IMPACT

Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**

Regolith Spectral Variation Due to Electrostatic Dust Lofting

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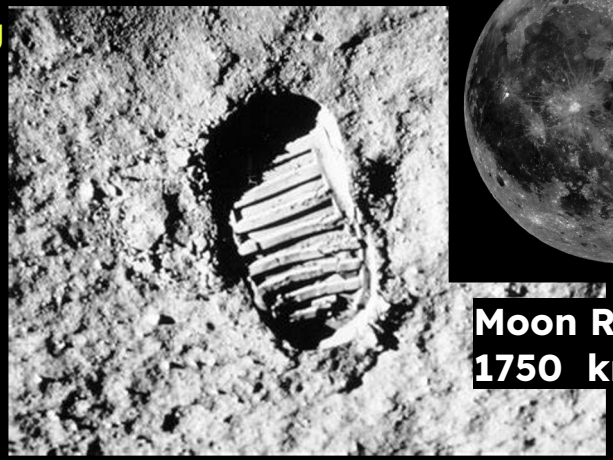
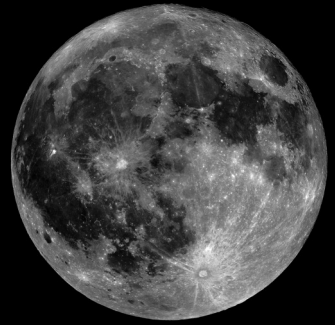
Motivation -

Abundance of regolith varies among different sizes of airless bodies.

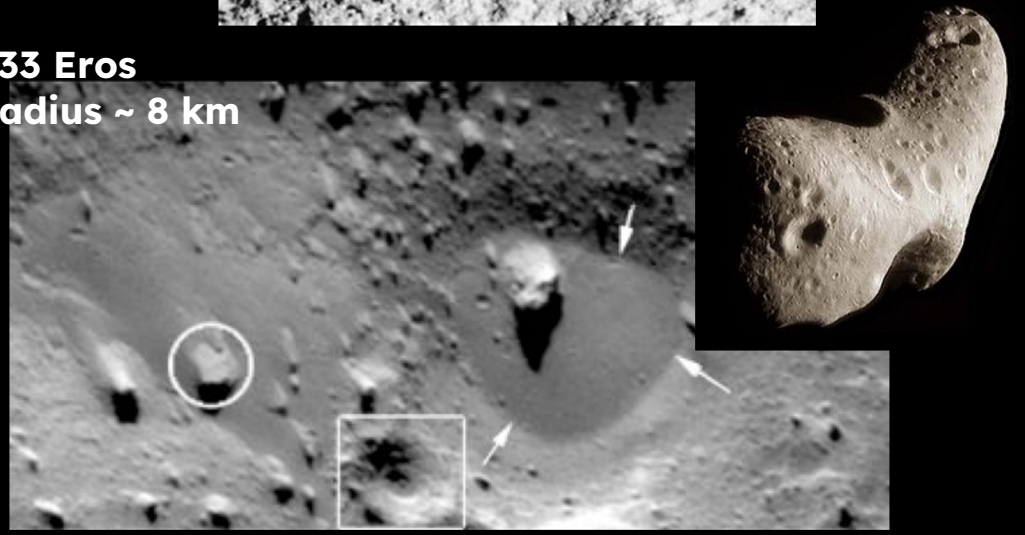
Bennu
Radius ~ 0.280 km





Moon Radius ~ 1750 km

433 Eros
Radius ~ 8 km

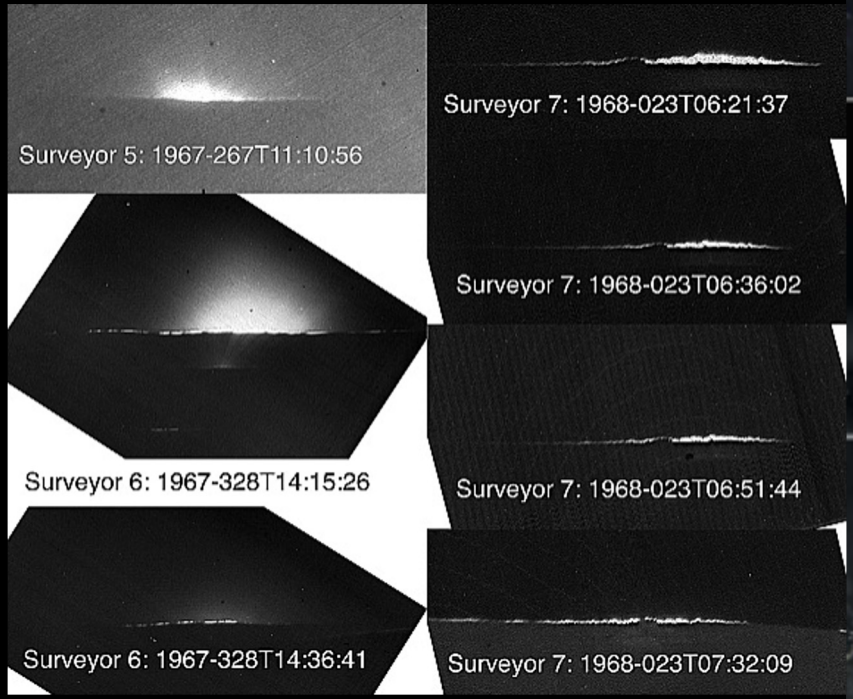


Source: NASA

Source: Renno et al, 2008

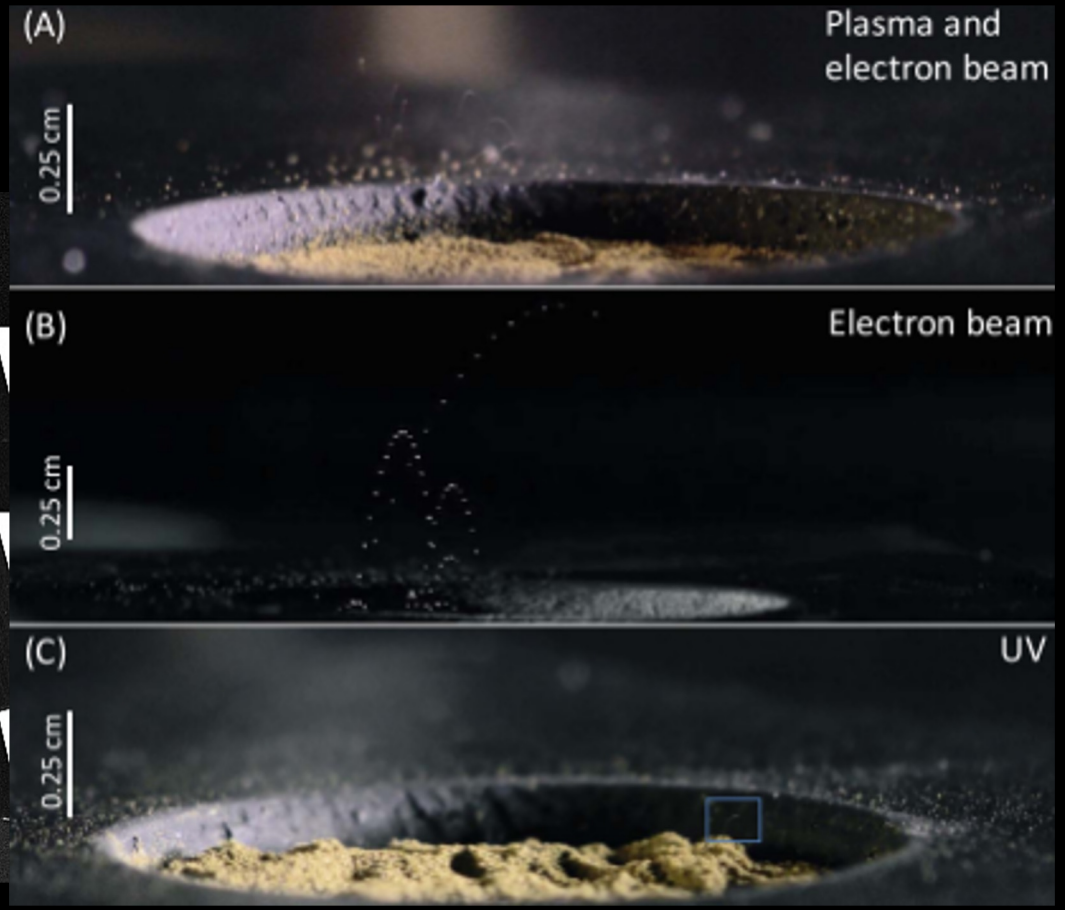
Electrostatic Dust Lofting

Lunar Horizon Glow (LHG)



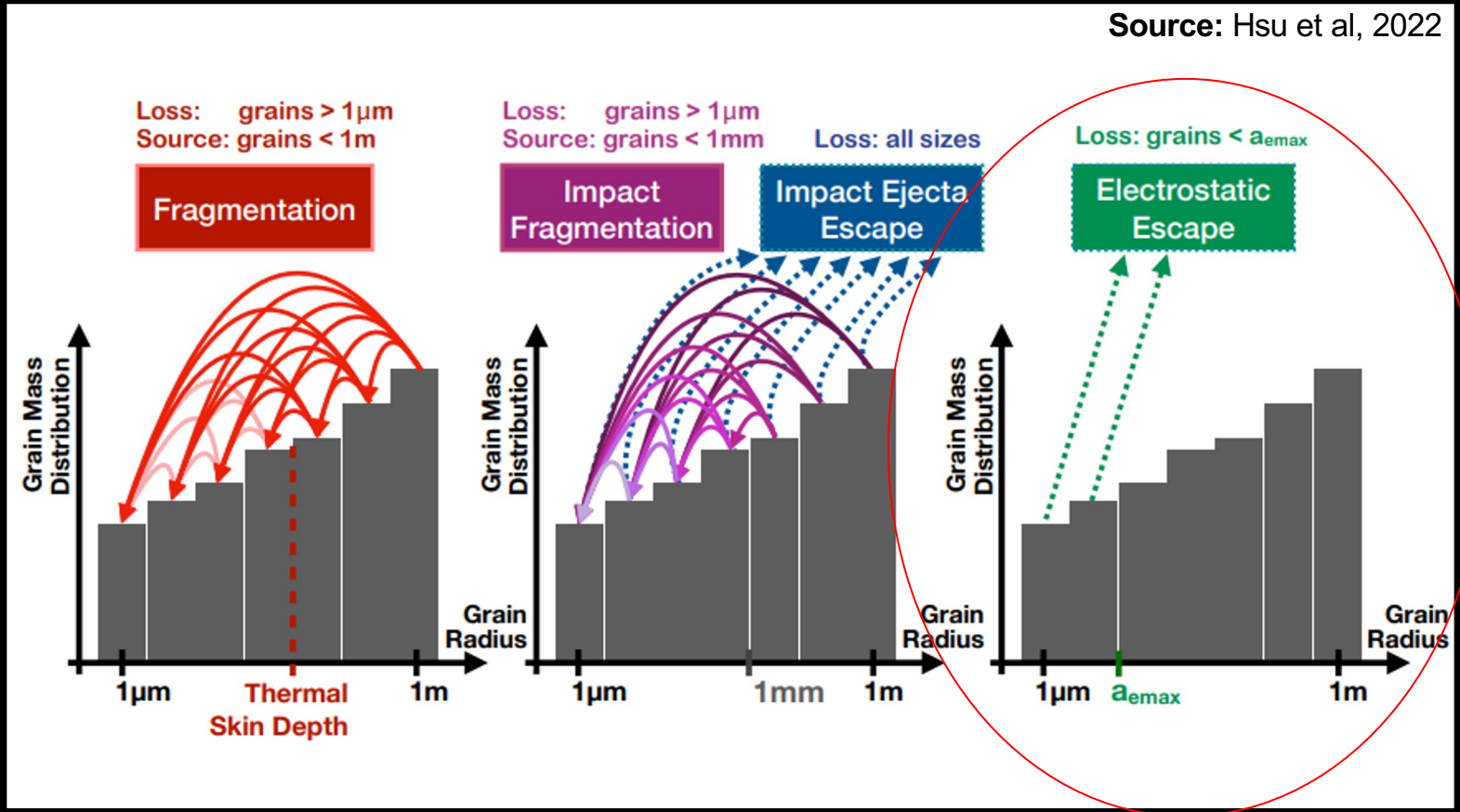
Source: NASA

Lab Experiments



Source: Wang et al, 2016

Regolith Size Distribution Evolution Model



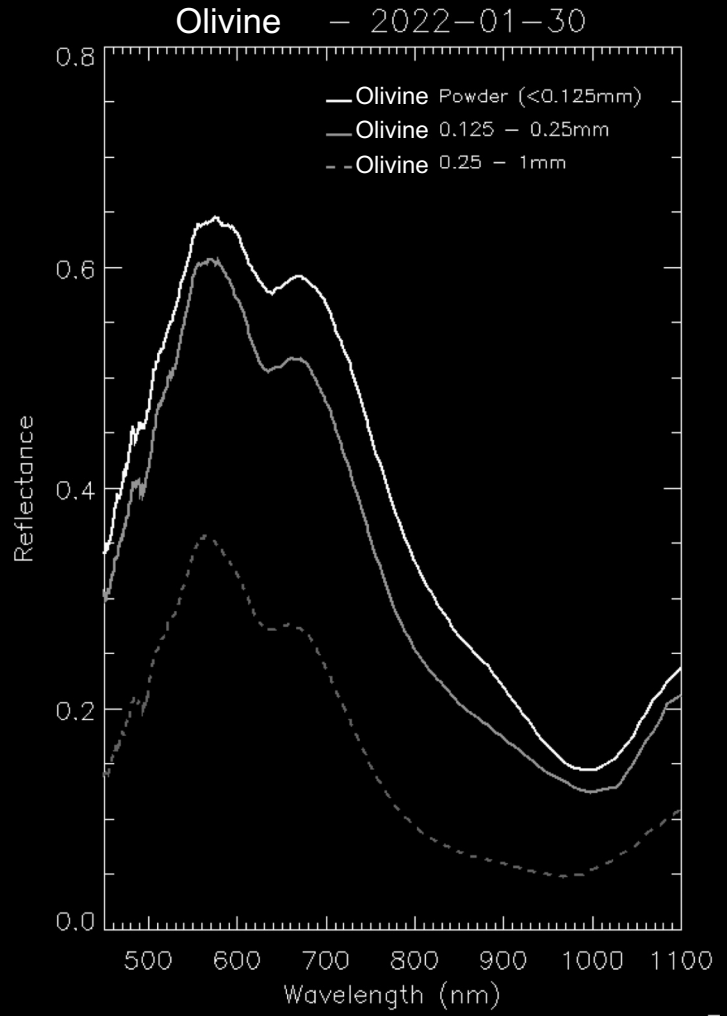
Grain Size effect on Reflectance Spectrum

Spectra-Dust Size Relationship

Large grains = less reflective

Small grains = more reflective

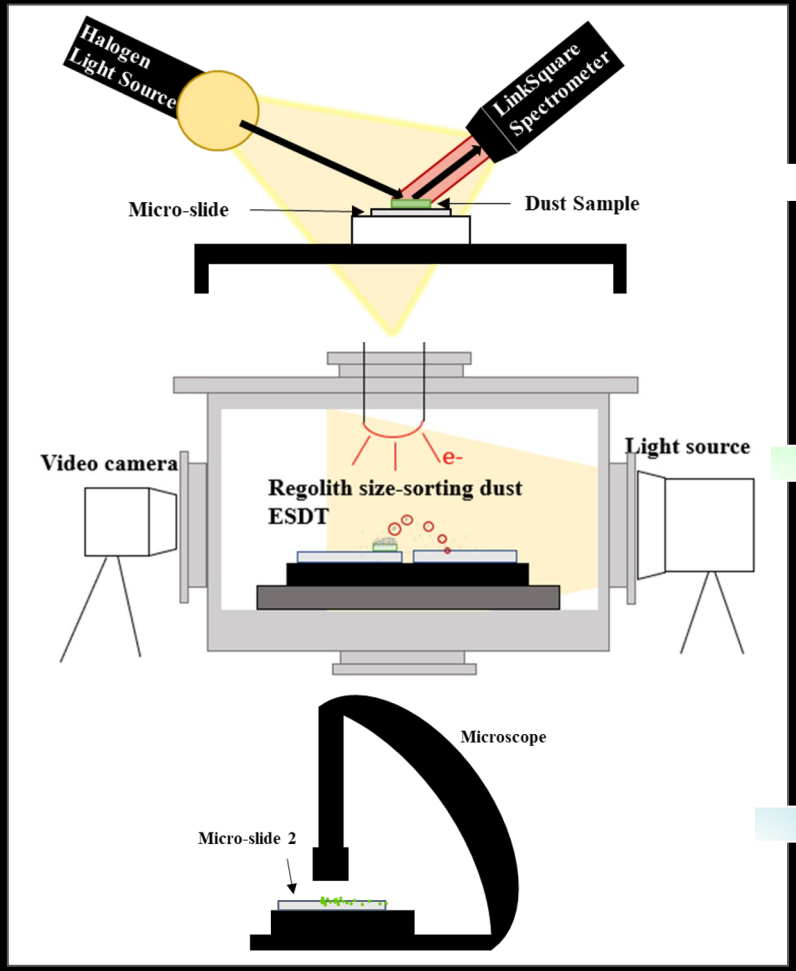
Source: NASA/Goddard /University of Arizona



Our Goal

To show there should be a relationship between regolith *electrostatic size sorting* and *spectral reflectance variation* through electrostatic processing .

Experimental Setup



Step 1

★ Measure reflectance spectra before lofting

Step 2

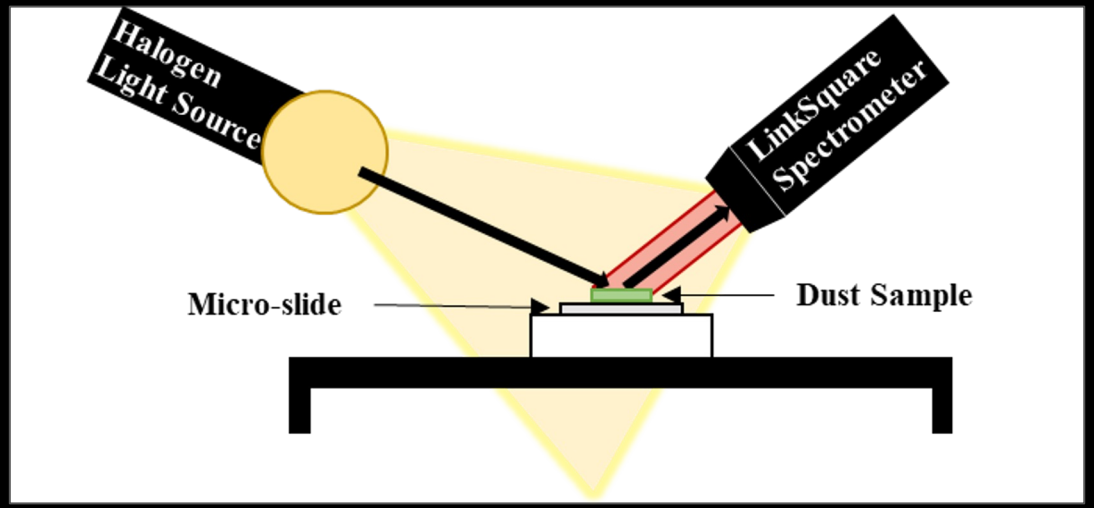
★ Sample (lunar and olivine simulants) into vacuum chamber

★ Measure reflectance spectra of regolith after

Step 3

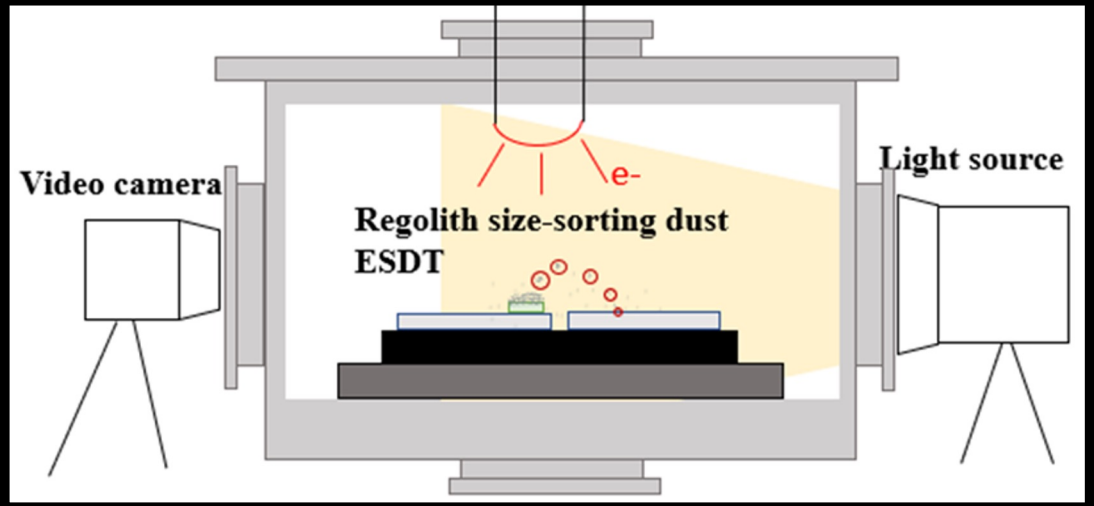
★ Size distribution

Step 1
Experimental Setup :
Spectral Measurements



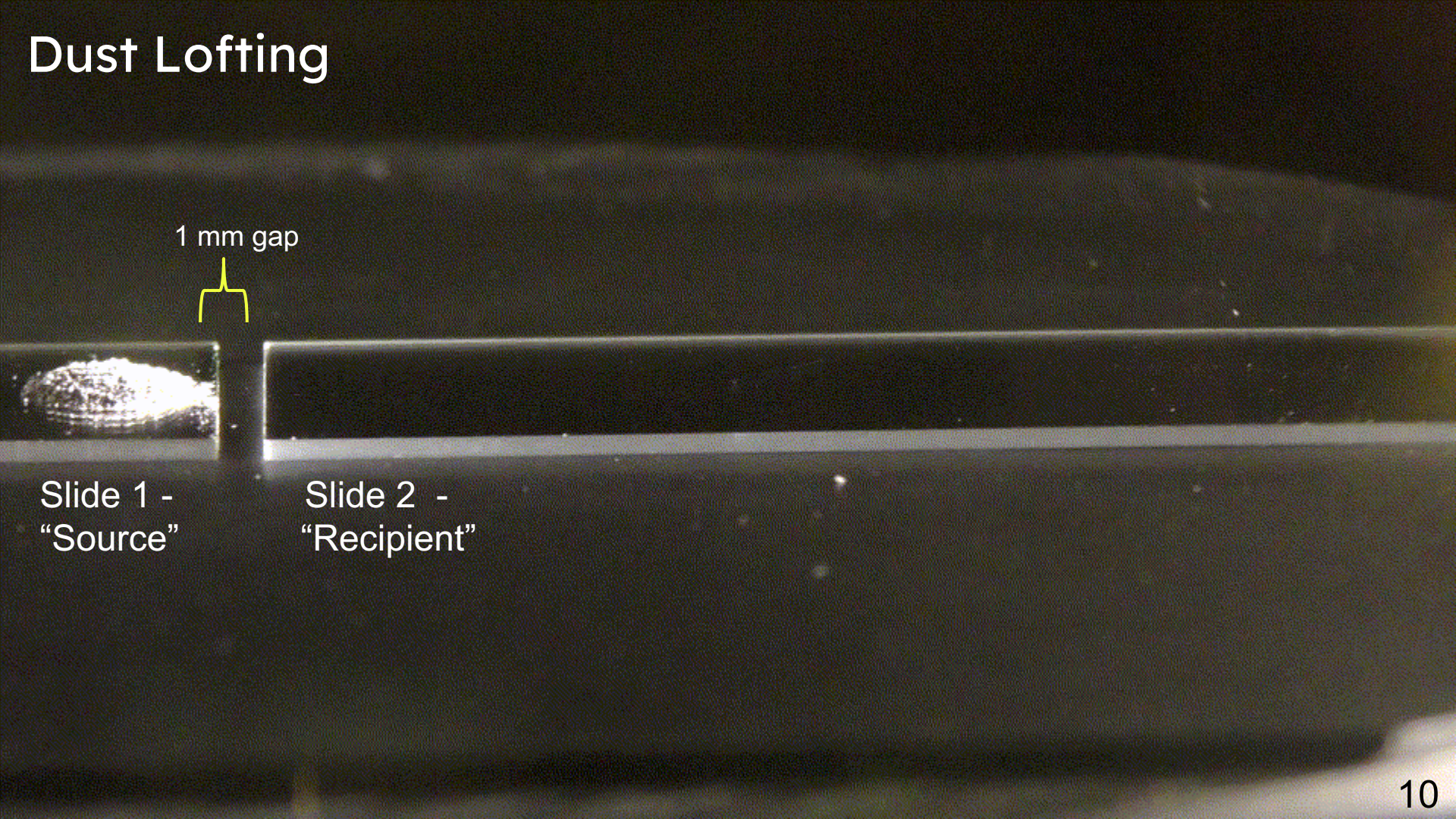
★ Measure reflectance spectra before lofting.
- Sample: larger grained regolith sample w/ smaller grained sample deposited over top through a 75-micron sieve
- Sample Compositions: Crystaline Olivine & powdered Olivine, JSC-1 mare & powdered highland

Step 2
Experimental Setup:
Lofting

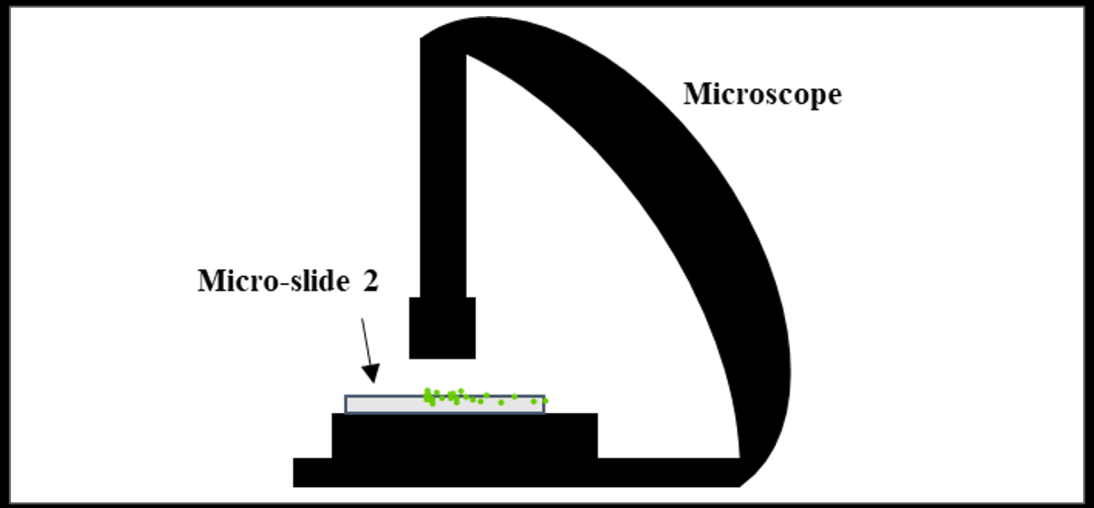


- ★ Place sample into chamber
  - expose sample to 120 eV and 10 mA e^- beam
- ★ After lofting significant amount of dust, measure new reflectance

Dust Lofting



Step 3
Experimental Setup:
Size Distribution Verification

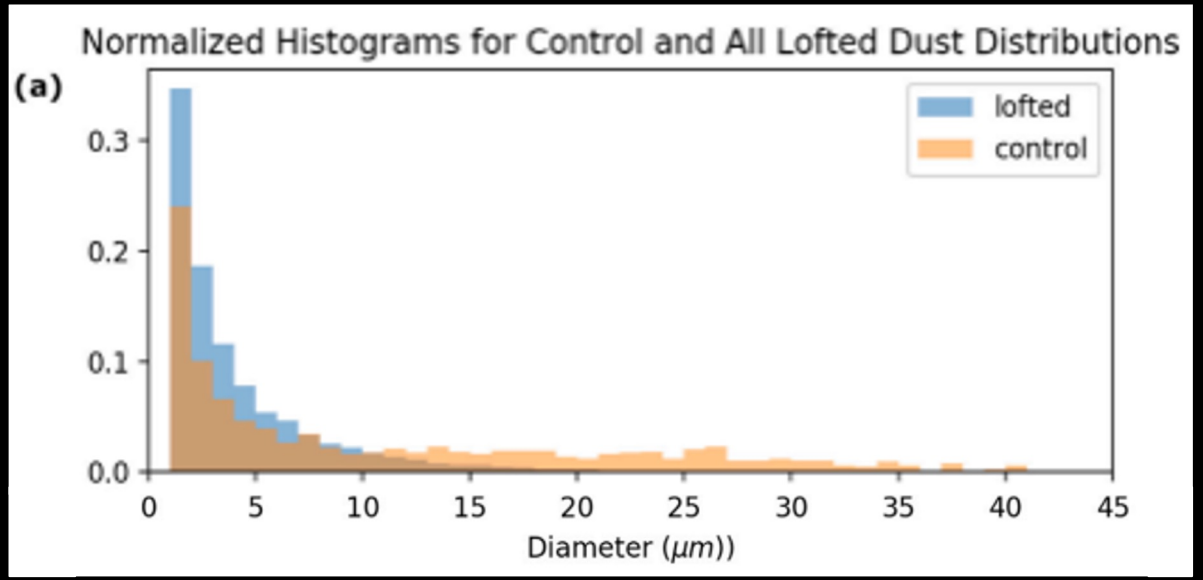


- ★ Following spectral collection, size distribution is measured by taking photos along the length of the microslide

Size Distribution

Key feature we want to confirm in this project:

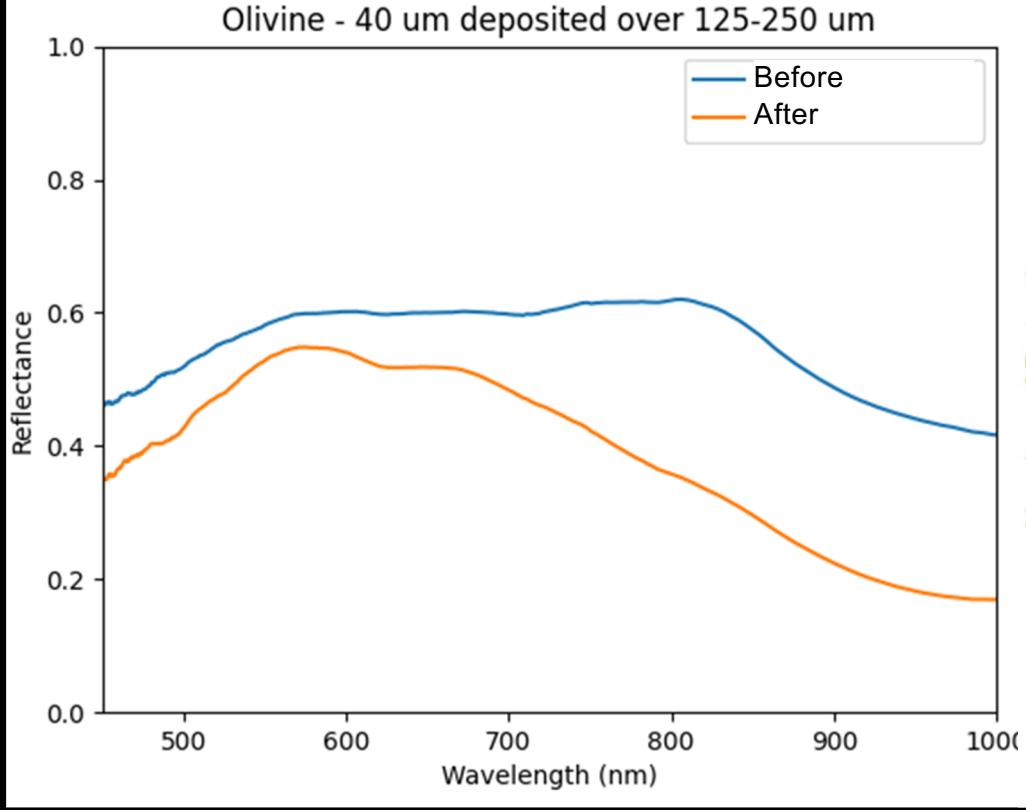
- The exponential decay trend for number of detections in comparison to dust diameter



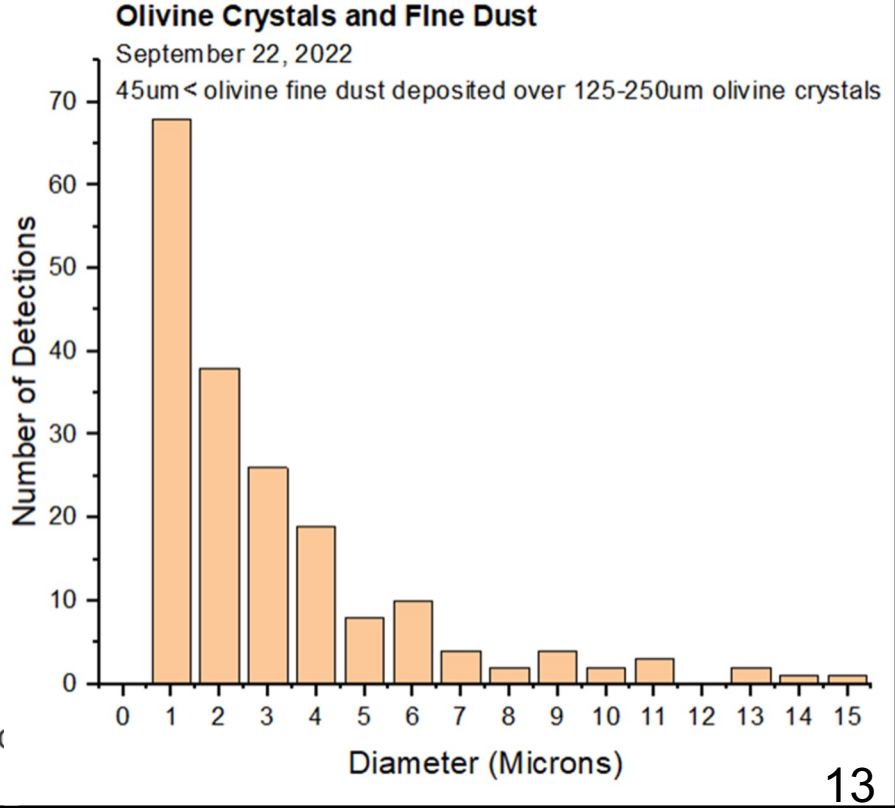
Hood et al. 2021

Olivine Results

Slide 1
Decreased reflectance after lofting

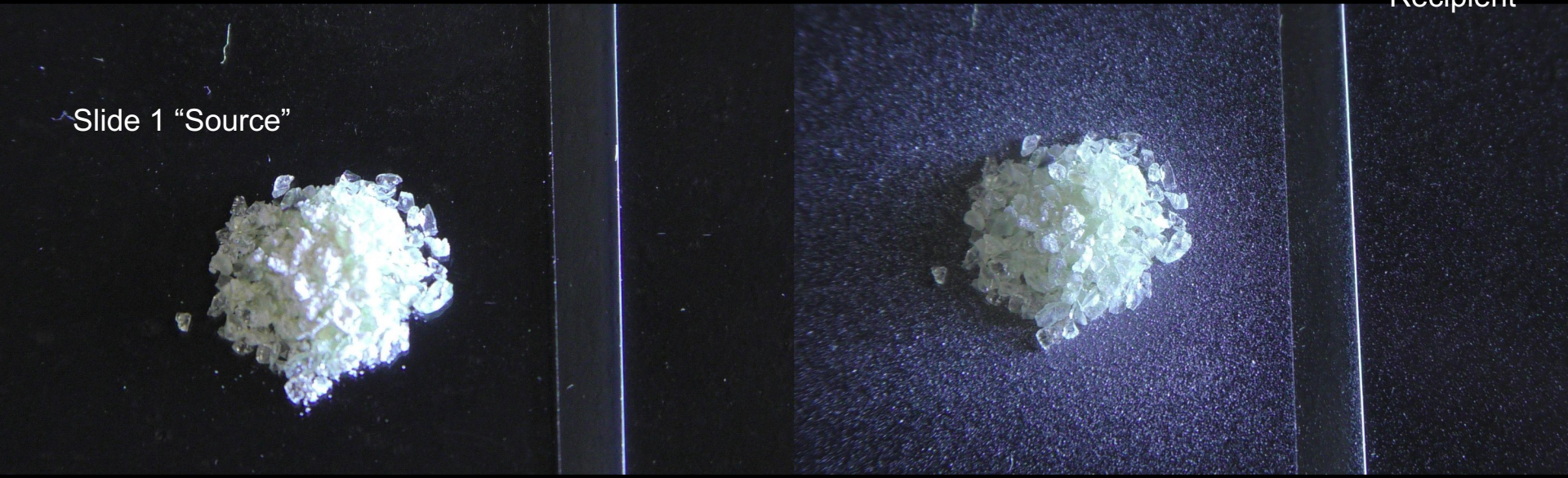


Slide 2
Top layer dust removed, bottom layer remains



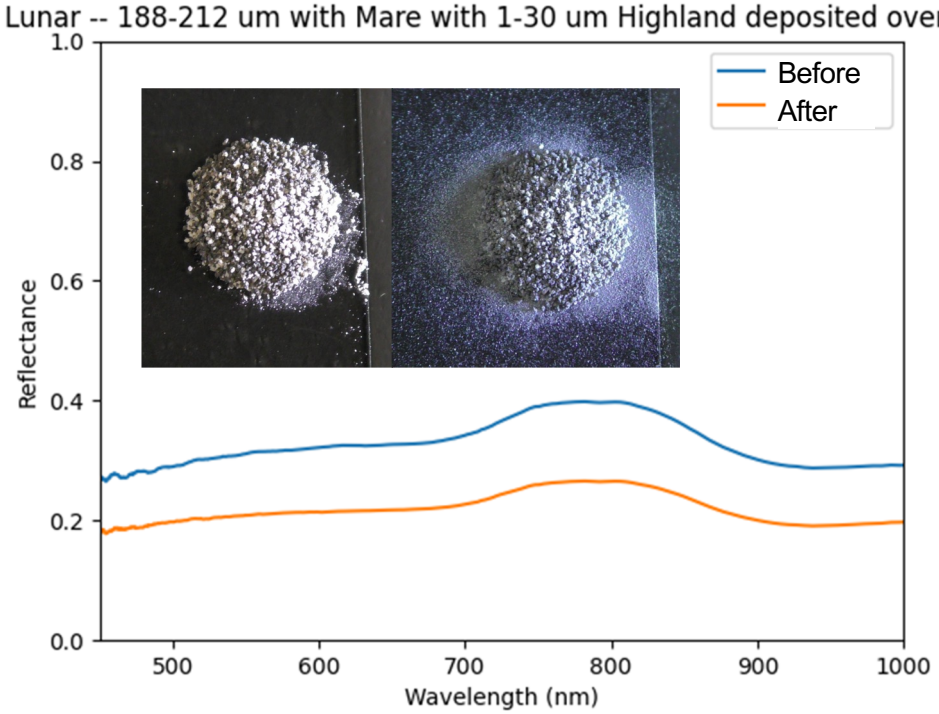
Before Lofting

After Lofting

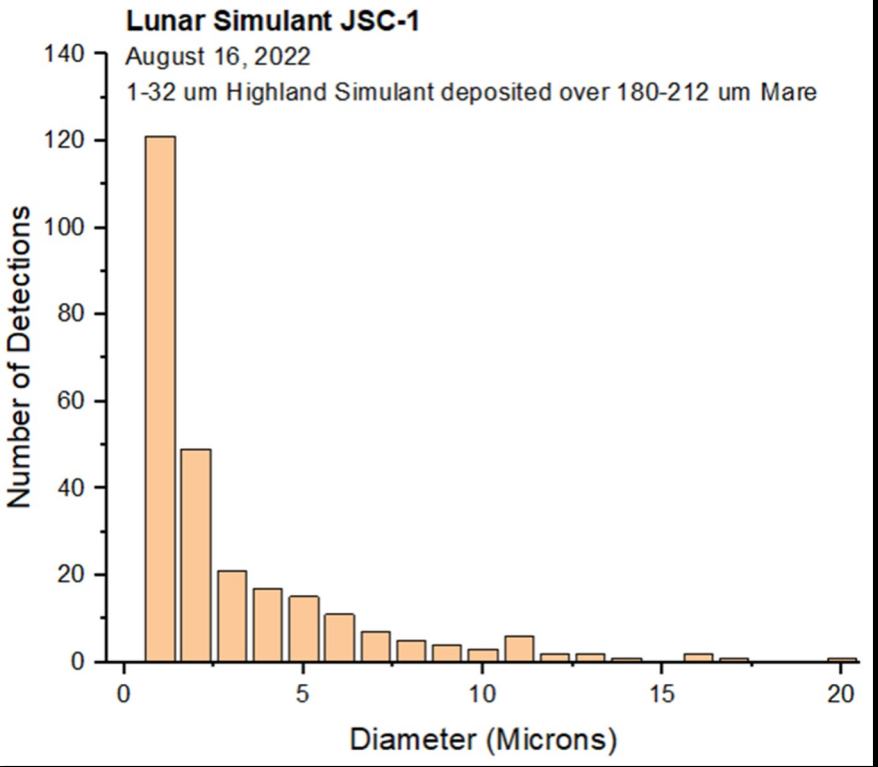


JSC-1 (Lunar Simulant) Results

Slide 1
Decreased reflectance after lofting



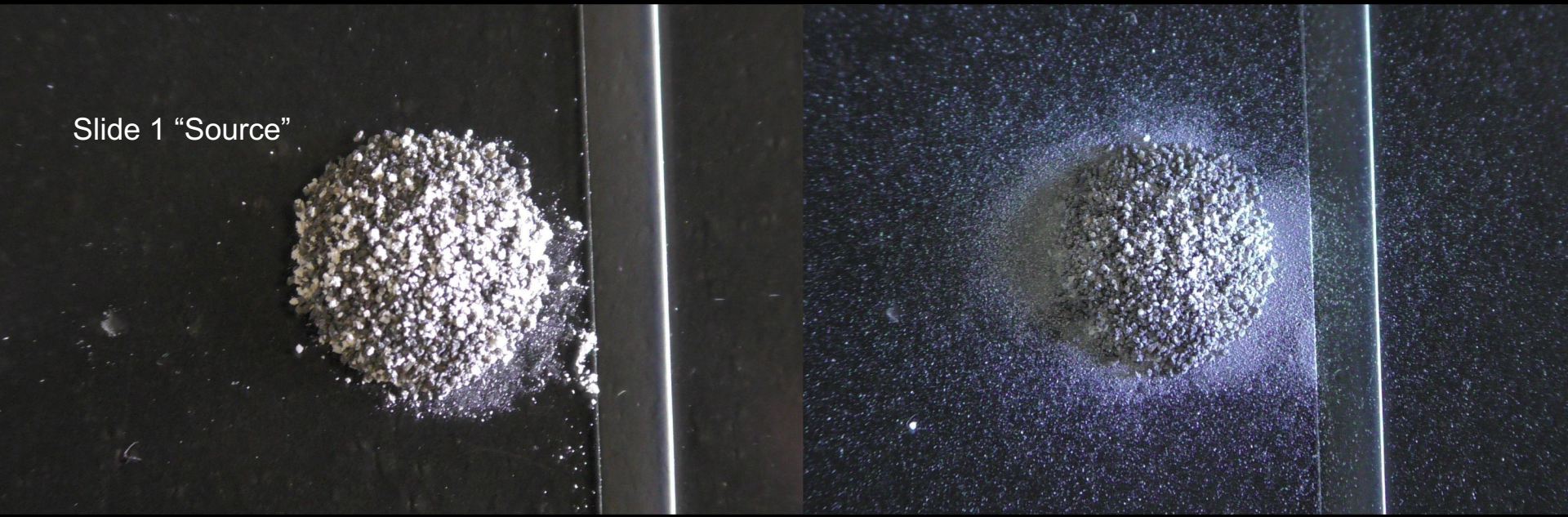
Slide 2
Top layer dust removed, bottom layer remains



Before Lofting

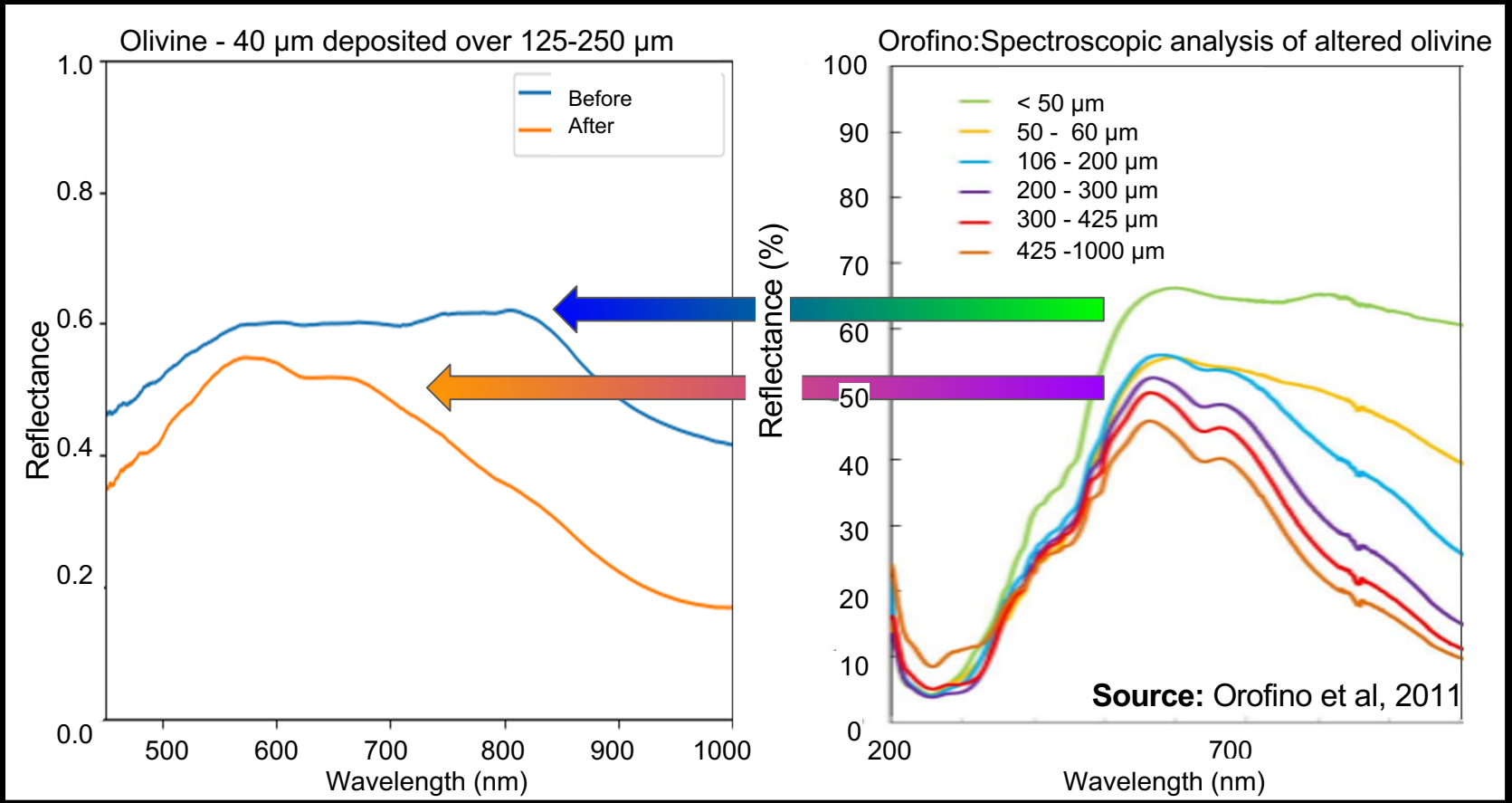
After Lofting

Slide 2 “Recipient”



Conclusion:

We show that electrostatic dust lofting can re-sort the dust size distributions, resulting in changes in the regolith reflectance spectra.



Summary

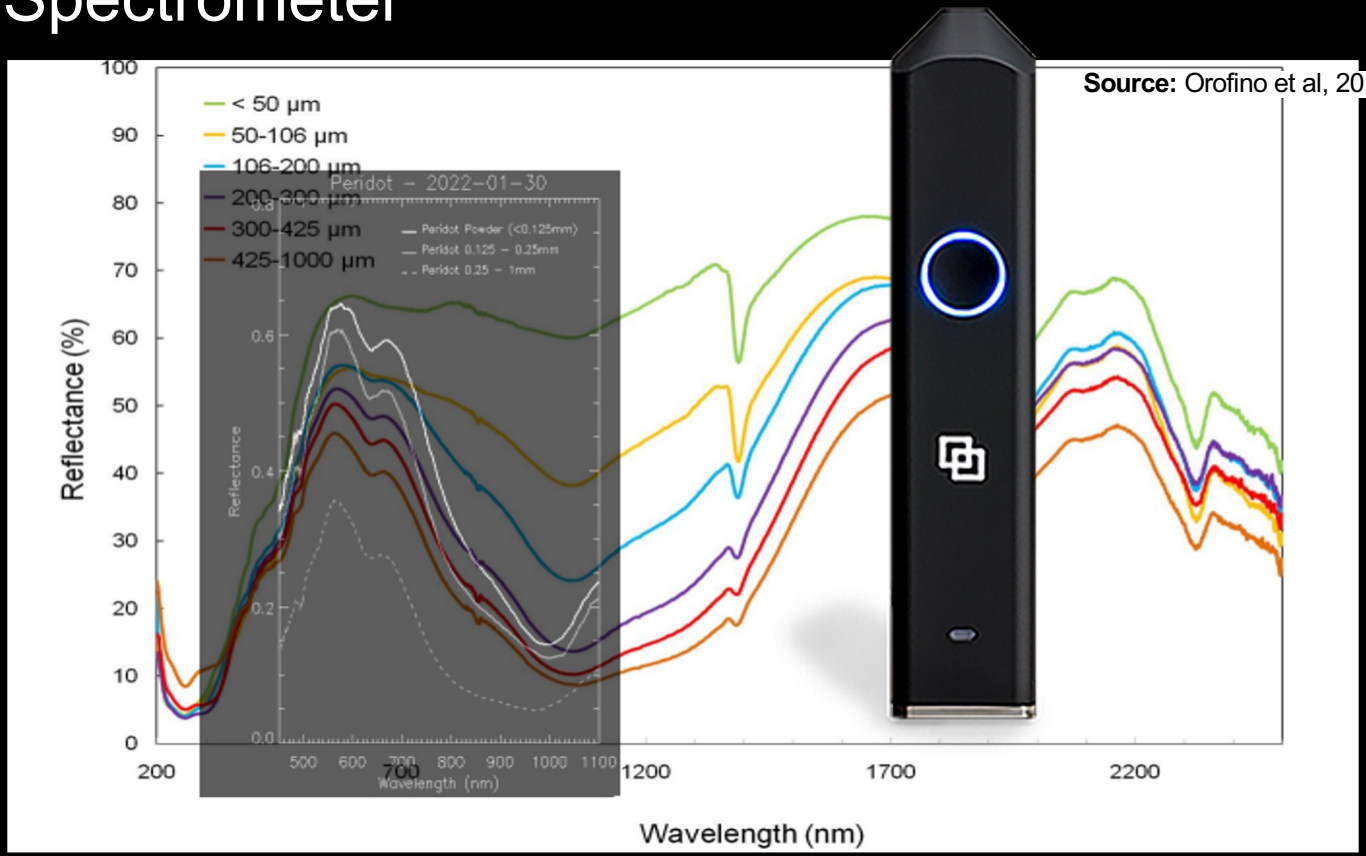
- Electrostatic dust size sorting changes reflectance spectra properties in laboratory experiments.
- Helpful for understanding asteroid spectra measurements
- Phenomena associated to color changes on asteroids and this could be area for future study.

Source: NASA

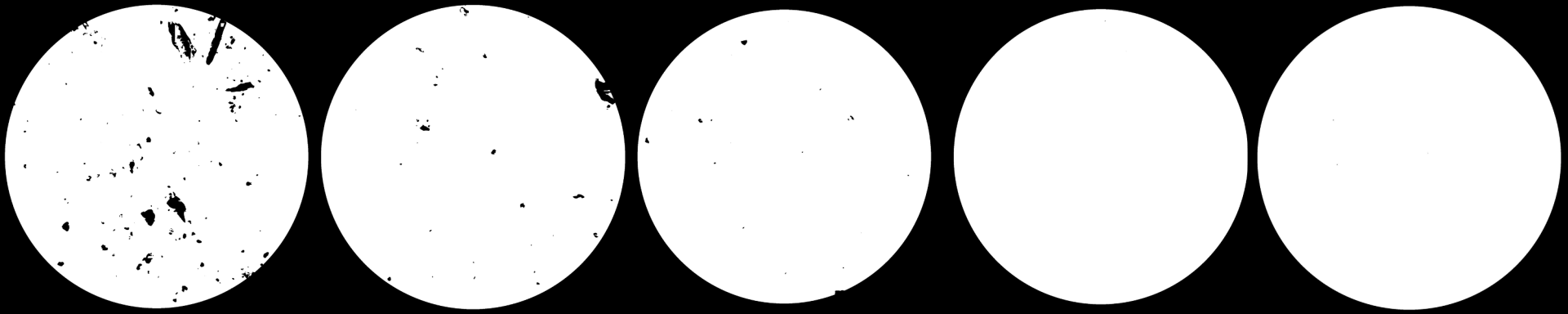
Linksquare Spectrometer

Data Collection

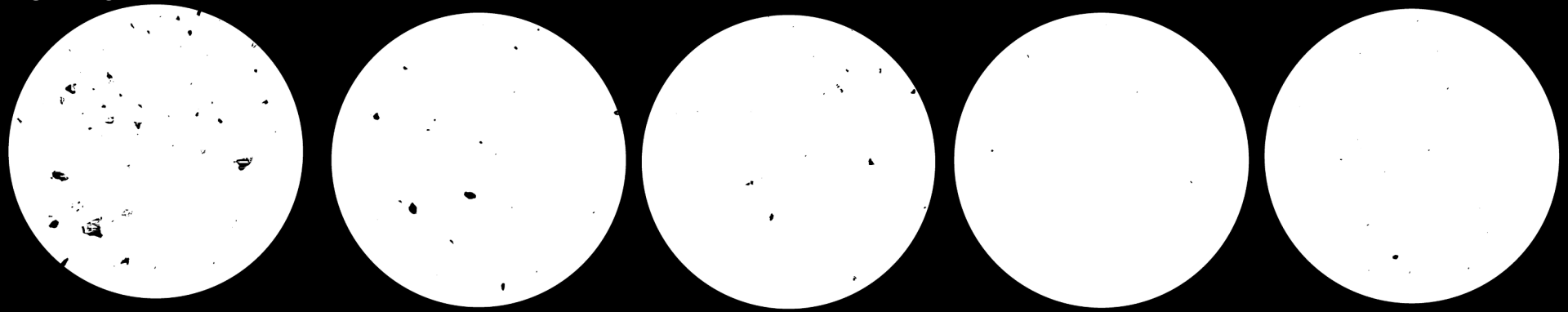
- Linksquare Spectrometer



JSC-1



Olivine



0.10 cm

0.70 cm

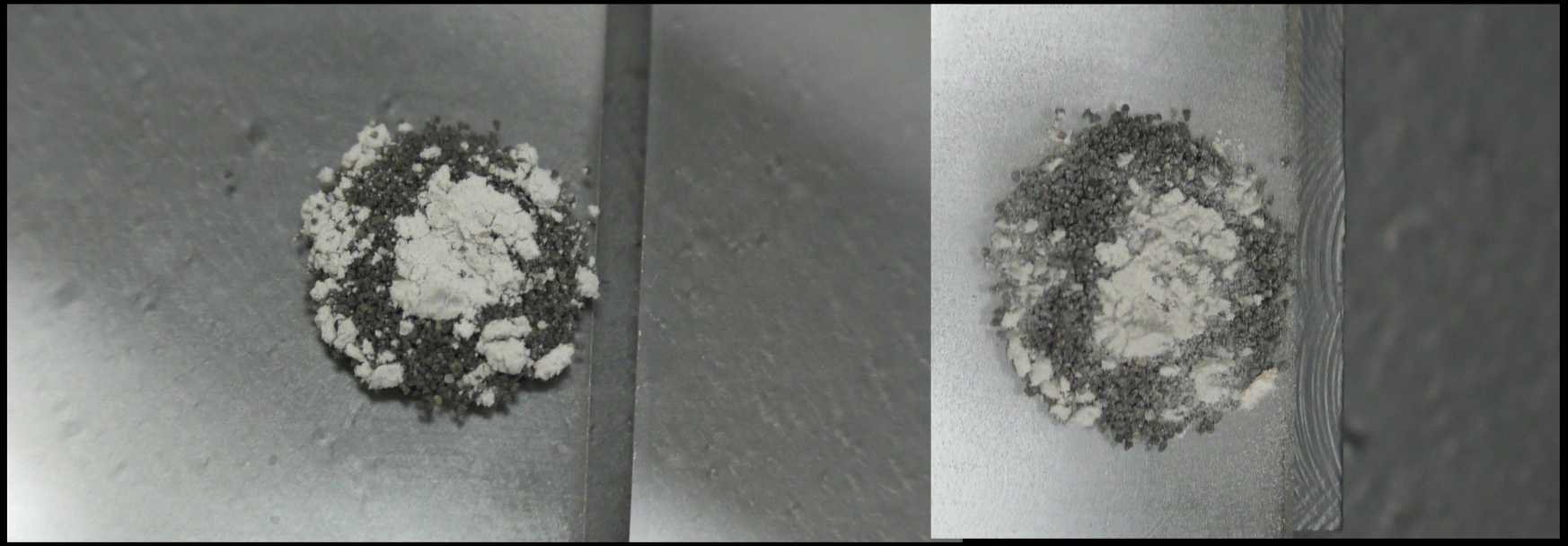
2.00 cm

4.00 cm

6.00 cm

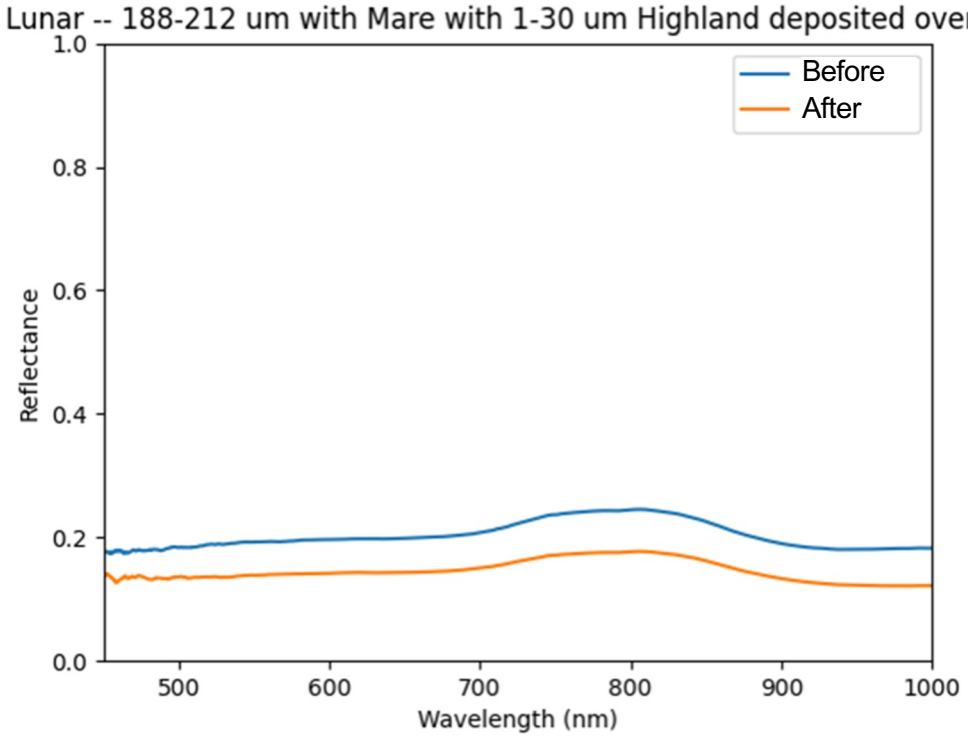
Before Lofting

After Lofting



Results

Slide 1
Decreased reflectance after lofting



Slide 2
Top layer dust removed, bottom layer remains