

# MINING & CONSTRUCTION

MECHANIZED ROCK EXCAVATION WITH ATLAS COPCO – NO 2 / 2014.



## EXPLORING LIFE deep inside the planet

Continuous loading for Norway's hydros

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Predator makes it big in Indian gas well

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Cutting fuel bills in Turkey's quarries

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*Atlas Copco*

Interaction, commitment and innovation have all been part of Atlas Copco's DNA for more than 140 years. To meet your needs, we continuously expand our offerings through new product development and strategic acquisitions. Our aim is to provide you with a full range of innovative products coupled with application expertise and unparalleled support.

By selecting the right combination from this offering, we can help you to achieve higher, sustainable productivity and a lower total cost of operation.

For underground mining and tunneling applications, we cover the full drill and blast cycle, from drilling, rock support and grouting to raise-boring, loading, and hauling. And in the last couple of years we have added continuous loaders, utility vehicles, ventilation, and sprayed concrete. Furthermore, we are developing future mechanical rock excavation methods that will reduce the total cost of ore extraction in many hard rock applications by targeting only the mineral seam that is of interest.

Beyond this, we continue to intensify our efforts in automation, energy efficiency and the environment. It also goes without saying that this continuous dedication to your needs is equally shared by our sister divisions for surface drilling equipment, rock drilling tools and service.

In this issue of M&C you will find many examples of how this dedication works in practice, from excavation projects in the mountains of Scandinavia to quarrying in Latin America, Australia and the USA.

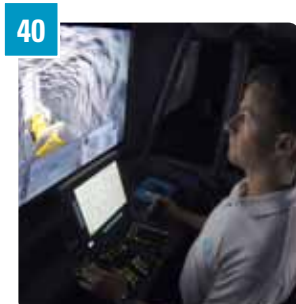
Irrespective of whether the product involved is a Boomer, Häggloader, Pit Viper, SmartROC or a Serpent ventilation system, the message is the same. Atlas Copco is totally committed to your business by

keeping you equipped for the present and prepared for the future. In doing so, we constantly strive to be your 'first in mind, first in choice' supplier.

**SCOTT BARKER**  
President,  
Atlas Copco Underground  
Rock Excavation Division



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# FLYING HIGH

## in fjord country

Excavation of a new hydropower plant in the mountains of Norway is going full steam ahead thanks to the continuous loading technique and a loader called Häggloader.







*The entrance to the 2.5 km headrace tunnel at the Govdessaåga hydropower site in Norway. Below, Häggloader operator, Tryggve Naess on the morning shift.*



*The Häggloader's backhoe digger shovels blasted rock from the muckpile onto the conveyor. Below, the conveyor dumps the muck straight into the waiting truck.*



» **A**t the best of times, loading and haulage operations in tunnels with small cross sections present logistical challenges. And the longer the tunnel becomes, the trickier it gets.

This was the scenario facing contractor Fauskebygg A/S when the company was assigned to provide the underground works for a new power station in a remote fjord region of Norway, some 700 km north of Trondheim.

In an effort to establish the fastest and most efficient production cycle in the headrace tunnel, Fauskebygg opted for

a continuous loading and haulage system featuring Atlas Copco's Häggloader 10HR-B continuous loader.

#### **Vast water resources**

As the largest producer of hydropower in Europe and with vast water resources, it is not surprising that Norway relies almost exclusively on hydropower for its domestic electricity.

Today, however, most of the new plants being built are small, privately owned projects designed to create a surplus of energy for export. The Govdessaåga project is a

typical example. With an installed capacity of 25 MW, enough to power 2 900 homes, it consists of a small dam and powerhouse and 3.4 km of tunnels comprised of headrace, tailrace, access and haulage drives.

Here, in this mountain terrain some parts of the worksite are inaccessible by road so a helicopter is used to provide a constant supply of concrete for developing the 30 m long diversion reservoir.

As the plant will not feature a penstock, the headrace tunnel, which is 2.4 km long and has a cross section of 20.5 m<sup>2</sup>,



“The Häggloader saved us the effort of excavating a lot more rock for loading bays.



John Magne Hansen Shift Manager, Fauskebygg A/S, Norway

will take full advantage of a steep, 226 m drop to the powerhouse.

The construction work is divided into two 8-hour shifts with a crew of three for each shift – two drillers, using the Atlas Copco drill rigs Boomer M2 C and Boomer E2 C, and one loader operator for mucking out.

Fauskebygg says it would have been difficult to achieve high loading efficiency at this site with conventional LHD vehicles.

“In small tunnels such as these, logistics are tricky because a larger number of loading bays would need to be excavated to enable the efficient flow of haulage vehicles,” explains John Magne Hansen, Shift Manager. “The Häggloader saved us the effort of having to excavate 50 cubic meters of rock for every niche, and we would have needed about 10 niches.”

### Minimizing the excavation

To solve the haulage logistics was critical, particularly in the headrace which is the project’s longest drive. The company wanted to avoid having haulage equipment standing idle, waiting to access the muck pile.

“In our planning, we could see that the longer the tunnel would get, the greater the logistics problems would become,” says Hansen. “By introducing the Häggloader, we reduced the required number of niches to four and also managed to maintain a consistent two-hour cycle time for mucking out and transportation.”

It was also important to minimize the volume of excavated rock due to a limited capacity for depositing rock at a nearby

stone quarry. “Beyond this,” Hansen adds, “we were very pleased to get electrically powered loading into our operations as it has benefitted the working environment and also reduced our energy consumption.”

### Good working environment

In contrast to a haulage setup using LHDs, the Häggloader takes up a stationary position at the muck pile. This enables the operator to focus on making sure that the blasted material moves onto the conveyor at a continuous pace.

“You don’t have to twist and turn your body to feel safe and in control while you are working,” says Lars Lunde, Fauskebygg’s Häggloader operator. “Also, the fact that we can use electrical power improves the air quality and keeps temperatures within tolerable limits.”

The Häggloader’s cabin is FOPS II approved and has an ergonomically designed driver’s seat with joysticks mounted in the armrests.

It is also equipped with air conditioning, a heater, protection bars, LCD technology for performance data, and

two rear-mounted cameras for maximum visibility.

Lunde took part in a training course provided by Atlas Copco and says it took him about two weeks to achieve a good level of proficiency.

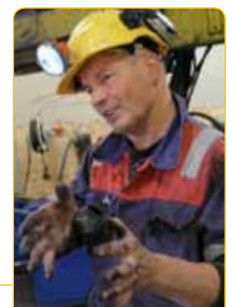
On previous tunneling projects, Fauskebygg has used the Atlas Copco Scooptram ST1030 LHD with side-dumping bucket, but in those cases the tunnels had a cross section of at least 36 m<sup>2</sup>. This meant that side-dumping was a viable option. The job of removing loose rock after blasting, however, has become easier with the Häggloader system.

“That’s another reason why we chose the Häggloader 10HR-B model,” emphasizes Hansen. “We get a two-in-one function. We can use it for loading but also for scaling and to clear the ditches.”

### Dealing with boulders

In some sections, oversized boulders often occur in the muck pile as a result of blasting in layers of slate. Boulders measuring 1 m x 1.5 m can be too large for the Häggloader conveyor so these are shifted

“The Häggloader has a compact design. Changing tires, couplings or hoses are easy jobs that can be done onsite.



Svein Rubbås, Service Manager, Fauskebygg A/S.





*Tunneling solution in the fjords: Continuous loading with the Atlas Copco Häggloader has solved a number of challenges for Norwegian contractor Fauskebygg A/S. Loader operator Lars Lunde (center) with Boomer operator Ronny Bakk (left) and Shift Manager John Magne Hansen (right).*

» to one side using the loader's backhoe digging bucket, which is also possible if the dual digging arms option is chosen. The boulders are then removed from the mucking point by an Atlas Copco Scooptram ST1030 LHD or left in place and blasted in the next round.

Thanks to a built-in sprinkler system on the Häggloader, water can be sprayed at the mucking point during loading to keep the level of dust low at the tunnel face. According to Ronny Bakk, a Boomer drill rig operator at the site, this also improves visibility making it easier and faster to accurately position the Boomer rig.

### **Maintenance and safety**

At the onsite service depot, all of the equipment, including the Häggloader, is overhauled at regular intervals. Any maintenance tasks that cannot be solved by the contractor's own engineers are handled by Atlas Copco service technicians.

"I've worked on overhauling tunneling rigs for many years, but I had never seen anything like the Häggloader before," says Svein Rubbås, who has been Fauskebygg's service manager for the past 15 years.

Rubbås says: "Preventive maintenance is what I look at first for all of the equipment. We follow the manuals with oil changes and lubrication of parts. I am getting used to the Häggloader and its compact design. Changing tires, hoses or couplings have been easy jobs that can be done onsite in the tunnel, which saves a lot of tramming."

The teeth on the Häggloader's excavator bucket are changed roughly once every two weeks, and as the machine is

new, Rubbås said he does not expect to encounter any mechanical wear issues for several months.

With a plan to boost the national hydro-power output by 12% from now until 2020, Norway's focus on innovative and

environmental construction techniques is expected to grow. In this respect, continuous loading with Häggloader is well placed to meet Norwegian standards for a good working environment and a minimum of impact on natural surroundings. ☉



### **THE HÄGGLOADER CONCEPT**

The Atlas Copco Häggloader is an electrically powered, continuous loading system that is ideally suited to small and medium-sized tunnels, such as at the Govddesåga hydropower plant. It improves the working environment for operators and reduces costs in a number of areas: running costs, ventilation costs and costs for excavating the loading bays that are typically required in a traditional LHD setup.

The Häggloader concept is based on the principal of shoveling blasted rock from the muck pile using either dual digging arms or an optional backhoe bucket, and feeding the material onto a conveyor, which then carries it up and over to a waiting truck. Designed for tunnel cross sections from 8 m<sup>2</sup> and upwards, the Häggloader comes in four different models – wheel, crawler and rail mounted – that are adaptable to a variety of tunnel sizes, haulage vehicles and dump buckets.

The rubber wheeled Häggloader 10HR-B, used at Govddesåga, is the largest in the range. It is powered by a 73 kW electric engine and a backhoe bucket and features a loading capacity of 4.5 loose m<sup>3</sup>/min of rock. It has a compact design with four-wheel drive, making it optimized for narrow tunnels and tight cornering. Diesel can also be selected as a secondary power source if required, making it possible to adjust to different tunneling environments.





*A perfect mix of high productivity and low fuel consumption: The SmartROC T45 at the Anakie quarry outside Geelong, where quarry owner Local Mix says it helped to increase the company's profit from the first day it arrived on the site.*



# A SMART DECISION

## Australian quarry increases productivity with SmartROC T45

For concrete and quarry company Local Mix, increasing productivity was simply a matter of finding the right drill rig. By all accounts, they've found it.

**T**he Anakie hard rock quarry outside the city of Geelong, on the south coast of Australia, supplies 500 000 tonnes of crushed rock and road base material to the construction industry every year.

Here, concrete and quarry company Local Mix, which took over the business in 1993, has been doing all of the drilling and blasting work by itself, rather than use contractors.

But when the company realized that the second-hand drill rig it had been using did not have the capacity to meet its aim to increase productivity, General Manager Steven Richardson set off to search for the best rig he could find on the market.

"We visited the Bauma show in Germany in 2013 and it was there that we first saw the Atlas Copco SmartROC T45," he recalls. "My first impression was that it was more

advanced than the others on display, so we went away, did our research and found that it outclassed its competitors in terms of technology, fuel savings, automation, precision and agility."

On returning to Australia, Richardson and his Quarry Manager, Mat Teesdale, visited Mt Magnet in Western Australia, together with Atlas Copco representatives, to see the SmartROC T45-10 (fixed boom version) in action. They were impressed and decided that the flexible boom version would provide the versatility required for the ground conditions at their quarry.





Steven Richardson (left) and Mat Teesdale saw the SmartROC T45 on show in Germany and later in action at Mt Magnet in Western Australia.



After just eight months on the site, the SmartROC T45 had increased drilling efficiencies and reduced operating costs.

#### Substantial fuel saving

The SmartROC T45 is consuming an average of 13.77 liters of fuel per hour, confirms Teesdale. “That’s impressive enough, but even more so when you compare it to our old rig which was running at about 15.37 liters per hour, with increases to air of 4 bar and 115 liters per second, plus an extra 9 kW for the rock drill,” he explains. “The fuel consumption we’re getting is partly due to the rock we’re drilling. It is not excessively hard, but it’s variable, which can cause wear and tear on consumables when drill force is not matched to ground requirements.”

“Another reason why we bought this rig is that it gives the operator exceptional control over the flushing air, so the machine produces only what is required. As a result, we’ve been able to greatly extend the life of the drill rods – in fact, the original rods are

still on the machine and after 8 500 meters they showed little sign of wear.”

#### Automatic processes

The SmartROC T45 can be equipped with the hole navigation system (HNS), which makes accurate setup and collaring extremely easy. Many aspects of the operative process, such as aligning the feed and the actual drilling, are automatic, which not

only gives continuous, satisfactory results but also exceptional precision.

The system is loaded with the drill pattern which allows tramping to the optimal position from which to drill multiple holes at the required depth and angle. And the whole process is driven and documented by the rig’s ROC Manager program which provides detailed information for accurate decision making. »

“ Our productivity has risen steeply with the SmartROC T45. We’re not just reducing the cost of rock drilling, but the overall rock excavation cost.

Steven Richardson General Manager, Local Mix.

» Bore tracking of blasts has seen accuracy between 85–100%

This rig has a 3G modem installed rather than the usual base station system to access the GPS coordinates. This provides the flexibility to move to different sites while retaining all the features of HNS.

Moreover, it has eliminated the inefficiencies and inaccuracies associated with manual measuring and markout of holes. Hole collaring is automatic and precise, as is the alignment of the holes at angles and depths that will deliver superior blast fragmentation. Markouts are being completed in 25% of the time and blast fragmentation is unprecedented. Drillmeters per engine hour have increased 23.7% due to the improved set up time, greater flushing air capacity and rock drill penetration.

### A strong return

Richardson says the savings promise “a strong return” on investment. “Our productivity has risen steeply since the SmartROC T45 arrived, he says. “We’re not just reducing the cost of rock drilling, but have reduced the overall rock excavation cost.

“In addition, we’re working faster than our needs, so we’re now expanding our

operations by doing contract drilling for others using this rig. This extra revenue was not factored into our purchase decision so it’s a great bonus on top of the exceptional results on our site.”

### Seamless transition

Richardson also points out that the transition to the new rig has been largely smooth. “Our rig was commissioned in March this year and although it is the most advanced rig on the market our operators and maintenance team have transitioned seamlessly to it after the Atlas Copco crew spent a week on site training our team. At all times they have been responsive and available and truly committed to ensuring we get the most out of our new machine.”

Richardson added that despite the rig’s high-tech design it is easier for the maintenance crews, as with fewer components there is less that can go wrong.

He concludes: “The SmartROC T45 has fast proven it is a rig we can rely on to deliver consistently accurate results, day after day. The only downside, if you can call it that, is that our operator is not feeling as challenged now as the machine does everything for him!”



*Smooth transition: Atlas Copco spent a week on the site training the Local Mix team.*



*Richardson and Teesdale discussing hole quality on the site.*





# First RC kit goes to **BARRICK PORGERA**

The Barrick Porgera gold mine in Papua New Guinea has become the first mine in the world to use an Atlas Copco DM 45 blasthole rig for in-pit grade control with reverse circulation drilling.

**A** reverse circulation (RC) kit that enables mines to use their DM45/50 blasthole drill rigs for in-pit grade control is now being successfully operated in the field.

The first mine to take advantage of this technology is the Barrick Porgera gold mine in Papua New Guinea, located high in the mountains about 600 km northwest of Port Moresby.

To accommodate the RC kit, the mine's DM45 was upgraded with a number of modifications. Craig Rintoul, who was Open Pit Manager at the time, says: "This drill rig is world class with multiple onsite engineered improvements to the original second hand drill. The upgrade means huge savings on a new rig and RC system."

Safety, functionality, ease of maintenance and cost were all improved with the

installation of the kit. Previously, the mine used its standard blasthole drills to take core samples from the drill cuttings, but this often contaminated the holes making it difficult, if not possible, to analyze the ore.

## **Good business sense**


The new reverse circulation package helps the geologists to better locate and analyze the ore, which, in turn, increases productivity as more time can be spent drilling in mineral-rich ground, compared to waste material. "It will also improve our mine planning, budgeting and reconciliations," adds Rintoul, "and that makes good business sense."

However, why spend time modifying an existing drill rig, when there are rigs specifically made for reverse circulation drilling? According to Rintoul, the main reasons include uniformity with the existing drilling

fleet, ease of sourcing parts, and easy transition for drillers who are familiar with the DM operating system.

In addition, a number of components are included with the optional kit, which can also be retrofitted on drills in the field. The cyclone arm allows for sampling from the ground or platform level, with a vertical raise and lowering function. A cyclone rotation of 160 degrees provides safe access for cleaning, maintenance, and attaching new sample hoses from ground level.

The cyclone assembly includes a hydraulic upper knife valve and pneumatic lower knife valve for collecting and isolating the sample; a hydraulic hinge between the dump box and cone splitter that allows for easy cleaning; and a fixed cone splitter with primary and duplicate sample chutes. All cyclone and sample functions are easily controlled from the operator's cab.

Along with the DM45, the RC kit is also available on the DML, offering hole diameters in the 114–146 mm (4½ – 5¾ in) range with maximum hole depths of 44 m (145 ft). 



ON TOP OF  
**THE**





*Location of the San Cristobal mine in southwestern Bolivia where Atlas Copco's rock drilling tools make a big contribution to expansion.*

# WORLD

## Omega is the bit of choice at San Cristobal



San Cristobal, a world class silver mine in Bolivia, recently trialed three different types of drill bits in order to find the one that could make the best contribution to future expansion plans. It was an easy choice to make.

**A** unique project by Japan's Sumitomo Corporation is under way to develop and expand its San Cristobal silver mine in southwestern Bolivia.

This rich open pit, situated in the mountains at a height of 4 000 m and approximately 500 km south of the city of La Paz, started operating in 2007. Today, it is the world's sixth largest producer of zinc and the third largest producer of silver.

Annual production was 150 000 tonnes of rock with a yield of 40 000 tonnes of ore. Sumitomo, which acquired full ownership of the mine in 2009, has been achieving 1 300 t/day of zinc-silver concentrates and 300 t/day of lead-silver concentrates but is making every effort to expand by

developing the mine's full potential of 180 000 t/day.

To help reach this goal, Minera San Cristobal (MSC), acquired two Atlas Copco Pit Viper 351 rotary drill rigs in 2013 to add to the fleet of three Pit Viper 271 units already on the site.

This meant that the mine would also need a tricone rock drilling tools to meet the larger diameter drilling requirements of the new PV-351. Atlas Copco's recommendation was either the Epsilon H53CA Open Bearing premium rotary drilling bit or the Omega OM54C sealed bearing bit.

The ground at San Cristobal consists of soft-to-medium formations ranging from 50 to 190 MPa, with an unconfined

compressive strength of 90 MPa. The mining process started with blasthole drilling on a 7 x 10 m pattern, with 270 mm and 311 mm diameter drill bits, depending on the type of rock being drilled and its location in the pit area. Normally, the powerful PV-271 and PV-351 drill rigs are both capable of penetrating this material at a rate of up to 60 m/h, or approximately 1 m/min.

### **And may the best bit win!**

In order to find out which bit was most suitable for the application, MSC decided to compare the Epsilon and Omega bits against each other, and then compare them both with a third open bearing bit from another manufacturer. In each trial, the operating parameters were set to achieve an increase in the daily productivity level.

By the end of the test period, the Omega was declared the clear winner, scoring an average life-length of 7 700 m. This

*The Omega sealed bearing bit: Providing vastly superior performance in rotary drilling compared with conventional air-bearing bits.*




» corresponded to 78% more meters drilled compared to the Epsilon, and all of 138% more than the third competing bit.

Jorge Rivera, Rotary Product Specialist at Atlas Copco, comments: “We were very pleased to see these results as they prove that the design of the Omega lives up to our high productivity expectations. It sets a favorable precedent for future applications, especially in contracts based on cost-per-meter drilled or total drilling cost. San Cristobal is now using the Omega and is getting much better bit life than ever before, which of course lowers their operating costs.”

Rivera also points out that although the Omega bit is designed for the type of geology and application at San Cristobal, it is also recommended for copper, gold and iron deposits where open bearing tricone bits can sustain premature bearing failure.

With the addition of the PV-351 rigs and the larger drilling diameter of 311 mm, the drilling pattern at San Cristobal was also enlarged, automatically increasing the breakage volume. At the same time, the mine also decided to increase the bench height for the PV-351 from 10 to 15 m.

The strategy succeeded. San Cristobal achieved its production target of 180 000 tonnes per day in January this year, according to plan. 



## THE OMEGA SECRET

**The word “Omega” is the name of the last letter in the Greek alphabet. It indicates “the ultimate”, “the definitive” or “the superior” – all appropriate descriptions for a top performing product from Atlas Copco Secoroc.**

This sealed bearing tricone bit for rotary drill rigs was introduced in 2012 with a design that is far superior to standard air-bearing roller cone bits. This is primarily due to its high precision machining to close tolerances, innovative seal technology, premium lubricants and proprietary materials.

The bits have extremely smooth bearing contact surfaces as well as a patented outer “excluder”

which prevents contamination from cuttings, grit and water, while an inner seal retains grease in the bearings to lubricate the bearing elements. Together these features have resulted in superior performance, service life and cost savings.

Excellent penetration rates and bit life have been achieved during field tests carried out in coal and copper mining in both Australia and the USA.

### OMEGA OBJECTIVES

- ▶ Exceed air bearing bit life, where bearing failures due to heavy bit loads, fast drilling with cuttings invasion, and contamination of bearings by ground water are the reasons for bit removal.
- ▶ Provide lower Cost/Distance than an air bearing bit in the same application.
- ▶ Use fewer bits, thereby increasing the safety level by reducing the frequency of bit changes.

### OMEGA FEATURES

- ▶ New patented tricone outer “excluder” and inner bearing seal.
- ▶ Sealed bearing with resistant synthetic lubricants – for high loads and high RPM.
- ▶ New cutting structure for abrasive and hard rock formations.
- ▶ Streamlined lug for fast evacuation of cuttings.







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Since 2009, the Minetruck MT42 has delivered productivity for mines around the world. Now we have loaded the truck with new features making it outstanding in its class when it comes to safety, productivity and sustainability. The result: unmatched performance in underground mining and construction operations.

Read more on [atlas-copco.com/MinetruckMT42](https://atlas-copco.com/MinetruckMT42)

*Sustainable Productivity*

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# Symmetrix does the trick in tricky Scottish ground

A special ground engineering project outside the city of Aberdeen involving the drilling of 220 boreholes in mixed rock formations required an equally special system to get the job done.

The result was impressive. Each hole took just 20 minutes to complete.

**D**rilling contactor Drilcorp Ltd., of County Durham, UK, was recently awarded a contract to carry out a ground dewatering operation outside the city of Aberdeen on the northeast coast of Scotland. The task: to drill 220 holes, 168 mm in diameter, to a depth of 7.5 m. Sounds simple enough, but proved to be easier said than done.

The site consisted of 5–7 m of overburden comprised of varying layers of sand and gravel and interspersed with large granite cobbles and boulders before finally reaching granite bedrock.

The Drilcorp team got to work but this mixed strata combination quickly proved problematic and time consuming. In an attempt to find a solution, John Gowans, Director of Drilcorp, consulted with his contacts at Atlas Copco.

“I wanted a tried and tested overburden system capable of tackling this chaotic strata,” he says, “and we wanted a system that was robust enough to take some serious punishment.”

Another of Drilcorp’s requirements was reliability. “We had tried other systems at previous projects and they all had reliability

issues,” he adds. “Now we just had to have a system that would run smoothly, with minimal downtime and maximum progress.”

Atlas Copco proposed a trial with the latest N series R168 Symmetrix overburden casing system complete with a new COP 54 hammer. The package was put together and delivered to the site followed by a visit from James Mollon, Atlas Copco Area Sales Engineer, to commission the system and train the operators.

Mollon recalls: “We set up the new system and began drilling the first hole, running the compressor at 10 bar and with a low rotation speed. We soon encountered numerous large boulders, but these proved to be no match for the Symmetrix system.

“The operators were a bit apprehensive about using the new equipment at first but they managed to achieve the required hole depth in just 20 minutes. One of the operators joked that it would take him longer to pull the casing than it did to drill the hole – and it did!”

## Design upgrade

The R 168 system, previously known as 131, had recently been given a design upgrade. This included an improved flushing capability as well as a dramatic improvement in quality, enabling it to sustain a great deal more stress and wear.

“I have personally drilled in similar ground conditions using the previous

“ We had to have a system that would give us minimal downtime and maximum progress.

John Gowans Director of Drilcorp Ltd








*The key components of the Symmetrix R168 system: The pilot bit on the COP 54 hammer (left) and the Symmetrix ring bit assembly (right). The system enabled Drilcorp to drill a 168 mm diameter hole, 7.5 m deep, through mixed formations in just 20 minutes.*



131 system and I can confirm that the new Symmetrix design is a real weapon," Mollon says. "Even just drilling to a depth of 7.5 meters on this site I could see a vast improvement. The latching in and out of the ring bit has also been dramatically improved with less rotation required due to the five latching points. It seamlessly glides into latched and unlatched positions, and this

was also noted by the Drilcorp operators." Drilcorp got the job done, and Gowans was impressed. "We were very pleased with the new R 168 Symmetrix system from Atlas Copco. As Jimmy proposed, it turned out to be the perfect solution to this problematic project and the onsite training was second to none." While at the site, Drilcorp also decided

to purchase a second Symmetrix system and COP 54 hammer. Mollon concludes: "Apart from securing orders, this successful trial has helped to build a strong and successful relationship with this customer. In addition, three other drilling contractors in the UK have now expressed an interest in the new Symmetrix system." 





# A great tool for the digital age

Easy access to information is a prerequisite for tunneling and mining engineers to help them produce a tunnel or a drift that matches the planner's original design. With Underground Manager from Atlas Copco, all of this information is now readily available.

By Johan Jonsson, Product Manager, Face Drilling Equipment, Atlas Copco Underground Rock Excavation

In the world of underground construction, where speed, accuracy and safety are paramount, the need for fast, practical and professional data management has never been greater.

When it comes to tunneling, huge amounts of information has to be collected, analyzed, shared and stored. This is especially true of today's increasingly complex urban tunneling projects that require more drill plans, more control and more adaptation due to an abundance of subsurface installations.

In mine development, it is a similar scenario. Many complex networks of drifts and cross passages are being constructed or planned through difficult formations in order to access new, deeper orebodies.

Fortunately, technology has kept pace with the demand for data and there are now several data management systems on the market which, in one way or another, make information management less of a burden. Among these, one system tends to stand out – Atlas Copco's Underground Manager.

## Born for tunneling

This tool was originally introduced under the name Tunnel Manager and was designed to support civil tunnelers using our Boomer face drilling rigs. A similar tool, called Ore Manager, had also been introduced for our production drill rigs used in the mining industry. These two tools have now been combined into one system for all Atlas Copco underground equipment and is

arguably the most comprehensive system of its kind.

Underground Manager brings together the planning and administration of drilling and blasting into one simple tool. Its primary function is to generate drill plans that enable the rig operator to position drill holes correctly, create log files showing where the drill holes have been placed and provide information for navigating and positioning. It does this by enabling drill plans created in the mine or site office to be seamlessly transferred to the drill rigs, either on a USB memory stick or via local area networks.

In addition, thanks to the RCS control system installed on all of our computerized equipment, the system is fully integrated with a broad range of useful functions



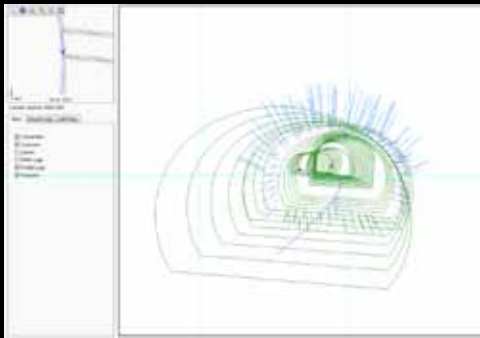


Fig 1

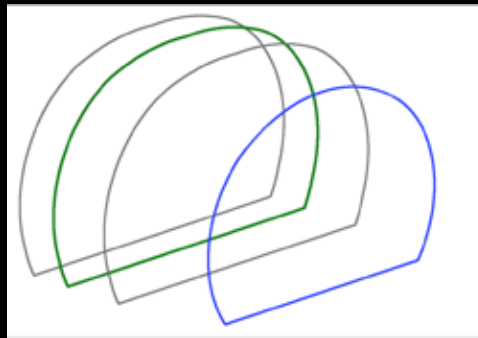


Fig 2



Fig 3

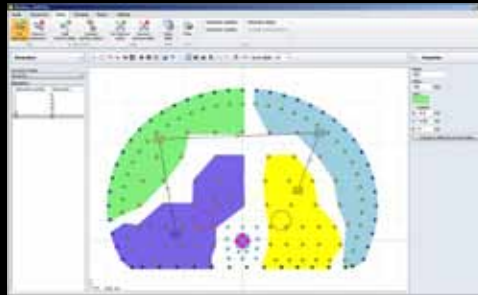


Fig 4

Four typical screen displays as presented in the drill rig by the Underground Manager tool:

Fig 1 shows a 3D image of a tunnel/drift, imported directly from an IREDES-compatible CAD-system.

Fig 2 shows the interpolation of the tunnel rounds to be blasted.

Fig 3 shows a typical drill plan with the correct positions of the holes marked out.

Fig 4 shows a typical firing pattern.

such as Tunnel Profiler and Measure While Drilling (MWD). This means that UM will capture all of the log files, including the scans produced by Tunnel Profiler, and reproduce them as reports. It is important to note here that although UM represents state-of-the-art technology, it can be used with older generation drill rigs as well the latest equipment and is being continually improved and refined.

### Drill plans in 3D

The latest version of UM includes three major upgrades, all of which will have a big impact on the user. The first, and perhaps the most important, is that the system is now able to directly import digital information from the CAD systems normally used by our customers for generating project drawings, provided they are compatible with the IREDES format (International Rock Excavation Data Exchange Standard).

This is a big step forward as it means that the 3D modeling functions used by these systems can be perfectly replicated in the drill rig, showing the exact position of the rig and the interpolated contours of the tunnel faces. Previously, if a drill plan was created for a section of a tunnel that

gradually widened, and no contours existed for that position, the interpolation of these contours had to be done manually. Today, both the planned contour at the bottom end of the round to be blasted, as well as the contour of the face, can be clearly identified by the mine planner using UM. As a result, drill plans can be created with the correct length, lookout angle, type and diameter.

Using 3D modeling in this way is a considerable time-saver and also greatly reduces the risk of error. In addition, the 3D renderings generated by UM are useful for coordinating with all key personnel involved in the project.

### Charging and firing


The second upgrade allows the full integration and administration of charging and firing plans. This enables drill plans to be generated showing how the hole is to be charged and exactly when it will be fired. In addition, any changes that are made are automatically updated and synchronized with all other information in the system.

This is also a great advantage. By selecting designated sections and using the UM's drawing tool, various firing scenarios can be tried and tested with blasthole sections

given individual delay times, according to a chosen sequence. This ensures that the right firing sequence is employed.

### New interface

Lastly, we have equipped the system with a completely new interface that is more user-friendly and more intuitive, with better graphics and improved logging and reporting functions. And thanks to the latest RCS 5 rig control system, many new functions have also been added. Not only is it easier to select options and interpret the data, the system is now available in 16 languages, which broadens accessibility, resulting in greater productivity and safety.

All this and more, makes Underground Manager an indispensable tool for underground construction and mine development for many years to come. 



Johan Jonsson is a member of the product development group at the Atlas Copco division Underground Rock Excavation based in Örebro, Sweden.

# A MEXICAN MI

## First PowerROC T35 E in the country shows its power

Mining and quarrying contractor Zemer Constructora recently became the first company in Mexico to acquire the Atlas Copco PowerROC T35 E drill rig. It was a milestone for Zemer, for Mexico, and for surface drilling technology.

**M**exican drilling contractor Constructora Zemer specializes in providing drilling services to the cement and aggregates industry. It has approximately 500 operators at work across 10 sites, nine of them in Mexico and one in the U.S., producing 70–80 000 tonnes of limestone per day.

When the company decided to upgrade its drilling fleet, it chose the Atlas Copco PowerROC T35 E and created a new milestone in the industry by becoming the first drilling contractor in the country to do so.

Zemer put the rig to work in the Cerritos quarry near San Luis Potosi which is owned by cement producer Cementos Moctezuma. At this site, 3.5 million tonnes of material is extracted annually of which 2.5 million tonnes is limestone.

### Significant difference

The new rig arrived on the site in 2013 and since then, according to Jaime López, Manager of Zemer Unidad Cerritos, it has made a significant difference to productivity.

“The PowerROC T35 E enables us to extract this material very efficiently,” he says. “Drilling on the benches here, which are 16.5 meters high, the rig gives us a production of 25 to 32 meters per hour. That’s a very good performance for us.”

A typical week at Cerritos consists of 7.4 hours of drilling per day and 11 shifts. The PowerROC T35, which uses Atlas Copco T45 rods, drills 89 mm holes, drills to a depth of 17 m according to a drilling pattern of 3.1 m x 4.3 m. Lopez notes that the rig takes an average of 32 minutes to complete one hole. It drills on average 25 m per hour for 16 hours per day which gives a total productivity of 400 m per day. In terms of wear, the lifelength of the drill rods has been calculated to be 1 390 m and

“ The operators appreciate it when they see we are concerned for their safety and comfort.

Jaime López Manager of Zemer Unidad Cerritos



The Zemer Constructora drilling team at the Cerritos quarry: From left, Gregorio Ortiz, Francisco Martınez (Atlas Copco), Jaime López, Eladio Pina, Delgadillo (Atlas Copco service) and Jorge Daniel Hernández.



# LESTONE

1 112 m for the shank adaptors, without regrinding.

## The safety factor

Lopez continues: “We have worked with several different machines over the years and we are proud to be using the PowerROC T35 E. It is a very innovative and efficient machine. In addition, it gives us increased safety which is very important for our operators. For example, the rig comes with different control panels so that it can be controlled from different angles. This enables them to work at a safe distance from the pit slopes between the benches.

“We are concerned for the safety of our personnel and this equipment provides better safety and comfort than other

equipment we have used. With the combination of improved efficiency, productivity and safety the PowerROC gives us what we need in order to be able to continue growing as a company. “Also, when we are buying this kind of equipment, it demonstrates our concern for our operators’ safety and comfort and that’s something they appreciate because it makes them feel more secure in their work.”

## Future expansion

Today, Zemer has two PowerROC T35 E rigs in its fleet which, until now, consisted of seven ECM 590 and ECM 350 pneumatic rigs, also supplied by Atlas Copco, and with its sights set on growth and expansion, the company says that Atlas Copco is making a big contribution.

“We have been working hand in hand with the personnel from Atlas Copco for a number of years,” Lopez points out. “They have answered all our calls for support. They gave us training when the equipment was delivered. They contact us regularly to see how the equipment is doing, and they have been here to carry out the few service operations that are required on this machine.”

Summing up, Lopez adds: “All of this enables us to comply with our customers’ requirements and gives us more confidence to continue working with Atlas Copco.”

*A first in Mexico: The PowerROC T35 E on the 16.5 m benches at the Cerritos limestone quarry.*







As India explores its oil and gas reserves to enhance domestic production, a new technology has emerged for deep well drilling – the Predator Drilling System. Developed by Atlas Copco Drilling Solutions in the U.S., Predator is now helping the Indian Oil & Gas industry to take drilling performance, energy efficiency and safety to a new level.

# PREDATOR – STAR

For a country looking to reduce its dependence on imports of oil and petroleum products by exploiting its domestic natural gas, the latest technology and advanced equipment is critical.

India still predominantly uses conventional methods of exploration and production drilling, which is time consuming and expensive. That's why,

when Indore-based contractor Shivganga Drillers Pvt Ltd., was approached by various oil and gas exploration companies, it realized that a significant advantage could be had by adopting the latest technology.

“We were aware that Atlas Copco had done extensive field trials with both mud drilling and air drilling and that its

Predator Drilling System incorporated very advanced, new generation technology,” says Anuj Rathi, Shivganga's Chief Operating Officer. “We decided it was extremely suitable for this task.”

As a result, Shivganga brought the world's first Predator system to India in 2013, and soon after its arrival, the company was awarded a major drilling contract from ONGC (Oil & Natural Gas Corporation Ltd) India's largest oil and gas exploration and production company, to drill a well more than 2 000 m in depth.

“The Predator system is extremely suitable for this segment as it incorporates very advanced technology.



Anuj Rathi Chief Operating Officer, Shivganga Drillers Pvt. Ltd

#### Difficult challenge

However, this project was not as easy as Shivganga initially thought. Located in the interiors of central India, the site posed a major challenge. In most zones, the company encountered sandstone with an abrasiveness of 80–85 percent, mixed





# OF INDIA

with much softer formations making it difficult for the driller to anticipate the hardness of the rock and act accordingly.

“The compressive strength of the formation was fickle, ever-changing and never a constant. When you encounter a formation that changes so fast you need to be very careful and have very precise control over all the parameters,” explains Rathi. “Thankfully, the Predator gave us that kind of precision and we were able to keep changing the parameters depending on the requirements. The machine responds very quickly and you can change these parameters instantly.”

During the project Shivganga says it achieved a performance of more than 400 m in 18 hours – a speed it believes may be a record in such formations. “We managed to keep our promise and delivered a time saving of 35 to 40 percent.”

Rathi comments. “Using conventional drilling technology, it would have probably taken around six to eight months to drill this well, whereas we did it in just two and half months, including field trials, testing, setup and drilling. That’s probably never been equalled.”

#### Outstanding rock drilling tools

Shivganga insisted on full support from Atlas Copco and therefore chose Secoroc DTH hammers and bits for this deep, high pressure, percussive drilling application. Secoroc QL 120 hammers were chosen for the larger diameters (442 and 323 mm) and QL 80 hammers for the final 216 mm diameter finishing section of the well.

The performance of these hammers was unmatched. Perfectly married to the Predator they delivered exactly the desired speed for the depths. The QL »»

*Nightfall at the site: The giant, mobile Predator drilling a gas well more than 2 000 m deep.*

hammers also came with additional attachments such as a hydrocyclone and a bit retrieval system, which made them even more efficient.

The retrieval system could hold the bit, in case of breakage from the shank, and under no circumstances could a bit be lost inside the well, eliminating the need for “fishing” and the risk of having to abandon a hole.

The bits also had buttons specially made with polycrystalline diamonds, on the face and gauge, to make them more aggressive in the hardest rock.

“ONGC was very excited with the progress we made with this rig,” says Rathi. “They were a little sceptical initially about the outcome if we found hydrocarbons, but we managed to finish the work successfully.”

#### Safety and environmental impact

The Oil & Gas industry is both hazardous and environmentally sensitive, calling for the highest levels of safety and health

“ We took the challenge and the risk because we had confidence that Atlas Copco could give us the right support.



BL Rathi, Director, Shivganga Drillers Pvt. Ltd.

precautions. Any contractor or company aiming to get into Oil & Gas exploration and mining has to follow strict guidelines set by the Director General of Mines Safety. Shivganga was no exception and had to ensure stringent safety and environment norms when carrying out the drilling work. In this respect, the energy efficient and environmentally friendly design of the Predator gave Shivganga an added advantage in negotiating the contract.

“The Predator consumes less diesel and

requires fewer oil changes in comparison to other drilling systems,” says Rathi. “The level of emission and sound pollution is also extremely low for the rig. In fact, it’s way below the permissible limits in India.”

Another big plus point was the Predator’s mobility that reduces the rig setup time. “With conventional rigs, it takes roughly two months to mobilize and set them up, whereas the Predator, being a mobile machine, can be set up in a matter of hours. Also, it’s an automated drill so you need less manpower



Mukul Bahety, Chief Executive Officer at Shivganga, says he is pleased with the results of the first well drilling project. “Overall we are extremely satisfied with the Predator’s performance and we think it has a huge future in this country.”



Ready to work: The Predator truck is backed up onto its platform and fixed into the drilling position before the mast is raised.





*Manning the control panel: The Predator completed the targeted depth of more than 2 000 meters on time and with a “best performance per shift” which the company believes is a record in the Indian O&G industry.*

which means there are fewer safety hassles and hazards,” adds Rathi.

Shivganga managed to complete the ONGC contracts in the preset time frame, which enabled the company to win two more drilling contracts in quick succession.

#### **High quality service and support**

One of the company’s main concerns, as a newcomer to the O&G drilling business, was the consequences of not being able to source spare parts in time in the event of a breakdown.

“In the O&G business, once the explorer identifies the well, they set up a timeline for drilling. This is defined in the actual contract and the job has to be completed within the stipulated time period. If the work goes beyond that, a penalty has to be paid by the contractor,” adds Shivganga’s Director B L Rathi, who has three decades of experience in water well drilling before entering the O&G business.

“We took this challenge and the risk because we felt confident that Atlas Copco could support us as they have been in India

for so many years. All of the promises made to us during the purchasing process, right from providing adequate backup to bringing engineers from abroad to support us and train our people, were fulfilled satisfactorily. Their response was fast, they listened to our problems and attended to them very quickly.”

#### **Working to improve**

Mukul Bahety, Chief Executive Officer at Shivganga, explains that the company is now working to make the Predator even better. “We are in a learning phase, understanding the opportunities that an advanced system like the Predator can offer and are working together with the Atlas Copco team to further improve the machine’s performance.”

He concludes: “Overall our customer, ONGC, as well as ourselves, are extremely satisfied with the Predator. I see this rig having a huge future in India and I anticipate that the Predator population in this country will go to at least eight or ten within the next five years.”



#### **PREDATOR DRILLING SYSTEM**

The Predator Drilling System is a unique package that applies innovation and proven technology to exploration and production drilling. With a 30-year history and an experience-base of over 300 rigs in the global oil industry, it reduces non-drilling time and cost, improves performance and energy efficiency and enhances safety.

With its 90 000 kg (200 000 lb) of hookload, the rig has the strength and capacity to drill vertical, directional and horizontal wells in today’s global oil, CBM and natural gas basins.

#### **See it on YouTube**

Discover how the Predator system works. Search for “Atlas Copco, Predator” on YouTube.



*Insight  
On*

# UNDERGROUND TRENDS

Tomorrow's underground mines will be more remote with orebodies that are difficult to reach and consequently more dangerous to excavate. Against this background, Atlas Copco's **Mattias Pettersson** says mining companies have only one option.

**Q:** *How would you summarize the biggest challenge for underground mining?*

**A:** The most important issue is how to excavate minerals and metals in difficult and dangerous environments, and do it efficiently and safely. The fact is, many of today's mines are becoming depleted and the next generation of mines will require a completely different approach in order to be successful.

**Q:** *In what way will these new workings be more difficult to deal with?*

**A:** Firstly, many of them will be located in very remote areas, which means they will be less accessible. Secondly, they are likely to be much deeper than today's mines with orebodies that are much harder, requiring more complex infrastructure. Thirdly, the challenge of working in deep, confined and unstable areas will inevitably involve more health and safety issues. Environmental and safety regulations are increasing constantly and in all probability, humans will not be permitted to work in such hazardous environments at all in the future.

**Q:** *So what options do mining companies have going forward?*

**A:** To my mind, there is really only one. They will have to embrace automation technology to the full and there are strong signs

that this is already beginning to happen. The interest in and demand for automation is stronger now than ever before, a trend that was clearly evident at the Euro Mine exhibition in Sweden this year.

**Q:** *What are the main advantages of automation underground?*

**A:** Apart from the obvious impact on safety, automation has a central role to play in terms of optimizing the mining operation. For example, automation allows machines to work between shifts, during blasting, and during the night. Optimization naturally leads to increased productivity because you can get more out of the equipment.

**Q:** *To what extent is automation technology being applied in today's mines?*

**A:** It's increasing all the time. One reason for this is that many mines have now greatly improved their communications infrastructure. Ten years ago, hardly anyone believed that a wireless Local Area Network could actually work underground. Now it is more of a given as most of the applications in the field of automation require access to a network of one kind or another.

However, we should remember that despite the growing interest in automation, a lot of people are still sceptical. It's normal to be a little apprehensive about something

new and what it might lead to. That's the way it's been throughout history, every time a major technology transition has come along. But nobody wants to turn the clock back to the days of hand-held rock drills.

**Q:** *To what extent is automation being applied in the tunneling sector?*

**A:** At first glance you might think that automation is more for mining applications because these involve continuous production. That's true to a certain extent, especially when it comes to remote control. But there is still a great need in tunneling for auto-assist functions that help the operator to be more efficient, such as systems that provide more consistent drilling accuracy. Monitoring and data logging are also important areas for automation that involve major benefits for tunnelers.

**Q:** *What are the key focus areas of automation development today?*

**A:** At Atlas Copco we are concentrating on three areas – the functions of the equipment, the operator's work situation, and the collection and integration of data. When it comes to designing new functions, the only limitations are our own imaginations and the cost of development. We have a great advantage in that all of our new machines are equipped with computerized control



*Mattias Pettersson is a leading member of the Atlas Copco team in Sweden working with the automation of underground mining and tunneling equipment.*



systems which enable a large number of automatic functions to be added.

We are also making it possible for the operator's workplace to be moved further and further away from the worksite. For instance, an operator today can stand 50 meters away from a drill rig to avoid being in an area where there is a risk of rockfall. But he or she can just as easily be located much further away than that. In Chile, for example, one mine placed its Scooptram operators as far away as 80 kilometers from the mine site, and it worked perfectly (see *M&C No 2, 2013*).

Other examples of Scooptram automation can be found in Canada where it is mainly used as a safety measure to give operators a safer work environment. In


Sweden, the LKAB mine operates a fleet of Simba long-hole rigs from one central control room, and there are similar systems installed in Finland and the U.S.

**Q: How long will it be before all mines are fully automated?**

**A:** That's impossible to predict. It is a step-by-step process. But what we can say is that given the current level of demand and development it is likely to be sooner rather than later. By embracing automation to the full, mines can realize huge gains in terms of productivity and availability. It is interesting to note that at the beginning of the 1900s, one operator with a handheld rock drill produced 3 to 5 drillmeters per hour. Today, that capacity has increased to

around 450 drillmeters per hour by using a drill rig. Now, thanks to automation, we can double that figure by simply enabling one operator to handle two machines... and that's only the beginning.

**Q: What will be the next innovation in automation for underground miners?**

**A:** We are soon introducing a new system for multi-machine control of underground loaders which enables one operator to handle several machines simultaneously. However, as the loaders are semi-autonomous, meaning that the buckets are still filled manually, there is still a limit to the number of loaders that one operator can control. 

(For more on automation see *M&C 2, 2013* and *1, 2014*).



# Drilling for **KNOWLEDGE**

Researchers from around the world are currently studying the evolution of the planet based on information provided with the help of Atlas Copco and a 2.5 kilometer deep drill hole.

**A** deep hole drilling project in the mountains of northern Sweden may help to unlock some of the Earth's best kept secrets. The project, launched by the Swedish University of Lund and involving 50 scientists from 14 countries, is expected to enhance global knowledge of the forces at work as the planet evolved over 400 million years.

The researchers have been using a specially designed Christensen CT20C core drill rig from Atlas Copco to gather information from 2 500 meters (2 495.8 m to be precise) down in the Earth's crust.

The site was at Fröa, a small mountain community not far from the skiing resort of Åre, some 600 km north of Stockholm. Due to its geological history, this is one of the few areas in the world where research of this nature can be carried out.

Using the Christensen CT20C rig, a team spent four months, from April to August this year, collecting core samples. Working two shifts per day, six days a week, they took a total of 18 tonnes of cores, 46.7 mm in diameter, from the 75.8 mm diameter drill hole. These cores are currently being examined by geoscientists in Berlin, Germany.

The international investigation aims to establish the various processes and changes that have taken place at this depth in the rock over million of years.

### **Looking at life 2.5 km down**

The investigation focuses on tectonics, geophysics, geothermal activity, hydrogeology and the deep biosphere. But one of the more exciting aspects being undertaken by microbiologists is to identify microbes and bacteria – in short to find out what

kind of life exists 2.5 km below the surface.

“This is an amazing project and there are many different areas of investigation underway that can make a significant contribution to our understanding of these processes,” says Henning Lorenz, from the university's Department of Engineering Geology.

“For example, by measuring the temperature of various rock types we can calculate the thermal flow and then work out what the temperature on the surface of the earth was like at various periods in history. We are also measuring water flows to find out how the water from the mountain range moves out to the Baltic Sea.”


Jan-Erik Rosberg, Project Director, says the researchers chose the Christensen CT20C primarily because of its ability to enable drilling at great depth. Not only that, it can drill a hole 2.5 km deep while





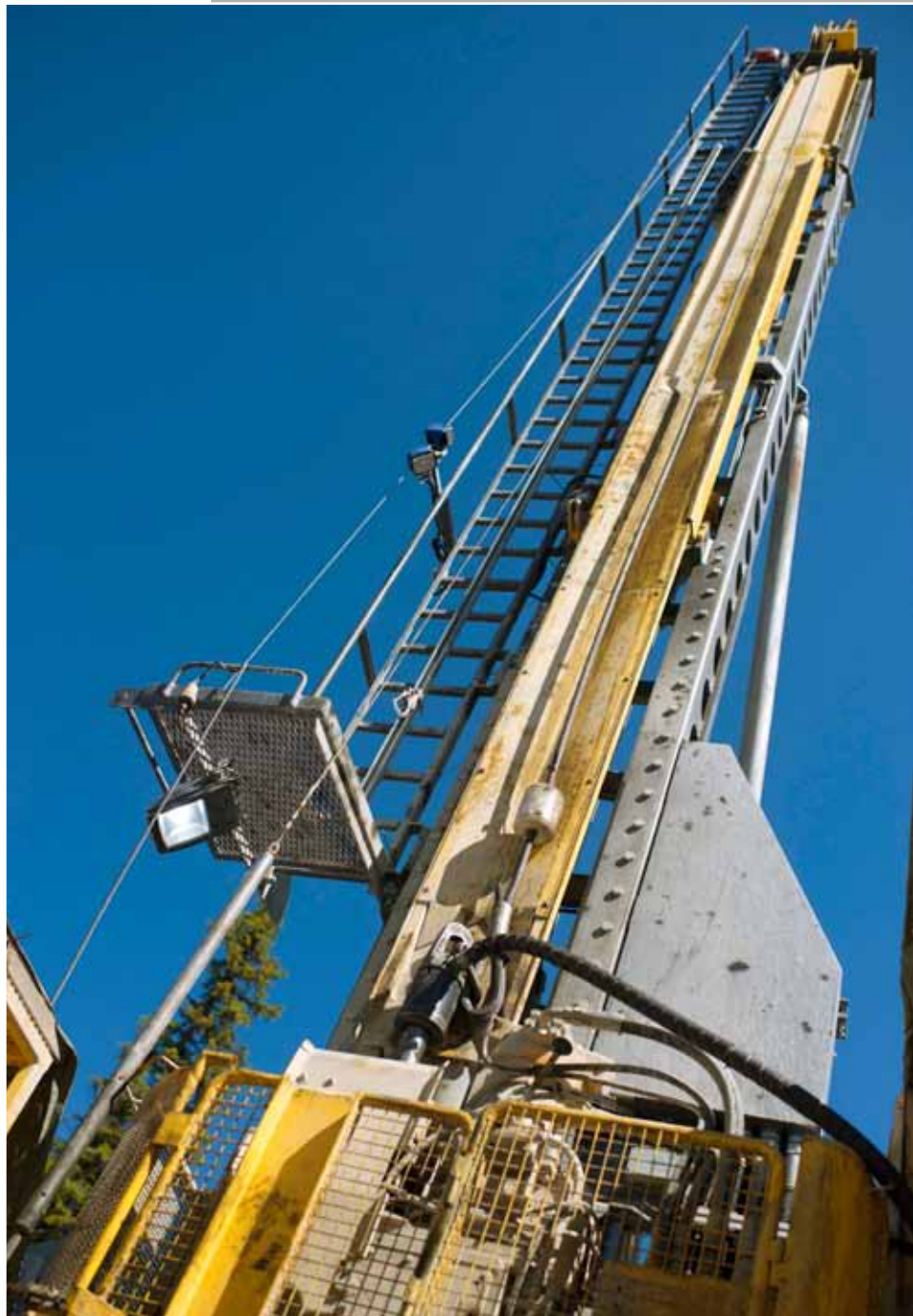
*Why here? The ancient Scandinavian mountains once had peaks as high as the Alps but these have been drastically eroded over time, making the site ideal as the surface geology is already considered "deep". From left: The core sampling team at work; boxing up the 46.7 mm diameter cores for analysis; overview of the work-site where the 2.5 km hole was drilled and, below, the Christensen CT20C with its distinctive wireline feed.*

mounted on tracks or on a truck which has allowed the team to test and develop new drilling technologies and tools.

The Christensen CT20C, which is owned by Lund University, has been named "The National Drill Rig" by the Swedish research team. "The reason for this is that it has proven to be ideal for scientific exploratory drilling projects of this type and particularly when it comes to coring in such deep holes," adds Atlas Copco's Product Line Manager Eric Diaz Arguelles. "As a result, the researchers plan to use it for similar projects elsewhere in Europe." 

#### THE PERFECT DEEP HOLE EXPLORER

The Atlas Copco Christensen CT20C is a diamond core drilling rig specially designed for deep hole drilling up to 2 500 m. It is the most powerful rig in the range and yet very easy to operate. Its feed system, which is one of the key characteristics of Christensen rigs, enables high productivity and the control console provides a high level of automation and safety. The rig is also equipped with a sound reducing engine canopy and a modern Tier III low emission engine. It displays specific drilling parameters such as rpm, feed force, WOB (weight on bit), water flow and drilling penetration rate. The drilling diameter was 75.7 mm and the diameter of the cores was 47.6 mm.







*Operator Chad Marchant: He was the first to be trained on both the SpeedCut diamond wire cutter as well as the SpeedROC D30 down-the-hole drill rig.*

*The remote control station allows operators to optimize the diamond wire line's speed and move the SpeedCut on its rails. Stone cuts of up to 185 square meters were made in about 10 hours in this ASTM Type III limestone.*

# SPEEDCUT in the USA

A dimension stone specialist in the USA has increased its productivity by up to 40 percent after switching the drill and blast method for diamond wire cutting.

**V**alders Stone & Marble Inc. of Wisconsin, recently decided to switch its production method from drill and blast to diamond wire cutting. The result is a 40% increase in productivity and lower costs.

The quarry, located in the small community of Valders, now uses a SpeedCut diamond wire cutting machine, in combination with a SpeedROC D30 down-the-hole drill rig to drill the 89 mm holes for the diamond wire, both supplied by Atlas Copco.

John Schnell, the company's Vice President, Operations, says: "We were shooting 800 feet (244 m) in 450-hole shots. Explosives, drilling and labor for a shot like that is tens of thousands of dollars.

Labor is still about the same, but we save on explosives now which accounted for a third to two-thirds of the cost for each shot."

### **Sawing for savings**

In addition to savings on explosives, the quarry has reduced waste by up to 50%. Schnell explains: "We have some of the most desirable limestone in the country, but we also have a lot of seams. Sawing optimizes what we have by preventing excessive fracturing." The smooth cut of the faces also means that there is less stone for the finishing crews to trim.

Operator Chad Marchant says: "Overall, the work is a lot easier on us than before,

and of course the saw doesn't make any dust at all since we're running water on the line in the stone."

To begin a cut, a 20 m long horizontal hole is drilled at the base. This hole is then intercepted from above with a vertical hole drilled roughly 6 m deep. The diamond wire is then fed through these holes, separating the back of the block from the rock formation.

At the beginning of the cut, 50 m of wire is threaded through the saw's flywheels and connected to form a loop. Slabs 2.5 m wide are then sliced off the block, with each slab requiring a horizontal hole drilled at the base.

As the saw cuts, Merchant maintains the tension using a remote control to back the machine up on its tracks. When the saw reaches the end of the track, the operator takes a 10 m length of wire out of the loop.









*The PV-311 during field testing at a U.S. copper mine. Several design features in combination enabled the rig to drill 20 m holes with excellent hole quality and fuel efficiency.*

“ The PV-311 had no trouble hitting the hole depth with the ideal hole quality.



**Maureen Bohac**  
Product Manager, Large Blasthole Drills, Atlas Copco.





*Quiet and comfortable:  
The cabin of the PV-311  
was especially appreciated  
by the operators.*

## FULL MARKS for Pit Viper 311

Atlas Copco's new Pit Viper 311 has successfully completed rigorous field testing at a copper mine in the USA, clearly confirming the value of many of the rig's key design features.

The latest member of Atlas Copco's blasthole PV-310 rotary drill rig range – the Pit Viper 311 – has recently completed a six month field test at a copper mine in the southwestern region of the United States. The result: full marks on all counts.

The prototype PV-311 went into service at the mine with the focus on cooperation between mine personnel and Atlas Copco engineers to test modifications that would help increase productivity and efficiency.

The PV-311 drilled 255 mm (10<sup>5</sup>/<sub>8</sub> in) and 317 mm (12<sup>1</sup>/<sub>4</sub> in) diameter holes – the largest hole this rig can drill – on benches 15 m high.

The 255 mm holes were drilled to a depth of 17 m with 2 m of subdrill, while the 317 mm holes were drilled to a depth of 20 m with 3 m of subdrill.

Five different drill patterns were used depending on the location of the test in the pit. The rig typically completed 35 to 40 holes amounting to 365 meters drilled in a 12 hour shift. The average availability was 90–95%.

The rock encountered in the mine is typical of most copper applications, not homogeneous and with a compressive strength around 250–300 Mpa.

Atlas Copco Secoroc Tricone/DTH bits

were used with each bit lasting 2.5–3 days. The prototype rig was subsequently purchased by the mine.

Maureen Bohac, Product Manager, Large Blasthole Drills, at Atlas Copco says: “The PV-311 had no trouble managing rough conditions while consistently hitting its targeted depth and maximizing the quality of the hole drilled.


“One of the contributing factors was that the PV-311 is designed so that the bits are changed above the rig's deck, even while single-pass drilling a 20 meter deep hole. This enabled the operators to focus on making and breaking the pipe connections each time.

“In addition, this prototype included our optional hydraulic clutch, which is designed to reduce fuel consumption during non-drilling operations and this had a big impact. Another factor that influenced fuel efficiency was the autodrill functionality of the rig's RCS rig control system.”

Fuel efficiency was approximately 20 per cent better than other rigs on the site. On top of this, the PV-311's quiet and comfortable cab proved to be especially appreciated by the operators.

“The new cab on the PV-310 series is one of the things operators are most excited about,” continues Bohac. “The cab has a

fully adjustable and elevated chair with joystick and cab controls and an excellent view with larger windows and mirrors, well placed so the operator can see what's going on at ground level and in front of the rig.”

The PV-311 is now production drilling at mines on three continents in applications including copper, coal and iron. 

Designed to fill a gap between the PV-270 series and the largest blasthole drill offered by Atlas Copco, the PV-351, the PV-311 can drill in soft and hard rock formations, operating at the lower end of the PV-351 and the upper end of the PV-270 series.

A multi-pass version of the PV-311, called PV-316 is now under development. The PV-316 will drill to a depth of 90 m (295 ft) using a 5-rod carousel with 50-ft drill pipe. The PV-316 will match the flexibility required for cast-blasting operations in coal mining.

The two-speed hydraulic rotary head (currently used on the DM-M3), delivers 17.62 kNm (12 880 lbf) of rotation torque at 140 rpm and 7 000 lbf at 240 rpm.

Hydraulic cylinders drive the cable feed system, and the patented automatic cable tensioning system reduces cable and rotary head guide wear by continually keeping the rotary head aligned and taut, reducing unscheduled maintenance time.

# THE WORD IS SPREADING

## Turkey discovers how to keep running costs down

The introduction of Atlas Copco's SmartROC T40 drill rig is helping Turkish contractors to slash their fuel bills and improve their productivity – and the word is spreading fast.

**W**ith fuel prices among the highest in the world, many Turkish contractors find it difficult, if not impossible, to keep their running costs under control.

Today, however, an innovation from Atlas Copco in the form of the SmartROC T40 surface drill rig is making a significant contribution, enabling drilling contractors to drastically reduce their fuel bills, in some cases by as much as 50 percent.

The quarrying company, Erkoç Kırmataş A.Ş., is a typical example. This well established family firm operates a limestone quarry in Bornova-Izmir city where it has been producing aggregate and limestone products for more than 40 years.

The quarry produces around eight million tonnes per year. However, like many similar businesses in Turkey, the biggest cause for concern is the price of diesel fuel which is the second highest in the world, after Norway.

Consequently, when the company learned that Atlas Copco had developed a new energy efficient drill rig, Erkoç Kırmataş was happy to be the first to put it to the test.

Owner Burak Erkoç explains: "They told

us this rig could cut our fuel costs in half and of course we were sceptical. We didn't think it was possible, but we were prepared to give it a try."

Erkoç Kırmataş already had a fleet of Atlas Copco drill rigs in operation and the ground conditions at its quarries, which are characterized by fissures and cavities, are a constant challenge for both rigs and drill steel. Any opportunity to reduce running costs in this harsh environment was welcome.

### Two rigs combined into one

The SmartROC T40 arrived on the site during the summer of 2013. One year later, it had become a permanent member of the equipment fleet, producing as much as two other drill rigs combined. And even more important, it drastically reduces the company's fuel bill with every shift.

"When we first considered buying the SmartROC T40, people in the industry were talking about machines that could save one liter per hour," recalls Erkoç. "However, during a test run at our quarry, our fuel consumption dropped from 37 liters per hour to 13 liters per hour, with the lowest being

12.81 liters per hour. If we didn't believe it before, we do now! SmartROC T40 is an innovation that lives up to its claims."

The test results were equally positive even when high performance was prioritized over fuel efficiency. "Even when we operated the rig at full capacity to get the highest possible productivity, the fuel consumption was still only 17 liters per hour," Erkoç exclaims. "That's excellent for us. At that rate, we estimate that the rig would pay for itself in 15 months, just through the savings we are making in fuel costs."

So far, the rig has drilled about 25 000 m and has about 600 hours on the tophammer rock drill. An added bonus is that the rig's wear and drill steel consumption have also been reduced.

The SmartROC T40 rig uses 89 mm bits to drill 12 m deep holes. Drill patterns vary from 3 x 3 to 3.25 x 3.5 m, and average production is 45–75 m/h, according to engine hour.





*The SmartROCT40 at work at the Erkoç Kirmataş limestone quarry: The rig produces as much as two other drills rigs combined at at less cost, with a reduced environmental impact and an improved working environment.*



Says Erkoç continues: “We have now deactivated all the other drill rigs and are using just the SmartROC T40 six days a week in two, seven hour shifts. Considering how productive it is in a 14-hour day, I think it could probably finish all the work in the quarry if we used it round the clock.”

#### **A better working environment**

The working environment on the site has also improved since the SmartROC T40 arrived, particularly since the reduction in fuel consumption also lowers the rig’s CO<sub>2</sub> emissions. Furthermore, its adjustable dust collector and quiet-running drilling system has made a big difference to the level of noise and dust.

Erkoç says: “Sometimes, depending on the direction of the wind, the only way I can tell that the machine is actually operating is by the rotating warning lamp on the top!”

Operator Çetin Bayram also praises the benefits to the working environment. “The low noise, comfortable cabin, easy controls and easy trouble-shooting are big plus points,” he says. “I feel safe and comfortable in this rig, and that helps me to be more productive.”

Emre A. Kantarcı, Atlas Copco Sales Engineer in Turkey, emphasizes that the

SmartROC series has been designed specifically to minimize energy loss. This is thanks to features such as the adjustability of the air volume and dust collection vacuum fan speed, which enable the operator to optimize energy consumption during the process.

Added to this, the SmartROC has 50% fewer hydraulic hoses and 70% fewer fittings, compared to the previous models, and the newly-designed hydraulic system uses 65% less hydraulic oil. Consequently, the best performance can be achieved while

only using the precise amount of energy required for each task, and no more.

Gurkan B. Buyurgan, Business Line Manager in Turkey, concludes: “All of these innovations and advantages add up to a pleasant surprise for the drilling industry. We are proud of this technology and that we have been able to introduce it to Turkish contractors since the end of 2012 when the SmartROC series was launched.”

*Based on an article by O. O. Cagim Tug in Mining Turkey Magazine.*



*Burak Erkoç, owner of Erkoç Kirmataş (right) with Emre Kantarcı, Atlas Copco Sales Engineer.*

# SIMULATOR TRAINING

## A 21<sup>ST</sup> CENTURY APPROACH



With the ever-increasing demands for production efficiency, fast-track training in the mining industry has never been more important. **Boliden Tara Mines** of Ireland is one company that is reaping the benefit of an effective and safe training method, without causing any disturbance to production.

**T**raditional ‘buddy training’ on a production drill rig can take four to six weeks in order to get a new fully trained operator. In addition, any drilling errors made by a trainee can lead to difficulties during blasting, causing unevenness in the mine’s tunnel walls and floor.

Similarly, if there are errors in depth alignment, subsequent rounds will be more difficult to drill and load, and without good profile quality, blast damage is increased, resulting in more time for scaling and rock reinforcement.

At Boliden Tara Mines in Navan, Ireland, Mining Manager Mike Lowther is fully aware of these production efficiency challenges. The mine, owned and operated by Boliden, the Swedish international

group, produces approximately 2.5 million tonnes of ore for zinc and lead concentrate per year and strives to constantly improve efficiency wherever possible.

Part of this effort included the use of an Atlas Copco Master Driller Simulator. “It was a brilliant opportunity not to disrupt production and make rapid progress on our training program in a 21st century environment,” Lowther recalls.

### Realistic experience

The simulator perfectly replicates the Atlas Copco Boomer development rig and Simba production rig. The cab layout and functionality create an extremely realistic representation of underground mining tunnels in the front and rear windscreen cab positions.

In addition, the Atlas Copco Master Driller Program offered the Tara Mines trainees three levels of certification – Bronze, Silver and Gold.

Pat Potterton, training officer at the time, now Technical Support Supervisor-Mine Development, organized the training and arranged for the simulator to be delivered during the peak summer holiday period to limit the impact on production.

Operators were brought in from leave to be trained while production continued underground. When the simulator arrived, initial training was given at the Atlas Copco Service Center in Portlaoise to Potterton, Mine Captain Roy Tallon, and Training Officer Jimmy Dunne, so that they could familiarize themselves with the simulator before it arrived at the mine.

Once installed at Tara, the training program was an inclusive process with craft and maintenance personnel, operators, surveyors and planners all given the opportunity to train on the simulator.

As part of the program, Atlas Copco provided a bespoke training package for the



*Members of the Tara team who took part in the program. From left, Pat Potterton (Technical Support Supervisor – Mine Development), Damien Healy (Atlas Copco Parts and Service Manager, Ireland) and drilling operators Mark Mooney, David Carolan and Ken Reilly.*





“A brilliant opportunity to make rapid progress on our training program.”



Mike Lowther Mining Manager, Boliden Tara Mines.

company’s fitters covering the RCS system, traming, boom, feed and rod handling operation as well as common maintenance requirements of the Simba rig.

The results were beyond expectation:

- 32 operators were trained and 7 new operators were licensed.
- The newly-trained operators boosted the previously limited number of Simba operators and fleet usage increased.
- The mine’s Simba drilling pool increased from 8 to 15.
- 19 Boomer operators graduated with Bronze and Silver certificates.

- 15 craft and maintenance personnel learned to move, drill and rod change the rigs.
- The overall “pass rate” for the course was 91.7%.

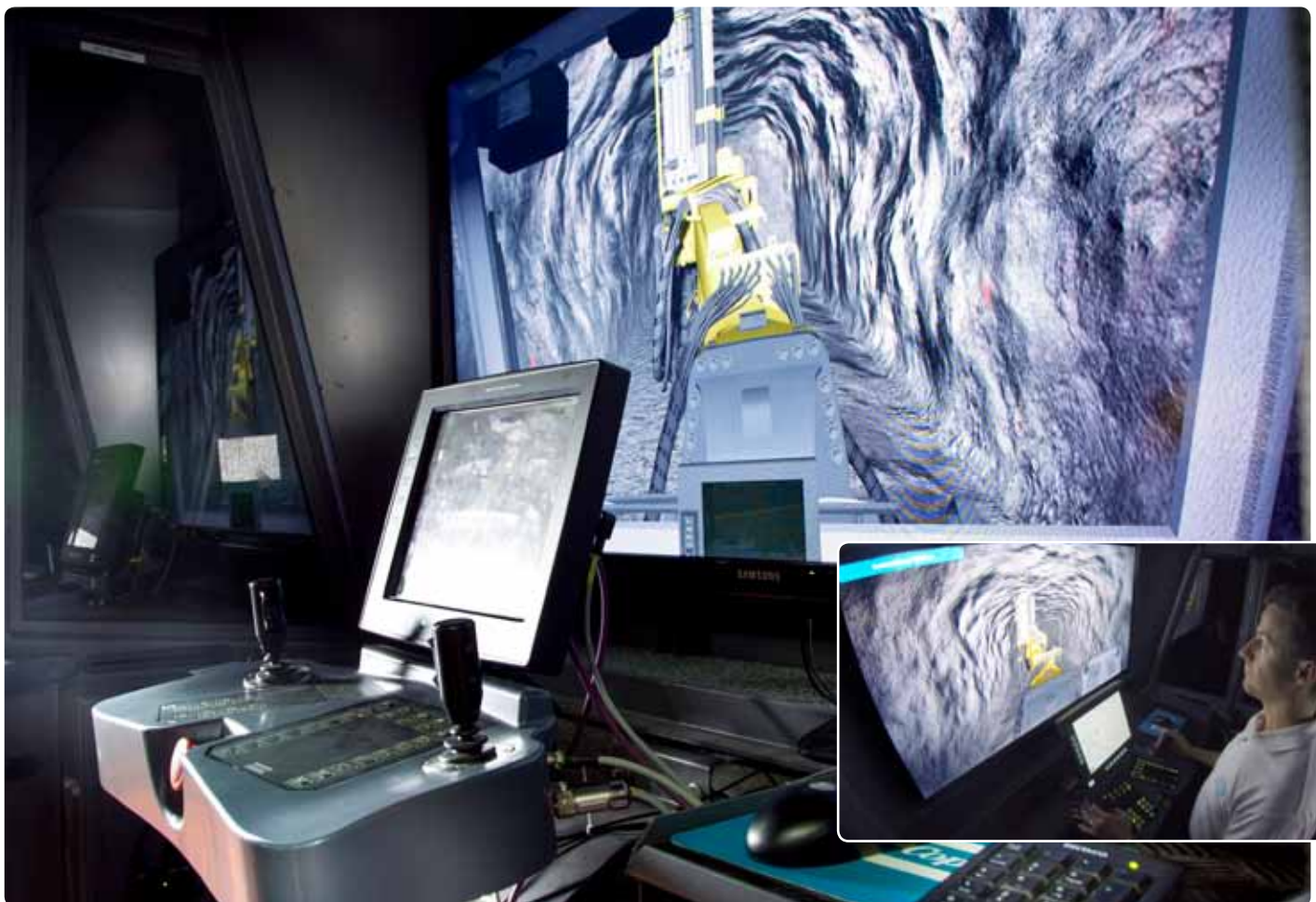
**Big step forward**

The learning rate was also extremely fast. As Potterton pointed out: “A miner with no previous experience of operating a Simba rig could be fully trained in a week.”

The training technology of the simulator provided a controllable, safe environment for the trainees. But this was not the only feature appreciated by Mike Lowther.

“We were able to quickly upskill the long-hole drillers that were bracketed into a skillset relevant to a particular machine but, we could also move the Cabletec [cable bolting] guys onto the simulator. Cross-training became rapid over a matter of weeks,” he concludes. “We got more out of it than we expected, and we expected a lot.”

Sickness and annual leave no longer impacts production at the mine due to the lack of trained operators, and during a special presentation ceremony, the Mine Management congratulated the crews on their improved skills, which further boosted confidence and morale.



Inside the Simba simulator: The operator’s control panel has exactly the same feel as in a real drill rig while the “cab’s” front and rear window positions, as displayed on screens, give the trainee an extremely realistic experience of the mining environment.

## Water for All celebrates 30 years

**WORLD** Water For All, Atlas Copco's global initiative to raise funds for water well drilling, celebrates its 30th anniversary this year.

The project was founded in 1984, initially to help finance water well development in Peru, but is now a worldwide organization established in 35 countries.

Its mission is to provide people in need with long term access to clean drinking water and it has so far helped more than 1.5 million people.

Water for All is today Atlas Copco's main community engagement project, initiated

and driven at local level by Atlas Copco employees.

Annika Berglund, Senior Vice President, Corporate Communications and Governmental Affairs, says: "The need for clean drinking water in the world is huge and we are very proud of the work done by dedicated employees, supported by the company."

Watch the video at [www.water4all.org](http://www.water4all.org)

*Water of life: A scene from a water well financed by Atlas Copco in India.*



## Garpenberg mine switches to Minetruck MT42

**SWEDEN** The Boliden-owned Garpenberg underground mine is to switch from general-purpose trucks to using dedicated mine trucks from Atlas Copco. The move comes as part of a plan aimed at doubling productivity by 2015.

Boliden plans to increase production from 1.4 Mt to 2.5 Mt per year and to help meet that goal, the mine's contractor, Långdahls Åkeri, has purchased a fleet of

Minetruck MT42 trucks along with two Scooptram ST14 loaders.

Until now, the Garpenberg mine, which produces lead, zinc, silver and gold concentrates, has relied on standard road trucks to haul the ore to the surface.

Elving Långdahl, owner and president of Långdahls, says: "By using the Atlas Copco equipment we are confident that we will be able to make the haulage

operation in the mine more efficient than ever before. The Minetruck MT42 takes a 42 tonnes load whereas the trucks that have been used up to now only take 28 tonnes. That's an improvement of about 40 per cent which will make a big difference to productivity."

Tire consumption is also an important cost factor. As the tires on the Minetruck MT42 are adapted for the tough mining environment they also last much longer than standard road tires.

Another reason for choosing the Atlas Copco equipment is safety, as the cabins on the Atlas Copco trucks are all FOPS/ROPS approved to withstand rock falls.



*Right trucks to drive productivity: The Garpenberg Mine will start using the Atlas Copco Minetruck MT42 as of 1 January 2015.*



The power behind the Serpent:  
Atlas Copco's ventilation system.



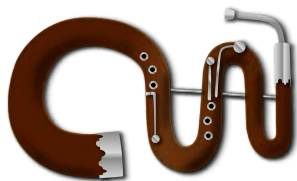
## Watch out for the Serpent!

**WORLD** Atlas Copco's underground ventilation systems have been given a new, distinct identity in the mining and construction market. Previously known as SwedVent, these products, which are used to provide miners and tunnelers with fresh air, are now being marketed under the name "Serpent".

Tomas Otterberg, Product Manager at Atlas Copco, says: "Air is an invisible product – something most people take for granted. Like electricity in a tunnel, we also need air to work there and this invisible air costs money. Poor ventilation lowers productivity and raises energy costs. Simply put, without proper ventilation, excavation work of any kind is impossible.

"By packaging Serpent as a complete ventilation system, including ducting, sound absorption and high-pressure fans, we are able to guarantee our customers a healthy underground working environment. Serpent also has the ability to reduce energy costs up to 50%."

*Footnote: Serpent was inspired by a snake-like woodwind instrument known as The Serpent, believed to have been invented in 1590.*



### IN BRIEF

#### Teaming up for automation

Atlas Copco and Remote Control Technologies (RCT) have teamed up to provide mobile equipment automation solutions to the underground mining industry. The aim is to provide a range of comprehensive solutions to meet growing demands for safe, productive mining.

Both Atlas Copco and RCT already offer a range of such solutions. While Atlas Copco focuses mainly on machines that utilize the well known RCS control system, RCT provides solutions that are a perfect match for some of the older generation Atlas Copco products that remain popular workhorses in the industry.

By combining expertise and solutions in this way, Atlas Copco and RCT can offer a broad range of remote control and guidance systems for the majority of Atlas Copco underground equipment.

Julian Reynolds, Product Line Manager for Atlas Copco, explains: "The world of underground mining is becoming increasingly challenging. Issues associated with deeper orebodies, increasing costs and the drive for greater social responsibility continue to pressure the viability of many operations. By teaming up with RCT we aim to offer similar automation functionality for our older machines that customers find on our newer generation equipment."

Phil Goode, Senior Business Development Manager for RCT, adds: "The intention is that Atlas Copco and RCT will provide a united front in addressing any safety or productivity issues that a customer may be experiencing. They will have access to the expertise of both organizations to ensure an automation solution can be found that meets their specific needs, no matter what type of Atlas Copco vehicles are in their fleet."

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