THE INFLUENCE OF GEOLOGICAL SAMPLE SURFACE PREPARATION ON TIR SPECTROSCOPY

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SCOPE OF PRESENTATION

Surface roughness influences
Spectral shape
Spectral contrast
WHAT WILL YOU LEARN?

- Significant enough for identification of different surfaces
- Surface roughness influences
- Peak position
- Feature depth
- Absolute reflectance

➔ Signficant enough for identification of different surfaces

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DRILL CORES
SAMPLE PREPARATION

Sawed

Polished

Sawed
PREVIOUS RESEARCH

Increasing surface roughness promotes “volume scattering” and the “cavity effect”
Increasing surface roughness promotes “volume scattering” and the “cavity effect”

→ Influencing the spectral signature
PREVIOUS RESEARCH

Increasing surface roughness promotes “volume scattering” and the “cavity effect” → Influencing the spectral signature

Emissivity based

Natural occurring surfaces

Extraterrestrial exploration
NOVELTY OF THIS RESEARCH

Determine effect of sample surface preparation

High spectral resolution LWIR spectroscopy

Compare to emissivity measurements

Translate results to LWIR imaging
ROCK SAMPLES

Gildehaus SSt
- Medium grained
- 99% Quartz
- 1% Kaolinite
- 20% porosity

Fontainebleau SSt
- Fine grained
- 100% Quartz
- 6% porosity

Shanxi gabbro
- Fine grained
- 57% Feldspar
- 28% Pyroxene
- Intergranular
  - 6% Quartz,
  - 6% Hornblende
SAMPLE PREPARATION

Split, Saw, Polish

Lortone LSS-14P lapidary saw
Diamond blade

Knuth Rotor
4000 grit

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SPECTRAL MEASUREMENTS

Bruker Vertex 70 FTIR with DHR integrating sphere
7.5 – 16 µm
Spectral resolution 4 cm⁻¹
9 measurements/sample surface
SAMPLE SURFACE ANALYSIS

Scanning electron microscopy (SEM)

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Surface roughness scans with Contour Profilometer
GILDEHAUS SST

- 99% Quartz
- 1% Kaolinite
- 20% porosity

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GILDEHAUS DHR SPECTRA

Gildehaus DHR spectra

- Red: Gildehaus polished
- Blue: Gildehaus sawed
- Orange: Gildehaus split

Normalized Reflectance

Normalized Reflectance
Weaker transmittance bands at 8.5 and 9 µm

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FONTAINEBLEAU SST

- 100% Quartz
- 6% porosity

Sawed

Split

Fine-grained quartz
FONTAINEBLEAU SPECTRA VS SURFACE PROFILES

Fontainebleau DHR spectra

- Red: Fontainebleau polished
- Blue: Fontainebleau sawed
- Yellow: Fontainebleau split

Wavelength (μm)

Reflectance

Polished

Sawed

Split

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FONTAINEBLEAU SPECTRA VS SURFACE PROFILES

Fontainebleau DHR spectra

- Red: Fontainebleau polished
- Blue: Fontainebleau sawed
- Yellow: Fontainebleau split

Reflectance vs Wavelength (μm)

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GABBRO

- 57% Feldspar
- 28% Pyroxene
- Intergranular
  - 6% Quartz,
  - 6% Hornblende

Gabbro polished
GABBRO SPECTRA VS SURFACE PROFILES

Gabbro DHR spectra

- Gabbro polished
- Gabbro sawed
- Gabbro split

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RESULTS VS THEORY

Increasing surface roughness

Polished
- Diffuse reflection
- Specular reflection

Sawed
- Diffuse reflection
- Volume scattering
- Specular reflection

Split
- Volume scattering
- Cavity effect

Gildehaus polished
Gildehaus sawed
Gildehaus split
Increasing **surface roughness** promotes **volume scattering** and the **cavity effect**, influencing the **spectral signature**

Interpretation of **high spectral resolution LWIR images** should take in account the effect of **surface roughness**

**Quantitative comparison of spectra** should ideally only be performed on samples with **identical sample preparation**
WORK IN PROGRESS

- Define a “best-practice-path” for sample preparation
- Create an extensive spectral library
- Correction of spectra by using surface roughness parameters
- Correction of spectra by normalization
  - Normalize entire spectra
  - Normalize specific spectral bands
QUESTIONS?

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