NEW BOLIDEN

Metals for modern life

2016

DIGITAL MINES

It's all about the chemistry

+

How mines and smelters work

Turning old mobiles into new metal

THE ORE DETECTIVES | *FROM DISCOVERY TO MARKET* | **OLD MINE BECOMES NEW WETLANDS**

We produce metals for modern life

Boliden extracts minerals and produces high-quality metals, which are mainly sold to industrial customers in Europe. Care and consideration for people, society and the environment is evident in all our activities – from exploration to customer deliveries.

PHOTO: STEFAN BERG

NUMBER OF EMPLOYEES

4878

PROPORTION OF FEMALE EMPLOYEES

18 %

SALES 2015

SEK 40242 MILLION

NEW BOLIDEN

Boliden is a metals company with a commitment to sustainable development. Our roots are Nordic, but our business is global. The company's core competence is within the fields of exploration, mining, smelting and metals recycling. Boliden has a total of approximately 4,900 employees and a turnover of SEK 40 billion. Its shares is listed on NASDAQ OMX Stockholm, segment Large Cap.

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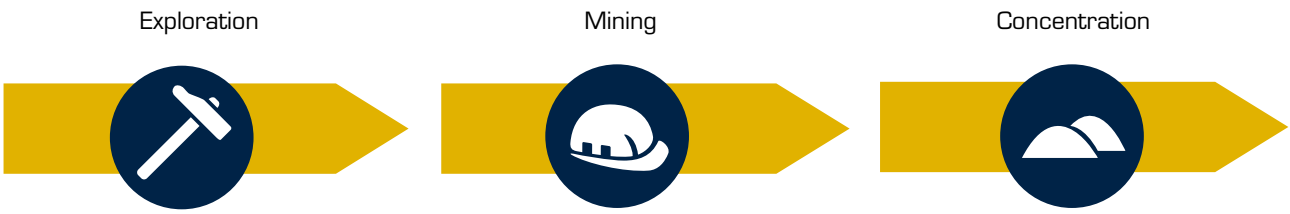
FROM DISCOVERY TO MARKET

Boliden's business model takes responsibility for the entire value chain – from exploration and mining to production and recycling of metals.



BOLIDEN'S MINES

Exploration

"Exploration – the search for mineral deposits – is conducted both in the vicinity of existing mines and in new areas. Boliden's exploration focuses on deposits that contain zinc, copper, nickel and precious metals. This is how we ensure long-term access to metals and is vital in terms of Boliden's long-term growth."

Johan Magnusson,
Geologist, the Boliden Area

Mining

"Boliden mines ores in both open-pit and underground mines. The work involves drilling, blasting, loading, and crushing the ore. Our in-house expertise in mine design, mining technology, and extraction methods coupled with a high degree of technology development, means that several of Boliden's mines have achieved world class productivity."

Erika Fagerlönn,
Team Leader, Aitik

Concentration

"The crushed ore is transported to concentrators in the mining area in question, where it is processed into mineral concentrates. The majority of the mines' concentrates are sent to Boliden's own smelters, although a certain volume of concentrates is sold to external customers."

Tobias Altörn,
Process Operator, Garpenberg

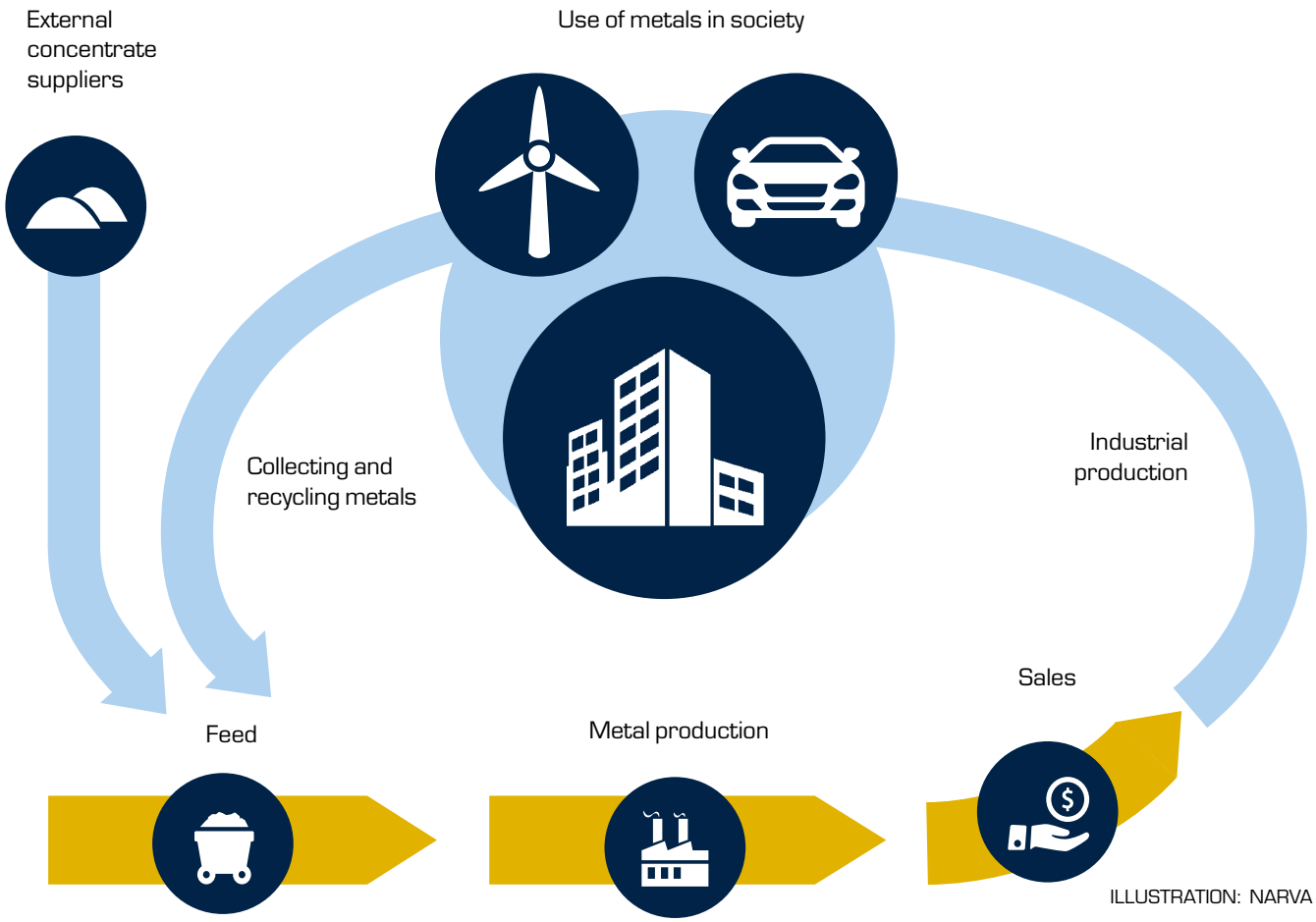


ILLUSTRATION: NARVA

BOLIDEN'S SMELTERS

Raw materials feed

"The smelters are supplied with concentrates from Boliden's own mines and with concentrates and recycled secondary raw materials from external suppliers. The secondary raw materials comprise recycled metals from circuit boards, mobile phones, automotive batteries, etc."

Therese Hedström,
Project Manager, Rönnskär

Metal production

"The smelters primarily produce zinc ingots, copper cathodes, lead ingots, nickel matte, and gold and silver granules, along with a number of by-products such as sulphuric acid, zinc clinker, aluminium fluoride, liquid sulphur dioxide, and palladium concentrate. Technical expertise and flexible processes enable Boliden to produce high quality metals from complex raw materials."

Marko Pajala,
Process Operator, Kokkola

Sales

"The majority of Boliden's metals and other products are sold to industrial customers in Europe. Zinc is supplied to steel companies, amongst others, while copper is supplied to manufacturers of wire rod, copper rods and copper alloys. The automotive and construction industries are important end-consumers of base metals."

Daniel Asplund,
Manager Zinc Sales, Stockholm

Has it occurred to you that every single product or service you use is made of metal, or is produced with the aid of metal? Here are some examples.

PHOTO: GRACEMILL

Zn

ZINC

Thanks to its ability to 'self-heal' and protect against rust, zinc is often used as corrosion protection. More than half of the world's zinc consumption is used for surface finishes and rust protection of steel, for example, within the automotive industry and on vessels, bridges and wind turbines.

Cu

COPPER

Electric power and electronics exploit copper's excellent ability to conduct electricity, and almost half of all copper is used for this purpose. Other major applications are in the construction, engineering and process industries. In the automotive industry copper is predominantly used in cooling systems and electronics.

Ni

NICKEL

Nickel resists corrosion and is used to plate other metals. The main use is in making stainless steel. Nickel is also increasingly used in batteries, including rechargeable nickel-cadmium batteries and nickel-metal hydride batteries used in hybrid vehicles. Nickel is used in building and construction, electro and electronics, tubular products, transports, metal goods and engineering.

Pb

LEAD

Car batteries and other accumulators are currently the largest area of application for lead, and 85 % of all lead is used in various types of lead-acid batteries, as well as in hybrid cars and cars with a start-stop function. Lead is also an efficient damp proofing agent and is consequently used in pipes and electrical cables that are laid underground or in water. Protective equipment for use when working with radioactive substances and x-rays is another application.

Au

GOLD

Gold is used in making jewellery, and also within dentistry and the electronics, space and pharmaceutical industries. Many space satellites have a thin external layer of gold, due to its resistance to electromagnetic radiation and radio waves. Gold is still also used in coins and as an investment object.

Ag

SILVER

Silver is used in jewellery and also in industrial applications, for example, in electronics, solar cells and mirrors and as a catalyst for chemical products. Silver is bactericidal and also resists the accumulation of mould and bad odours. People have therefore started to use silver ions in, for example, clothing materials and keyboards. Water purification is yet another application. Silver, as silver coins and ingots, is also an investment object.

Boliden owns both open-pit mines and underground mines. The geometry and composition of the ore body determine how it is mined and which concentration processes are used.

How a mine works

Drilling

Reinforcement

Crushing

Drilling and blasting

When mining underground the ore is accessed by means of ramps and drifts. Holes are drilled into the ore that can measure between 45 and 100 mm in diameter and are 5-25 m deep. The holes are pumped full of an emulsion explosive. Each hole has an individual detonation delay, meaning there can be up to six seconds between the first and last detonation. One charge can produce between 500 and 20,000 tonnes of ore.

At the Aitik open-pit mine, the holes are 16-17 metres deep, and here a normal round produces approximately 700,000 tonnes of extracted rock.

Loading

At a number of Boliden's underground mines the blasted ore is loaded with the aid of remote-controlled loaders. These can either be controlled by an operator or operated automatically, with loading and unloading being performed remotely by an operator using a CCTV camera system, while transport is conducted automatically via a local WLAN system. At an open-pit mine, the ore is loaded onto mining trucks by excavators.

The ore is then transported to a crushing plant, which may be above or below ground.

Reinforcement

At any place in the mine where people are working, systematic safety work is performed through scaling, shotcreting and bolting. During scaling, loose rock is removed from the ceiling and walls using mechanical scalers. The rock surfaces are then sprayed with a layer of steel fibre-reinforced concrete.

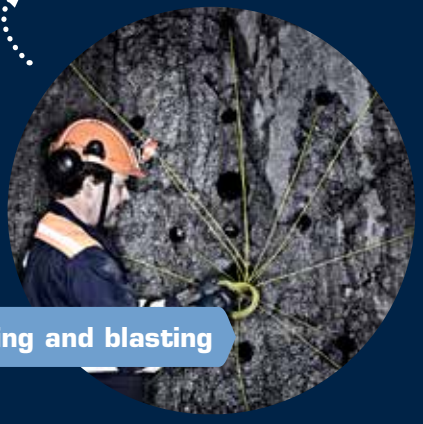
Finally, rock bolts are drilled and cast in place in a systematic pattern.

Crushing

The mined ore is crushed into smaller pieces at the crushing plant before being transported first to an intermediate ore storage facility and then to the concentrator.

At an underground mine the crushed ore is carried up through a shaft to the surface using a rock hoist.

At an open-pit mine, the ore is carried by mining trucks up a spiral ramp.



Charging and blasting

Loading and transport

PHOTO: STEFAN BERG

Grinding

The valuable mineral is separated from the waste rock at the concentrator.

The first stage in this process involves adding water and grinding the ore in large mills. A popular method is autogenous grinding, which means that the ore grinds itself without the addition of external grinding media.

The end result is a slurry containing water and finely ground ore.

Flotation

The flotation process is a surface-chemical process, where small amounts of chemicals are used to affect the surface characteristics of valuable minerals, causing them to become hydrophobic. When air is blown into the slurry, the hydrophobic mineral particles adhere to the air bubbles and are carried up to the surface, where they can be removed in the form of a foam. This process is monitored by operators who can adjust a number of parameters, thereby maximising the amount of extracted metal.

Dewatering and concentrate

The mineral is drained and filtered, producing a fine-grained concentrate, which is the mines' end product.

Boliden's mines produce mainly zinc, copper and lead concentrates, which are refined by various processes at smelting plants, resulting in a pure metal. Precious metals are bound to these concentrates and are extracted at the smelters. Find out more on page 16.

In modern mines, an increasing amount of the work is performed with the aid of autonomous machinery and wireless networks. Its benefits are increased production and a safer work environment.

TEXT: EVELINA LÖÖV PHOTO: TOMAS WESTERMARK

DIGITAL MINES

MODERN MINES ARE becoming increasingly digitized. In the most utopian image of tomorrow's underground mines, there are no people present, only machines controlled remotely from – in principle – anywhere on earth.

Boliden is currently conducting a unique initiative to develop automation in mines. This takes place in a cross-functional programme with employees from various departments together with external parties such as Volvo, Ericsson, Atlas Copco and ABB. The long-term goal is to streamline mining so that production can continue round-the-clock, all year round. Peter Burman, in charge of Boliden's mine automation programme, tells us:

"Today, there are distinct peaks and troughs in the production flow in mines. During shift changes, lunches and breaks, production falls significantly. With better production control, productivity could increase by between 10 and 20 per cent. If we use autonomous machinery that operates even when nobody is present, that number increases to between 40 and 80 per cent."

It began with the network

The Boliden mine in Kristineberg has been in operation since 1940. In 2012, the mine was the first in the world to employ a combination of wireless networks, IP telephony and positioning. The network had 100 per cent coverage over a total distance of 35 kilometres. Today, all communication takes place via the network. In the next phase, Boliden installed wireless networks in the Kankberg and Garpenberg mines.

A clear strategy is to avoid specialist solutions that only work in Boliden's own environment. It must be possible to sell the solutions developed with various partners on a global market.

"Take the wireless network as an example – in our case it is an extension of the office network. It is not mine-specific and contains no unique components. The telephones used in the mine are another example. They were actually designed for the healthcare sector, to handle being cleaned with spirits. Their moisture resistance makes them ideal for the mine environment," declares Peter Burman.

The advantages of positioning technology

Wireless networks allow the use of positioning systems, which have a number of advantages.

"The mine used to be like a black hole, but now we can see what is happening down there in real time. We can do things like controlling ventilation depending on where in the mine vehicles are located and whether or not they are operating, thus sparing the environment and conserving resources. The technology also leads to

reduced emissions as operators can plan their runs better and use ecodriving," explains Peter Burman.

Safety the biggest gain

While all of the projects in the mine automation programme have great potential for increasing productivity, the greatest gain is in safety. One example concerns 5G – the fifth generation mobile network – which is tested together with Ericsson at one of Boliden's mines during 2016. The technology provides shorter response times and better remote control capabilities. Thus the successful implementation of 5G should lead to a safer working environment.

"We will have technology that gives us greater scope to move staff away from hazardous areas. Shorter response times are crucial as we prepare to make greater use of remote-controlled machines," explains Peter Burman.

Another interesting project concerns fire safety and is being conducted together with researchers from e.g. Luleå University of Technology. The project is investigating the possibility of using remote-controlled work vehicles, such as fire-fighting units.

"It means we won't have to risk lives in the event of a rescue operation," says Peter Burman.

The rescue function is also under test in another project in Boliden's Kristineberg mine. In an emergency, the system will strip away all production-related information and only show people and rescue chambers. This will allow targeted efforts to help employees in a specific location.

"This not only provides support for operations centre personnel, but also for the emergency services. Just being able to see a 3D view with the people in danger clearly marked before the rescuers go down into the mine is a huge help," says Peter Burman.

Hottest projects right now

As an early adopter of mine automation, Boliden has taken on something of a client role. The company acts as a test facility and also the standards setter for a number of different projects.

"The highest priority projects at the moment are autonomous trucks and remote-controlled loaders. But fully autonomous mining robots are probably a long way off," concludes Peter Burman.

DRONES MAKE MINING SAFER

TEXT: TOMAS WESTERMARK

Boliden is testing helicopter drones to inspect mine faces more safely.

BOLIDEN IS NOT ONLY TESTING HELICOPTER drones above ground to survey roads and piles of material, but also underground to inspect rock faces that are inaccessible to personnel. During the underground tests, the operator follows the progress of the drone through the gallery via live streaming of a high-resolution image from a downward-angled camera. Sensors, similar to those on modern smartphones, keep the drone in stable flight.

In the future, the technology could be used to locate people in underground mines in the event of accidents and fires.

Cores examined using UV radiation

THE GOLD AND TELLURIUM in Boliden's Kankberg mine are hard to see with the naked eye, but because they fluoresce they can be seen with UV light. Changes in the surrounding rock, known as transformation, indicate where the ore is located. The fluorescent minerals appear more frequently as you get closer to the ore, and with the right skill you can get an idea of the direction in which to look.

In Kankberg, the strongest types of transformation are andalusite and topaz. Boliden is mapping these minerals in order to assess the degree of transformation. As many details as possible are mapped, because there's no way of knowing which pieces of the puzzle are important at an early prospecting stage.

BRIEF FACTS ABOUT **GARPENBERG**

LOCATION: DALARNA, SWEDEN
NUMBER OF EMPLOYEES: 400, MOST OF WHOM WORK SHIFTS IN ORDER TO KEEP MINING AND CONCENTRATION OPERATIONS RUNNING ROUND THE CLOCK.
PRODUCTION: 2.5 MILLION TONNES OF ORE PER YEAR.
END PRODUCT: ZINC, COPPER AND LEAD CONCENTRATES, WHICH ARE THEN TURNED INTO PURE METAL AT A SMELTER.

Careful planning from cradle to grave

The new ore body discovered at Garpenberg about 15 years ago laid the foundations for work to expand the mine, which was commissioned in 2014. There is calculated to be enough ore to keep the mine in operation for at least 20 years, but already there are plans in place for how it should be restored.

"Thanks to efficient treatment plants and systems that re-circulate process water, we are able to minimise our emissions and discharges from the day-to-day operation. However, our environmental responsibility extends well beyond that. Even before construction work begins on a new mine, we have to plan its closure, and we are also obliged to set aside funds now to cover the costs that such work will entail," says Ann-Charlotte Almquist, HR manager with responsibility for quality and environment at Boliden Garpenberg.

The planned reclamation work includes, among other aspects, digging out, enclosing and covering over contamination and materials containing metal. Within the mining area, for example, there is a tailings pond containing residual products from the concentration process. What matters here is ensuring that metals do not leach out of the tailings, and a variety of methods are used to restore the site to the natural area it once was.

Find out more on page 24.

GARPENBERG

TEXT: SUSANNA LIDSTRÖM
PHOTO: STEFAN BERG

Sweden's most modern mine

A new record ore deposit turned the closure-threatened mine in Garpenberg into an expansive industrial area complete with world-class technology and equipment.

THE 68-METRE-HIGH pithead frame is visible from some distance away – a tall windowless concrete building that fulfils a key function within the new mining area. Here, just over 400 tonnes of crushed ore is raised every hour with the help of a gigantic rock hoist that achieves a speed of 17 metres per second.

It takes just a minute to raise a load from the deepest level of the mine, which lies approximately one kilometre below the surface.

This is just one of many new investments since Boliden decided to invest heavily in expanding Garpenberg in 2011. The investment, totalling SEK 3.9 billion, which included everything from fixed installations and machinery to advanced IT systems for remote control and automation, has enabled Boliden to streamline mining at Garpenberg, and increase production to 2.5 million tonnes of ore per year

"Things looked a lot different when I started as a miner 15 years ago. Back then the mine's future was uncertain and the entire operation was threatened," says safety representative Dan Östman, who greets us at the lift down through the mine's newest shaft.

THIS PART of the mine was commissioned in the spring of 2014, after three years' intensive expansion work both above ground and below. In addition to Boliden's own project organisation, around 800 contractors were hired during the comprehensive expansion of operations, which resulted in Garpenberg becoming Sweden's most modern mine, and one of the world's most efficient. At the same time, it is Sweden's oldest mining area still in operation. Ore first began to be mined here back in the 13th century. Boliden has owned the mine since 1957. At that time, around 300,000 tonnes of ore were being produced each year.

Mining today in no way resembles the mining of yesteryear.

"A lot of heavy manual processes have been replaced with computerised machines," says Dan Östman, pointing to an enormous drilling rig waiting to be serviced at the mine's fully equipped workshop, which is situated 900 metres below ground.

Nowadays a miner's most important tool is a joystick or tablet, which is used to control everything from drilling and blasting in underground cavities to loading and crushing the mined ore.

THE SAME IS TRUE of the next stage of the extraction process, which takes place in the adjacent concentrator – a building over 200 metres long to which the crushed ore is transported by conveyors via an intermediate ore storage facility above ground.

Mill manager Jenny Gotthardsson is used to guiding industry colleagues and other interested visitors through the state-of-the-art facility. In order to be heard over the deafening noise, she uses a wireless microphone and headset when providing information on the latest developments in the concentrator's three crucial processes: grinding, flotation and dewatering.

"The principles for this method of separating the correct minerals from the waste rock were first established at the end of the 19th century, but the production methods used have, of course, changed beyond all recognition since then. And they are still evolving today. We are constantly working to fine-tune everything from chemical additives to material flows in order to optimise the process and safeguard the quality of our end products – zinc, copper and lead concentrates," says Jenny.

She points to a 70 m^3 flotation tank and the bubbling grey sludge inside as she explains that the contents are analysed online every six minutes. All this is done automatically and monitored from the control room, which is situated in an office building next to the concentrator.

After the noise of the unmanned production hall, the silence here is palpable. Four process operators sit in front of large screens, keeping a check on the flows and samples and watching for any alarms from the various concentration substations.

"The new facility has generally resulted in a more refined production chain providing greater capacity and a greater degree of automation. This means that we can produce almost twice as much as before with the same number of employees," says Jenny, before saying that the process remains ongoing.

"That is what is so fascinating about working with process improvements. There is always some little detail you can tinker with in order to be able to extract that little bit more from our rich raw material."

CURRENT SITUATION AND **ZERO VISION**

- In the last decade the number of serious accidents in the mining industry has more than halved.
- The most common types of incidents and accidents involve people tripping, falling or injuring fingers when working with hand tools. In most cases the person returns to work within a day.
- A common measure within the work environment field is Lost Time Injury (LTI), which indicates the number of accidents leading to an absence of more than one day per million hours worked. Among Boliden's employees, this figure increased from 5.8 in 2014 to 6.6 in 2015. Including contractors, the figure went from 7.9 to 8.9. The increase is partially attributable to Boliden's intensification during the year of its efforts to improve its safety culture, which has led to e.g. better reporting of risks and incidents.
- Boliden has recently introduced an ambitious reduction model for achieving an accident-free workplace. This sets out a 33 per cent reduction in accidents per unit and per year up to 2018, by which time the company wants to be accident-free.

"**BOLIDEN** has come a long way, but to achieve our objective of an accident-free workplace, we have to work even harder on the human factor," says Per Renman, Group Safety Director at Boliden.

Forty years ago the mining industry topped accident statistics for Swedish workplaces. Since then conscious efforts in terms of personal safety and technology have led to many of the most dangerous manual work processes being abandoned, while physical protection has been introduced to eliminate the risk of collapse and similar dangers.

"Today, statistically speaking, it is no more dangerous to work in mines or at smelters than any other workplace. The transport industry, the agricultural sector and the construction industry, for example, all have considerably higher accident figures," says Per Renman.

However, he does point out that you should never lose respect for the risks associated with handling large material flows, heavy machinery, chemicals and, in some cases, high temperatures. At Boliden's facilities continuous technical improvement of machinery and equipment has led to innovations such as more efficient ventilation systems and an option to remotely control underground machinery, as well as better flameproof protective clothing for hot work and a more reliable communications system using radio and mobile telephony.

"Overall the transition from heavy physical labour to automated machine work has contributed enormously to reducing the number of risks and serious accidents. We have also introduced explicit procedures, a work environment management system and improved information, which has further increased the level of safety. However, the most difficult step, which we are still working hard on, is behaviour-based safety,"

TEXT: SUSANNA LIDSTRÖM
PHOTO: TOMAS WESTERMARK

Better protective equipment, safer machinery, more transparent procedures and increased automation have significantly reduced the number of mining and smelting accidents over the last few decades.

SAFETY FIRST

says Per, explaining that the starting point for these efforts is understanding that the majority of incidents that occur today have a strong link to the human factor.

Tiredness and stress can, for example, cause employees to take short cuts – and in some cases disregard regulations and protective equipment – with the best of intentions, i.e. keeping production going.

"However, safety comes before all else. Anyone experiencing the least doubt about an element of their work should always stop what they're doing so as not to expose themselves or others to risks. This is an important aspect of the strong safety culture we are currently promoting throughout the company," says Per.

He emphasises the importance of involving all employees in this work and explains that fundamentally it is about being considerate towards one another. Under a common slogan, BSafe, Boliden is encouraging all employees and contractors working at the company's facilities to report risky situations as soon as they identify one. In addition, all incidents are to be reported and the underlying causes analysed in order to constantly identify new risks and avoid similar incidents happening again.

Per points out that Boliden's active preventive risk work has been given the highest priority for a number of reasons:

"Everyone is entitled to a safe and healthy work environment. There is also a direct link between good safety and profitability. If you cannot manage work environment issues, then you won't be able to run a business that is sustainable in the long term. There are no short cuts to an accident-free workplace – that is something we create together."

"The transition from heavy physical labour to automated machine work has contributed enormously to reducing the number of risks and serious accidents."

Per Renman, Group Safety Director

Mine concentrates and secondary materials are refined at Boliden's smelters, producing pure metals. These metals are separated using reactions at high temperatures or with the aid of leaching.

How a smelter works

ZINC SMELTER

Metal concentrate

Roasting

Leaching

Direct leaching

Metal concentrate

Metal concentrate from mines usually comprises approximately 50 per cent zinc.

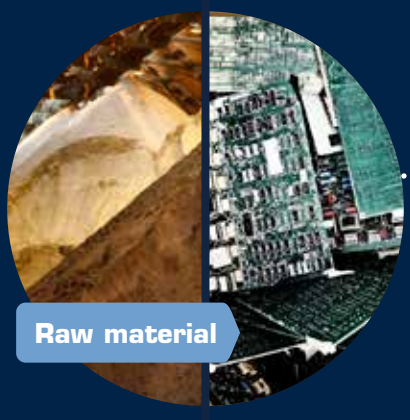
Roasting

The concentrate is roasted in furnaces to remove any sulphur. The result is so-called calcine, which comprises approximately 60 per cent zinc. The roasting process can be omitted when using so-called direct leaching.

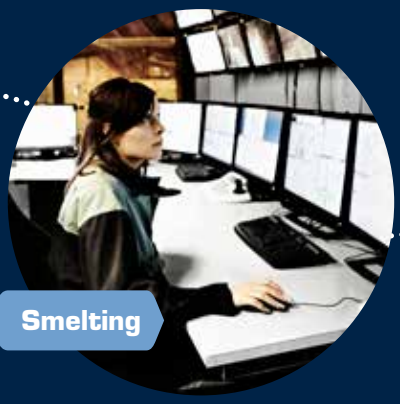
Leaching

The calcine is leached using sulphuric acid to precipitate and filter out any iron. The result is a zinc sulphate solution containing small amounts of impurities.

COPPER SMELTER

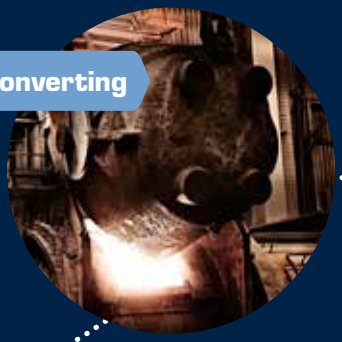


Raw material



Smelting

Converting



Anode casting

Raw material

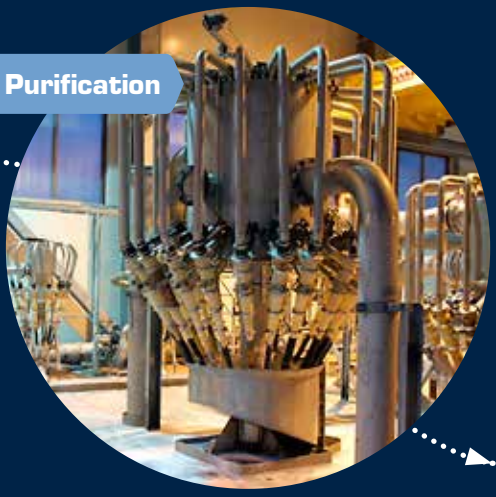
Raw material from mines usually comprises approximately 25 per cent copper, while recycling material contains on average around 30 per cent.

Smelting

Smelting takes place in different types of furnaces depending on the raw material and process technology. An upper layer of slag and a lower one of matte, which has a copper content of approximately 55 per cent, form in the furnace.

Converting

The copper matte is tapped into a converter furnace where iron and other impurities, together with sulphur, are separated out. The converter is also charged with scrap metal and, in some cases, black copper – an intermediate product from the recycling of electronics. The result is known as blister copper, which has a copper content of 97-98 per cent.



Purification

The zinc sulphate solution is purified in three stages, after which it contains approximately 150 grams of zinc per litre.

Electrolytic refining

The zinc is separated from the solution using the electrolytic refining process. The result is zinc cathodes with a zinc content of 99.995 per cent.

Casting

The zinc is then cast into ingots or so-called jumbos, which can weigh up to four tonnes. The zinc can also be alloyed with other metals in line with customer requirements.

End product

The majority of zinc is sold to steelworks, which use it to rustproof their own products. These products are then used in cars, bridges, high-rise buildings and wind turbines, for example.

PHOTO: STEFAN BERG AND PÄIVI KARJALAINEN

Precious metals plant

Gold, silver, palladium and platinum are extracted during the various processes and make a substantial contribution to the revenues of copper smelting plants.

Anode casting

The blister copper is then processed in an anode furnace to reduce its oxygen content. This increases the purity level to 98-99 per cent and the copper is then cast to form anodes.

Electrolytic refining

The anodes are places in tanks with steel cathode plates. In the subsequent electrolytic refining process, copper migrates from anodes to cathodes, which have a copper content of 99.9975 per cent. The cathodes are separated from the steel plates and washed. They are then ready for delivery.

End product

The copper is sold mainly to wire rod and copper rod manufacturers and will eventually be used in the construction industry, for example, or in electrical and electronic products.

Turning old mobiles into

Boliden's Rönnskär copper smelting plant is a world leader in recycling electronic scrap – thanks to a furnace that resembles a spinning soft drinks bottle.

WE ARE USING more and more electrical and electronic devices in our day-to-day lives. A lot of countries are also introducing legislation on collecting scrap electronics. This means that the amount of recycling material is increasing, providing smelters with a new – and plentiful – source of raw materials. The gold content in electronic scrap varies, but on average it is around 100 g/tonne, which is comparable with the gold content of the 4 g/tonnes of ore concentrate produced at Boliden's Kankberg gold mine.

Electronic scrap thus accounts for an ever increasing proportion of Boliden Rönnskär's total metal flow. A new e-Kaldo plant opened here in 2012, where crushed electronic scrap is melted down in order to recover the metals it contains. The molten metal then continues on through the normal copper process.

Someone who works at the new e-Kaldo plant is process operator Tomas Bäckström.

What is an e-Kaldo plant?

"It is essentially an energy-smart way of recycling electronic scrap and metals. We smelt electronic scrap here 24 hours a day, every day, all year round."

What do you mean by energy smart?

"Well, we kick-start the process, but then we don't need to supply any more energy because the heat from the plastic contained in the electronic scrap causes it to melt. The steam produced is transferred to our energy centre and used for district heating and to produce electricity."

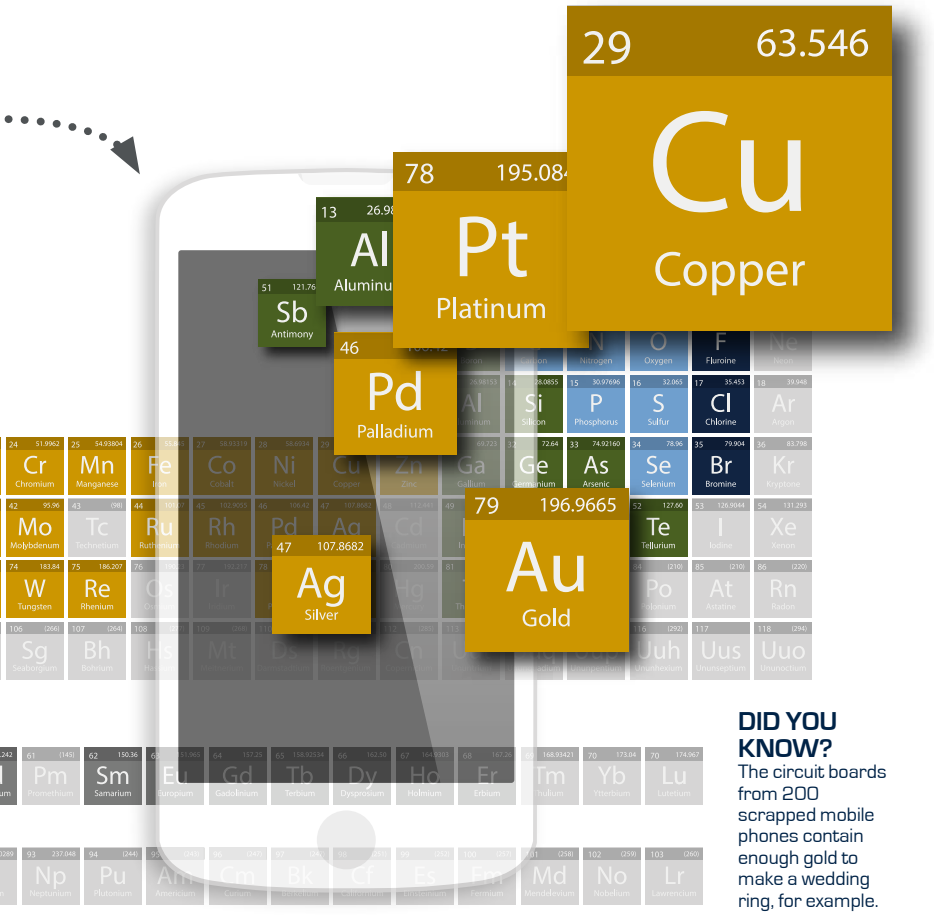
Which part of the process are you responsible for?

"I'm involved at an early stage in the process. Once the scrap has been crushed and sampled, it is brought here for smelting. It is then integrated with the normal smelting process, which results in copper, gold and silver. I monitor the process, making sure that all the levels are correct. We follow a rolling schedule, which involves a lot of preventive maintenance.

It is one of the most independent roles I've had because a lot revolves around thinking for yourself, for example, sampling the molten metal and sending it for rapid analysis. Once the results come back you have to decide what to add or remove in order to ensure molten metal of the best possible quality."

TEXT: EVELINA LÖÖV
PHOTO: STEFAN BERG, EVELINA LÖÖV, SHUTTERSTOCK
ILLUSTRATION: TR

new metal



DID YOU KNOW?
The circuit boards from 200 scrapped mobile phones contain enough gold to make a wedding ring, for example.

Bergsöe completes the cycle

Boliden's lead smelting plant in Bergsöe is one of Europe's biggest recyclers of use lead-acid batteries and as such forms an important part in the metal's life cycle.

TEXT: RICHARD CUTLER

THE LEAD FROM 4 million worn-out lead-acid car batteries is recycled at Boliden Bergsöe every year. At least 70 per cent of the lead produced there is sold to the battery industry in Europe and used again.

"Our lead smelter helps recover and recycle a finite resource that is of great importance to modern society but which can be extremely toxic if not handled in the right way during smelting and recovery," says Peter Carlsson, General Manager at Bergsöe.

Minimized environmental impact

Bergsöe seeks to minimize the environmental impact of its discharges to atmosphere and water, and the plant exceeds both national statutory requirements and EU requirements. For example, the total lead discharge to water in 2015 was five times lower than the permissible level stipulated in Bergsöe's new environmental permit. The plant already meets most of the regulations in the EU Industrial Emissions Directive rules for the Best Available Techniques in the Non-Ferrous Metals industry, which will become mandatory as of 2020.

Ultramodern systems take care of waste water containing sulphuric acid and scrub process air including lead-bearing extraction air, and collects filtered particles for recycling externally. Ash from crucibles, casting machines and lead-bearing slag are also processed on site.

District heating from worn-out batteries

Worn-out batteries contain plastic that serves as a reducing agent in lead production. The plastic also gives off heat together with the coke used during the smelting process. The residual heat, equivalent to the annual heating requirement of 2000 homes, is supplied to Landskrona municipality's district heating system.

DID YOU KNOW...
That lead is one of the most recycled metals and around 99 per cent of lead-acid batteries are recycled in Europe. The lead in the batteries is fully recyclable. The major part of the recycled lead is sold back to the battery industry which uses it to make new batteries.

IT'S ALL ABOUT THE CHEMISTRY

CHEMICAL EXPERTISE IS ESSENTIAL IF BOLIDEN IS TO CONTINUE MINING AND EXTRACTING METALS.

BOLIDEN'S METAL extraction is based on advanced chemical processes that are constantly developed by the group's many chemists, metallurgists and laboratory staff. This expertise is absolutely essential for the operation. A few examples:

EXPLORATION

When Boliden's geologists search for new deposits they analyse soil samples and cores from test drills using chemical methods.

MINING

It's been a long while since dynamite was the only explosive used in mines. Today's explosives are based on ammonium nitrate, a chemical compound which, when mixed with water, oils and an emulsifier becomes an explosive that is much safer to handle. It also gives off less dangerous explosion gases. Rock bolts constitute another example; they are anchored into the rock using thermoset plastic, which also protects the bolts against corrosion.

CONCENTRATION

The concentration process, when minerals are separated from the waste rock, is based largely on chemistry. Special chemicals are added to the floatation tanks and adhere to the valuable mineral so that air bubbles can lift it to the surface. The bubbles form a scum that is separated and whose end product is a mineral concentrate. Sometimes this concentrate must receive further treatment in order to separate two valuable minerals from one another.

Another way of extracting valuable minerals from ore is leaching where chemicals are used to separate metals from a mixture of milled ore and water. Leaching is used to extract gold as well as tellurium at the Boliden Area. Gold leaching is patented by Boliden and the tellurium leaching technique was developed in-house.

REFINING

Mineral concentrates and various recyclable materials are smelted and refined at the smelters, where most methods take place away from the furnaces in one

Development engineer Risto Alapiha at Boliden Kokkola inspects the new process for extracting silver from zinc concentrate.

More from the same amount

Extracting more from the material processed by the smelters not only increases profitability – it also guarantees environmental benefits.

kind of chemical process or another. Electrolysis is an important example of such a process at the copper smelters, where the metal is purified with the help of chemicals in combination with electricity. Direct leaching is used to a great extent at the zinc smelters, where sulphuric acid is the active chemical. Sulphuric acid is also recovered from process gases at several smelters, here too with the help of chemical processes. Inbound raw materials and production streams are also analysed in labs using chemical methods.

ENVIRONMENTAL PROTECTION

Boliden is constantly developing its cleaning processes to reduce the operation's environmental impact. Chemistry is the basis of this work. For example, several of Boliden's mines use what is known as the Fenton process for cleaning process water. Smelters also use various chemical methods to clean their water.

Reclamation work around mines is also based largely on chemical processes by e.g. optimizing the cover layer's characteristics and reducing acid ingress to minimize the risk of metal leaching.

TEXT: ANN LUNDHOLM
PHOTO: STEFAN BERG

TEXT: ANNA-KARIN RABE OCH MAARIT FRILUND
PHOTO: PÄIVI KARJALAINEN

SMELTERS are facing a new challenge. An increasing amount of the raw material we use contains substances that interfere with the process used by the smelters to produce their principal metals. These substances have until now been regarded as impurities, but are in actual fact often valuable materials in their own right. With the aid of new technology and improved processes, these materials could also be utilised, providing new and profitable products.

Extracting more metals from the same amount of raw material is not just financially profitable; it also benefits the environment. Once the smelters have processed the raw material and extracted the metal that will be turned into a saleable product, any residual products and waste must be dealt with in a sustainable way. Extracting more metal from the same amount of material may therefore maximise the number of valuable products, while also minimising the amount of waste.

There is a lot to be gained here, and Boliden constantly works to develop technologies and processes that increase the ability to handle complex materials.

ONE EXAMPLE OF process development along these lines can be found at Boliden Kokkola in Finland. Here, the main products are zinc and zinc alloys, but in 2014 the smelter also began extracting silver from the zinc concentrate.

The new process has been integrated into the existing production flow, with the silver content being extracted using a chemical process called flotation, and filtration.

Someone who works on the silver extraction process is development engineer Risto Alapiha.

"Flotation technology is new to us and so learning how it works and how best to manage it has been extremely interesting. The process also brings new demands to my role, and I have to draw on my specialist knowledge within the field of chemistry," explains Risto.

The end product is a silver concentrate, which is sold to external customers or turned into pure silver at Boliden's own smelters.

"Silver concentrate is set to become one of Boliden Kokkola's most valuable by-products. The new process is very important for us because it increases profitability and means that we can better utilise the raw material," says Jarmo Herronen, General Manager at Boliden Kokkola.

Boliden's prospectors are constantly on the lookout for new deposits.

ORE DETECTIVES

TEXT: MONIKA NILSSON PHOTO: NEIL CRIGHTON AND STEFAN BERG

LOOKING FOR new mineral deposits or 'exploration' is the foundation for Boliden's activities and a prerequisite for being able to produce metal. This work is carried out by geologists and geophysicists, who take measurements and conduct surveys out in the field, as well as analyse the information collected. The objective is to identify deposits that contain enough metal to make it worth mining. Such deposits are classed as ore, which is thus an economic term.

"Society is dependent on, for example, copper and zinc for electronics, communication and social development. All mines have a limited life, so to safeguard production at Boliden and to meet demand both in the Nordic region and elsewhere in the world we have to identify new workable mineralisations," explains Jonas Wiik, Boliden's Exploration Director.

IN BOLIDEN'S CASE this means first finding minerals that contain copper, zinc, lead and precious metals, although other metals are also of interest to the company. One example is tellurium, which is excavated at Boliden's Kankberg gold mine and used in solar cells, among other things.

There are numerous different exploration methods used to find mineralisations, including, for example, boulder prospecting, geological mapping in the field, geophysical surveys, geochemical sampling and sample drilling. All collected data is processed and interpreted by Boliden's geodata department using various computer programs to produce a multidimensional model. Financial calculations are also performed to determine whether or not the deposit is deemed profitable to mine.

All this provides a basis for decision-making about whether or not to continue with more sample drilling with the aim of eventually commencing mining. The path from discovery to mine is a long one and often takes five to ten years from the initial surveys.

"We want to know whether there is mineralisation in the bedrock, what sort of mineralisation it is, where and how it is positioned, the volume and the actual metal content. Boliden's strategy is to expand our mining operation, both by opening new mines and increasing the life of the mines we already have. Our objective is for the mines to have a service life of at least ten years," says Jonas.

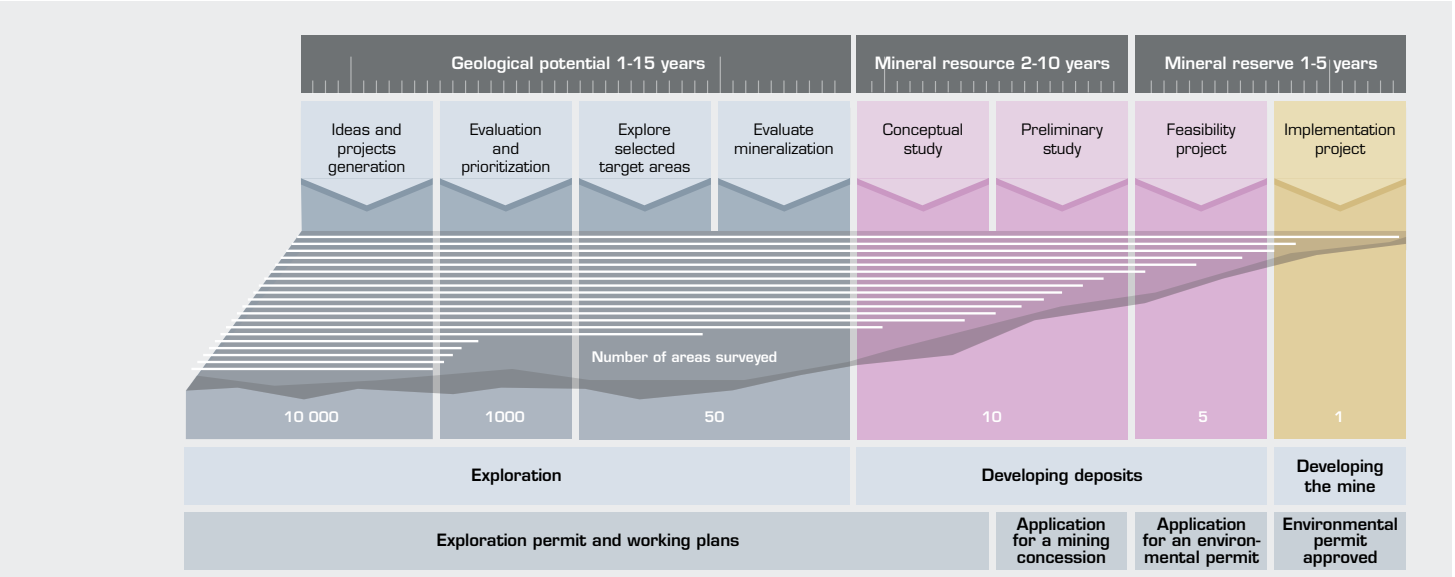
There are two types of exploration at Boliden. Near-mine exploration takes place close to existing operational mines, while field exploration is conducted in brand new areas where it is thought that the bedrock may contain interesting mineralisations. Boliden conducts field exploration in Sweden and Finland.

FROM EXPLORATION **TO MINE**

Opening a mine is an extensive and expensive process, and it can take anything from five to ten years from finding an ore deposit before mining begins. There are countless interesting exploration finds that never get that far.

Work continues all year round and each exploration project is managed by a group of experts who produce work plans and ensure that work is conducted in accordance with applicable rules and legislation. The group also engages in dialogue with the Mining Inspectorate of Sweden (Bergstaten) and the Chief Mining Inspector, who is responsible for issuing permits for test drilling, as well as with landowners and other stakeholders.

"It is extremely important that we have a dialogue with the authorities, landowners and other interested parties, who may include forest owners, reindeer keepers and homeowners. It is vital that we exercise the utmost caution when it comes to our environmental responsibility and that we always do our share. We will always restore the area in as much as this is possible and rectify any damage that has occurred," says Jonas.



Even when planning a new mine you still have to consider how the site will be reclaimed and returned to the natural landscape.

Closed mine becomes dynamic wetland

TEXT: HELENA ÖRNBERG
PHOTO: BOLIDEN

HOW **IT WORKS**

Kedträsk, September 2012. While draining the open pit, the water was limed a number of times. The water was collected in settling ponds so that the sludge could be dealt with and the water quality controlled.

January 2013. Waste rock and material from the industrial area was deposited in the empty open pit. This work began in January 2013 and was completed in June 2013.

May 2013. The deposited material was covered with peat and a 0.5 m thick layer of till.

Money set aside right from the start

Before a new ore deposit can be mined extensive investigations are carried out to determine how the surrounding land and any watercourses will be affected, and how much reclamation work will cost.

In Sweden mining companies are obliged to provide a guarantee equivalent to this cost, which is determined by the Land and Environmental Court. Boliden's provisions for this purpose are based on an assessment of future costs, using current technology and conditions as a starting point. The resulting sum is revised on an ongoing basis, as advances are made in research and technology.

BOLIDEN is responsible for the reclamation of around 30 active and closed down mining areas, which all have their own long-term plan for inspections, risk analyses and other activities required.

Some of the closed mining areas have previously been reclaimed, but this work can be improved upon using new knowledge and new environmental technology.

"Boliden's ambition is always to use the best available technology, followed by continual monitoring and evaluation. We therefore participate in various research projects on subjects such as the opportunities for using residual products from other industries to prevent oxidation of sulphur compounds. Residual products from the pulp and paper industry are already being used as buffering materials to raise pH levels and precipitate metals," says Emma Rönnblom Pärson, Manager of Boliden Mines' Environmental Department.

Conservation and reclamation of mining areas is one aspect of Boliden's business and runs parallel with its operations. The conditions of the particular area dictate the method used. The most common methods of preventing oxygen permeation and weathering of the material are water cover, advanced till cover and elevated ground water levels.

ONE EXAMPLE is the Kedträsk mine, which is located in the Skellefte field in the north of Sweden. Here there was a water-filled open-pit mine, an industrial area and a waste rock dump with oxidised and weathered waste rock that needed to be dealt with. Reclamation of the site began in 2012, and the preferred method in this case was water cover.

"The first step was to drain the water from the open-pit mine. Waste rock was then deposited at the bottom, before material from the industrial area was laid on top. Finally, peat was added. The material was then covered with a 50 cm-thick layer of till," explains Emma.

The open pit was then filled with water again and is now a lake approximately 5-6 metres deep.

"Water of this depth means we can avoid strong wave erosion of the lake bed, which can have a harmful effect on reclamation efforts," she continues.

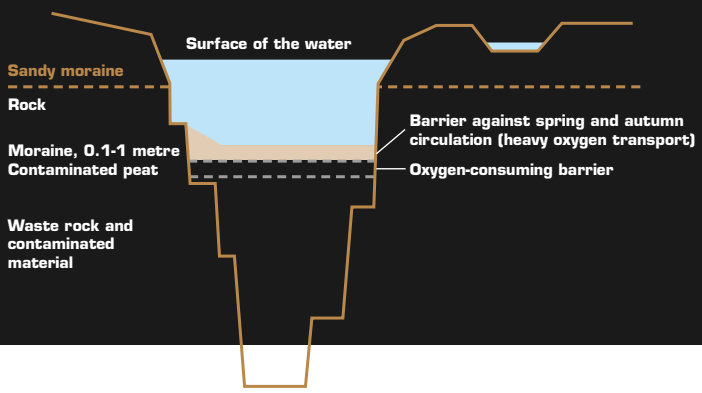
The water purification process generated sludge that was placed in an old shaft at the open-pit mine, and the remaining sludge in the settling pond was covered with bentonite, which was itself then covered with a layer of sandy till. A till barrier was constructed on the upstream side of the sludge deposit to guide surface ground water around the sludge.

"As a final step in the process vegetation is now being established, and areas of the site will gradually become wetland," concludes Emma.

WATER COVER

Water cover can be achieved by creating ponds, using voids created during mining or even natural depressions in the land. Water thus provides a barrier that limits oxygen permeation of the underlying waste.

Watch the film "Thank you for the loan", which describes the reclamation work performed by Boliden, at www.boliden.com



June 2013. The area that had previously been an open pit is now filled with waste rock, contaminated material and lime and has been covered over.

July 2013. As well as monitoring the water quality, regular soil samples are taken to be analysed both on the spot and in a laboratory.

October 2013. Reclamation of the ponds used during the purification process.

September 2014. Reclamation of the Kedträsk site is concluded. Efforts to promote biodiversity continue.

A gilt-edged history

ON 10 DECEMBER 1924 gold fever broke out in Boliden. Test drilling in an area known as Fågelmyran revealed the presence of the Boliden ore body – Europe's richest ore. A new community, Sweden's very own Klondike, is established and a gold rush begins. However, this wasn't the first time this had happened.

Gold fever hit for the first time in Skellefteå and the surrounding area back in the early years of the 20th century. A company was set up to acquire mining concessions and conduct surveys, but that particular venture was less successful and went bankrupt in 1918. A shortage of metal during the latter years of World War I prompted renewed interest in ore exploration in the area. A new type of speculative company, known in Swedish as an 'emissionsbolag', was established by the banks.

The Boliden we know today has its origins in one such company, Centralgruppens Emissionsbolag. In November 1924 the first borehole was drilled in the Boliden Area. On examination, the core was shown to contain interesting samples. A number of other holes were drilled before the Boliden ore body was discovered on 10 December.

The community of Boliden rapidly developed close to the mine. In 1926 a set of town plans was proposed, which showed the town laid out in the unique shape of a fan. The mining community took on the character of a well-organised, peaceful and idyllic residential area.

While the world was experiencing the Great Depression in the 1930s, Boliden's Skellefte operations flourished. This led to economic development in the region and local population growth. The number of employees rose steadily, and by 1935 the workforce numbered 2,500.

Over time more deposits were discovered close to Boliden and more mines opened – so far there have been 30. Activities at the actual Boliden mine continued until 1967.

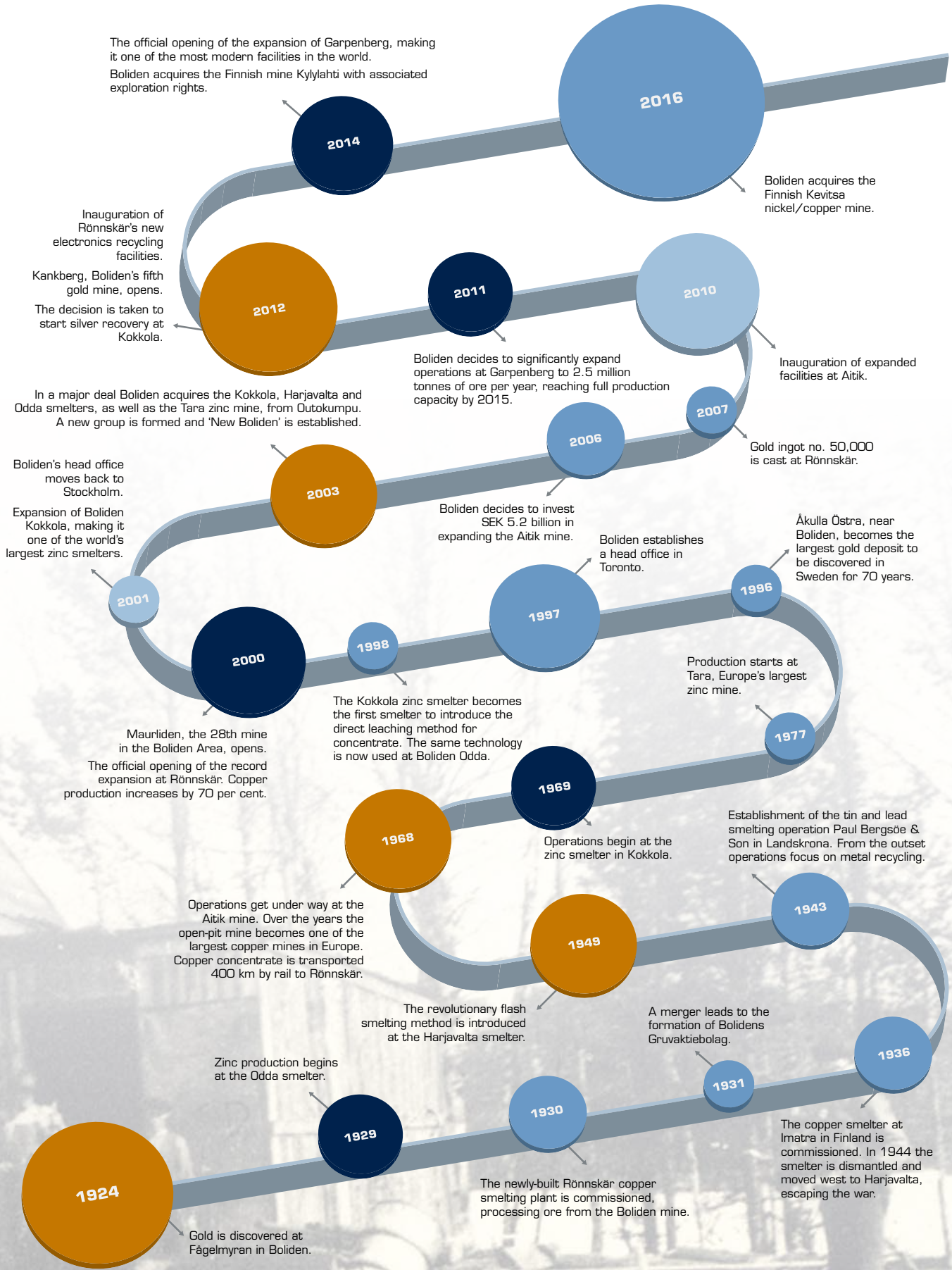
Margareta's land hid real treasure

Margareta Lundberg was a widow who had been born in 1866. She lived on a farm called Bjurliden and owned a parcel of land at Fågelmyran, where the original Boliden ore was discovered in 1924.

A year later the mining company that had discovered the ore deposit purchased 75 hectares of Margareta's land for SEK 20,000, which is approximately SEK 500,000 in today's money. Margareta is said to have imposed a condition, which was that her male children and grandchildren should be guaranteed employment with Boliden. Her grandson Henry Lundberg enjoyed a long managerial career with Boliden and eventually became president of steel manufacturer SSAB.

People said it was a cheap price for the land, but Margareta herself was happy. It pleased her to see thousands of people in employment as a result of the sale of the land, which she considered "worthless". The district flourished and people entertained hope for a better future.

Margareta Lundberg died in 1931.


2016
Boliden acquires the Finnish Kevitsa nickel/copper mine.
The official opening of the expansion of Garpenberg, making it one of the most modern facilities in the world.
Boliden acquires the Finnish mine Kylylahti with associated exploration rights.
2014
2012
Inauguration of Rönnskär's new electronics recycling facilities.
Kankberg, Boliden's fifth gold mine, opens.
The decision is taken to start silver recovery at Kokkola.
2011
Boliden decides to significantly expand operations at Garpenberg to 2.5 million tonnes of ore per year, reaching full production capacity by 2015.
2010
Inauguration of expanded facilities at Aitik.
2007
Gold ingot no. 50,000 is cast at Rönnskär.
In a major deal Boliden acquires the Kokkola, Harjavalta and Odda smelters, as well as the Tara zinc mine, from Outokumpu. A new group is formed and 'New Boliden' is established.
2006
Boliden decides to invest SEK 5.2 billion in expanding the Aitik mine.
2003
Boliden's head office moves back to Stockholm.
Expansion of Boliden Kokkola, making it one of the world's largest zinc smelters.
2001
2000
Maurliden, the 28th mine in the Boliden Area, opens.
The official opening of the record expansion at Rönnskär. Copper production increases by 70 per cent.
1998
The Kokkola zinc smelter becomes the first smelter to introduce the direct leaching method for concentrate. The same technology is now used at Boliden Odda.
1997
Boliden establishes a head office in Toronto.
1996
Åkulla Östra, near Boliden, becomes the largest gold deposit to be discovered in Sweden for 70 years.
Production starts at Tara, Europe's largest zinc mine.
1977
1969
Operations begin at the zinc smelter in Kokkola.
1968
Operations get under way at the Aitik mine. Over the years the open-pit mine becomes one of the largest copper mines in Europe. Copper concentrate is transported 400 km by rail to Rönnskär.
1949
The revolutionary flash smelting method is introduced at the Harjavalta smelter.
Establishment of the tin and lead smelting operation Paul Bergsöe & Son in Landskrona. From the outset operations focus on metal recycling.
1943
A merger leads to the formation of Bolidens Gruvaktiebolag.
1936
1931
The copper smelter at Imatra in Finland is commissioned. In 1944 the smelter is dismantled and moved west to Harjavalta, escaping the war.
1930
The newly-built Rönnskär copper smelting plant is commissioned, processing ore from the Boliden mine.
Zinc production begins at the Odda smelter.
1929
1924
Gold is discovered at Fågelmyran in Boliden.

TEXT: CATRINE JOHANSSON LANTTO
PHOTO: DANIEL OLAUSSON

"It's all a matter of openness"

GROW
WITH BOLIDEN

Erika Fagerlönn, Head of Mine Planning at Boliden Aitik, is one of Boliden's young managers.

SINCE MARCH 2016, Erika Fagerlönn has been the head of the Aitik mine planning department, i.e. the group that decides which parts of the mine will be worked and when. Previously, Erik supervised the mine's drillers and drill service. She was utterly inexperienced in her managerial role, so she wasn't about to just jump in and start bossing around eight different shift teams.

"I began with a very humble attitude indeed. I thought to myself, the employees are all expert at what they do," says Erika.

She realised quickly that there were all kinds of problems to deal with, not least the fact that she only worked daytime hours in her role as supervisor, while shifts went on around the clock. By juggling her working hours, Erika managed to make meeting each shift face-to-face possible, even if only for short periods – something which was much appreciated by the employees.

COMMUNICATION with staff is incredibly important to Erika.

"The management role, for me, means getting all staff involved and encouraging them to develop themselves. They're the ones who have to do the job, they're the experts. My job is just to be there for them and give them support and opportunities.

This means she doesn't want to just go in and ride roughshod over her staff. Instead, she prefers leadership that involves her staff's feeling they are truly able to contribute solutions and improvements.

"It's all about transparency" As a manager, you have to be able to listen and take things on board. Staff provide loads of really good ideas, but only when you show them that you're listening to them and make sure things do actually happen," says Erika.

As a manager, Erika has found the management forum in which Aitik supervisors meet up and swap thoughts and ideas to be really useful.

"Without the opportunity to swap experiences and get support from my colleagues and managers, I'd never have done as well as I have. These meetings also clarify what the company expects and demands of us supervisors, and that's helped me to prioritise my work."

Boliden offers several kinds of training. New employees are inducted according to a structured process and all employees receive the training they need to carry out their assignments safely, efficiently and skilfully.

Boliden also has ongoing leadership programmes for managers with a focus on leadership and employee development. A number of statutory training courses are also arranged, as are courses in ethics, labour legislation and personnel-related issues.

In order to provide employees with the opportunity to develop both personally and professionally, each employee has an individual development plan that is agreed in consultation with his or her manager. Because it is important for all employees to understand how the value chain is connected, Boliden also arrange courses and study visits to the various units.

Boliden also has a number of group-wide programmes and initiatives such as the Boliden Academy Young Professionals Programme and Women at Work.

5 QUICK QUESTIONS
HOW TO APPLY FOR A JOB AT BOLIDEN

Where can I find out about job vacancies?

All job vacancies within the Boliden Group are advertised on the website www.boliden.com under the Career tab. Click on the heading you are interested in for more information and contact details for the recruiter concerned.

Boliden often also uses other channels, such as LinkedIn and advertisements in the press.

How do I apply?

We can only accept applications submitted through the job advertisement's application function. It is therefore important that you submit your application via our website and that you submit separate applications for each position you are interested in.

The first time you apply for a job with us you will need to create a profile, which will then be used every time you apply for a position. Once you have created this profile, you can log in whenever you want and add new information.

By creating job alerts you will receive a targeted mailshot each time we advertise a new job that matches the criteria you have included in your job alert. It is possible to create multiple job alerts if you are interested in a number of different professional categories or sites.

What happens next?

Once you have submitted your application, you will receive confirmation that your application has been received. Once the application period has ended, the selection process begins, unless the advertisement states otherwise.

You can always turn to the named contact if you have questions about the ongoing recruitment process. Once a suitable candidate has been chosen, we will notify all applicants.

How can I contact Boliden?

We only accept applications via the job advertisements on our website, but if you have questions of a more general nature, you can e-mail our HR function using the address work@boliden.com, which you can also find on our website.

BOLIDEN SITES

The Boliden Area

Five mines in a mineral-rich field

Today the area is home to the Renström, Kristineberg and Kankberg underground mines, and the Maurliden open-pit mines. All the mines, with the exception of Kankberg, produce complex sulphide ores, which contain zinc, copper, lead, gold and silver. Gold ore with a high tellurium content is mined at Kankberg.

The mines in this area supply ore for the concentrator in Boliden, where there are also leaching plants for gold and tellurium production.

Bergsöe

Supporting the lead cycle

Bergsöe is one of Europe's largest recyclers of lead batteries. Its main products are lead and lead alloys. Approximately 60 per cent of the lead produced is sold to the battery industry in Europe, while the remainder is used in the manufacture of e.g. lead sheet and radiation shields.

Garpenberg

Sweden's most modern mine

Complex sulphide ore containing zinc, silver and lead is mined at Garpenberg, along with small quantities of copper and gold.

Metal concentrates from Garpenberg are supplied to Boliden's smelters and to European lead smelters.

Aitik

World-class productivity

Aitik is Sweden's largest and the world's most productive open-pit copper mine. Copper, gold and silver are all mined here. Large volumes and a high level of automation ensure a high level of productivity.

Kevitsa

Boliden's most recent acquisition

The Kevitsa open-pit mine was acquired by Boliden in June 2016. This mine produces ore concentrate containing copper, nickel, gold, platinum and palladium. The operation encompasses a mine and a concentrator, both of which were commissioned in 2012.

Harjavalta

Copper and precious metals

Harjavalta refines copper and nickel concentrates. The main products are copper, nickel mattes, gold and silver, as well as by-products such as sulphuric acid.

Kylylahti

Boliden's fifth mining area

Boliden acquired the Finnish copper mine Kylylahti in 2014. The mine, which opened in 2012, produces copper, gold, zinc and silver.

Kokkola

Silver production boosts competitiveness

Kokkola produces zinc and zinc alloys, sulphuric acid and silver from mined concentrate. Kokkola is the world's eighth largest zinc smelter. Approximately 85 per cent of zinc production is exported to Europe.

Rönnskär

A world leader in recycling electronics

The main products of the Rönnskär smelter are copper, gold, silver and lead and by-products such as sulphuric acid and zinc clinker. The plant's recycling capacity is the highest in the world – 120,000 tonnes per year.

Odda

Zinc for Europe's steel industry

The Odda smelting plant produces pure zinc and zinc alloys, as well as aluminium fluoride and sulphuric acid.

The zinc produced is mainly exported to the steel industry in Europe.

Tara

The biggest zinc mine in Europe

The Tara mine is Europe's largest zinc mine and the ninth largest in the world. In addition to zinc, it also produces lead concentrate.

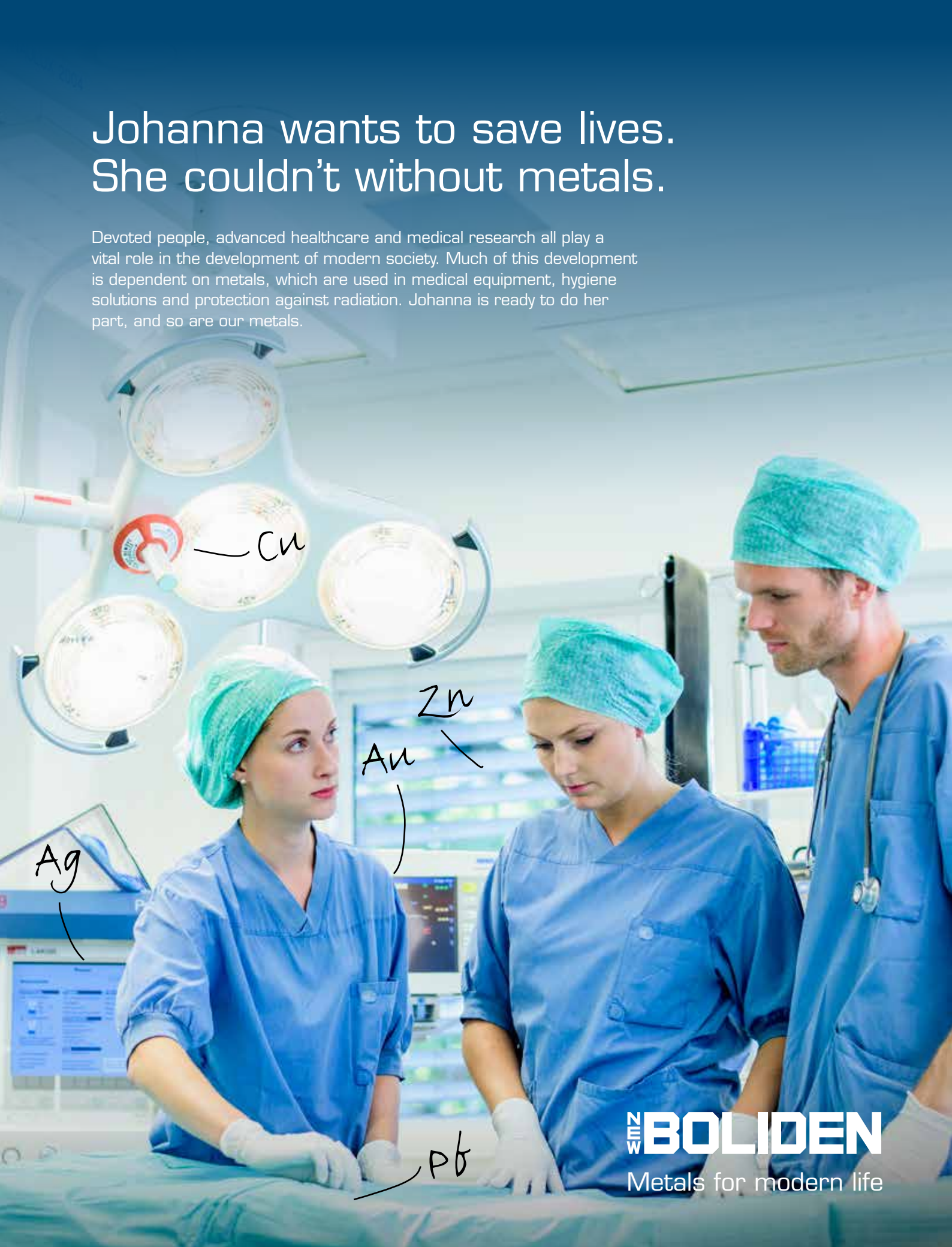
Metal concentrate from Tara is supplied to Boliden's own smelters and to European lead smelters.

Offices

Stockholm: Head office and Boliden Smelters
Boliden: Boliden Mines
Neuss: Market office
Leamington Spa: Market office
Glostrup: Market office

Johanna wants to save lives. She couldn't without metals.

Devoted people, advanced healthcare and medical research all play a vital role in the development of modern society. Much of this development is dependent on metals, which are used in medical equipment, hygiene solutions and protection against radiation. Johanna is ready to do her part, and so are our metals.



NEW BOLIDEN

Metals for modern life