PROGRAM 1:
DEFINE

Magnetic Resonance Bench Analysis
Stage 1: Laboratory Feasibility

PROJECT P1-013

This project is designed to investigate the use of Magnetic Resonance (MR) as a measurement technique for mapping out a three-dimensional grade profile of a bench at high resolution (~2 metres).

The ability to generate a high resolution, three-dimensional grade map of a bench is an enabling technology for assisting differential blasting and selective mining in the blast, dig and deliver phases.

Research collaboration

CSIRO has extensive experience developing Magnetic resonance (MR) based technology for mineral measurement, from concept through to commercialisation. MR is amenable to the detection of most economic copper minerals (except bornite) and to virtually all arsenic containing minerals.

More recently, CSIRO has demonstrated bulk measurement in an on-conveyor MR measurement embodiment for quantitative mineral detection to support sensor-based bulk sorting. Field trial measurements at low detection limits and rapid detection speed were successfully completed, where sensing volumes of ~ 1m3 were involved. This on-conveyor embodiment has been described previously at CRC ORE meetings.

CSIRO has also successfully completed a CRC ORE Centre funded project on the detection of the mineral covellite, which showed MR amenability for the bulk sensing of this mineral.

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Project Leader:	David Miljak, CSIRO
Timing:	June 2018 to March 2019
Participants:	CSIRO

Background & aims

CSIRO has developed large volume MR sensors for quantitative detection of selected copper, arsenic and iron minerals. MR is a radiofrequency based spectroscopy suited to the deep penetration for sensing in rocks.

Whilst large MR based loops have previously been used by others for the detection of fresh water aquifers at depth, MR sensors for mineral detection at very significant depth > 1m have not been previously developed. This capability is seen as an enabling technology for obtaining three dimensional, high resolution images of mining benches to assist differential blasting and selective mining prior to drilling and blasting.

The fundamental project challenge is to develop an MR sensor that will meet the objective of deep sensing of minerals in mine benches. The key attributes of MR that make it highly suited for mine bench sensing include:

- Deep sensing penetration, typically many metres in typical porphyry matrices.
- Quantitative detection with very low detection limits, well below cut off grade, in seconds.
- Unaffected by surface conditions, such as moisture or dust.

Focus on outcomes

Should Stage 1 produce positive technical outcomes, later stage-gated work could be contemplated, and may include:

- Initial sensor trial in the field - This would involve the testing of a full sized sensor, designed for field-worthy use, on actual mine benches. This work would essentially represent elevation to TRL 5.
- Initial site implementation. This would involve construction of a highly engineered quasi-autonomous solution, demonstrated at the mine (elevation to TRL 6-7).
- Commercial development of final system (TRL 8 and beyond).

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