Caving Propagation Study for the Esmeralda Block 1

CIVIL • **MINING** • ENERGY • MATERIALS

PROJECT DESCRIPTION

CODELCO

Esmeralda Mine, El Teniente Division, Chile

3DEC™

In the context of the transition studies from Open Pit to Block Cave mining at the Chuquicamata Underground Project, the validation of Itasca´s caving algorithm (IMASS) being used to predict caveability in a structurally controlled environment was deemed necessary. CODELCO proposed application of the caving algorithm to the observed caving behavior of Block 1 case study at Esmeralda Mine, El Teniente Division, which was known to have been influenced by the presence of a few major faults in its development.

ITASCA'S ROLE

The caving algorithm developed by Itasca over the last 20+ years has been successfully applied to many operations across the world. The caving algorithm makes use of a unique strain-softening constitutive model (now IMASS). The algorithm was initially implemented within FLAC3D and then migrated to 3DEC. The mining transition studies of Chuquicamata mine require to simultaneously consider open pit and underground mining. The stability of Chuquicamata open pit has been studied by ITASCA for more than 15 years, having achieved a good understanding of the failure mechanisms applying the 3DEC, which allows the implementation of a large number of faults. However. there was limited experience (at that time) using 3DEC for caving simulations. ITASCA agreed first to validate the code with a real caving experience within a similar mining environment strongly influenced by discontinuities but involving fewer faults. Block 1 is part of Esmeralda sector, belonging to El Teniente mine in central Chile. It has been mined via panel caving since August 2011, and the breakthrough to the upper level (Teniente 5 level) occurred between June and October 2012. The calibration period was defined from August 2011 until December 2012 following Block 1 historical draw schedule.

PROJECT RESULTS

Itasca implemented the caving algorithm in 3DEC using all the data provided by CODELCO and successfully matched the observed behavior at El Teniente´s Esmeralda mine. From the calibration, it was concluded that the parameters with the most significant influence were the stress field, rock mass properties, and faults properties. A good correlation was obtained when compared with the emerging cave shapes from the model and the position of the micro-seismic activity recorded in the period of interest. When comparing the results of the geometric observational modeling developed by CODELCO with the emerging results from the 3DEC model, a reasonable match was observed in terms of geometry and volume of the caves. Additionally, breakthrough to the upper level Teniente 5 and the main propagation mechanism influenced mainly by J and H Faults were captured.

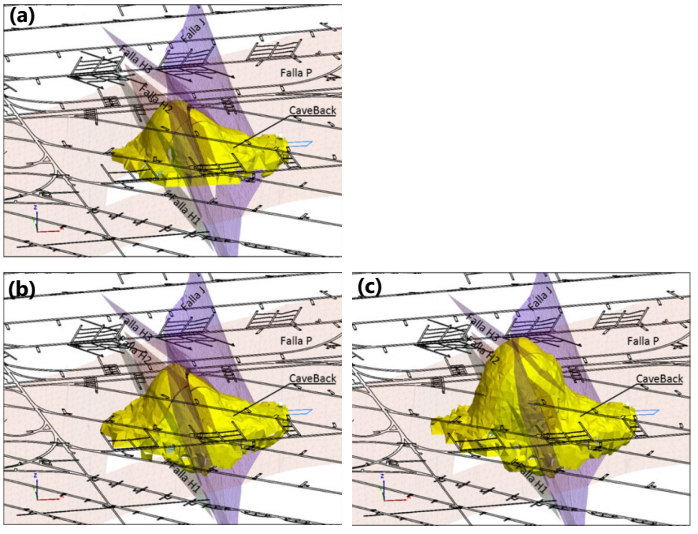

Figure 1. 3DEC model predicting propagation as shown in isometric view for (a) July, (b) October, and (c) December of 2012.

REFERENCES

Álvarez, C, Gómez, P, Orrego, C & López, S 2020, "Calibration of structurally controlled caving propagation using 3DEC. The Esmeralda Block 1 case study", in R Castro, F Báez & K Suzuki (eds), MassMin 2020: Proceedings of the Eighth International Conference & Exhibition on Mass Mining, University of Chile, Santiago, pp. 418-427, LINK.

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