MINING OPERATIONS
Hyperspectral imaging systems deployed for prospecting, processing, inspection, and for safety

Hyperspectral sensing has been used for many years in the prospecting and mining industry, but in recent years field-portable imaging systems as well as unmanned airborne vehicle (UAV) based platforms have gained traction as companies adopt technology with benefits to efficiency as well as to safety.

Ruggedized sensor-solutions can also be used early in the production process where raw material is analyzed both off line and on line for mineral content. Headwall sensors are available in a variety of wavelength ranges that best fit with the needs of the mining industry.

Typical applications are:
- Airborne mineral mapping
- Environmental impact assessment
- High-wall safety inspection
- Blending optimization
- On-line conveyor processing

Automated hyperspectral detection and classification benefit from fast artificial intelligence (AI) and machine-learning algorithms. Classification schemes for a wide variety of tasks can be quickly developed by “training” systems that are installed on the production line or installed in laboratory.

Figure 1. According to GlobalData, an industry data and analytics firm and Mining Technology Magazine, the popularity of unmanned aerial vehicles (UAVs) across the mining industry has grown rapidly in recent years. Approximately 70% of the major mining companies have conducted drone trials since 2016 and several are considering widespread deployment not just for survey applications, but also for safety, stockpile management, and monitoring tailings and tailings dams. Ground-based hyperspectral imaging can also be used for many of the same applications.

Figure 2. Minerals have their own spectral ‘fingerprint’ (center) that scanning kits (upper left), handheld spectrometers (lower left), or ground-truth (right) imaging sensors can detect. Single-point measurement solutions have existed for decades, but advances in imaging solutions enable much larger areas to be covered, as well as hazardous areas inaccessible to those on foot to be surveyed.
space. Headwall’s hyperspectral UAV systems can also be equipped with LiDAR sensors for high-resolution terrain mapping, and can be deployed at will instead of having to schedule expensive flights by manned aircraft that cannot supply data at the high spatial resolution that a UAV is capable of.

**VALUE PROPOSITION**

- Proven technology
- Flexible deployment
- Evaluate quality objectively
- Upgradable algorithms
- Identify structural dangers

**BENEFITS OF USING HYPERSPECTRAL IMAGING IN MINING OPERATIONS**

Unlike conventional grayscale or RGB color cameras, Headwall’s hyperspectral sensors capture a wide range of the visible to near-infrared spectrum in extraordinary spectral and spatial resolution. Such resolution is often needed to identify the spectral “fingerprints” of minerals of interest.

Multispectral sensors are limited to a small selection of wavelengths, and most need their hardware and optics to be reconfigured when different wavelengths are required. Headwall hyperspectral sensors benefit from in-house holographic grating fabrication and spectrograph designs that optimize performance of the “spectral engine” to the job at hand capturing hundreds of wavelengths with narrow bandpasses.

Headwall’s turnkey VNIR/SWIR co-aligned hyperspectral UAV comes with everything needed to fly missions, including flight and data acquisition and analysis training at Headwall’s facility in Massachusetts.

Benchtop laboratory scanning systems can augment systems deployed in the air or on the processing line. These compact and intuitive systems enable off-line imaging of samples to improve the algorithms used for inspection without having to shut down the processing line to run tests.

With systems deployed worldwide, contact Headwall to find out the best solution for your needs. Our systems are used every day in the laboratory, in the field, underwater, in the air, and in space!

**APPLICATION NOTE**

**MINING OPERATIONS**

Figure 3. A single flight over challenging terrain captured both hyperspectral data over the VNIR to SWIR (400–2,500nm) wavelength range and a high-resolution LiDAR point cloud, enabling this exquisitely detailed orthorectified and geo-located 3D image.

Figure 4. Airborne hyperspectral imaging can be used for leach mineral mapping, water and wetness mapping, alteration surveys, as well as acid mine drainage monitoring.

Figure 5. Hyperspectral and LiDAR imaging can also be used for production line monitoring, as well as stockpile inventory management, simultaneously capturing chemical and volumetric information.


2 Image of ASD field spectrometer courtesy Malvern Panalytical, a spectris company