FINAL PROJECT SUMMARY

ELASTIC LIMIT BLAST DESIGN TO MAXIMISE THE GRADE ENGINEERING RESPONSE

Project number:	P2-009
Program Coordinator:	Garth Hamilton, Greg Wilkie
Project Leader:	Ebrahim F. Salmi, Ewan J. Sellers
Timing:	September 2019 to December 2020
Participants:	Mining3, CRC ORE

crcore.org.au

PROJECT OUTCOMES

- This research has provided a proof of concept to enhance Natural Deportment during the blasting stage by using carefully controlled explosive energy application, below the elasticity limit of the gangue, to create zones of optimal preferential fragmentation for exploitation at downstream screening stages. The study tried to demonstrate zones where differential stresses or strains would induce gangue liberation in coarse sizes. It also investigated and identified practical blasting techniques that enable controlling the blast energy to improve natural deportment.
- The research showed that the blast-induced stresses and strains can be controlled to selectively fragment the ore in fine particles and to minimise the breakage of waste to fine fragments but just to digable sizes. The in-situ block size distribution of the rock mass and the digability of the excavators are two important factors affecting the design of the selective fragmentation. The research outcomes also showed that several approaches can be used to control the breakage of rocks, such as using guide holes, or notched holes, using delays, de-coupled or air deck charges, and varying the explosive type or stemming. Among these, using de-coupling seems to be an efficient approach for controlling the breakage of rocks and for matching the blast loads with the elastic limits of ore and waste rocks (see Fig 1 and Fig 2).

RESEARCH COLLABORATION

- Mining3 has expertise in the design and optimisation of blasting for Grade Engineering®. Mining3 has also developed tools and technologies for the characterisation of rocks and the optimisation of differential blasting in heterogenious rock masses.
- Mining3 capabilities for numerical and analytical modelling, such as the enhanced Fragmentation-Energy Fan, the Distribution Free Model, were used for investigating the selective blast design in heterogeneous orebodies containing soft ore and hard barren gangue materials.
- CRC ORE Implementation team who are experienced in Grade Engineering can also help to identify or create the data for the most suitable cases.

BACKGROUND TO THE PROJECT

- The value proposition of Grade Engineering can be enhanced by identifying additional ways in which any of the five "Grade Engineering Levers" can be deployed into the mining value chain to undertake gangue rejection. This project investigated a new concept to blast designs that seeks to capture these opportunities. It is proposed that by introducing selective breakage as a controlled parameter in blast design, this project creates the potential for a new deployment mechanism for grade engineering, and at the earliest possible stage of the mining process. This can add values to the mine design (see Fig. 3).

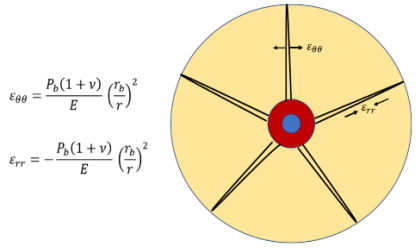

Fig 1: Schematic view of tensile fracturing around the blastholes

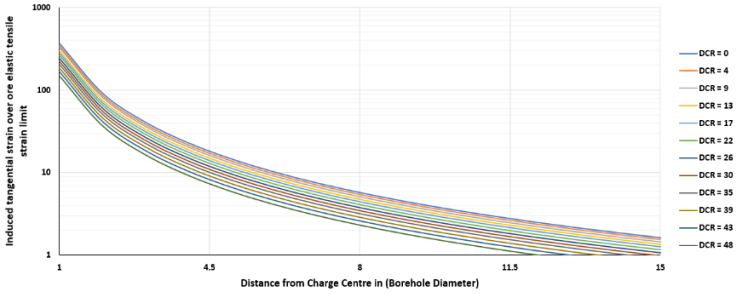

Fig 2: Blast induced tangential strains over the elastic tensile strain limit of a soft ore for different de-coupling ratios and versus distance

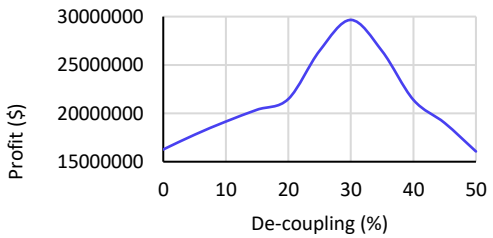

Fig 3: Value achieved from de-coupling blast design for GE for a specific case study

CRC ORE Optimising Resource Extraction

mining3 TRANSFORMINGMINING

Australian Government Department of Industry, Innovation and Science | Business Cooperative Research Centres Program