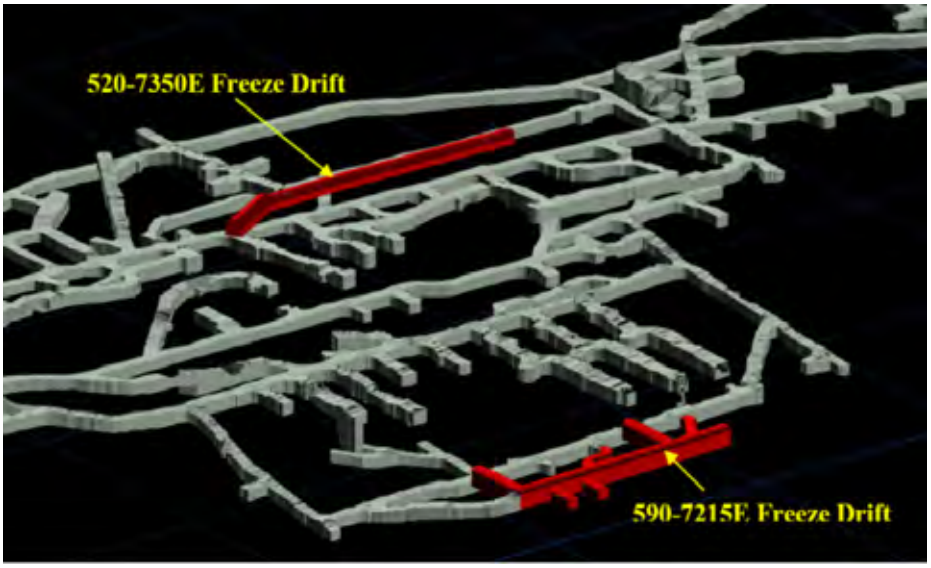
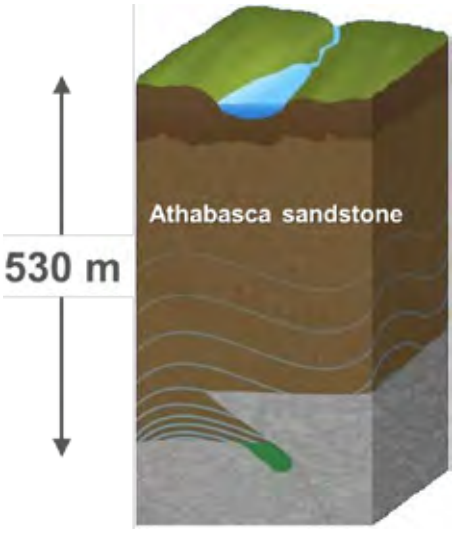
MAPTEK™ Vulcan™

McARTHUR RIVER URANIUM

Having pioneered a unique raise bore mining method for uranium production, Cameco uses Maptek Vulcan™ for planning and production as well as critical geotechnical modelling.





Freeze drilling drifts are located above and below the orebody

Saskatchewan Province, Canada hosts some of the world's most significant and unique uranium deposits.

The McArthur River deposit was discovered in 1988, and with ore grades 100 times the world average, is now the world's largest high-grade uranium mine. The operation mines 150 to 200 tonnes of ore per day, producing more than 18 million pounds of uranium each year.

Maptek Vulcan software has been central in overcoming the challenges presented by the geology of McArthur River and the radiological risks of producing uranium.

The orebody is formed at a plunging fault between basement rock and the Athabasca sandstone, which is saturated with water. The contact between the basement and the sandstone marks the unconformity.

STRINGENT MINE DESIGN IS THE CORNERSTONE OF CAMECO'S DEVELOPMENT AND PRODUCTION PHILOSOPHY AT McARTHUR RIVER.

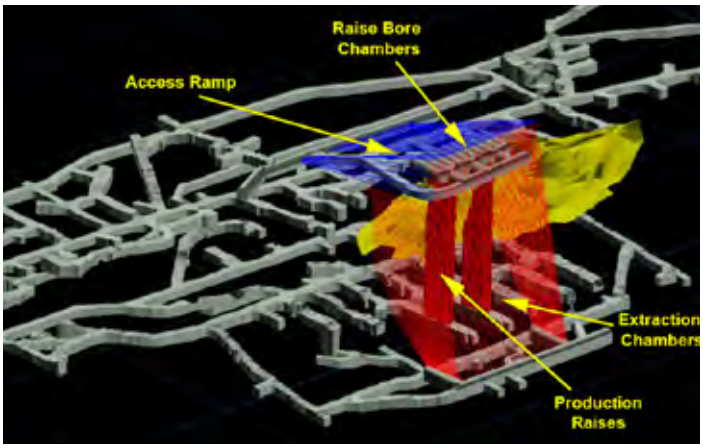
Freeze wall methods are used to control the groundwater and minimise the risk of shaft flooding. An underground milling facility turns the ore into a thick slurry which is pumped to the surface and transferred remotely to trucks.

Ore zones are planned several years in advance to ensure a seamless transition between zones, with no dip in production. This accommodates the necessarily slow process of installing the pipes that will distribute the freezing brine solution to isolate ore from the water bearing sandstone.

Current work sees the development of freeze drifts at the 520 and 590 levels to enable ore from Zone 4 North to be extracted. This involves developing a raisebore and extraction chambers as well as access ramps under freeze protection.

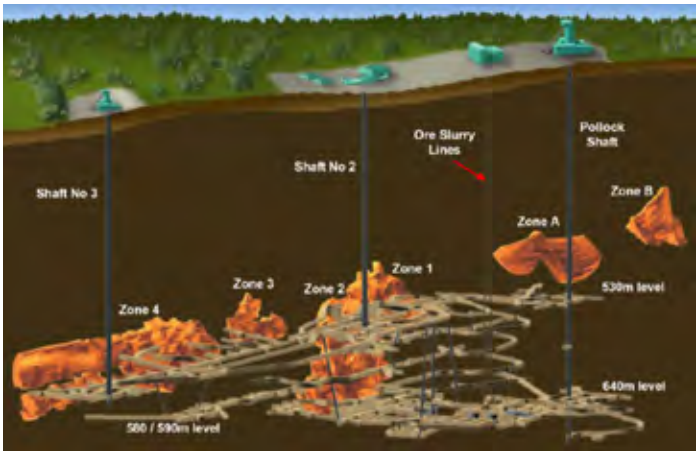
Designing the freeze wall at the 520 level incorporates a 10-metre offset to the unconformity contact. Before development can begin, a diamond drill is used to drill a very tight pattern into the face where holes will be drilled for pipes. Any signs of water are plugged with high pressure grouting to avoid surprises as development progresses.

Drilling also confirms the location of the unconformity. All drill cuttings are captured and pumped to the milling circuit to avoid loss of any of the high grade ore.



The orebody is shown isolated by freeze walls, with completed chambers and production raises

An in-the-hole Cubex drill is used to drill the freeze holes on 520L



McArthur River underground with orebodies

Negative ventilation is used extensively at McArthur River as a part of the control against radiation. Rigid ducts suck the air into the heading so the workers always have the fresh air at their backs.

Large, heavy steel bars are installed to avoid rock failures during excavation. Mechanical excavation minimises ground disturbances and is done in short rounds, 2.5 metres at a time, before shotcreting, bolting and screening to increase stability. Adhering to strict design criteria and development methods provides confidence that the ore can be extracted safely.

Careful planning and accurate mine design is required to ensure freeze pipes are not damaged when developing close to the freeze walls. Special measures are also required at the 590 level close to the unconformity. A roadheader excavator may be used to cut through the rock. A 15-metre offset is created to account for back of drift development.

Holes around 120 metres long are drilled upwards from the 590 level, with horizontal holes drilled along the 520 level. Holes are spaced about 2 metres apart to carry the 18-inch pipes, through which brine at -32^{o}C will be pumped from the freeze plant on the surface. Freezing can take up to 6 months.

The as-built holes are surveyed to correct the orientation of planned adjacent holes. Once the ore zone is isolated, the raise hole is developed. A 12-inch hole is followed by the 3-metre diameter reamer which is pulled up through the pilot hole.

Loose ore is collected from the bottom of the hole with a remote-controlled scoop tram that delivers it to the processing facility underground. Each raise removes about 200 tonnes of ore. The raises are developed next to each other in a honeycomb pattern.

Maptek created a specific technique in Vulcan for calculating the recoverable ore tonnage and grade from the honeycomb arrangement of raise-bore stopes. Sometimes the raise-bore is required to mine through insitu ore and at the same time, intersect regions of cement fill present in the previously mined primary stopes. Calculating the diluted ore tonnages and grades, as well as sequencing the mining and backfilling of these stope arrangements is performed by Vulcan's Cubic Reserving option.

Careful design and development practice, aided by the best technology, enables McArthur River to overcome the challenges of mining in this high risk environment. They have been able to confidently control high-pressure groundwater, stabilise weak rock and eliminate the risk of radiation exposure to staff.

Thanks to
Brian Mattie, Senior Mine Engineer
McArthur River, Cameco Corporation
Presented at North America Users Conference, 2012

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