Bolstering bolting for Barrick

Contributing to safety: The Swellex range of bolts from Atlas Copco.

In an effort to contain costs and effectively reinforce heavily fissured and jointed rock, Barrick Gold in Nevada, USA, has substantially refined its rock reinforcement operations. The results are outstanding.

Faced with the difficult task of mining in a complex network of tectonically disturbed faults, efficient and cost-effective rock reinforcement is of major importance for Barrick Gold's Goldstrike property in Nevada.

Located north of the small town of Carlin, the mine produced more than 2.26 million ounces of gold in 2001 with a 24/7 working week.

There are two major underground operations in the area – the Meikle and Rodeo deposits – and out of a total workforce of 1,700 approximately 200 people are involved underground.

The development of first Meikle and then Rodeo has required an increasing amount of ground support due to the difficult geology in the area and this, coupled with the need to contain costs, has led Barrick to continue refining its rock reinforcement practices.

Network of faults

The compact Meikle orebody is mainly comprised of high-grade ore surrounded by competent limestone, in addition to fissured and fractured rock.

The Rodeo deposit, which extends about 800 ft vertically across an area of approximately 2,500 x 1,000 ft, is expected to mine 600,000 t in 2002. This will contribute 250,000 ounces to a total output from the company's underground division of about 700,000 ounces of gold using longhole stoping (slot and slash) with backfilling as the preferred mining method.

Vital operation: In the fissured and fractured rock, mesh and bolts are placed simultaneously.

Scott Herr, Superintendent Underground Operations, explains that the predominantly competent rock at Meikle allows for most of the development to be supported using friction bolts, with resin grouted rebars used in some permanent excavations.

Tectonic events have created random joints, further reducing stability. Excavations must therefore be supported immediately after blasting. The ground conditions also mean that stopes are relatively small – 4,000 to 6,000 tonnes.

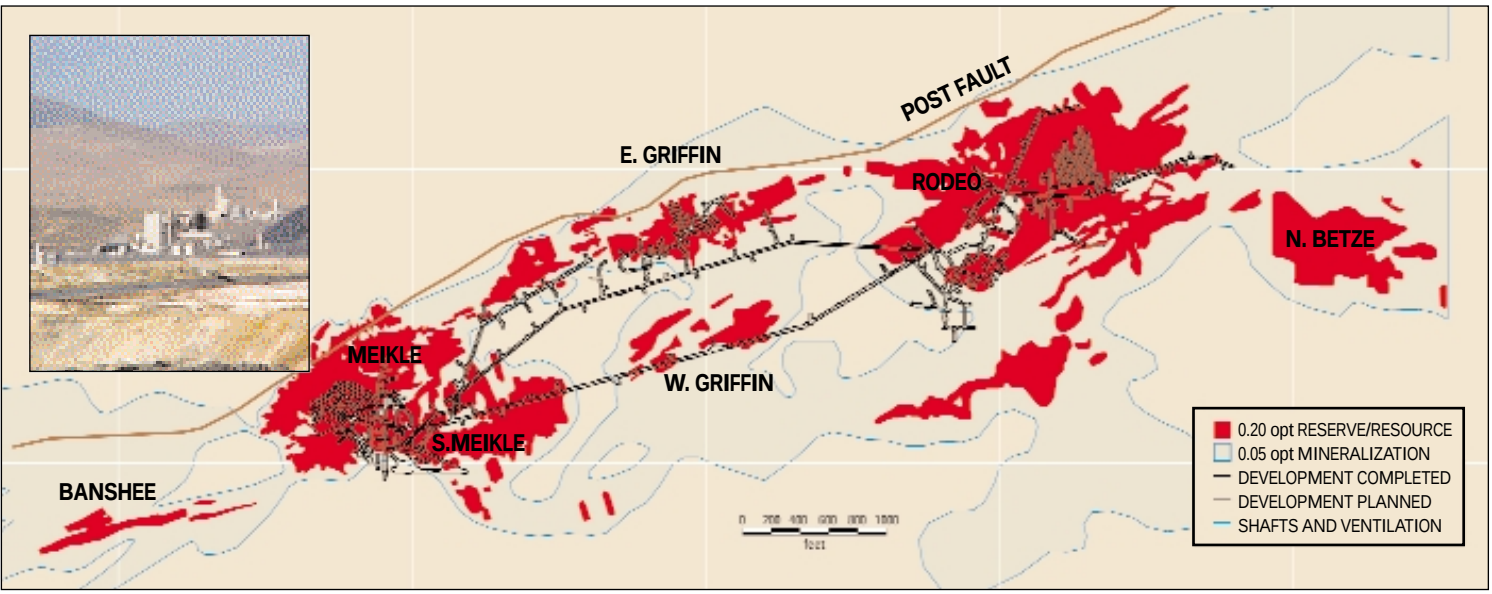
Initially, Barrick started bolting using pusher leg rock drills and both resin grouted rebars and friction bolts. But although the resin would initially seem to have anchored the bolt, the ground around the resin would later crumble and the bolts would fall out.

"Furthermore," explains Denis Thibodeau, Senior Rock Mechanics Engineer at the site, "rebar bolt installation is a very slow, labour-intensive process in these conditions because it's difficult to inject the right amount of resin. The friction bolts may have been easier to install, but they did not achieve satisfactory long-term anchorage."

In conjunction with rock mechanics studies, Barrick then decided to try another type of bolt in the worst conditions at Rodeo – Swellex and Super Swellex from Atlas Copco.

Excellent results

Rock reinforcement design principles showed that it is possible to use 8ft-long Swellex bolts to support the back of a 20ft wide drift. These bolts will have a maximum transfered load capacity of around six tonnes, given a useful embed-



Overhead and cross section views of the ore deposits at Barrick Goldstrike Mines Inc. in Nevada, USA.

ment length of 1.3 ft. The wedge apex will sometimes be higher than 8 ft, requiring 12 ft Swellex bolts to be used instead.

"All in all, the extremely poor quality of the rock mass imposes very tight limits on panel sizes making thorough support essential," continues Mr Thibodeau.

"Pull testing of the Swellex bolts gave excellent results. The Swellex design achieves more confinement in the soft, friable rock because of the water injection, creating more grip in the rock and better anchorage than friction bolts."

However, there were still problems with the ground between the bolts, so a shotcrete layer was placed before bolting and meshing. Scott Herr explains: "It was the widespread and rapid variation in ground strength in the mine that convinced us to standardize on Swellex. The bolts hold in all conditions encountered and they substantially reduce the risk of roof failure."

"The Swellex bolt creates better anchorage."

Denis Thibodeau
Senior Rock Mechanics Engineer at the Rodeo site.

The width is the main factor affecting bolt density, while the type of Swellex used – non-coated or coated – usually depends on whether the drift will be mined through or not. Occasionally, 16 ft Super Swellex may be used.

In 15 x 15 ft headings, the bolts are typically placed in rings on 5 ft centres, with the rings on a 5 ft spacing. Placing mesh and Swellex bolts at the same time, the operator starts close to the floor, inserting 6 ft friction bolts in the rib, then - 8 ft standard Swellex bolts across the roof.

In 25 ft wide headings, a staggered pattern is created by placing alternating rings of five and four Swellex bolts on 5 ft centres. The patterns are still fairly constant, except where the ground is especially weak.

Comfortable from Day One

"You could say we started with an overkill support scenario and are now refining the approach," says Kevin Melong, Mine General Foreman at Rodeo. "From the miners' point of view, Swellex is the bolt that made us feel comfortable from day one."

The bolter operators and stoping supervisors are allowed to use their own judgement in deciding bolt type, size and precise pattern. While refining its rock reinforcement regime, the rate of bolt use has been reduced by about 30%.

Says Robbie Traynor, bolting rig operator at Rodeo: "Typically, we can install up to 110 8 ft Swellex bolts per shift. You can always rely on them once they are inflated, and they are way faster than the others."

Co-operative effort

In addition to Swellex bolts, Goldstrike also relies on Secoroc drill steel and bits for its underground operations and continuous technical service support.

Atlas Copco began a "cost-per-foot-drilled" contract with Barrick Goldstrike for the Secoroc products in October 2000. "We provide Secoroc supplies to both of the mines seven days a week," explains Clay Gremel, Secoroc Area Manager. "It has become a very efficient and effective co-operative effort. While we are refilling inventory at the mine, all the used steel and bits are picked up and taken to our service shop in Elko for reconditioning and then returned to the mine."

The Atlas Copco technical service representative at the site, Troy Thiel, functions as the Master Driller, troubleshooting not only the Atlas Copco Secoroc and Swellex applications, but the drilling function as a whole.

Barrick is working with Atlas Copco to try out 10 ft Connectable Swellex bolts as a potential replacement for 20-25 ft cable bolts and is also testing the new PVC coated Swellex. M&C 3•02

Goldstrike has a guaranteed cost per foot contract with Atlas Copco Secoroc, which provides the Meikle and Rodeo mines with a full line-up of hammers, adapters, rods and bits. These are:
DTH drilling: Secoroc COP 34 hammers and 95 mm SpeedBits.
Drifting: R38 shankadapters, Drifter rods (Lengths 10', 12', 14') R38 x Hex32 x R32, 48mm button bits, 3" Dome bits (reaming).
Bolting: R32 shankadapters, Drifter rods (Lengths 10', 8'6") R32 x Hex25 x R25, 38mm button bits.
Cable Bolting: R32 shankadapters, R32 Speedrods, R25 Extension rods, 48 mm and 51 mm button bits.
Bench Drilling: T45 shankadapters, T45 Speedrods, 76 mm Retrac button bits, T45 Secoroc Backhammer, 5" Dome bits (reaming).
Jackleg Drilling: Tapered rods 11 degree (Lengths 2'6", 4'6", 8'6", 10'6"), 35 mm and 38 mm tapered cross bits.

More details at: www.rockreinforcement.com