

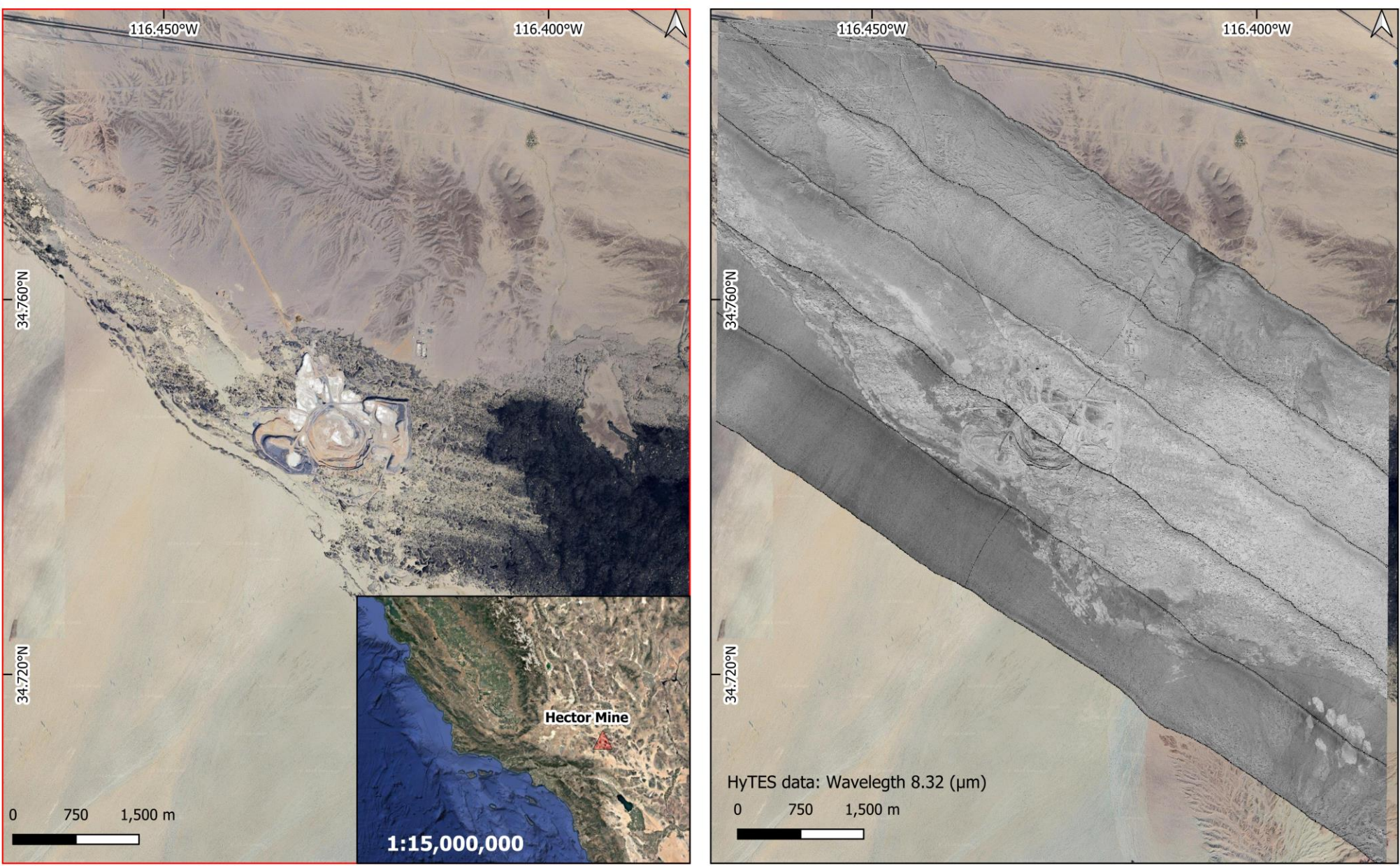
Postdoc Research

# Mapping the strategic Lithium bearing mineral – Hectorite – with the airborne Hyperspectral Thermal Emission Spectrometer (HyTES)

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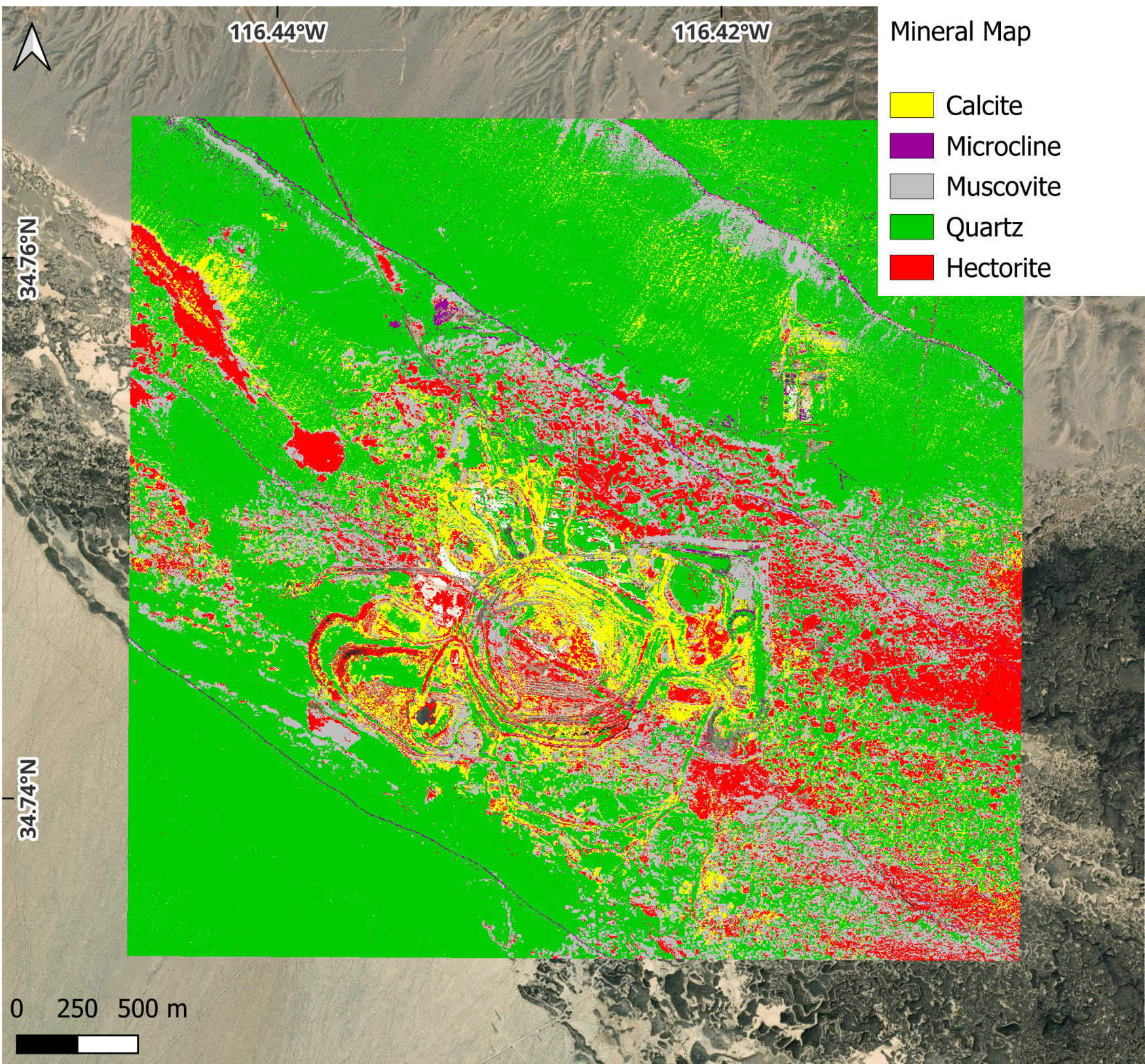
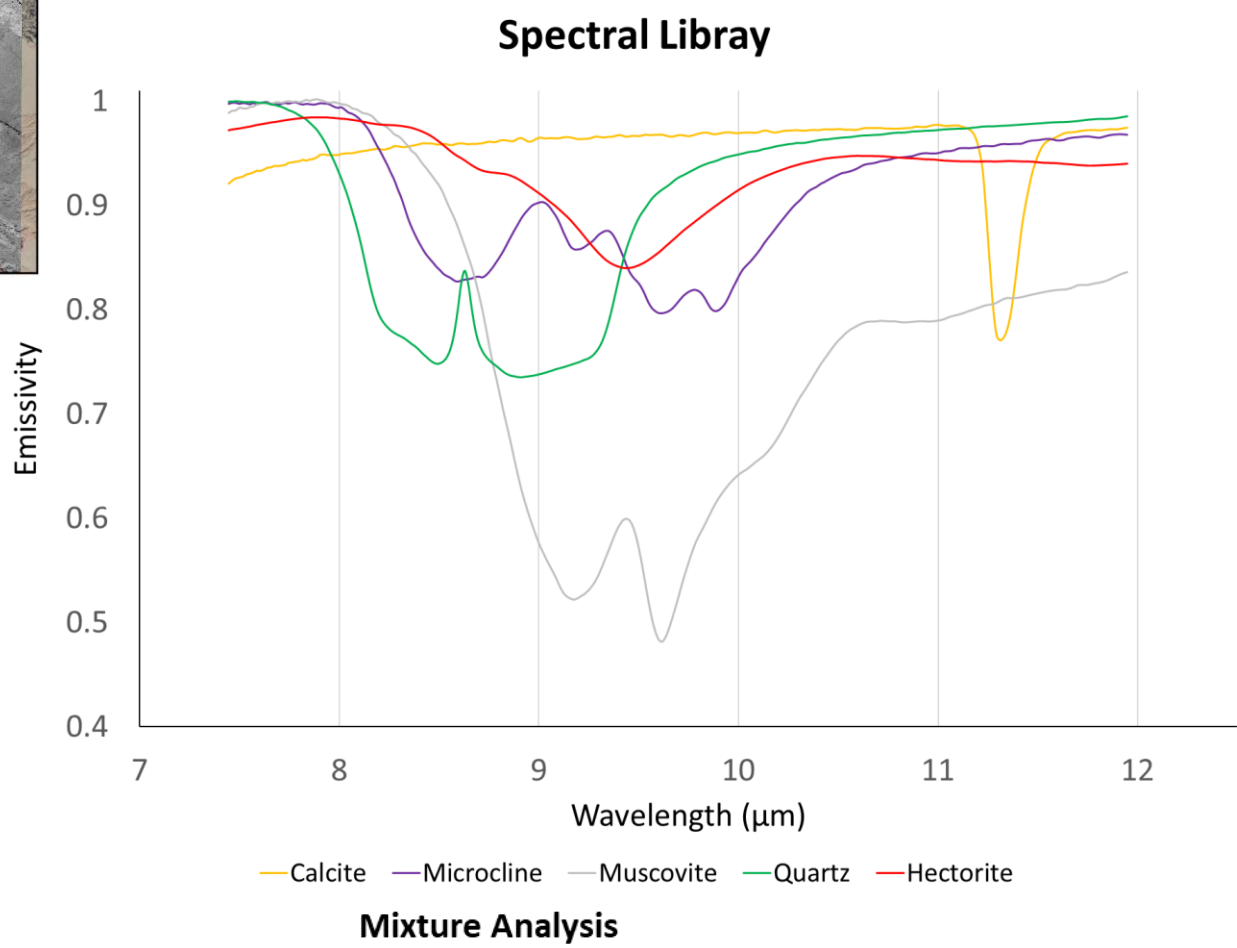
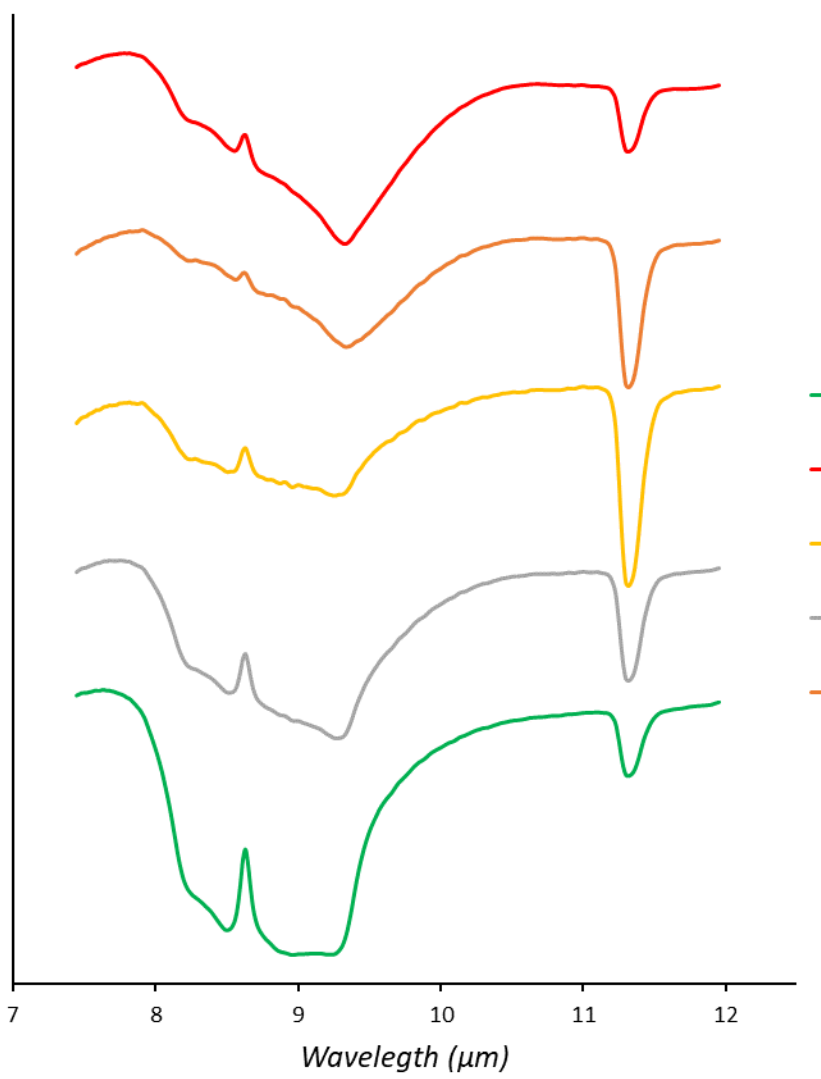
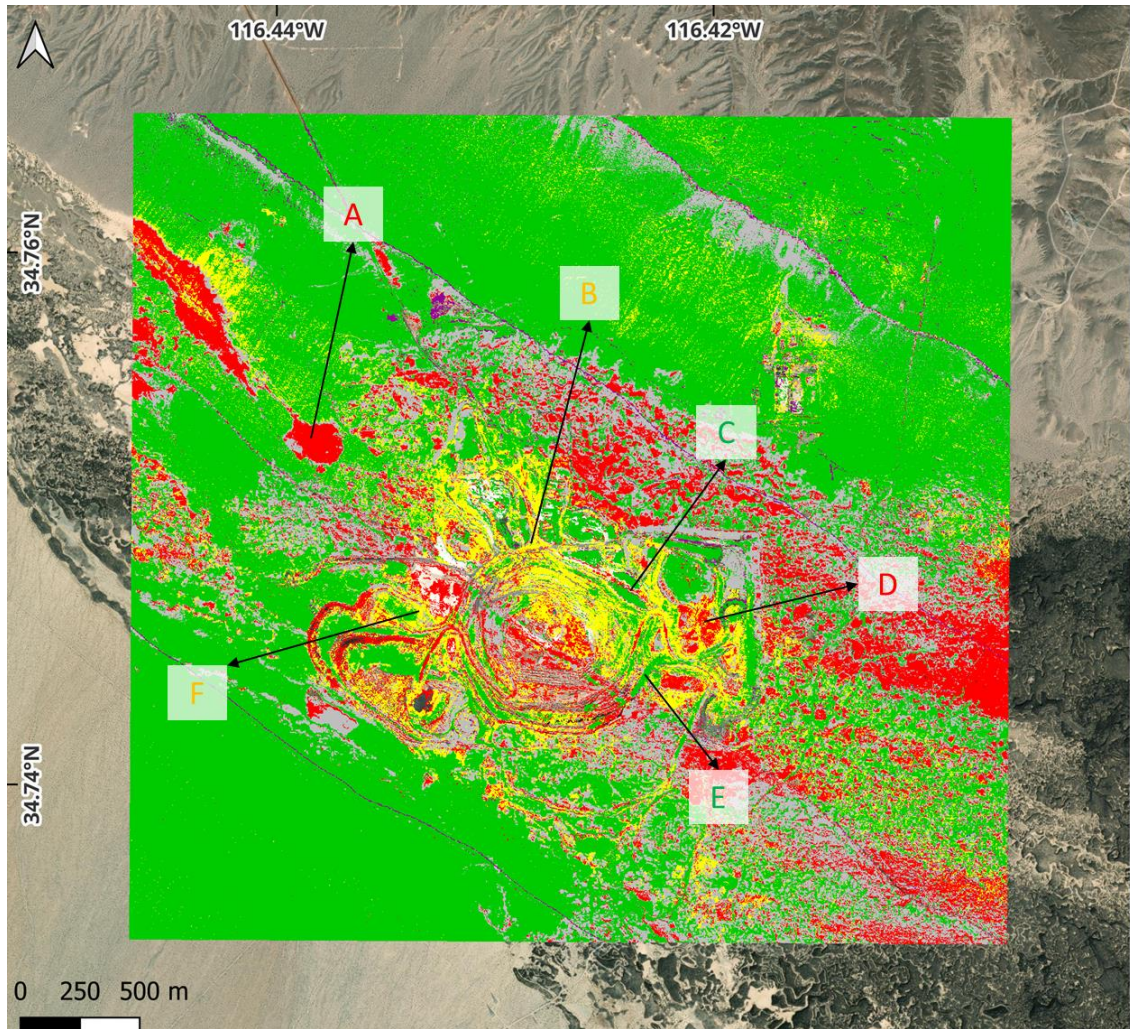
## Background & Objectives

The US Government has recognized the need to identify strategic - critical minerals. A *critical mineral* is defined as a non-fuel mineral or mineral material essential to the economic or national security of the U.S. and which has a supply chain vulnerable to disruption. This work aims to highlight the capability of thermal spectroscopy images in mapping critical Lithium bearing mineral. Hectorite ( $\text{Na}_{0.3}(\text{Mg,Li})_3\text{Si}_4\text{O}_{10}(\text{OH})_2$ ) is a Li-bearing clay mineral. It may results from the alteration of volcanic ash or glass, precipitation from lacustrine waters, or incorporation of Li into existing smectite clays (Asher-Bolinder, 1991).



## Approach and Results

HyTES data (March 24<sup>th</sup>, 2022) has been used to produce an high resolution (2m) mineral map over Hector mine, a clay mine located in San Bernardino county, California. The map highlights such minerals with distinctive spectral characteristics in the thermal range. Clay minerals exhibit Si-O stretching absorptions feature around 9  $\mu\text{m}$ . The exact placement of the feature is function of the chemistry of the tetrahedral sheet and the symmetry of the crystal structure. Substitution of  $\text{Al}^{3+}$  for  $\text{Si}^{4+}$  into the tetrahedral sheets shifts the absorption to higher wavelengths. The mineral map results from a comparison based on a linear regression analysis between the continuum removed of the unknown spectrum (HyTES) and the continuum removed diagnostic feature of the known spectrum (spectral library).



## Significance of Results/Benefits to NASA/JPL

- It was possible to discriminate the presence of strategic Lithium bearing mineral - Hectorite using thermal spectroscopy image.
- Quartz Calcite and Hectorite appears as the principal mineral component over Hector mine.
- The spectral response from the pixel located inside the mine, results in a variable-weight combination of these 3 main minerals.

The government now publishes a list of strategic - critical minerals and lithium bearing minerals, such as hectorite, are part of that list. NASA/JPL has developed technology and expertise to aid in the exploration for these minerals, in particular visible to thermal infrared imaging spectroscopy. This study provides a clear example of how this technology can be used and further developed to address the Government’s need and utilize imaging spectroscopy developed by NASA/JPL to locate and map outcropping strategic minerals.

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## Future Work

The analysis will be improved by adding laboratory analysis of samples from the mine that will help to better characterize the Hectorite spectral response in the TIR and if the presence of Lithium will affect the diagnostic feature of clay.

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