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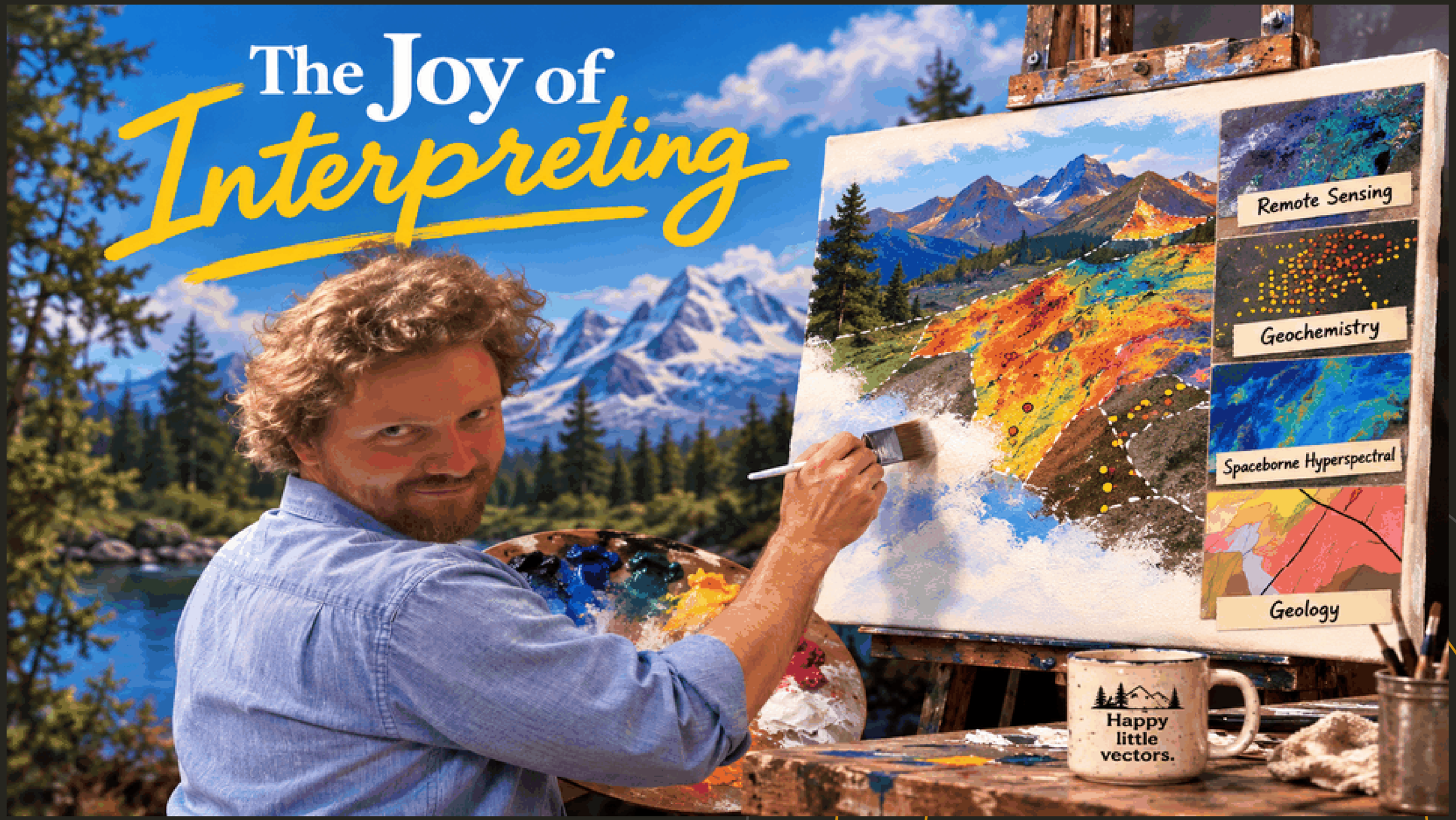
GeOCHemISTea
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SEG 2026

PORPHYRY CU EXPLORATION

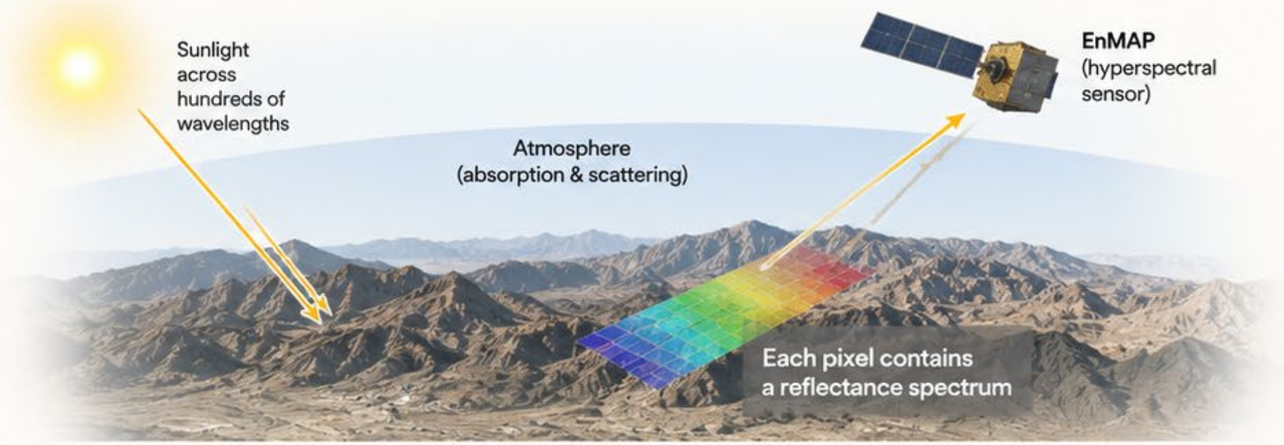
From hyperspectral pixels to lithogeochemical vectors

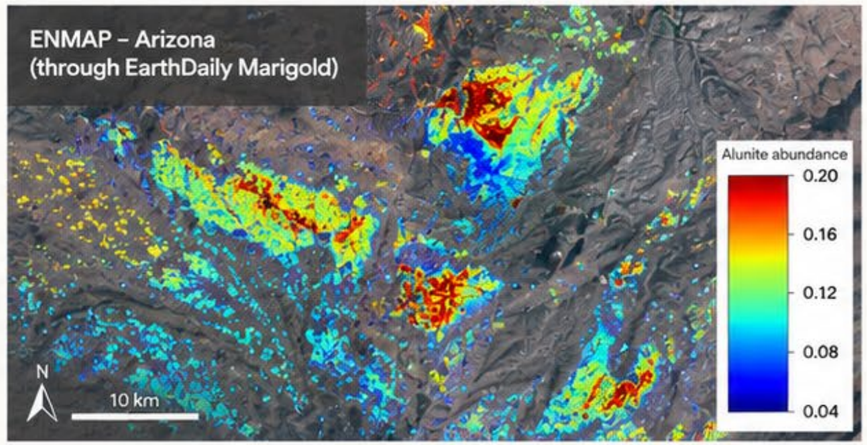
Sam Scher | sscher@lkiconsulting.com
LKI Consulting
October 1, 2026


The Joy of Interpreting
Remote Sensing
Geochemistry
Spaceborne Hyperspectral
Geology
Happy little vectors.

Hyperspectral mineral mapping from space

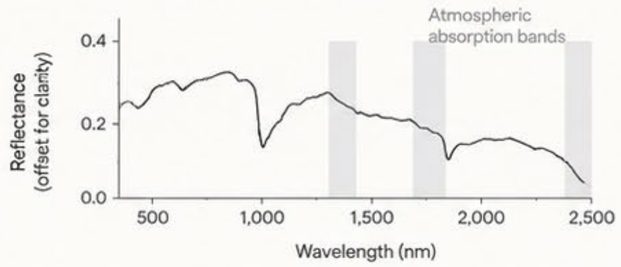
SATELLITE HYPERSPECTRAL IMAGING SPECTRSOCOPY · FROM REFLECTANCE TO MINERAL MAPS





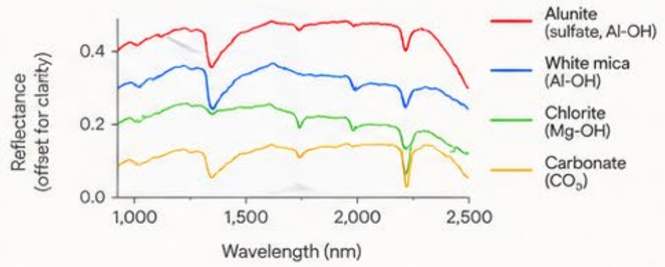
1 Hundreds of narrow spectral bands

EnMAP measures continuous reflectance from ~420–2,450 nm at 30 m spatial resolution (VNIR–SWIR).



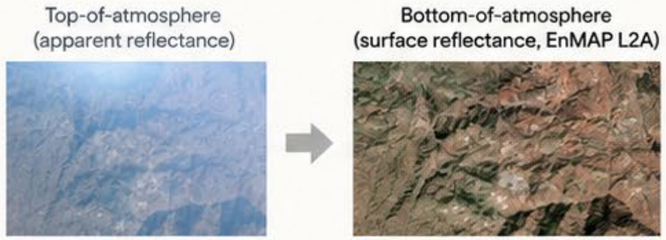
2 Minerals leave spectral fingerprints

Al-OH, Mg-OH, carbonate and sulfate minerals have diagnostic absorption features in the VNIR–SWIR.



3 Atmospheric correction enables analysis

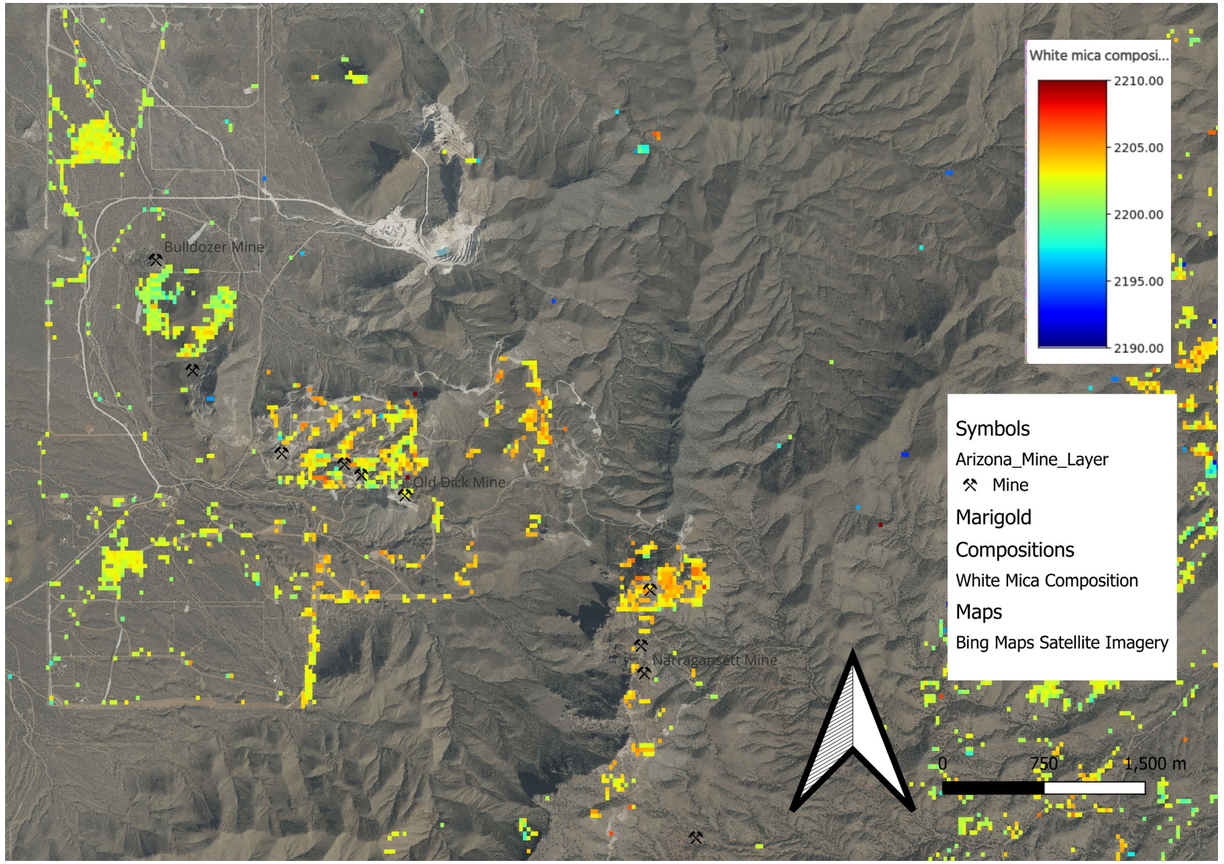
Modern processing removes atmospheric effects and delivers analysis-ready surface reflectance, allowing mineral mapping from orbit.



We can now ask mineralogical questions of the landscape from orbit.

EarthDaily kindly provided Marigold access in support of this SEG case study.

Porphyry systems should leave a very large surface footprint



OREBODY

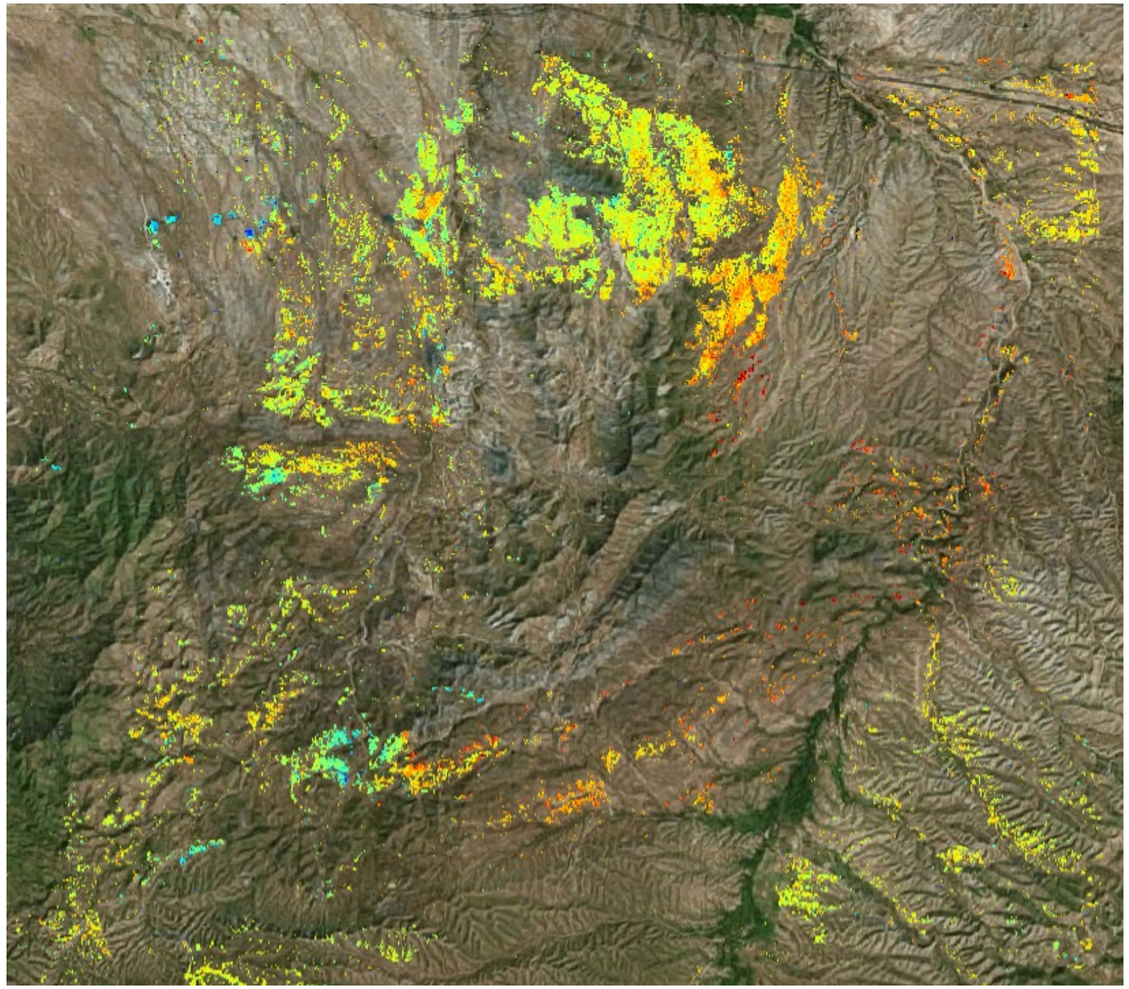
May be relatively small.

HYDROTHERMAL SYSTEM

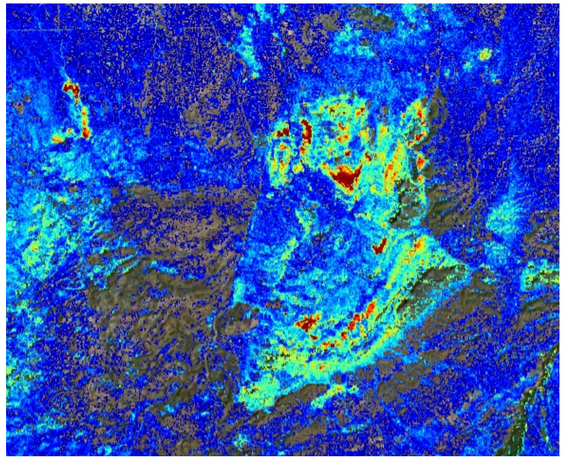
Is not.

And from space, the alteration can be spectacular

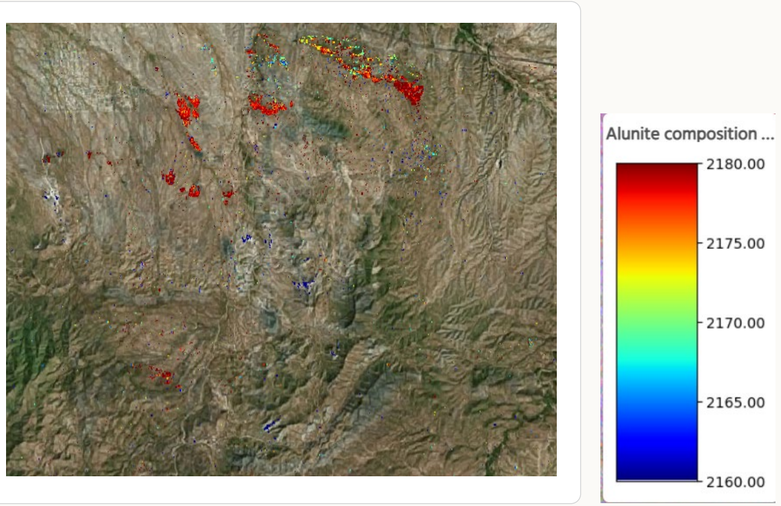
KNOWN SYSTEM · COPPER WORLD



White Mica Composition

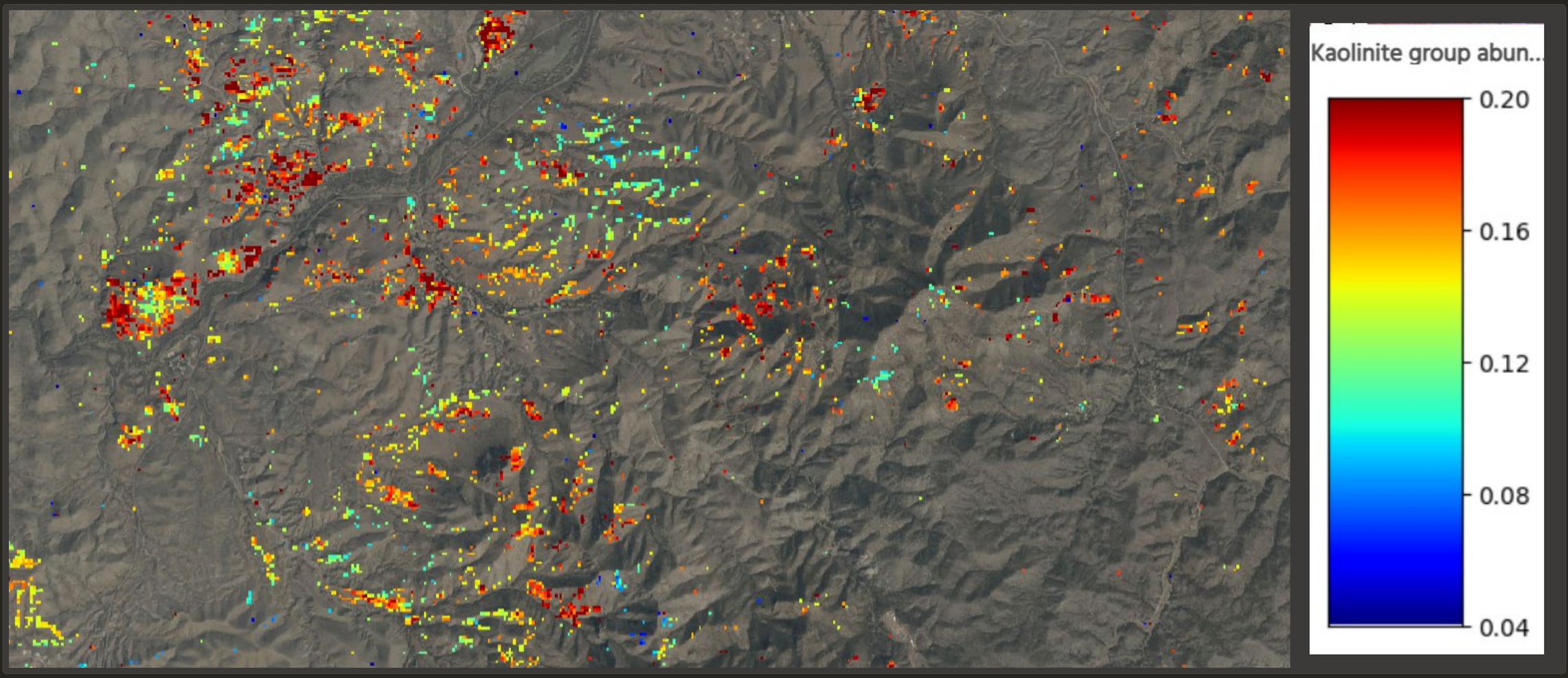


Carbonate Abundance



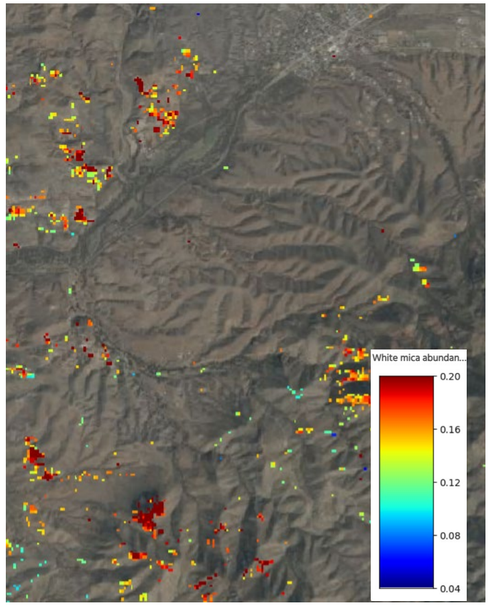
Alunite Composition

Spectacular is not the same as diagnostic



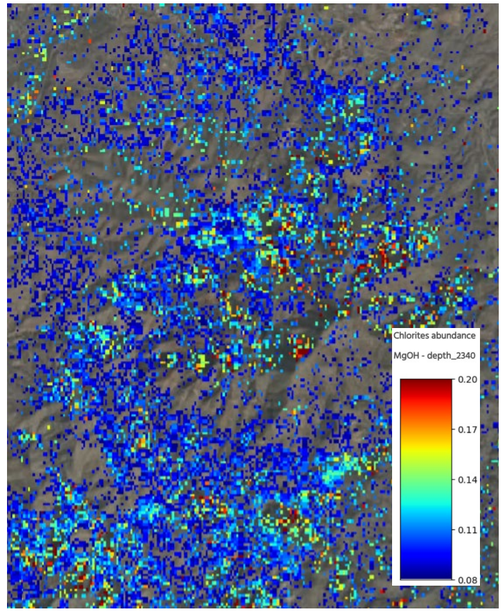
Which of these pixels would you actually follow?

The same mineral can tell very different geologic stories



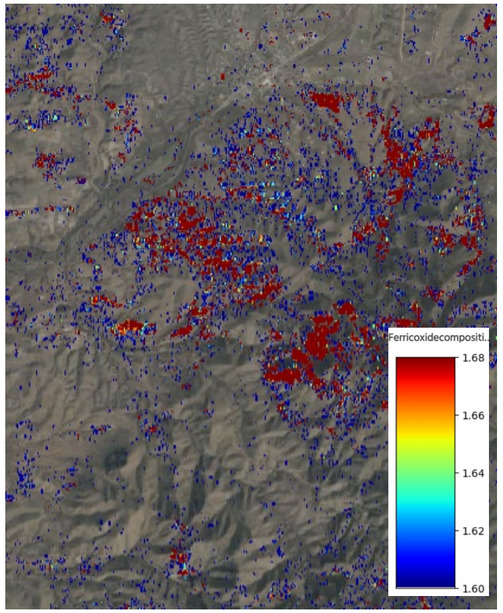
WHITE MICA / ALOH

Hydrothermal or metamorphic?



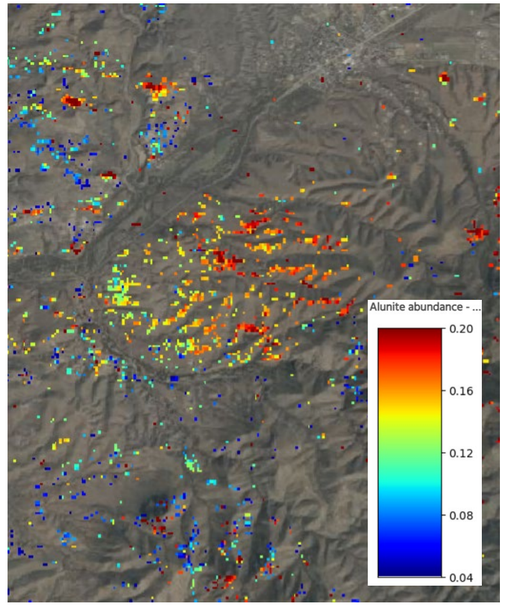
CHLORITE

Propylitic or mafic lithology?



FERRIC IRON

Hydrothermal or weathering?

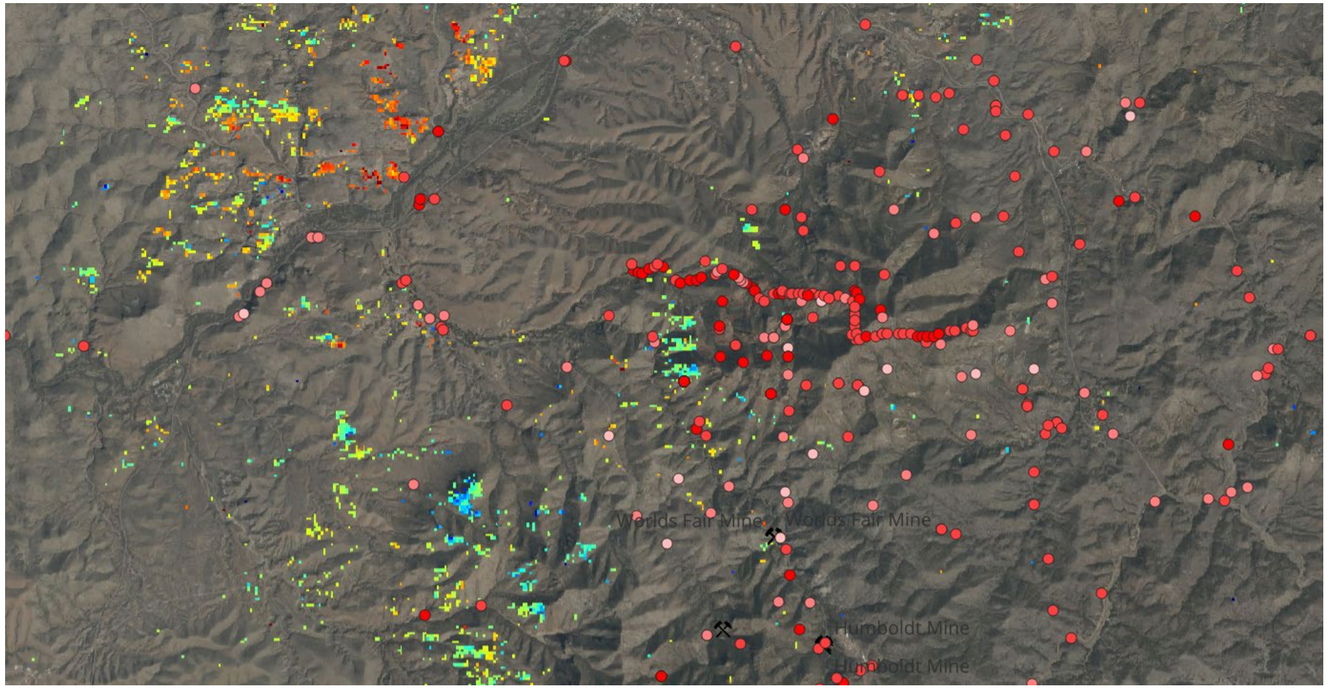


ALUNITE

Interesting but context matters.

Remote sensing generates hypotheses. It does not diagnose a porphyry system.

First question: where is the copper?



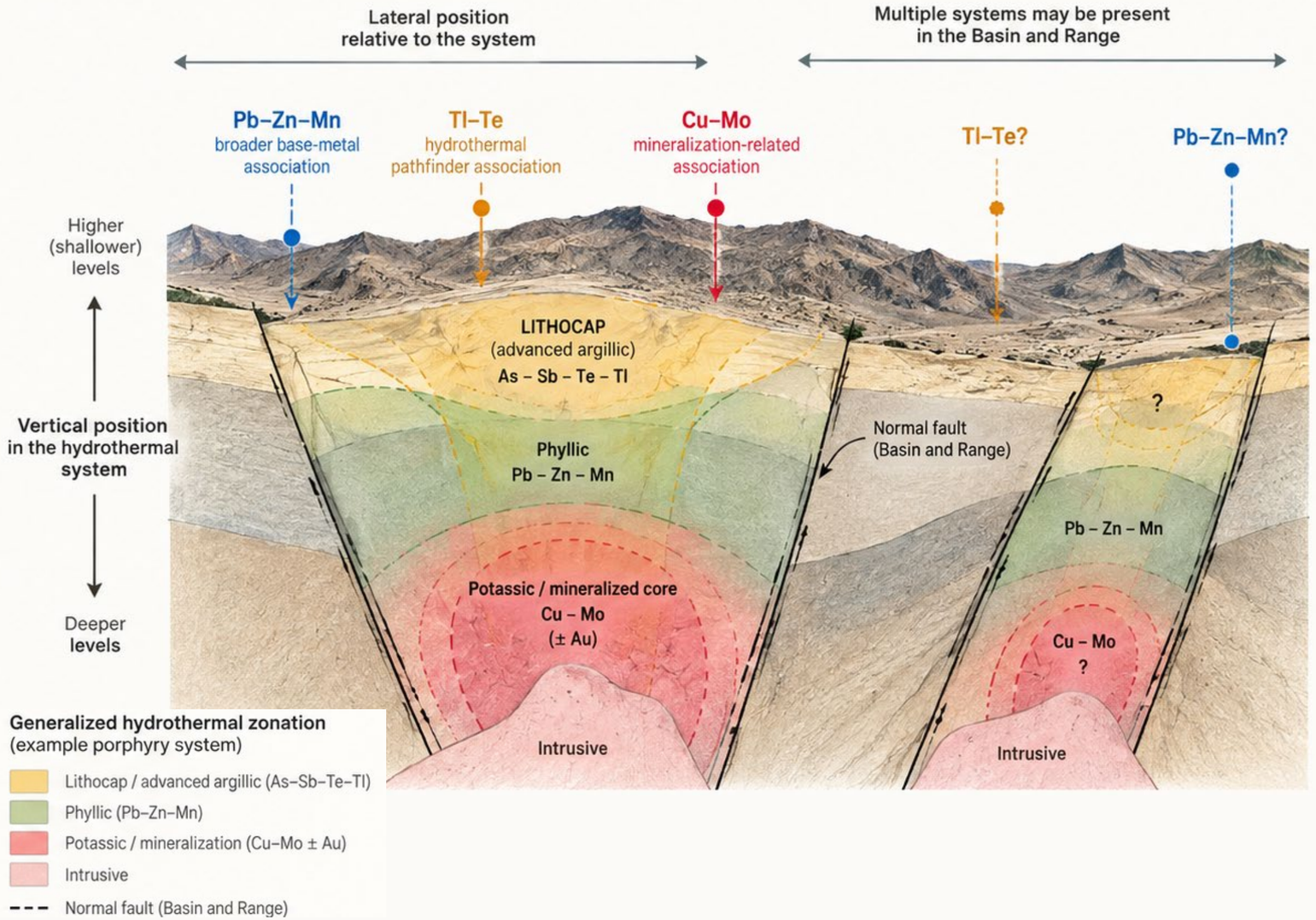
01

Where do Cu and the spectral footprint agree?

02

Where do they not agree?

The surface is a slice through the system



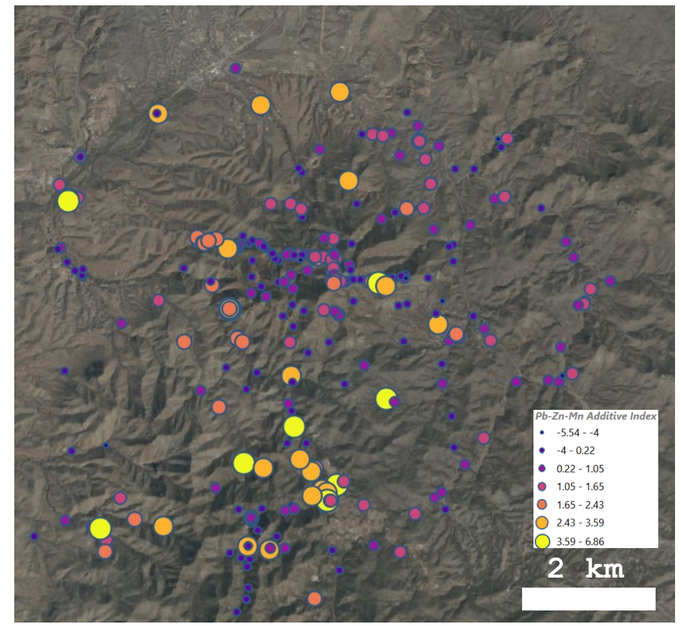
Surface exposure cuts across a 3D hydrothermal system

Faulting, uplift and erosion in the Basin and Range mean adjacent surface samples may represent different lateral positions, and different vertical levels, withing one (or more) hydrothermal systems.

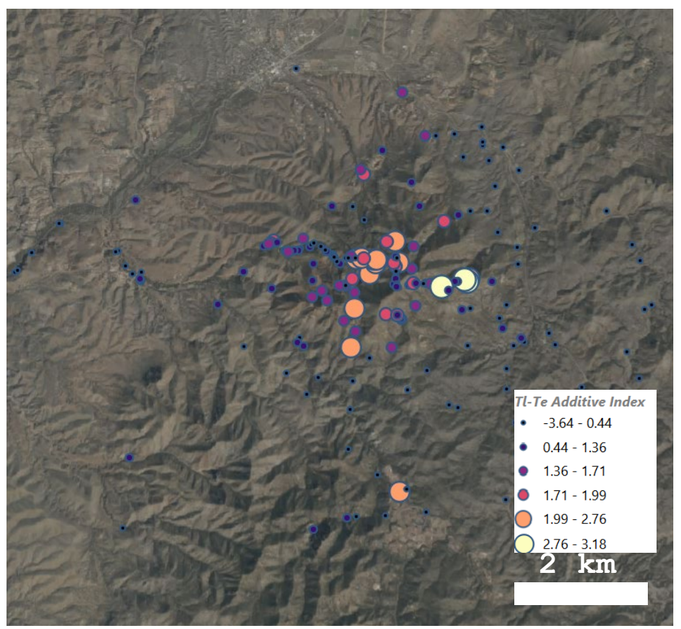
Can the geochemistry tell us where we are in the system?

Does the chemistry organize itself around the system?

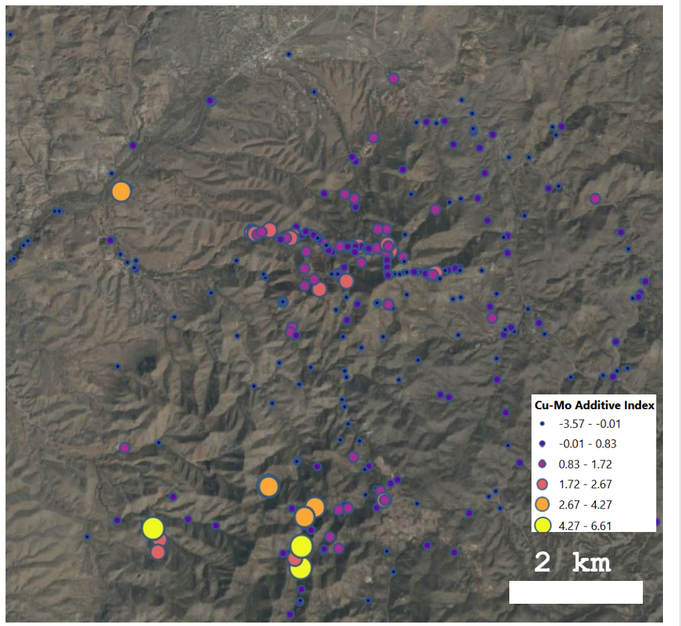
Pb-Zn-Mn Association:
Broader base metal footprint



Tl-Te:
Hydrothermal pathfinder expression (n = 283)

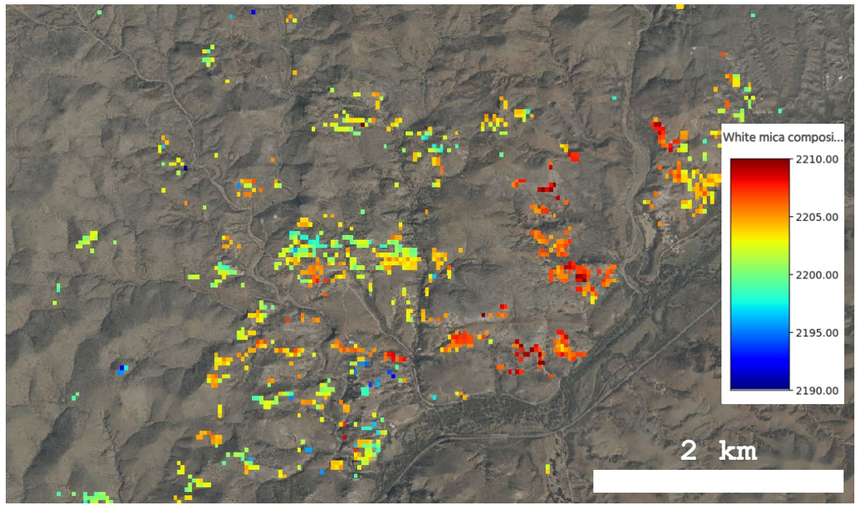


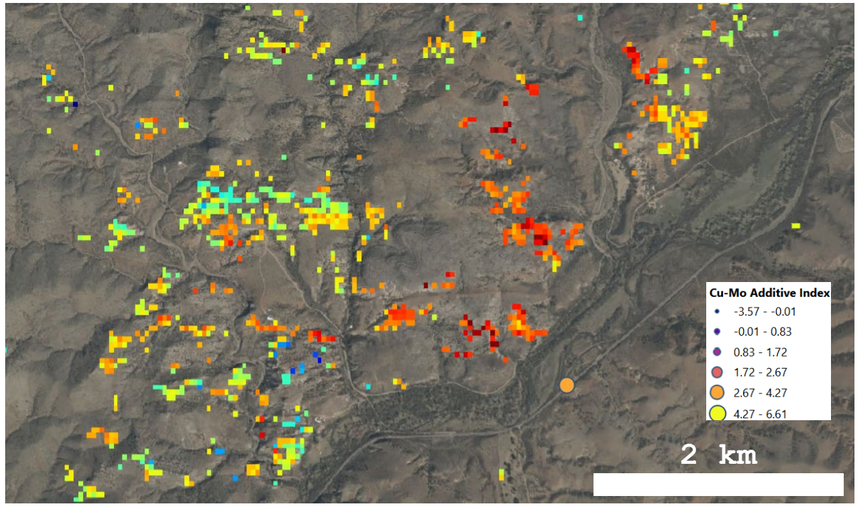
Cu-Mo:
Mineralization-related footprint

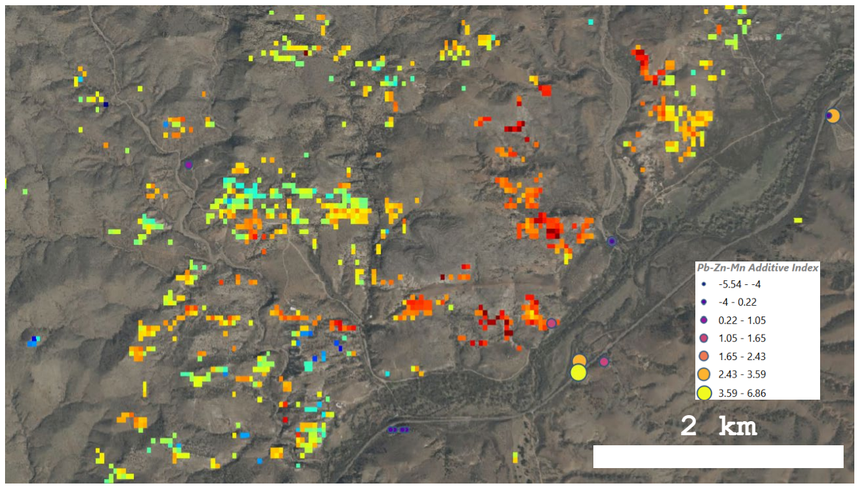


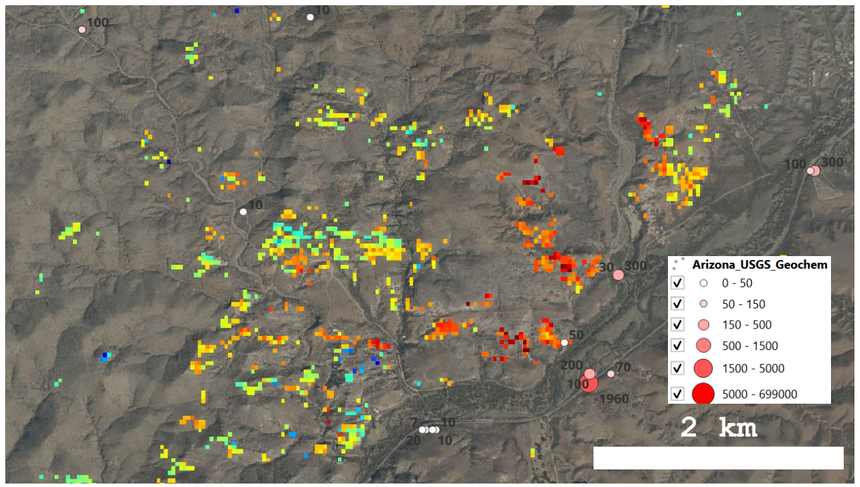
Three geochemical associations. Are they mapping different parts of the same hydrothermal systems?

Now the remote sensing looks different









01 **Spectral**
White mica composition defines a coherent feature.

02 **Geochemical Context**
Different parts of the hydrothermal signature converge on this area.

03 **Mineralization**
Elevated Cu provides additional evidence.

An intriguing spectral response with independent geochemical reasons to follow up on it.

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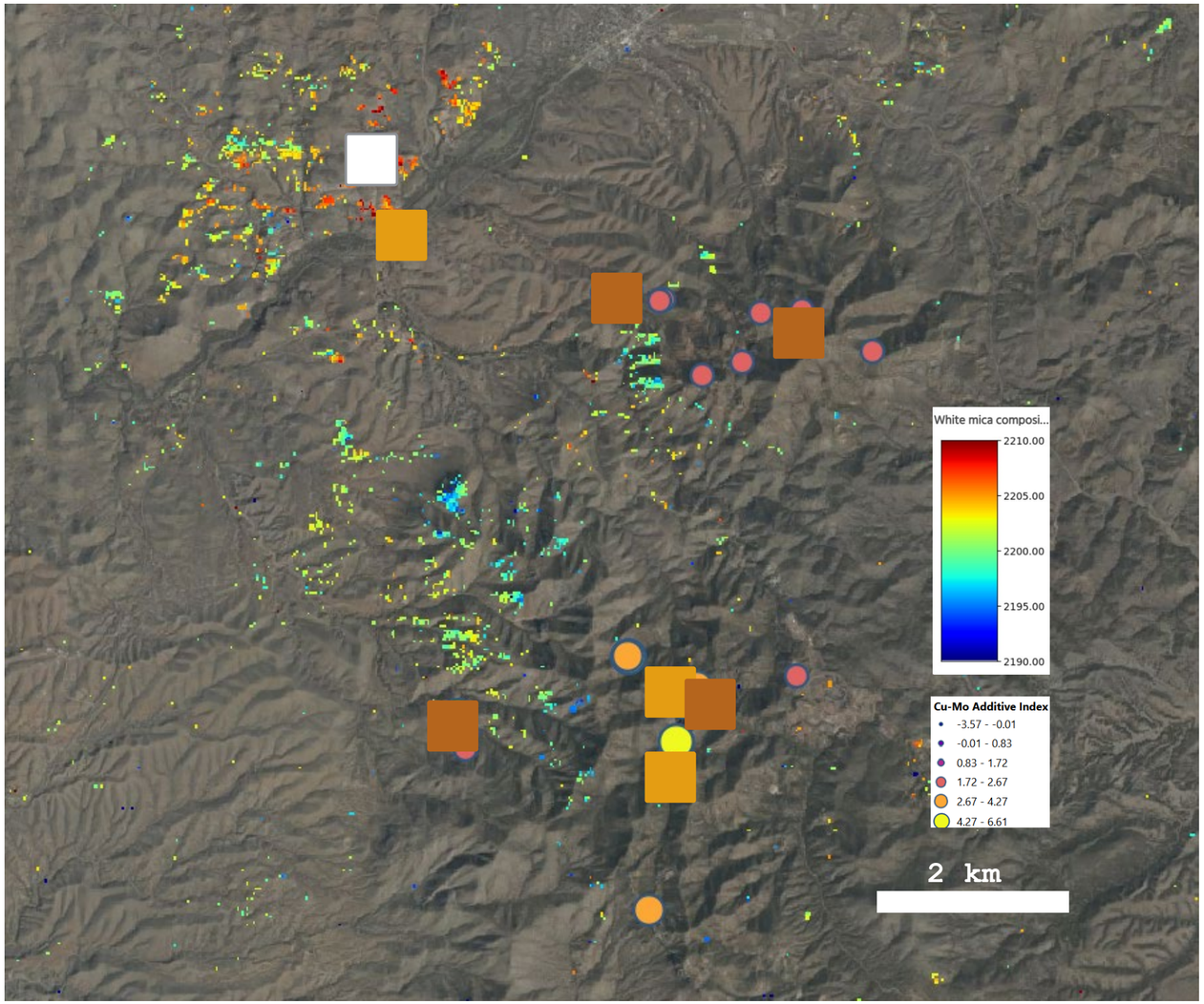
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The anomalies that disagree may be the most useful

SPECTRAL	SYSTEM GEOCHEM	CU	POTENTIAL EXPLANATION
●	●	○	**Altered system without exposed Cu** – lithocaps, upper/distal expression, erosional level
●	○	○	**Mineralogy without geochemical support** – lithology, weathering, or unrelated alteration
○	●	±	**Geochemical system the sensor has not seen** – cover, vegetation, exposure, or non-spectrally active mineralogy

Disagreement is not failure. It tells us which geological question to ask next.

What would I actually follow?



FOLLOW
Complex hyperspectral response + multiple geochemical associations + elevated Cu

QUESTION
Complex hyperspectral response + multiple geochemical associations with little to no Cu

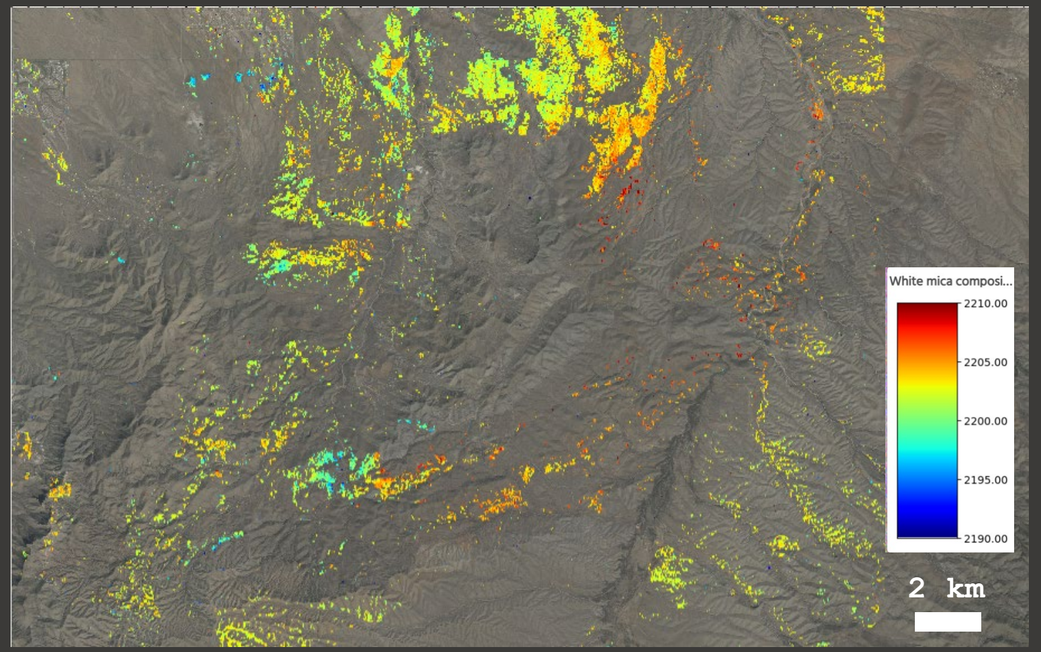
UNDERSTAND
Spectral- or geochemistry-only responses

Convergence prioritizes. Disagreement tells us what to further investigate.

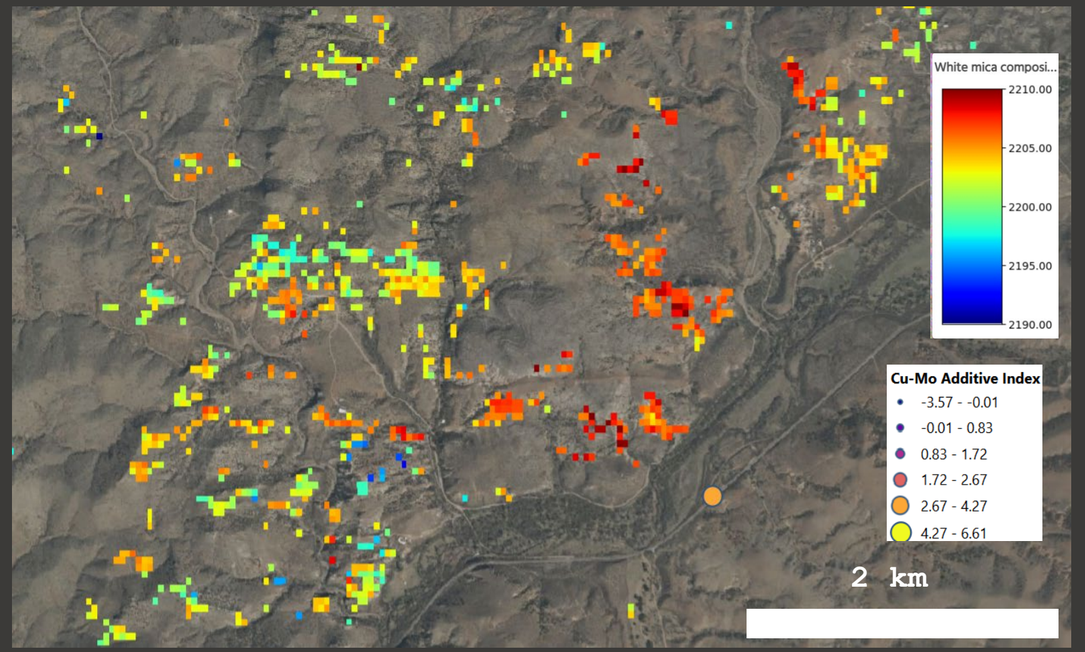
There is no porphyry pixel

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COPPER WORLD · KNOWN SYSTEM



AOI 1 · SYSTEM HYPOTHESIS



REMOTE SENSING

tells us what is exposed.

GEOCHEMISTRY

tells us how the system is expressed.

GEOLOGY

tells us whether they belong to the same system.

Thank you

EarthDaily

Marigold platform access and support.

SOCIETY OF ECONOMIC GEOLOGISTS

For the opportunity to share this work.

Questions?