CASE STUDY

Optimising Complex Stope Designs Via Wireless Blasting Methods

Borden, Canada

Site Profile

Borden is a Canadian mine located in the Porcupine region of Ontario owned by world's largest gold mining company, Newmont Corporation. The site has been in production since October 2019, extracting gold via a portal/ramp mine construction. Famously dubbed the "mine of the future", Borden utilises state of the art methods and technologies to complete mining activities. Orica has been a partner since mine commencement and the mine production since initiation. The WebGen™ technology is used in a full-time capacity accounting for well over half of all production blasts.

Figure 1: Borden mine layout of the Western Zone (WEZ), looking North

The Situation

Orica was presented with the 390L WEZ 49A block in July 2020. While the block size was typical for a Borden WebGen™ stope, the complexity lied in the geometry. Due to varying stages of completion in the development drifts surrounding the stope, successful extraction would need to be accomplished via drilling on 4 separate horizons, at a multitude of angles. The drilling would consist of a combination of up-holes, down-holes and side-holes from the 390 and 375 levels.

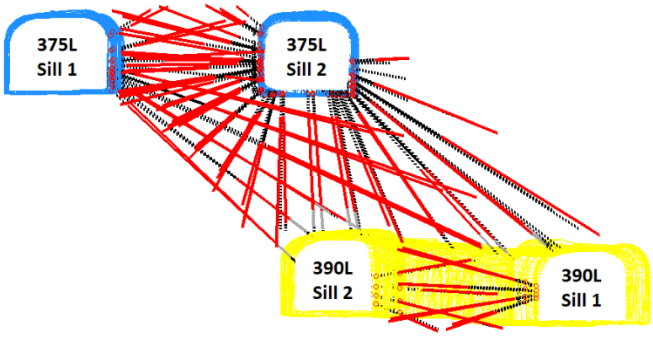

Figure 2: Complex drill design involving all sills

The Borden orebody dips North-East at a very shallow angle. To minimise dilution, stope sills are typically driven in ore, resulting in flat stope shapes as well. This presents the most challenging obstacle: flow of blasted material on the footwall. Due to the shallow angles (sometimes as low as 40°), muck has the tendency to rest on the footwall post blast. In the case of 49A, the footwall angle was designed to follow the design shape at 43°. While the stope shape may be drilled and blasted effectively, valuable ore can and will remain unrecoverable as a result. The design considerations are as follows:

- Loading and timing design to optimise muck throw.
- QA/QC of holes being drilled from multiple horizons.
- Drilling design standards in stope with preloaded WebGen™ holes.
- Breakdown of entire stope into multiple Group ID's (GID's) to improve blast sequence and recovery and achieve an efficient loading sequence.

Orica's WebGen™ technology, design methodology and practical techniques were applied in order to facilitate and optimise recovery despite the conditions presented.

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Technical Solutions

At Borden, Orica regularly utilises key mining methods developed exclusively for use with a wireless blasting technology. It is commonplace to see several of these methods in a stope design, but to achieve the anticipated results with a stope of this complexity, 3 methods were employed.

1. The RTR (Reverse Throw Retreat) is used to throw muck toward the draw point to help reduce mucking cycle times, the RTR method, in essence, mines the stope backwards. Once the slot (blasted with i-kon™ III) is blasted and mucked, the adjacent blast(s) creates the necessary free face for successful Longitudinal Transverse Retreat (LTR) blasting.

2. The LTR is the preloaded section of footwall holes along the length of the entire stope. Once the bulk of the stope is blasted longitudinally along the hanging wall, the LTR holes are designed to blast perpendicularly into the void, transversely at a high speed, to throw muck up and away from the footwall. Both the loading of holes as well as sequencing/ timing are crucial in successfully casting the muck into the undercut and void space created by the RTR, avoiding having it hang up on the shallow footwall, rendering it un-recoverable.

3. The TRP (Temporary Rib Pillar) is the final blast in the sequence. This geotechnically sized pillar separates the previously mined and backfilled 48A stope from the 49A block currently being mined. This method allows for full recovery of the stope in mines like Borden which rely on unconsolidated fill, where typically a fill retention pillar would need to be left behind. During blasting, some unconsolidated rockfill from the 48A is expected to rill into the 49A stope. The rapid inter-hole timing and sequence of the TRP blast enables most of the pillar material to be cast into the open void that was created by the RTR and LTR sequences ensuring waste dilution with the rockfill is kept at a minimum.

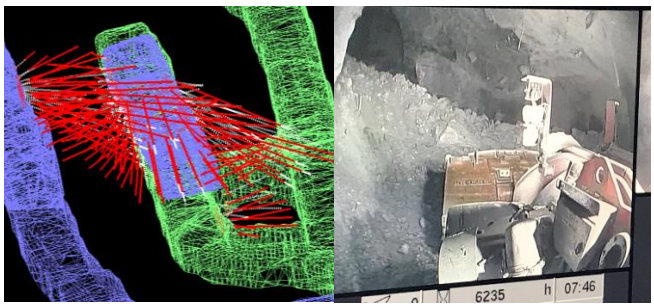

Figure 3: Stope design and mucking horizon post blast

The ability to split the stope in multiple GID's enabled the loading operations to reduce rework in setup and demobilization, and confusion with the ring and hole ID's. A total of 6 GID's were used in this stope.

The Result

Once the stope reconciliation was completed this stope's performance was evaluated as an exemplary success. With targeted recovery of 90% and 15% dilution, the efforts put forth by Newmont, Orica and Redpath resulted in a 98% recovery and 17% dilution. The additional dilution was due to slight overbreak in the hanging wall along a joint set, which is typical of Borden. Minimal broken muck was left sitting on the footwall despite its 43-degree angle, thanks to the enhanced timing and sequencing capabilities of WebGen™ 100.

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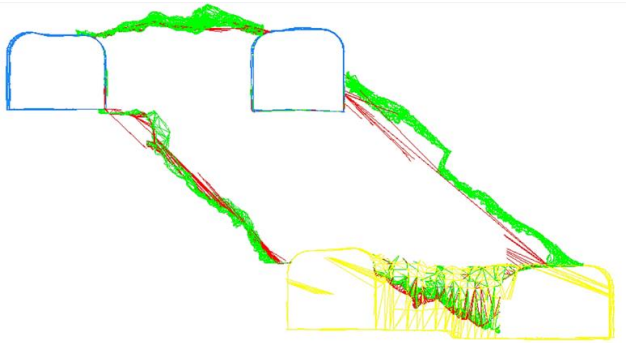

Figure 4: 98% post-blast CMS (Green) vs. designed blast shape (Red)

It is important to note, this stope is not an outlier. It contributes to an entire month of stope blasting producing an average recovery of 95%. Newmont's continued support of the WebGen™ service stems from stopes regularly achieving well over 90% recovery at Borden when applying Orica's wireless enhanced mining methods and the proper execution.

Measure	Result
Target Recovery	90%
Target Dilution	15%
Actual Recovery	**98%**
Actual Dilution	**17%**

Testimonial

"Orica/WebGen have been partners with us from the very beginning. The WebGen team is very professional, knowledgeable, and easy to work with. The technology is great but the people behind it make it happen. WebGen technology allows us to be a safer and a more efficient mine. It removes the need to send people around hazardous conditions that exist after a blast."
- Eric Fournier, Mine Engineering Supervisor-Newmont Borden

Acknowledgements

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