CASE STUDY

Modified Sub-Level Shrinkage in Narrow-Vein Mining – Recovery of Sterilized Ore Using WebGen™ Technology

Minjar Gold Pajingo Mine, Australia

Site Profile

The Pajingo gold operation is in Queensland, approximately 150km south-west of Townsville. It was discovered by Battle Mountain Gold Company in 1983 and first gold production commenced in 1986 from open pit mines. Since its initial discovery, there has been various ownership changes of Pajingo with Minjar Gold acquiring the operation in August 2016. The Pajingo gold operation has produced more than 2.7 million ounces since 1996 and is forecast to produce between an average of 60,000oz and 65,000oz p.a from 2017-2019.

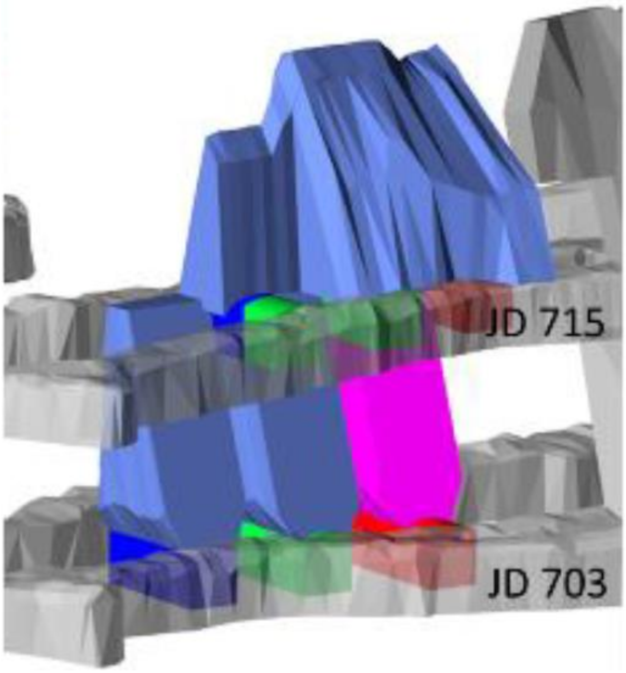

Figure 1: MSLS demonstration area (Carswell, 2020)

The Situation

Pajingo's long-established methods of mining have been Narrow-Vein stoping and modified (bottom up) Avoca. Alternate methods of mining are being investigated for viability of production. A method of Modified Sub-Level Shrinkage (MSLS) consisted of incorporating traditional Sub-Level Caving methods into previously mined and backfilled zones. This enables extraction of remnant high grade pillars as well as backfill material that contained grade. Improvements in efficiency and technology have reduced the cut-off grade since the start of the mine. Remnant pillars and backfill is now economic, but safety and logistics hinder the recovery through alternative extraction methods. The demonstration area of the mine was classified as containing reactive ground from recent routine testing.

Technical Solutions

Minjar saw that WebGen™ could provide a solution to recovering resource previously deemed sterilized proximate to previous workings. The ability to control safety of personnel, to exposure at the brow and working off rill, were risks that were controlled or eliminated. To control all risks extensive WebGen™ signal surveys, in-hole pressure test, WebGen™ awareness toolbox talks and Minjar's change management process were completed in the lead up phase. A remote communication system allowed firing from the surface mine control room.

The trial encompassed 2 levels, Jandam (JD) 715 and JD 703. Each level consisted of three drawpoints with 12 rings drilled to cover the drawpoints and the extraction drive. The initial design planned to fire one ring at a time on a retreat sequence.

Orica's Technical Services identified initiation timing for each level as a single blast event. This timing would then be broken down into multiple individual blast file keys (BFK's) / blasts. Utilising the unique features of merging blasts provided Minjar the flexibility to adjust the number of pre-charged rings fired in each blast. Each blast could be changed to suit the condition of the cave at firing without risks to personnel accessing brows to tie-in.

Orica's SHOTPlus™ Underground was used to review timing for vibration/damage minimisation, relief and effectiveness. Software visualisation helped Minjar to adopt all recommendations.

Subtek™ Eclipse™, Orica's underground inhibited bulk emulsion product was used in all firings allowing a maximum 7-day sleep time. Manufacturing and delivery of the bulk product into the up-holes was via the

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customer's Normet mounted Orica Hypercharge™ Drive system.

Figure 2 shows a loaded draw point featuring three different initiating systems:

1. Exel™ Long Period (LP) detonators were loaded in the drive face for the breakthrough drive blast into the cave.
2. i-kon™III detonators were utilised for the stand-up rings drawing up into the cave.
3. WebGen™ primers were used in the pre-charged rings for the subsequent firings of the cave front.

The breakthrough drive blast and the stand-up rings were fired together to start the caving process sequentially in each drawpoint. Each level was charged in a single event with the charging sequence aimed at mirroring the planned blasting sequence. e.g. first to fire was first to be charged, thus allowing to get the most from the 7-day sleep time limitation.

Figure 2: Photo of the start-up of a draw point.

The Result

WebGen™ 100's flexibility greatly reduced the pressure on scheduling and added an extra engineering control, should a significant event occur during the mining process i.e. reactive ground event, unplanned / uncontrollable movement of the cave.

Results from the demonstration were well above expectation with: -

- Additional 29% recovery
- Additional 85% recovered ounces
- Additional 200% backfill tonnes (Dilution)

The results are detailed in Table 1. The backfill material began caving into the drawpoints from the first firing, as planned. This material was reported to potentially include a small amount of a remnant stope which contained possible higher-grade ore (>20 g/t) seeing the additional amount of backfill material contribute positively to the overall additional recovered tonnes and ounces. Minjar's concept caving method (MSLS), using WebGen™, is endorsed and will be part of future production.

		Design	Actual	Variance
715	Tonnes	7501	11475	↑ 53%
	Grade (g/t)	4.8	4.2	↓ 13%
	Ounces	1164	1557	↑ 34%
703	Tonnes	5763	12805	↑ 122%
	Grade (g/t)	3.8	4.7	↑ 24%
	Ounces	712	1915	↑ 169%
Total	**Tonnes**	**13264**	**24280**	**↑ 83%**
	Grade (g/t)	**4.4**	**4.4**	**↔ 0%**
	Ounces	**1876**	**3472**	**↑ 85%**
	Dilution	**30%**	**90%**	**↑ 200%**
	Recovery	**70%**	**90%***	**↑ 29%**

Table 1: Design and actual tonnes, grade, ounces, dilution and recovery (Carswell, 2020)

Testimonial

"A significant risk in the MSLS trials was the unknown condition and expected behavior of the backfill once exposed. There was a real risk the brow of the cave would become inaccessible and pose an unacceptable risk to personnel, ultimately sterilizing ounces, WebGen™ allowed us to not only mitigate the need to access the brow at all but also gave us flexibility in the production sequence of rings. I would attribute approximately half the ounces recovered in the MSLS trials to the use of WebGen™."

Jack Carswell

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References

Carswell, J. (2020). Sublevel Caving A Narrow Vein Mine – Pajingo's Case Study.

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