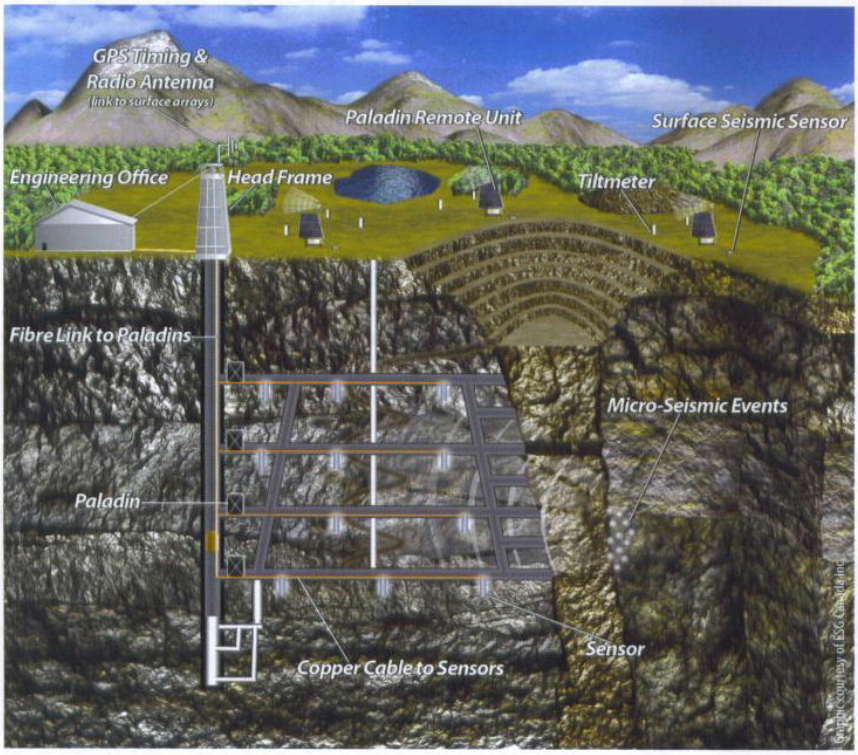
For the love of terra firma

A Canadian company delivers hi-tech, integrated solutions to keep mine management on firm ground



Diagrammatic representation of a typical ESG system installed at a mine

There is a deep, instinctive value accorded to the simple act of standing on firm ground. Perhaps because we derive such comfort from terra firma, human beings have been fascinated and terrified by the prospect of the ground beneath their feet being shaken. As far back as AD 132, the Chinese scientist, Chang Heng, invented an ingenious device to record and locate earthquakes. Comprised of a pendulum and metallic dragons and frogs, Heng's contraption was beautiful and somewhat effective, but largely imprecise.

In the ensuing centuries, seismometry has come a long way. What has remained unchanged is our need to know when and where the ground will not be firm. Nowhere is this need more acute than in the mining industry, tied to the ground as its fortunes are.

Addressing this requirement is the core purpose of Engineering Seismology Group (ESG) Canada Inc. a Canadian company established in 1993 that provides passive seismic monitoring systems to the resources and geotechnical industries.

A one-stop shop

Seismic monitoring systems are not rare. Jamie Alexander, ESG's director of North American mining, estimates that about 80 per cent of Canada's deep mines have them, with greater concentrations in Sudbury and Val-d'Or. ESG microseismic instrumentation has been installed at over 300 sites worldwide. The state-of-the-art systems have ISO 9001:2000 and MSHA Intrinsically Safe certification.

ESG was born of a decade of intensive industry-sponsored research into seismic hardware, software and interpretative processes. Employing top-flight seismologists, software professionals, geophysicists and technicians, the company remains true to its roots. ESG's active research and development department seeks to improve products and develop new functionalities making the detection and recording of seismic-type activity more accurate and useful.

Better with age

A typical ESG system is made up of a series of finely tuned sensors distributed across strategic underground and surface locations. These are connected by copper cables to ESG Paladin seismic receivers that record and process the sensor data and transmit them by Ethernet cable to surface stations for archival or analysis. Other surface units generate geographic information system (GIS) and timing data, permitting every recorded event to be located precisely in space and time.

The entire system is set up, as Alexander put it metaphorically, "to make a video recording of seismic activity, instead of just taking a snapshot." Continuous, real-time recording means that no seismic activity, however minute or fleeting, goes unnoticed. "Ethernet connectivity uploads the data to a web-like system, where you can log in remotely or at the surface," Alexander added.

"Many mines put the ESG system into new developments, so that they can get background-level data on what they can expect seismologically," Alexander explained.

"Every mine will generate some seismic activity. It's pretty normal. What you need to do is find out what's not normal."

It is in distinguishing normal seismic events from concerning ones that the ESG system ages really well. Continuously recording and archiving seismic activity, the system builds up a fund of high-definition data on the site with the passage of time. Voluminous archival data make it easier for analysts to interpret current data more meaningfully and integrate the information into decision-making processes more usefully.

ESG in action at Kidd Mine

At Xstrata's Kidd Mine, an ESG system was first installed in 1997, where, according to the mine's ground control specialist, Norm Disley, it helps make informed decisions. "The seismic data is used on a daily basis for re-entry, planning, ground support, sequencing and estimating seismic hazard," he explained. Because the systems are PC-based, they could be easily integrated into existing equipment and facilities at the Kidd Mine. "We didn't require any specialized information systems support and we could even use some of our existing sensors that were not manufactured by ESG," said Disley. "Our central control supervisors have 24-hour access to the seismic visualizers and database. With the full waveform data combined with triaxial sensors, we have a reliable microseismic magnitude scale and a much better understanding of seismic ground motion and its effect on ground support systems.

Disley also uses data from the ESG system as raw material for other computerized analytical systems to get a more detailed picture of seismic conditions at his mine. "After processing, all data from the ESG microseismic systems is downloaded into the Mine Seismicity Risk Analysis Program." Developed by the Australian Centre for Geomechanics, this risk assessment database software processes the ESG-generated data to produce advanced metrics like energy indices and seismic hazard maps based on peak particle velocity.

Because it gels well with and feeds into existing systems at Kidd, Disley reports: "We are currently expanding our systems below the 8600 level with ESG 24-bit Paladin recorders, as mining continues to expand to depth."

For safety and productivity

Using the ESG system to map seismic activity, mine safety personnel can set safe-zone boundaries, especially during events like major blasting. The system can also help assess pillar and ore pass stability, identify potentially dangerous active fractures and faults, and pinpoint areas of potential roof collapse and cave-in hazard.

In the harsh mine environment, sensitive instruments can be easily damaged. So that the occasional cut cable or jarred junction box does not throw the whole system out of kilter, there is redundancy built into it. "If a few sensors fail, there's enough backup for the system to keep running," Alexander explained. Still, on rare occasions, things do go wrong. This, according to Disley, is where the company's provenance played an important role. "ESG is a Canadian company based in Kingston, so they could send someone over to the mine within a day, if required," said Disley. Precision and reliability also lend the system an important fringe functionality — productivity enhancement. If risk-prone locales are identified and delimited accurately, areas where personnel need to be evacuated or work needs to stop are greatly reduced. Individually, such reductions in stoppage or loss of productivity may not seem much, but over time, they can add up to substantial savings.

The ripple effect

More than 1,800 years after Chang Heng's proto-seismograph, the repute of its modern-day, made-in-Canada descendant has spread to Heng's native land where it is used every day at several mines. China is just one of the dozens of countries in which ESG has helped meet humankind's primordial need to be on terra firma. CIM