

# SOLID

#1.2013

# GROUND

A MAGAZINE FROM SANDVIK MINING

◆ Outside the tunnel for automated LHDs at Rio Tinto's Northparkes mine.

Hefty handling in Hungary:  
**Giant power**

Conveyor belts:  
**Futuristic inventions**

**Australia:**  
**Automated productivity**

# ACCELERATED ACTION

Rock tools: **One for each** Sandvik MC470: **Robust flexibility**



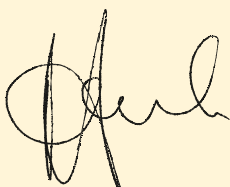
# Dear reader,

**SANDVIK MINING PLACES** great importance on supporting our customers and helping them meet the ever-increasing challenges in the industry, regardless of the market situation.

We consistently strive to find ways to improve the service we provide. Many of these improvements will remain unseen by you because they're taking place in the background, deep within our organization – but we are confident that you will benefit from the results they bring.

**ONE THING THAT** will never change is our focus on safety, an area in which we continue to invest. Similarly, we will always invest heavily in R&D. In this issue of *Solid Ground* you can read about the MC470 continuous miner, designed to combine high productivity with flexibility, and the RR321 premium rotary drill bit, which provides a significant increase in service life compared with its predecessor. Then, of course, we have the new additions to our underground truck family, the TH551 and TH663, bringing increased productivity and overall hauling speeds, and the AutoMine product family, designed for open integration with other IT systems at mine sites.

I've hopefully given you just a taste of the many exciting developments here within Sandvik Mining, designed to bring you, the customer, what you're looking for – safety, productivity and peace of mind. I'm not going to take up any more of your time, so please read on to find more about what Sandvik Mining can do to help you meet the challenges you face, both now and in the future!



**Gary Hughes**  
President  
Sandvik Mining



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Compact bucket-wheel excavator in Hungary is the first of its kind.



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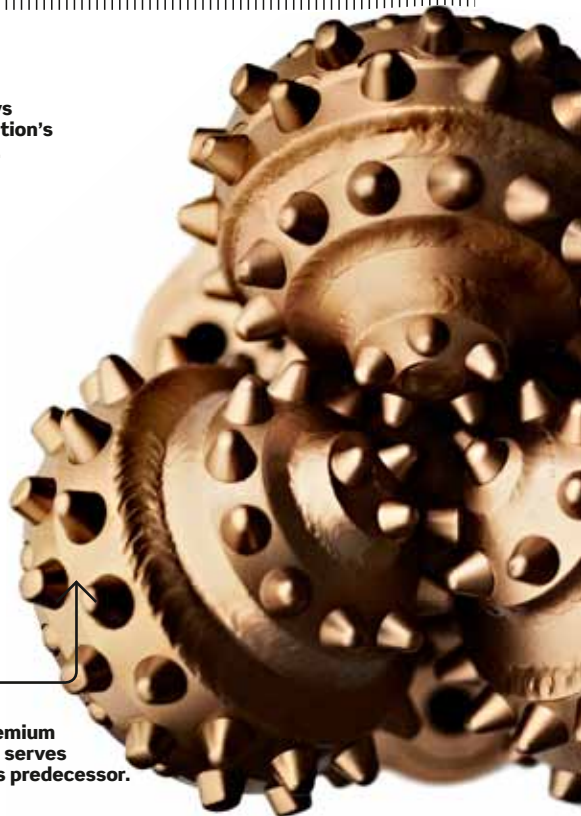
Meet Kazakhmys Copper Corporation's chief mechanic.

ZHANAT AYTKHOZHIN/NOVIC PHOTO STUDIO



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MINCO PHOTOGRAPHY

## South Africa's first MC430 springs into action

● South Africa's first Sandvik MC430 continuous miner was in operation in Mpumalanga only a few months after it was purchased at the Electra Mining Africa 2012 trade show.

STA Coal Mining has been impressed with the MC430's power-to-weight ratio and its cutting rates in the hard coal of Mpumalanga's coalfields.

"The MC430 has several features that will help us maintain our excellent safety statistics," says Bob Nkosi, director partner at STA. "I believe the

purchase of this machine from Sandvik heralds the beginning of a solid relationship between our two companies."

The Sandvik MC430 continuous miner



## Strong bond within mineral processing

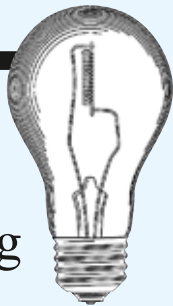
● Finnish mining equipment supplier Outotec signed a letter of intent with Sandvik in September to develop mineral processing solutions focusing on comminution.

The two companies have collaborated on several projects in the past, and their mineral processing solutions complement each other, creating a complete value chain solution for processing plants that includes ore crushing, grinding and concentrating.

"Strengthening our relationship with Outotec will further enhance our proven concept," says Gary Hughes, president of Sandvik Mining.

### THE QUOTE

"Sandvik has been operating successfully for 150 years, always with a strong focus on innovation."



- Jan Lissåker, Sandvik's executive vice president for group communications, on business data leader Thomson Reuters recognizing Sandvik on its 2012 list of the world's 100 most innovative companies.

# Quicker than ever

## New speedy system

● With a hydraulic-pressure sampling rate of 200 times per second, Sandvik's recently released advanced electric dump valve system is the quickest tramp iron protection system of any cone crusher on the market.

The control and hydraulic system reacts instantly to unwanted objects in the crushing chamber, including tramp iron, drill bits, mill balls, excavator teeth, pieces of steel or severe packing of fine material in the crushing chamber.

When coupled with the design of the Sandvik Hydroset system, the speedy electric dump valve system decreases exposure to pressure peaks by more than 90 percent, reducing the risk of internal damage to the crusher.

The external dump valve is located on the side of the crusher, increasing operator safety



● Sandvik's new electric dump valve system offers fast tramp iron protection.

and making maintenance access easier.

Factory-installed electric dump valve kits are available for Sandvik's CH870, CH890 and CH895 models, while retrofit kits for crushers already installed in the field are available for several additional models.

"Customers who have already installed the electric dump valve have seen significant improvements in the protection efficiency," says Andreas Christofferson, product specialist for cone crushers.



+ **Emergency escape window in cabin**

+ **Adjustable steering wheel angle and length**

+ **Optional onboard jacking**

● As mines go deeper underground, the demand for safer, faster and more efficient hauling continues to increase. Sandvik presented two new additions to its underground truck family at MINExpo International 2012 to answer those needs.

The TH551 and TH663 underground trucks have been designed for state-of-the-art safety, higher productivity and increased overall hauling speeds to ensure high annual output. They feature massive hauling capacity per envelope size and will be available with up to Tier 4i-technology engines that boast high torque characteristics with low fuel consumption and low emissions.

The trucks are engineered to

work most productively with the LH517 and LH621 loaders. "Innovative thinking, comprehensive research in the complete underground hard rock hoisting application and customer feedback have played a major role in the design process of these new trucks," says Mark Ryan, product manager for Sandvik trucks.

The trucks feature more than 63 different safety features to protect operators, maintenance staff and the machines. The ergonomic cabin is 35 percent larger than predecessors.

The TH551 will be available in mid-2013 and the TH663 at the end of 2013.

# Versatility in Vietnam

• A steel plant in Vietnam will benefit from 14 new stackers, reclaimers and staker/reclaimers by the end of 2015.

The Sandvik materials-handling machines delivered over the next three years will operate within a capacity range of 675 to 6,000 tonnes per hour for materials including iron ore, coke and sinter.

The contract includes design, engineering and supply of all components, forwarding and transportation to the steel plant in Vietnam and installation and commissioning of all machines on a turnkey basis.

Fourteen Sandvik materials handling machines will be delivered through 2015.



GETTY IMAGES

# 1,000

**Shifts without a lost time incident (LTI) celebrated by Sandvik Mining Namibia last November, a milestone that has been achieved over the past three years at the company's operation in Swakopmund.**

## Rio goes all-in on automation at Argyle

• The world's largest underground mining automation system will be installed by the end of this year at Rio Tinto's Argyle Diamond Mine in Western Australia.

Sandvik's advanced AutoMine system will help Argyle improve efficiency, production and safety. The order comprises 11 LH514 electric loaders and two diesel LH410 loaders, which will be operated from Sandvik control room systems above ground. In addition, Sandvik's recently launched Draw Control will enable accurate tracking, reporting and overall management of manual production loading during the mine's development phase.

Argyle's production structure is designed for automation. Sandvik's AutoMine system will help increase block cave annual production to about 9 million tonnes per year.



Argyle will receive its remaining LHDs this year.

## Exploration expansion

### DE130x is ATEX certified

• The Sandvik DE130x is a fully certified exploration drill rig for underground coal applications according to stringent European standards.

The ATEX-certified rig is the latest in Sandvik's DE100 series of compact core drills for surface and underground exploration. ATEX consists of two EU directives — one for equipment manufacturers and one for operators — that outline permissions for explosive environments.

The DE130x features a redesigned power unit, upgraded steel parts and a wire

emergency stop on the feed boom for increased safety.

George Tophinke, global exploration equipment manager, says expanding coal markets led Sandvik to bolster its offering to include a certified drill in the DE100 series.

"Historically this series has been very successful for Sandvik," Tophinke says. "We expanded our offering in line with our important ongoing efforts to integrate EHS into our products."

+ ATEX derives its name from the French title of the 94/9/EC directive: *Appareils destinés à être utilisés en Atmosphères Explosives.*



## Growing AutoMine family

• High-quality, reliable fleet automation for drilling, loading and hauling, single loader automation, block cave draw control and process-management systems were among the highlights of Sandvik's offerings at MINExpo INTERNATIONAL 2012.

One of the major customer benefits across Sandvik's new AutoMine product family is improved safety, since fewer people work in potentially hazardous areas. Real-time process management and control increases productivity, and smoother control of equipment reduces maintenance costs.

**ABOUT OLEG LI**

**AGE:** 37.  
**POSITION:** Chief Mechanic of Kazakhmys Copper Corporation, Kazakhstan, CIS.  
**RESIDENCE:** Moved from Zhezkazgan to Astana.  
**FAMILY:** Wife Olga and a daughter.

*Kazakhmys Corporation is a UK-headquartered copper mining company whose primary assets are located in Kazakhstan. The company operates 16 open pit and underground mines along with two smelting and refining plants in the Republic of Kazakhstan.*

## COPPER TOPPER

**OLEG LI JOINED KAZAKHMYNS** Corporation in 2001. Since then he has advanced from being a mining equipment fitter in a Zhezkazgan factory to becoming the chief mechanic of the whole corporation. Now he lives and works in Astana, the capital of Kazakhstan.

**WHAT ARE YOUR MAIN DUTIES AS CHIEF MECHANIC?**

“I ensure efficient usage and high-quality maintenance and repair of all the technological equipment of Kazakhmys Corporation.”

**WHAT DO YOU THINK OF SANDVIK EQUIPMENT?** “I have worked with Sandvik equipment since my very first days at Kazakhmys. It is used in all our mining companies. We have at least 300 pieces of Sandvik equipment: underground trucks, loaders, drilling machines – basically all of Sandvik’s product line. In my opinion Sandvik technology is one of the very most reliable. And the Sandvik staff is very flexible and always responds to our problems.”

**WHAT CHALLENGES DO YOU ENCOUNTER IN YOUR WORK?**

“The biggest challenge for us – and, I believe, for many companies around the world – is to find personnel with the right qualifications. Another challenge, which is also one of my KPIs, is to provide a safe work environment.”

**WHAT ARE YOUR HOBBIES AND INTERESTS?** “I love reading and exercising. I’m heavily involved in working with the Youth Kickboxing Association in Zhezkazgan.” ■

# Rio races on

## Iron ore giant boosts capacity in Pilbara



Rio Tinto advanced plans to expand production capacity in Western Australia's Pilbara region to 283 million tonnes annually by the end of 2013.

GETTY IMAGES

● Rio Tinto, the world's second-largest iron ore producer, maintained plans to increase production in late 2012 as many mining companies scaled back operations to combat higher costs and falling prices. The company's iron ore output jumped 5 percent in the third quarter of 2012 as mines in Western Australia's Pilbara region achieved a quarterly record of 63 million tonnes. While Rio Tinto confirmed in October that the company was cutting more costs, it upheld plans to increase iron ore production in anticipation of strong demand.

"Significant stimulus efforts have been announced in China, the US and Europe, but it's uncertain exactly when we will see the impact of these on our markets," Tom Albanese, Rio Tinto's CEO at the time, said. "Given this, and the considerable price fluctuations in recent times, we are somewhat more cautious on the outlook over the next few quarters." Still, the company advanced plans to expand production capacity in the Pilbara region to 283 million tonnes annually by the end of 2013 and to more than 350 million tonnes by mid-2015.

### THE QUOTE

**"More needs to be done."**

Joseph A. Main, assistant secretary of labor for mine health and safety, says that although the US mining industry achieved historically low fatality and injury rates in 2011 according to results announced in late 2012, all such incidents are preventable.



MINCO PHOTOGRAPHY

Women currently represent less than a fifth of Queensland's mining workforce.

## Australia wows women into mining industry

● The Queensland government has launched a scholarship program to incentivize women to study mining and proceed to jobs in the male-dominated industry. In October, John-Paul Langbroek, state minister for education, training and employment, announced 500 scholarships of up to 20,000 Australian dollars over four years to help women study such subjects as agricultural science, architecture, building services, engineering, geological science and IT. Women represent less than a fifth of Queensland's mining workforce.

## TB sweeps South Africa

● South Africa's gold mining industry may have the highest incidence of tuberculosis in the world, according to the Department of Health's Tuberculosis Strategic Plan for South Africa 2007-2011. TB cases range from 3,000 to 7,000 per 100,000 miners annually. The World Health Organization classifies an incidence of 250 per 100,000 per year as a "health emergency". Tuberculosis has long been linked to silicosis, a lung disease caused by inhaling crystalline silica dust, which is a widespread hazard in the South African mining sector.



Jorge Merino Tafur, Peru's minister of energy and mines.

## Big time investments

● Mining investments in Peru could top 50 billion US dollars by the end of the decade, according to the country's minister of energy and mines. Showcasing projects for South American and Arab investors in October, Jorge Merino Tafur said Peru's mining and energy sectors surged from 1.87 billion US dollars in 2001 to 8.5 billion dollars in 2011. He also noted potential planned mining investments of up to 53 billion dollars by 2020, more than half of which are already under development as gold and copper projects.



## Zambia to double copper

● Since the Zambian government privatized the sector more than a decade ago, mining companies have invested 6 billion US dollars to rehabilitate and expand processing plants, according to Fredrick Bantubonse, general manager of the Chamber of Mines of Zambia. Bantubonse estimated that the country should double production to 1.5 million tonnes within the next five years.

## China pushes coal-to-gas pilots

● China is investing 14 billion US dollars in pilot projects to convert coal extracted in remote regions into natural gas for urban areas.

The government has green-lighted four projects in northern provinces that it hopes will produce 15 billion cubic metres of gas annually by 2015 — almost 7 percent of the country's demand — and help China meet its need for cleaner fuel while avoiding dependence on expensive gas imports.

China hopes to transform its rich coal reserves into gas via technologies similar to those used in South Africa for oil-from-coal projects under apartheid.

In Inner Mongolia last July, state-run Datang Power launched the first coal-to-gas conversion plant, which will have a full capacity of 4 billion cubic metres by 2014.

## France eyes domestic rare earth minerals

● France's minister of industrial renewal, Arnaud Montebourg, hopes to develop new mining projects in the country after decades of closures.

Montebourg told a French strategic metals committee in October that a planned overhaul of the country's age-old mining code would encourage new projects while protecting environmental concerns.

The government also hopes to update a 30-year-old geological survey and target strategic rare earth minerals.



Arnaud Montebourg, French minister of industrial renewal.

GETTY IMAGES



Chuquicamata in Chile is the largest open-pit copper mine in the world.

# Upside down

## New start for Chuquicamata mine in Chile

● As ore grades decline and trucking becomes economically unviable, the world's largest open-pit copper mine is going underground.

Chile's massive Chuquicamata, which began production in 1915, is forecast to be unprofitable before the end of the decade.

In an effort to avoid closure, state-owned Codelco has already invested nearly 4 billion US dollars to transform it into the world's largest underground mine. The company will dig more than 1,000 kilometres of tunnels below the pit and plans to replace dump trucks with an in-pit

crushing and conveying (IPCC) system. Trucks currently drive more than 10 kilometres to bring lower-grade ore from the bottom of the world's second-deepest open pit to the surface.

Codelco believes the mine's untapped deposits are equal to more than half of all copper extracted there over the past century. The company is confident an underground mine at Chuquicamata can produce more than 300,000 tonnes of copper per year for another 50 years. The open-pit mine produced 443,000 tonnes in 2011.

# 1,000,000,000,000

Estimated value of copper, iron and other mineral deposits in Afghanistan, in US dollars. US military researchers have estimated the cost of constructing and operating a railway network across the country at more than 54 billion US dollars. The price tag and logistical challenges of a railway system required to transport minerals out of Afghanistan could render major mining financially unfeasible.





## Forever young

● Despite its age of 12.2 billion years, one of the tens of thousands of stars in the Messier 4 globular cluster has kept its young features. And surprisingly, the star is rich in lithium, one of the most sought-after metals on earth.

Normally, the lithium in stars is destroyed over billions of years. But this star has found a way to stay young, either by retaining its original lithium or by creating a fresh supply.

Regenerating lithium should interest mining companies looking into exploration in space. The Moon is the first place where studies are ongoing.

The lithium star in the Scorpius constellation is 7,200 light years away, so travel arrangements for a potential exploration mission should be made promptly.

## India must go deep

● As coal-reliant India's power demands grow and options for cheap open-pit operations dwindle, some energy industry experts say shifting the focus to expensive underground mines may be the only viable way to prevent a major power crisis.

India, which holds massive estimated coal reserves of 286 billion tonnes, meets close to 75 percent of its demand domestically. Much of that is not accessible through open-pit operations, which some experts believe will be exhausted within a decade.

State-run Coal India Limited produces 80 percent of the country's coal at an average cost of around 13 US dollars per tonne in open pits — less than one-fifth as much as underground mines. The company says the higher costs and lower output of existing underground mines make them financially unfeasible at today's prices, but importing is also costly.

Only 10 percent of Coal India's output currently comes from underground mining.



Underground coal mines are expensive but will be necessary in India, experts say.

## The Expert

**TONY DAVIES** is a retired professor of occupational health who has focused on lung diseases for many of his 50 years working in central and southern Africa. He served as director of South Africa's National Institute of Occupational Health from 1985 to 2002 and has published more than 100 articles, many on subjects related to health in the mining industry.

### Q: Why does exposure to quartz dust predispose miners to tuberculosis of the lungs?

**A:** Small particles of quartz (silica) reach the depths of the lungs and damage the cells that remove foreign material from the air spaces. These cells are the first line of defense against tuberculosis. Once the lungs are thoroughly dusted with silica, the increased risk of contracting tuberculosis persists throughout life. Silicosis commonly progresses or develops after workers retire. It impedes breathing and can eventually lead to heart failure.

### Q: What makes the situation in South African mines so serious?

**A:** Uncontrolled exposure to quartz dust has been associated with high levels of tuberculosis for a very long time, but in South Africa a poor tuberculosis control service and the uncontrolled spread of HIV/AIDS have pushed the level of new infections to unprecedented levels.

### Q: What is the key to reversing the epidemic?

**A:** The key is dust control — and in fact most occupational disease originates from aerosols in the workplace. The interaction of quartz dust, tuberculosis and HIV has proved disastrous for South Africa. Mines must become more conscious about controlling dust. Respiratory protection isn't always enough, especially for regular full shift work. Source control can't be underestimated, whether it's the use of wet methods, engineering controls like local ventilation or specialized systems and equipment.

**Health expert Tony Davies believes in dust source control.**



An Australian resources company has identified a maiden resource of more than half a billion tonnes grading 0.47 percent copper in Indonesia's northern Sumatra.

## Sumatra hits huge prized metals deposit

● An Australian resources company has discovered a massive copper and gold deposit in Indonesia's northern Sumatra that it says could rival Rio Tinto's Bougainville deposit in Papua New Guinea, which was the world's largest open-cut mine when it ceased operations in 1989.

Tigers Realm Group has identified a maiden

resource of more than half a billion tonnes grading 0.47 percent copper. The Beutong deposit also holds gold and silver and has a higher-grade core of 153 million tonnes at 0.63 percent copper.

The company has implemented a scoping study to investigate the viability of a mine at the discovery.


GETTY IMAGES

MÁTRAI ERŐMŰ LIGNITE MINE

# BULKY BIZ

■ **BÜKKÁBRÁNY, HUNGARY.** Eight million years ago, a forest of swamp cypress trees as tall as 40 metres towered above what is today an opencast lignite mine providing fuel for one of Hungary's largest power plants.

Text: ERIC GOURLEY Photo: MÅNS BERG



The world's largest compact bucket-wheel excavator continuously strips overburden, helping Mátrai Erőmű reach lignite more quickly.

**A**rchaeologists discovered 16 preserved cypress trunks on the lowest level of the Bükkábrány pit in north-eastern Hungary several years ago.

While most of the ancient forest turned to coal during the Miocene period, a suspected sandstorm covered some of the massive trees, preventing the wood from becoming fossilized. The first European discovery of such old trees in their original location excited scientists, who can learn about the Earth's climate during the period.

Around the time that the most-intact trunks were extracted from Bükkábrány and transported to museums for preservation, in mid-2007, the mine's owner, Mátrai Erőmű (Mátra Power Plant), contracted with the Austrian branch of Sandvik Mining Systems on

the world's largest compact bucket-wheel excavator (BWE) PE100 with a belt wagon PB100.

Mátrai operates two opencast mines to produce the 8.5 million annual tonnes of lignite required for continuous operation of its 950-MW power plant, the largest such operation in Hungary. The plant produces more than 15 percent of Hungary's energy demand, a vital domestic operation in a country of 10 million people who rely on Russian natural gas and other foreign imports for as much as 70 percent of their primary energy needs.

**L**ignite, sometimes referred to as brown coal, has a high moisture content and is used primarily as fuel for steam-electric power generation.

Sixty percent of Mátrai's lignite



## First of its kind

● As mining in the Bükkkábrány pit moved into an area where Mátrai had to strip a growing amount of overburden to access the underlying lignite seam, the company demanded a unique excavator to expand capacity, boost productivity and decrease reliance on costly shovel-and-truck operations.

Sandvik designed and built the first-of-its-kind PE100, the world's largest compact bucket wheel excavator with a theoretical hourly capacity of 6,700 cubic metres. At an annual capacity of around 12 million cubic metres, the PE100 works in tandem with the PB100 beltwagon and boasts more than double the lignite-stripping capacity of other excavators used in Bükkkábrány.

The Sandvik PE100 compact bucket-wheel excavator with PB100 beltwagon (background) is standing still for inspection. In full production the PE100 boasts a theoretical capacity of 6,700 cubic metres per hour — double that of other systems in Bükkkábrány.

**EHS note:** The machine is not in operation in this photo and the people are standing a safe distance away, avoiding the potential safety hazard of falling objects.





Mátrai mining strategic director Barnabás Derekas was pleased that Sandvik erected the machine before the deadline.



Operator Zoltan Toth has been working with the bucket-wheel excavator since its birth in 2009.

**“It’s an easy system. The interfaces are very user-friendly.”**

comes from the larger pit in Visonta, about 90 kilometres north-east of Budapest. That lignite, with lower heating value, is conveyed a short distance to the neighbouring power plant and mixed with a higher heating value lignite that is transported 60 kilometres by train from the younger Bükkábrány pit.

Bükkábrány began production in 1985 as a shovel-and-truck strip mining operation. Mátrai debuted its first BWE here in the early 1990s to continuously strip overburden and access the underlying lignite seam more quickly.

As mining moved into an area where the overburden covering the lignite continued to increase, Mátrai sought a unique excavator to increase production capacity and boost productivity.

“We already had all the other equipment in the pit,” Mátrai mining

**26**  
million cubic metres, the approximate amount of overburden Mátrai must remove to produce 3.5 million tonnes of lignite annually.

strategic director Barnabás Derekas says. “We had our belt systems and a spreader. We were searching for a big machine because over time it became clear that continued cutting would be significantly cheaper than shovel-and-truck in our operation.”

Needing an annual capacity of around 12 million cubic metres, Mátrai estimated calculations for the capital investment and operating and maintenance costs of a new BWE. The company initiated negotiations with prominent suppliers in Europe, assigning different percentages of importance to three crucial criteria: price, technical specifications and payment conditions.

“We didn’t want to find the cheapest solution,” Derekas says. “We wanted to find the best overall solution based on

our most important measures as an operator. We chose Sandvik because they offered the best solution based on a combination of those factors.”

Mátrai consulted experts in complex excavator projects at German utilities company RWE. Sandvik representatives for various parts of the machine met with Mátrai and RWE every other week for several months to plan details.

Components for the excavator were manufactured partly in Hungary and partly in other countries across Europe. As many as 130 erectors worked on site daily for almost nine months to build the PE100 excavator and accompanying PB100 beltwagon, which went into production ahead of schedule in mid-2009.

Mátrai conducted a series of capacity and performance tests over different durations, and the machine



Zoltan Jager, sales manager for Sandvik Mining Systems, left, and Simon Csaba, chief of Bükkábrány's maintenance department, are all smiles about the bucket-wheel excavator.



Bükkábrány is located in north-eastern Hungary, about 150 kilometres from Budapest.

►► achieved all targets established in the contract two years earlier.

“Sandvik built up a very unique machine for the deadline,” Derekas says. “When it was finished and went from the job site into the pit it started running immediately and produced the contracted values. We were very pleased.”

**S**hrouded in fog early one winter morning, the sheer size of the 1,650-tonne PE100 becomes clear as the sun starts to creep over the edge of the Bükkábrány pit and the mist begins to lift.

The excavator boasts a theoretical capacity of 6,700 cubic metres per hour — more than twice that of the three smaller excavators in operation at Bükkábrány — though actual capacity is limited by the width of the conveyor system and capacity of a spreader at the other end.

The excavator’s steel boom is 28

metres long and features a 12-metre-wide wheel fitted with 16 buckets. It works in parallel with a crawler-mounted beltwagon that overcomes high bench changes, conveying overburden an additional 50 metres to one of Bükkábrány’s three conveyor systems.

Bükkábrány has to remove as many as 26 million cubic metres of overburden to produce 3.5 million tonnes of lignite annually. The first 20 metres of overburden are a mix of dirt and soft, wet clay. Beneath the clay is a layer of sand with the occasional thin line of coal, but the primary coal seam is even deeper.

The PE100 enables operators to select specific programs for cutting the different types of overburden, since each requires unique cutting forces and rotating speeds.

“It’s an easy system,” says Imre Papp, an excavator operator who has been working with the system since its birth. “The interfaces are very

## About Mátrai Erőmű and Visonta/Bükkábrány mines

● Mátrai Erőmű (Matra Power Plant) operates a 950-MW coal-fired power plant in north-eastern Hungary, the country’s second-largest operation. Over the past 35 years, Mátrai has produced around 130 billion kilowatt-hours of electricity. The company mines around 8.5 million tonnes of lignite annually from two opencast operations to fuel the plant, which produces more than one-tenth of Hungary’s electricity demand.

Mátrai mines lignite with lower heating value from a massive pit in Visonta, about 90 kilometres north-east of Budapest, which is conveyed a short distance to the neighbouring power plant and mixed with a higher heating value lignite transported by train from the younger Bükkábrány pit an hour away.



user-friendly. Everything is clear for the operators. We never have any issues with the operation.”

Unlike Bükkábrány’s other excavators that require the cutting level to be set manually, Sandvik’s solution features a system that can automatically cut the appropriate level based on GPS coordinates. Mining engineers in an office use AutoCAD (computer aided design) software to plan cutting points and upload the data to a GPS system in the excavator’s cabin.

“When we upload the data into the GPS system we manually set to the zero level, and the machine calibrates automatically,” operator Zoltan Toth says.

An odometer in the operator’s cabin shows it has travelled more than 550 kilometres in less than four years — at a maximum speed of six metres per minute.

“We don’t have to worry about speeding here,” Toth jokes, drawing a laugh from Simon Csaba, chief of Bükkábrány’s maintenance department.

**A** bulletin board in Csaba’s office a few hundred metres from the pit is plastered with pictures of the excavator being built and in operation. Across the room, his laptop receives

# 400

**million tonnes, proven lignite reserves in the Bükkábrány open pit.**

live transmissions of technical parameters of the excavator and the other 12 machines he’s responsible for ensuring operate smoothly.

“We’ve had no problems with the Sandvik machine,” Csaba says. “In the tender description we said we wanted a ‘maintenance-free’ solution, and this machine has really pleased me from a maintenance standpoint. I have a lot of machines to take care of, and this has lived up to my expectations.”

Bükkábrány’s proven lignite reserves are about 400 million tonnes — around a century at current production rates — and Sandvik’s system figures to help Mátrai access much of that.

The primary steer structure is designed to operate for 40 years, and the theoretical lifetime of the bearing in the bucket wheel’s main gearbox is 50,000 working hours without maintenance — around 12 years at the current 4,800 planned working hours per year.

“Our mining systems are built to last, and this one-of-a-kind BWE is no exception,” says Claus Butter, Sandvik’s lead engineer for the project. “This excavator is just getting started at Bükkábrány.” ■

## TECH SPECS

PE100 compact bucket-wheel excavator

**WEIGHT:** 1,650 tonnes

**THEORETICAL CAPACITY:** 6,700 cubic metres per hour

**CUTTING HEIGHT:** 20 metres

**BLOCK WIDTH:** 40 metres

**BOOM LENGTH:** 28 metres

**CUTTER WHEEL DIAMETER:** 12 metres

**NUMBER OF BUCKETS:** 16

**VOLUME OF EACH BUCKET:** 1.83 cubic metres

**BUCKET WHEEL DRIVE OUTPUT:** 1,100 kW

**PLANNED ANNUAL WORKING HOURS:** 4,800



See the video about Bükkábrány and Mátrai at [www.solidgroundmagazine.com](http://www.solidgroundmagazine.com)

## “This excavator is just getting started at Bükkábrány.”

The Sandvik PE100 compact bucket-wheel excavator, right, and PB100 beltwagon work in tandem almost 5,000 hours per year.

ROCK TOOLS

# PRIME POWER



The new design of the Sandvik RR321 extends the drill bit's service life.

■ A new air bearing design means more operating hours for the Sandvik RR321 premium rotary drill bit. With its standard and ultra-premium bits, the RR family forms the most comprehensive range for blast hole drilling.

Text: ÅKE R MALM Photos: MÅNS BERG



**T**hanks to our know-how and experience, we managed to find a new and better configuration of the air bearings for our RR321 drill bit range,” says Petter Nilsen, Sandvik product support and sales manager, Europe.

The RR321, Sandvik’s latest model of premium rotary drill bits for blast hole drilling, features three air bearings with a new design to provide better load distribution. The result is longer bearing life, improved bit meters and reduced drilling costs. This means increased run time on the rig as well as more holes between bit changes.

The new design extends the drill bit’s service life by an average of 10 to 15 percent beyond what its predecessor the RR320 could achieve. In fact, test results indicate that the increase could be as high as 50 percent in some cases.

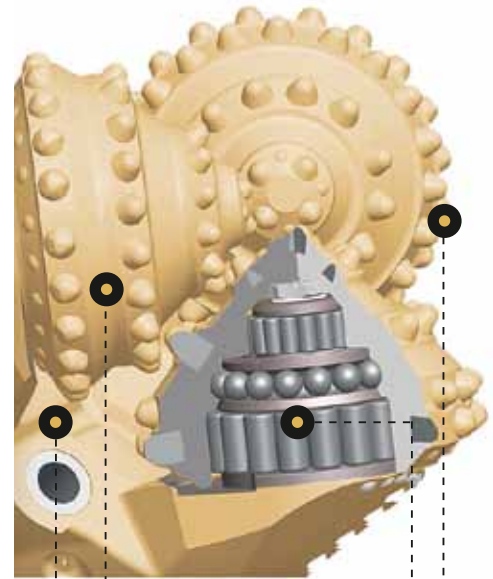
“It is quite an accomplishment to get this type of improvement on a product like the cemented carbide insert bit,

which has already been honed for 50 years,” Nilsen says.

The rotary drilling method has been around for a century, but the technology took a leap 50 years ago with the introduction of carbide inserts in the drill bit cones. The carbide inserts make the bits more durable, and today a whole range of insert designs are available to cover all operating conditions. The challenge is to balance their durability with that of the air bearings.

**S**andvik saw that the performance of its premium air bearing drill bits needed improvement.

This is easier said than done on such a mature product, so the company decided to devote a substantial amount of research and development resources to the project. The initial phase included finite element analysis, followed by laboratory prototype tests. Then the viability of the concept was verified in



### RR321 DRILL BIT

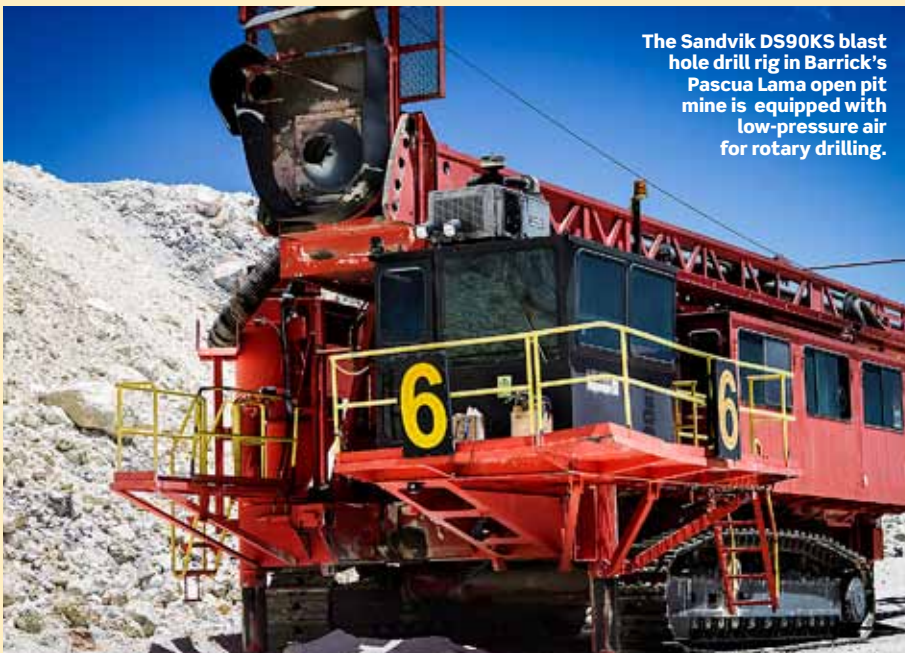
--- Cones

--- Legs

Air bearings ---

Carbide inserts ---

## TECH SPECS ROTARY DRILL BITS



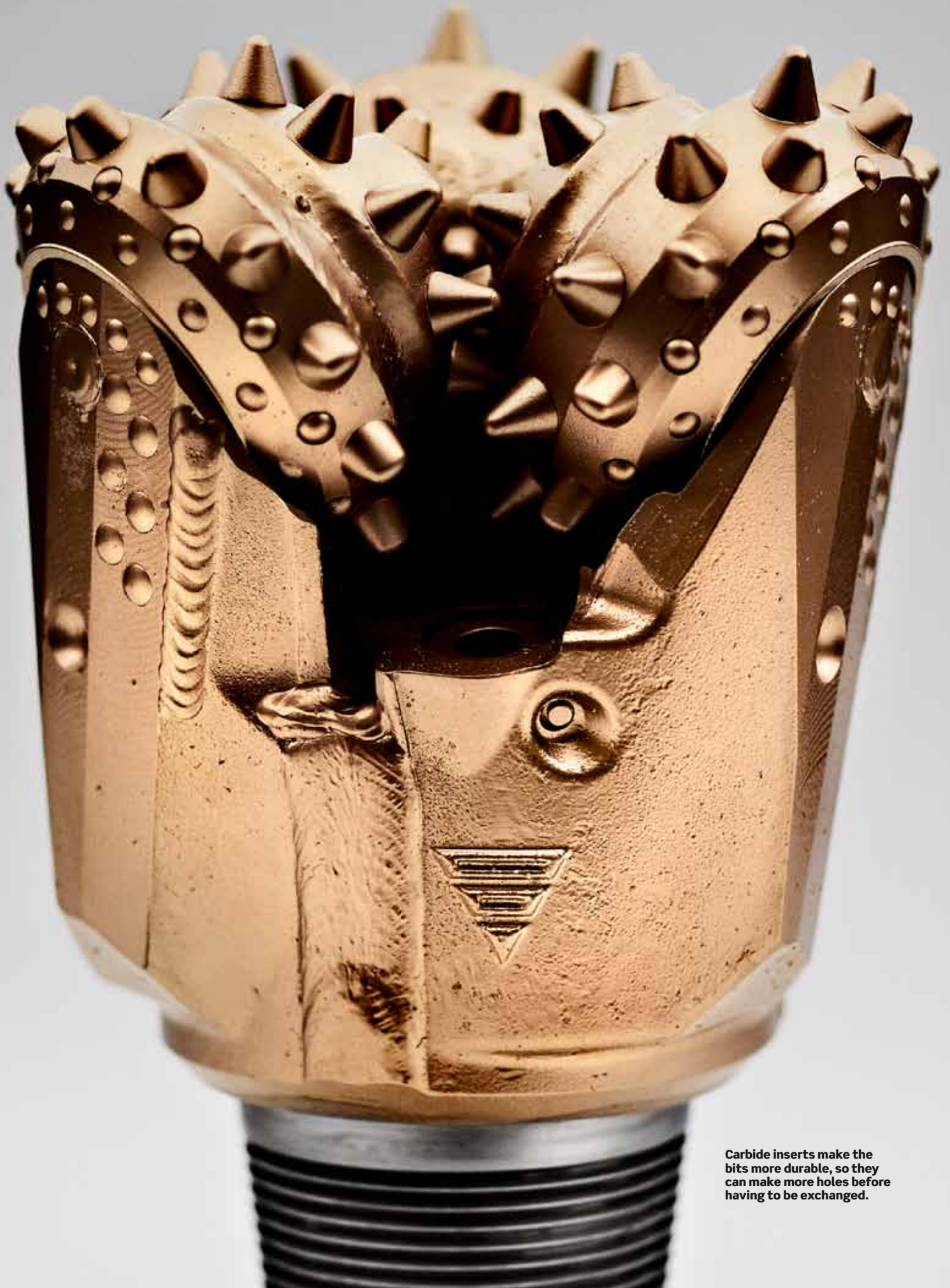
The Sandvik DS90KS blast hole drill rig in Barrick’s Pascua Lama open pit mine is equipped with low-pressure air for rotary drilling.

**ROTARY DRILL BITS** are mainly used for blast hole drilling in open pit mines. The original design can be traced back to the beginning of the 20th century.

They have three legs, each with a bearing-mounted cone and pressed inserts. When a drill rig rotates a drill bit under pressure via a drill pipe, the cones will roll in a circular pattern on the rock surface. The carbide inserts on the cones then crush the rock, and the cuttings are flushed up from the hole by compressed air.

The rotary drill bit is a system of integrated components, each with its specific challenges in terms of design and materials. It is also a disposable article, so the longer it lasts the lower the drilling costs will be. At the same time, productivity will improve because of reduced downtime for bit changes.

To achieve this improvement, the combined performance of inserts and bearings must be optimized.



Carbide inserts make the bits more durable, so they can make more holes before having to be exchanged.



**The RR family offers solutions for a wide range of drilling applications.**

“Our products include rotary drill bits for all types of rock”

**PETTER NILSEN**

►► field tests over a two-year period. The final result was an air bearing range with more operating hours.

**F**or those who want even better performance, Sandvik offers the RR440 ultra-premium rotary drill bit range, which has already proved its worth for more than a decade. It features a set of grease-filled journal bearings with a dual seal to keep abrasive cuttings out. With the right combination of inserts, these bits will normally give at least twice the operating life compared with a rotary drill bit with air bearings.

Even though the ultra-premium RR440 has been on the market for some time now, the premium RR321 series is still the predominant choice. However, a growing focus on drill rig availability and productivity is causing a noticeable shift in market preference in favour of RR440. Longer operating life means fewer bit changes, which gives more drilling time per shift.

“The market is gradually moving towards drill bits with sealed journal bearings,” Nilsen says. “During the last

few years we have seen a very good development for the RR440.”

The third member of Sandvik’s family of rotary drill bits is the standard model RR220. Compared with the other two, this bit has fewer features, but that doesn’t mean it has low performance. The RR220 product range was devel-



**Petter Nilsen**  
product support  
and sales manager.

oped for price-focused customers, but it benefits from many of the developments of the RR320 and RR321 range.

“Our products include rotary drill bits for all types of rock,” Nilsen says. “This allows us to offer solutions suitable for a wide range of drilling applications.” ■

## On-site results

**The performance of Sandvik’s RR321 premium air bearing bits has been tested in several types of mines. Here are two examples.**

Mine type	Iron ore	Coal
Bit size	311 mm (12 ¼")	229 mm (9")
Bit type	S60	S07
Standard bit distance/ service life	2,978 m (9,773 ft) / 64 h	5,434 m (17,828 ft) / 47 h
RR321 test bit distance/ service life	4,163 m (13,658 ft) / 84 h	6,284 m (20,616 ft) / 56 h
Distance increase	39%	16%
Bit hours increase	31%	19%



S/N 20352  
CLASS C4/M4  
Reg. CR 6-50756/03

*Eilbee*

# The mining

■ **PARKES, AUSTRALIA.** Rio Tinto/Northparkes Mines in central New South Wales, Australia, has successfully implemented Sandvik Mining's AutoMine loading system over the past three years - and is now moving towards 100 percent autonomous loading.



# factory

Text: KATE BILLS & MARK CHERRINGTON Photo: MINCO PHOTOGRAPHY ▶▶

# F

or Northparkes management, underground block cave mining is regarded as a “rock factory” – and the more factory operations that can be automated, the more safety and productivity can be increased and costs lowered. While Northparkes’ materials-handling system has been fully automated for years, the requirement for manually operated loaders kept the rock factory vision from being fully implemented – until Sandvik’s AutoMine loading system.

“By automating the loader fleet, we increase the utilization, which we do by being able to operate across shift changes and through blast clearance times,” says Matthew Betts, Northparkes’ manager for infrastructure and mine design for the project.

“It means we get more tonnes out of the mine,” Betts says. “More tonnes means more copper produced. For us automation is a key enabler for Northparkes to produce at a lower unit cost, and mine deeper, lower-grade ore bodies cost-effectively in the future.”

**S**uccessful underground block cave automation is also beneficial for Rio Tinto’s operations around the

world, as it moves from open-cut operations to large underground block caving operations at a number of sites. “They are looking at Northparkes and what we have achieved to see what they can adapt to larger block caves in areas such as Mongolia and the United States, which are operating in much more difficult conditions than we do here,” he says.

Northparkes has a long history of innovation on site and has been



**Matthew Betts sees automation as a key enabler for extracting tonnes at a lower unit cost.**



**Rio Tinto’s Northparkes copper and gold mine is situated in central New South Wales, Australia.**

involved with loader automation for nearly 10 years.

Joe Cronin, Northparkes’ LHD automation manager, says the mine has traditionally been regarded as a test mine for technology for Rio Tinto globally. AutoMine loading system’s successful implementation at Northparkes sets the stage for rolling out the system to other Rio Tinto underground hard rock mines.

“There’s an old expression within Rio Tinto that ‘if it doesn’t work at Northparkes it’s not going to work,’” Cronin says. “We’ve got a very high level of experience at the mine, very high levels of technical expertise, and we have a large majority of staff



## WHAT IS AUTOMINE LOADING?

● AutoMine loading allows remote operation and supervision of an automated underground loader or truck fleet from a surface control room. The autonomous fleet is operated in an area that is isolated from personnel and other equipment, greatly enhancing underground mine safety.

Driving (tramming) and dumping are fully automated, while bucket loading is performed using tele-remote operation. A single system operator is able to manage the operation of multiple automated machines. A wide range of Sandvik underground loaders and trucks can be fitted with the AutoMine onboard package.





Joe Cronin, LHD automation project manager for Rio Tinto, and Ashleigh Braddock, Sandvik systems engineer for mine automation, are helping Northparkes' transformation from manual to automated operation.

**“The shift is very interesting culturally to watch.”**

who've been here for more than 10 years.” Northparkes can therefore more readily conduct technology trials, because it has the experience needed on site and can facilitate the tests safely.

As of early December 2012, 40 percent of the mine's loading operations were automated and delivering productivity benefits. This will soon expand to 80 percent, with 100 percent autonomous operation planned to start during 2013.

**S**ome of the immediate benefits that mine management is seeing relate to shift changes and blasting re-entry. “On some days, there's potentially up to two hours where there's no one on the level with manual loader operation,” Cronin says. “Now, even though there's no one in the mine, the loaders are continuing to produce.”

It's now possible to plan and be a lot more strategic about how to draw from the level. “We've probably gone from about 20 or 21 hours a day of utilization up to 23 hours or even more,” he says.

Safety is another major advantage of an automated load and haul system. Betts says the environment is safer for the operators working with AutoMine loading. “The underground environment is hazardous, and they're exposed to vibration, noise and dust,” he says. “By automating the fleet we remove them from that environment and bring them to a controlled office environment.”

Cronin agrees, even though he describes Northparkes as a highly stable mine with good geology. “We don't have problems with mud rush, high temperatures or rough roads that cause vibration. But potentially for other mines within Rio, where those situations may occur in the future as deposits get deeper and we have to extract them in more challenging environments, this type of technology will allow the extraction of those resources without putting any personnel at risk.”

The next stage at Northparkes is to continue the rollout of automation across the other zones in the level. “We'll work with Sandvik right across this level to get the system optimized

**10**

**years the Northparkes mine has been involved with loader automation.**

and make it as efficient as possible, which is something we'd expect to do in the next 12 months,” Cronin says.

Sandvik has put together AutoMine loading as a full package to suit the mine's coming needs. “It's got the loader automation side, the traffic management and the production management side, as well as the interface to our SCADA system,” he says, referring to the company's Supervisory Control and Data Acquisition system for monitoring remote operations from a central location. ▶▶



Sandvik's Paul Anthony Evans provides product support for electric motors and mine automation at Northparkes.



Six Sandvik LHDs have been fitted with the AutoMine loading system at Northparkes.

## About Northparkes

● Northparkes mine is located 27 kilometres from the town of Parkes in central New South Wales, Australia, and is a joint venture between Rio Tinto (80 percent) and the Sumitomo Group (20 percent).

The underground copper and gold mine processes high-grade copper concentrate on site before it is transported to Port Kembla, south of Sydney, and shipped to international customers.

Northparkes was the first mine in Australia to use a variation of the cost-effective block cave mining technique in its underground operations. Northparkes currently has around 300 full-time employees.



► “Having had Sandvik on site for some time and them knowing our mines and our procedures, it was easy to work with them for this implementation.”

Talking to Sandvik Mining’s personnel responsible for the implementation of AutoMine loading at Northparkes, it is obvious that they take enormous pride in their achievement and the close working relationship with the Northparkes team.

“Northparkes has a really good reputation as a mine,” says Ben Rix, Sandvik Mining’s acting Northparkes Mines performance contract manager, who describes the relationship as a partnership.

“Under our service contract we maintain all the mobile equipment in the production fleet, plus we are now responsible for the automation infrastructure and the onboard automation equipment on the machines,” he says. “We work around the clock, 24 hours a day, seven days a week, 365 days a year to keep the machinery running for production.”

“There have been challenges on the way to get the system to work and operate to a level where the mine can also be productive, so from a Sandvik point of view the achievement has been really satisfying,” Rix says.

**A**shleigh Braddock, Sandvik Mining systems engineer for mine automation, has been fascinated to observe firsthand the transformation going from manual to automated operation.

Automation systems in mining, especially in underground mining,

make for a new environment.

“In the past, those machines have been essentially mechanically operated, so to be working with advanced electrical machinery plus the automation systems is a shift that’s very interesting culturally to watch,” Braddock says.

According to Teemu Lintula, Sandvik Mining’s automation product line manager, the cooperation with Rio Tinto and Northparkes has been highly beneficial and has given Sandvik valuable feedback to further develop its products.

“We are now looking forward to continued collaboration with Rio Tinto with its Argyle Diamonds project, and we are also aiming to further develop our



Northparkes started underground mining using the block caving method in 1997.

systems,” Lintula says. “Northparkes has set the bar high and is pushing us forward in achieving those goals.”

**N**orthparkes underground technicians Amanda Hartin and Ian Morresy have had experience operating loaders underground at the mine, and they are now responsible for operation of the automated loaders. Hartin finds the automated system a lot more efficient and pleasant to work with.

“With manual loader operation, we’d turn up to work, we’d do a shift change meeting and find out our tasks for the day,” Hartin says. “Then we’d head underground, which usually takes about 10 or 15 minutes to tag on, we’d find our equipment, set up our area with barricades and the like, then we’d get to work with the bidders [underground loaders].”

Now, with the automated system, she can walk straight into the control room when she arrives at the mine and get to work within a few minutes. “The bidders are already set up for us with the draw points entered for the day.

“All the operators have to do is bog the draw point, then send the loader on its way to the ROM (run-of-mine) area, and it will tip by itself automatically. Then the loader will turn up at the next draw point where it’s needed and we just go again from there.

“It’s a lot of technology involved, but it’s really easy to use from an

## 214

**draw points in Northparkes’ E48 block cave, where Sandvik AutoMine loading is currently operating.**

operator’s point of view,” Hartin says. As potential interactions with people in bidders are eliminated, the working environment has become better. “There’s also more social interaction up here, because you can talk to the person next to you with none of the radio noise in the background.”

Morresy says the AutoMine system has its benefits. “It’s a good system, it’s an easy system to learn,” he says. “It’s

also a system that a lot of people who couldn’t drive big machines could use.”

The major difference between the automatic system and manual operation in Morresy’s view is that it’s a lot safer. “It separates our staff from machine operating zones,” he says. “I’ve been underground driving them manually, and when you’ve got bidders in all the drives, it can be a bit hairy at times, so I think this is good.” ■



**Northparkes underground technician Amanda Hartin finds Sandvik’s automated system more efficient than manual loading.**

**“It’s a good system, it’s an easy system to learn.”**



**See the video about Northparkes at [www.solidgroundmagazine.com](http://www.solidgroundmagazine.com)**

### SANDVIK SOLUTION

#### Autonomous ore loading

At Northparkes, AutoMine is currently operating at the mine’s E48 block cave, consisting of 10 extraction drives with a total of 214 draw points. Six Sandvik LHDs — five

LH514Es and one LH514 — have been fitted with the AutoMine system, which allows for safe operation autonomously from the surface control

room. The surface operator is only required to operate the loader for a short time in each cycle: simply filling the bucket at the draw point. The loader then trams autonomously with a full bucket to the ROM bin, dumps and returns to the next designated draw point.

Currently the AutoMine system is working on 40 percent of Northparkes’ underground operations, a figure that will soon increase to 80 percent. For the rest of the mine’s extraction drives, autonomous operation is planned to start in early 2013.



# SHEAR UP

■ High cutting power is a key feature of Sandvik’s continuous miner MC470. This and a heavy frame allow the machine to shear up and increase productivity in coal and potash mines.

Text: ÅKE R MALM

**P**roductive board-and-pillar coal mining demands a chain of machines that operate efficiently together. This includes shuttle cars and roof bolters, but first in line is a continuous miner that sets the pace.

“The mines wanted a machine with high productivity and flexibility,” says Gerhard Reiter, product manager at Sandvik Mining.

Having South African coal mines particularly in mind, Sandvik developed the MC470 continuous miner. With a cutting power of 540 kilowatts and a weight of 127 tonnes, it shears both down and up to increase productivity. Shearing up is an operation where other types of machines would typically become unstable. This happens if the picks on the cutting drum begin to “climb” on the face, but the MC470 is designed to prevent that.

“To use the cutting force properly, the cutting tools and machine frame need to be very strong,” Reiter says. “So we ended up with a heavy, robust and powerful machine.”

To tap the full capacity of the MC470, the standard operating cycles for this type of mining need to be revised. One example is to begin by shearing up at a depth of half the drum diameter. This will produce around 15 tonnes of coal, almost enough to fill a 20-tonne shuttle car. The remaining five tonnes will come when the machine

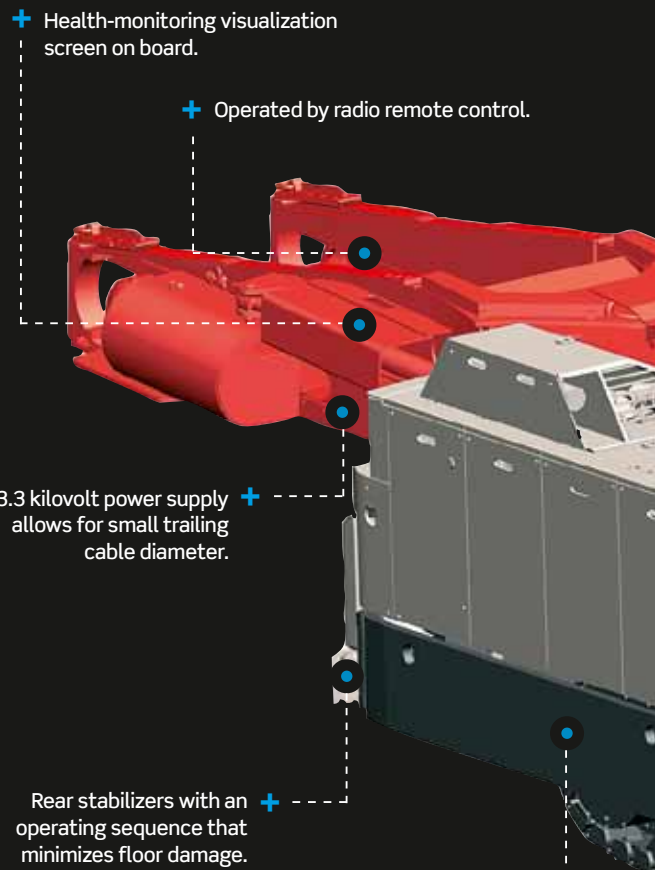
sumps in to full drum diameter, after which the first car can leave. Shearing down will then fill a second car in one go. Finally, a third car stays behind the MC470 as it brushes the floor before it moves forward for another operating cycle. The large bunker capacity on the loading table allows the machine to continuously cut during shuttle car change-out.

**W**hile productivity is also affected by other factors, such as overall availability, this continuous cutting process and the shear-up function potentially add 30 minutes of coal cutting per shift.

Like Sandvik’s successful MB600 series of bolter miners, the MC470 moves on crawlers. They help the continuous miner to avoid unnecessary damage to the floor, which could slow the shuttle cars or destroy their wheel hubs. The crawlers are also important to create the required flexibility.

“After around 15 metres of cutting, a continuous miner has to move out of one entry (a ‘tunnel’ in board-and-pillar mining) and go into another one to allow a bolting machine to install roof support,” Reiter says

A quick change will add to productivity by giving the machine more operating time in a shift. The MC470 has a maximum tramping speed of 25 metres per minute and an electronically ▶▶



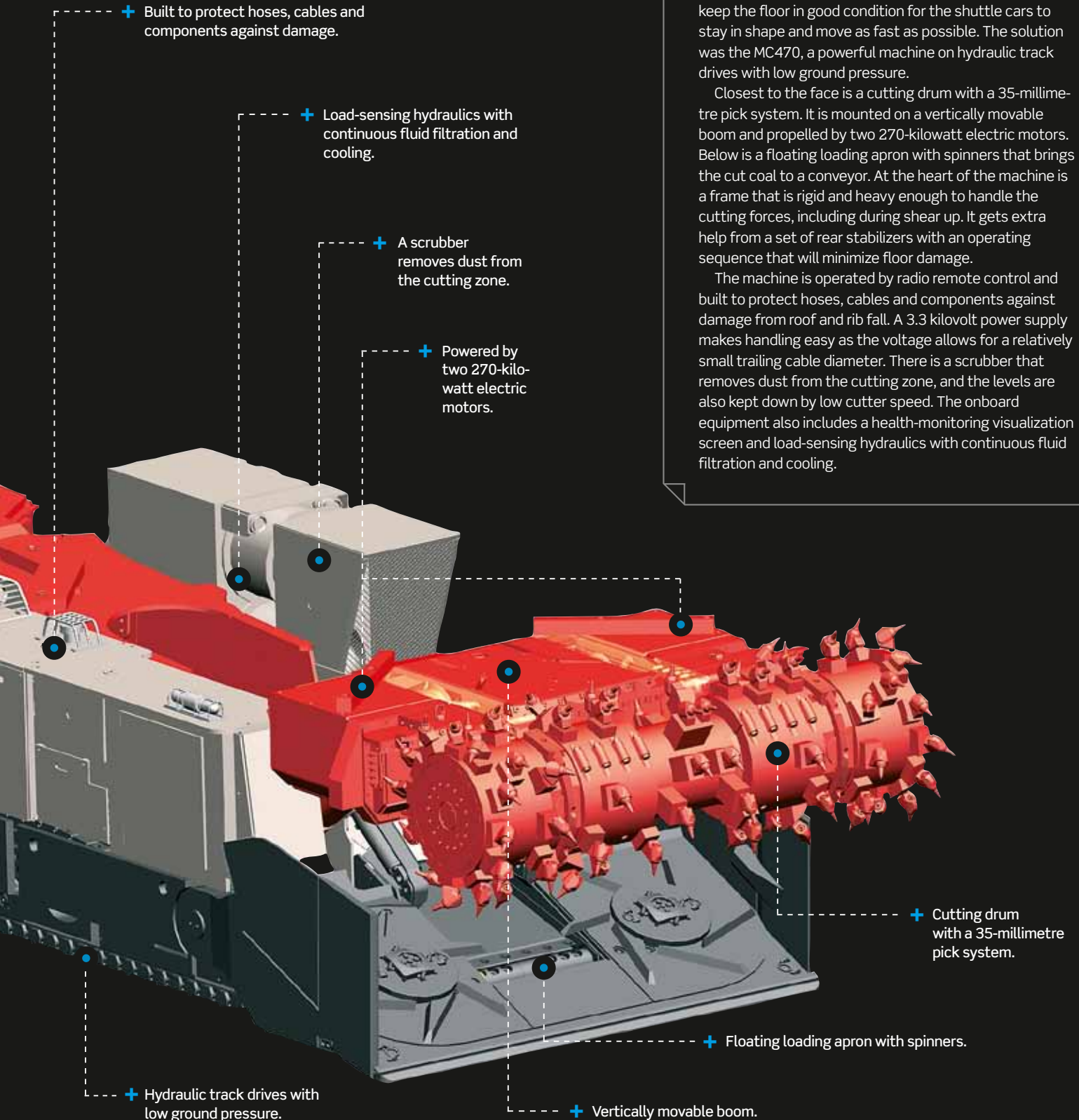
Rigid and heavy frame to handle the cutting forces. +

## Strong and heavy - with a light footprint

• Sandvik Mining was faced with the challenge of creating a flexible continuous miner with maximum productivity for board-and-pillar coal mines. It should also keep the floor in good condition for the shuttle cars to stay in shape and move as fast as possible. The solution was the MC470, a powerful machine on hydraulic track drives with low ground pressure.

Closest to the face is a cutting drum with a 35-millimetre pick system. It is mounted on a vertically movable boom and propelled by two 270-kilowatt electric motors. Below is a floating loading apron with spinners that brings the cut coal to a conveyor. At the heart of the machine is a frame that is rigid and heavy enough to handle the cutting forces, including during shear up. It gets extra help from a set of rear stabilizers with an operating sequence that will minimize floor damage.

The machine is operated by radio remote control and built to protect hoses, cables and components against damage from roof and rib fall. A 3.3 kilovolt power supply makes handling easy as the voltage allows for a relatively small trailing cable diameter. There is a scrubber that removes dust from the cutting zone, and the levels are also kept down by low cutter speed. The onboard equipment also includes a health-monitoring visualization screen and load-sensing hydraulics with continuous fluid filtration and cooling.



“The mines wanted a machine with high productivity and flexibility.”

GERHARD REITER

►► controlled drive system that keeps a straight line. And since the roof where it cuts has not yet been secured, the miners operate it from a safe distance by radio remote control.

So when should you use a continuous miner, and when is a bolter miner the best option? The latter is a single-pass machine that cuts one entry width and bolts the roof at the same time. A continuous miner, however, is designed for multiple passes and cuts many different entry widths. This makes it a more productive option when several entries are cut in parallel, but the bolting must then be done by a separate machine.

In addition to coal mines, the MC470 is also used for potash mining. ■



Product manager  
Gerhard Reiter.



The Sandvik MC470 adds to productivity by increasing operating time.

## Improved production cycle

- The MC470 was first tested in a regular production environment at Xstrata Coal South Africa's South Witbank coal mine in January 2010. The operating conditions included an average mining height of 3.2 metres, a board width of 6.6 metres and 13x15-metre pillar centres. There was also an occurrence of sandstone layers from 5 to 25 centimetres thick, with a uniaxial compressive strength of up to 120 megapascals.

After initial trials to hone the performance of the MC470, production began in the third week of February. This included a new production cycle, facilitated by the machine's ability to shear both up and down. Upward shearing had previously not been an option because the picks could “hook

up” in the face and disturb the operation. That is not the case with this machine, due to its combination of power, weight and design.

During its first year of production, the MC470 produced around 800,000 tonnes of run-of-mine coal. This is 50,000 tonnes more than the current South African average of 750,000 tonnes per year. The encouraging results have led to further orders from South African coal mines, where a total of three machines are now in operation. The machine at Greenside Colliery is constantly producing at record level, peaking at 121,000 tonnes in the month of October 2012 (average production rate: 106,000 tonnes/month). Four more have been ordered by a potash mine in Britain.

## TECH SPECS SANDVIK CONTINUOUS MINER – MC470

A radio remote-controlled continuous miner on crawlers made for maximum productivity in mining applications that demand high cutting force. The MC470 is designed for typical South African board-and-pillar mining as well as potash mines.

Cutting power:	540 kW (2x270 kW)
Cutting width:	3.76 m
Maximum cutting height:	5.0 m
Minimum cutting height:	2.4 m
Drum diameter:	1.3/1.4 m
Loading capacity:	45 tonnes/min
Maximum tram speed:	25 m/min
Total weight:	127 tonnes
Ground pressure:	26 N/cm <sup>2</sup>

A heavy, robust, powerful and flexible machine.



# ARCTIC SAFETY RECORD

Text: **LINDSAY HOLMWOOD**

■ In the face of some of the world's most challenging mining conditions, Sandvik's maintenance team at a De Beers diamond mine in northern Canada has managed to work around the clock without a lost time injury – ever.

**N**orth of the 60th parallel, where arctic winds rip unabated across the Canadian tundra and the sun barely rises in the harsh winter months, a Sandvik maintenance team is working to ensure that the equipment at the De Beers diamond mine operates as it should, and without causing injury.

The team has been working at the Snap Lake mine in Canada's Northwest Territories since 2007. In their nearly six years there, there has never been a lost time injury (LTI) in which an employee had to miss work, even for a day, because of an accident. The reasons for this impressive record are many – extensive safety policies and management systems put in place by Sandvik and De Beers – but it mostly comes down to the awareness and responsibility of the employees.

“Much of the credit goes to the crew and the supervision on site,” says Peter Larsen, vice president of Environmental Health and Safety for Sandvik Mining Americas. “Both companies have systems, policies and procedures in place that support the right thought process when it comes to safety. From there, the front-line team and their supervisors encounter changing situations where they have to decide what to do. We try to put systems and a culture in place to support the right decisions in every situation a worker can face.”

These systems are myriad. The 45-member Sandvik team maintains all

the mobile underground mining equipment and related vehicles at the mine for De Beers, and its members operate under safety policies and procedures put in place by both companies. The policies largely mirror each other with the goal of recognizing, assessing and mitigating risks before things go wrong.

“Both companies share the desire to get to zero harm, which is fundamental in terms of how we approach our day-to-day operations,” Larsen says. “Neither company accepts that an injury is natural in the course of doing business. The awareness, enforcement, coaching and support are there so that employees are trained to be attentive at all times, and at the end of the day we have a safe working environment.”

**B**oth Sandvik and De Beers hold the required certifications and management systems that form the foundation of their safety programmes and ensure that the daily work is being done correctly and safely. But management systems can't cover every conceivable dynamic and condition. Local safety programmes then kick in and close any gap between the management systems and site-specific risks. ►►





**Peter Larsen, VP EHS Sandvik Mining Americas; Neil Miller, Customer Services Sandvik Mining Americas; Marc Stuparyk, Sandvik Mining Maintenance Team Leader; Maxwell Morapeli, Snap Lake Mine General Manager; David Gardner, President Sandvik Mining Americas; Morag Howell, Yellowknife Area Sales Manager; and Glen Koropchuk, COO De Beers Canada, celebrate five years without a lost time injury last year.**

► All employees participate in a daily safety meeting before the start of each day and night shift, and a separate once-a-week meeting. Each employee also has a five-point safety card that poses questions such as these: Are entrances and travel ways in good order? Is the workplace and equipment in good order? And is the work being done safely and properly? The card also encourages employees to perform an act of safety each day, a practice of noticing unsafe conditions such as a power cord that could cause someone to trip.

“Reaching a milestone like this takes a long-term focused commitment to holding each and every employee accountable for their personal safety and that of their co-workers, from the workers on the maintenance floor to senior management,” says Cathie Bolstad, director of external and corporate affairs for De Beers Canada.

**T**he team also uses a system called Risk Assessment Training to assess risk, as well as a Big Five Task Assessment, in which employees answer 10 questions about their jobs and job sites before working to identify risks and correct unsafe conditions. Before the start of each job, employees receive a safe work plan outlining the procedure for a specific job or a repair.

“Historically in the mining industry there are lost time injuries, and maintenance is usually one of the key areas where there are accidents,” says Marc Stuparyk, the project manager for Snap Lake maintenance. “But with the safety programmes put in place by Sandvik and De Beers, we are very

safety-conscious so that there is no job we do that’s unsafe. We don’t put our people in harm’s way.”

This is an understatement. Not only has Sandvik gone nearly six years without a lost time injury, but the only incident of note in that time was when an employee fell and needed three stitches on his elbow. He returned straight to work.

**M**ining is known to have certain risks, and public perception is that it is a highly uncontrolled environment,” Larsen says. “The reality is that risks can be managed and mitigated. We don’t want to see people hurt. There’s no value in a product that has human suffering associated with it.”

Both Sandvik and De Beers have had to work hard to reach this point, battling a number of challenges that on their own would pose safety risks, such as cold, windy weather and soft ground conditions.

The Sandvik employees working at Snap Lake, the first true underground diamond mine in Canada, are flown in for 12-hour shifts for two weeks, followed by two weeks off. There is no commercial airport nearby, another reason why maintaining a safe operation is of paramount importance.

“De Beers is committed to mining diamonds safely, securely and profitably, without harm to people or the environment,” Bolstad says. “To achieve that goal, it’s essential to have business partners who share that same principle.”

Sandvik has had other mining sites with impressive safety records, but Snap Lake is special because of the successful partnership between the two companies, which began in 2004 as De Beers was

## About Snap Lake Diamond Mine

- Located in Canada’s remote Northwest Territories on the shore of Snap Lake, Snap Lake Diamond Mine is De Beers’ first mine located outside Africa and Canada’s first true underground diamond mine. It boasts an annual processing capacity of 1.1 million tonnes and a recoverable ore grade of 1.2 carats per tonne, resulting in a production capacity of approximately 1.4 million carats of diamonds each year.

The mine began commercial production in 2008 and has an estimated life of more than 20 years. The Snap Lake ore body is a 2.5-metre-thick dyke that dips an average of 12 to 15 degrees from the north-west shore down under the lake. It is unlike most diamond-bearing kimberlite deposits, which are known as ‘pipes’ because of their conical or carrot-like shape.

## “Risks can be managed and mitigated.”

PETER LARSEN, VP OF EHS FOR SANDVIK MINING AMERICAS

searching for a supplier partner.

“De Beers didn’t talk about equipment or money involved for the longest time,” Larsen says. “When we were approached, the question was more ‘Can we get married, and if we do can we get along?’”

The two companies did a thorough evaluation to see if the cultures and values would mesh, allowing them to get along. Ultimately, the companies aligned closely, and while there have been ongoing changes in staff, management, resources and the economy, the culture and safety focus have thrived.

“We’re still married, and we’re doing just fine,” Larsen says. ■





# Keeping it moving

MÄNS BERG

**F**or more than a century, belt conveyor systems have helped minimize human labour in industrial applications ranging from automotive to agricultural.

While belt conveyor systems have been widely used to continuously transport ore in some mines, truck haulage has traditionally been the industry favourite.

But as mines go deeper and trucking distances and associated costs continue to climb, conveyors are proving an attractive alternative for many operators, says Craig Wheeler, associate professor in the School of Engineering at the University of Newcastle in Australia.

“The scales of new mining operations are resulting in unprecedented demands for greater haulage lengths, lifts and, of course, capacity,” says Wheeler, who began a career with BHP Billiton in 1989 as a cadet mechanical engineer and earned extensive belt conveying experience working in maintenance, operations and design posi-

■ Advances in belt conveyor technology over the years have led many mines to reconsider whether traditional truck haulage is always the best option for transporting materials.

Text: **ERIC GOURLEY**

tions at BHP’s Newcastle steelworks for more than a decade.

As bulk materials handling by roller-supported rubber belts has become more articulate and mobile over the years, conveyors have started to replace an increasing percentage of road truck haulage.

Today, conveyors work closer to the face behind blast and load operations than ever before. In many underground coal mines, conveyors are employed practically from the moment the

coal is liberated from the face.

While early mining industry applications were primarily short in-plant conveyors, single flight conveyors tens of kilometres long can today move up to 20,000 tonnes per hour at speeds of more than 9 metres per second.

**C**onveyor technology, from components to capabilities, has developed continuously since the first systems were employed in the mining sector in the early 1900s. Today’s

## 20

Maximum degree of grade that overland conveyors can effectively traverse.



## “Belt conveyors have clear operational advantages.”

►► intelligent conveyor designs drastically reduce friction and rolling energy losses. Optimized trough shapes and pronounced curvatures are now common. In-plant and underground conveyors have become more adaptable and are able to negotiate tighter corners. Higher-quality materials have improved operability and increased the life expectancies of today’s overland conveyors to more than 30 years in some cases, reducing

capital and operating costs even further in new mines.

**W**heeler says conveyor systems offer distinct advantages over truck haulage in efficiency and environment.

“Belt conveyors being continuous, rather than a batch transportation system, are used wherever they are technically and economically feasible,” says Wheeler, who undertook his



**Craig Wheeler,**  
associate  
professor at  
Australia's  
University of  
Newcastle

doctoral studies in belt conveying. “With the demand for more and more automated mining operations, belt conveyors have clear operational advantages.”

Overland conveyors can be routed more directly than haulage roads and can effectively traverse grades of up to 20 degrees, while haulage road systems are often limited to less than 5 degrees. Conveyors carry more material per hour over longer distances and at



**Sandvik has designed, manufactured and installed conveyors for many years, such as this horizontally curved, conventional troughed overland system in South Africa.**

## The wide world of conveyors

**SANDVIK IS CREDITED** with engineering the first steel belt conveyors in 1902. Today Sandvik designs, manufactures and installs complete conveyor systems in mining operations around the globe.

“Sooner or later, every mine, every crushing plant, every processing plant will involve conveyors if it doesn’t already,” says Thomas Jabs, vice president product lines, Sandvik Mining Systems.

Long overland conveyors in Australia form the backbone of many mining operations and cooperate with the natural lie of the land, while shorter in-plant systems across Europe and South America feature large capacities and can include belt feeders, high-angle conveyors and totally closed conveyors.

“Many mines investigate how quickly they can introduce conveyors to replace some of their expensive trucks,” Jabs says. “We have a mine planning group to help operators determine at what point it becomes feasible to make the investment to replace trucks with conveyors.”

Important factors to consider include mine life, geology and deposit shape, scheduled material tonnage rates and the price of diesel fuel versus electricity.

“Every mass mining operation will eventually ask those questions, especially new mines,” Jabs says.

In addition to popular overland and in-plant systems, Sandvik offers innovative mine conveyors, compact-type conveyors, apron feeders and special conveyors that overcome differences in elevation.

“Our internal factories produce all conveyor components, including rollers, pulleys and other integral parts of



MANS BERG

conveyor systems,” Jabs says.

Solutions for opencast mines also include semi-mobile, shiftable and fully mobile track-mounted systems tailored to operator needs. Sandvik is now answering more demands for underground conveyor applications, which frequently involve extreme operating conditions.

“We’ve long served the global mining industry with conveyors for surface mining and materials handling applications, but we’re transforming into a major player in underground conveyor haulage too,” he says.

Jabs also notes the ever-increasing popularity of in-pit crushing and conveying (IPCC).

“It’s an efficient way to move part of the processing plant into the mine, bringing it closer to the shovel, to the face, so that trucks don’t have to travel a long distance to a processing plant outside a mine,” he says. “Conveyors are an integral part of each IPCC system, and they’re the crucial link between primary crushers and spreaders.” ■

“Our internal factories produce all conveyor components, including rollers, pulleys and other integral parts of

**Today’s conveyor components are far more advanced than their century-old predecessors.**



**Thomas Jabs, vice president product lines, Sandvik Mining Systems**

higher speeds, increasing efficiency and reducing operating costs.

Conveyors also offer distinct environmental advantages over trucks. A conveyor belt in the average mine uses one-fifth as much energy as a heavy truck, reducing carbon dioxide emissions. Trucks burn diesel on empty return hauls, while conveyors haul material continuously. Conveyors are also quieter, generate less dust and consume less land.

Each mine’s operational needs are unique, and Wheeler says different factors should be analyzed to determine whether ore might best be transported using belt conveyors, trucks or a combination of the two.

Conveyors carry a high cost per metre, and many operations that lack fixed haulage distances will always require the mobility of trucks, he says. Some mines have learned to combine the flexibility of trucks conducting level

haulage with the lower operating costs of conveyors for primary haul out of a pit.

“Choosing the appropriate bulk handling system depends on transportation distance, throughput and terrain, among other things,” Wheeler says. “Research has shown belt conveyors are generally more cost-effective on a life-cycle cost basis than both road and rail transport for throughputs up to 5 million tonnes per annum over horizontal conveying distances up to 40 kilometres.” ■

# A rare gem

**Its unusual crystals and mode of occurrence distinguish tridymite from all other minerals.**

Photo: FRED KRUIJEN

● Since the silicate minerals compose about 95 percent of the Earth's crust and upper mantle, you might think they're all rubbish. Well, look again and look closely.

Tridymite is a silica mineral ( $\text{SiO}_2$ ) not only valuable to collectors but also used in scientific study.

This rare and distinctive mineral's crystals are usually microscopic; the largest are under 1 cm long and very thin. Here you see tridymite aggregate from Ettringer Bellerberg in Germany's Eifel Mountains with an image width of only 2.5 mm.

Yet they provide key information on how crystals form and how they change in different environments. Tridymite is also synthetically produced to make refractory

ceramics for linings in equipment such as hot stoves, open-hearth furnaces and blast furnaces used in smelting to produce industrial metals.

Tridymite is actually more common as a component of opal than as an individual mineral. The play of colours in opal arises from the diffraction of light from sub-microscopic layers of regularly oriented silica spheres.

Its unusual crystals and mode of occurrence distinguish tridymite from all other minerals.

Some of the finest examples are from the Euganean Hills in Italy. Other localities include Lyttelton Harbour in New Zealand, Cornwall in England, the Northern Slanske

Mountains in Slovakia and Pachuca in Mexico.

In the US, tridymite occurs in the Thomas Range in Utah; the Obsidian Cliff in Yellowstone National Park, Wyoming; and Mt. Lassen in Lassen Volcanic National Park, California, among other places.

Tridymite is a high-temperature polymorph of quartz and usually occurs as minute tabular white or colourless pseudo-hexagonal crystals, or scales, in cavities in acidic volcanic rocks.

The mineral was first described in 1868 and given its name from the Greek *tridypos* for triplet, as tridymite commonly occurs as twinned crystal trillings. ■

ANDERS LINDGREN



## High utility factor

**SUPREMELY MULTIFACETED:** Silica is extremely versatile and used in an almost endless range of applications. A silica-based aerogel was used in the Stardust spacecraft to collect extraterrestrial particles. Down on Earth it may be used in the extraction of DNA and RNA. In pharmaceutical products, silica aids powder flow when tablets are formed.

You can also find it in toothpaste as a hard abrasive to remove tooth plaque. In cosmetics, it is useful for its light-diffusing properties and natural absorbency. Food and beverage industries use colloidal silica as a wine- and juice-finishing agent. In its capacity as a refractory, it is useful in fibre form as a high-temperature thermal protection fabric.

**Microscopic crystal of the thin, colourless silicate mineral tridymite.**

# Excellence in innovation

Find the complete range at [mining.sandvik.com](http://mining.sandvik.com)

Sandvik Mining's complete portfolio of innovative equipment pushes the boundaries of modern mining machinery to help operators **improve safety and productivity** in today's increasingly competitive environment.

## ROCK TOOLS AND SYSTEMS

**Deep impact.** Sandvik offers the world's most comprehensive range of tools for exploration, rock drilling, raise boring, coal cutting, mineral mining, tunnelling, trenching, road grading and cold planing. As world leaders in steel and cemented carbide technology, our products have revolutionized the rock drilling industry, while our advanced tool systems for machines raise productivity sharply.



## DRILL RIGS AND ROCK DRILLS

**Know the drill.** Sandvik rock drilling equipment is renowned for quality, reliability and productivity. Every machine we make is designed to give the lowest possible cost per foot drilled and a low life-cycle cost. To meet the needs of all customers, we offer a wide choice of machines, ranging from robust and simple drill rigs to semi-automated units that give extraordinary production rates and low total cost.



## LOAD AND HAUL MACHINES

**The powerful loaders.** Sandvik underground loaders and haul trucks are extremely productive and reliable. They are vigorous and highly manoeuvrable, offer enormous capacity for their size and return a very low cost per tonne.



## CONTINUOUS MINING AND TUNNELLING

**Keep on going.** Sandvik continuous mining and tunnelling equipment reflects the unique advantages of total in-house control over the machines and their cutting tools alike. Optimized cutting technology and machine design result in high productivity, long service life and low total costs.



## CRUSHERS AND SCREENS

### Maximum size reduction.

Sandvik crushing and screening equipment is engineered for productivity. We offer advanced solutions for any size-reduction challenge, stationary or mobile. We can upgrade existing plants, deliver complete solutions and effect turnkey installations. We also supply individual crushers and screens, as well as key components and a wide range of consumables.



## CONVEYOR COMPONENTS

### Roll it up.

Sandvik focuses on developing and manufacturing conveyor components to meet customer needs in mining applications. Sandvik's complete offering supports modern mining practices and includes rollers, frames, pulleys and belt cleaners, safety and control devices, and dust control systems. With an emphasis on performance and reliability, they are easily available through the global Sandvik network both as original components and as replacements in existing systems.



## BULK MATERIALS HANDLING EQUIPMENT

### Total handling.

Sandvik has the long-term experience to design, manufacture and install virtually any kind of bulk materials handling system. From mining systems on surface and underground to integrated stacking and reclaiming systems for mines, terminals and port facilities, we offer total solutions and turnkey installations. We also offer a wide range of conveying equipment and quality components for plants, as well as upgrading and modernization services.



## BREAKERS AND DEMOLITION TOOLS

### Hit harder.

Sandvik demolition tools make short work of difficult breaking and demolition jobs. They are optimized to deliver high-impact cutting or crushing force. With high power-to-weight ratios, easy interfaces and simple connections, they transform a wide range of excavators into highly productive demolition machines.



## MINE AUTOMATION

### Total control.

Sandvik has a deep understanding of modern mining operations and of how automation of loading and hauling processes can contribute to safer, more efficient transport.



## SAFETY AND ENVIRONMENT

### Keep it safe.

Sandvik focuses on the environmental, health and safety aspects of all its products, but some are designed especially for safety. An example is the broad range of products for fire protection.



**Thoralf Klehm**, vice managing director at the Polish coal mine PG Silesia, is responsible for the safety of the employees and keeping productivity increases on track.

# HOW DID PG SILESIA IMPROVE BOTH SAFETY AND PRODUCTIVITY? **THIS WAY!**

When you are in the mining business, you know that an improved safety record means a lot to your employees, their families and your company.

This safety mind-set is part of everything we do – from research and product development to on-site service.

Read the story about PG Silesia and join the movement towards  
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