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## On the radar: the technology of planning for mine wall slides

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Radar, prisms and robots would seem more appropriate in the latest Hollywood blockbuster than in a mine in Utah, but exactly this kind of technology helped a Rio Tinto copper division avert what could have been a major human catastrophe last month.

Kennecott Utah Copper (KUC), which operates the vast Bingham Canyon mine near Salt Lake City, has for years used the most advanced technology available to detect, monitor and plan for slides, an infrequent but anticipated occurrence in mining.

KUC was particularly vigilant regarding a part of the northeastern wall of Bingham Canyon, the location of a geologic structured element known as the Main Fe Fault.

It is here that one of the biggest mine wall slides in history took place on April 10, which despite the collapse of around 150 million tonnes of overburden into the pit led to no human casualties

The company uses a combination of GroundProbe radars, Ibis radar and a prism network to give it comprehensive data on even the slightest movement in the mine slopes, Matt Lengerich, mine general manager, told Metal Bulletin.

The mine also uses extenometers – which measure displacements on highwalls – to monitor very specific, localised changes.

The company also has a team of geotechnical staff and mining engineers, trained to recognise potentially dangerous movement, he said.

“We had that northeast wall under surveillance, as we have a number of concerns along that wall. In early February, geotechnical staff noticed data on our Ibis radar units that highlighted what looked to be point spots of movement, less than a tenth of an inch a day,” he said.

“Isolated movements had consolidated and the entire mass above the Main Fe wall – technically referred to as the hanging wall of the Main Fe fault – had started to move.”

The consolidated nature of the movement rang alarm bells, and Lengerich’s team sprang into action.

“On Tuesday February 12, our geotechnical staff said they thought we had a problem. That day we engaged our network of worldwide experts and said, ‘we think we have a major issue on our hands and we want to get as many opinions and eyes on this as quickly as possible,’” Lengerich said.

Just like predicting landfall for a hurricane, working out when the wall might fail was also possible. Engineers used the movement rates to plot an inverse velocity graph, showing the number of inches the

mine moved per day and the acceleration of that movement.

“In February, the geotechnical engineers predicted the failure would happen in mid-to-late April. As the date became closer, their projections became more focused,” Lengerich said.

Using a Homeland Security-style threat advisory scale, KUC set about removing people and infrastructure, and established operating and contingency plans.

“Our primary purpose was to protect people, then the sustainability of operations and then protection of infrastructure. On Tuesday April 9 we crossed the threshold to shut down the 10% ramp – this was the last failure zone area we were using – and we continued to run some operations in the bottom of the pit via the light vehicle access road.”

KUC closed operations in the lower pit of the mine on Wednesday April 10 at 1100.

“By 2030 that day the geotechs said, ‘the movement rates are so high that the wall’s going to go at any time,’ and at 2130, it failed,” Lengerich said.

### **Surprise**

What KUC could not predict was how much material would move and where it would end up.

“Those were the two variables that were the most difficult to predict. We had modeled several scenarios, which ultimately guided our planning,” Lengerich said.

“We knew we’d lose the 10% ramp, and that it would impact lower pit operations, which would affect all lower supply downstream,” he added.

The slide took place in stages: an anticipated initial failure at 2130 that filled the bottom of the pit, and an unexpected second failure mass at 2300, which covered the initial failure and a lot of the equipment the company had carefully positioned in the pit to allow it to resume operations more quickly.

That included 13 trucks and 3 shovels – only about 10% of the company’s equipment fleet, but a blow to KUC because it had lost the mine’s heavy vehicle access road, leaving it with just one shovel and 18 trucks in the restricted area.

Lengerich said that the shape of the failure, how far back it went and where the material ended up all surprised KUC.

“We obviously wouldn’t have staged the equipment in those locations in the pit if we had known what was going to happen; we’d have staged it somewhere else,” he said.

KUC recently recovered another truck from the affected area, taking its total to 19 trucks in the lower pit.

The mine is currently stable: no further slides are anticipated in the near future.

Andrea Hotter

[Hotter on Metals](#)

[ahotter@metalbulletin.com](mailto:ahotter@metalbulletin.com)

Twitter: [@andreahtotter](#)

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