PHOTOSAT

Rapid. Accurate. Reliable.

Multispectral vs. Hyperspectral Analysis for Satellite Alteration Mineral Targeting

Comparing and Contrasting Key Differences in Spectral Imaging Technologies

Hyperspectral analysis technology has existed for over thirty years, but practical benefits for mineral exploration have been limited. Recent advancements in processing, particularly with deep learning algorithms, have improved results and efficiency. Now, with new satellites equipped with high-quality hyperspectral sensors, exploration teams can utilize this technology from space.

Multispectral vs. Hyperspectral

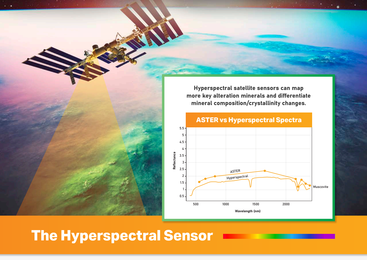
More spectral bands = more minerals that can be detected

Consistent narrow band spacing = differentiate mineral compositions/crystallinities

Multispectral satellite sensors collect ~3 – 20 broad spectral bands, with each band being unevenly spaced, collecting data across various wavelength ranges. Hyperspectral data collects hundreds of spectral bands where each band covers a much narrower wavelength range and with consistent band spacing.

In spectral analysis, a mineral can be identified by measuring how it absorbs light at different wavelengths, primarily in the Short-Wave InfraRed (SWIR) spectrum. The number of minerals that can be identified is limited by the number of spectral bands collected by a given sensor.

Satellite Sensor	# of Spectral Bands
Sentinel-2	VNIR: 10 SWIR: 3
ASTER	VNIR: 4, SWIR: 6 TIR: 5
WV-3	VNIR: 8 SWIR: 8
Hyperspectral with SWIR capability (EMIT, PRISMA, EnMAP, Tanager, etc.)	100+ to 400 across VNIR and SWIR



Hyperspectral satellite sensors can map more key alteration minerals and differentiate mineral composition/crystallinity changes.

The Hyperspectral Sensor

Key differences between hyperspectral and multispectral technologies:

Characteristic	Multispectral Sensor Technology	Hyperspectral Sensor Technology*
Spectral Range	8–16 discrete bands across the **VNIR**, **SWIR**, and **TIR** regions of the electromagnetic spectrum	200+ spectral bands across the VNIR and SWIR regions
Spectral Resolution	Low resolution; samples specific, broad segments of the spectrum	Very high resolution; continuous spectral bands which sample narrow segments of the spectrum
Spatial Resolution	Variable resolution based on the spectral band **e.g. ASTER:** 15m **VNIR**, 30m **SWIR**, 90m **TIR** **WV-3:** 1.2m **VNIR**, 3.7m **SWIR**	Medium resolution, with a spatial resolution of 30m to 50m for both **VNIR** and **SWIR** ranges
PhotoSat Products	**ASTER** + 8 minerals **WV-3** + 12 minerals	20+ mineral deliverables including compositions / crystallinities
Key Advantage	Broad spectral coverage, including thermal infrared	High-resolution spectral detail in the **SWIR** range for better mineral identification

*Note: *PhotoSat's deep learning models can be applied to any hyperspectral satellite data.*

Understanding Spatial vs. Spectral Resolution

Spatial resolution is the detail of an image based on the size and number of its pixels.

In contrast, **spectral resolution** refers to a sensor's ability to distinguish between narrow wavelength intervals of electromagnetic radiation (higher resolution = more spectral bands).

Even though hyperspectral satellites may have a lower or equal spatial resolution than multispectral satellites, the higher spectral resolution means that each pixel contains much more information. As a result, minerals can be identified with much higher confidence.

Hyperspectral imagery enables the identification of subtle mineral changes through **sub-pixel alteration** detection, allowing the analysis of individual pixels to determine the presence of alteration minerals. In contrast, multispectral data often requires multiple pixels for accurate spectral unmixing, making it less effective for this purpose.

Importantly, with hyperspectral data multiple minerals within the same pixel can be identified, and minerals can be identified even when the pixel is majority vegetation (mixed vegetation and mineral signature), which is not the case with multispectral data where nearly bare ground is necessary for positive identification.

MULTISPECTRAL

Cannot confidently identify minerals when signatures are intensely mixed.

HYPERSPECTRAL

High spectral resolution means minerals can be identified with higher confidence even when signatures are intensely mixed.

Key Benefits of Hyperspectral Sensors for Satellite Alteration Mineral Targeting

Hyperspectral satellites are a leap forward for alteration mineral targeting for mineral exploration. Once limited to handheld scanners or airborne sensors, geologists can now get similar results using satellites to cover much larger areas, all without the need for site access. This technology can:

- Map more key alteration minerals such as pyrophyllite, muscovite, and illite.
- Differentiate compositions and crystallinities of minerals such as K-alunite vs Na-alunite or high-Al Muscovite vs low-Al muscovite.
- Detect subtle subpixel alteration signatures using advanced deep learning models, which improve accuracy and reduce false positives.
- Map relative abundances of minerals, allowing for the development of better exploration targets.
- Acquire compelling visuals that aid in building a complete ore deposit model story for investors, executives, and other stakeholders.

Map 20+ Key Indicator Minerals

NEW

PhotoSat Hyperspectral Alteration Mineral Targeting Solutions

PhotoSat is developing new deep-learning hyperspectral solutions that map more minerals and subtle alterations than traditional multispectral data, leveraging 20+ years of experience supporting the exploration industry. This technology helps geologists make informed decisions, providing new resource discoveries and optimized strategies. PhotoSat's Hyperspectral Exploration Targeting (HET) products support exploration projects by mapping more minerals, their relative abundances, and changes in mineral compositions than traditional multispectral datasets.

Regional HET

PhotoSat's new Regional Hyperspectral Exploration Targeting tool uses medium-resolution satellite datasets, like EMIT and other hyperspectral satellites, for cost-effective claim assessment and project target generation. Hyperspectral satellite analysis is entirely remote and can cover vast areas. Our deep learning models can be applied to any hyperspectral satellite, unlocking potential for additional applications.

Property HET (Launching soon)

This tool will provide high-resolution hyperspectral data for property scale areas, enabling geologists to identify potential targets for field work and better understand their site's geology. The key advantage of this offering will be a much higher spatial resolution applied to smaller-scale areas (exploration properties) while taking advantage of the benefits of high spectral resolution from the hyperspectral sensors.

Our Products And When To Use Them

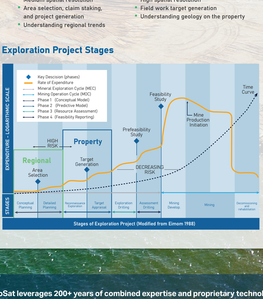
Regional HET

- 1000s – 100,000s of km²
- Medium spatial resolution
- Area selection, claim staking, and project generation
- Understanding regional trends

Property HET

- 100s of km²
- High spatial resolution
- Field work target generation
- Understanding geology on the property

Exploration Project Stages



PhotoSat leverages 200+ years of combined expertise and proprietary technology to support the entire mining lifecycle, from exploration to closure.

Better Data. Better Decisions.

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