Cave Tracker: Safe and performing block cave mines

Improving decision making through detailed insights

Block caving as a mining method is a risky enterprise given the lack of insight into the environment in which the mine must operate.

Block caving relies on fragmentation and forces of gravity to 'cave' the fragmented ore to draw points built deep underground, from where it is collected and taken away for processing. Mine operators cannot see what is happening in the fragmented body of ore, which means that behaviour of the ore when it flows cannot be accurately predicted. Without accurate knowledge of ore behaviour, risks to safety and output are high and difficult to manage. These risks include unpredicted events that impact personnel safety, loss of resources and inefficient operations.

A number of monitoring methods have been developed which attempt to provide greater insight into the cave's extent. These include time domain reflectometer, extensometers and seismic systems. Each of these methods has limitations and, in isolation, is unable to provide the broad ranging data required to have a comprehensive 3D view of the extent of the cave.

Cave Tracker – Eyes into the mine

Elexon Mining developed the Cave Tracker system in conjunction with CRC Mining, Rio Tinto and Newcrest so that mines can more accurately determine the extent of the cave and track ore flow. Through the data gathered with the Cave Tracker system mine mangers are able to make better decisions to protect the mine asset and keep it working as it should, safely and efficiently.

The system operates through a series of beacons that are embedded in the mine, which can be tracked in 3D as they move with the fragmented rock of the ore-body.. The ability to track beacon movement allows mine engineers to determine which parts of the cave are moving and which parts are not. The rate and direction of movement can also be established.

Cave Tracker beacons are wireless and robust. They are able to remain underground for years and withstand the rigours of a harsh underground environment.

What is the Cave Tracker system ?

Cave Tracker is a highly sensitive but robust system that consists of the following components:

Beacon: A rugged cylindrical fiberglass enclosure containing a strong magnet, batteries and electronic circuitry. A microcontroller in the Beacon is programmed to control an electric motor which spins the magnet at desired intervals. Beacons are embedded in a mine's ore-body so that their 3D position may be tracked at regular intervals by Cave Tracker System Detectors. Beacons are intended to be installed in deep mine holes. Calibration Beacons are identical to Beacons, with the exception that they can be powered and can communicate with the outside world via an umbilical cable.

Detector: A rugged cylindrical fiberglass enclosure containing a sensitive magnetometer and various electronic circuitry including a small computer. Detectors are strategically placed throughout the mine so that the system may detect the 3D positions of Beacons installed in the mine. Detectors are also intended to be installed in deep mine holes. Detectors send the measured Beacon ranging information via the Communication Adaptor Module's (ITCAM) serial link to the Cave Tracker Management System server for data storage and analysis.

Communication Adapter Module (ITCAM): The Communication Adapter Module provides a DC power and serial data communication link for Detectors and Calibration Beacons. Messages between Cave Tracker Management System, Wireless User Interface and Calibration Beacons/Detectors are relayed through the ITCAM.

Cave Tracker Management System (CTMS): The CTMS is responsible for data storage of Detector range readings, converting received Detector ranges into 3D Beacon positions, and managing installed Cave Tracker System Devices.

Wireless User Interface: A small ruggedised laptop + USB Activation Wand is used for system commissioning and the wireless activation of Beacons prior to installation.