

PALABORA'S EFFICIENT CAVE MANAGEMENT SYSTEM ENHANCES PRODUCTIVITY FROM MODELING THROUGH TO OPERATIONS

Block cave operation achieves plan and produces 60,000 annual tonnes



The shaft head gear at Palabora's Mine Site.

Challenge:

Looking to develop copper resource output, Palabora needed to manage draw control and increase resource development and exploration.

Solution:

GEOVIA GEMS™ SQL provides collaborative geology and mine planning capabilities that support cross-functional teams involved in exploration, modeling, mine design, long-term planning, and production scheduling.

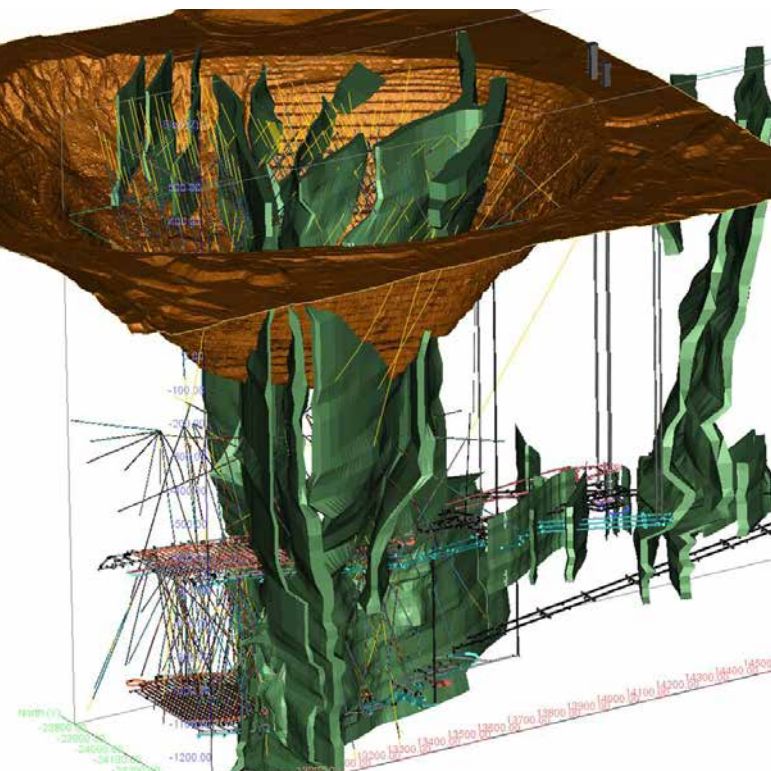
GEOVIA PCBC™ improves profits through better block cave mine plans, schedules and production management.

Benefits:

Evaluate multiple different scenarios and conduct realistic sensitivity analyses. Smooth integration between reconciliation and forecasting data. Sound cave management increases profitability and promotes a safer mining environment. Annual time savings equivalent to one man year.

COMPANY PROFILE

Located in the northeast corner of South Africa, near Kruger National Park, Palabora Copper (Palabora) is South Africa's only producer of refined copper. Between 1960 to the mid-2000s, Palabora operated solely as a large and successful open pit mine, producing over 2.7 million tonnes of copper concentrate. In the mid-2000s, Palabora transitioned from an open pit to a block cave mine and has produced approximately 60,000 tonnes of refined copper annually. A long time user of GEOVIA applications, Palabora has been using GEMS for geological and exploration needs, and PCBC for block caving.



A 3D view of Palabora's open pit and two block caves.

REDUCED ERRORS IN GEOLOGICAL MODELING

Palabora began using GEMS in the early 2000s for their open pit geological modeling. Prior to 2010, all geological modeling was completed offsite; with the help of GEOVIA, Palabora brought the resource modeling in-house. As a result, onsite staff now develop their own models that show different rock patterns in different domains. From there, staff create wireframes to complete their calculations.

Palabora has a geologist dedicated to updating the geological models to conform to the latest drilling, all of which is stored in the GEMS SQL database. Palabora appreciates the built-in variogram functionality found in GEMS, as data is directly reviewed, which reduces errors. The ability to complete complex domain modeling using indicator kriging has also been beneficial. They use the ordinary kriging functionality for their resource calculations and block modeling. The advanced kriging functionality helps them to assess reserves and resource categories.

Palabora appreciates the ease of use and cross functionality between GEMS and PCBC. Hans-Dieter Paetzold, Palabora's Geotechnical Superintendent says "We update the geological block model inside GEMS, and it is immediately available for work within PCBC, as opposed to previous methods that required us to build the models separately, export them and complete several other checks."

SIMPLER RE-EVALUATION OF MINE PLANS

In the mid 2000's, a major collapse of the open pit required Palabora to undergo re-evaluations of their underground mine due to the changes in the configuration of the cave. Palabora relied on GEMS to create a surface plan of the open pit, by incorporating the fly-over survey results into the software. Using their wireframing, they could see how the pit failure evolved.

PROCURING BEST GRADE OF COPPER

Cave management was originally very difficult. As the rock was strong, it required secondary breakage, which meant the draw points for mining the rock were not available for production. To mitigate the waste that gravitated throughout the mine, much work was completed with PCBC to focus on obtaining the best possible grade of copper.



"PCBC is the best system out there to estimate reserves for a block cave. We generate monthly plans on PCBC, which are interlinked with the Cave Management System, to receive daily reconciliations within the system. We don't plan to try anything different, as we have not come across any system that is better than PCBC."

— Sam Ngidi, Mine Study Manager

IMPROVED CAVE MANAGEMENT SAVES ONE MAN YEAR

When moving to a Block Cave operation, Palabora's initial goal was to deploy a user-friendly system to improve cave management, where they could manipulate data at any time. After several years of struggling with an in-house software package that proved difficult and inefficient for their long-term work, Palabora wanted a system that could be easily integrated with their existing production system to send data back and forth. They selected PCBC to monitor and communicate job activity on a day-to-day basis, and especially value the Cave Management System (CMS), which they have been using daily for draw control and management.

Palabora has worked extensively with GEOVIA Services since 2004 to enhance their use of PCBC. GEOVIA Services provided software configuration, which included changing from a daily tonnage order to shift tonnage to match their draw point availability. They now have an automated system that generates a call three times over a 24 hour period. This keeps their day-to-day operations working without interruption through a shift-based draw order, which automates the system and eliminates the need for shift personnel to manually start the system several times a day. Palabora estimates that this new automated system saves two hours per shift. With three shifts daily, annual time savings equates to over 2,100 hours annually, or the equivalent of one man year.

Palabora has been pleased with the success of the CMS over the last decade. When the occasional staff turnover challenged production, GEOVIA Services was quick to work with Palabora to find a solution.

LONG TERM PROFITABLE MINING

GEOVIA Services staff worked collaboratively with Palabora to create a solid plan for the next 10 – 15 years of mining.

Using PCBC's Footprint Finder, in combination with capital estimates, data and working costs, Palabora can locate the footprint at the right place, to identify the draw points for profitable mining. They can further increase this profit by targeting slightly higher-grade draw points and footprint shape, which helps Palabora to concentrate primarily on the higher-grade areas.

UNIQUE TRANSITION STRATEGY TO NEW LIFT

Palabora is gearing up for the End of Life of Lift 1 in their block caving operation within the next few years. They have currently completed 70,000 meters of drilling from the base of Lift 1 down into Lift 2 to gather all the geological information, and use GEMS SQL to store all of that data. "GEMS forms the backbone to calculate the resources data to generate the block model," says Paetzold "All of the data of the resource then determines how the mine is designed." With GEMS, Palabora has created a resource block model between Lift 1 and Lift 2 to determine its viability for mining.

Once their geological data is in the database, Palabora uses GEMS to provide section views and plan sections. "GEMS allows us to step through the block model," says Paetzold. "When drilling down from Lift 1 to Lift 2, GEMS identifies areas where more drilling is required for in-fill drilling." Palabora appreciates that GEMS captures distances between holes as it shows when they are in a low density of drilling,



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when spacing is very far apart, and directs them to plan more holes into that area to increase coverage.

Palabora has undergone extensive planning for the transition from Lift 1 to Lift 2 to understand the quality of the remaining reserve tonnage. Because of the unique situation of a cave on top of a cave (Lift 2 is directly below Lift 1), Palabora developed a unique transition strategy between the two lifts to help minimize reserve losses. The end result capitalizes on the mining of Lift 1 without compromising Lift 2 reserve production, or reserve depletion as they now run both lifts simultaneously, in a multi-level/multi-lift run.

Palabora sees much benefit to partnering with GEOVIA for their CMS, especially in terms of shift and tonnage generation. "PCBC is the best system out there to estimate reserves for block caves", says Sam Ngidi, Palabora's Mine Study Manager. "We generate monthly plans on PCBC, which are interlinked with the CMS, to receive daily reconciliations within the system. We don't plan to try anything different, as we have not come across any system that is better than PCBC."



Underground production at Palabora's mine.



"It's a willingness from GEOVIA to share knowledge and understanding that has assisted in our using the software optimally at all times."

— Hans-Dieter Paetzold, Geotechnical Superintendent

ONSITE TRAINING ENHANCES RESOURCE MODELING

Palabora engaged GEOVIA Services for onsite training and services to further enhance their understanding of resource modeling and to optimize their use of GEMS. GEOVIA staff worked directly with Palabora's data and establish better methods of calculating the available resource.

With GEOVIA's help, in-house staff can now generate wireframes and resource models, and link the data directly to PCBC. They are more self-sufficient and no longer spend capital on external resources or other software.

NEXT STEPS

As Palabora phases out Lift 1, they have completed between 500 to 1000 runs looking at different options, block heights and footprint sizes. Since reserve estimation work is done with PCBC, they also need to continue ongoing work on the

reserve side – specifically, the shape of the resource changes or when higher grade is found to determine the best design layout for Lift 2. They are looking at a smaller footprint that will help reduce capital costs that will not compromise the overall output. The goal is to reduce its size at a higher grade to help maximize the overall copper output. Palabora plans to continue with PCBC training so they can track the underground sampling in the block cave.

Focus on Palabora

Palabora operates a large block cave copper mine and smelter complex. The refinery produces continuous cast rod for the domestic market and cathodes for export. Useful by-product metals and minerals include zirconium chemicals, magnetite and nickel sulphate as well as small quantities of gold, silver and platinum. Palabora has developed a US \$410 million underground mine with a production capacity of 30,000 tonnes of ore per day.

Headquarters: Phalaborwa, Limpopo, South Africa

Employees: 2,200

For more information
www.palabora.com

Applications Used: PCBC, GEMS SQL

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