Networked Smart Markers – wireless cave back monitoring.

Enabling safe and performing cave propagation.

Networked Smart Markers – a cable-free approach to cave back monitoring

During the phase of growing the cave to breakthrough, the understanding of the cave back location is critical for making informed decisions.

Existing methods for monitoring and managing cave back are not able to provide all of the data required by mine operators.

Elexon Mining has developed the Networked Smart Marker System to complement existing monitoring systems. This system enhances knowledge of cave back behaviour, offering insight into areas not previously visible to mine operators.

With this enhanced knowledge, mine safety and economic risks can be more effectively managed.

Why monitor the cave back?

Monitoring and managing cave back propagation is critical to achieve safe and performing cave mining. Cave establishment and cave propagation until the cave breaks through to surface is a highly critical and stressful period of time during cave mining projects. The understanding of the location of the cave back at any time during this phase enables managing safety and economic risks. These risks include:

- *Airblast:* A stalling cave growth and the excessive production can lead to an airgap. If the cave back collapses and releases rock into the airgap then this material can displace large volumes of air. The displaced air can penetrate the muck-pile or find other exits from the cave. The influx of air into mining infrastructure can be so violent that it causes causalities and damages large scale equipment.

- *Excessive subsidence:* Subsidence is part of any caving operation. Existence of valuable structures or the placement of new infrastructure close to the area affected by subsidence may not be possible to be avoided. Excessive subsidence may affect or damage these structures.

- *Cave hang-ups:* Mining projects economic values are based on the extraction of a certain amount of ore resources. Caves are planned such that expected cave propagation progresses such that the muck pile includes these resources. If the cave doesn't propagate as planned and resources are not fragmented and included in the muck pile then the economic value of the mining project is importantly diminished and may diminish the return on investment below the expectations of investors.

The downsides of traditional cave back monitoring solutions

Traditional cave back monitoring solutions may not provide sufficient insights into cave back monitoring and expose cave operations to the above listed risks.

- TDRs and Extensometers rely on cables for measurements, powering sensors and transmitting data back to data loggers. Due to the nature of caving, mining induces stresses in rock above and around the cave. These stresses may cause structures to open and ground to move which can happen at a far distance from the actual cave back location. This ground movement is likely to damage any cables installed in the ground. Damaged cables will render the monitoring systems inoperable or provide inaccurate readings.

- Open holes are used for lowering cameras down the hole and into the cave. Displacement of holes may obstruct the camera's path and disable monitoring the cave back.

- *Micro-Seismicity:* The location accuracy of seismic events around propagation cave backs is often hampered by the changing rock mass condition that attenuate the micro seismic signals, making it difficult to evaluate the cave back's location.

Networked Smart Markers

Networked Smart Markers use radio frequency communications to identify gross movement and to transfer this measured data from units installed in the cave to a reader.

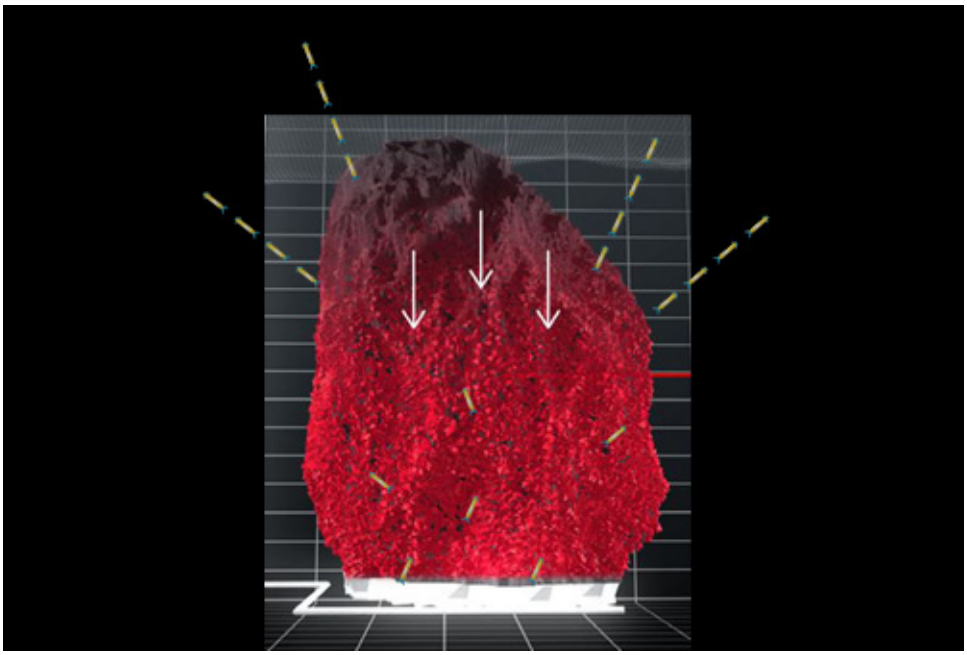

Illustration of Networked Smart Marker installation

Arrays of Networked Smart Markers are installed and grouted in holes. The Markers communicate with neighbouring Markers which enables them propagate data wirelessly through rock over long distances. Markers record radio signal strength for communication between Markers.

Radio signal strength is directly related to the distance between Markers. Changes in radio signal strength over time indicate movement between Markers until Markers move too far apart which is when communications is interrupted.

Figure 2: Indication of cave moving through an area.

The communication range is dependent on the rock properties and usually is around 6 – 10 metres. This communication does not rely on cables which means that ground movement in the range of a few metres does not break communications, unlike cable based monitoring systems.

This recorded data is analysed for identifying the cave back's location and cave growth. Ground movement of up to several metres will not break the communication chain of Markers.

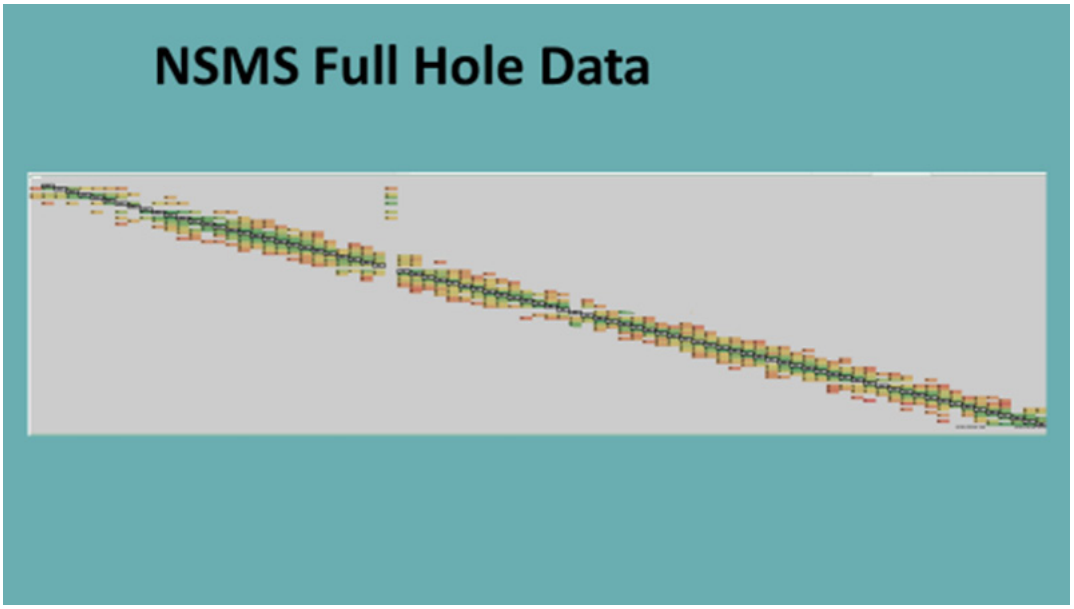

Figure 1: Networked Smart Marker hole overview

Networked Smart Markers are based Elexon Mining's rugged, blastproof and multi-year battery-powered Smart Markers which have been successfully used in the majority of large scale cave mines for monitoring cave flow.

Contact our team to learn more about current Networked Smart Marker System installations and their outcomes, and to discuss how we can work with you to enhance your cave monitoring capabilities.

Elexon

SMART MARKER SYSTEM

NETWORKED SMART MARKER SYSTEM

CAVE TRACKER SYSTEM

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