

SOLID

#1.2014

GROUND

A MAGAZINE FROM SANDVIK MINING

Safety in Peru:
**Partners
in progress**

New +Range:
**Rock tools
of the future**

◆ At the Rampura
Agucha zinc mine
in India.

**INDIA:
Rampura Agucha**

ZINC IN SYNC

Sandvik DD211 jumbo: **Slick style** Canada: **Deep freeze**



Dear reader,

INNOVATION AND TECHNOLOGICAL

evolution are set to play an increasingly important role in the future of mining.

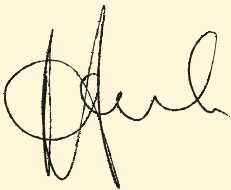
Sandvik is therefore seeking to work even more closely with its customers in helping them to address the challenges they face and improve safety and cost-efficiency through automation and other smart services and products.

With the challenging market conditions that the mining industry has been experiencing for the past couple of years set to continue for some time yet, Sandvik is continuing to take resolute action to become an even stronger solution provider to its customers.

YOU'LL FIND INFORMATION about just some of our latest innovative developments – as always, designed with safety and productivity in mind – in this issue of *Solid Ground*, including the Sandvik DD422i and Sandvik DD211 jumbos and our new Sandvik +Range rock tools.

There's also coverage of a visit to India and the world's largest zinc operation and an insight into the unique process by which a Canadian company extracts ore from the world's highest-grade uranium body.

I HOPE YOU ENJOY learning about our latest exciting developments and discovering how Sandvik can help you to meet not only today's challenges, but those of the future also.



GARY HUGHES
PRESIDENT
SANDVIK MINING



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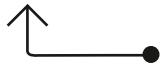
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Precise performance in narrow places with Sandvik DD211.

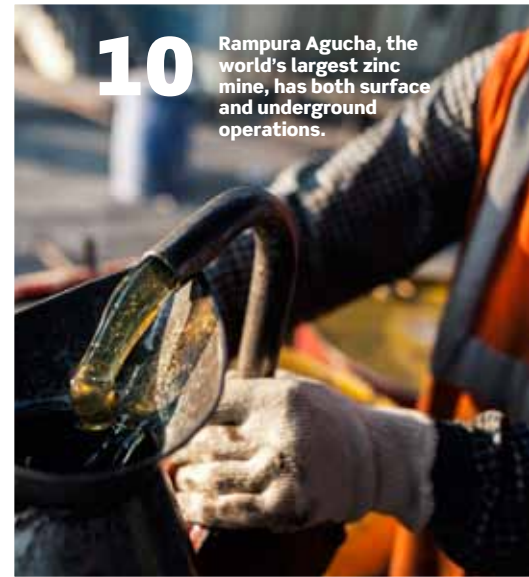


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Carnival in a Romanian salt mine.

Tailored credit options



● Customers purchasing new Sandvik equipment can now benefit from customized credit packages. Sandvik Credit, a wholly owned subsidiary of the Sandvik Group, is a new in-house financing service that offers customers competitive interest rates, flexible finance terms and conditions, and the benefit of working with a finance provider that understands their industry.

Export credit transactions are available in most countries and can be offered anywhere on a case-by-case basis.

“Our understanding of the customer’s business enables us to quickly approve a finance package that is tailored to their needs,” says Angelica Adamski, global manager for Sandvik Credit.

High-tech acclaim

● The automatic cutting software system from Sandvik has won the New South Wales Minerals Council’s Mining Technology Award. The technology was designed for the Mandalong mine in Australia.

Since the technology was introduced at the mine in 2009, slips, trips and falls have decreased by 60 percent, while monthly production has improved by more than 200 percent. All Sandvik bolter miners can be upgraded to the automatic cutting system with a small software upgrade and the implementation of a mine-site-based process control.



Rowan Melrose,
president PA Mining
Automation,
Sandvik Mining.

LIFETIME OPTIMIZATION

● Optimization can lead to substantial savings and dramatically increase profits from massive capital machines in mines and large-scale bulk materials handling operations. For this reason, Sandvik has developed an after-sales optimization service that extends a plant’s lifespan.

“Our after-sales optimization service is designed to increase volumes processed and add years to the life of the equipment,” explains Rudi Pieterse, Sandvik market development and sales manager. “It also helps to prevent breakdowns and minimizes downtime of a plant.”



+ Paulsens gold mine has the third-highest grade of any gold mine in Australia.

Star performance

● Northern Star Resources’ Paulsens gold mine has rapidly emerged as one of Australia’s most promising gold producers.

“Sandvik equipment and service have helped us achieve this performance,” says Bill Beament, Northern Star’s managing director.

When Northern Star acquired the mine in 2010 Beament added a new Sandvik DD421 jumbo and a new Sandvik DL431-7 long hole production drill to the machine fleet. “The choice of the two new Sandvik rigs was a no-brainer,” he says. “These are simply the best development and production drills available anywhere in the world.”

Northern Star’s new jumbo is delivering 86 percent availability, and two months after its arrival the company broke site records for metres developed, along with both development ore and waste tonnes broken and trucked. Both Sandvik DD421 and DL431 are performing well in excess of the equipment they replaced.

“Within 18 months we had managed to double production and at the same time reduce production costs by more than 20 percent,” Beament says.



Sandvik CMS can be installed on any Sandvik rotary drill rig.

Compressor Management System cuts fuel consumption

● The patented Sandvik Compressor Management System (CMS) can reduce fuel consumption by 20 to 35 percent, extend engine and compressor life and lower emissions. The CMS can be installed on new or existing Sandvik rotary drills.

To put it to the test, Sandvik Mining teamed up with Cloud Peak Energy, one of the largest coal producers in the United States. The result was a 26.2 percent reduction in diesel consumption, translating into significant

savings of about 24,000 gallons of fuel worth more than 100,000 US dollars, and a reduction of more than 300 tonnes of carbon emissions annually from fuel alone. Additional savings are expected from increasing the engine life.

“As part of our environmental stewardship programme we work to reduce fuel use and emissions,” says Mark Gilbertson, director of asset management for Cloud Peak Energy. “The CMS will save us thousands of gallons of fuel every year.”

In the pink

● October was National Breast Cancer Awareness Month in the United States. To show support, employees from the Sandvik production unit in Alachua, Florida, gave a total makeover to a drill rig parked outside the facility.

"It's about being part of the community," says Ken Stapylton, Sandvik Alachua site director and vice president surface drills.

"Breast cancer affects us here and around the world. We want to be a part of that global awareness."

National Breast Cancer Awareness Month was founded in 1985 to promote mammography. The pink ribbon was established in 1993 when Evelyn Lauder, senior corporate vice president of Estée Lauder, founded the Breast Cancer Research Foundation.



THE QUOTE

“Sandvik 1175E rotary drill exceeded our performance expectations and is more efficient than the domestic drills we currently have on site.”

Xiaobin Luo, deputy team leader of on-site operations, Xichang Mining, Chongqing Iron and Steel Co Ltd, which acquired the first Sandvik 1175E rig in December 2012.

Comfy cabins

● Sandvik Mining recently launched ROPS- and FOPS-tested acid-proof versions of its iron cabins. They are designed for use in underground mining and can be used on the full range of new Next Generation drill rigs.

Although the acid-proof cabins look identical to the new iron cabins, they offer a number of safety, ergonomic and technical benefits, according to Kai Närvänen, Sandvik project manager. “They have better air ventilation and a better air cooling and warming system than in older versions of the cabin,” he says. “In addition, it’s quieter inside the new cabins.”



The view from a quieter cabin.

75,000

Australian dollars, the amount the Sandvik Mining fundraising team contributed when participating in the “Ride to Conquer Cancer” event to raise money for the Western Australian Institute for Medical Research (WAIMR). The 2013 event generated a total of more than 5 million Australian dollars (4.5 million US dollars) for cancer research.

INTELLIGENT DEVELOPMENT

● As mines go deeper over the next 25 years, new challenges will arise. The new Sandvik DD422i underground jumbo meets these demands.

“Our forthcoming Sandvik DD422i development jumbo provides a clear direction to the future of mining, incorporating a wide variety of new features for more efficient drilling,” says Alain Comorge, Sandvik product line manager, underground development drills.

The mining jumbo is the first of the Next Generation underground hard rock drill rigs from Sandvik, and also the first with an intelligent control system.

“DD422i development jumbo will be compatible with Sandvik AutoMine Drilling fleet and information management system

and will be the most advanced underground mining drill on the market,” Comorge says.

DD422i offers the widest range of automated features on the market, including new drilling and boom control systems, full face drilling automation and drill rig navigation and industry-leading drill planning, analysis and optimization systems. Other key features are a “human detection system,” readiness for tele-remote-operated functions, a ROPS/FOPS canopy, a redesigned and larger cab, improved visibility, brighter LED lighting and reduced noise, heat and dust levels.



+ Sandvik DD422i underground development drill is automation-ready.

ABOUT SIMON CSABA

TITLE: Maintenance department chief at Bükkkábrány lignite mine
COMPANY: Mátrai Erőmű Zrt
AGE: 46
LIVES: Miskolc, Hungary
FAMILY: Single

Mátrai Erőmű (Mátra power plant) operates a 950-MW coal-fired power plant in north-eastern Hungary. The company mines around 8.5 million tonnes of lignite annually.

MAN AND MACHINE

AT MÁTRAI'S BÜKKÁBRÁNY mine in Hungary, the world's largest compact bucket-wheel excavator, Sandvik PE100, extracts lignite with an annual capacity of around 12 million cubic metres. Simon Csaba, maintenance department chief at Mátrai, fondly remembers the excavator arriving on site.

WHY DID YOU CHOOSE TO WORK IN THE MINING INDUSTRY?

Ever since my childhood I've been fascinated by mechanics. That's the reason I chose a technical direction both in secondary technical school and at university. I had the fortune to do my university summer training here in the Bükkkábrány mine. It was a very positive experience, and there was never any question of where I wanted to work when I finished my studies.

WHAT ARE YOUR RESPONSIBILITIES AT THE MINE?

I'm chief of the maintenance department at Mátrai's Bükkkábrány lignite mine. It's my job to oversee the operation and the maintenance of all the machines in this mine. I'm also responsible for establishing new acquisitions on site.

WHAT KIND OF RELATIONSHIP DO YOU HAVE WITH SANDVIK?

I first met Sandvik as a project leader when we bought two Sandvik machines for the Bükkkábrány mine in 2007. We installed a Sandvik PE100, the world's largest compact bucket-wheel excavator, and a PB100 beltwagon. Since then it's been an ongoing partnership.

WHAT DO YOU ENJOY MOST ABOUT YOUR JOB?

It's surprisingly varied. Every day brings fresh challenges, although some of the work is routine. In my line of work I get to meet an interesting mix of companies and people. My colleagues are highly skilled, and I've made a lot of friends.

Mátrai's maintenance department chief Simon Csaba stands on the crawlers of a Sandvik PE100 bucket-wheel excavator.

Safety note: The machine is fully shut down and has been prepared for a routine maintenance check.

GETTY IMAGES



The hotel sits in the middle of the desert, but close to China's rare earth miners.

New ancestor discovered

● The fossilized jaw of a tiny primate that lived about 35 million years ago has been unearthed in a coal mine in Krabi, Thailand. A recent excavation of the mine turned up a number of fossils, including part of a jaw and teeth from the creature, dubbed *Krabia minuta*. Based on the tooth geometry, the research team believes the *Krabia minuta* is part of a group called amphipithecids, an extinct group of anthropoids that once lived in Southeast Asia.



Orangutans are another close relative of humans.

Luxury for desert miners

● A luxury resort in the middle of the Mongolian desert? A crazy idea - if the Desert Lotus Hotel hadn't been built just outside the city of Baotou, capital of China's booming rare earth industry.

Chinese mines, such as the ones at Bayan Obo, near Baotou, produce more than 90 percent of the world's rare earth elements (REEs). There are 17 elements officially listed as REEs, including scandium, yttrium and europium. REEs are vital to the

electronics industry, and worldwide demand is constantly increasing. So the Desert Lotus Hotel might not be such a bad idea after all. But building a 30,000-square-metre resort on sand proved to be a challenge for the architects and engineers.

Desert Lotus doesn't have a traditional foundation, and no cement or water was used during construction. The building rests on a flat metal base filled with sand, which keeps it stable.



Greenland's hidden wealth

● Exploration companies are flocking to Greenland to take advantage of its untapped potential wealth. One company that has shown some success in its exploration activities is North American Nickel (NAN), which has been drilling for nickel sulphide and copper deposits at its Maniitsoq Project, in an area that is notoriously challenging due to its rugged terrain.

These promising findings have helped it secure financing for follow-up drilling. In addition, the local authorities have increased NAN's total exploration area to 5,106 square kilometres.

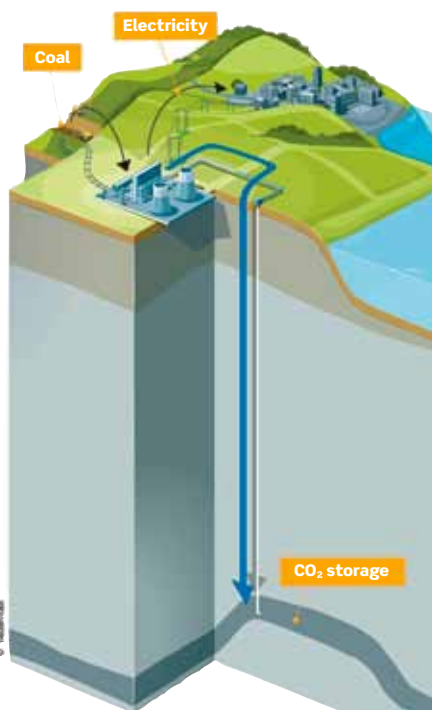
Greenland's ice-free coastal areas contain mineral belts that are believed to be highly prospective for gold, copper, lead, zinc, iron ore and even precious gemstones such as diamonds and rubies. Keen to expand Greenland's resource sector, the local government has increased the number of active exploration licences sixfold since 2002.

Cleaner coal in Canada

● When it begins operations, the new 110 MW coal-fired boiler with full carbon capture and storage (CCS) at the Boundary Dam power plant in Canada's Saskatchewan Province will be one of the first large-scale CCS coal-fired power plants in the world.

A 1.16 billion US dollar government-industry investment, the project is significant for economic and sustainability reasons. Not only has it been designed to bring down the costs of CCS, it aims to produce electricity from coal while emitting two and a half times less CO₂ than a modern gas plant.

The CO₂ from the plant is to be sold for enhanced oil recovery, and the sulphur dioxide will be converted for sale as sulphuric acid. SaskPower, the plant's operator, is establishing a Global CCS Consortium to share the knowledge.



Reliable warnings with 3D maps

● Slope failure is a constant risk factor in many open pit mines, and monitoring and warning systems have often been inaccurate and prone to give false alarms. But in the Orapa diamond mine in Botswana, a new integrated mine-monitoring system has helped to increase safety and reduce false alarms.

SiteMonitor, developed by 3D Laser Mapping, is a slope-monitoring system comprising a laser scanner and powerful monitoring software.

Unlike radar solutions, the 3D system uses a measuring laser technique that separates movements in the wire mesh covering pit walls for safety from actual slope movements that might be hazardous.



Pilbara once on its own

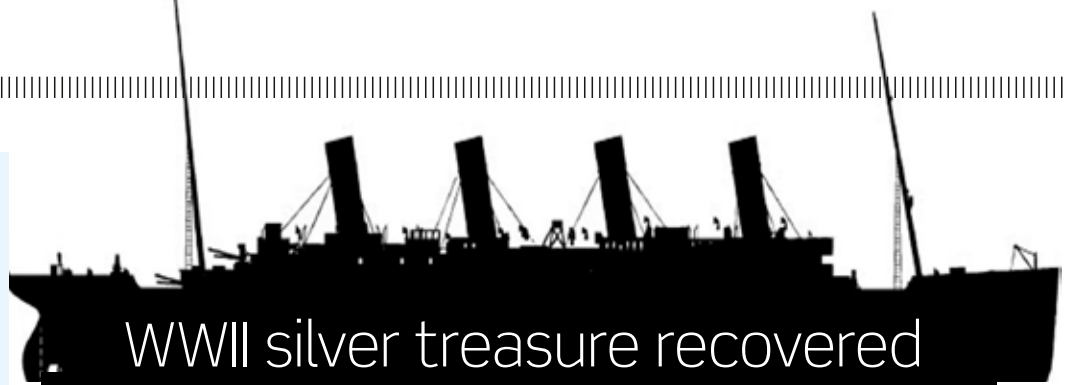
● The iron-ore-rich regions of Pilbara and Yilgarn Cratons in Western Australia were once a small continent about the size of Japan, according to a study backed by the Geological Survey of Western Australia.

According to geologist Simon Johnson, central Western Australia was formed by remnants of tectonic plates that crashed. Until now, geologists have had to rely on aerial magnetic surveys and data generated by mining firms exploring for potential mineral deposits. Johnson and his team applied a new method, based on data from geophones laid manually on the ground, and they have shed new light on the Earth's early history.

Partnership for precious stones

● The east African nation of Mozambique has sought help from Angola to jumpstart its diamond industry. A survey eight years ago found diamonds, but geologists are not sure where they are exactly.

The two countries signed a cooperation agreement on mining and geology in 2007, and now Angola, which has more mining experience, will help Mozambique locate its diamonds.



WWII silver treasure recovered

● From depths deeper than where the *Titanic* rests, a 100-tonne silver treasure has been recovered. The silver, worth 150 million British pounds (250 million US dollars), is the largest quantity of precious metals ever recovered from such depths.

The cargo was salvaged from the wreck of the British ship *SS Gairsoppa*, sunk by a German torpedo 300 miles off the west coast

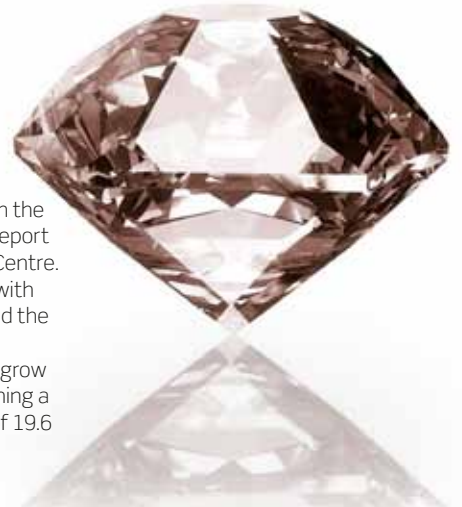
of Ireland in 1941. The recovery mission was conducted by US salvage firm Odyssey Marine Exploration, which was contracted by the British government. Under the contract, Odyssey will keep 80 percent of the silver.

The rest will go mainly to Britain's Treasury, with a small amount going to the intended receiver – the Royal Mint, which will issue commemorative coins from the ship's silver.

Diamond output peak

● Rough diamond production will increase significantly in the coming years and will peak in 2018, according to a new report from Bain & Company and the Antwerp World Diamond Centre.

A steady market in the United States in combination with growing demand in China and India are key factors behind the forecast in the *Global Diamond Industry Report 2013*. The authors believe that rough diamond production will grow at an average rate of 4.8 percent a year until 2018, reaching a peak production level of 169 million carats and a value of 19.6 billion US dollars.



Outside the mine site of Kazakhmys' copper mine in Zhezkazgan, Kazakhstan.

Kazakhstan attracts investors

● Kazakhstan's mining industry has been growing constantly since 2005. Its value is expected to reach close to 30 billion US dollars by 2017, according to a report by Business Monitor. Coal, gold and copper account for the majority of the value. Coal production is one of the core industries for Kazakhstan, employing around 40,000 people in the mineral-rich province of Karagandy alone. The

country's mining boom is now attracting investments from global giants such as Rio Tinto, which is committed to investing USD 100 million in exploring for copper in northern Kazakhstan.

Kazakhstan, bigger than all of Western Europe, also holds huge reserves of uranium, chromium, lead, zinc, manganese, iron, diamonds, petroleum and natural gas.

THE QUOTE

“The Covergall is not only a better fit than a regular coverall, but it’s safer.”

After more than a decade in the Canadian mining industry, Alicia Woods of Sudbury, Ontario, got tired of wearing ill-fitting coveralls designed for men. She decided to do something about it.

The result: the Covergall, workwear in a fire-retardant material for the growing number of women working underground.



COVERGALLS, FUEL MULTIMEDIA

THE BIDS START AT...

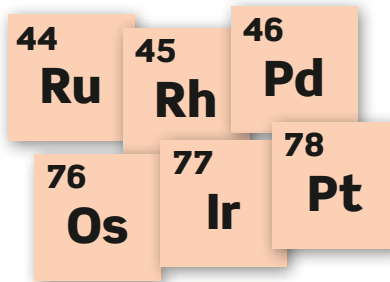
● A 50 percent stake in the world’s biggest iron ore deposit is up for grabs. In 2013 the Bolivian government declared it was open for tenders for the Mutún deposit, located near the border with Brazil.

Estimates indicate that Mutún contains 20 billion tonnes of iron ore. To put that in perspective, all of India’s iron ore deposits add up to 28.5 billion tonnes.

Mutún would be Bolivia’s first integrated steel facility and its largest foreign investment.



Iron ore being transported in railcars.



Platinum recycled from cars

● As global demand for platinum group metals (PGMs) rises, so too does the cost of extracting it. With usage of catalytic converters increasing globally, automotive manufacturers are in a bind as to where to obtain PGMs. Recycling catalytic converters is an option. However, the current recycling process takes around six months.

The Canadian company Pro-Or has come up with a new chlorination process to recover PGMs from recycled automobile catalytic converters that takes less than eight weeks at its small-scale prototype plant. The time required could be shortened to just one or two weeks when it moves to a larger facility.

The Expert

RUTH BATSON is the executive director and CEO of the American Gem Society (AGS) and AGS Laboratories in the United States. In both 2012 and 2013, *JCK Magazine* included her in its list of the industry’s most powerful leaders.

Q: Why are diamonds so popular and pricey?

A: Diamonds have been marketed to represent the rarity of true love. Their physical and optical properties also make them popular, and their hardness [10 on the Mohs scale] is unmatched compared with other gemstones.

People pay so much for diamonds because of their historical and romantic context. Also, diamonds take a lot of effort to source, extract and process. To recover a single rough diamond weighing 1.00 carat, a mine must process approximately 20 tonnes of overburden.

Q: What are diamonds used for?

A: Diamonds have a variety of uses, as well as being decorative. Their uses range from coatings for files and drill bits to computer processors as a heat sink to prevent overheating and scalpels for the medical industry.

Q: How has the industry addressed the issue of conflict diamonds?

A: The Kimberley Process, launched in 2002, regulates 99 percent of the rough diamond trade worldwide, through a system of import and export controls that prevent conflict diamonds from entering the legitimate supply chain.

Q: What are “space diamonds?”

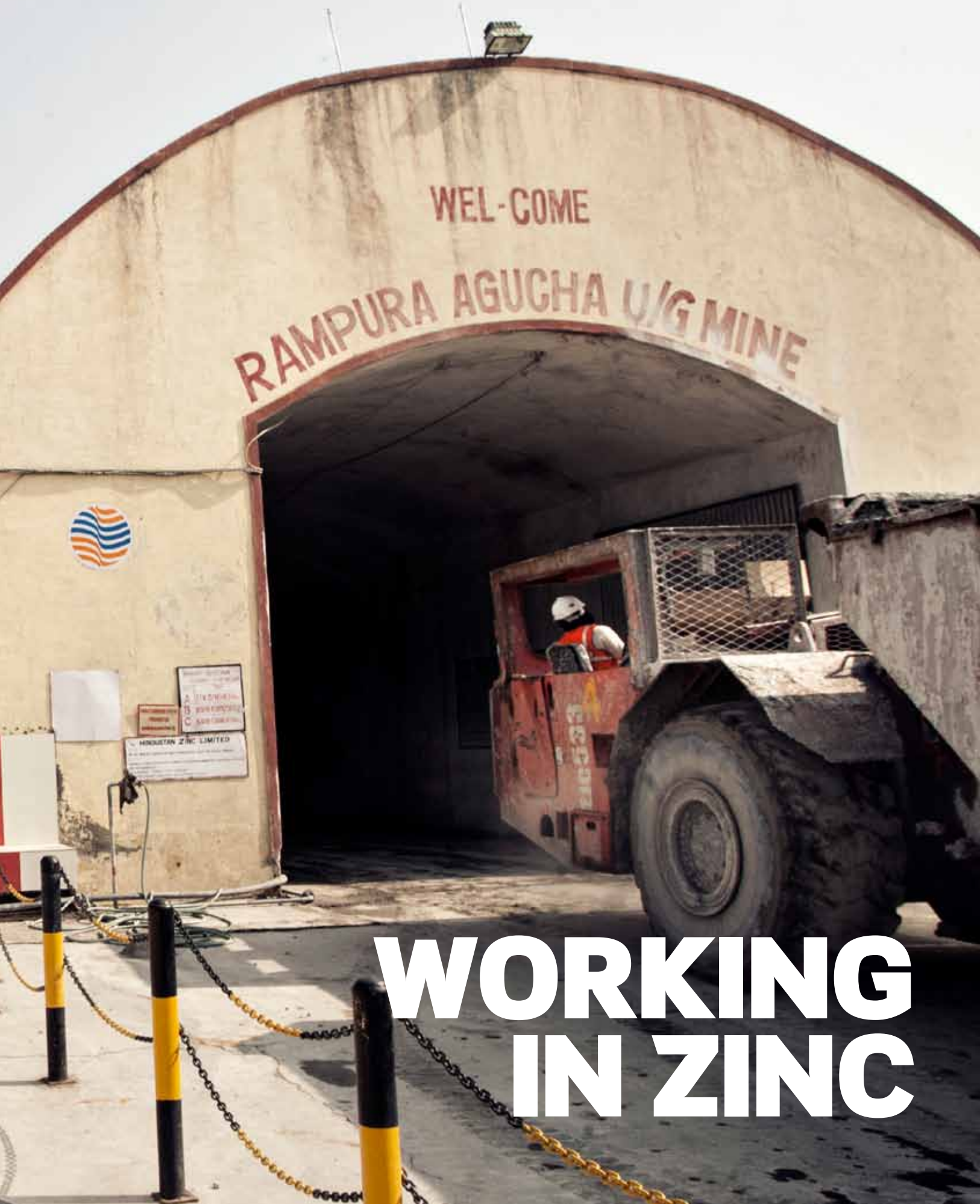
A: “Space diamonds” can be found in primitive interstellar meteorites. They can also be formed by asteroid impacts with the Earth’s surface or collisions in space. Diamonds have also been documented as being part of the core of stars as crystallized carbon, or created as a result of star death.




For more with Ruth Batson, visit minestories.com, where you’ll also find an additional diamond expert interview.

31,200

tonnes of copper and 53 tonnes of gold were discovered in 2013 in a new precious metals deposit in the Xinjiang region in north-western China. The mine, expected to start production by the end of 2015, holds gold worth about 3.2 billion US dollars and copper worth USD 230 million.



**WORKING
IN ZINC**



Rajeev Shrimali,
associate general
mine manager, HZL,
has worked at the
Rampura Agucha
mine since 1990.

■ **RAJASTHAN, INDIA.** Many sounds blend together at the Rampura Agucha mine, the world's largest zinc operation and one of the lowest-cost producers of the metal globally. A busy fleet of passing mobile equipment drowns out miners' voices and ringing mobile phones.

Text: **CHI AN GRAMFORS ENGLUND**
Photo: **ADAM LACH**



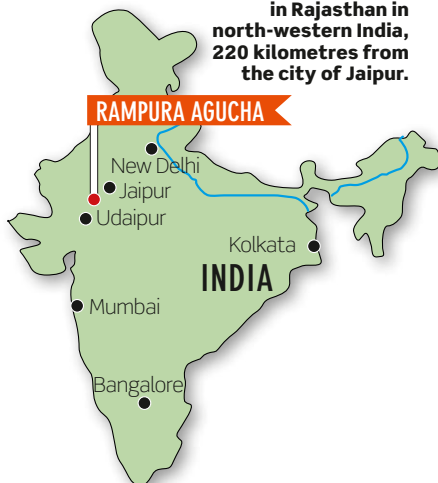


Sandvik DP1524 provides more than 18,000 metres of drilling per month.

IT'S HOT outside the decline – very hot. The machines run virtually nonstop even as temperatures top 45 degrees Celsius, while workers are scheduled around the clock in three eight-hour shifts.

Here, near Jaipur in north-western India, Hindustan Zinc Limited (HZL) is running the largest zinc operation in the world. The Rampura Agucha mine has been an open pit operation since mining began more than 20 years ago, but the company is now also going underground to extract ore with the development of a 950-metre hoisting shaft.

The mine is located in Rajasthan in north-western India, 220 kilometres from the city of Jaipur.



A fleet of Sandvik equipment simplifies the task of advancing deeper and deeper. The underground equipment includes jumbo drills, loaders, trucks and a cable bolter.

Sandvik DS421 cable bolter is used specifically for solving geotechnical issues underground, providing reinforcement and support for the wall, roof and floor of the mine.

“We recently commissioned the bolter, and we’re getting a lot of benefits out of it,” says Abhay Kumar Nalwaya, associate vice president, underground mines, Rampura Agucha, HZL.

“This mine has been having some ground-condition challenges, so we’re using the bolter to solve that problem. The installation of the bolter has completely changed our mine strategy. We’re saving a lot of time, so we are very happy with this machine.”

The mining jumbos drill holes for blasting to remove rock in the cave, which is then extracted by Sandvik LHDs working in tandem with Sandvik underground trucks.

“The Sandvik drills are giving very satisfactory results,” Nalwaya says. “Every day we get two or three blasts using this equipment.” He says he is very satisfied overall with the

109.8

million tonnes, the Rampura Agucha mine's reserves and resources as of March 2013

performance of the various Sandvik machines. “The most impressive thing is that we don’t have long downtimes, performance is high, and we’re working around the clock with these machines.”

Rampura Agucha commenced operations as an open pit mine in 1991, but to meet market demand HZL opted to also go underground.

“For the past 23 years we have been mining zinc at Rampura Agucha,” says L.S. Shekhawat, vice president and unit head, Rampura Agucha mines, HZL. “Initially it was an open pit mine, but now both operations are running parallel – open pit as well as underground.”

The company’s choice of equipment came down to productivity and

SANDVIK FLEET AT RAMPURA AGUCHA

- Six Sandvik LH517 LHDs
- Six Sandvik EJC533 underground trucks
- Two Sandvik DD320 twin boom jumbo drill rigs
- One Sandvik DD321 twin boom jumbo drill rig
- One Sandvik DS421 cable bolter
- One Sandvik DP1524 surface drill

“In terms of productivity, the equipment from Sandvik is absolutely the best.”



L.S. Shekhawat,
vice president and
unit head, HZL



The installation of Sandvik DS421 cable bolter has transformed the mine strategy.



►► efficiency. “Most of our underground equipment is from Sandvik,” Shekhawat says. “We also have a Sandvik drill rig in the open pit. In terms of productivity, the equipment from Sandvik is absolutely the best. Looking at the productivity and overall efficiency, we have chosen these machines for our operation.”

Shekhawat points to the equipment’s versatility as another important factor in the strenuous environment deep underground. There’s no escaping the heat – especially 950 metres below ground.

“The machines are very robust, and the operators are confident running them. The cabins are ergonomically designed, so you feel very comfortable in any environment. Here in Agucha, where the above-ground temperature exceeds 45 degrees Celsius, it’s comfortable to be inside the air-conditioned cabin,” he says.

Rampura Agucha is a thriving mine. Its predominant ore, which has a unique lens-shaped characteristic, consists of

stratiform, sediment-hosted, high-grade zinc and lead deposits. The mine’s ore reserves and resources stand at 109.8 million tonnes.

The mine has developed from an initial capacity of 1 million tonnes in 1991 to today’s 6 million tonnes a year, and the Sandvik fleet has played a major role in the increase.

The open pit operation currently accounts for some 5 million tonnes of the total annual production, and a Sandvik DP1524 drill has worked in the pit for about a year.

Rajeev Shrimali, associate general mine manager, Rampura Agucha mines, HZL, says there was some doubt internally as to whether DP1524 could handle the type of drilling needed at Rampura Agucha. But its performance has exceeded expectations, with more than 18,000 metres of drilling per month, which is a landmark achievement by any single drill at the Rampura Agucha mine.

“Before putting this equipment into operation, we were worried whether or not it would get the required results,” ►►

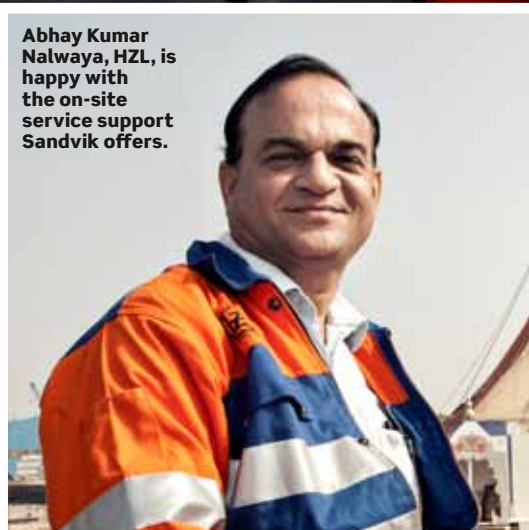
Preventive scheduled maintenance by the dedicated Sandvik service team ensures optimal performance and upkeep of the machines.



Before, Rampura Agucha was solely an open pit mine. Now it is complemented by an underground operation.



John Palmer, HZL, is pleased with the low emissions from the mine's Sandvik fleet.



Abhay Kumar Nalwaya, HZL, is happy with the on-site service support Sandvik offers.





The partnership between HZL and Sandvik is very close.



“Whenever we require it they’re available on site.”

► Shrimali says. “But after deployment, the equipment availability and performance has been much better than expected. Our mine has had a sixfold increase in ore treatment, and for that kind of expansion we’ve needed a lot of improvements and productivity-driven equipment, such as Sandvik DP1524.”

Environment, health and safety considerations are always in focus at a mining operation, including engine emissions. HZL chose Sandvik equipment in part for the machines’ fuel-saving features.

“As for the environmental aspect, there are always many challenges,” says John Palmer, HZL general engineering manager, Rampura Agucha mines. “The Sandvik machines have the benefit of the engine exhaust that meets world emission standards. The lower emissions from the machines obviously support us as regards our underground ventilation.”

In the surface operation, the fuel-saving features of Sandvik DP1524 are helping to reduce overall mine emissions. Apart from the fuel efficiency, Shrimali also emphasizes the benefits of wet drilling when it comes to reducing dust emissions, both for workers and the environment.

“The Sandvik drill’s built-in water-injection system is very efficient and prohibits dust shedding during drilling,” he says. “While drilling, we’re also saving fuel in terms of metres. So environmentally it’s very eco-friendly.”

When mining operations started at Rampura Agucha, HZL was struggling to be able to obtain machines with attractive safety features. Today it has

found sustainable solutions through the robust safety-oriented machines from Sandvik.

“At Rampura Agucha Mines, we’re proud to say that safety is our first priority,” Shrimali says. “Sandvik DP1524 drill rig is robust and has good safety features, such as the ROPS-compliant cabin. Sandvik is also following all safety compliances, and in some cases even exceeds them.

“The service support is excellent, particularly for this type of equipment,” Shrimali says.

Preventive scheduled maintenance ensures optimal performance and upkeep of the machines.

“We have a service team of nine engineers, and all of them are trained in our academy,” says Kartikey Panwar, Sandvik senior operations

85%

Average availability of the mine’s Sandvik machines



manager. “They’re working very hard. All credit goes to them for achieving this kind of availability and reliability.”

A dedicated Sandvik team is on call 24/7/365 to maintain the machines and keep the fleet running. As a result, the equipment is available more than 85 percent of the time.

Nalwaya is very satisfied with the high service level for the underground equipment. “We’re getting regular support from Sandvik, and we’re satisfied with how the equipment performs,” he says. “Whatever issue we might have, Sandvik does everything to resolve it, and whenever we require it they’re available on site.” ■

See videos about Rampura Agucha at www.minestories.com

About Rampura Agucha


• Owned by Hindustan Zinc Limited (HZL), Rampura Agucha is the world’s largest zinc mine. Located in the state of Rajasthan in India, the mine is highly mechanized, using a variety of mining methods that include drilling, blasting, loading and hauling. The mine produces zinc concentrate and lead concentrate, which are transferred to HZL’s Chanderiya Smelter Complex, the world’s largest lead-zinc smelter complex. It refines lead-zinc ore and produces zinc, lead, cadmium and other metals.



SANDVIK + RANGE

THE FUSS ABOUT PLUS



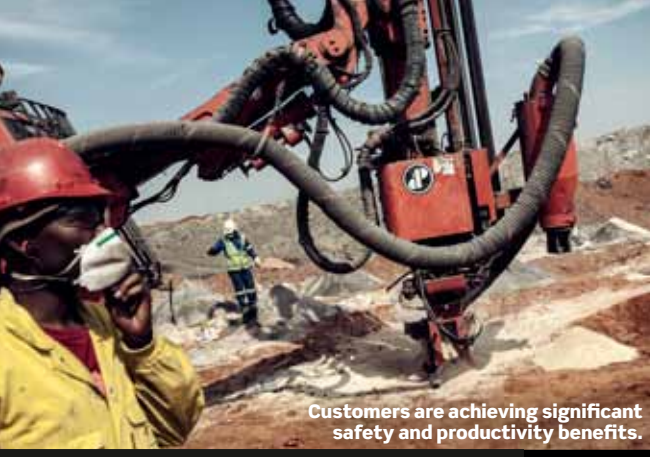


Longer lifetime for the rods
means less time spent in a
potentially hazardous area
while changing them.

■ Customers using the innovative new +Range drill rods benefit from a substantially longer service life, thanks to a new steel grade.

Text: TURKKA KULMALA Photo: ADAM LACH





Customers are achieving significant safety and productivity benefits.



Trials have been done in cooperation with mining contractors in South Africa.



Agryppa Makwakwa, operator at Diesel Power.

The company was born from a metallurgical breakthrough. In 1862, Göran Fredrik Göransson and his skilled engineers and workers were the first to successfully apply the Bessemer process for steel production on an industrial scale. Swedish steel soon became a celebrated commodity associated with the highest quality. Rock drilling tools were among the first practical applications, and Sandvik started supplying these products in the 1870s.

Today Sandvik proudly carries on this time-tested tradition, giving the company the unique capability of producing its own steel for rock drills.

Research and development operations have never ceased, as attested by the large number of Sandvik patents granted to innovations in material technology.

Metallurgy continues to play a major role in today's rock tools. The new +Range of Sandvik top hammer drill rods for bench drilling applications is based on a completely new steel grade.

The new range of drill rods has been developed to meet ever-increasing market requirements. The basis was laid in an extensive research and development project that specifically aimed at solving real-life problems encountered by customers in their everyday operations. "We studied collected samples of worn-out rods and analyzed



Stefan Hvalgren, Sandvik product manager for surface mining top hammer tools.

them at our R&D laboratories in Sweden to find out how to improve the weak points," says Stefan Hvalgren, Sandvik product manager for surface mining top hammer tools.

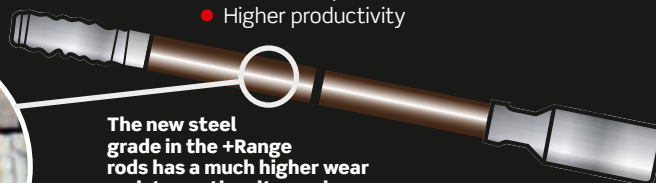
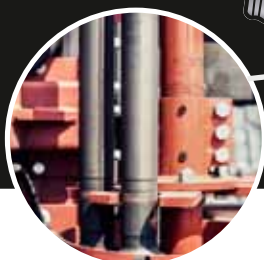
Huge forces are exerted on drill rods, including accelerations of 3,000 to 4,000 g per percussion, repeated thousands of times over the life cycle of each rod. By comparison, modern fighter jets are generally designed for maximum acceleration forces in the range of 10 g. The threads connecting one drill rod with another can be subjected to temperatures of several hundred degrees Celsius due to the high pressure and friction when used with new high-performance rock drills.

When test data from the Sandvik study started to emerge, it soon became clear that the new steel grade had a much higher wear resistance than its predecessors. Thanks to this, the new drill rods are capable of more than 30 percent longer service life – and potentially even more in some applications. The increase in service life is based not on theoretical calculations but rather on cold facts.

"Extensive tests have been carried out at many of our customers' work sites in countries such as South Africa, Germany and Australia," Hvalgren

Tech specs & benefits

- Threads: T38+, T45+, T51+, GT60+ and more
- Drill rods, guide and pilot tubes, drill tubes
- Fully compatible with standard threads T38, T45, T51, GT60
- Improved safety
- Improved environmental impact
- More than 30 percent longer service life
- Lower cost per drilled metre
- Higher productivity



The new steel grade in the +Range rods has a much higher wear resistance than its predecessors.



Fewer rod changes save time, directly improving productivity.



Erick Walker, Diesel Power, and Bruce Van Niekerk, Sandvik, are happy about the trial results.



Drill rods are subjected to extreme forces, with percussions repeated thousands of times.



The new +Range focuses on high productivity and demand for cost-effective drill holes.

says. “The results have shown impressive increases in service life for the drill rods in all rock conditions. The service life improvement with the larger T51- and GT60-sized rods was much higher than 30 percent.”

The longer service life starts a positive domino effect, resulting in major customer benefits. Drill rods that last 30 percent longer substantially lower the tool cost per metre drilled.

30
percent, the minimum expected service life increase compared with standard models.

“The results have shown impressive increases in service life.”

There are fewer rod changes and less need for tramping to fetch new rods, which saves time and thus directly improves productivity.

Another major advantage is improved safety. With fewer rod changes, and less time spent in the hazardous area, there is less risk of injury for the drill rig operator and mechanics. There are also environmental benefits. Less-frequent rod changes mean fewer rods to be recycled, which saves raw material and energy. Less material to be transported results in lower fuel consumption and fewer emissions, reducing transport costs to, from and within the site, and when the rods go to recycling. ■

What customers say about +Range rods



“The new +Range rods were tested side by side with the old type, so we could compare apples with apples. With some of the best new +Range rods we achieved 13,800 metres. That’s more than double the average. We are getting about 30 to 35 percent longer tool life out of the new type of rods, which means huge cost savings for our business. In terms of production, that’s an increase of 10 to 15 percent.”

**JOHAN COETZEE, MANAGING DIRECTOR
HIGH POINT OPENCAST MINING SERVICE,
SOUTH AFRICA**



“We were wasting diesel by changing rods two or three times a month. The new +Range will help us bring our diesel costs down.”

**ERICK WALKER,
SENIOR DRILL AND BLAST FOREMAN
DIESEL POWER, SOUTH AFRICA**

MCARTHUR RIVER URANIUM MINE

The uranium ore from the McArthur River mine is crushed and turned into a slurry underground. The slurry is then pumped to the surface and into these tanks for shipment.



PRECIOUS CARGO



■ **CANADA.** It's all about the ice. Even in the cold winter wonderland of northern Saskatchewan, mining company Cameco has to build an underground curtain of frozen groundwater around the McArthur River mine's ore body - the world's highest-grade uranium.

Text: **HENRIK EK** Photo: **PONTUS HÖÖK**





Curtis Taylor, Cameco freeze drill general foreman, leads the team that's building a 15-metre-thick freeze wall underground.

The Athabasca Basin in the Canadian prairie province of Saskatchewan is one of those places meant to be seen during early morning hours, when the first rays of light make the landscape sparkle. The snow that creaks beneath boots can freeze feet through even the heaviest of soles. The air is clean and crisp, but a minus-40-degree wind chill makes miners hustle to the more temperate underground mine environment.

Some 500 metres below the surface lies the world's richest and highest-grade uranium ore body. Its existence has been known since the 1980s, and the ore has been excavated since 2000,

The mine is located in Saskatchewan, a prairie province of Canada.



but only recently did the mine reach peak production efficiency.

"It's located in a sandstone formation filled with water," says Curtis Taylor, freeze drill general foreman at the McArthur River mine. "It looks like a sponge. We're seeing 500 gallons of water a minute being produced from a drill hole while we're drilling. When you shut the hole in and close it down, it can have a hydrostatic pressure of up to 600 psi. A regular longhole production drill isn't built to handle that."

At the 520-metre level, everything is clean and neatly covered in concrete. Endless pipes of different diameters run along the drifts.

Taylor stops in front of a board on the wall that illustrates the mine. The uniqueness of this situation, which is common only in the Athabasca Basin area, is that the ore body has to be shielded off from the surrounding sandstone for production drilling to take place.

"These are freeze holes," he says, pointing to some coloured lines on the board in straight formation. "The holes are up to 130 metres deep. We're using a Sandvik DU331-TW drill and six-and-a-quarter-inch rods. Then we double-case the holes with steel and PVC plastic inner pipes to circulate

8,620

tonnes of uranium are produced at the mine annually.

chilled brine through them."

Huge compressors on the surface pump the brine down the mine and into each hole. It goes first through the centre of the inner PVC tube, then is flushed back out on the outside, still sealed off from the bedrock by an outer casing. The brine is then returned to the compressor loop to be recharged.

"This cools the ground and makes up a freeze wall, like a curtain around the ore body," Taylor says.



SANDVIK FLEET AT MCARTHUR RIVER

- Five Sandvik CRH10SD raise borers
- Three Sandvik DU331-TW drills
- Two Sandvik 6200W drills
- Two Sandvik KW130 water pumps
- One Sandvik LH410 loader
- One Sandvik H205D jumbo
- One Sandvik AM75 alpine miner



Cameco machine operator Dallas Taylor (right) is a third-generation uranium mine worker.



Chilled brine is pumped into the drill holes. It makes the groundwater freeze and creates an ice curtain around the ore body.

TECH SPECS SANDVIK DU331-TW

Sandvik DU331-TW boom-mounted Wassara ITH production drill:

- HH mast with 60,000 pounds force
- SAHR (spring applied hydraulic release) clamping and breakout foot arrangement
- HD underground frame
- HD undercarriage assembly
- 360-degree boom pivot
- Centralized manual grease lubrication
- Petol chain wrench to open hammers, mounts on feed with hydraulic cylinder
- Soft-start electric system
- Hydraulic oil fill pump
- 2 x 100 amp plugs

Sandvik KW130 triplex plunger pump module:

- Water pump capacity of 350 litres/minute
- 2,600 psi working pressure
- Built-in gear reduction drive
- Engine-mounted charge pump
- Two parallel mounted desilting cones
- Secondary water filter system
- Ultrasonic water flow meter

Sandvik DU331-TW in action at McArthur River. Sandvik has also supplied drills to Cameco's Rabbit Lake mine and is currently implementing a jet boring system at the company's Cigar Lake operation.



“Our current life-of-mine plan extends to at least 2035.”



At 520 metres below the surface, everything is clean and neatly covered in concrete.

All drill holes and mining chambers are filled with concrete after the section has been excavated.

SANDVIK SOLUTION

SPECIAL DELIVERY

“It’s not so much about how big they are,” says Jordan Letkeman, Sandvik underground ITH product manager. “It’s about how small they are.”

At this site, Cameco has to do very specific things to work around the small ore body.

“They really have to make sure they’re doing it right,” Letkeman says. “If they don’t get that freeze curtain, there’s no way they can mine that ore body. They spend time getting everything 100 percent.”

The first Sandvik 6200W drill rigs were delivered in 1998 and refurbished in 2001. This equipment was mainly standard equipment with a few key modifications.

The new DU331-TW drills, which were custom designed to the mine’s specifications, were delivered starting in 2009.

“The new machine has a heavy hoist mast on it, 60,000 pounds, and goes well beyond the 130-metre holes required,” says Curtis Taylor, Cameco freeze drill general foreman.

The equipment is also smaller and easier to mobilize and demobilize.

“We’ve been able to reduce the size of our drifts too,” Taylor says. “We were driving drifts of seven and eight metres high. Now we only have to drive six-and-a-half metres. It’s a huge cost saving for the mine to be able to do that.”

▶▶ It’s a 15-metre-thick ice curtain, to be exact, and it keeps water from the basin away from the mine.

“Once the ground is frozen we go up and develop excavation chambers where the ore itself is drilled and extracted,” Taylor says.

Put simply, they drill holes to be able to drill holes, and it’s a technique that takes precision.

The spaces between the holes here are no more than 2.5 metres wide. If the drill were to deviate and reach more than 3.8 metres from the toe of the hole next to it, Taylor’s team would have to make another one.

“The setup of the drill is very critical, and the drill itself has to be



Cameron Chapman, Cameco operations manager.

able to be easily set up on the hole and drill accurately once in the hole,” says Jordan Letkeman, Sandvik underground ITH product manager, who has been working with the team at McArthur River to get such an accurate rig in place.

The uranium business is as tricky as it is sensitive, both politically and in terms of market uncertainty. The tsunami that caused the nuclear disaster at Japan’s Fukushima Daiichi power plant in 2011 gave many countries second thoughts about their nuclear operations. All such incidents have a big impact and earn a notable place in history, but societies usually return to

the idea that nuclear power is an environmentally friendly, safe source of energy.

“We do believe it’s part of the future,” says Cameron Chapman, Cameco’s operations manager for the McArthur River mine.

The mine is currently producing 8,620 tonnes of uranium annually, up from 8,480 tonnes when it first started. Demand hasn’t decreased, Chapman says.

The top three uranium producers in the world – Kazakhstan, Canada and Australia – account for around two-thirds of the world’s total annual production of 58,000 tonnes.

Kazakhstan, the world leader, ▶▶



McArthur River uranium mine's main shaft catches the first rays of morning sun.

Jordan Letkeman, Sandvik underground ITH product manager.



▶▶ produced 21,317 tonnes in 2012, or 37 percent of the global total, according to the World Nuclear Association. Canada produced some 15 percent of the total.

Still, no single mine can measure up to McArthur River. “From a geological perspective, we’ve got a high-grade ore body in a relatively small location,” Chapman says. “Essentially, in zone 2 of the ore body, where we first began commercial production, we’ll get some 136 tonnes out of something the size of a football field.”

The mine has officially reached the halfway mark of what can be excavated. But that was based on earlier estimates, and Chapman believes the McArthur River mine will be operational for decades to come. “Our current life-of-mine plan extends to at least 2035,” he says. “But there is ongoing geological potential within the area.”

From atop the highest nearby hill, looking down from a height of 100 metres provides an overview of the mine’s surface structures. The whole thing looks surprisingly small.

The McArthur River mine is located some 600 kilometres north of the city of Saskatoon. Some of the workers travel in from small settlements even farther north. However, a majority of the 430 employees and the 250 long- or short-term contractors fly in for their week-long shifts from the south. For them, the private airstrip and the planes chartered by Cameco are the only way in and out.

The lone private road leading to the mine is only for equipment and ore transports. During their stays at McArthur River, the men and women

have their own rooms in the nearby living quarters. There’s also a gym, a basketball court, a sauna and a big social room at the camp.

After what is usually an 11-hour workday, yellow school buses transport those who don’t want to brave the cold the few hundred metres from the mine to the housing complex.

There they enjoy home-cooked meals in a large cafeteria, which is also open for sandwiches and snacks around the clock. “They take good care of us,” Taylor says.

Taylor’s son Dallas, 25, is a third-generation uranium worker. Currently a machine operator on the latest Sandvik DU331-TW drill, which Sandvik and Cameco developed together, he talks with the same confidence as his father.

“As far as the drill is concerned, we’re able to make a freeze hole, start to finish, in around a week,” he says. “With the older drill, it would take us closer to three weeks.” ■

“We’re able to make a freeze hole in around a week.”

About Cameco

- McArthur River is Cameco’s richest uranium mine, with some 19 million pounds of ore extracted annually. The ore from McArthur River is transported to nearby Key Lake, where it is processed and turned into the final yellowcake, triuranium octoxide (U₃O₈).

Cameco as a whole accounts for about 14 percent of the world’s uranium production. That makes the company a world leader, with mines in Canada, the United States and Kazakhstan. Cameco’s leading position is backed by some 465 million pounds of proven and probable reserves and extensive resources. The uranium is sold for use in power plants all over the world. In 2012, Cameco had revenue of 2.3 billion Canadian dollars (2.1 billion US dollars) and net profit of CAD 266 million (USD 248 million).

 See videos about **McArthur River** at www.minestories.com



SANDVIK DD211

SAFE IN A SAFER VEIN

Sandvik DD211 is well suited for those typically narrow tunnels with a low heading, many of which were originally intended for manual extraction.

■ Narrow-vein mines are feeling increased pressure to modernize their operations for improved safety and productivity. The new **Sandvik DD211** drill rig helps them to achieve these goals in cramped underground conditions.

Text: TURKKA KULMALA



Focus is on strong overall productivity.

The new Sandvik DD211 jumbo is a dedicated electrohydraulic development drill rig for narrow-vein applications and hard-rock conditions.

“Narrow or narrow-vein mining, as opposed to large open stopes or other mass mining operations, typically refers to the working of mineral deposits of no more than two to three metres wide,” says Johannes Vålivaara, Sandvik product manager, underground development drills. “They are generally associated with a variable and often very steep dip, the angle at which the mineral deposit is inclined to the horizontal plane.”

Mines of this type are common in South America, South Africa, the former Soviet Union, the United States and Australia. Minerals typically occurring in these formations include gold, silver and diamonds, but also base metals. Ore in many narrow-vein mines, particularly in South America and Africa, has traditionally been extracted with very limited mechanization.

“There are several drivers enticing mining companies to modernize their narrow-vein operations with new technology,” Vålivaara says. “Many of the easily extractable deposits have been depleted, and the remaining, less-accessible reserves call for more advanced technology.” The high demand for qualified employees presses employers to improve safety and working conditions.

“DD211 boasts advanced safety and ergonomic features that help prevent accidents and also make it easier to attract and retain a skilled workforce,” he says.

“Particularly compared with manual methods, the safety upgrade is extreme. Better, safer working conditions also improve productivity.”

One of the drill’s primary safety features is its canopy, which protects the operator from both roll-over (ROPS, in compliance with ISO 3449) and falling objects (FOPS, ISO 3471). The safety canopies or cabins in many competing designs only offer one protection or the other.

Another key safety feature is the drilling module movement-prevention function. In practical terms, this means that the drilling system remains safely switched off for the duration of rod changes. This makes one of the most hazardous tasks in the process much safer for the operator. With the automatic rod changer, available as an option, the need to approach the moving parts can be eliminated almost completely.

Product safety was the top priority in the design process of the new DD211 rig.

“The remaining, less-accessible reserves call for more advanced technology.”



Johannes Vålivaara.

“With this new product, Sandvik has succeeded in significantly increasing the level of safety without sacrificing the ease of use, operator comfort or drilling performance,” Vålivaara says.

The key challenge in the economies of narrow-vein mining is dilution control. In other words, as little waste material as possible should be extracted along with ore. One of the main aspects in effective dilution control is not only to keep the drilling operation efficient and precise but also to carefully plan the charging and blasting, as every tonne of mined waste rock impacts on a mine’s profit.

“The new DD211 provides a high level of accuracy and control for drilling that helps the subsequent process stages to achieve maximum precision with minimized overbreak,” Vålivaara says, referring to the caving-in of loose materials at the edge of an excavation.

DD211 uses the RD314 percussive rock drill optimized for hole diameters of up to 51 millimetres. The compact design, 559 millimetres long without a shank, makes it possible to use longer rods and enables multidirectional



The new jumbo offers a high level of accuracy and control for drilling.



Benefits

- Superior safety standards
- Compact rock drill for high, productive percussion frequencies
- Capability to perform all three main tasks required in narrow-vein mining: 1) development drilling, or the excavation of access tunnels; 2) cross-cut drilling; and 3) drilling of both production and bolting holes in roofs and walls.

Sandvik DD211 shows extraordinary operational flexibility.

drilling in confined spaces. Rather than maximizing the power rating, Sandvik targets optimized impact energy for high precision and long tool life. High, productive penetration rates are achieved by means of a high percussion frequency of 110 Hz – more than 30 Hz higher than in the predecessor model.

The compact dimensions are an asset in narrow-vein operations. Good penetration rates thanks to higher impact frequency give good productivity. Lower impact energy means longer tool life and fewer tool changes, resulting in direct safety and productivity benefits.

“The focus on maximized impact frequency gives more accurate holes,

resulting in more accurate blasting, thus less dilution and consequently better economy,” Väliavaara explains.

The combination of the compact CFX feed module and the telescopic SB20NV boom with two roll-over heads particularly comes into play in the cross-cut drilling and bolting operations in formations with a steep dip.

The extended mode of the CFX module, with a rod length of 3.66 metres, enables the use of long rods for development drilling. After reaching the ore deposit, the compact telescopic feed module can again be retracted to a rod length of 1.83 metres and thus increase mobility and allow production drilling in the cramped tunnel. ■

Tech specs

Canopy	FOPS & ROPS
Drilling coverage	26 m ²
Hole diameter	33–89 mm
Feed length	10–14 feet, 6/12 telescopic
Rock drill	RD314, 14 kW, 110 Hz
Length	10.7 m
Height	2.5/2.7 m (depending on canopy configuration)
Width	1.4 m
Cornering	2.5 m x 2.5 m T-crossing
Operating weight	13 tonnes

Peruvian connection

■ A safety milestone reached by one of Peru's oldest mines together with partner Sandvik is an impressive achievement in a country striving to improve safety and environmental standards.

Text: **ALANNAH EAMES**
Photo: **MARCO SIMOLA**

Together with Milpo, technician Gregorio Hernández Cure and his Sandvik colleagues strive to maintain El Porvenir's reputation as one of the safest mines in Peru.

A "Best Hazard Report" award has been introduced at the mine for a person who reports and eliminates a potentially dangerous situation.

There's no mistaking Milpo's safety attitude in its motto: "No job is so urgent that it can be done without safety – none."

Milpo strives to be Peru's most safety-conscious mining company.

Established in 1949, Milpo's El Porvenir mine is one of the deepest underground mines in Latin America, extracting lead, zinc and silver at a depth of 1,250 metres. Because of its age and depth, it's not surprising that safety is a key concern for its owner, Milpo.

Juan Feijóo started his career as a mining engineer at El Porvenir, in the remote central province of Pasco. A family man who has always been interested in employees' safety, he was appointed occupational health and safety superintendent at the mine in 2008.

Feijóo is adamant that safety is as important to the company's productivity as it is for the employees' lives.

"Focusing on safety helps to minimize loss and shows respect for our employees," he says. "It's a win-win situation. By improving safety, the company also gets a more productive and efficient process."

Every task Feijóo does is driven by a desire to ensure that the site avoids incidents.

In October 2013, the Sandvik team on site at El Porvenir reached a milestone: one year without an incident, a commendable achievement.



Milpo is applying best practices from the El Porvenir site to its other sites in Peru.

"It's a win-win situation."

Milpo's increased focus on safety is being pushed from two directions. Firstly, it was acquired in 2010 by Brazilian steelmaker Votorantim Metais, which has introduced stricter environmental, health and safety (EHS) processes to align the Peruvian mines with international standards. Secondly, Peru is in the throes of a mining improvement wave, with new regulations forcing companies to provide better working conditions for their employees.

1,250

The depth in metres of El Porvenir mine, one of Latin America's deepest.

Mining activities in Peru are challenging from an infrastructure perspective and well-regulated from an environmental standpoint. After the Peruvian government introduced new mining regulations in 2001, the number of mining incidents declined. However, incidents caused by human error and non-compliant procedures remained high, highlighting the need for better safety and health management systems.

Many fatal incidents from earlier years could likely have been avoided if safety awareness processes were in place. In January 2011, Peru implemented stricter health and safety regulations for its mining sector, forcing companies to educate their staff on such issues in an effort to improve the country's safety image. All mining companies, as well as their contractors and suppliers, are now required by law to have an internal health and safety programme and committee in place to increase safety awareness among employees.

According to Feijóo, improving safety at El Porvenir meant starting from scratch to change the miners' attitudes. ►►

EL PORVENIR MINE

- Located 320 kilometres north-east of Lima in Peru, the El Porvenir mine began mining operations in 1949. It produces zinc, lead and copper concentrates with silver and gold content, extracting around 5,600 tonnes per day at a depth of about 1,250 metres, making it one of the deepest mines in Latin America. It has some 1,400 employees. Sandvik has a team of 72 technicians and advisers at the site.



Criss-crossed by the Andes mountains and Amazon rainforest, Peru presents a variety of safety and environmental challenges for mining companies.



Supplier award

● To encourage suppliers to improve safety and reward those who help to make the mine a safer workplace, Milpo has introduced several safety awards.

Each year, one supplier receives the mine's EHS Award for its team's overall safety performance in fulfilling Milpo's safety requirements as well as keeping its equipment in good working order. Sandvik was honoured with this award in 2013.

► “We focused on the people and changing the mindset,” he explains. “To make long-term changes, you have to convince people that their behaviour is the most important element of your EHS system.”

Running leadership training courses, sharing lessons learned from incidents, introducing safety steps to raise awareness, conducting regular and unscheduled inspections and rewarding safe behaviour have all become part of daily life at the mine.

Employees are encouraged to participate in making the mine a safer place to work by noticing and reacting to potentially hazardous situations. Hazard reporting has become the norm. Employees are expected to report hazardous conditions and to say “no” to potentially dangerous activities. These conditions could involve working in a poorly ventilated, cramped space or a dimly lit excavation area, or using a dangerous vehicle or tool. The incident is reported, ranked on a scale of one to six in terms of criticality, and acted on immediately.

The hard work and focus is paying off. The last recorded lost time incident (LTI) in the mine was back in early 2012.

Sandvik has worked with Milpo for 16 years, providing maintenance for the

miner's Sandvik equipment and many other vehicles operating at the site.

Pablo Nangles, Feijóo's EHS counterpart at Sandvik, says the headway that El Porvenir has made in improving safety is very noticeable.

“They've really raised their safety culture and are investing more in their people, safety and training,” Nangles says.

Much of Milpo's progress in safety improvements is attributable to the implementation of new internal processes and changes in workers' attitudes.

However, the mine's safety improvements would not have been possible without the cooperation of its partners.

“We need to work with companies that take care of their employees and the environment as well,” Feijóo says, pointing to Sandvik as an example. “We share many values – notably solidarity, ethics, respect, entrepreneur-

ship and unity. But the most important thing is that everyone goes home unharmed at the end of the day.”

Like Milpo, Sandvik has an on-site safety policy of zero tolerance. “We do the Take Five – a quick risk assessment to evaluate hazards in our daily work,” says Nangles.

“In some ways, Sandvik has become a role model for the other suppliers,” Feijóo says. “They fulfil and exceed all our safety measures.” ■



Juan Feijóo, Milpo health and safety superintendent, at El Porvenir.



Employees at all levels of the mine get continual training and raised safety awareness.

Peru's mining industry

- The mining sector accounts for more than 13 percent of foreign direct investment in Peru
- Second-largest producer of silver in the world
- Second-largest known copper reserves in the world
- Sixth-largest global producer of coal
- Mineral exports account for around 60 percent of Peru's total shipments abroad
- In 2011 the mining sector employed about 120,000 people, and this figure is growing



BACK TO THE FUTURE

■ As technology advances and our world becomes increasingly futuristic, new innovations will need to be able to keep up – in more than one sense.

Text: **ALANNAH EAMES** Illustration: **RONNY WULF**

IN AUGUST 2013 a new form of transport was revealed – the Hyperloop, a capsule-like vehicle that would be catapulted through a tube reaching from one place to another.

This might sound like a scenario from a science-fiction movie, but Hyperloop could be the transport solution of the future, if you ask its inventor, Elon Musk.

If Musk's Hyperloop were installed between Los Angeles and San Francisco, it would cut the 570-kilometre trip to 35 minutes with an average speed of 962 kilometres per hour.

However, transport engineers are skeptical that his estimate of 7.5 billion US dollars for the project would cover the development and implementation costs.

Musk is not the first to come up with a transport concept like the Hyperloop. Back in the late 1990s, Stephen Fairfax, president of MTechnology Inc, built a demo unit to move 3 million

tonnes of ore per year in a phosphate mine.

The "ore car" was based on a concept from high-tech transport developer Magplane, which had an idea in the 1970s for a magnetically levitated train with a speed of 500 kilometres per hour.

Fairfax, back then a young engineering student at MIT, got a contract to build an ore car system to test the concept and reduce the cost of transporting ore at a phosphate mine in the United States.

962
kilometres per hour, the estimated average speed of a 35-minute Hyperloop trip between Los Angeles and San Francisco.

When scaled up, the same technology should also be capable of transporting 50 million tonnes per year to a port 60 kilometres away.

The way it works is simple. The ore car is pushed into a tube, the controls are turned on, and linear electric motors push the car through the tube at up to 18 metres per second. The car itself is a basic vehicle – two end plates holding the wheels in place and a steel bar in the middle containing a hopper used to transport the rock.

"We used a lot of math and science to calculate the reliability, just like structural engineers use it to calculate the required dimensions of steel girders and other components," he says.

MTechnology is still working on future innovations for the mining industry but won't offer details for reasons of confidentiality.

All that Fairfax will say is: "I'm very interested in mine electric power systems and safety systems and finding ways to improve their reliability and performance."

Good news, as smart ideas always will be part of the future of mining. ■

Innovations for customers

● Janne Uotila, Sandvik Mining, thinks an idea like the Hyperloop is interesting.

"But I think the Hyperloop is not mature enough for commercial use within the next 10 years, and it's too complicated a solution to apply to underground mining in the near future."

Sandvik Mining develops automated

and semi-automated solutions to match the industry's shift toward safer environments and more efficient mining operations.

"Simplified and safer operations and maintenance and lower energy usage are the driving forces for future customer satisfaction," Uotila says.



Janne Uotila,
product development director at Sandvik Mining.

Salt of the earth

Salt, once called “white gold,” has been a valuable commodity since biblical times. As it was relatively scarce it was used for trading; the word “salary” is derived from the fact that ancient Romans were often paid in salt instead of money.

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● **BEFORE THE** Industrial Revolution and the introduction of new mining techniques and tools, salt mining was considered expensive, labour-intensive and dangerous.

Workers in salt mines were in close contact with salt and inhaled it for long periods of time, risking severe dehydration. Few people wanted to work in such an environment, so it was often slaves or prison labourers who toiled in the mines.

Today, salt is harvested in three different ways: through deep-shaft mining, solution mining or solar evaporation. Apart from sea salt, which is produced in salt pans, salt is extracted from mines.

In deep-shaft mining, the salt is usually deposited in old underground seabeds that were buried by tectonic activity over thousands of years. Shafts are sunk down to the floor of the mine. Then the salt is removed, crushed and hauled by a conveyor belt to the surface. This salt is usually sold as rock salt.

In solution mining, wells are erected over salt beds or domes, and water is injected to dissolve the salt. The salt solution (brine) is pumped out and taken to a plant where it is

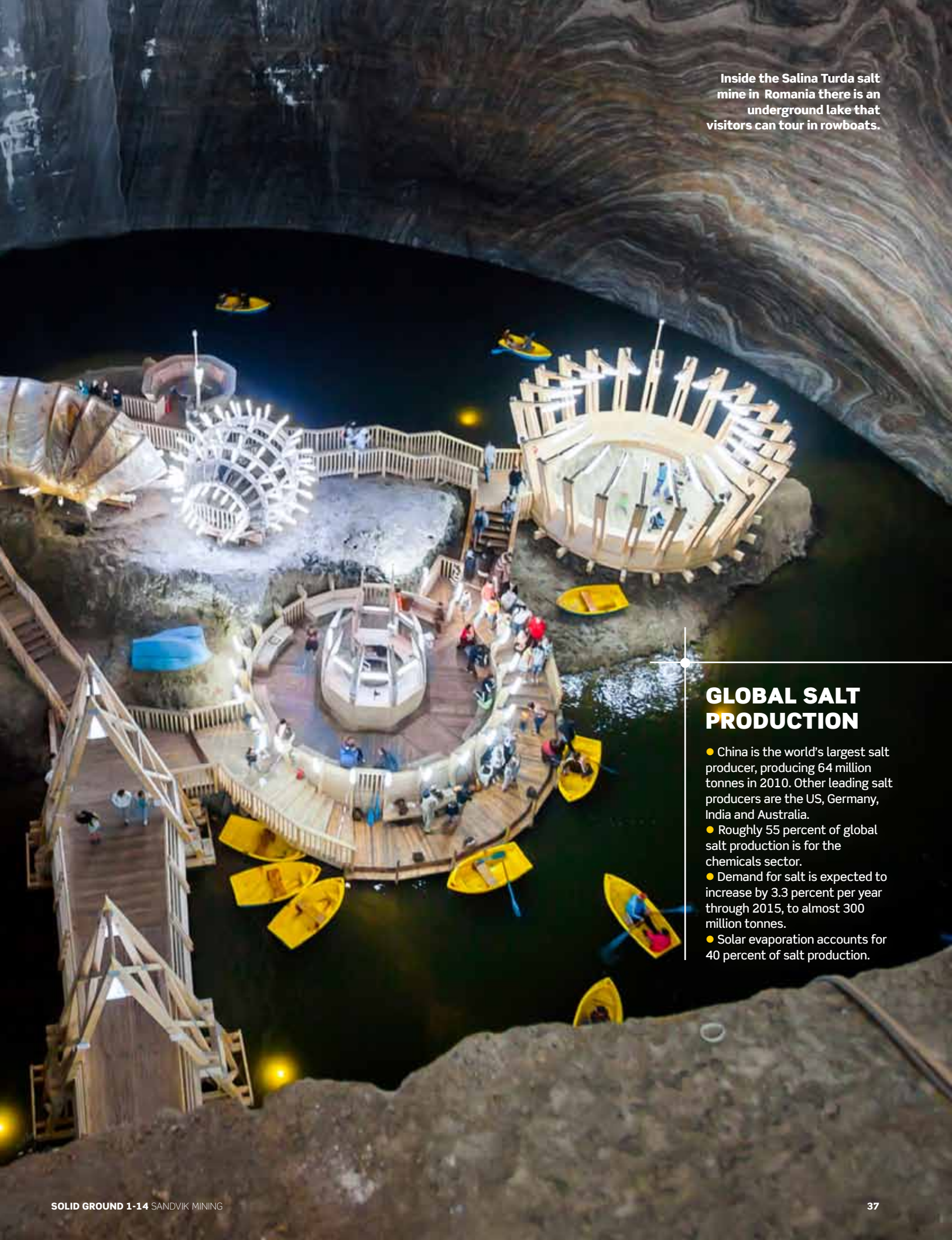
boiled and evaporated, leaving behind the salt, which is then dried and refined. This is how table salt is produced.

The third method of mining salt is through solar evaporation, which is only suitable in places with low rainfall and high evaporation rates. Wind and sun evaporate the seawater from shallow pools, leaving the salt behind. It is then harvested, cleaned and refined. This is the purest form of salt, which can often be almost 100 percent sodium chloride.

Salt is used for everything from cooking and preserving food to purifying aluminium, chlorinating swimming pools and de-icing roads.

As confirmation of the world's ongoing fascination with salt, many mines have been turned into tourist attractions. The Salina Turda salt mine in Romania's Transylvania region was turned into a halotherapy (salt therapy) centre and amusement park complete with big wheel, mini-golf course and amphitheatre. The salt mine at Berchtesgaden, Germany, is an interactive museum where visitors dress in miners' clothing and are taken deep underground in a funicular and a raft. ■



A high-angle, top-down view of an underground lake inside a salt mine. The water is dark and still. Several yellow rowboats are scattered across the lake. A complex network of wooden walkways, stairs, and railings is built around the lake, providing access for visitors. The surrounding rock walls are dark and have a layered, crystalline texture. The scene is lit with warm, yellowish lights, creating a dramatic and somewhat surreal atmosphere.

Inside the Salina Turda salt mine in Romania there is an underground lake that visitors can tour in rowboats.

GLOBAL SALT PRODUCTION

- China is the world's largest salt producer, producing 64 million tonnes in 2010. Other leading salt producers are the US, Germany, India and Australia.
- Roughly 55 percent of global salt production is for the chemicals sector.
- Demand for salt is expected to increase by 3.3 percent per year through 2015, to almost 300 million tonnes.
- Solar evaporation accounts for 40 percent of salt production.

Your global mining partner

Discover the complete product range at mining.sandvik.com, and by scanning the QR codes below to download the latest Sandvik Mining Offering Guide app.

Sandvik, with operations in more than 130 countries, offers a complete portfolio of solutions for the global mining industry. Sandvik Mining products are used for rock drilling, rock cutting, rock crushing, loading and hauling and materials handling, and are supported by round-the-clock service and technical expertise.



iOS



Android

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 metre 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 trucks. 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.

The Sandvik AutoMine product family covers all aspects of automation, from single equipment to full fleet control. In the safety and comfort of a control room, operators can simultaneously control and monitor the movements of a fleet of driverless loaders, trucks or drill rigs. By adding remote monitoring and process management capabilities, supervisors are able to directly communicate with equipment and operators from wherever they are working.



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.



LOW CONSUMPTION WAS YESTERDAY'S NEWS. READY FOR THE FUTURE? **THIS WAY!**

Sandvik drill rigs have been developed for maximum cost-efficiency for decades. Still living by the same rule when it comes to consumption, we developed a percussive drill platform that will elevate surface drilling to a whole new level. Built to meet the needs of tomorrow's mining industry as well as future requirements for automation, the new PANTERA™ is an intelligent, forceful and safe drill with variants for both down-the-hole and top hammer drilling. Designed for enhanced drilling efficiency, lower cost per metre and reduced environmental impact, it stands for utmost productivity.



Join the movement toward The Future of Mining.
It's This Way: mining.sandvik.com

