

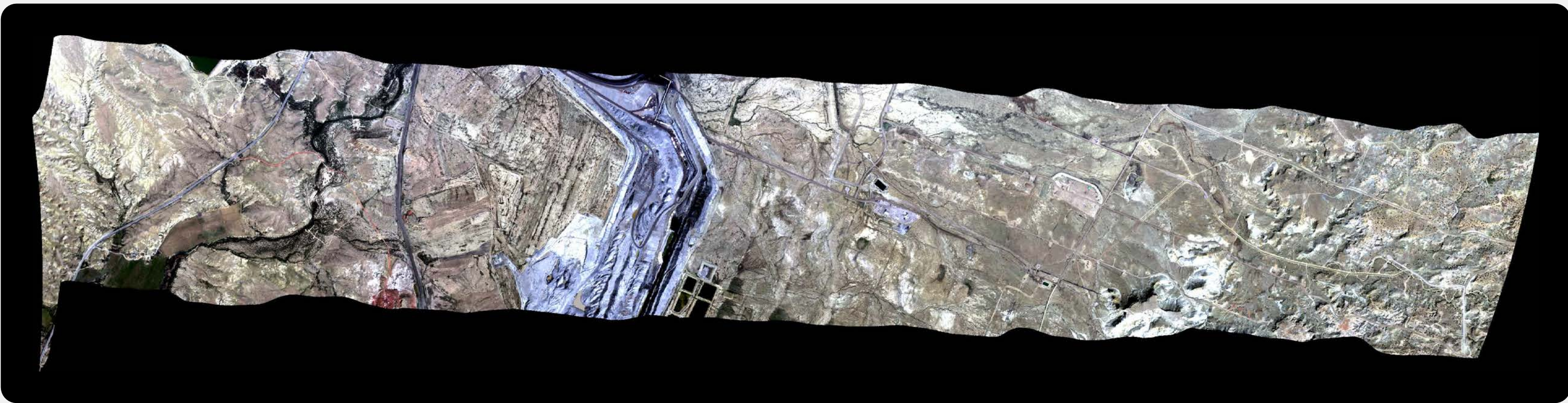
Measuring mining impacts on water resources

Problem

- Mining is known to affect the environment, but few software tools exist to quantify its impacts
- A large volume of **AVIRIS imagery** is available
- **Spectral libraries** contain samples of thousands of minerals and other materials
- **Environmental data** is collected by local, state, and national governments as well as non-governmental organizations
- Our goal is to contribute tools to **combine this data** in a coherent way

Solution

- Python library implementing a **suite of algorithms**
- **Classify minerals** and other land surface types
- **Identify mines** and other geographic features
- **Correlate environmental impacts** with mining operations
- Release as **Free and Open Source Software**



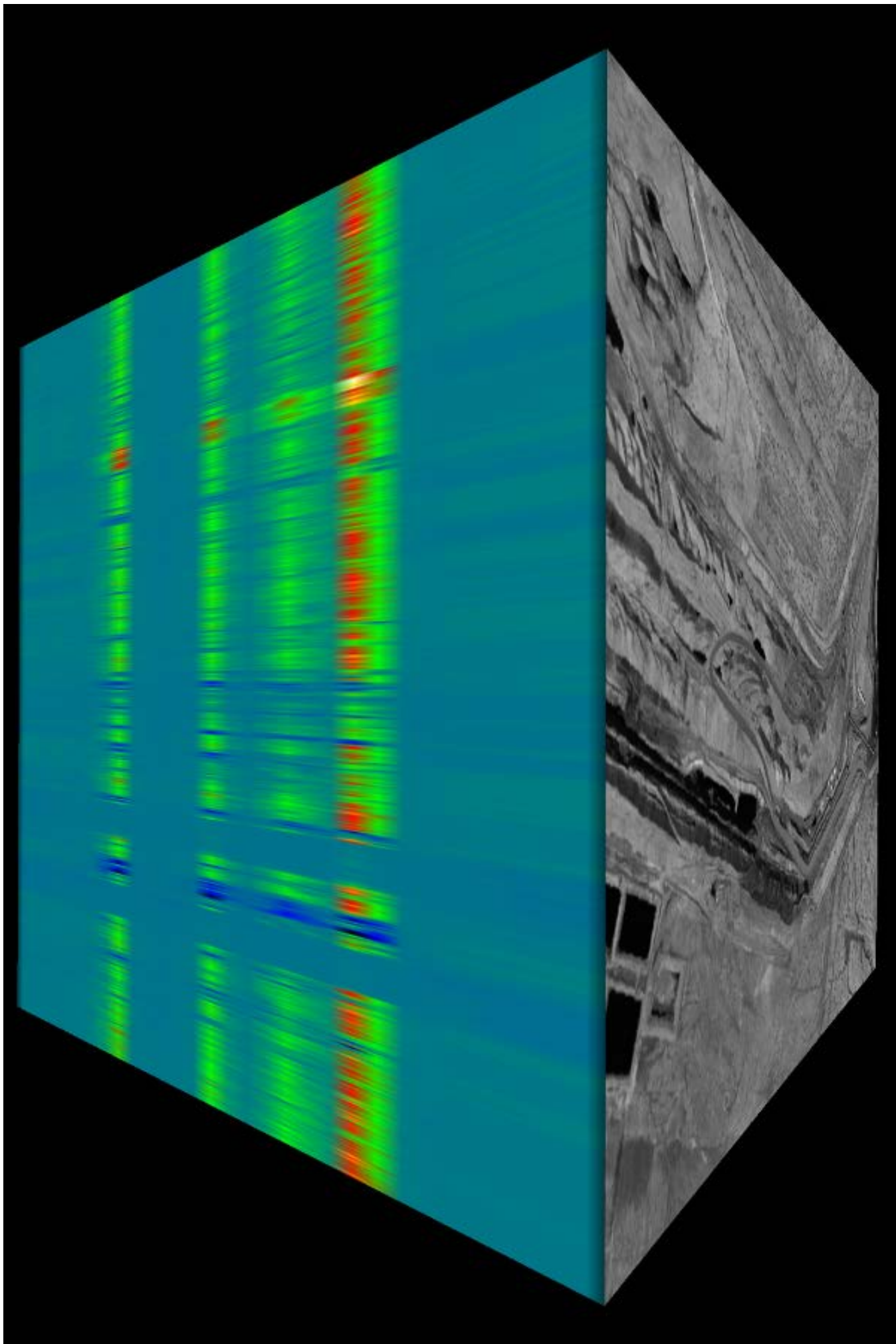
An AVIRIS flightline over the San Juan Coal Mine in Waterflow, New Mexico



The San Juan Coal Mine and Generating Station. Courtesy San Juan Citizens Alliance/EcoFlight.

COAL AND OPEN-PIT SURFACE MINING IMPACTS ON AMERICAN LANDS (COAL)

COAL is a Python library for processing hyperspectral imagery from the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS)



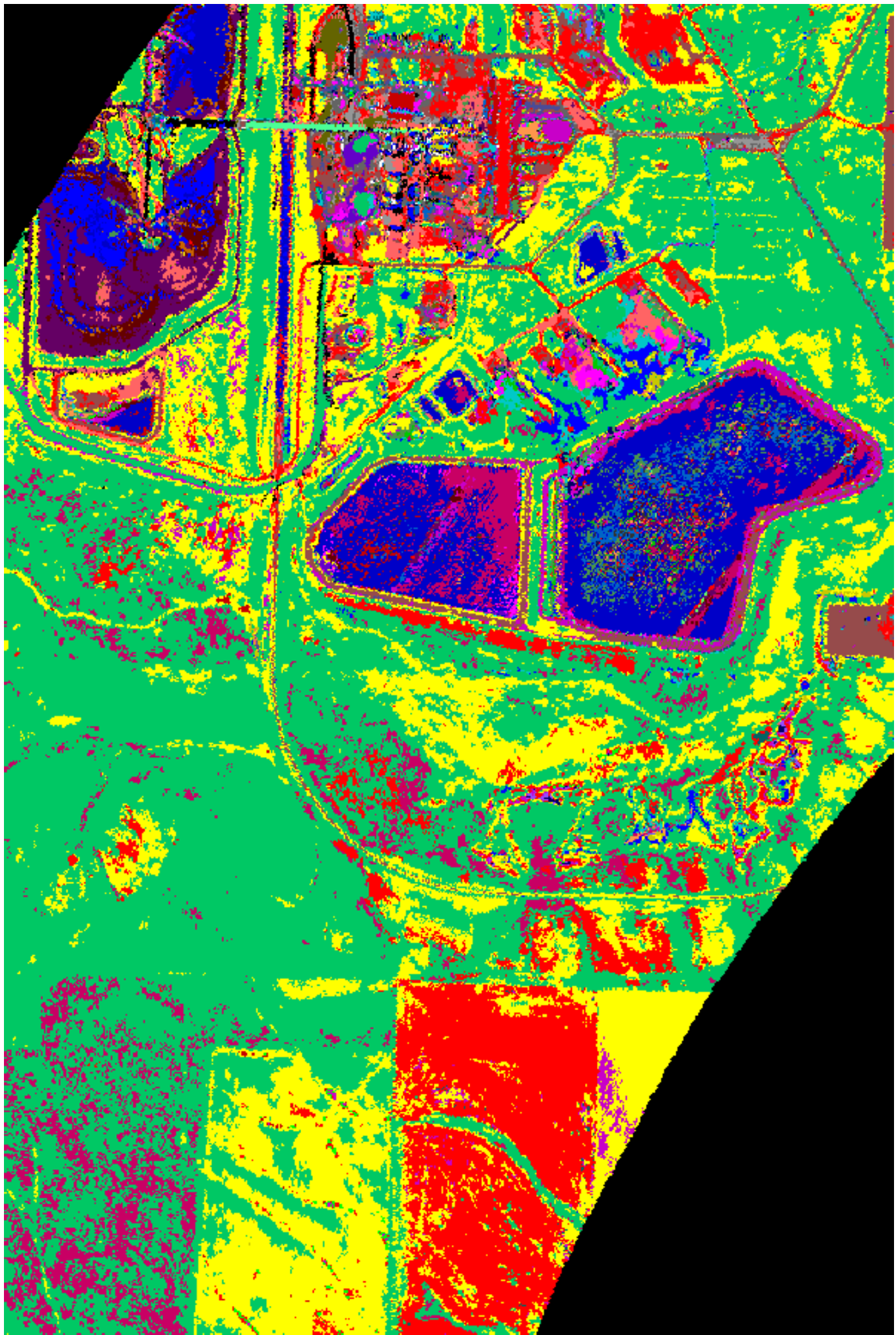
Three-dimensional visualization of hyperspectral imagery displaying spectral bands

Mineral Classification

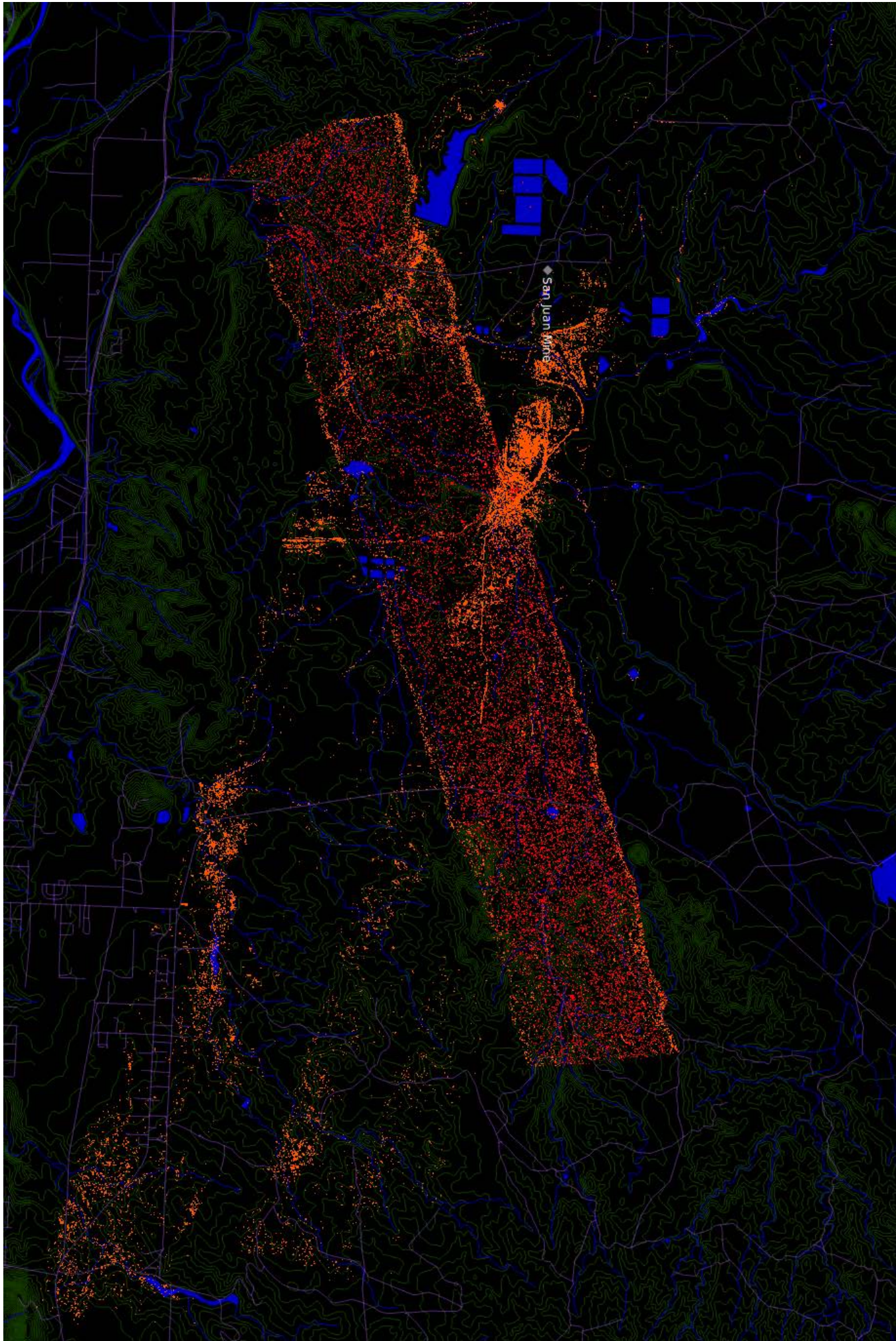
- All minerals have unique **spectral signatures**
- Samples of those spectral signatures are contained in **spectral libraries**
- Using the raw AVIRIS images with unknown land cover and spectral signatures, **classify** each pixel with **spectral angle mapper** classification
- Output is a **mineral classified file** where each pixel is assigned to a particular class in the spectral library

Mining Identification

- Use certain classes of minerals as **proxies** for presence of mining
- Output is a **mining classified file** where each pixel is identified as either corresponding to mining or not



Mineral-classified image showing land surface types surrounding a coal facility in Craig, Colorado.



Map of coal mine, waste classifications, water resources, and surrounding geography.

Environmental Correlation

- **Map identified mines** in GIS applications and correlate them with water quality measurements
- Determine whether **water pollution** is linked to mining
- Use results to enhance **environmental understanding**

Temporal Analysis

- Implement a **Science Data System** to batch process past and present imagery
- **Facilitate research** with unique data products
- Enable analysis of **changes over time**



Distribution of coal mining waste classifications along streams and water bodies.



Hyperspectral imagery of the Escondida Mine in Chile. Courtesy NASA/JPL-Caltech.

Capstone COAL

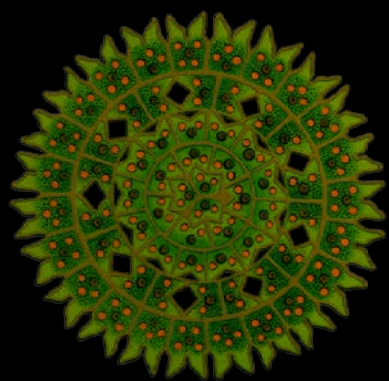
Team



Lewis John McGibbney, Ph.D.
Data scientist in the Computer Science for Data Intensive Applications Group at JPL. <lewis.mcgebney@gmail.com>



Kim Whitehall, Ph.D.
Tropical climate variability and climate change researcher and educator at JPL.



Taylor Alexander Brown
Computer Science major with emphasis in computer systems and math minor. <browtayl@oregonstate.edu>



Heidi Clayton
Computer Science major with an applied option in statistics. <claytonh@oregonstate.edu>



Xiaomei Wang
Double major in Finance and Computer Science. <>wangx2@oregonstate.edu>

Website

For more information, visit our website:
<https://capstone-coal.github.io>