Infrared Imaging of Feldspars in Intrusive Rocks

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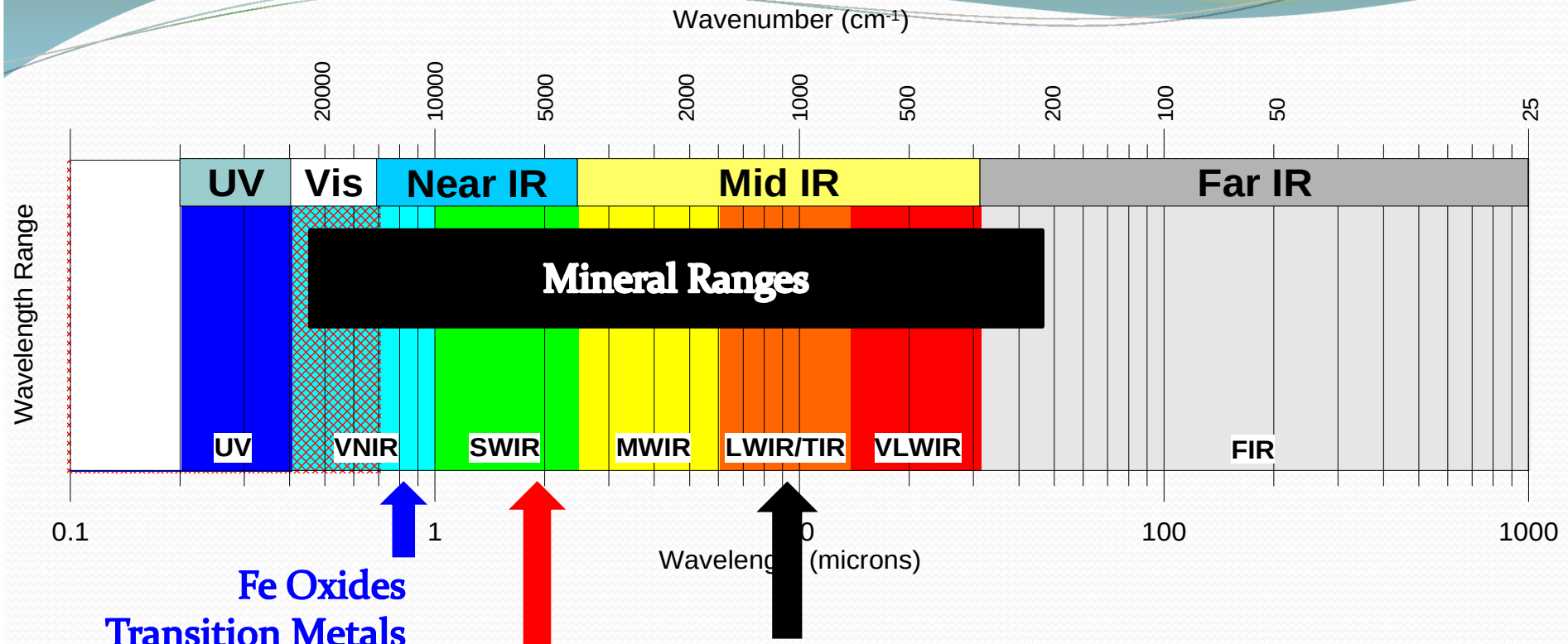
Rainer Bars, Harri Karjalainen – Spectral Imaging Ltd
Jack Voncken, Mike Buxton – TU – Delft

Infrared Wavelength Ranges



Fe Oxides
Transition Metals

Hydroxyls
(Clays, Phyllosilicates)
Water
Carbonate
Hydrated sulphates
OH-bearing Minerals (Amphiboles)

Silicates
(Olivine, Pyroxene, Garnet)
(Quartz,Feldspar)
Si-O
Al-O-Si

LWIR Imaging Study Objectives

LWIR Imaging of Feldspars:

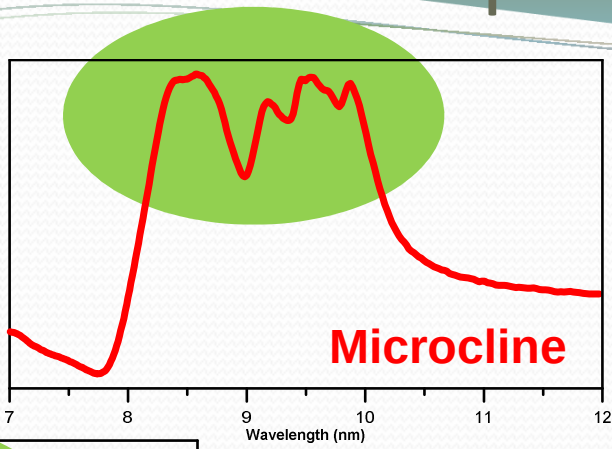
1. How to Correct, Prepare and Process LWIR Image Data?
    1. System correction requirements
    2. Data correction and preparation requirements
    3. Spectral processing requirements

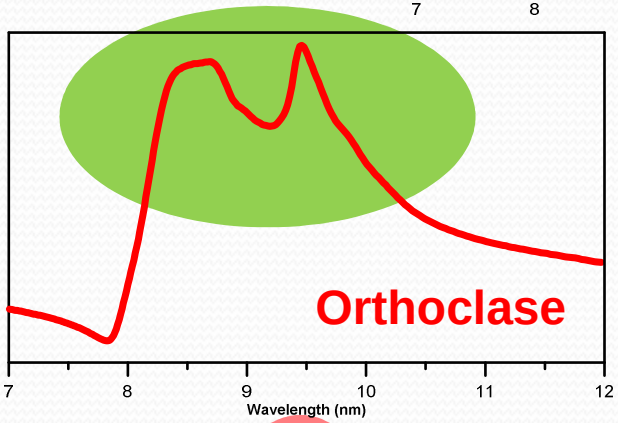
2. What Spectral Signatures can be used to Characterise the Feldspars?
    1. Feldspar identification in the LWIR
    2. Feldspar species discrimination
    3. Methods to monitor changing compositions

3. What are the System Requirements for Imaging Feldspars?
    1. System resolution (spectral and spatial)
    2. Parameters that record systematic changes in feldspars

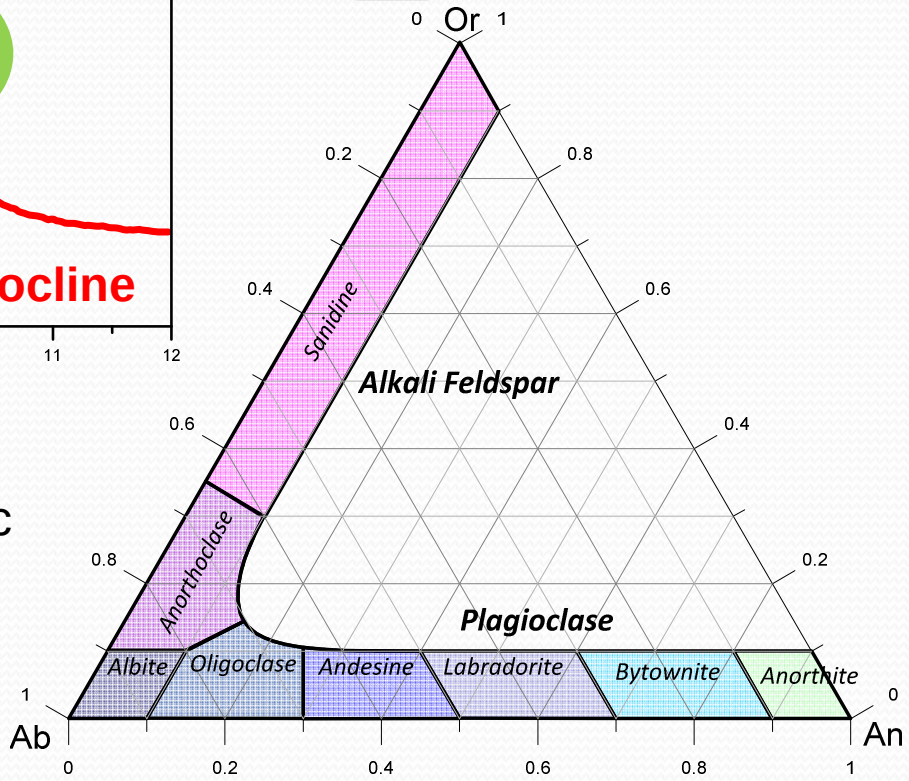
Feldspar LWIR Library Spectra

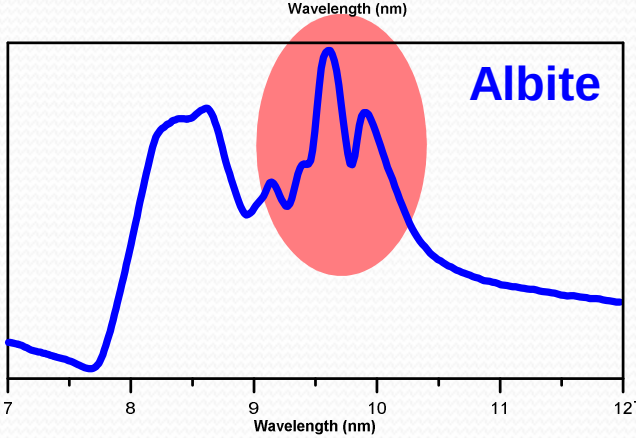
Triclinic Feldspar

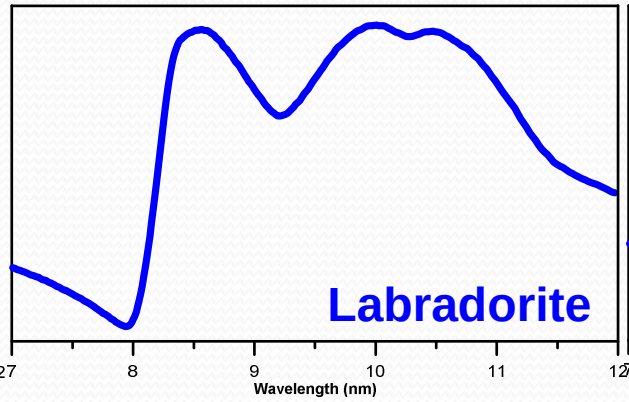


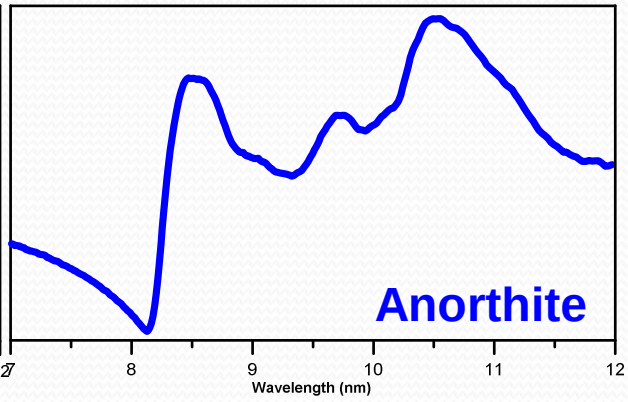


Monoclinic Feldspar









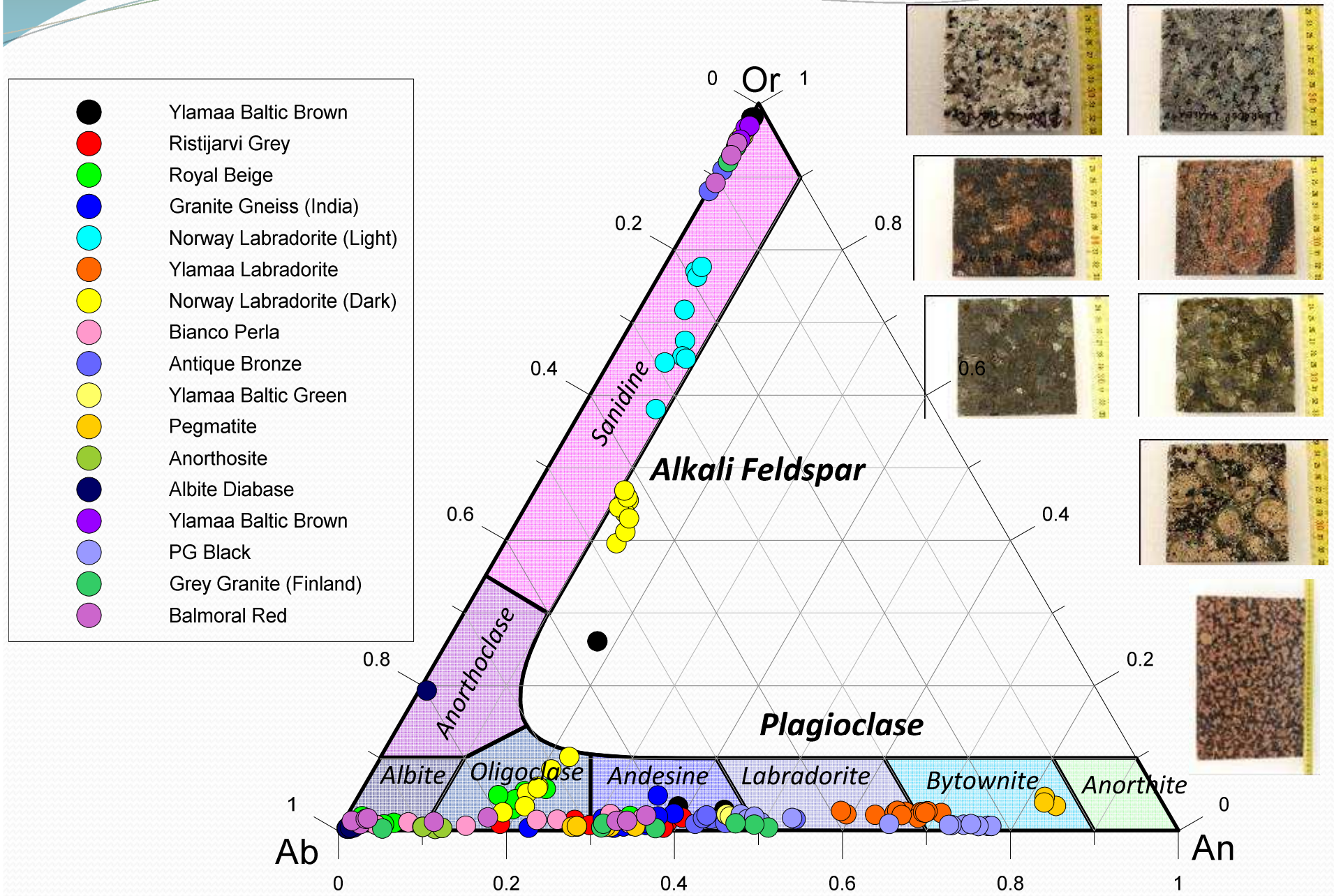
Spectra from JHU Spectral Library in ENVI

LWIR System Specifications

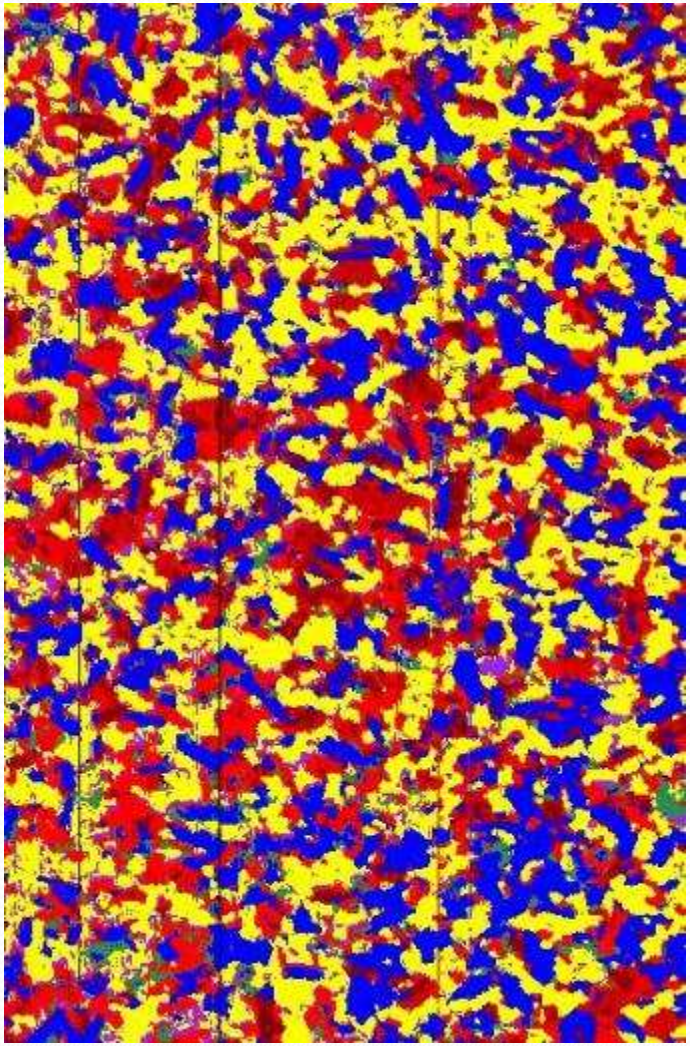
LWIR Systems	OWL
Wavelength Range	7.4µm to 12.4µm
Bands (spectral pixels)	84
Spatial Pixels	384
Spectral Resolution	100nm
Detector Type	MCT
Spectral Sampling	48nm
Instrument Temperature	300 K Stabilized

After Holma et al., 2009

Sample Suite Feldspar Compositions

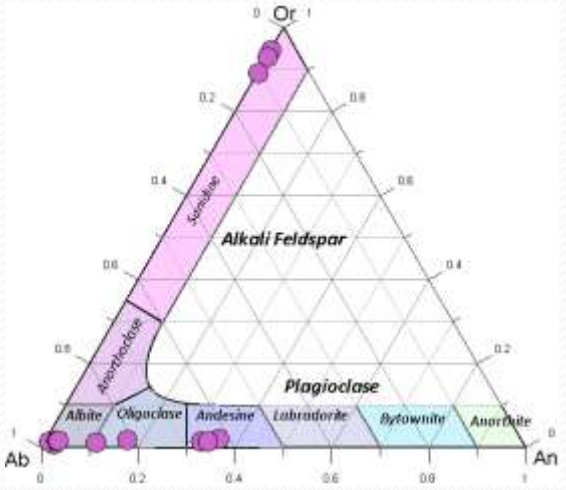


LWIR Image (Balmoral Red)

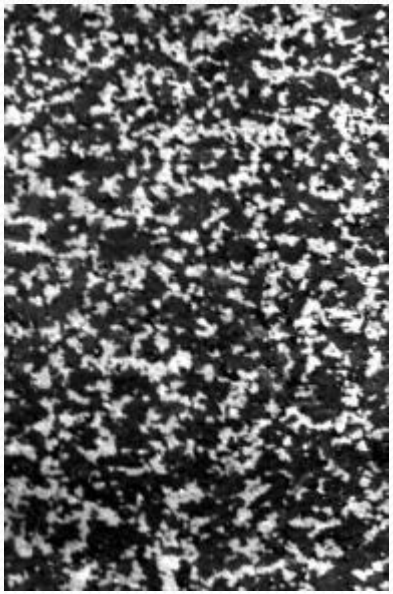


Mineral Map

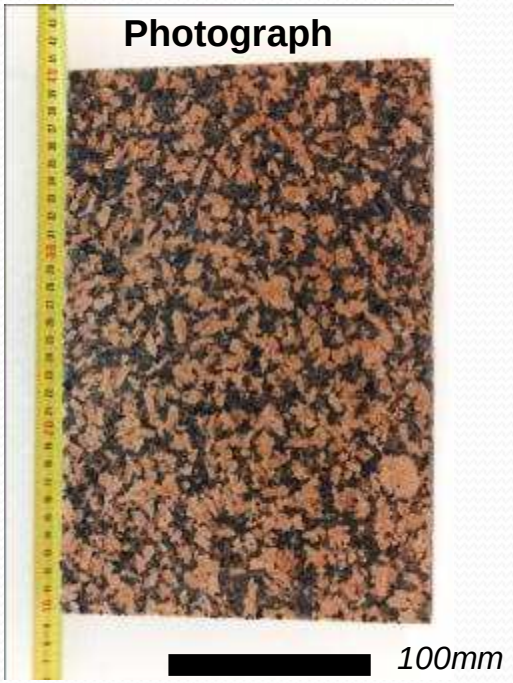
- **Feldspar (Alkali?)**
- **Feldspar (Plag?)**
- **Quartz**
- **Mafic Minerals**
- **Mafic Minerals**



Infrared Image



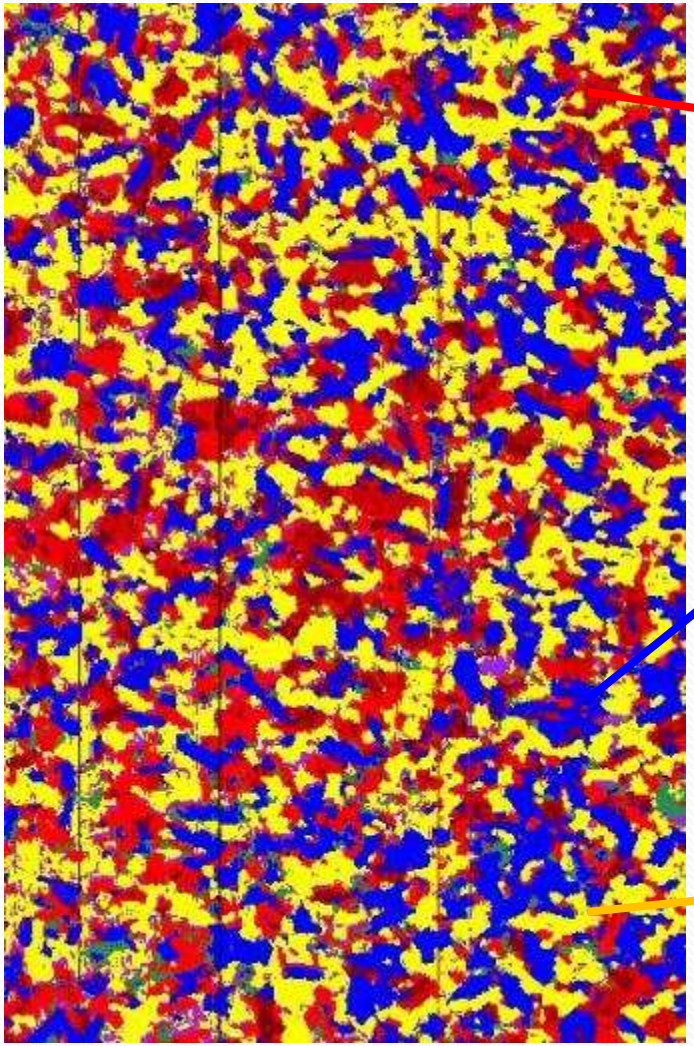
Photograph



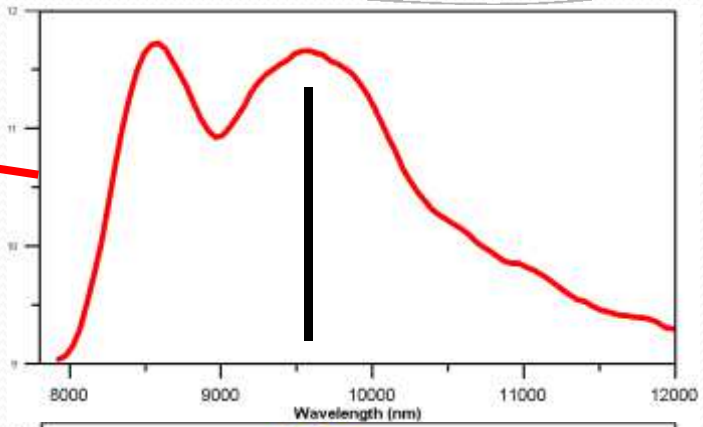
Note: SWIR images show sericite alteration in some zones and feldspars

LWIR Image (Balmoral Red)

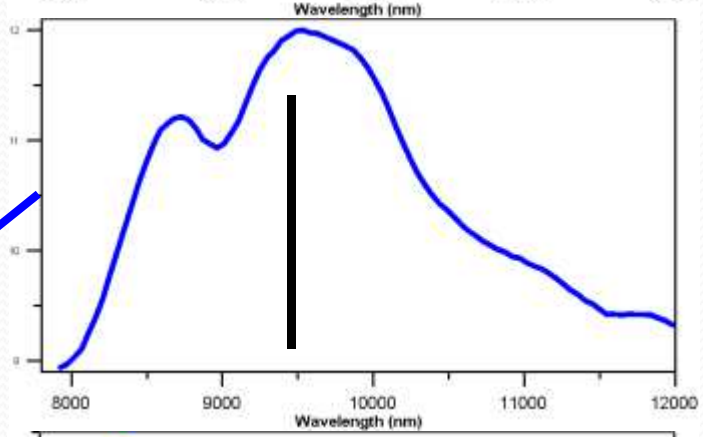
Mineral Classification Image



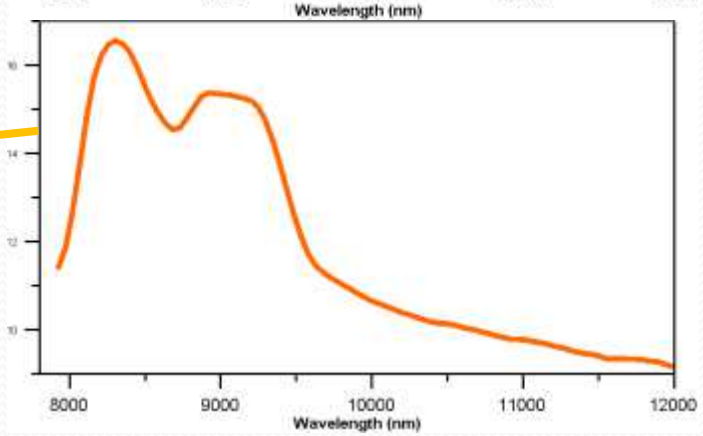
Feldspar (Alkali?)
Feldspar (Plag?)
Quartz
Mafic Minerals
Mafic Minerals



Feldspar
(K-feldspar?)



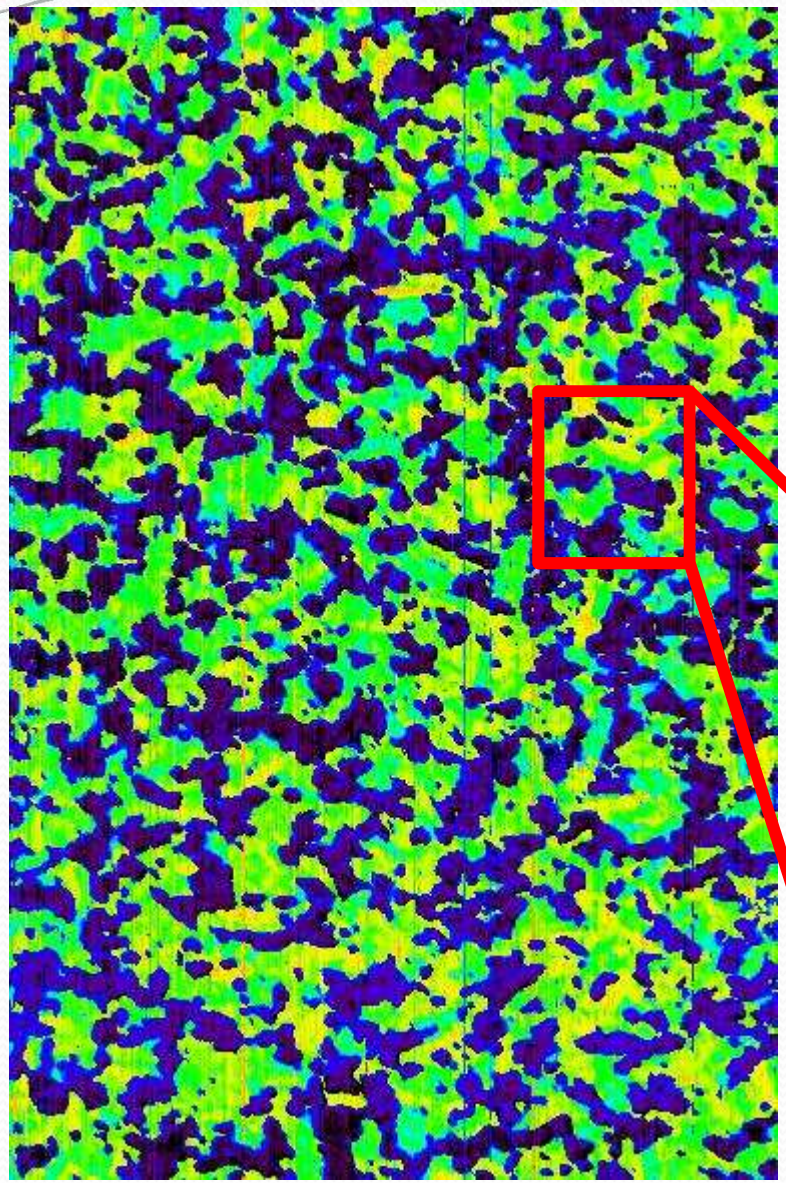
Feldspar
(Plagioclase?)

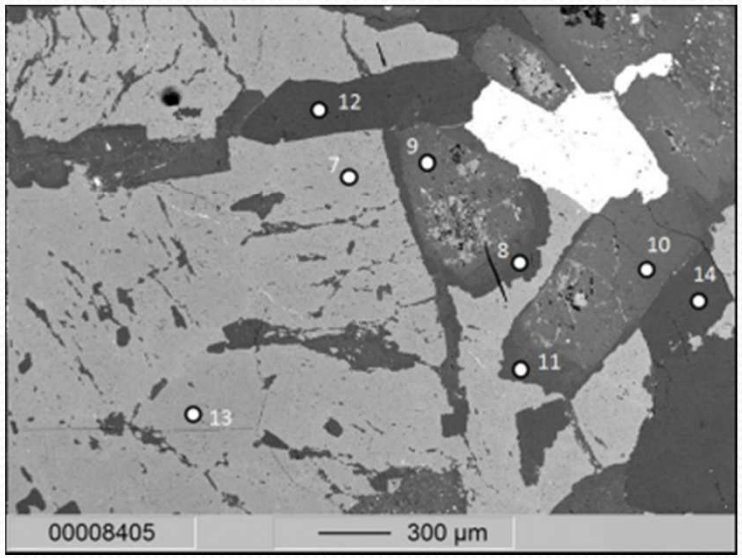


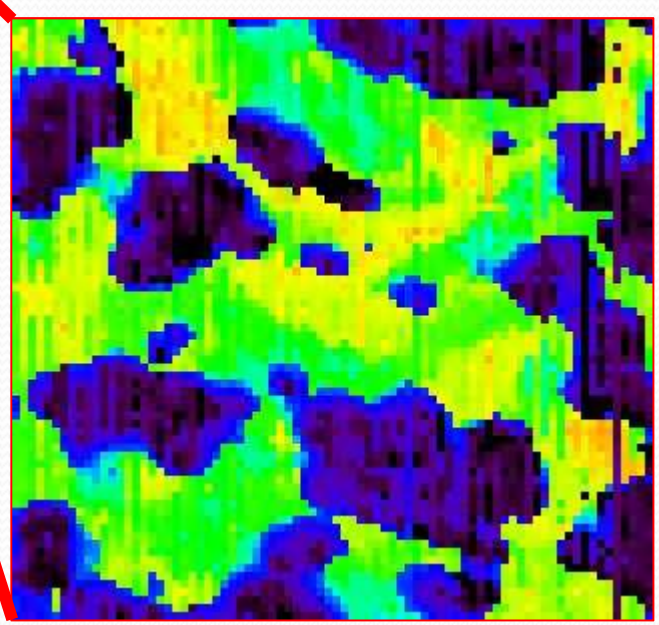
Quartz

100mm

LWIR Image (Balmoral Red)





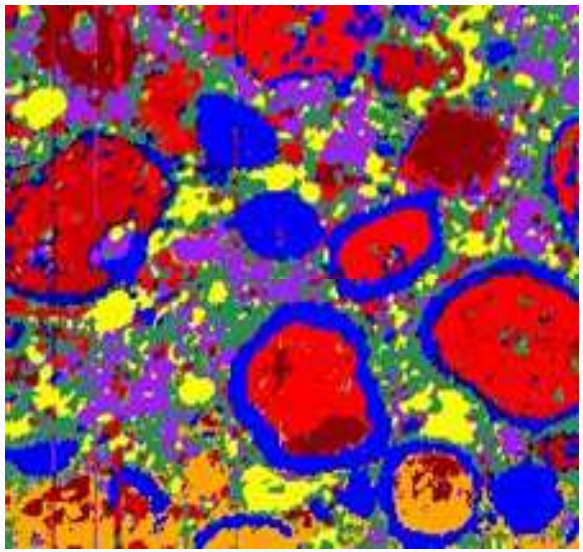


100mm

Wavelength Feature Maximum between 9um and 10um

LWIR Image (Baltic Brown)

Mineral Map



- **Feldspar (Alkali)**
- **Feldspar (Alkali)**
- **Feldspar (Plagioclase)**
- **Quartz**
- **Mafic Minerals**
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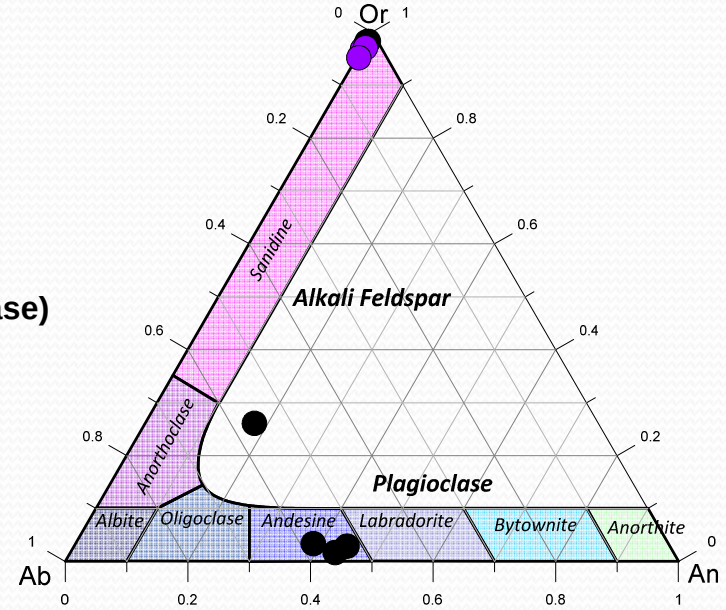
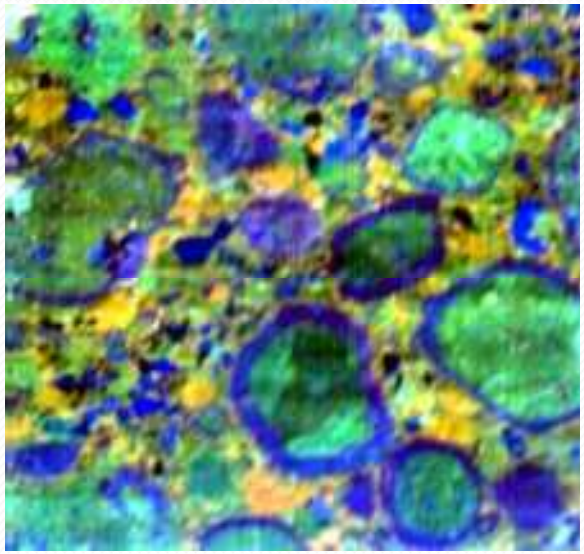


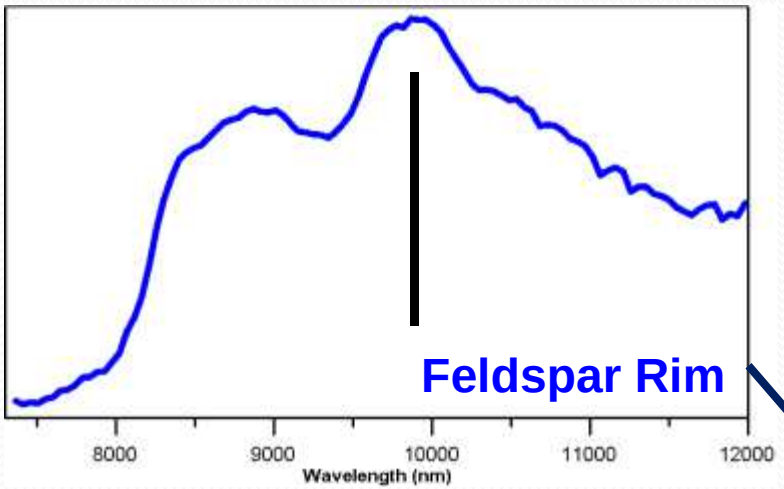


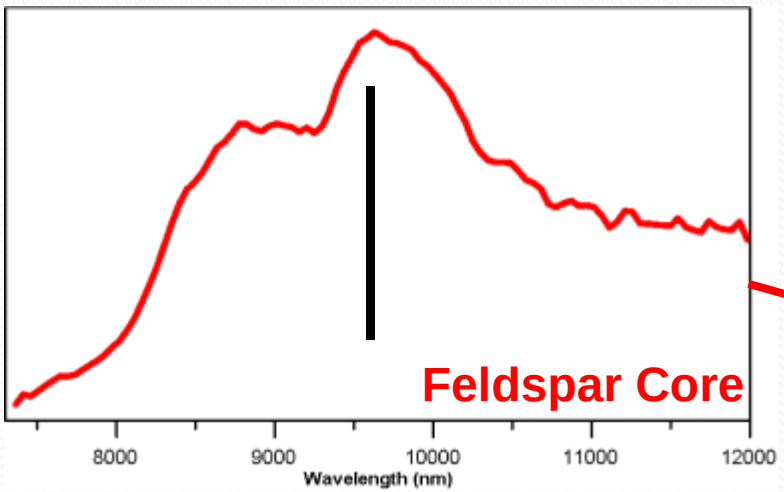
Enhanced Infrared Image

Photograph

40mm

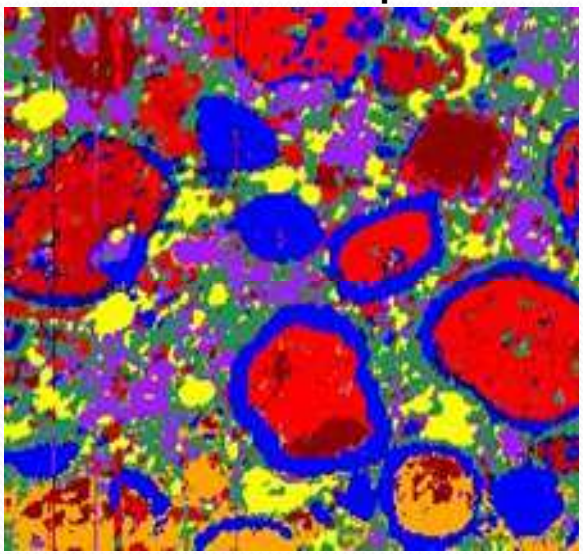
LWIR Image (Baltic Brown)





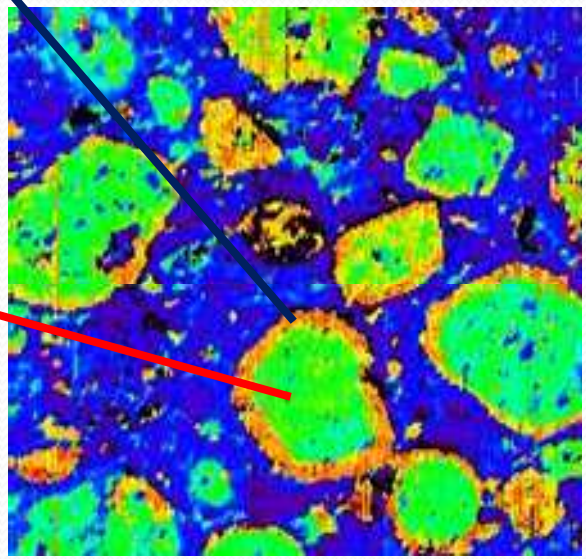
40mm

Mineral Map



- Feldspar (Alkali)
- Feldspar (Alkali)
- Feldspar (Plagioclase)
- Quartz
- Mafic Minerals
- Mafic Minerals

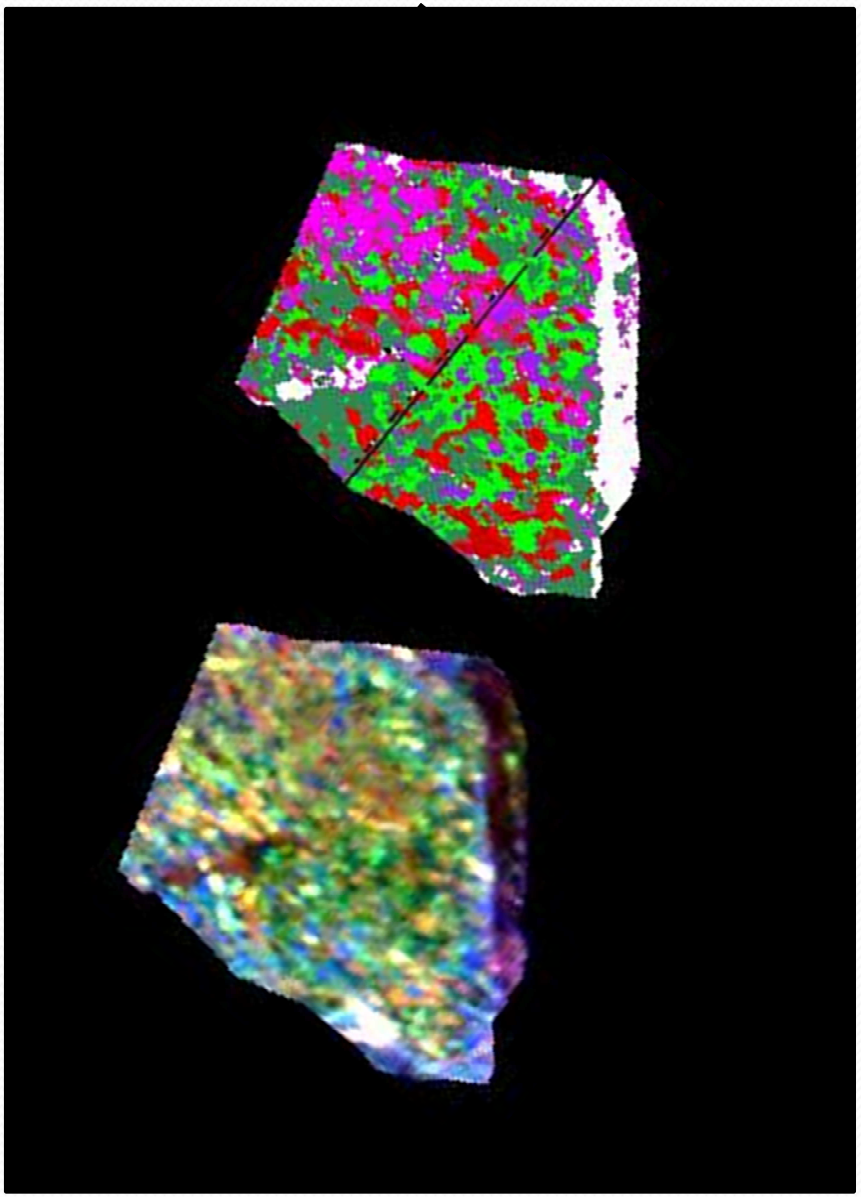
Wavelength Maxima



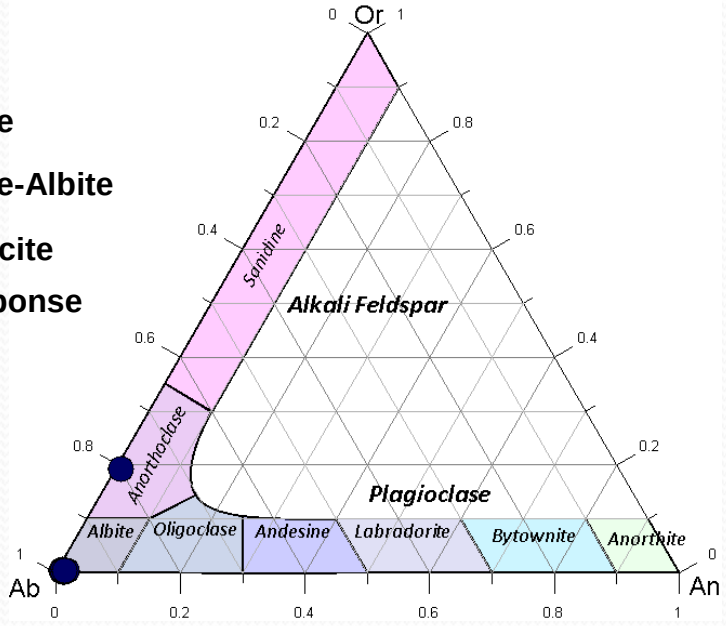
10um

9um

LWIR Image (Albite Diabase)

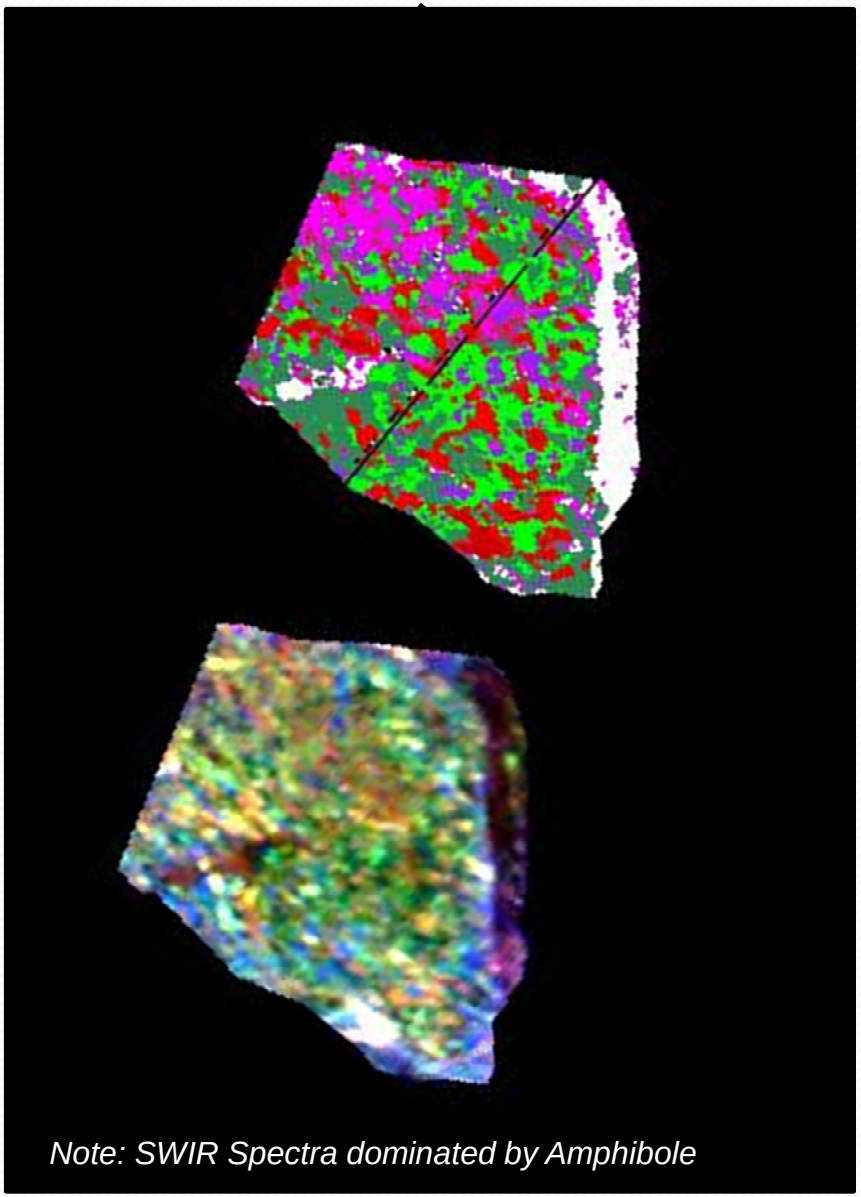


- **Albite**
- **Amphibole**
- **Amphibole-Albite**
- **Albite-Calcite**
- **Dark Response**

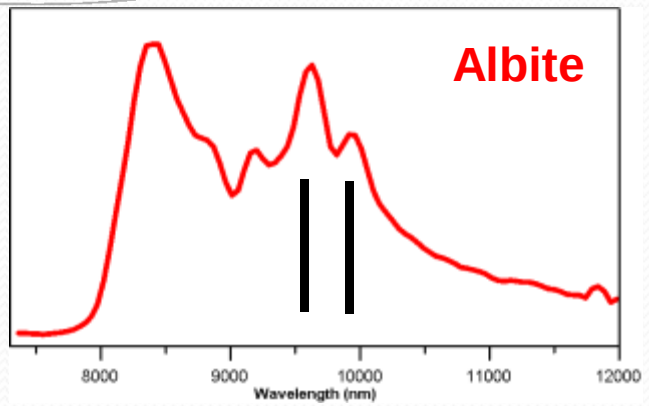


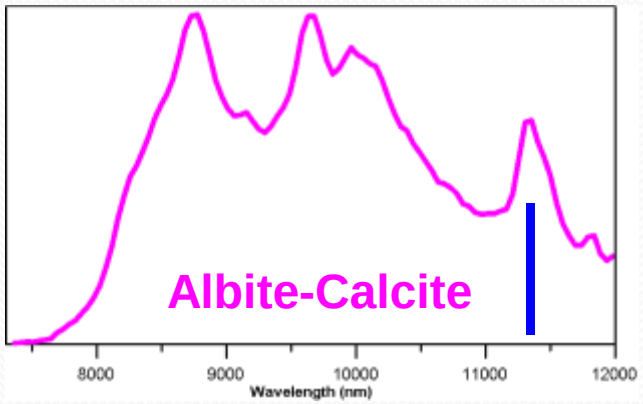
20mm

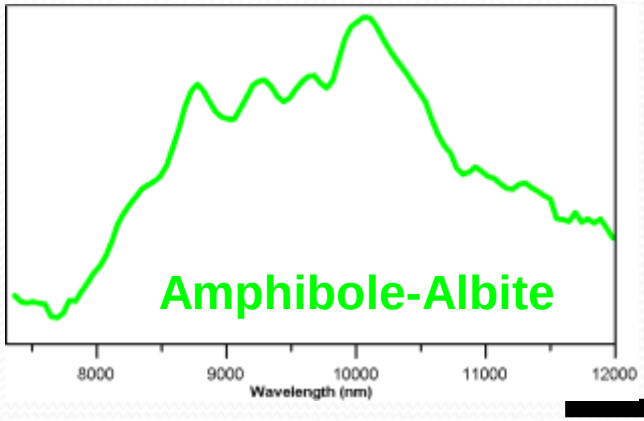
LWIR Image (Albite Diabase)



- Albite
- Amphibole
- Amphibole-Albite
- Albite-Calcite
- Dark Response



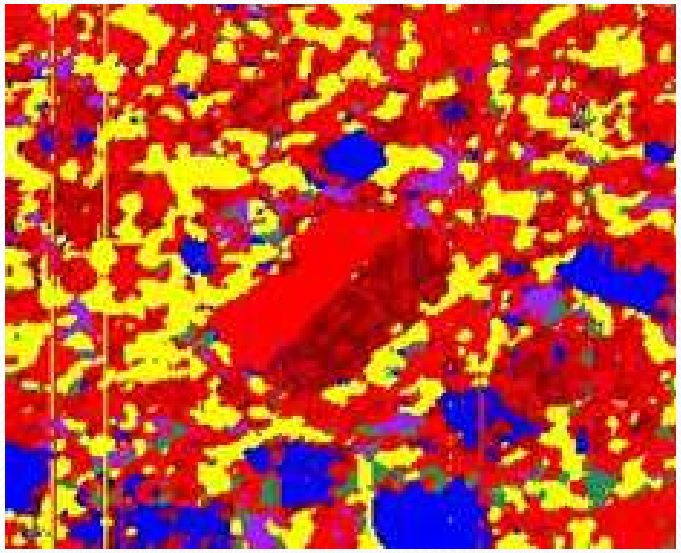




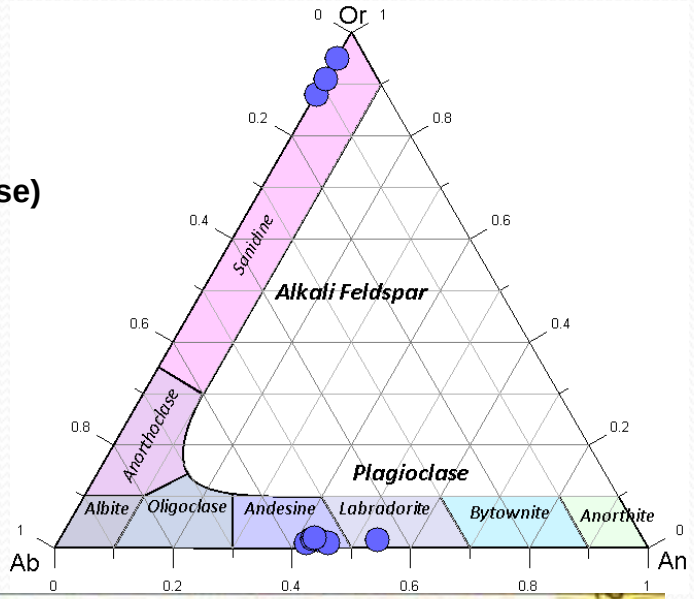
20mm

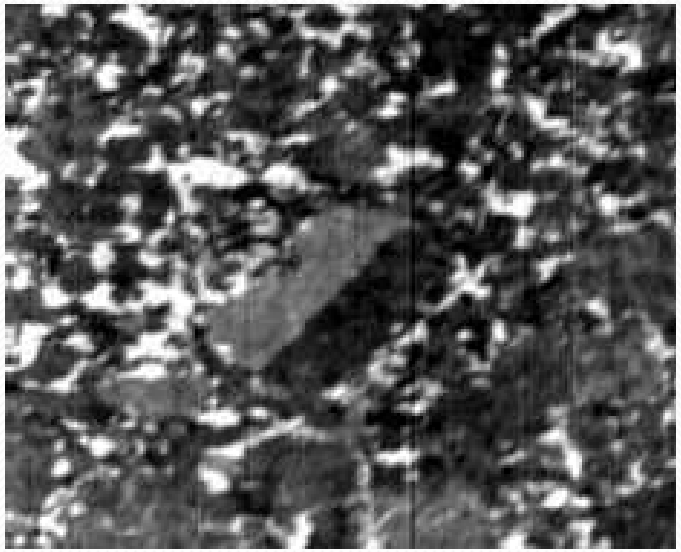
LWIR Image (Antique Bronze)

Mineral Map



- Feldspar (Alkali)
- Feldspar (Plagioclase)
- Quartz
- Mafic Minerals
- Mafic Minerals

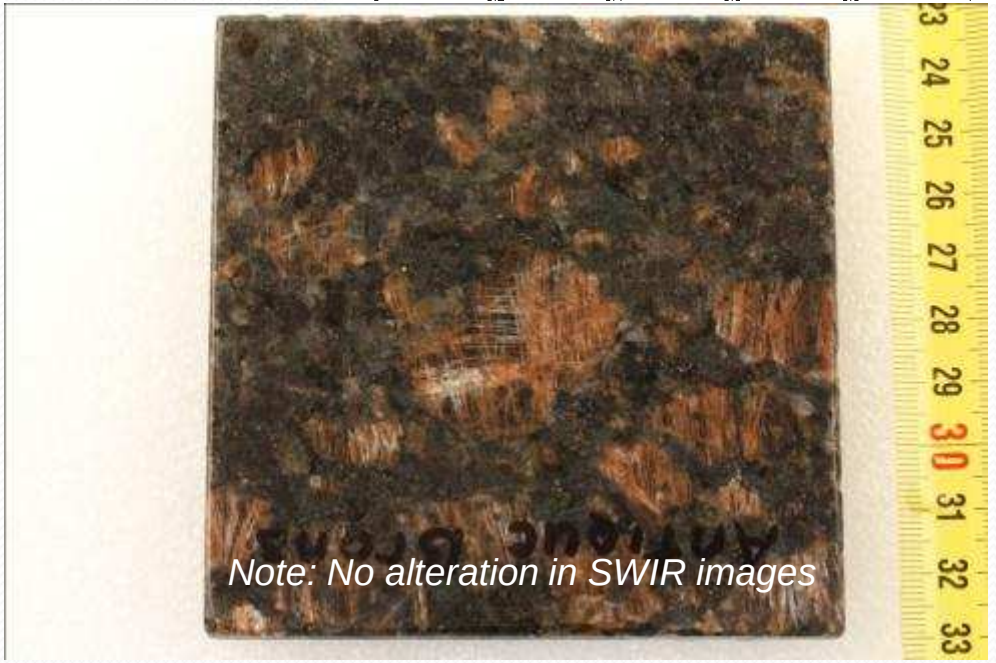




20mm

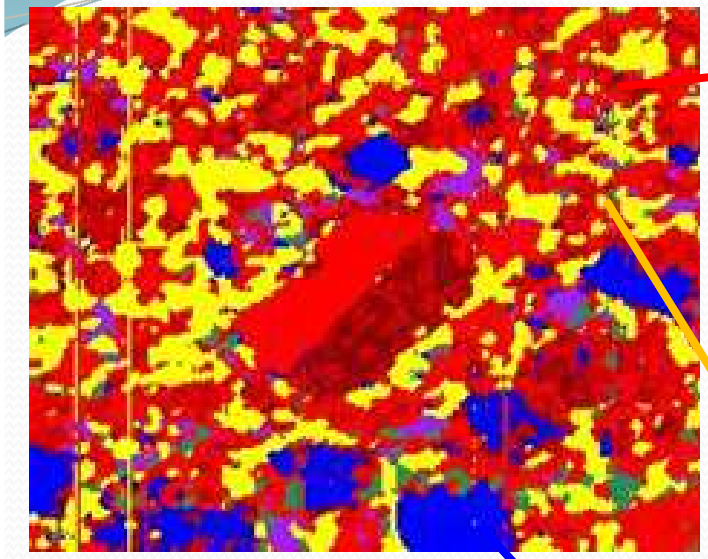
Infrared Image

Photograph



LWIR Image (Antique Bronze)

Mineral Map



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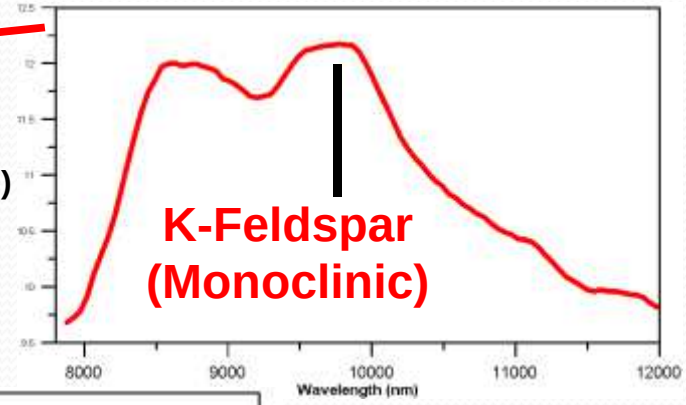
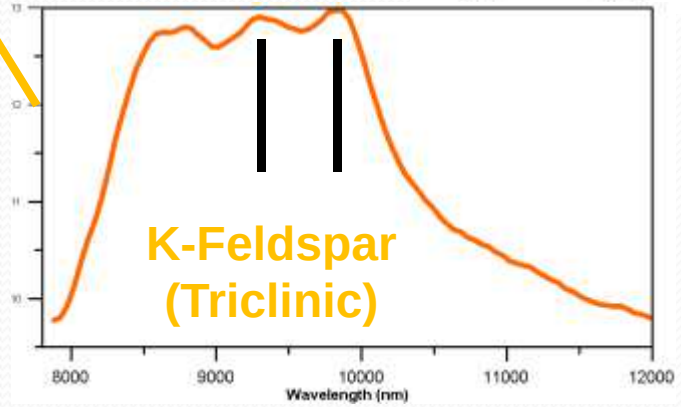
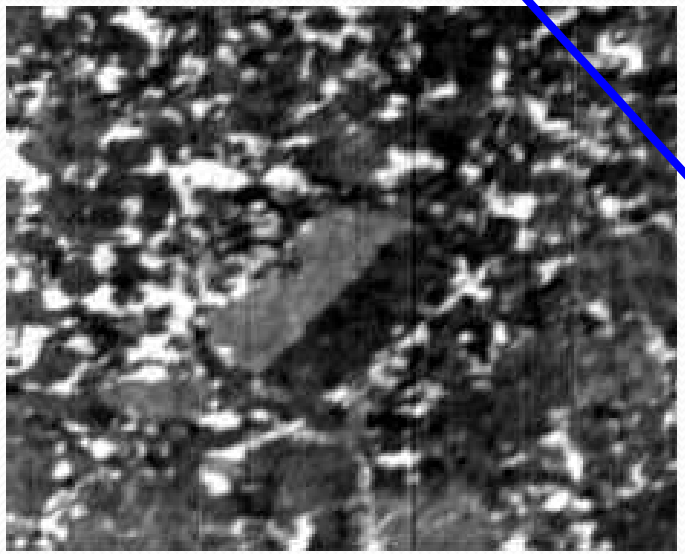
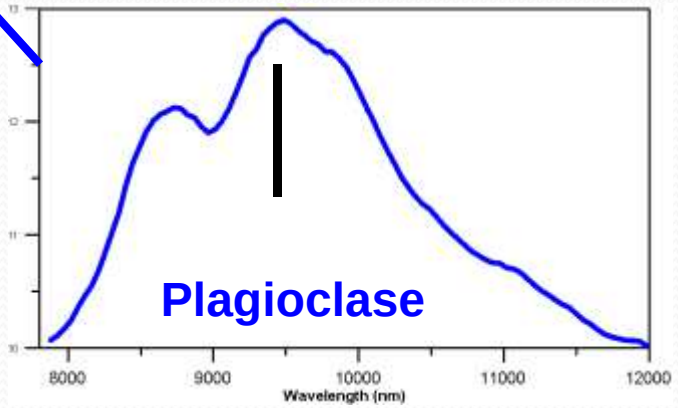






20mm

Infrared Image

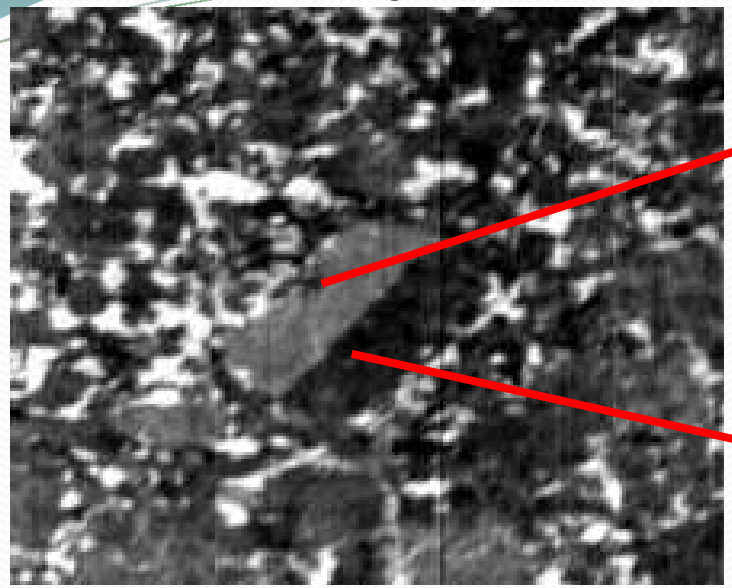


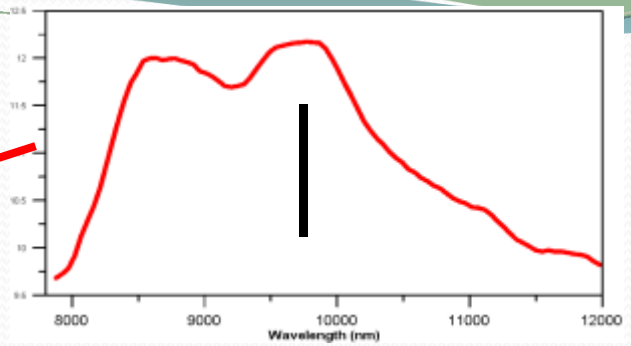
Feldspar Discrimination

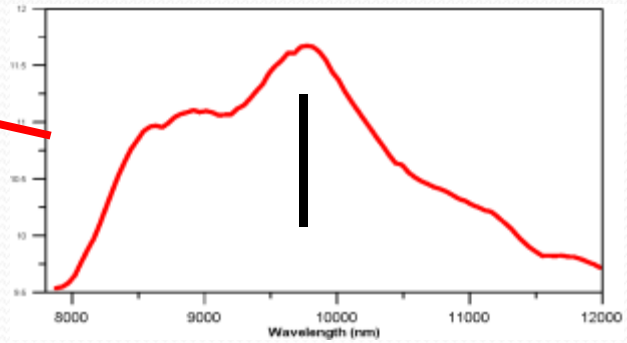
- Possible discrimination
- Effects of alteration
- Crystal structure (ksp)

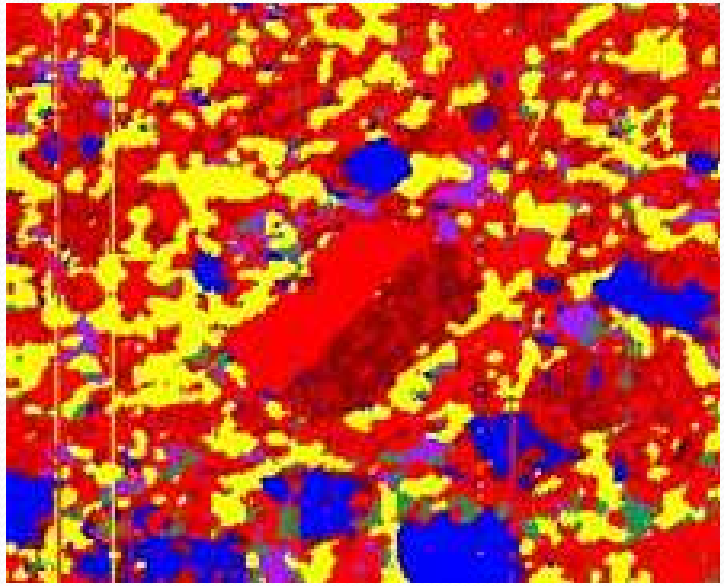
LWIR Image (Antique Bronze)

Infrared Image

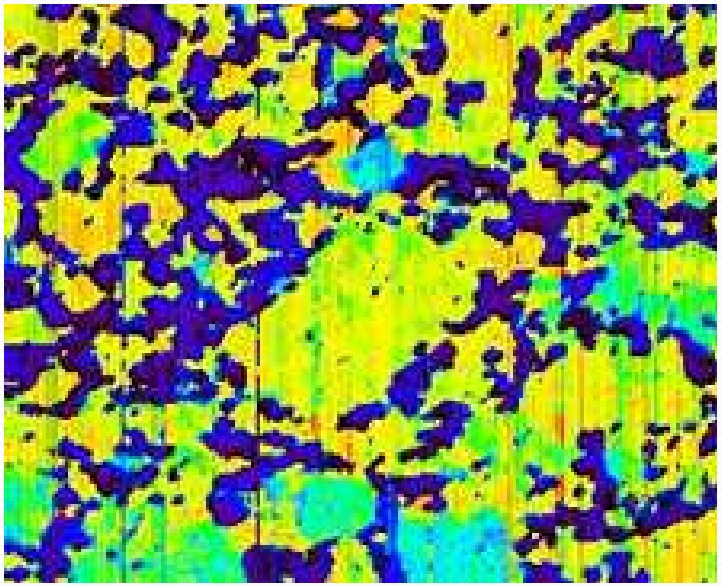








Mineral Map



Wavelength Maxima

10um

9um

20mm

Conclusions

Summary

- Variations of LWIR signatures between feldspars are observed
- Wavelength shifts observed in reflectance bands
- These changes have spatial coherency
- Supported by petrographic investigations

Challenges

- Identification of specific feldspar species currently difficult from datasets at this stage
- Compositional discrimination yet to be tested
- Albite LWIR signatures different to those observed from other plagioclase minerals