# Magnetic resonance of covellite for geo-sensing

PROJECT P1-003

To enhance the capability of CSIRO's existing Magnetic Resonance (MR) sensor technology.

The outcome will be the laboratory demonstration of a prototype on-conveyor MR Analyser for a species other than chalcopyrite. The non-chalcopyrite mineral being targeted is covellite, sulphide mineral commonly associated with chalcocite and found in the supergene zone of some copper deposits.

This will result in the on-conveyor MR technology attaining a TRL 4 for detection of selected non-chalcopyrite mineral targets.

TRL 1 TRL 2 TRL 3 TRL 4 TRL 5 TRL 6 TRL 7 TRL 8 TRL 9

invent. integrate. implement. introduce.
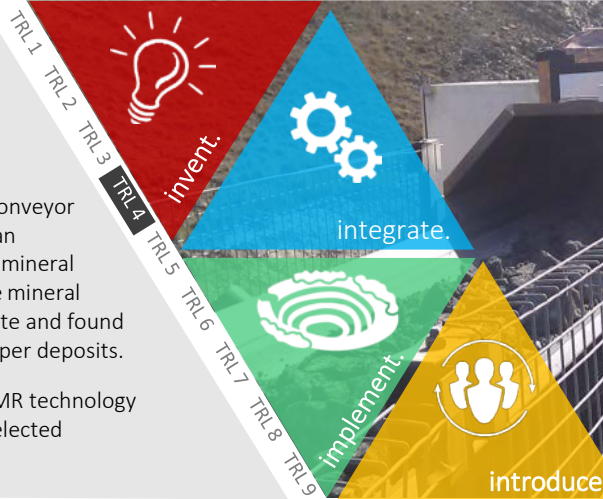
Research collaboration

CSIRO at Lucas Heights has developed and demonstrated a full scale on-conveyor MR Analyser for measurement of chalcopyrite in primary ore. The work proposed in this project builds upon the significant development already undertaken by CSIRO in this area. The lead scientists in the project are experts in MR instrument design, MR mineral physics and industry measurement applications.

The core CSIRO MR team is supported by an experienced group of mechanical and electrical technicians. The group at Lucas Heights has a strong track record in the development and commercialisation of on-line analysis systems for the minerals industry.

Program Coordinator:	Paul Revell, CRC ORE
Project Leader:	Peter Coghill, CSIRO
Timing:	March 2016 – February 2017
Participants:	CSIRO. Potentially tested and trialled at suitable mining sites

Image: MR chalcopyrite analyser at the Ridgeway mine, supplied by CSIRO

Background & aims

In 2013, CSIRO demonstrated a magnetic resonance sensor for detecting and quantifying the chalcopyrite mineral content at the Ridgeway mine in NSW. The sensor measured the average chalcopyrite (and by implication copper grade) at 20 second intervals from the ~1300tph Ridgeway conveyor belt. This demonstration highlighted the real-time variability of small parcels (~7 tonnes) of ore on the conveyor belt and highlighted the potential for a Grade Engineering® approach based on mass sorting.

The MR sensor is mineral specific. Each mineral has a unique response and the peak input radio frequencies differ depending on the physics of the mineral system. This project aims at enhancing the MR sensor to enable identification of additional copper mineral species, specifically covellite.

Focus on outcomes

- Build a prototype covellite on-conveyor sensor for laboratory evaluation. The newly constructed sensor component will be integrated with existing CSIRO MR electronics.

- Build and test customised electronics submodules, based on existing CSIRO concepts and designs, that relate to improvements in radio frequency switching speed (a key requirement of successful measurement of targets with fast MR decay).

- Develop the capability for the sensor unit and testbed electronics to run at higher average powers and/or peak radio frequency voltages.

- Develop new radio frequency pulsing concepts to optimise detection performance in large volume "power limited" applications.

- Evaluate and quantify the optimised covellite measurement performance of the laboratory test bed system.