PROGRAM 1:
DEFINE

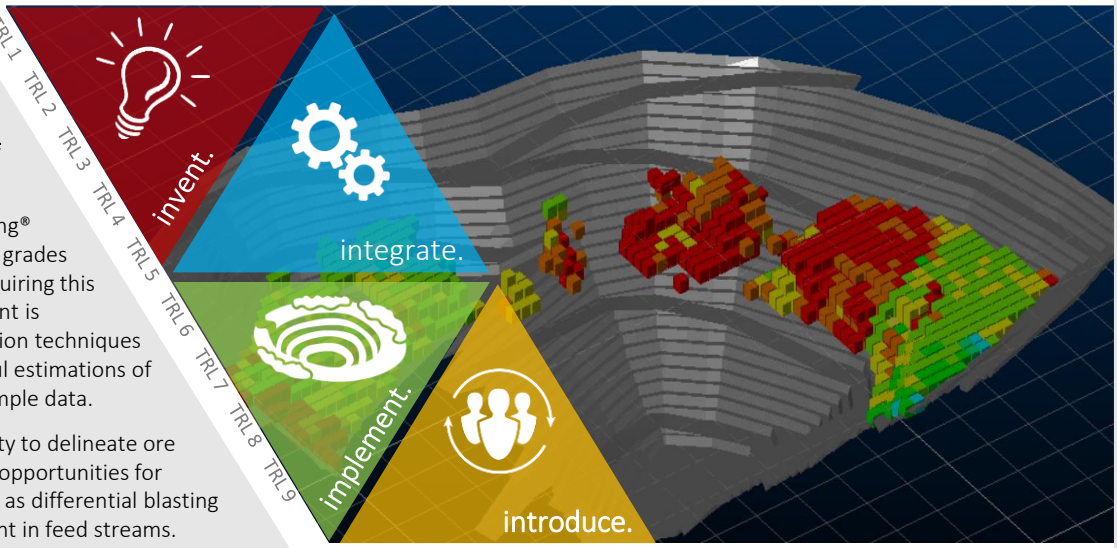
Resource scale heterogeneity evaluation

PROJECT P1-011

The aim of this project is to evaluate a suite of next generation geostatistical techniques to overcome the challenge of low sample density and provide quantitative measures of grade heterogeneity within resource blocks.

The effective application of Grade Engineering® requires knowledge of spatial distribution of grades (heterogeneity) within a resource block. Acquiring this knowledge by drilling and direct measurement is constrained by time and cost. Grade estimation techniques are important but cannot provide meaningful estimations of grade on scales that are smaller than the sample data.

The aim of the project is to develop the ability to delineate ore zones in resource block models and identify opportunities for application of Grade Engineering levers such as differential blasting and bulk sorting to upgrade the metal content in feed streams.



THE UNIVERSITY of ADELAIDE

CRC ORE

Research collaboration

The University of Adelaide hosts the leading geostatistics education and research group in Australia. The team has been recognised by awards at the highest international levels.

This capability will be complemented by the inclusion of a post-doctoral researcher with expertise in clustering techniques and its application to geometallurgical modelling.

Two lines of research will be pursued to quantify in-block grade heterogeneity.

(1) Indirect: Evaluation will be done using data currently available in most mining operations. This includes grades measured on cores and other variables that are correlated with grade. It will investigate techniques such as spatial clustering, fractals, scaling, and spatial patterns of grade.

(2) Direct: Using additional down-hole sensed data, the research components will investigate:
- a) Large-scale geostatistical modelling of rock heterogeneity at both the block and deposit scale (estimating mean block grades and grade distributions within blocks).
- b) From sensed data provided, generate small-scale models within blocks.
- c) Data and model integration of the large and small scales to generate local heterogeneity models within blocks.

Program Coordinator:	Dr Greg Wilkie, CRC ORE
Project Leader:	Prof Peter Dowd, The University of Adelaide
Timing:	April 2018 – June 2019
Participants:	The University of Adelaide

Image (top): Heterogeneity in situ. Image supplied by CRC ORE

Background & aims

Grade heterogeneity can be expressed as a measure of the degree of clustering of classes of grade values. All resource-scale grade estimation methods are limited by the amount and locations (scale) of the available data. It is not possible to provide meaningful estimations of grade on scales that are significantly smaller than the scale on which samples are available. While it is possible to estimate the statistical distribution of the grades of all sample-size volumes within a resource block, it is not possible to estimate the grades of these volumes at specific locations within the block.

Heterogeneity is a function of location. Grade estimation is a function of spatial dependence. Given sufficient data at appropriate scales, the heterogeneity problem could be solved by the spatial dependence approach.

The spatial dependence component outlined in the indirect approach would generate what might be termed as the coarse-scale grade model. The sensed data from blast holes would be used to generate a local fine-scale model for each block. Integration of the local coarse-scale and fine-scale spatial estimates would provide a dynamic heterogeneous model at the fine local scale that could be obtained and updated in real-time as more sensed data is collected.

Validation of outcomes will be undertaken on a simulated orebody conditioned to real data. If suitable data is available, it will be validated against observed heterogeneity patterns in post-blast processes.

Focus on outcomes

- Deliver effective measures and estimates of grade heterogeneity for applications based on the data available at the resource scale and for near real-time applications when resource data is augmented by sensed data.
- Integration of the fine and coarse-scale spatial models.
- If sufficient in-situ and validation data is available, the project will also demonstrate the indirect and direct methods of in-block heterogeneity assessment in an operating mine environment.

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Optimising Resource Extraction