HyLog™ is a new way to study rocks from beneath the earth’s surface, providing mineralogical information not available to the naked eye.

At least $0.5 billion is spent annually on drilling in Australia and most of the drilled materials remains under used. Geological Survey of Queensland (GSQ) has two dedicated core libraries and one core yard which receives cores from both in-house programs as well as contributions from private organisations, submitted as part of the state’s exploration legislation. This huge collection of cores is publicly available, however individual geological logging of cores can lead to subjective (inconsistent) results. Moreover, these records are not easily revisited or archived as company/state assets.

HyLogging™ is an advanced technique from CSIRO that helps geologists to non-destructively assess the mineralogical distribution of an entire drill core, with minimal sample preparation or removing from its original tray. The virtual online library will offer geologists the chance to examine detailed mineralogical results remotely from their desks, thus avoiding visits for physical inspection.

HyLogger™ 3-5 consists of highly sensitive visible-near infrared, shortwave infrared and thermal infrared spectrometers, a high resolution digital camera, a laser profilometer, a robotic x/y table, quartz–halogen lighting and associated control/ data management softwares. GSQ can also supplement its HyLogger™ data with elemental mapping using a hand-held X-ray fluorescence spectrometer.

**Principle**

HyLogger™ works on the principle of reflectance spectroscopy. Reflectance is the ratio of reflected energy to incident energy and varies with wavelength, as a function of the molecular properties of the material. Most materials have reflectance signatures characteristic to their molecular structure which can be used to identify them. Generally, spectral regions in the visible and near infrared (VNIR; 400–1000 nm), shortwave infrared (SWIR; 1000–2500 nm) and thermal infrared (TIR; 8000–12000 nm) regions are relevant for mineral identification.

A detailed analysis of these spectral signatures can help us to extract new geological knowledge on mineralogy, cation substitution, crystallinity (disorder), water (free, adsorbed and structural), mixtures, organic matter etc. HyLogger™ helps us to identify mineral groups such as:

- Iron oxides — hematite, goethite, magnetite
- Sulphates — alunite, jarosite, gypsum
- Al(OH) — paragonite, muscovite, phengite, illite, pyrophyllite, kaolinite, halloysite, smectites, gibbsites etc.
- Si(OH) — opaline silica, hydrothermal quartz with fluid inclusions
- Ammonium-bearing minerals — NH-alunite, buddingtonite etc.
- Fe(OH) group — saponite, nontronite
- Mg(OH) — chlorites, biotite, phlogopite, tremolite, actinolite, talc, hornblende, serpentines, palygorskite etc.
- Carbonates — calcite, dolomite, magnesite, ankerite, siderite, malachites, Cu carbonates
- Anhydrous silicates — quartz, feldspars, garnets, pyroxenes, olivines
- Selected OH-bearing silicates — epidote, prehnite, tourmaline, topaz etc.
- Selected Zn silicates/phosphates — sauconite, tarbuttite
- Selected Zeolites — laumontite
- Selected RRE-bearing minerals — bastnasite
- Selected massive sulphides — sphalerite, pyrite etc.
HyLogger™

Three spectrometers simultaneously measure reflectance spectra from contiguous 10 mm pixels along the core, while a high resolution camera captures continuous 0.1 mm digital colour imagery. The samples remain in their original core trays during scanning. A laser profilometer continuously measures the core height, detecting core breaks and fractures at 0.2 mm resolution.

CSIRO’s TSG–HotCore™ software interprets mineralogical information by comparing raw spectra against the standard library of minerals, delivering the mineralogy of the core as detailed logs, spatially linked images of the core, core tray images and mosaics of whole drill core. A typical core tray takes about 4–5 minutes to scan and the HyLogger™ can log about 350–400 m of core in a day.

National Virtual Core Library

The Auscope National Virtual Core Library (NVCL) is a unique new collaborative research infrastructure project funded by the federal government’s National Collaborative Research Infrastructure Strategy (NCRIS) within the Department of Innovation, Industry, Science and Research, and implemented by the CSIRO and all state and territory geological surveys.

NVCL will facilitate research into the composition of the top 2 km of the Australian continent by hyperspectrally scanning the millions of metres of drill core archived in the federal, state and territory geological surveys along with cores offered by the private sector.

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