarse and fine ore, with 15,000t live capacity (16.7h).
- Two 7MW AG mills operating in parallel on material fed from the stockpile
- The AG mills operate in partial closed circuit with hydrocyclones, and with transfer of AG mill discharge slurry to the pebble mill by pump. Cyclone overflow is final product to flotation.
- A single pebble mill in closed circuit with cyclones to produce a final product (P80) size of 95µm.
- Sequential flotation of copper and nickel concentrates
- Copper flotation cleaning in four stages with regrind of scavenger concentrates product.
- Nickel flotation cleaning in five stages with regrind of the 2nd cleaner concentrate product.
- Flotation of sulphide rich concentrate from the nickel scavenger flotation tails to produce a low Sulphur content tailings with low acid forming capacity.
- Dewatering of Cu and Ni concentrates by thickening and filtration
- Deposition of primary tailings into conventional (unlined) tailings storage facility (TSF)
- Deposition of sulphide rich concentrate into a dedicated lined tailings storage facility.
- Reagent make-up, storage and dosing systems.
- Water services and reticulation systems.
- Compressed and instrument air generation and reticulation systems.

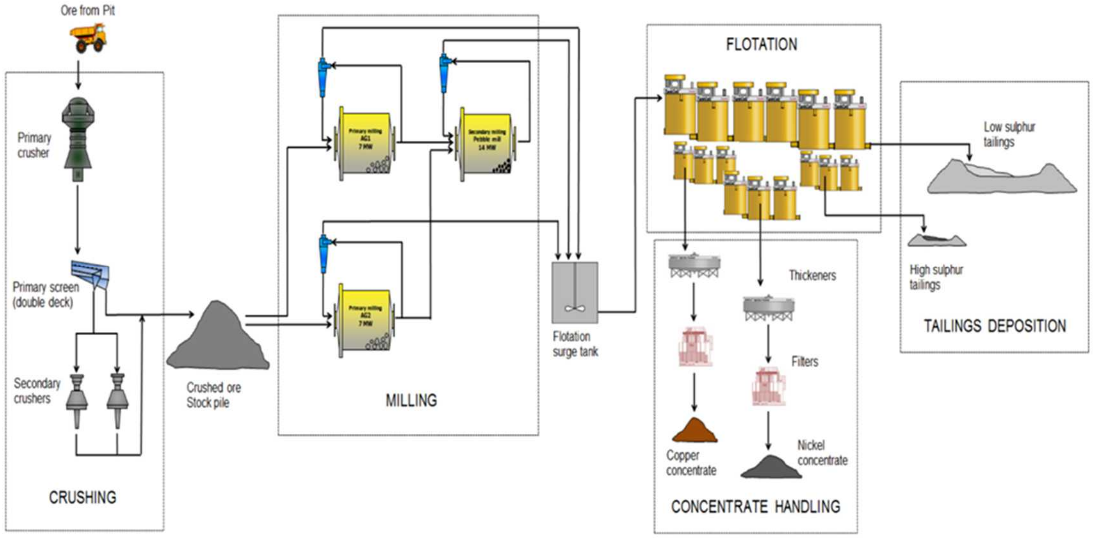

Figure 7. Simplified flowchart of the Kevitsa Mine process

Historical test work in the 1990's and early 2000's indicated that by flotation a bulk sulphide concentrate containing Cu and Ni could be produced successfully. The grades of the bulk concentrate produced during these metallurgical studies did not meet the requirements for downstream processing and the test work for producing separate saleable concentrates of copper and nickel was not successful. From 2004 to 2009 metallurgical testing was carried out at the laboratories of GTK (formerly VTT) in Outokumpu, Finland, with the focus being on developing a flotation process to produce separate smelter-grade copper and nickel concentrates. This work was carried out at bench scale and in a pilot plant campaigns. Numerous operational test work programs have been run in the site laboratories.

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 9. The maintenance, mining, processing and concentrate transporting costs are included in calculations for the cut-off at the Kevitsa Mine.

Table 9. Long term planning prices currently used in Boliden relevant to Kevitsa Mine

	Planning prices, 2018
Copper	USD 6,600/tonne
Gold	USD 1,200/tr.oz
Nickel	USD 16,000/tonne
Palladium	USD 1,000/tr.oz
Platinum	USD 1,000/tr.oz
Cobalt	USD 25/lb
USD/SEK	7.50
EUR/SEK	8.85
EUR/USD	1.18

The NiEq equivalency formula is based on a combination of in-situ metal grades, process recoveries and the relative value of Ni and Cu concentrates which are produced at Kevitsa. A cut-off value of 10 EUR/t, at NiEq cut-off ≥ 0.16 %, was chosen for the 2018 Mineral Resource, which is equal to approximately 0.16% Ni(S) based on the NSR value strictly for Ni(S). This in turn can be applied to blocks with Cu grades based on the following Ni(S) equivalency formula:

Ni(S) (%)+0.60 Cu (%)=NiEq.(%)

The NSR formula is based on process recovery figures from the process plant as well as general terms for payables and deleterious elements. It assumes the recoveries and prices, which are set from Boliden's Long Term Price (LTP) outlook for 2019 onwards. The 2018 Mineral Reserve has been reported in two-stage cut off based two Net Smelter Return (NSR) budget prices defined by forecast production period

A cut-off of NSR ≥ 16 €/t is used for Net Smelter Return during 2019 according to the following formula:

NSR=Ni(S) x 48+Cu x 38.7+Pt x 6.5+ Pd x 7.4+Au x 8.9+Co(S) x 81.4

A cut-off of NSR ≥ 15 €/t is used for Net Smelter Return Long Term Prices from 2020 forwards:

NSR=Ni(S) x 65.3+Cu x 43.4+Pt x 7.1+ Pd x 7.2+Au x 8.2+Co(S) x 83.4

3.11 Mineral resources

The 2018 Kevitsa Mineral Resource was estimated by Lion GeoConsulting (LGC) in October 2018. Seven grade elements (Cu, Ni(S), Co(S), Au, Pt, Pd, and S) and density were estimated. An additional 8 diamond drill holes were utilized in the estimate compared to the previous 2016 Mineral Resource estimate, including infill and resource conversion holes drilled in 2017 and 2018. Some of the drilling from the 2018 programme was pending logging and assay results and has been excluded from the estimate.

Mineral Resource grade shells and faults defining fault blocks were generated using Leapfrog 4.2.3. Statistical analysis was undertaken using Supervisor 8.3.1.20. The model extent was defined to cover the stage 5 pit design and all drilling. Grade estimation was completed using Ordinary Kriging (OK). For a detailed description of the estimation methodology, including statistical data analysis, grade variography, estimation parameters and model validation, refer to Degen & Kokko (2018).

3.11.1 Model depletion

Optiro was retained by Boliden to recode, deplete and report the 2018 Kevitsa Mineral Resource for the end of year (EOY) reporting period (to 31 December 2018). The following data was supplied as Datamine (.dm) or Surpac (.dtm) files:

- 2018 Mineral Resource block model
- 31 December 2018 survey pickup

- 31 December 2017 (EOY 2017) survey pickup
- forecast EOY position for 2019
- stages 1 – 4 pit designs
- 2017 stage 4 pit design

The block model was coded using the above surfaces in Datamine RM. Subcelling was generated down to a 2.5mE by 2.5mN by 3mRL resolution. The coding fieldnames and descriptions are provided in (Table 10) A long section along 3499005mN, illustrating the block model coding, is presented in Figure 8.

Table 10. Block model codes and descriptions used for reporting

Fieldname	Code	Description
Resource		
WHITTLE	0	Outside constraining Whittle pit
	1	Inside contstraining Whittle pit
MINED	2017	Depleted and mined 2017 and earlier
	2018	Depleted and mined in 2018
	2019	Forecast prodution in 2019
	0	Unmined
STAGE	1	Pit stage 1 (mined)
	2	Pit stage 2 (current source)
	3	Pit stage 3 (current source)
	4	Pit stage 4 (final pit)
	0	Outside pit stage 4
Reporting fields		
2018 Reporting		
2018NIEQ	NiS% + 0.6*Cu%	

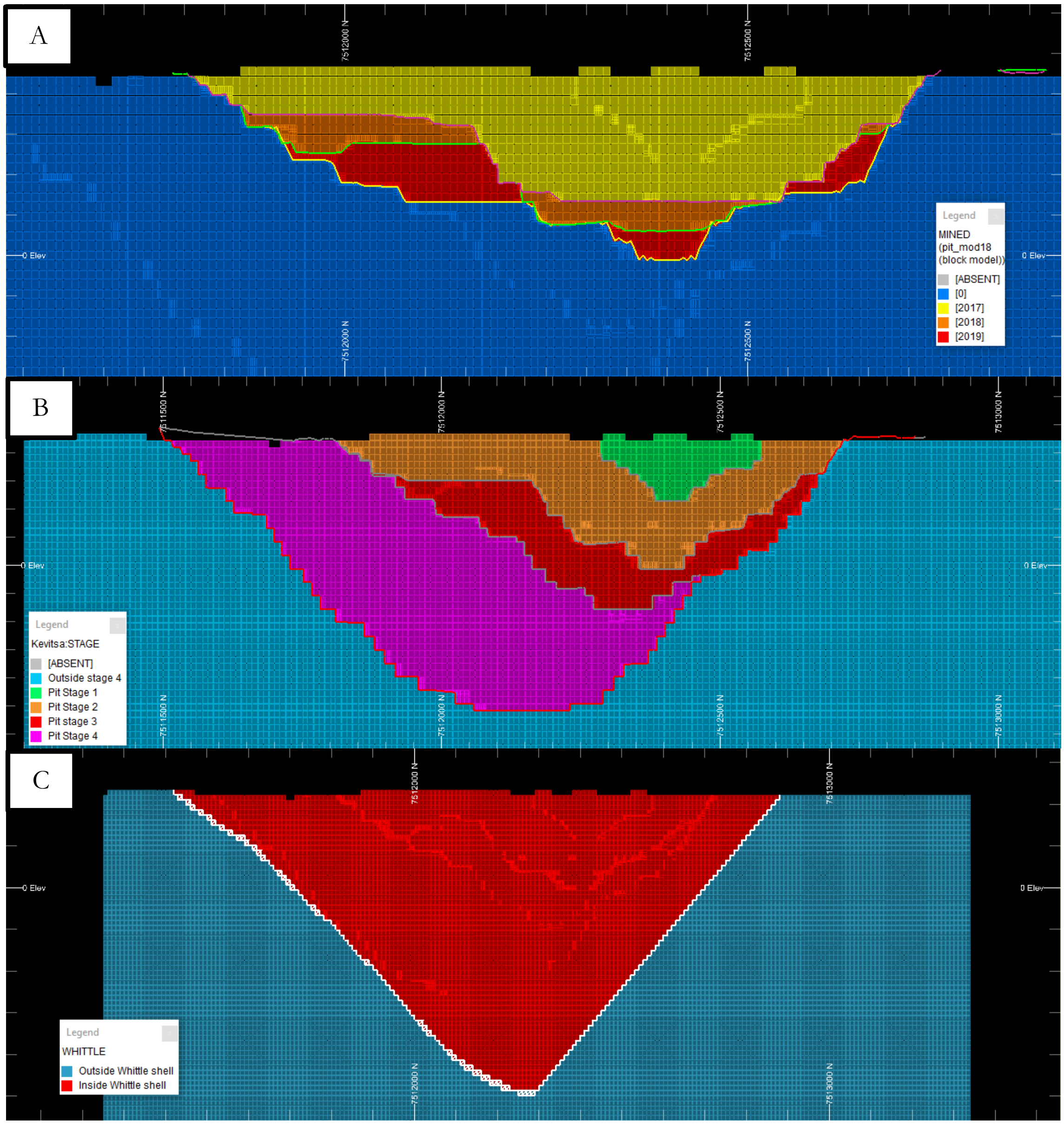

Figure 8. Block model coding used for reporting; N-S long section along 3499005mN (A: mined by year, B: Pit stages, C: Whittle resource constraint)

3.11.2 Mineral resource reporting

The Mineral Resources have been reported using a Ni equivalent formula at a cut-off of 0.16% (NiEq). For justification of this calculation, refer to Degen and Kokko (2018).

Ni(S) (%)+0.60 Cu (%)=NiEq.(%)

Blocks were constrained below the stage 4 final pit (2018) and within the Resource Whittle shell. All blocks outside the Whittle shell were excluded. For more detail on the generation of the Whittle shell, refer to Degen and Kokko (2018).

The Mineral Resource has been reported exclusive of and additional to the Mineral Reserve.

The 2018 Mineral Resource tabulation, depleted to 31 December 2018, is presented in Table 11. The Mineral Resource has been reported at a 0.16% NiEq cut-off and has been constrained within a Whittle shell, reflecting reasonable prospects of eventual economic extraction. The Mineral Resource is reported exclusive of and additional to the Mineral Reserve.

Table 11. 2018 Kevitsa Mineral Resource, depleted to 31 December 2018, at a 0.16% NiEq cut-off

	2018							
Classifications	Tonnes (Kt)	NiEq (%)	NiS (%)	Cu (%)	Au (g/t)	Pd (g/t)	Pt (g/t)	CoS %
Measured	23,600	0.41	0.22	0.31	0.08	0.11	0.17	0.01
Indicated	114,900	0.43	0.23	0.34	0.08	0.09	0.14	0.01
Total (Meas + Ind)	**138,500**	**0.43**	**0.23**	**0.33**	**0.08**	**0.09**	**0.15**	**0.01**
Inferred	19,200	0.41	0.22	0.32	0.06	0.06	0.13	0.01
Total Mineral Resource	**157,800**	**0.41**	**0.23**	**0.33**	**0.08**	**0.08**	**0.14**	**0.01**

Note: Some totals may not sum due to rounding

3.12 Mineral reserves

The Mineral Reserve is based on the 2016 Mineral Resource, not the 2018 Mineral Resource outlined in Section 3.11. For details on the calculation of the Mineral Reserve refer to Grey et al. (2016).

Optiro was retained to deplete and report the Mineral Reserve to 31 December 2018. The same files as per the Mineral Resource were used to code the 2016 Mineral Reserve in Datamine RM using the same methodology as described in Section 3.11.1. Additional codes used to flag the Mineral Reserve block model are presented in Table 12.

Table 12. Block model codes to report the Mineral Reserve

Fieldname	Code	Description
Reserve		
RESV	11	Proved Reserves - 2019 production
	22	Probable Reserves - 2019 production
	1	Proved Reserves - 2020-2032 LOM
	2	Probable Reserves - 2020-2032 LOM
Reporting fields		
2018 Reporting		
2018NIEQ	NiS% + 0.6*Cu%	
NSR19	48*NiS%+38.7*Cu%+7.4*Pd+6.5*Pt+8.9*Au+81.4*CoS%	
NSR20	65.3*NiS%+43.4*Cu%+7.2*Pd+7.1*Pt+8.2*Au+83.4*CoS	

The Mineral Reserve was constrained within the stage 4 pit (Figure 8) and has been reported using a two-stage cut-off based two Net Smelter Return (NSR) budget prices defined by forecast production period (as stipulated by Boliden).

Blocks within the scheduled 2019 production period were reported above a cut-off grade of NSR2019 ≥ 16, using the following NSR multipliers:

NSR2019=NiS x 48+Cu x 38.7+Pt x 6.5+ Pd x 7.4+Au x 8.9+CoS x 81.4

Blocks scheduled between 2020 and 2032 were reported using a second NSR calculation (see formula below). A cut-off of NSR2020 ≥ 15 was applied.

NSR2020=NiS x 65.3+Cu x 43.4+Pt x 7.1+ Pd x 7.2+Au x 8.2+CoS x 83.4

Only blocks above the respective cut-offs and classified as Measured within the 2016 Mineral Resource were classified as Proved Mineral Reserves. Indicated blocks above the NSR cut-offs were classified as Probable Mineral Reserves. No Inferred Mineral Resources have been included in the Mineral Reserves.

Mineral Reserves are factored before reporting to account for the recovery (ore loss) and dilution typically experienced with mining at the Kevitsa Mine. Mining recovery was set to 93% and dilution was set to 7%. No grade was attributed to the dilution.
The 2018 Kevitsa Mineral Reserve, depleted to 31 December 2018, is presented in Table 13. The Mineral Reserve has been reported within the stage 4 pit shell, using a two-stage NSR cut-off approach (see above) and factored to account for dilution and recovery. Note that figures may not sum due to rounding.

Table 13.2018 Kevitsa Mineral Reserve, depleted to 31 December 2018

	2018							
Classification	**Tonnes (Kt)**	**NiEq (%)**	**NiS (%)**	**Cu (%)**	**Au (g/t)**	**Pd (g/t)**	**Pt (g/t)**	**CoS (%)**
Proved	62,500	0.42	0.21	0.35	0.09	0.12	0.18	0.01
Probable	66,100	0.44	0.24	0.34	0.1	0.14	0.21	0.01
Total	128,600	0.43	0.22	0.34	0.1	0.13	0.19	0.01

3.13 Comparison of mineral resources and mineral reserves with previous year

3.13.1 Mineral resource changes

The main differences between the 2016 Resource Model (used to report the 2017 Mineral Resource) and the 2018 Mineral Resource are:

- an additional 8 diamond drillholes have been included in the 2018 estimate
- modifications have been made to the estimation parameters
- minor changes in Resource classification adjacent to additional drilling have been applied
- an updated NiEq calculation (exclusion of PGEs, Co and Au) has been used
- a modified cut-off
- New technique of defining the RPEEE was used. Constraining within a Whittle pit shell, instead of reporting NiEq cut-off outside the designed final pit shell

A waterfall chart, quantifying some of the major differences, is presented in Figure 9.

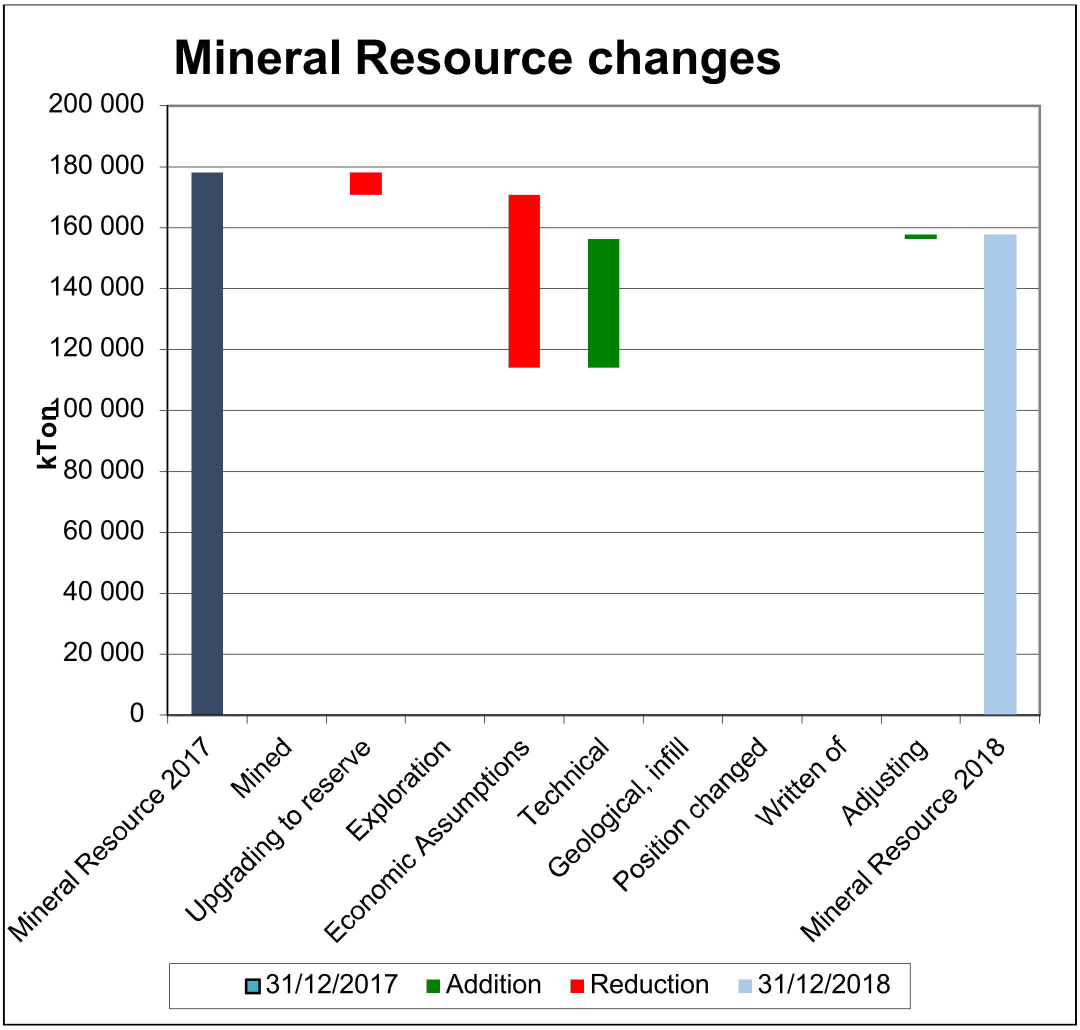

Figure 9. Mineral Resource changes

3.13.2 Mineral reserve changes

As the 2018 Mineral Reserve is based on the 2016 Mineral Resource model (the same model as used in 2017) the main differences are due to:

- modification in the cut-offs (NSR calculations) used to classify and report the Mineral Reserve
- changes to the stage 4 pit in response to geotechnical considerations and size of the smaller haul trucks
- changes to the EOY 2019 forecast production position

Changes in the Mineral Reserve are presented graphically in Figure 10

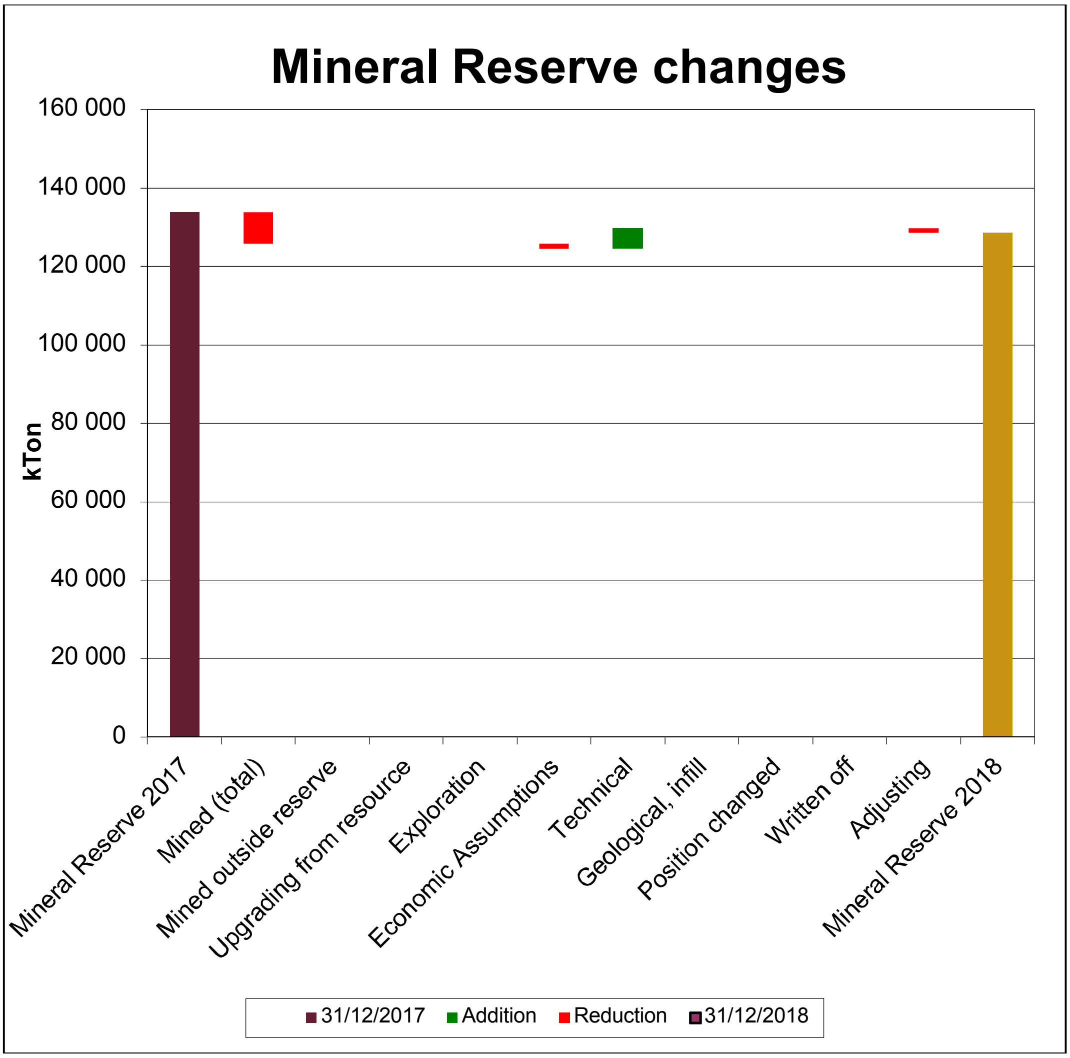

Figure 10.Mineral Reserve changes

3.14 Reconciliation

For the 2018 production period, reconciliation was carried out between production and the 2016 Mineral Resource and Mineral Reserve. Comparisons are presented in Table 14, which refer to data from the LOM Reconciliation 2018 spreadsheet.

	Tonnes (Mt)	NiS %	Cu %
Reserve	7.93	0.25	0.37
Resource (2016)	8.06	0.26	0.39
Grade Control	8.16	0.28	0.38
Forecast	6.92	0.28	0.38
Actual Mined (Trucked)	7.93	0.28	0.38
Plant (Float Feed)	8.04	0.26	0.39
	Variance (t)	**Variance NiS**	**Variance Cu**
Reserve vs GC	-2.90%	-14.30%	-4.70%
Reserve vs Actual Mined	0.00%	-14.10%	-2.90%
Resource vs GC	-1.30%	-6.50%	2.50%
Resource vs Actual Mined	1.60%	-6.30%	4.10%
GC vs Plant	1.50%	5.70%	-2.70%
Forecast vs Plant	-16.10%	5.20%	-2.40%
Actual vs Plant	-1.30%	5.50%	-4.50%

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