

# SOLID

## GROUND

#1 2021

A MAGAZINE FROM  
SANDVIK MINING AND ROCK SOLUTIONS

**Russia:**

**Above ground,  
below zero**

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**Sandvik LH518B:**

**Next generation  
in electrification**

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**AutoMine Concept:**

**A blueprint  
for tomorrow**

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**Sweden: LKAB**

# Scaling up by doubling down

**SANDVIK**

# Dear reader,

**WE NOW HAVE** a new name within Sandvik Group, Sandvik Mining and Rock Solutions (previously Sandvik Mining and Rock Technology). Be assured that technology remains our constant focus in providing our customers, old and new, with innovative solutions.

“The future is now” is a commonly-used expression, but is reality when it comes to the AutoMine Concept vehicle – our future vision for autonomous mining equipment, already operating at our test mine in Tampere, Finland. Designed exclusively for automated and remote operation, this high-performance battery-electric loader is equipped with 3D online mapping capabilities and reliable collision detection, able to find the optimal route even in continuously changing mine environments.

**THE EXPRESSION APPLIES** also to the Sandvik LH518B battery electric loader, third generation BEV design, with new solutions for improved operator visibility and easier, faster battery swaps. It also applies to the revolutionary Top Hammer XL concept, the latest innovation in our strengthened surface drilling offering – a realistic alternative to DTH technology in hole sizes up to 178 millimetres (7 inches). Our solutions are just part of the picture: what really makes the difference when it comes to maximizing equipment productivity are our highly-skilled service personnel, providing onsite support.

Our commitment extends not only to our customers, but to the industry and wider world. That is why we are continuing to push the boundaries when it comes to automation, digitalization, electrification and sustainability. We believe productivity and sustainability go hand in hand – a more productive mine is also a more sustainable mine.

Technology and solutions: an evolution that when looking back, will feel like a revolution.



**HENRIK AGER**  
PRESIDENT SANDVIK MINING AND ROCK SOLUTIONS

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**SOLID GROUND** is a business and technology magazine from Sandvik Mining and Rock Solutions, Kungsbron 1, 111 22 Stockholm, Sweden. Phone: +46 (0)845 61100. *Solid Ground* is published twice a year in English, Chinese, French, Polish, Portuguese, Bahasa, Russian, Spanish and US adaptation. The magazine is free to Sandvik Mining and Rock Solutions customers. Published by Spoon Publishing in Stockholm, Sweden. ISSN 2000-2874.

**Editor-in-chief:** Tiina Heiniö. **Project leader:** Eric Gourley.  
**Editor:** Jimmy Håkansson. **Sub editor:** Michael Miller. **Art director:** Pernilla Stenborg. **Language coordination:** Louise Holpp. **Prepress:** Markus Dahlstedt.  
**Cover photo:** Adam Lach. **Editorial board:** Robert Ewanow, Eric Gourley, Tiina Heiniö, Antti Niemi, Kate Parkinson and Katja Rivilä.

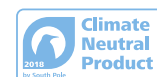
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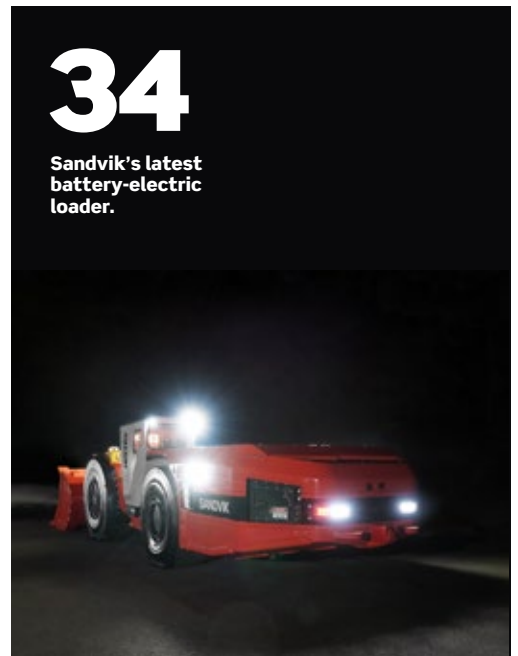
Email and distribution enquiries email: [solidground@sandvik.com](mailto:solidground@sandvik.com)  
Internet: [solidground.sandvik](http://solidground.sandvik)

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# HEAVY DELIVERIES

Two heavy-duty Sandvik MT720 tunnelling roadheaders, especially adapted for hard rock excavation, are ready for Sandvik's first-ever shipment of this kind to South Korea. Their robust design and unique features offer excellent performance and profile accuracy. The roadheaders will be put to work on a 3.5-kilometre extension of the Incheon metro line in the Seoul area. Due to urban restrictions on drilling and blasting, the Sandvik MT720s will tackle geology with high compressive strengths and abrasivities that are not typical for mechanical cutting, by using Sandvik's ICUTROC technology. Furthermore, the CUTRONIC system will provide automated cutting to increase productivity and improve accuracy.

A Sandvik MB670-1 bolter miner bound for India will have its work cut out when it arrives at Muraidih underground coal mine in Barora, Dhanbad. Ambitious targets in a new and growing market await the electrically powered mining machine, which will be used in the roadway development for longwall panels. Designed to excavate roadways and install roof and rib bolts simultaneously, Sandvik MB670-1 is a safer, more efficient solution for rapid entry development in longwall mining than other technologies on the market.



## iSeries smashes two records



**Demetre Harris**

▶ A close collaboration between Sandvik Mining and Rock Solutions and a mining operation in the Mesabi iron ore range in North America has resulted in two new drilling records at the site. In an area known for its hard ground, implementation of a Sandvik DR412i drill rig with an optimized AutoMine on-board solution immediately showed greater productivity than competitor rigs.

Once a change in geology was addressed with Sandvik's premium tooling options and the full support of its experts, the site achieved a new single shift record of 305

### THE RECORDS

**305**  
metres in a  
single shift

**18.5**  
metres per  
scheduled hour

drilled metres (1,000 feet). Two months later, an all-time record of 18.5 metres (61 feet) per scheduled hour (average penetration rate) was realized with the next-generation adaptive AutoDrill algorithm.

"The combination of the correct algorithm to allow auto adjustment of both rotation and pull-down force, and the customer's willingness to think outside of the box, drilling smaller holes in tough terrain, has yielded unprecedented results. Our close relationship is now set to continue with the deployment of two additional drills and their seamless integration into the customer's existing fleet management system," says Demetre Harris, product manager, Automation, Sandvik Mining and Rock Solutions.

### AWARDED FOR BEST PRACTICE

▶ Frost & Sullivan has recognized Sandvik with the 2020 Global Autonomous Mining Solutions Product Leadership Award for its advanced mining automation, teleoperation and digitalization solutions portfolio, AutoMine and OptiMine.

"Sandvik is the only mining equipment and solutions company that was awarded in our 2020 Class of Top 50 Digital Best-Practitioners across the industrial and energy space," says Rohit Karthikeyan, industry analyst at Frost & Sullivan.



## Supersized rig to South America

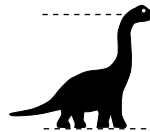
Sandvik's largest rotary drill rig, Sandvik DR416i, has been successfully shipped from Alachua, Florida. Weighing in at more than 200 tonnes, Sandvik DR416i recently arrived in Brazil where it will drill large-diameter 311-millimetre blast holes in a tough iron ore application.

### SIZE MATTERS: HOW DOES SANDVIK DR416i COMPARE?



#### Hole diameters

270 millimetres (10.63 inches) and 406 millimetres (16 inches) - the latter is the same size as an average beach ball



#### Single pass drill depth

21 metres (69 feet) - the length of an Apatosaurus



#### Rod/pipe size

273 millimetres (10.75 inches) in diameter - the same as a standard medium pizza



#### Horsepower

1,118 kW (1,500 bhp) - the same power as the turbocharged engine of a Bugatti Chiron



**Weighing nearly 212 tonnes, Sandvik's largest drill requires nine heavy-duty trucks to transport it.**

## Boosted efficiency with connected tools

▶ The drive towards better-connected construction equipment in infrastructure projects continues, but one of the challenges is to consolidate mixed cloud data systems in order to identify trends and boost efficiency, uptime and safety. Sandvik is the first equipment OEM to offer this interoperability via Infrakit, which connects its SanRemo remote monitoring system for surface drilling equipment with other work machinery, field equipment and personnel on a single platform. The aim is to reduce complexity and share data with other systems and users to maximize productivity.



## Sandvik establishes a new business area

▶ The Crushing and Screening division of Sandvik has become a stand-alone business area known as Sandvik Rock Processing Solutions. In recent years, the Crushing and Screening division has improved its performance significantly, and the decision was taken to enable a fully customer-centric approach and a 100 percent focus on the rock processing value chain. The creation of the new business area will also allow Sandvik Mining and Rock Solutions (formerly Sandvik Mining and Rock Technology) to further strengthen its core rock extraction offering, including digitalization, automation and electrification.

Stefan Widing, president and CEO of Sandvik, says, "Sandvik is market leading within rock processing, and our Crushing and Screening division is a well-performing business. By establishing Rock Processing Solutions as a business area we will improve transparency and strengthen our growth ambitions within this area." Going forward you will find the Sandvik Rock Processing Solutions offering on [rockprocessing.sandvik](http://rockprocessing.sandvik).



# A RENEWED GIANT

**KIRUNA, SWEDEN.** The industry's largest-capacity underground loader is helping the world's largest underground iron ore mine stay at the forefront of technological development above the Arctic Circle in northern Sweden. ▶

TEXT: ERIC GOURLEY PHOTO: ADAM LACH



**Toro LH625iE is the largest of Sandvik's cable-electric loaders and it has a 25-tonne payload capacity.**



**“Diesel was just not an option if we wanted to have big, productive machines down here,” says Per Brännman, who oversees the Kiruna mine’s loading division.**

a good environment; you also have to do more tunnelling. Diesel was just not an option if we wanted to have big, productive machines down here.”

**KIRUNA WAS AMONG** the industry’s earliest adopters of cable-electric loading, and LKAB is no stranger to the sustainability and productivity benefits of electric mining. Kiruna trialled its first cable-electric loader in 1985, and within a few years the mine decided to migrate to electric-powered production equipment.

“Ventilation requirements were one of the biggest motivators in the beginning, and better working conditions underground were an added benefit,” says Brännman, whose division’s responsibilities include scaling, charging, blasting, loading, renovating ore passes and maintaining both the equipment and the roads.

With no exhaust emissions, less heat, fewer vibrations and lower noise levels, electric motors improve underground conditions and operator comfort while considerably reducing ventilation requirements. Electric equipment can also reduce a mine’s energy costs to a fraction of that of a comparable diesel-operated unit.

“We proved a long time ago that you can achieve massive carrying capacity and productivity without the use of traditional diesel engines and fossil fuel,” Brännman says. ▶

## “We had to scale up the mine and for that you need bigger machines

**NEARLY 1.5 BILLION** tonnes of crude iron ore have been extracted from the depths of LKAB’s famed Kiruna operation since mining began in 1898. Five hundred kilometres of maintained road run through the mine, widely considered one of the world’s most modern underground operations and renowned for a commitment to innovation and implementing pioneering technology.

Kiruna’s orebody is about 80 metres wide and four kilometres long, and reaches a depth of up to two kilometres. What started as an open pit has gradually grown to become a deep, high-tonnage underground mine. Kiruna surpassed the 1,000-metre mark in 1999, and in 2012 LKAB completed an even deeper main haulage level at a depth of 1,365 metres that is expected to support iron ore production until around 2035.

The deeper the mine has developed, the

more costly and complex ventilation has become.

“We had to scale up the mine and for that you need bigger machines, but we saw a lot of problems to take in diesel,” says Per Brännman, who oversees the mine’s 300-person loading division. “It’s not just that you have to put in more ventilation to get

### LKAB

Luossavaara-Kiirunavaara AB (LKAB) is an international high-tech mining and mineral group. Its core business is mining and processing iron ore in northern Sweden for the global steel market. The company mines 80 percent of all the iron ore mined in Europe, producing 27.1 million tonnes of iron ore products in 2020. Established in 1890 and wholly owned by the Swedish state, LKAB had sales of about SEK 33.9 billion (USD 3.9 billion) in 2020 and employs about 4,500 people in 12 countries. Other group business includes industrial minerals, drilling systems, rail transport, rockwork services and property management.





**LKAB mines 80 percent of all of the iron ore in Europe. In 2020 it produced 27.1 million tonnes of iron ore products.**





## If you are going to do a project like this together, you have to be very open-minded.

“We have done this since the early 1980s. We know what the electric machine can do. We want to try better here.”

Since the decision to implement electric production loading, Kiruna has steadily replaced its diesel-powered machines. Today the mine relies heavily on a fleet of 17 Sandvik LH625E electric loaders, whose 25-tonne payload capacity is essential for achieving Kiruna’s daily target of 85,000 tonnes of ore feed material.

“We are a big mine, but we don’t have areas all over the place,” Brännman says. “We have a few areas that we can load in. The machine that is there has to work. We don’t want to be a bottleneck in the mine. And if you have a lack of 25s in the mine, we can’t do our daily production. So the capacity that you have in those machines is very important.”

The oldest of the mine’s well-proven Sandvik LH625E loaders is 13 years old and has more than 35,000 production hours, and the legacy units have outdated components. What began as a project to modernize those, and a side project to enhance the cable reeling system, ultimately evolved into a completely upgraded loader model.

“We are very satisfied with the old LH625E,” Brännman says. “So we wanted that machine, but Sandvik said to us that a lot of these things were obsolete. After much discussion, we took the decision together with Sandvik that if we can’t build an old 625, then we build a new one. And that we did.”

“Time travels fast, and what was the most advanced technology in the 1980s isn’t the most advanced today. Many parts are from the proven LH625E, but with new technology.

We combined Sandvik’s know-how and expertise with this machine together with the knowledge our operators have gained from many years operating it, and out came Toro LH625iE.”

**SANDVIK COLLABORATED CLOSELY** with LKAB to customize the design of Toro LH625iE to meet Kiruna’s needs. These included better energy efficiency than the original model with the same industry-largest 25-tonne payload capacity, and a larger, more ergonomic operator’s cabin.

Toro LH625iE is 14 metres long and sports a four-metre-wide bucket. It connects to the mine network via a 350-metre trailing cable that enables an operating range of up to 700 metres.

### KIRUNA MINE

Located in the town of Kiruna in Swedish Lapland, LKAB’s Kiruna mine is the world’s largest underground iron ore mine. The mine has produced nearly 1.5 billion tonnes of crude iron ore since mining began in 1898. It employs around 1,800 people, of whom 400 work in the mine. In 2020, Kiruna produced 25.6 million tonnes of crude iron ore. The mine produces around 85,000 tonnes of ore feed material daily and has proven and probable reserves of more than 730 million tonnes grading around 41 percent iron as of January 2021. Ore is shipped by railway to an ice-free port in Narvik, Norway.

Since its establishment in 1890 LKAB has grown to an international operation. Today it operates in 12 countries, employing about 4,500 workers around the world.

Its roomy cabin offers unrivalled space for operators and enables the inclusion of a unique 180-degree turning seat not possible in more compact Sandvik loaders. Operated on the steering joystick, the seat can be turned to face the direction of travel, improving operator ergonomics and eliminating the need to look over the shoulder.

“The chair is so important for me as operator,” says John-David Sundbris, who operated Sandvik LH625Es for two years and has since spent the past six months behind the controls of the mine’s first Toro LH625iE. A gold placard on the cabin identifies it as the 600th electric loader delivered by Sandvik globally.

“The swivel seat is much more ergonomic than a typical seat and it improves my visibility,” Sundbris says. “You’re following the flow with the chair and just turn it when you need to look in a different direction. It makes for much more comfortable working conditions.”

**TORO LH625iE’S CABLE** reeling system has also been re-engineered. The new low-tension closed loop system is designed to increase trailing cable lifetime and reduce cable damage on drift corners.

“It’s a significant improvement to increase

the trailing cable’s lifetime,” Brännman says. “You can have an equal speed all the time and you then don’t get the pulls in the cable. It goes much smoother. And the cable is one big maintenance thing on the machine, so if we can improve that one, we have more production time.”

**THE NEW SYSTEM** initially presented some challenges, but LKAB and Sandvik worked together to overcome them.

“It’s a completely new system and you have to improve it so it works better,” Brännman says. “With some small adjustments, it works very well right now.”

Confident in testing performed at Sandvik’s factory, LKAB immediately put the prototype Toro LH625iE into a production environment in February 2020. The unit produced 140,000 tonnes of ore over its first 350 hours of operation without stopping at all, Brännman says.

“It’s really important that we have equipment with the productivity to deliver the high volume of rock we need,” Sundbris says. “If we’re not delivering the tonnes, we can become a bottleneck.”

Sundbris trams into a drift, fills the 10-cubic-metre bucket with ease and navigates to the nearest ore pass. He tips 25



With valuable input from LKAB, Sandvik customized the design of Toro LH625iE to meet Kiruna’s needs.



One of Toro LH625iE’s many new features is the re-engineered cable reeling system, designed to increase trailing cable lifetime.



“It’s a very trustworthy machine. It delivers exactly what we want,” says operator John-David Sundbris.



## TORO LH625iE

The largest of Sandvik's cable-electric loaders, Toro LH625iE boasts a 25-tonne payload capacity and an energy-efficient, IE4 classified electric motor to deliver a low cost per tonne. The upgraded giant features a new, low-tension reeling system to extend the trailing cable's lifetime, and its roomy cabin contains a turning seat that swivels 180 degrees. In the area of digitalization and intelligence, Toro LH625iE loader features smart solutions such as Sandvik Intelligent Control System and My Sandvik Digital Services Knowledge Box on-board hardware as standard. For production monitoring, it can also be fitted with Sandvik's Integrated Weighing System (IWS), as well as AutoMine and OptiMine solutions.

tonnes into a rock bin just above the main level, where ore is collected before being transported to large underground crushers by driverless trains 1,365 metres below ground.

"It's a strong machine," says Sundbris, who also praises the size and functionality of a seven-inch colour touchscreen that shows vital information on a single large display and enables him to keep his eyes on the road.

**THE DISPLAY PROVIDES** service information, easy system diagnostics and alarm log files to simplify maintenance. The Sandvik Intelligent Control System monitors and warns the operator before failures occur, preventing severe damage and potential loss of production.

"LH625iE is more digital and it's easier to see if something happens," Sundbris says. "Everything is more integrated in the panel. It's a very trustworthy machine. It delivers

exactly what we want, really."

Kiruna received its second Toro LH625iE in November 2020. It will take delivery of three more in 2021 and a sixth in early 2022. With an option for two more, LKAB is changing its whole fleet to Toro LH625iE, Brännman says.

The mine also operates three automated Sandvik LH621 loaders, the largest diesel-powered loader in Sandvik's fleet, while gases are cleared after night blasts. The third of its six Toro LH625iEs, expected in the third quarter of 2021, will also feature AutoMine.

"We're excited about the potential of increasing our use of automation," Brännman says.

He says the renewed giant has exceeded LKAB's expectations.

"If you're going to do a project like this together, you have to be very open-minded from both sides," Brännman says. "I will

recommend Sandvik because of their professionalism. In that I include open-minded, keen and very skilled. Win-win collaboration, I would say." ■



# **BLAZING THE TRAILS AHEAD**

**Combining advanced sensing capabilities, sustainable battery-electric technology and artificial intelligence, the AutoMine Concept vehicle is Sandvik's future vision for autonomous mining equipment. And it's already operating in Sandvik's test mine in Tampere, Finland.**

TEXT: **TURKKA KULMALA** PHOTO: **SANDVIK**



**Using advanced surroundings perception, mapping technology and artificial intelligence the AutoMine Concept vehicle is able to plan its own routes.**



### **AUTOMINE CONCEPT VEHICLE**

- High-performance battery-electric loader
- Surroundings perception thanks to 3D online mapping capabilities
- Adaptive capability to find the optimal route even in continuously changing mine environments
- Instant obstacle detection and real-time reactions for collision avoidance

**JUSSI PUURA, DIGITALIZATION** lead at Sandvik Mining and Rock Solutions, is excited about the AutoMine Concept vehicle, and no wonder. “This is essentially the way to the future and Sandvik’s roadmap to get there,” he says. “This shows what a typical piece of mining equipment could look like in 10 or 20 years. And more than that, it’s not just a vision in a slide deck presentation. It’s an existing, physical vehicle actually working down in our test mine.”

His enthusiasm is understandable. In

addition to being a cutting-edge battery-electric loader, the AutoMine Concept vehicle packs advanced surroundings perception in 3D, mapping technology and artificial intelligence to enable it to adapt and plan its own routes to find the most suitable paths, even in continuously changing environments. Ultimately, it represents a big step towards comprehensively autonomous mining operations.

The AutoMine Concept vehicle is also a major milestone in Sandvik’s development of the AutoMine and OptiMine solutions. Since 2004, these digital systems have supported automated mining operations. The marketplace initially was hesitant to adopt such revolutionary solutions, but the last several years have seen a marked increase in demand. The current growth rate is strong, including in developing markets such as Africa, India,

China and Latin America.

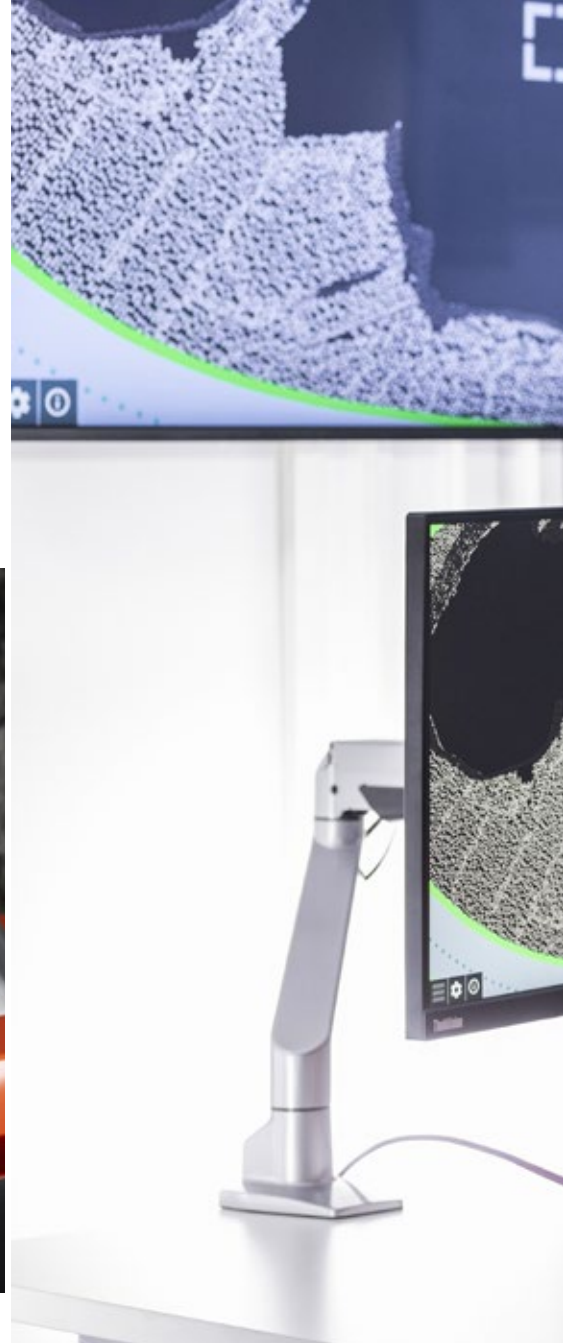
The capabilities of the AutoMine systems have also seen a marked improvement over the years. However, more recently it has become increasingly clear that the next generation of mine automation is coming, and upgrades to the existing platform help unlock new, even greater capabilities. This developmental leap could be compared with recent developments in autonomous road vehicles, including innovations such as the Google car, Tesla and others. Also, developing markets and challenging mining conditions in particular require maximum reliability and robustness.

Riku Pulli, president of the Rock Drills and Technologies division at Sandvik Mining and Rock Solutions, reveals more about the breakthrough technologies in the AutoMine Concept vehicle. ▶

# This shows what a typical piece of mining equipment could look like in 10 or 20 years



With the AutoMine Concept vehicle Sandvik aims to set the benchmark for future generations of autonomous mining operations.



“First of all, this vehicle is designed and engineered for automation from the outset,” he says. “The design philosophy of existing fleets is based on a conventional loader, which always includes a cabin, joysticks, pedals and so on.”

**THE AUTOMINE CONCEPT** vehicle is designed exclusively for automated and remote operation. There is no cabin at all, which means cost savings and the elimination of unnecessary limitations, enabling more efficient and reliable overall design because there is no need for duplicated steering systems and controls, one for the human operator and one for the computer control system.

Another major innovation is the tremen-

dous expansion of sensing capabilities. Existing mining equipment is limited in this respect. It can essentially sense where the sidewalls of the tunnel are, for example, but not much more. The AutoMine Concept vehicle creates a true 3D view of its entire surroundings, including the vertical direction.

“This opens up really significant possibilities compared with existing mine automation systems, which are restricted to gated areas separated from people and other equipment, much like security gates around robots used in manufacturing,” Pulli explains.

The existing AutoMine safety system is based on isolation barriers that enable automated equipment to operate in designated, barricaded areas, and stops equipment

immediately if a safety barrier is tripped. The all-around sensing capability of the AutoMine Concept vehicle is designed to make isolation of automated operations unnecessary. The vehicle can stop or move around any obstacle on its route.

**“THIS IS A** huge improvement because it eliminates a host of limitations linked to mine automation,” Pulli says. “It has until now been necessary to separate automated mining operations from conventional manual operations. The new platform will increase operational flexibility tremendously because the isolation of automated operations becomes unnecessary. Work can go on around and among the automated vehicles simultaneously.”





The AutoMine Concept vehicle is designed exclusively for automated and remote operation.

Why is it, then, that the concept vehicle is specifically a battery-electric loader? According to Pulli, Sandvik wanted to demonstrate that future mining equipment will be not only autonomous but also emission-free. Another reason is linked with the AutoMine platform. Most of the equipment controlled with this system consists of loaders, and what sets loaders apart from other mining equipment is their relatively high speeds, demanding performance requirements and round-the-clock operation at a high utilization rate in extremely cramped conditions.

Sandvik wanted to set a benchmark: if the company was able to pull this off, it could be confident of its capability to transfer the technology to other types of mining

equipment, such as drill rigs, where the requirements are typically less stringent.

What will the next steps be? The capability to further scale the technology to other types of mining equipment is an early goal that should be met soon. Another focus area

will be the technology mix, which now includes several types of scanner technologies and, for the first time in mining equipment, artificial intelligence. Some of these components will be imported to the existing AutoMine system in 2021. ■

#### ADVANTAGES:

**Safety:** reliable collision detection and emergency stops

**Flexibility:** possibility to operate both conventional and autonomous vehicles in the same area

**Productivity:** unlimited potential for automated mining operations

**Sustainability:** battery-electric, emission-free vehicle

## SANDVIK D50KS BLASTHOLE DRILL RIG

Engine power range: 403–522 kW

Max hole depth: up to 45 m

Dimension (L-W-H): 10.3 x 4.9 x 11.4 m

Dimension mast down (L-W-H): 14.2 x 3.81  
x 5.82 m

Hole diameter: 152–229 mm

Operating weight (empty): 47,727 kg

Rotary head: 194 rpm/6,643 Nm

First pass depth (single-pass): 8.7 m

Compressor range: 29.7–45.3 m<sup>3</sup>/min

Drilling technique: Rotary

"It's a very powerful machine," says Sandvik D50KS operator Sergey Devyanin.

# At the extreme end

**SIBERIA, RUSSIA.** In the heart of Siberia, drilling contractor Altayvzryvservis handles a variety of rock types in extremely harsh weather conditions with ease, thanks to a reliable trio of rotary blasthole drill rigs.

TEXT: VLADIMIR KOZLOV PHOTO: VOZDUH FILM COMPANY

**KEMEROVO OBLAST, OR** Kuzbass, in south-western Siberia has long been known as Russia's main coal mining region. This year marks the 300th anniversary since prospector Mikhailo Volkov found a "burnt mountain" on the left bank of the Tom river, launching Kuzbass's centuries-long history of coal extraction.

Although coal deposits in Kemerovo Oblast were significant, progress was slow initially due to the region's remoteness. However, the construction of the Trans-Siberian Railway in the 1890s gave a much-needed boost to the entire area's development, including its coal industry.

In the 20th century, Kuzbass emerged as a major coal mining region, and it remains so to this day, accounting for roughly 60 percent of Russia's coal output and 70 percent of exports.



**Alexander Leonov, general director of Altayvzryvservis.**


"Currently, Kuzbass is Russia's leader in coal extraction, and the Kemerovo region's development strategy through to 2035 stipulates an annual increase in coal output," says Alexander Leonov, general director of

Altayvzryvservis, a contractor providing drilling services in the area.

**IN MID-DECEMBER, THE** temperature hovers around minus 20 degrees Celsius and the sun shines brightly in a clear sky above the snow-covered taiga near the Kuznetsky Alatau foothills.

Among the snow-capped forest areas, dozens of square kilometres of quarries are busy with 130-tonne dump trucks carrying freshly extracted coal.

Here, some 40 kilometres south of the major city of Novokuznetsk, OOO Resurs, one of the Kemerovo region's largest companies, runs the Novokazanskoye coal operation. And Altayvzryvservis is the drill and blast contractor.

Back in 2018, when the newly established 



With its 300 year history of coal extraction Kuzbass is Russia's main coal mining region.

Temperatures of minus 20 degrees Celsius are business as usual when mining in the heart of Siberia.



**Yevgeny Martynushkin,**  
engineering director at  
Altayvzryvservis.



**Alexey Gorlov, Altayvzryvservis's deputy general director of production, knows what it takes to mine under Siberian conditions.**

## Productivity was constantly on the rise

Altayvzryvservis was launching operations, it was looking for a reliable drill rig that would endure the region's harsh weather conditions.

"In winter, temperatures fall as low as minus 40 degrees Celsius, and equipment has to be able to operate under these difficult conditions," Leonov says.

Yevgeny Martynushkin, engineering director at Altayvzryvservis, says that in addition to withstanding the harsh climate, drilling equipment must be suitable for a variety of rock conditions.

"In the northern part of the region the rock is harder, in the central part it is softer, but with interlaying, and in the south, near the foothills of the Altay mountains, it is much harder again and sits next to ore deposits," Martynushkin says. "So the drilling equipment has to meet several requirements,

such as be usable in wet rock, be compatible with climate conditions – so that people and machinery don't freeze – and, of course, it has to ensure high productivity."

Productivity and reliability were among the key criteria for selecting the ideal drill rig, says Alexey Gorlov, Altayvzryvservis's deputy general director for production. After considering options from multiple suppliers, the contractor ultimately chose Sandvik D50KS.

"One of the main factors that influenced our decision was the fact that Sandvik has been a leader in the surface drilling segment for decades," Gorlov says.

**SANDVIK D50KS WAS** a new drill rig for most of Altayvzryvservis's operational staff.

When the drill was commissioned, the contractor had only one crew of operators

familiar with this type of rig, and two more crews had to be trained from scratch.

"Of course, there was an adaptation period," Martynushkin says. "Although our personnel are highly qualified, most operators previously worked with other types of drill rigs. We had to try different settings until we arrived at the right combination, but productivity was constantly on the rise. At this point, we are confident about our monthly plans, setting a monthly drilling target between 27,000 and 30,000 metres and knowing that the ▶

### NOVOKAZANSKOYE COAL OPERATION

**Location:** Erunakovsky area, Kuzbass region, Russia

**Discovery:** 1973

**Total area:** 19.66 sq. km.

**Licence holder:** Resurs

**Contractor:** Altayvzryvservis

**Sergei Zapara is Sandvik's regional head of service for West Siberia.**



machine will be able to handle that.”

One crucial factor that helped Altayvzryvservis achieve optimum performance was close collaboration with Sandvik.

“We’ve been working closely with Sandvik on enhancing performance parameters of the machine and making improvements,” Martynushkin says.

Sergei Zapara, Sandvik’s regional head of service for West Siberia, says the contractor’s fleet of three Sandvik D50KS rigs maintain an average availability of between 91 and 93 percent.

“We are storing a substantial number of spare parts for this kind of machine to maintain an adequate availability and ensure the fastest reaction possible to any potential emergency situation,” Zapara says.

“In this region, coal deposits lie under varying types of rock, which complicates drilling. But our equipment is quite adaptable to those conditions, and the optimal drill tools are easy to select.”

Now, more than three years into operation,

## **ALTAYVZRYVSERVIS (CONTRACTOR)**

**Founded:** 2018

**Fields of activity:** Drilling and blasting services

**General director:** Alexander Leonov

**Number of employees:** 100+

**Operation area:** Kuzbass, Russia

**Operated Sandvik equipment:** Three Sandvik D50KS blasthole rigs

Altayvzryvservis’s first Sandvik machine has proven to be a reliable choice, delivering high productivity in difficult climate conditions and over a long number of operating hours.

“In three years of operation, we haven’t had any issues with this drill rig,” Gorlov says.

Operator Sergey Devyanin was part of the first crew to run the contractor’s first Sandvik D50KS.

“Throughout my career, I have operated different kinds of machines,” he says. “And this is a good one, compared with the others. It has a lot of advantages. It’s a very powerful machine.”

Moreover, as productivity constantly grew, the fleet of Sandvik D50KS rigs set several performance records across all of Altayvzryvservis’s operations.

“In 2019, our Sandvik D50KS drilled 33,000 metres a month,” Gorlov recalls. “And, in 2020, it drilled 35,000 metres. So we’re seeing growth year by year.”

He adds that the productivity of the Sandvik drill rigs is expected to continue to grow, and new performance records are likely to be set.

“This is the goal we are setting for all of our crews,” he says.

Meanwhile, Altayvzryvservis is already planning to grow its drilling capabilities in the years ahead.

“We’ll certainly need more drilling equipment, and based on our experience with Sandvik, we’ll be looking closely at what they can offer,” Leonov says. ■

In Siberia, winter temperatures fall as low as minus 40 degrees Celsius, causing tough working conditions for both personnel and equipment.

**The most optimal in terms of productivity, reliability and quality**



# Q&A

## BLACK BOX OF MINING

Data and transparency will help make mining “safer, cooler and more efficient,” according to Newtrax Technologies CEO Alexandre Cervinka. The Quebec native sat down with *Solid Ground* to talk about Newtrax’s “black box of mining.”

**Q: CAN YOU GIVE US A BRIEF SUMMARY OF WHAT YOU DO AT NEWTRAX?**

**A:** Newtrax has been developing a variety of Internet of Things devices, which monitor people, machines and the environment in underground hard rock mines, for the past 10 years. You know the black boxes that monitor everything on an aircraft? Well, we’ve got the only black box in the mining industry that’s compatible with all the OEMs.

**Q: HOW DO THESE DEVICES MAKE UNDERGROUND MINING SAFER AND MORE EFFICIENT?**

**A:** Transparency. People underground simply don’t have access to the information they need to make the best decisions. So we’ve put a system in place that measures everything and makes that information available to workers and managers to empower them with the insights they need. That’s what the devices do that you use for people, machines and monitoring the ground, air and water levels. They measure the mining process, make the entire chain visible and achieve transparency.

**Q: WHEN YOU STARTED, NEWTRAX HAD NOTHING TO DO WITH MINING. WHEN AND WHY DID YOU PIVOT?**

**A:** My background is in electrical engineering. Twenty years ago, when I graduated from

McGill University in Montreal with some friends, we tried to launch a variety of ventures, creating wireless sensor devices to monitor all sorts of stuff. We were scattered all over the place. On one of these projects, we came across a professor who had PhD students trying to apply wireless technology to underground hard rock mines in Quebec and an experimental mine in Val-d’Or. We started working with them, and one thing led to another, and then in 2008 we decided to focus 100 percent on mining.

**Q: WHY IS IT BETTER TO GET DATA DIRECTLY, RATHER THAN AT THE END OF A SHIFT?**

**A:** A good example of an application for which real-time connectivity and monitoring is important is evacuation notification and management. If there’s a fire underground, you need to receive the evacuation notification as soon as possible. Historically, mines have used stench gas, or blinking lights if there are lights in that part of the mine. This can take 20 or even up to 40 minutes to reach every area. Then, for maintenance, you’ve got some alarms like low tyre pressure that you need to act on as soon as possible, or you’re going to lose your tyre. In terms of productivity, you’ve got applications like post-blast re-entry, where you need to know what the gas levels are in various areas before you can re-enter.

**ALEXANDRE CERVINKA**

**Age:** 41

**Home:** Montreal, Canada

**Title:** CEO

**Family:** Wife Valerie and two sons, Jacob and Zac





**Q: WHY HAS UNDERGROUND MINING LAGGED BEHIND CERTAIN SECTORS IN ADOPTING AUTOMATION AND DIGITALIZATION?**

**A:** The answer has several vectors to it, but the first one is the access to GPS. GPS is a satellite-based system that doesn't work underground. Right off the bat, all the solutions that depend on GPS on the surface are not available underground. Then you have the problem with communications. It's a classic in the telecom industry that the most expensive and complex part is the last mile connecting the core network to each house. And underground, by the very nature of the mining process, there is a new last mile every week. And then you have the fact that the mine sites have a heterogeneous fleet from multiple OEMs and the industry has not had a very open architecture when it comes to data. That's one of the things that our black box does – it basically forces all the data to be open.

**We have put a system in place that measures everything**

**Q: WHAT ARE THE GREATEST CHALLENGES FACING MODERN UNDERGROUND MINING, AND HOW DO YOUR SOLUTIONS HELP ADDRESS THEM?**

**A:** When it comes to attracting people to work at a mine site and underground, we help by making sure the environment is safer. Nobody wants to work in an unsafe environment. It's also very frustrating for the younger generation not to have access to the digital tools in their work that they're used to in their everyday life. We provide them with the tools that they expect to do their job effectively and safely. ■

# EXPAND THE LIMIT

Top Hammer XL expands the hole size range of top hammer drilling up to 178 millimetres (7 inches), offering the benefits of top hammer technology as a viable alternative to down-the-hole (DTH) drilling on a much larger scale than before. ▶

TEXT: TURKKA KULMALA PHOTO: SANDVIK



The rig, the rock drill and the rock tools have all been reviewed and redesigned for optimal effect.



RD1840C

LT90

PANTERA™ DP1600i

## TECH SPECS

### PANTERA DP1600i

Hole size: 140–178 mm (5½–7 in)

Rock drill: RD1840C

Rock tools: LT90

Engine power: 287 kW/1800 rpm

Air volume: 14 m<sup>3</sup>/minute (490 cfm)

Cabin: Excellent ergonomics, air conditioning, ROPS/FOPS

# It was a natural choice to upgrade the existing platform to the next level

**EARLIER THIS YEAR**, Sandvik Mining and Rock Solutions launched a new top hammer drill rig – Pantera DP1600i. It is the newest member of the Pantera DPi family of large hydraulic crawler-based drill rigs, characterized by high penetration rates and advanced automation options for data-based fleet management and drilling performance optimization. However, their hole size range has until now maxed out at 152 millimetres (6 inches).

The design engineers' starting point for Pantera DP1600i was to craft a careful balance between all three dominant components of the drill rig: the carrier, the rock drill and the rock tools, to be able to drill large hole sizes between 140 and 178 millimetres (5.5–7 inches).

The carrier solution is essentially based on the reliable and proven Pantera DPi series platform, upgraded with critical parts in the hydraulic system and a redesigned boom

structure to carry a more powerful rock drill. This results in a higher capacity and eventually a larger hole size, without increasing the physical drill rig footprint.

“We have a long track record with proven performance in top hammer drilling with the Pantera DPi series rigs, starting as far back as 2008, so therefore it was a natural choice to upgrade the existing platform to the next level for this new solution,” explains Jarno Viitaniemi, product manager surface drilling at Sandvik Mining and Rock Solutions.

**THE NEW RD1840C** rock drill tackles the challenge of increasing the percussive energy of drilling action without increasing the physical size of the drill by means of a longer and consequently heavier drill piston. The geometry, length and weight of the piston have been optimized for the rock tools and the target, larger optimum hole size of 165 millimetres, resulting in a more effective,

longer impact wave shape and improved drilling dynamics.

“A key asset of the Top Hammer XL concept is that the three main components of the drilling system – the rig, the rock drill and the rock tools – have all been reviewed, redesigned and mutually optimized,” says Jukka Siltanen, product line manager rock drills at Sandvik Mining and Rock Solutions “It truly works very well as a whole.”

As an option, RD1840C comes with the Sandvik RockPulse tool stress monitoring system, which offers the drill operator real-time measurement data on three key drilling parameters: drill bit response, tool load and feed level. The system measures in real time the stress waves induced by each piston impact, and this helps the operator to avoid poor rock contact and excessive tensile stresses as well as over- or underfeed.

**THE TOOLING SYSTEM** optimized for the Top Hammer XL drill rig concept is the new Sandvik LT90 family. The challenge in developing these rock tools was the longer, more powerful shockwave generated by the new RD1840C rock drill. More specifically, how to transfer it in a controlled manner to the bottom of the hole with minimal energy losses to maximize penetration rate.

“We have more energy in the whole system,” says Fredrik Björk, product manager rock tools surface drilling at Sandvik Mining and Rock Solutions. “If you don't crush rock with that energy, it will destroy the drill string and threads instead. It will transform to heat.”

The challenge was mainly solved by improving the drilling dynamics, which in turn requires careful balancing of several potentially conflicting parameters. One of

**A new set of rock tools were developed for Top Hammer XL.**





**The RD1840C rock drill has gone through thousands of hours of bench testing, and the entire rig has drilled more than 100,000 metres in difficult rock conditions.**

of conditions typical to subarctic areas, including two winter seasons, with temperature minimums close to  $-40^{\circ}\text{C}$ , and also hot summer weather, up to  $30^{\circ}\text{C}$ . The rig and the tools have taken the beating in stride.

The results show a 50 percent reduction in fuel consumption, 25 percent reduction in total drilling costs and 15 percent increase in productivity compared with the down-the-hole (DTH) drilling method\*. Additionally, the new rock tools deliver excellent bit service lives compared with competing products and technologies. To illustrate the scale of the fuel savings in typical mining conditions, they are comparable to the annual consumption of 107 average family cars. The benefits are also available in high-altitude mining applications. The 50 percent reduction in fuel consumption naturally has a significant impact on  $\text{CO}_2$  emissions as well.

Sandvik is the first OEM to introduce this kind of innovative top hammer drilling technology that can achieve cost-effective drilling results in large mining hole sizes. Top Hammer XL expands the hole size range of top hammer drilling technology up to 178 millimetres (7 inches), making the inherently more fuel-efficient top hammer drills a viable alternative to DTH technology on a significantly larger scale than before. ■

*\*Based on field test results under specific controlled conditions.*

these is the stiffness of the drill string to achieve straight holes, while at the same time avoiding excessive stiffness to prevent breaking of the tools under bending. Limiting the stiffness practically also means avoiding overly large rod diameters because that will result in higher stresses in the thread joints under bending.

In the rod threads, the balancing is about making the threads as slim as possible but still strong enough to optimize the coupling characteristics of the drill string. The practical benefit of this is easy threading and unthreading of the rods and the bits.

Yet another key balance is between wear resistance and hardness, because excessively hard tool steel will also be too brittle. A major asset for Sandvik in this respect is the steel grade and heat treatment know-how available in house at Sandviken, Sweden.

**THE RD1840C ROCK** drill went through thousands of hours of bench testing, and the entire rig has clocked more than 100,000 metres of real-life drilling in difficult rock conditions. The field tests have been taking place in northern Europe since January 2019, which means that the Top Hammer XL solution needed to endure the wide spectrum

## TOP HAMMER XL ADVANTAGES

- Top hammer drilling becomes a realistic alternative to DTH in hole sizes up to 178 millimetres (7 inches)
- Outstanding fuel economy and significantly reduced emissions
- Notably lower total drilling costs
- Improved productivity
- Advanced MWD and automation options

# Digging deep for change

Together with four industry partners, LKAB is planning to set a new standard in underground mining. To succeed, it needs to dig deeper than ever before.

TEXT: JIMMY HÅKANSSON PHOTO: ADAM LACH & FREDRIC ALM

**LKAB'S UNDERGROUND IRON** ore mine in Kiruna, northern Sweden, is the largest of its kind in the world. Nevertheless, the resources at the main level of 1,365 metres below surface are depleting, and to meet increasing demand there's only one way to go: follow the orebodies farther down.

By 2030, LKAB must be ready to go deeper than ever before. But the Swedish mining company won't settle for simply digging deeper. It also wants to set a new industry standard for carbon-free underground mining.

"I was in a transition phase in my career when this project came up," says Michael Lowther, manager of LKAB's test mine Konsuln in Kiruna.

After 35 years in the mining industry, Lowther was looking for a new career challenge. This coincided with the start of the LKAB-led project Sustainable Underground Mining, an opportunity he felt he couldn't miss.

"The concept of this project is absolutely incredible," Lowther says. "We are looking at a more sustainable way of working, and ultimately protecting the climate and the long-term future of all our societies. To me, it's on the cutting edge of what has to be done within the mining industry."

Initiated in 2018, the project is a huge joint effort bringing together LKAB, Sandvik, ABB, Epiroc and Combitech to fundamentally

Nils Stenberg, manager of LKAB's Kiruna mine.



change underground mining at its core.

"We see that the future is CO<sub>2</sub>-emission-free, digital and automated," says Nils Stenberg, manager of LKAB's Kiruna mine. "But we cannot get there alone, so this is something we have to do together with other talented suppliers and operators."

The objectives of the project can be narrowed down to four main goals. The first is zero harm and ensuring a safer workplace for all personnel. The second is to take carbon dioxide out of the mining system. The third is to increase productivity by 50 percent.

"That's probably the greatest challenge of all, because we're going deeper," Lowther says. "And generally, when you go deeper in a mine, the cost goes up and productivity goes down."

Stenberg nods, and chimes in:

"Our deepest operation today is 1,365 

**We are looking at a more sustainable way of working, and ultimately protecting the climate**

## The time plan

### 2018

LKAB initiates the project, together with ABB, Epiroc, Combitech and Volvo Group.

### 2018-2022

Pilot tests of technology and mining methods in the test mine Konsuln.

### 2020

Sandvik joins the venture and Volvo Group opts out.

### 2022-2033

Prepare for future main levels and production on industrial scale.

### 2030

A new industry standard for sustainable underground mining is set.

Even though LKAB's underground mine in northern Sweden is the largest of its kind in the world, it must expand to meet the increasing demand.

The Sustainable Underground Mining project was an opportunity that Michael Lowther, manager of LKAB's test mine Konsuln, couldn't miss.



new technology we are developing needs to be ready for implementation by then.”

Although the targets are clear, the road ahead is not. And the pandemic has caused a bump in the schedule, delaying the initial tests at Konsuln. However, the real challenge is to get the partners to work together in an unprecedented collaboration.

“Big companies like Sandvik, Epiroc and ABB are not used to putting their cards on the table and showing what they’ve got,” Lowther says. “We are trying to do something different here, and that’s the challenge – to get people to think differently.”

Adds Stenberg: “Where we’re headed, we can’t find solutions in product catalogues. We need a concentrated effort.”

**IN NOVEMBER 2020**, LKAB presented a historic transformation plan. The company’s new strategy sets out to achieve net-zero carbon emissions from its own processes and products by 2045 and secures operations with expanded mining beyond 2060. One of three main priorities for the transformation is to establish a new industry standard for mining with more autonomous and digitalized operations.

Furthermore, there will be a gradual transition from being a pellet producer to a producer of direct-reduced iron, so-called sponge iron, using green hydrogen. The third priority is to extract critical minerals from mine waste.

This is the biggest transformation in LKAB’s 130-year history and could end up being the largest industrial investment ever made in Sweden.

“I am really proud to be a part of this and actually help to secure a future for coming generations,” Stenberg says. ■

## The concept of this project is absolutely incredible

metres. We will need to dig another 700 metres straight down.”

The fourth and final goal? To set a new standard for sustainable underground mining at great depths.

**TO ACHIEVE THESE** ambitious goals, LKAB and its partners are using the Konsuln test mine to experiment with new technologies. Electrification, digitalization and automation will of course be important components. And in the virtual copy of the actual Konsuln test mine, new technology is trialled.

“The virtual mine allows us to simulate systems before we spend a lot of money implementing them,” Lowther says. “It’s useful, for example, if you have an emergency and you want to know where all the people are and find the best paths to safety. Another example is if you have a production plan for the day, but something happens, like a burst

pipe or a flat tyre, or a number of planned workplaces become unavailable. Then you can ask the lab to run three to four simulations and see what is the next best thing to do.”

This might sound futuristic, but as Lowther explains, it’s a logical next step for a business that’s becoming more and more digitalized.

“All of this comes from the applications of technology where you are in constant communication with the people in the mine, and their positions are known,” he says. “Go back 20 years and it could be difficult to know where you parked a truck in the last few days.”

In a project of this scale and ambition, time is a precious commodity. By 2030, the technologies developed must be fully operational and ready to go.

“We’ve set 2030 as the deadline because the level we’re currently working at will last until 2035 or 2040,” Stenberg says. “Around 2030 we will need to go below 1,365 metres. The

### THE COLLABORATION

The project is a collaboration between LKAB, Sandvik, ABB, Epiroc and Combitech. Volvo Group was part of the project when it started in 2018, but opted out two years later. The vision is to work together as partners to push the boundaries in the fields of automation, digitalization, electrification and sustainability to secure a more sustainable future for the underground mining industry.



# The Expert

**William Pratt Rogers, an assistant professor in mining engineering at the University of Utah, has no doubt that automation will continue to reshape the mining industry, but not necessarily in the ways everyone expects.**

**WILLIAM PRATT ROGERS** is one of the authors of a publication titled “Automation in the Mining Industry: Review of Technology, Systems, Human Factors, and Political Risk.” He shares some of his insights with *Solid Ground*.



systems we’ll need far more precise designs and engineering of variables, and this may also lead to more predictable mineral economics. I am curious to see how automation will affect equipment size. I have heard some technologists claim that future automated machines will be smaller sized, but fleets will be larger.

**Q: IN YOUR THESIS YOU TALK ABOUT LEVELS OF AUTONOMY FROM 1 TO 10. CAN YOU EXPLAIN WHAT THIS MEANS?**

**A:** The key point we are trying to make is that automation isn’t binary – it exists on a spectrum. This is critical because a lot of large companies are making decisions and executing automation strategies based on false pretences. When it comes to automation there is room for incremental change as well as whole system changes. Mining companies around the world, from small to medium and large sites, are all adapting to an increased pace of technological change. Each of those mining classes needs to execute an automation strategy that matches their capital constraints and system demands. A better understanding of the levels of automation will enable them to execute a technology and digital strategy more successfully.

**Q: HOW WILL AUTOMATION AFFECT MINING?**

**A:** Automation offers the opportunity to rethink the importance of economies of scale – in other words, larger means more. Up until now, in some areas, economy of scale has meant that precise mining engineering is underrated. However, with automated

**Q: WHAT ARE THE BIGGEST MISCONCEPTIONS ABOUT AUTONOMOUS MINING?**

**A:** The “all-or-nothing” binary thinking, where either a mine is fully automated or it’s not. Mining companies use automation frequently and will continue to adopt automation incrementally. There are also misconceptions about what it means for jobs. Automation will cause disruption and a shift in mining employment – that is certain – but not to the extent expected by many. You cannot have intelligent computation without intelligent human input, so the next step is creating a new

generation of mining technology specialists. We will need to retrain existing personnel and attract top talent to mining engineering programs as well as a diverse set of people from computer sciences and systems engineering to our industry.

**Q: SO AUTOMATION WILL NOT LEAD TO THE REMOVAL OF HUMANS FROM MINING?**

**A:** I think the future of total automation of mining is very far away. For the most part, mining sites will have a mixture of human-operated and automated machines. All too often I hear executives say, “We need to automate to reduce our dependency on humans.” This is a bad mentality to have as it creates a premise that we can automate away from humans. I don’t believe we can.

**Q: HOW WILL AUTONOMOUS TECHNOLOGY MAKE UNDERGROUND MINING SAFER?**

**A:** Whenever we remove humans from zones of high kinetic or potential energy, the outcome is always better. Much of the improvement in mine safety and health can be attributed to this. Long-term health concerns tied to underground emissions and particulates will be eased by reducing the number of hours humans need to be underground. In future, as we continue to mine deeper, mines will become warmer and more difficult to ventilate. The proposed Resolution Copper project in Arizona, USA, is one example. It’s deep and extremely hot, and automation will be crucial to its success. I can’t imagine working in a mine that hot, so I hope the technology will be ready for making the mine fully automated. ■

**You cannot have intelligent computation without intelligent human input**

**SANDVIK LH518B**

# **CHARGED UP AND READY TO LOAD**

The new Sandvik LH518B loader offers the heat reduction and ventilation potential typical of battery-electric vehicles (BEVs), combined with excellent operational flexibility and total cost of ownership comparable to conventional diesel-powered equipment.

TEXT: TURKKA KULMALA PHOTO: SANDVIK



“**OUR SYSTEMS WORK** in the real world,” says Mike Kasaba, managing director of Sandvik’s Artisan Business Unit. “We have a decade of actual underground production use. That makes us the most experienced BEV team in the mining industry. Combine that with Sandvik’s ability to manufacture and support a global-ready product and you can see how the future of underground mining is here today.”

His confidence is well founded. Sandvik has long been a leader in the electric loader market with its proven product line, built on decades-long collaboration with mining customers. Sandvik knows what mine owners and contractors typically look for when updating their fleets. This experience now meshes with Artisan’s fresh perspective on the mining industry. Roughly two years after the acquisition, the formerly independent innovation centre can now present the first fruit of the joint

R&D efforts: Sandvik LH518B battery-electric loader. It combines advanced BEV technology with selected elements from Sandvik’s existing fleet, including proven common solutions, such as the bucket and boom design and the loader cabin.

Sandvik’s new team of BEV specialists sum up their engineering thinking in their First Principles Design philosophy and its three core values: reliability, system redundancy and cycle optimization, which combine seamlessly with Sandvik’s existing philosophy on loader design.

**WHAT DOES THIS** mean in practice? The first-generation BEVs entailed simply replacing the diesel engine with an electric motor and a battery, while keeping unchanged the transmission, torque converter and PTO driving the hydraulic system. In the second generation, the torque converter was eliminated, and the PTO was replaced with a

separate electric motor. While these early iterations of BEV designs offer real improvements on the efficiency of the loader, they remain limited by the mechanical design of the actual loader as well as by the limitations of the mechanical driveline.

Sandvik LH518B represents the latest, third generation of BEV design. The whole vehicle was designed from scratch, eliminating the limitations of the older, originally mechanical designs. Legacy solutions from diesel-powered loaders are replaced with a new overall design centred on the battery system and an electric driveline, which allows an entirely different driveline topology. The resulting design freedom enables new solutions, such as using smaller wheels at the back for improved operator visibility and a detachable rear frame section for easier and faster battery swaps.

In terms of daily mining operations, the third-generation BEV design philosophy ▶



**Customers often think that this new technology is going to be more costly. The reality is, it’s not.**



## TECH SPECS

### SANDVIK LH518B

- Load capacity:** 18 tonnes
- Heading size:** 4.5 metres
- Tractive effort:** 450 kN
- Climbing capacity:** 12 kph haul/  
20 percent grade/fully loaded
- Top speed:** 30 km/h
- Continuous power output:** 560 kW  
(750 hp)
- Peak power output:** 660 kW (885 hp)

**Sandvik LH518B represents the third generation of BEV design. Designed from scratch, it doesn't have the limitations of the older, originally mechanical equivalents.**

provides highly meaningful, concrete benefits. The loader has a substantially higher payload for its size and weight, making Sandvik LH518B arguably the most powerful 18-tonne loader to date. It has an 18-tonne bucket designed for a 4.5-metre heading and a driveline with 450 kilonewtons of tractive effort, while the dimensions of the machine are compliant with the 14-tonne envelope size.

For a mine owner or contractor, this practically means capability to do more with a smaller machine. For example, a full bucket load can be hauled along a 20 percent grade at 12 kph. Another example of Sandvik LH518B's capabilities is a top speed of 30 kph.

The "refueling" cycle of Sandvik LH518B is the fastest in the industry, thanks to the patented battery swapping system and a stability system integrated in the battery pack.

The charging station does not require any heavy infrastructure or extra arrangements, such as a crane. The charging station consists of three compact cubes that rely on the common power infrastructure already in place at the mine, which means they can be easily moved and redeployed as the mining operation develops.

A few suitable old tunnel ends or turnouts at strategic locations along the route of the loader are all that is needed for the extremely simple battery swap. At the charging station, the operator simply drops the depleted battery and picks up a new fully loaded one. Also, the on-board battery connections are automated, so the entire battery swap cycle can be completed without leaving the cabin.

Sandvik LH518B offers mine owners and contractors true freedom of choice regardless of their existing fleet compositions. It can replace both diesel-powered and tethered-electric loaders if that is what the operational needs require, but it can just as easily coexist with any type of legacy system that needs to stay in service, and in all cases with minimal changes to the loading cycles.

**THE TOTAL COST** of ownership is a common concern regarding BEVs, particularly if the new battery machines have to be adopted into an existing mine site.

"Customers often think that this new technology is going to be more costly," says Brian Huff, vice president of technology at Sandvik's Business Unit Artisan. "The reality is, it's not. Batteries are a new cost component to the existing model, so you have to add that to your line items. But the reality is that it offsets the expensive diesel fuel. Furthermore, there is no engine, transmission or torque converter on the machine, which means no midlife rebuilds, no transmission rebuilds, and a lot fewer cooler changes."

When all these factors are accounted for, the total cost of ownership is not likely to exceed that of a typical diesel-powered loader. The costs are also likely to decrease as BEVs become more commonplace technology and production volumes go up. Furthermore, these calculations do not even account for the significant potential for reduced heat generation and lower mine ventilation costs. ■

## SANDVIK LH518B ADVANTAGES

- Productivity:** powerful 18-tonne loader compliant with the 14-tonne envelope size
- AutoSwap:** fast and easy battery swaps without manual handling
- Flexibility:** minimum changes to the mine infrastructure as needs change
- Agility:** minimal need to adjust loading cycles
- Zero local emissions:** no diesel engine, no exhaust emissions
- Total cost of ownership:** comparable to diesel equipment

Sandvik LH518B battery-electric loader is the result of combining Sandvik's unique experience with Artisan's fresh perspective on the mining industry.



# A ray of light for remote mining

**REMOTE MINING OPERATIONS** typically rely on diesel gensets for their energy supply, but this arrangement has several disadvantages. High fuel transport costs make this type of power generation expensive, and the environmental impact caused by carbon emissions is significant.

Renewable energy, such as solar or wind power, is the obvious alternative. Hybrid power – usually a combination of diesel gensets and renewable energy systems with or without storage – is one solution. In this case, a typical off-grid mine prioritizes solar or wind energy but has the possibility to

switch to diesel if the power supply is compromised. Hybrid power is also available in the form of portable solar and wind microgrids for mines that are unwilling or unable to commit to a long-term electricity supply.

Where long-term commitment is not an issue, solar power ultimately ensures that costs and environmental impact are significantly reduced over the lifetime of a mining operation. It is now possible to deploy solar panels without an upfront investment by securing a Power Purchase Agreement. The provider installs the system, allowing

mining operators to focus on their core business, and payments are made per kWh delivered during an agreed term. There is also an option to purchase the system at the end of the contract.

Solar power offers many advantages to the energy-intensive mining industry. Its modular design allows panels to be moved as the mine expands, sunshine is free and generating the electricity produces zero carbon emissions. For these reasons alone, industry experts expect to see a boom in solar energy use at remote mines in the near future. ■







# SANDVIK DL422iE

## INTELLIGENT AND FULLY ELECTRIC

Sandvik DL422iE is a fully automated, battery-powered, top hammer production longhole drill. The electric driveline system with zero diesel emissions while tramming and the continuous, automated production drilling ensure a safer, productive working environment for teams underground.

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