Mine Modelling Using Hyperspectral Imagery

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Current Mine Modelling Technique

- Manually drilling to obtain core samples
- Visual inspections
- Slow, safety concerns
- Identify Materials

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Why Identify Materials?

- Extracting bitumen from Oil Sand
- Oilsand: 10-12% bitumen
- Mixed with hot water
- Bitumen rises to surface
- Problems: wrong %, clay, breccia, graben..
- Mistakes: LOSSES! $$$

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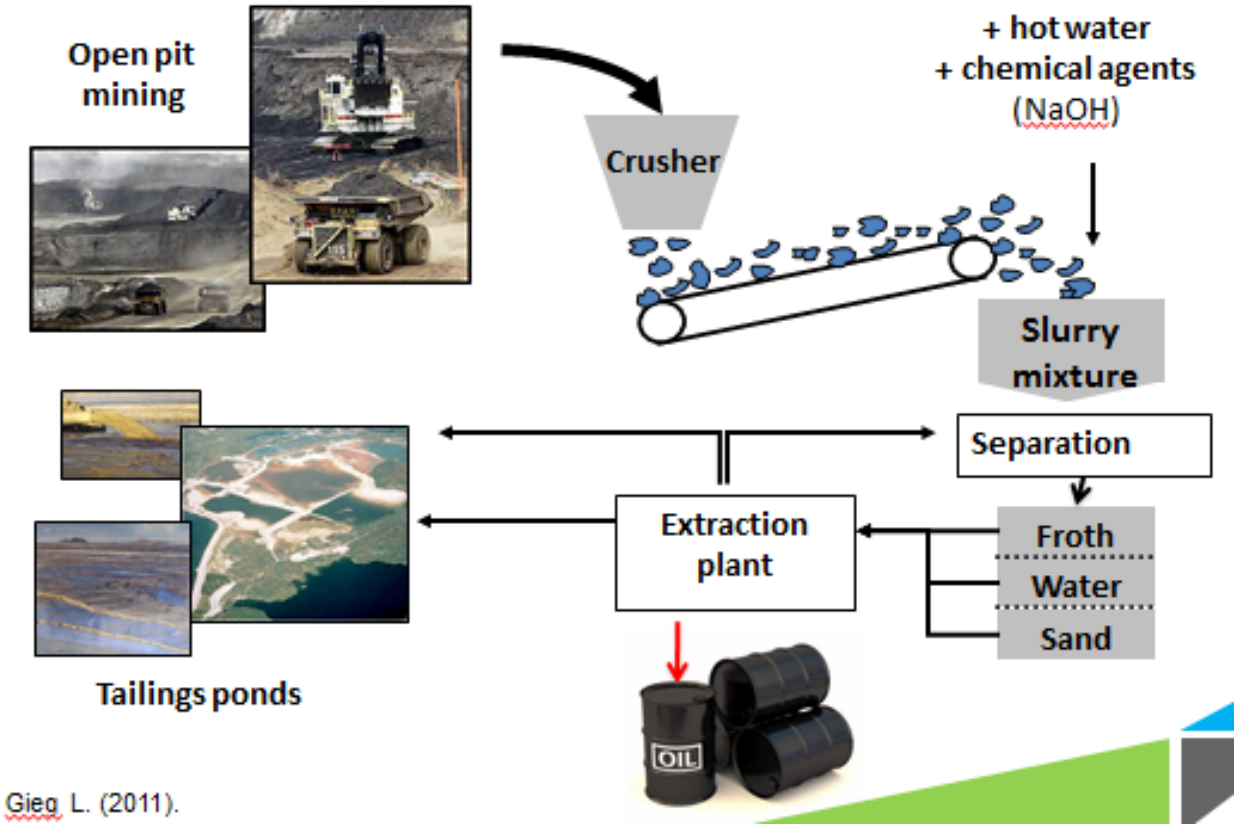
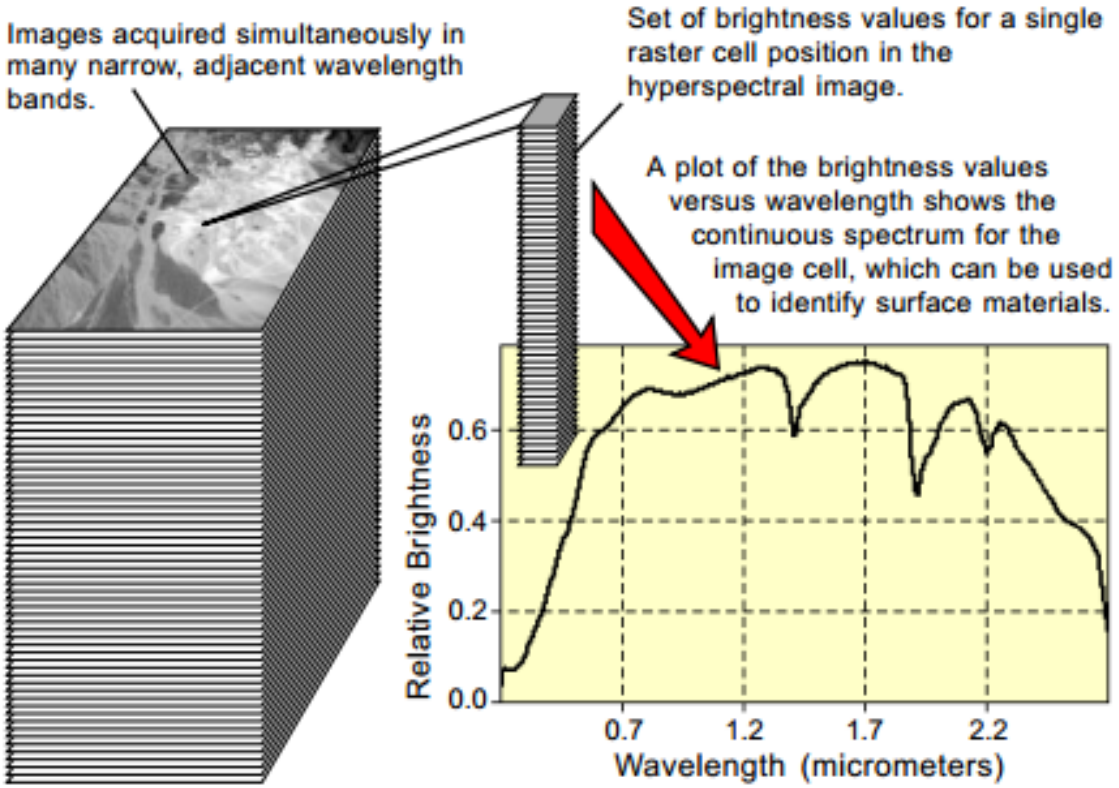


Gieg L. (2011).

Retreived from http://2011.igem.org/

Hyperspectral Imagery

- Humans: 380 nm to 700 nm.
- Camera: 970 nm – 2500 nm.
- Radiance: amount of reflected light received.
- Reflectance: ratio of light striking and leaving a target.
- Reflectance: Independent
- Ground Truths



Geomatics: The Solution to All Problems

- Identify materials using Geomatics technology?
- Equipment
- Specim SWIR Hyperspectral Camera
- ASD FieldSpec Pro Spectrometer

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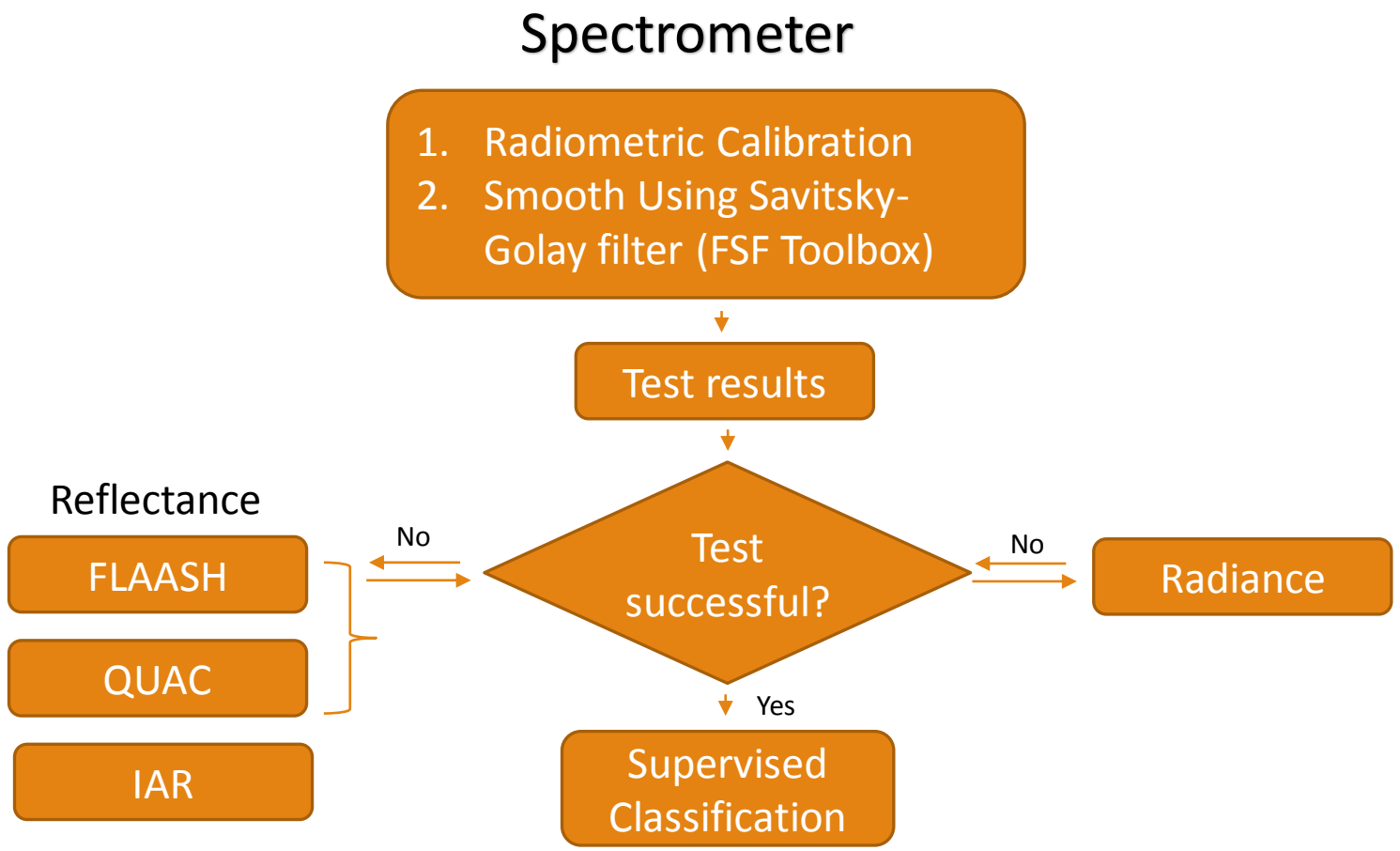
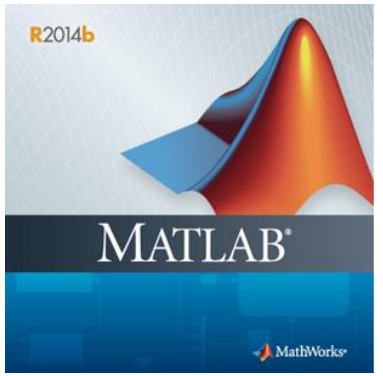
http://www.asdi.com/images

Workflow: Spectral Library





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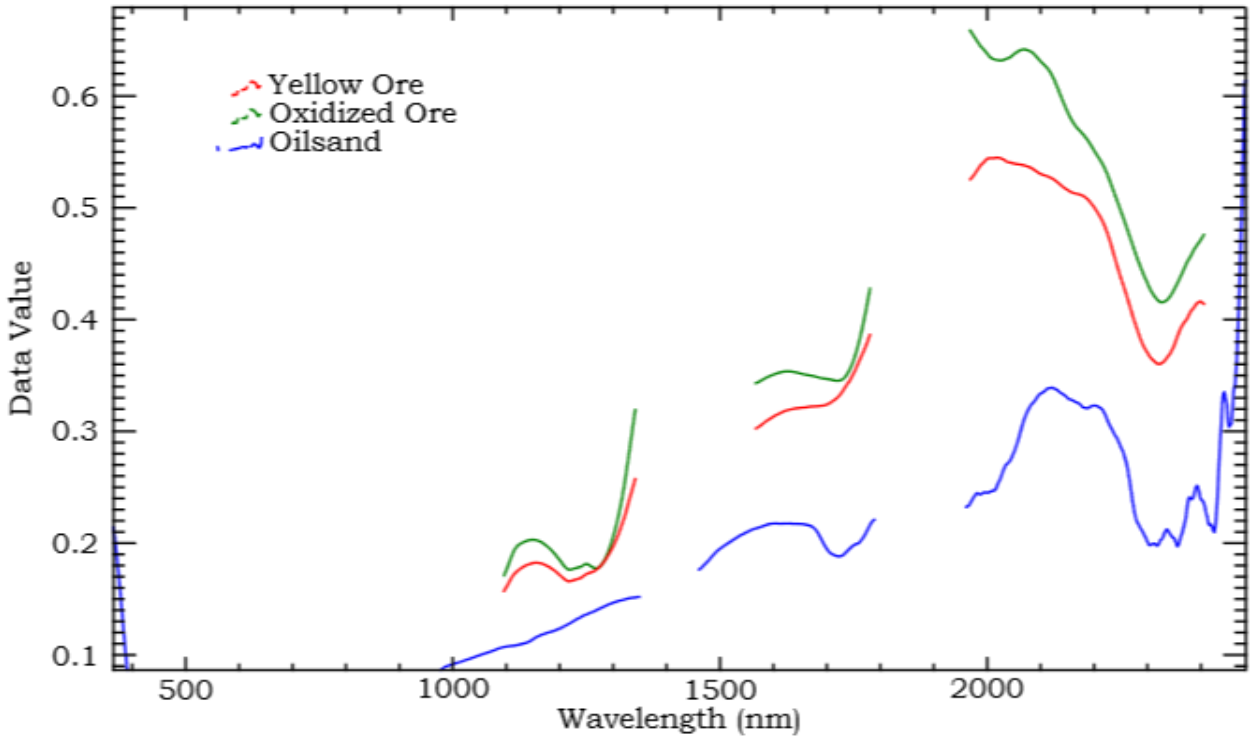
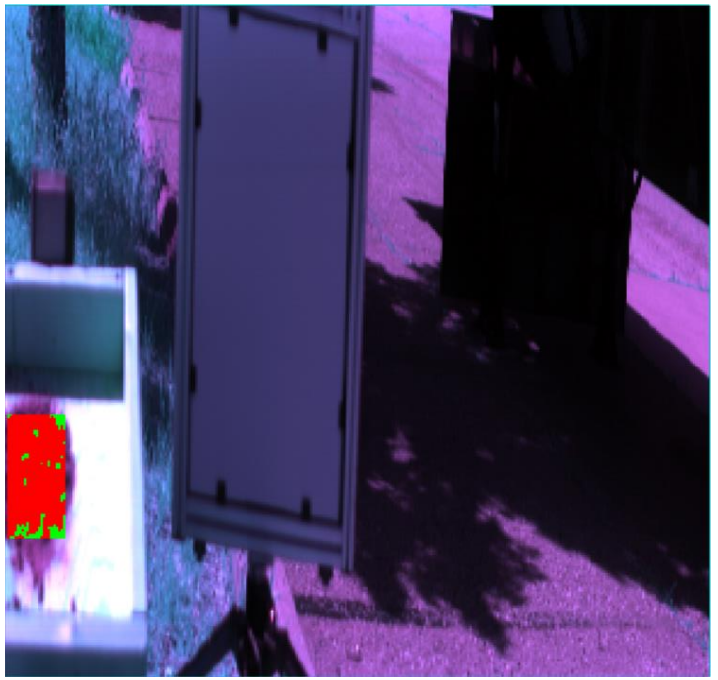
Spectrometer vs. Specim Camera

ASD Spectrometer (blue) vs SPECIM Camera (red & green)





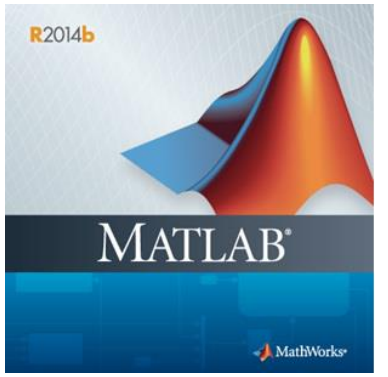
Workflow: Spectral Library

Hyperspectral Camera

1. Radiometric Calibration
2. Test results
3. Test successful?
   - No → Radiance / FLAASH / QUAC / IAR
   - Yes → Supervised Classification

ISODATA

1. Minimum noise transform
2. Data Reduction
3. Derive endmembers from input image using Pixel Purity Index (PPI)



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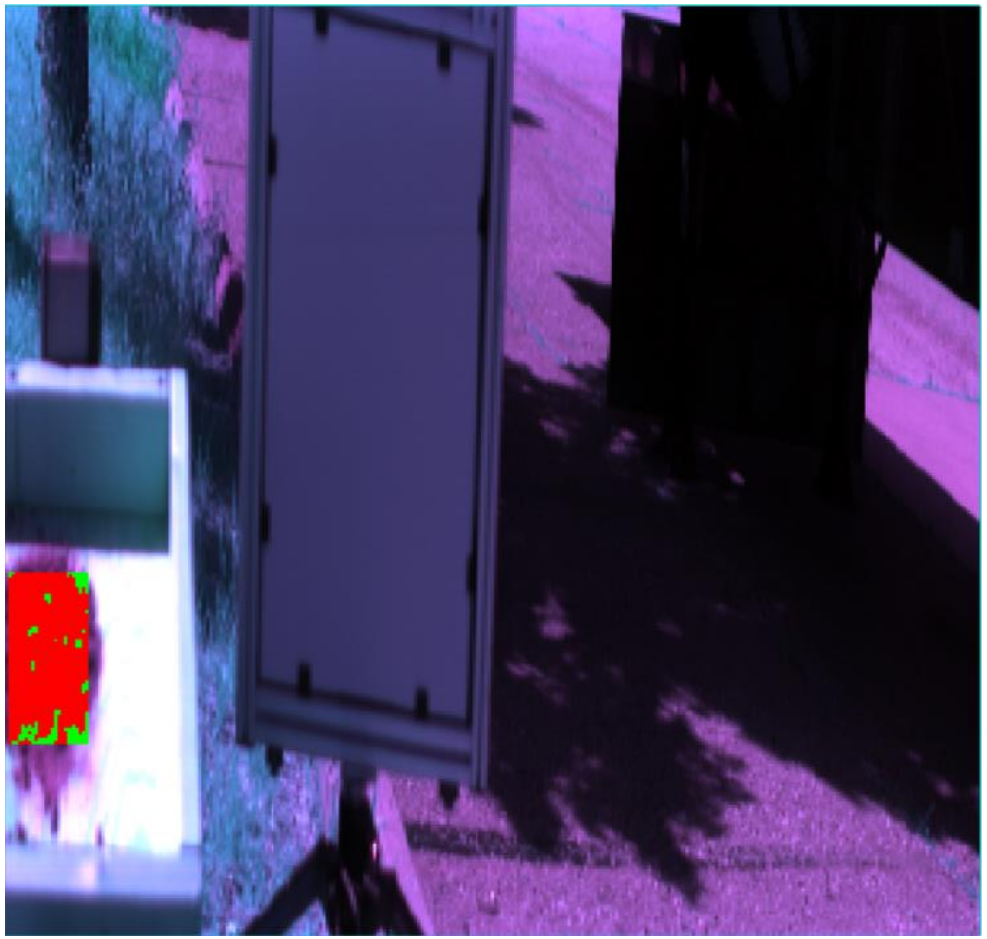
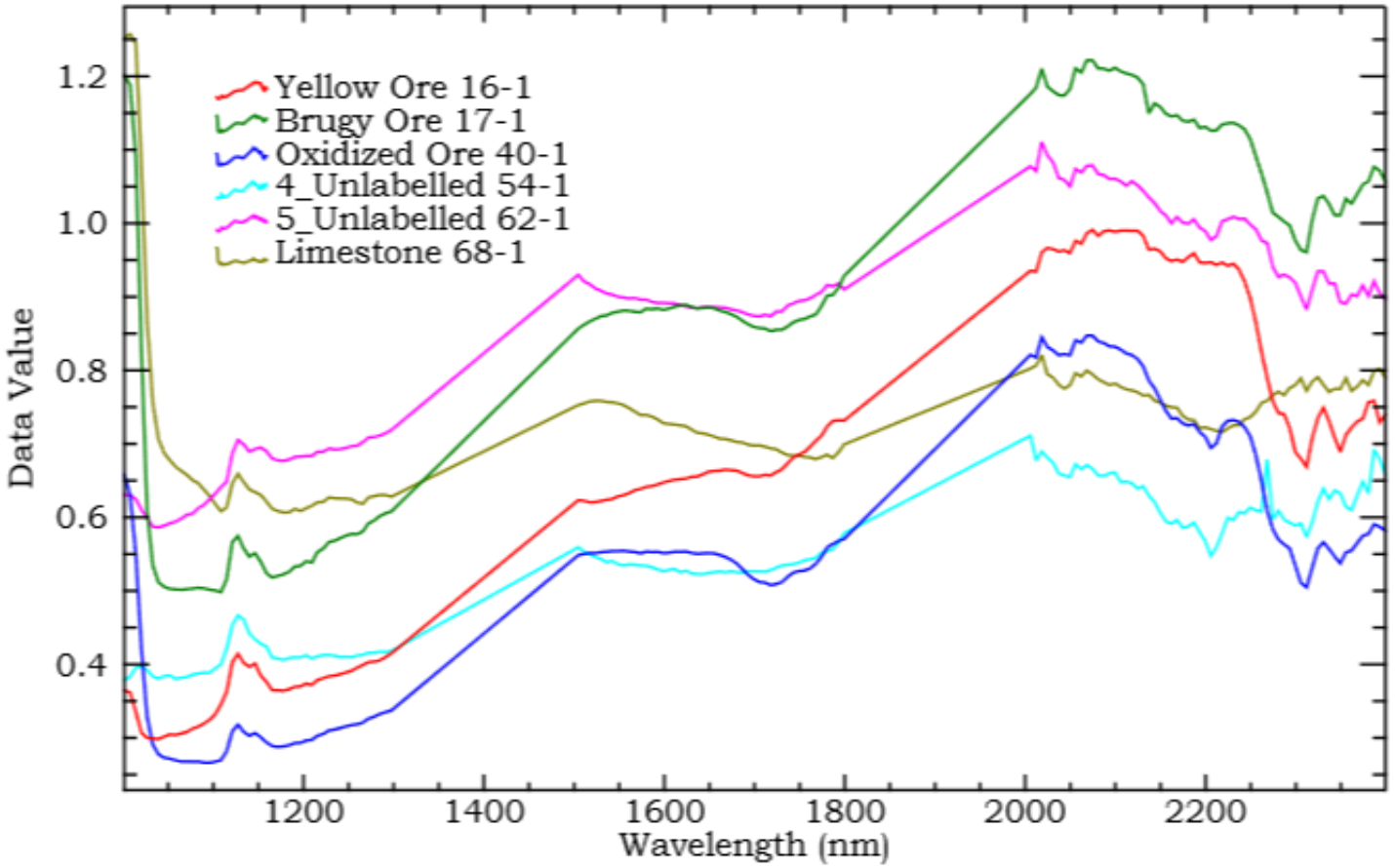
Brugy Ore Sample

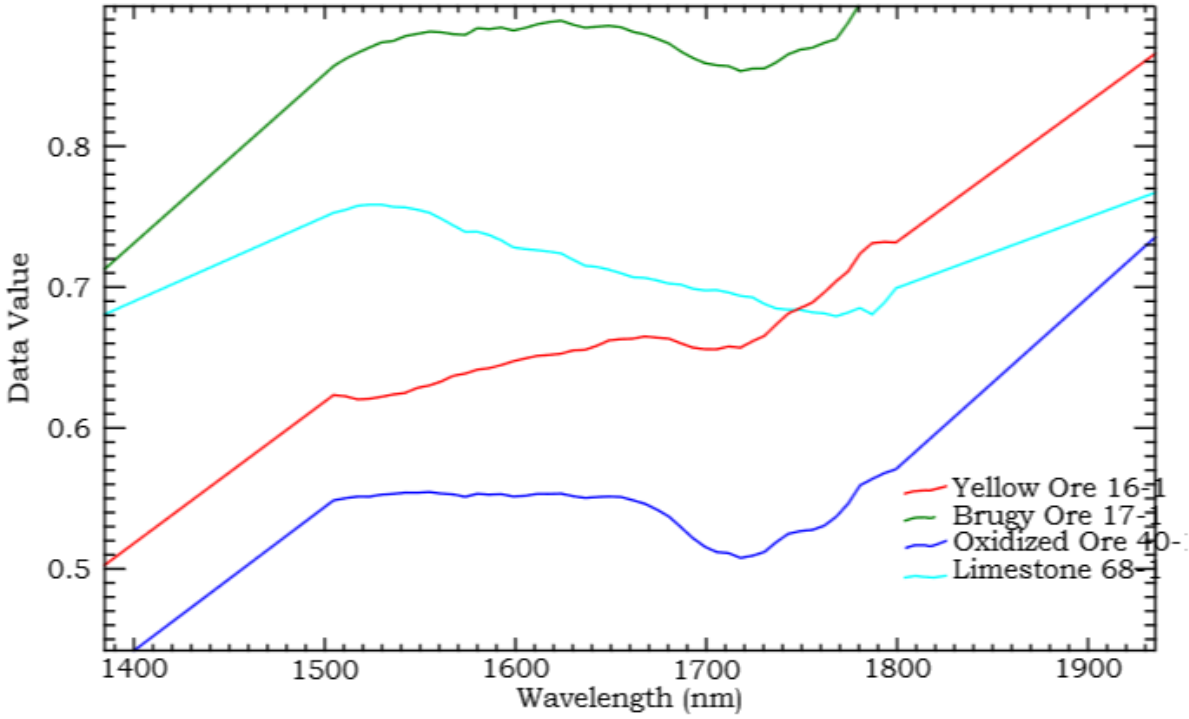


Internal Average Reflectance (IAR)

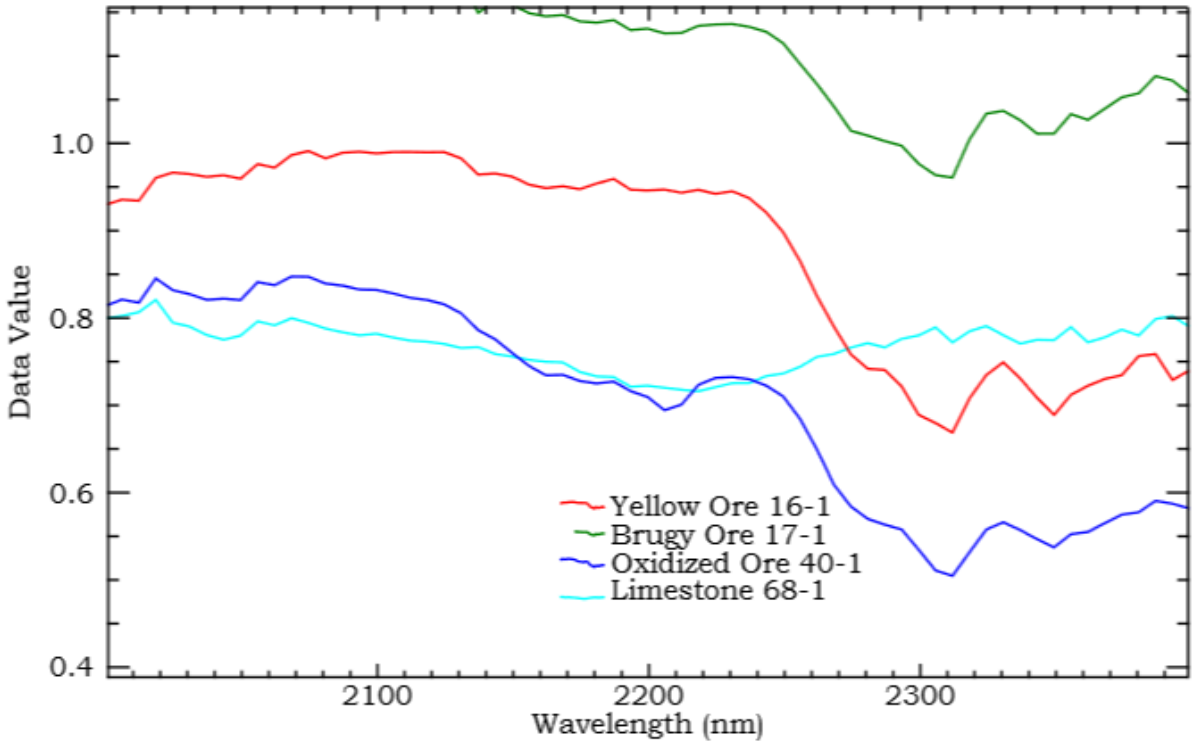


IAR: Hydrocarbon Absorption Feature

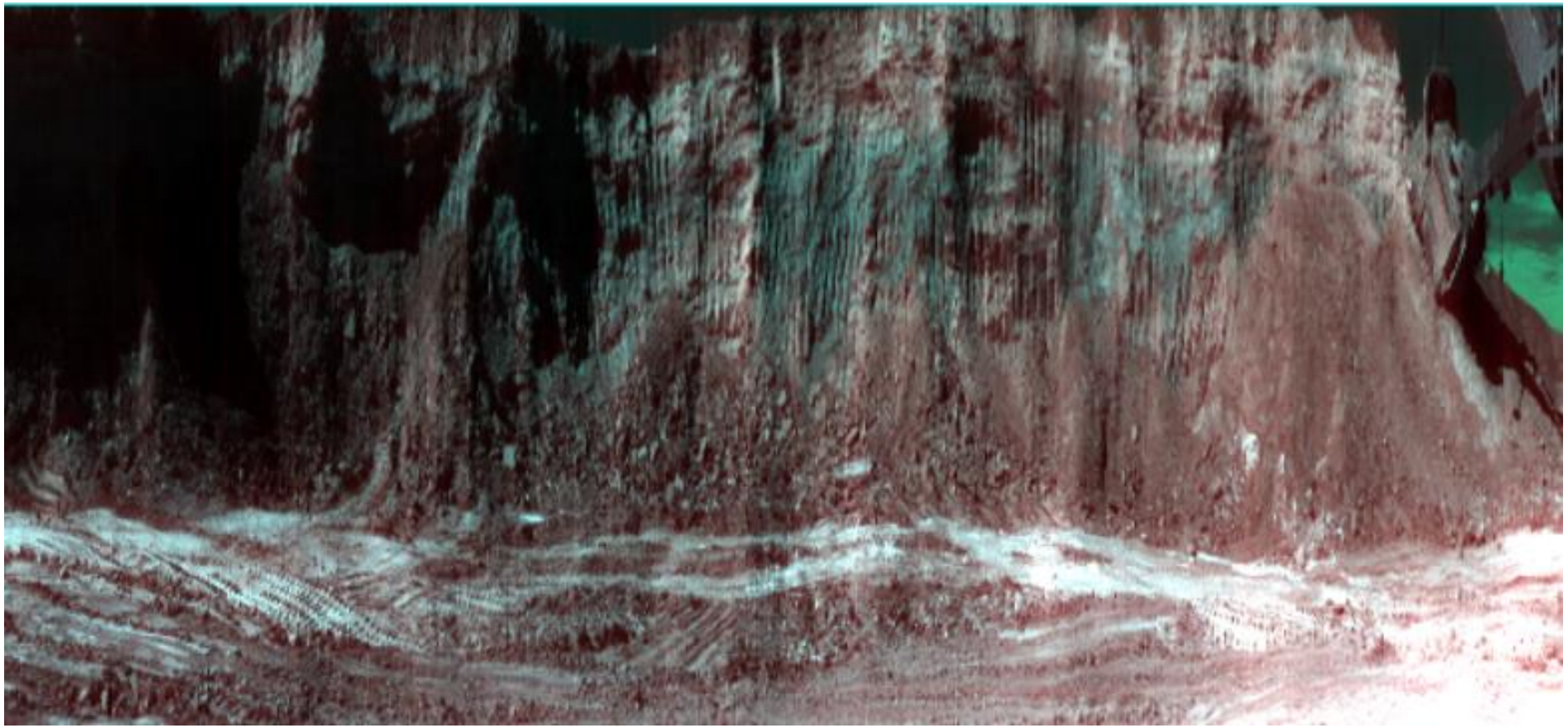
1730 nm Hydrocarbon Feature



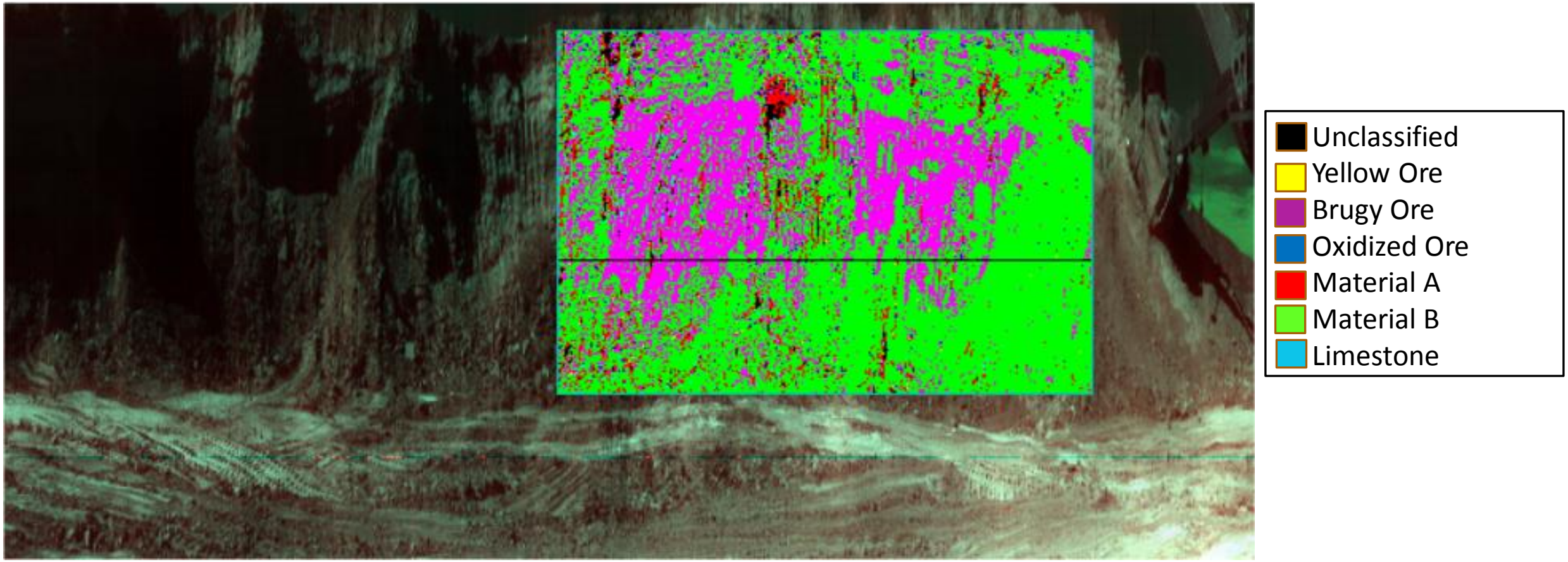
2310 nm Hydrocarbon Feature



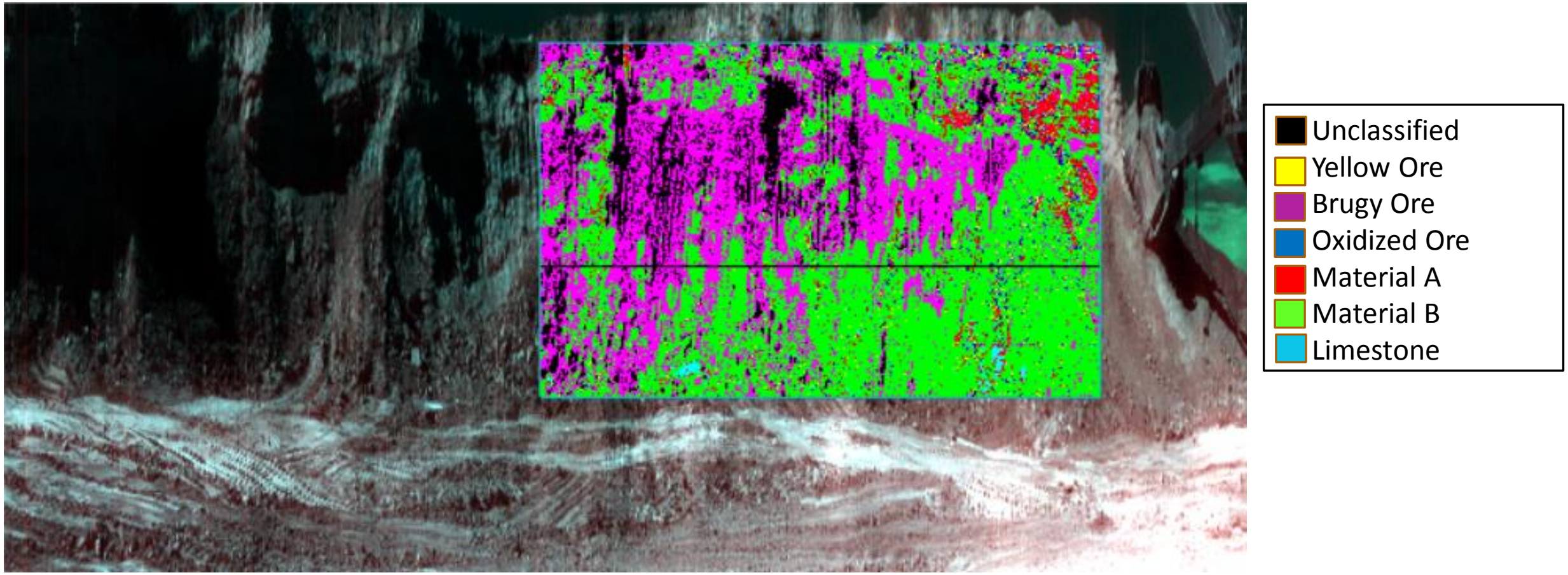
Mine Face in Active Shovel Pit: IAR



Mine Face Classification: 30 Hz 10 ms



Mine Face Classification: 30 Hz 5 ms

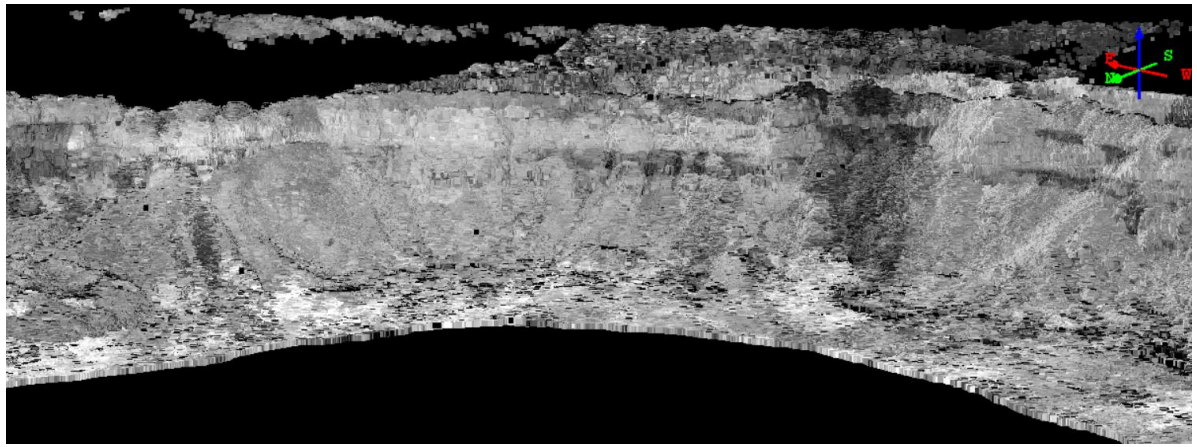


Challenges and Recommendations

- Field errors: dark frames
- Spectralon Panel
- Ground Truths: not collected in Mine
- Radiometric Calibration Files: Finland

Future: Real Time Mine Model

- Integrating Laser Scan Data
- 3D Classified mine model in real time
- Geographic Information System



Acknowledgments

- SarPoint Engineering
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