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New Developments: In-Field Measurements and Analyses

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The process of ore discovery relies on the incremental building of rock knowledge, understanding four key parameters at multiple scales: geochemistry, mineralogy, texture, and spatial location. Traditionally this data was collected disparately and could take anywhere from weeks or months to collate in order to make decisions, often long after the drill rig had demobilised. Using geological sensing to collect in-field measurements, and the ability to deliver information where it is needed, reduces this time to decision and supports the geoscientist to make rapid informed, reliable, and auditable decisions (Cleverley et al., 2017). This change is happening at a time of rapid advancement in sensor hardware development for field deployment, automation, and the data infrastructure to deliver information to the geoscientist where and when it is needed.

The last 20 years has seen geosensing technology move from the laboratory into the field. In-field measurement technology is developing with innovation in 1) sensing technology, 2) hardware platforms to deliver the measurements closer to the sampling site, and 3) infrastructure ecosystems and analytics to capture, exchange, and turn data into information. Increasingly, products are a combination of all of these, implemented within or interfacing with other systems as an ecosystem. There has been a shift from single technologies to whole systems of sensors and open data exchange.

Geochemistry has benefited from improvement of direct-measurement sensing technology like portable XRF, but now new sensors such as laser-induced breakdown spectroscopy (LIBS) and Raman spectroscopy deliver elemental and molecular analysis that are physically not possible with XRF in the field. Mineralogy is mostly calculated by proxy through hyperspectral sensing or directly in X-ray diffraction using portable formats. Getting mineralogy is critical yet in both instances the processing of the raw signal and confidence in a result is where the innovation and development is centred. There are many new analytic developments that are speeding up the process of delivering the quantified result from spectral or X-ray analysis and the way the results are delivered to the field.

The methods by which the sensors are deployed to the field is centred on platform technologies, robotics, and automation. Core scanners have been developed as ways of collecting multiple sensing streams but also starting to automate the workflow for processing diamond drill core, delivering consistency compared to handheld point-and-shoot methods. In geochemical and mineralogical sensing, the quality and representivity of the sample is also critical to the result. Supporting technology to allow in situ spot or interval measurement, downhole, or sample preparation prior to analysis is important to getting a reliable, quality result supporting a quality decision and is as important as the sensing hardware itself.

For mineralogy, future research in the processing of the raw sensor data will lead to improvements, especially in the coprocessing or inversion of chemical and mineralogical data. Future advances in sensing technology will broaden the range and quality of variables that can be measures in-field to underpin quicker, more robust rock knowledge and lead to quicker, quality decisions in the discovery process.