Is there a magnetic field on asteroid (4) Vesta?

by **Benoît Carry**[1,2]

in collaboration with:
P. Vernazza (ESA/ESTEC), C. Dumas (ESO) & M. Fulchignoni (Obs. Paris)

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[2]LESIA,Observatoire de Paris

Outline

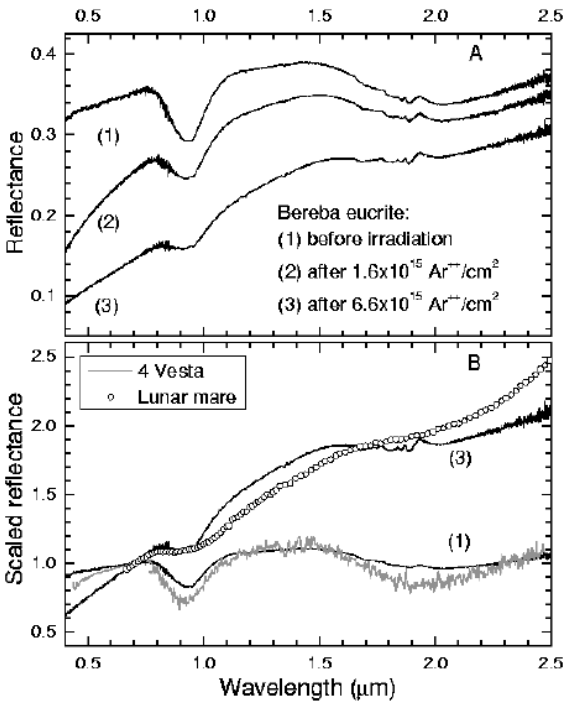
1. Why is (4) Vesta a highly interesting body ?
2. Observations with SINFONI
3. Mineralogy analysis
4. Distribution of spectral slope
5. Magnetic field?

Asteroid (4) Vesta

McFadden et al. (2008)

- Second largest asteroid
  - Large crater at south pole
  - Parent body of Vestoids

Asteroid (4) Vesta



Vernazza et al. (2006)

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- Composition
  - Mostly similar to HED meteorites
  - Unweathered???

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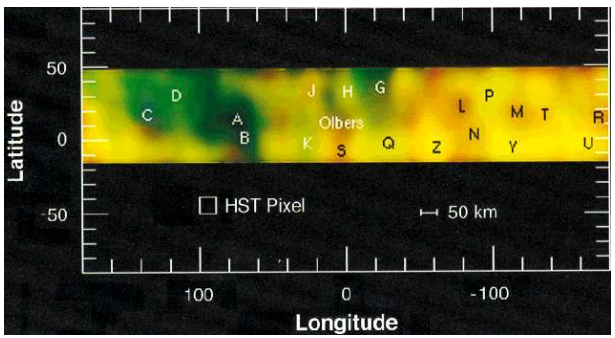
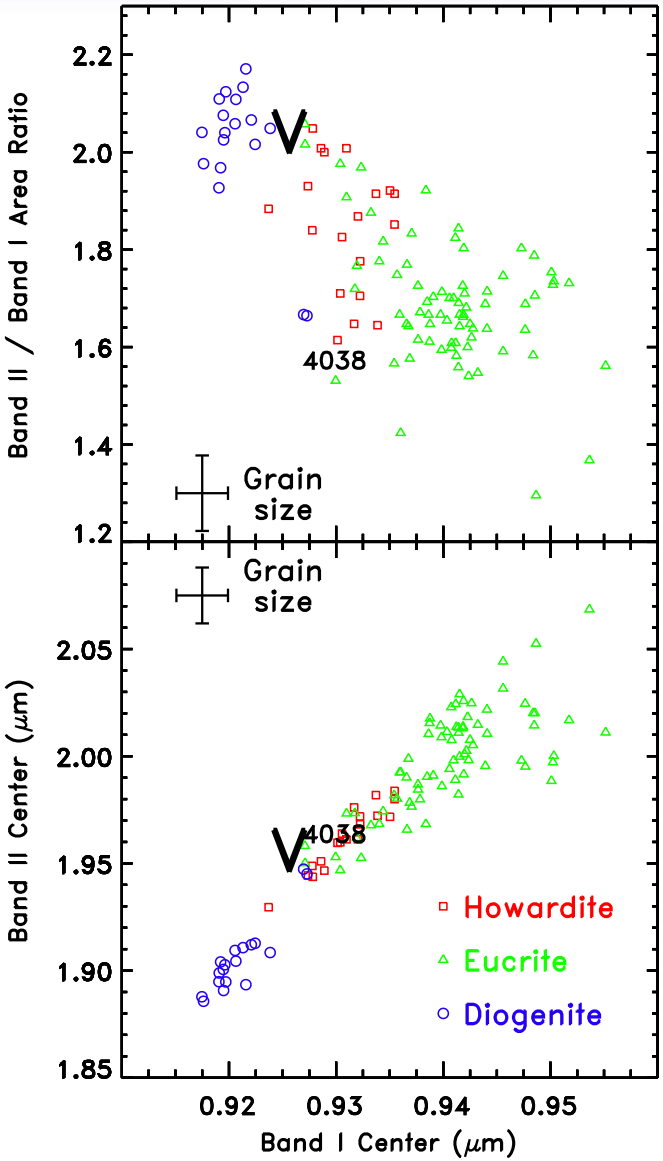
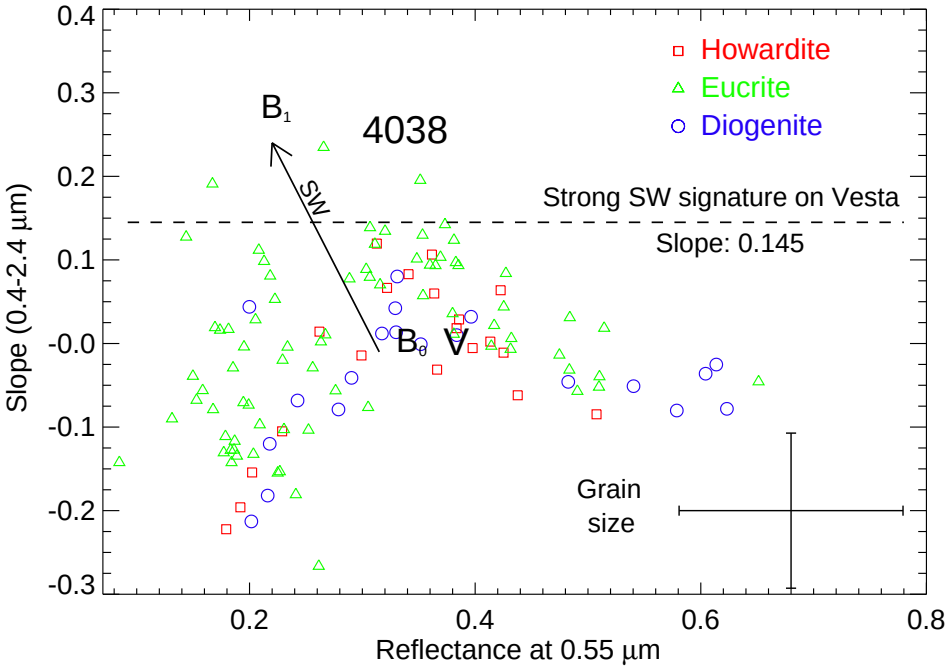


Binzel et al. (1997)

- Second largest asteroid
  - Large crater at south pole
  - Parent body of Vestoids
- Composition
  - Mostly similar to HED meteorites
  - Unweathered???
- Albedo
  - Strong variations
  - Lava flow?
  - Composition?
  - Space weathering?

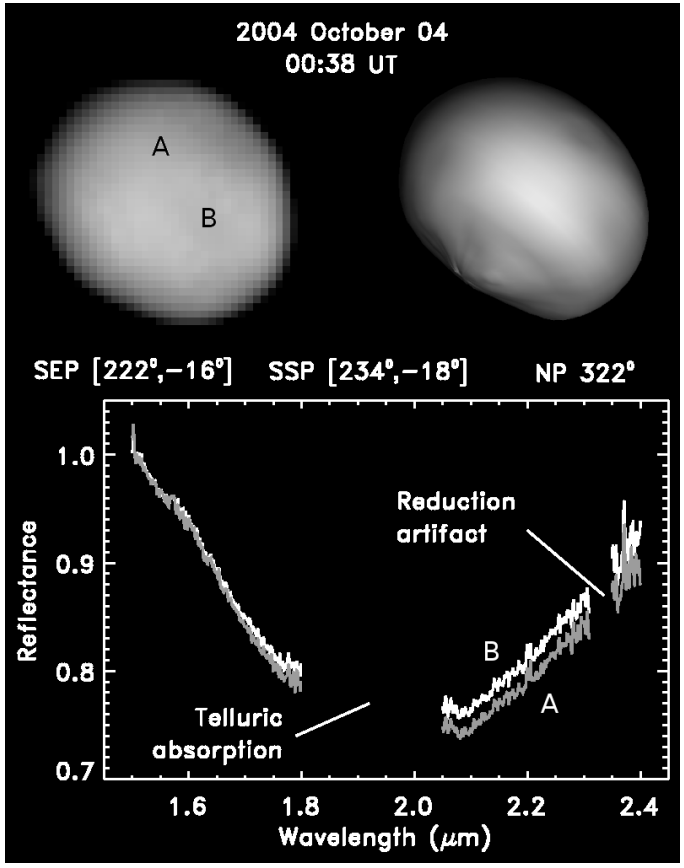




- V: Vesta
- 4038: Vestoid (4038) Kristina
- B_0: Bereba before irradiation
- B_0: Bereba after irradiation

Observations

- Aug. & Oct. 2004
  - Science Verification
  - Reduction's a pain
  - J & H+K: 1.1-2.4 μm



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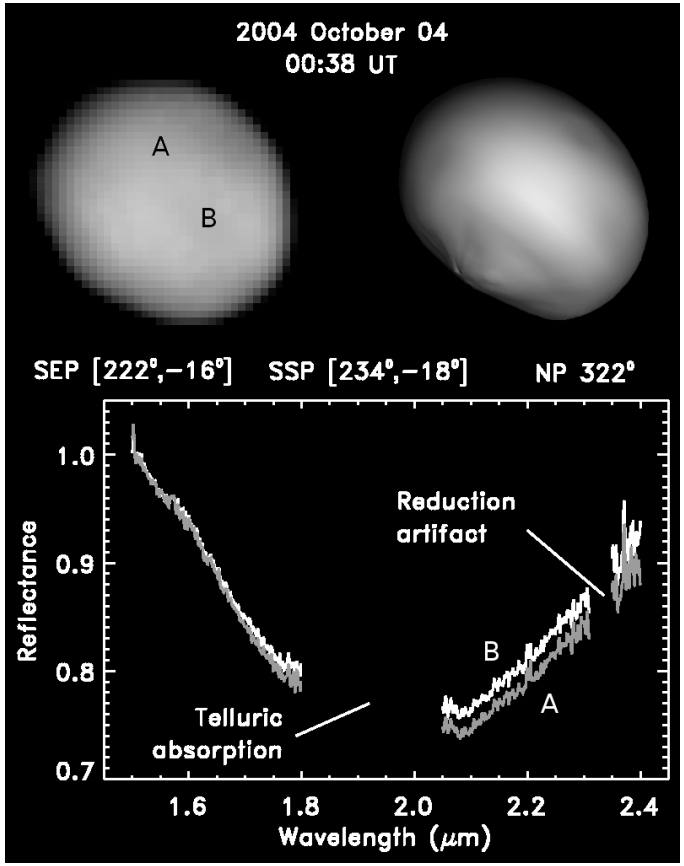
  - $\phi \sim 0.55''$
  - Southern hemisphere
  - 14% surface



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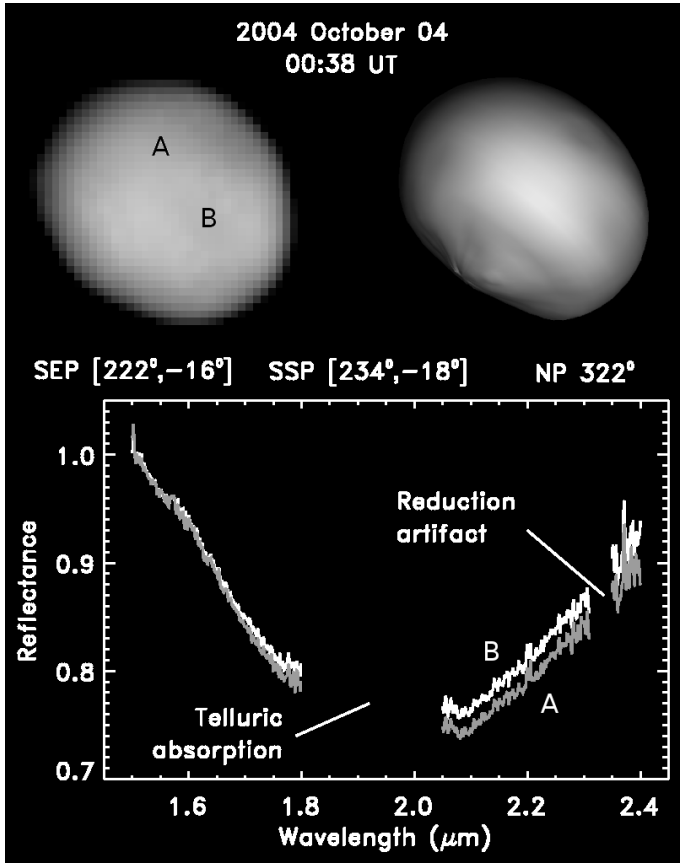
  - 14% surface
- Spatial resolution
  - Smallest spaxel (0.025″)
  - FoV: 0.8×0.8 arcsec
  - Θ 92, 144, 371 km !!



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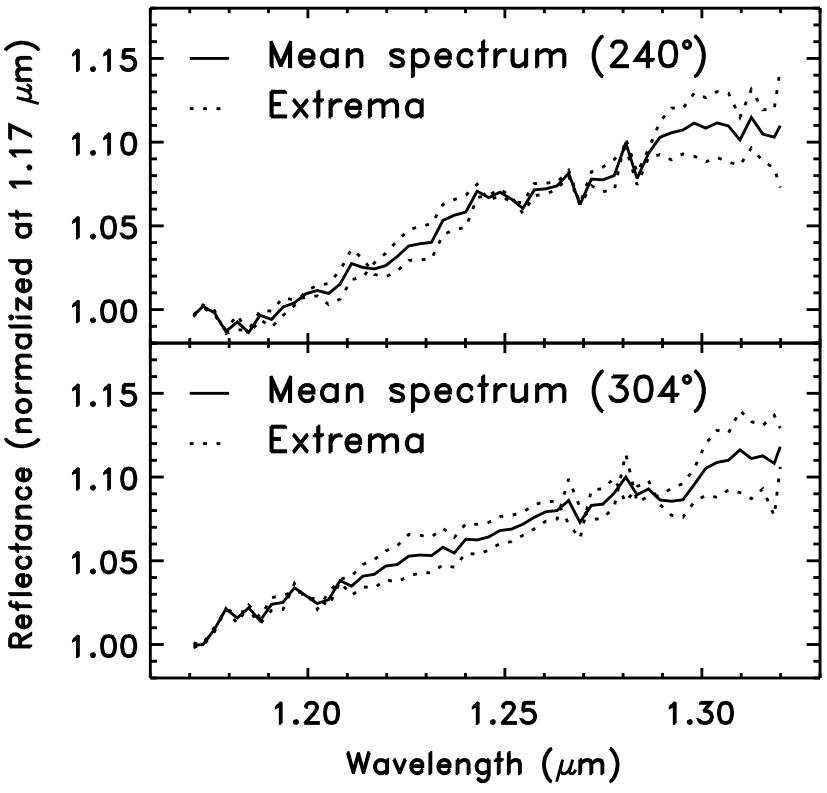
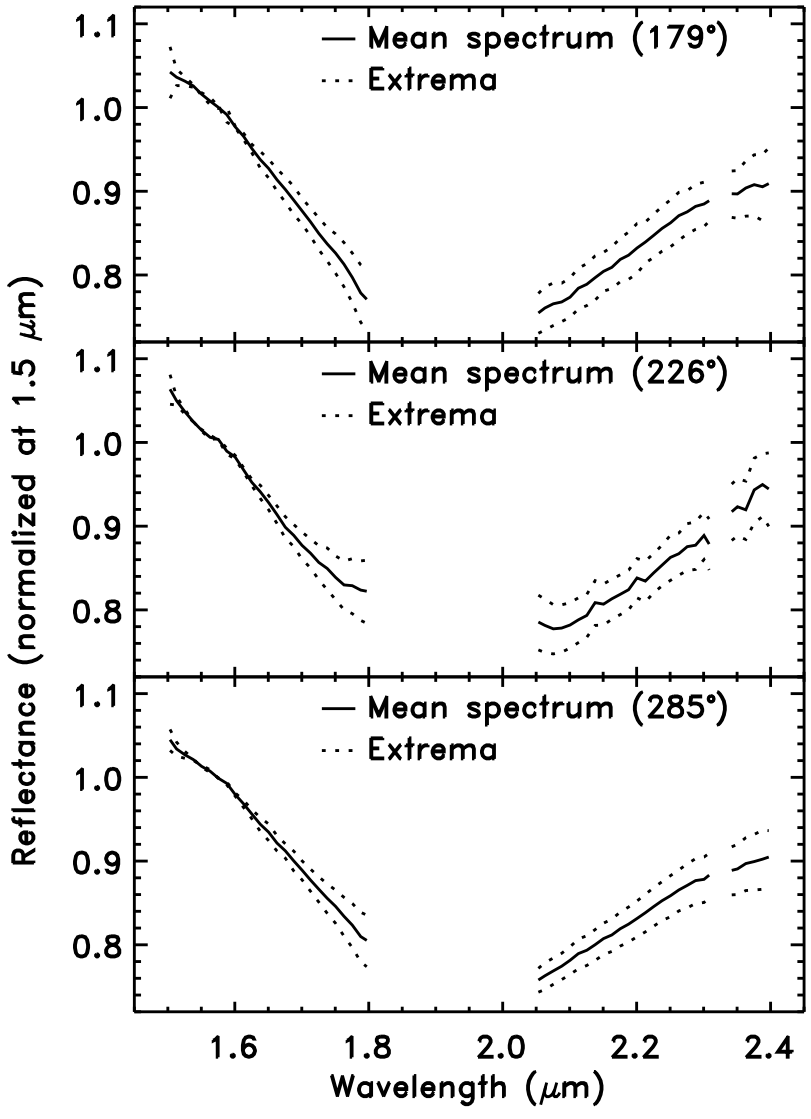
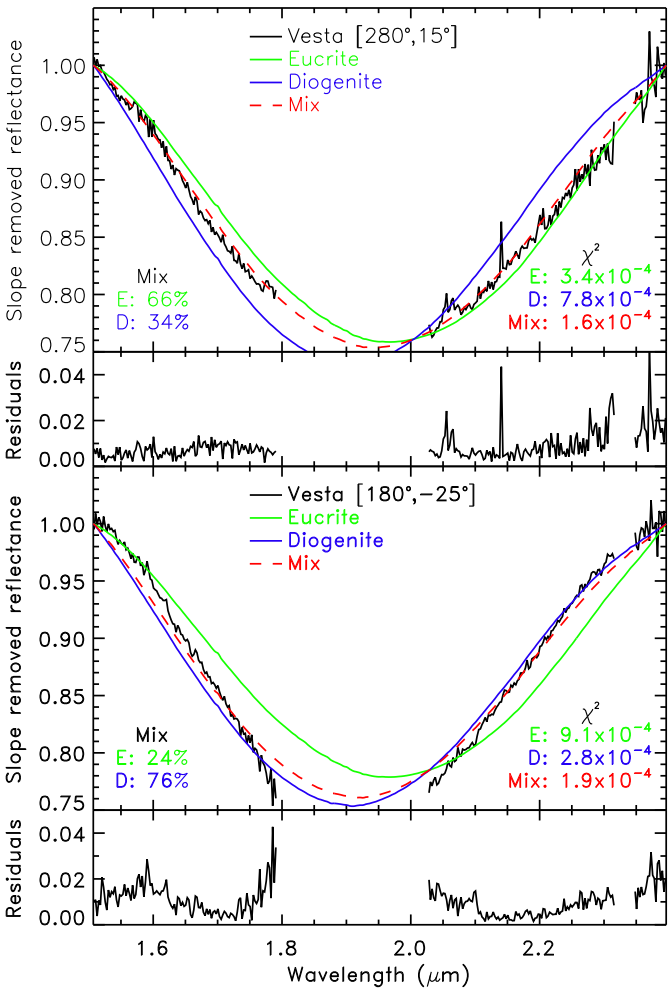




Mineralogy



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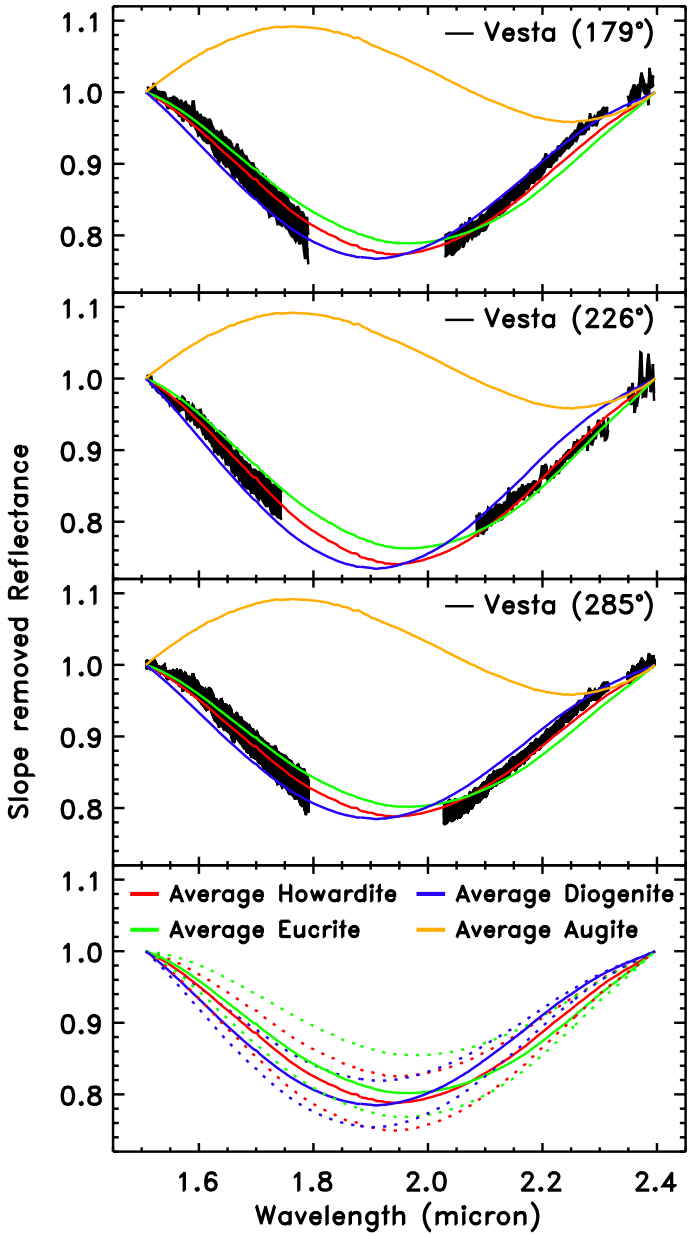
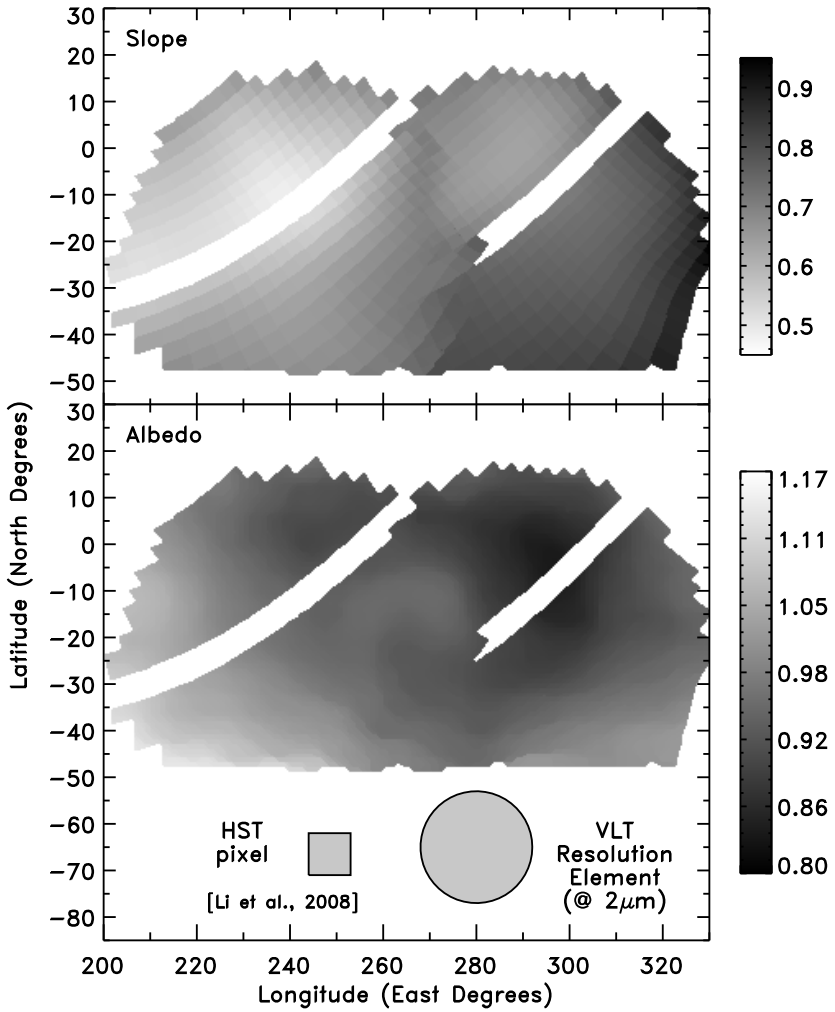


- Compare to laboratory
  - HED meteorites
  - Fit band wings
- Composition
  - Howardite-like
  - Steady over longitude
  - N-S trend
  - Diogenite spot at (180°, -25°)

Spectral slope distribution

- Slope distribution
  - E-W trend
  - Consistent with HST



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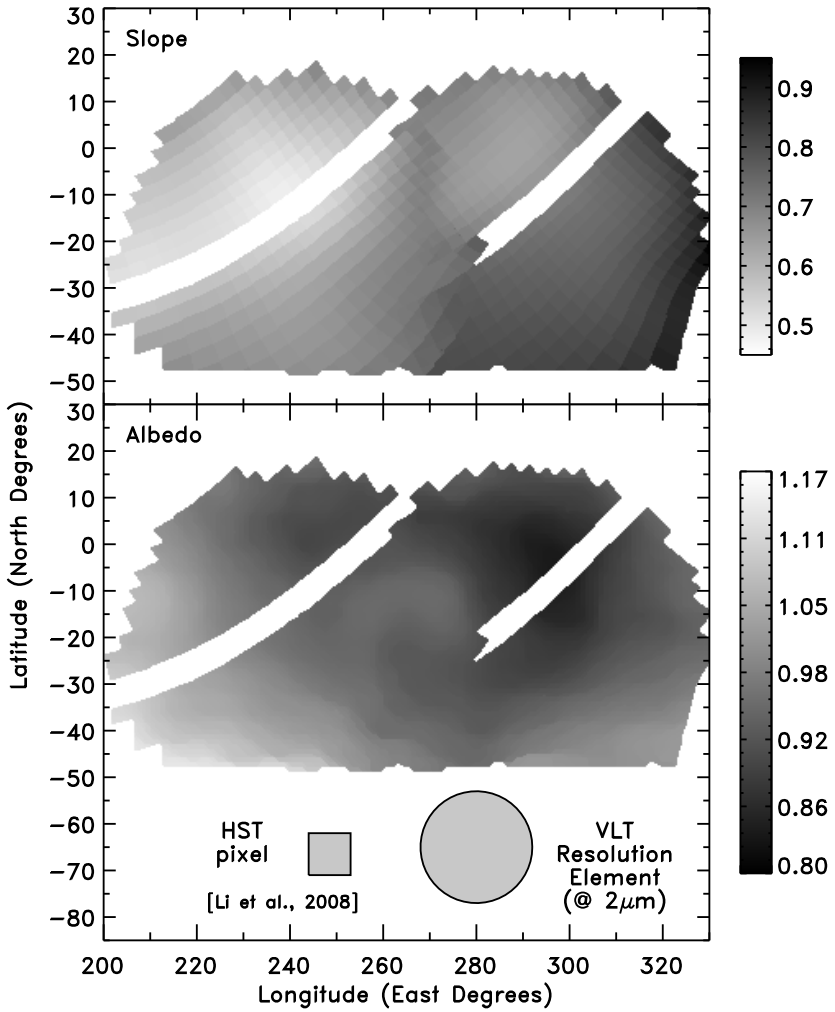

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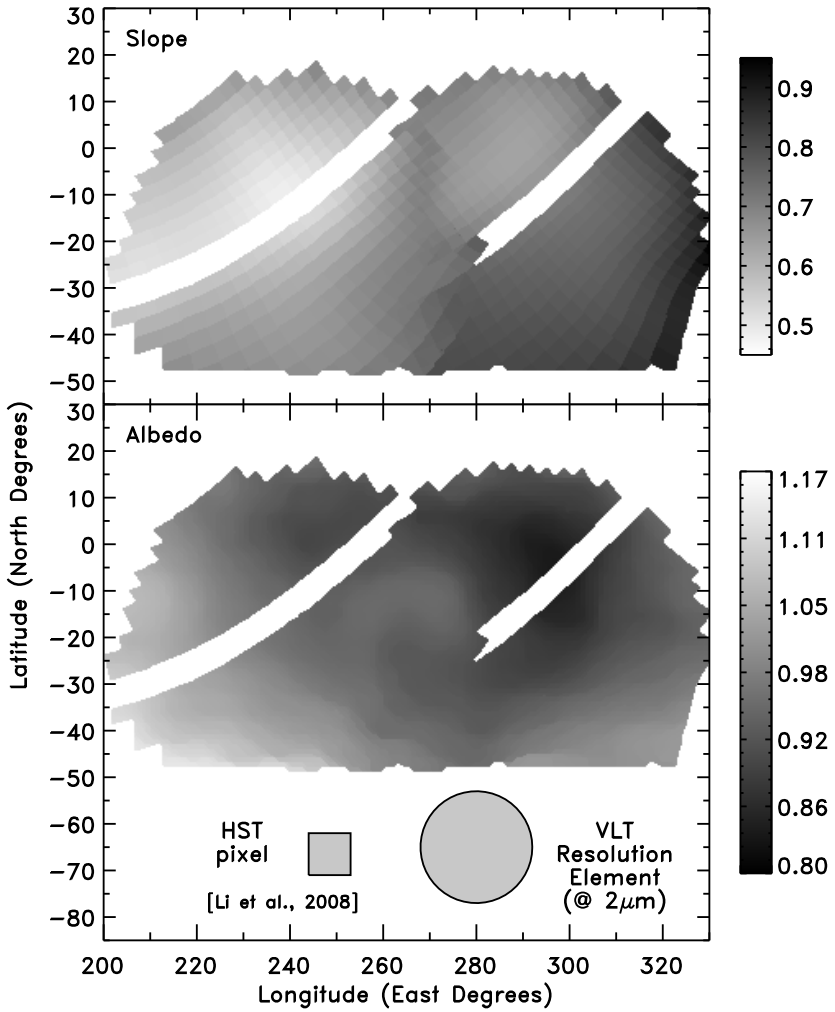

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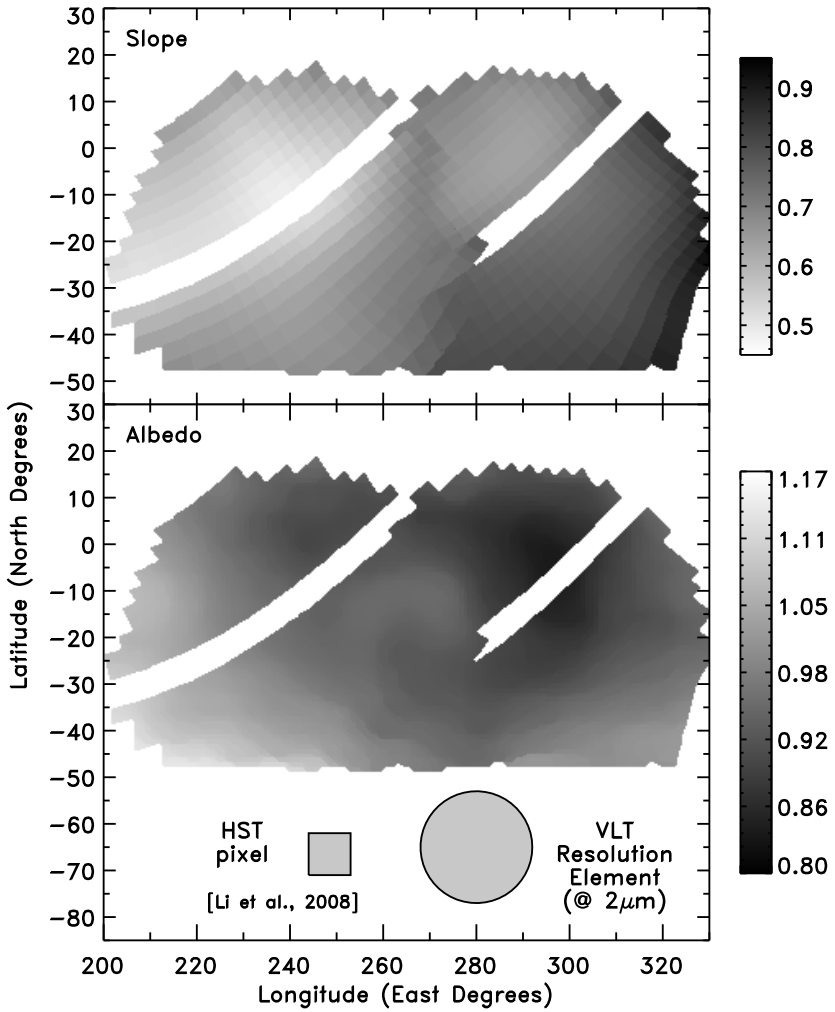

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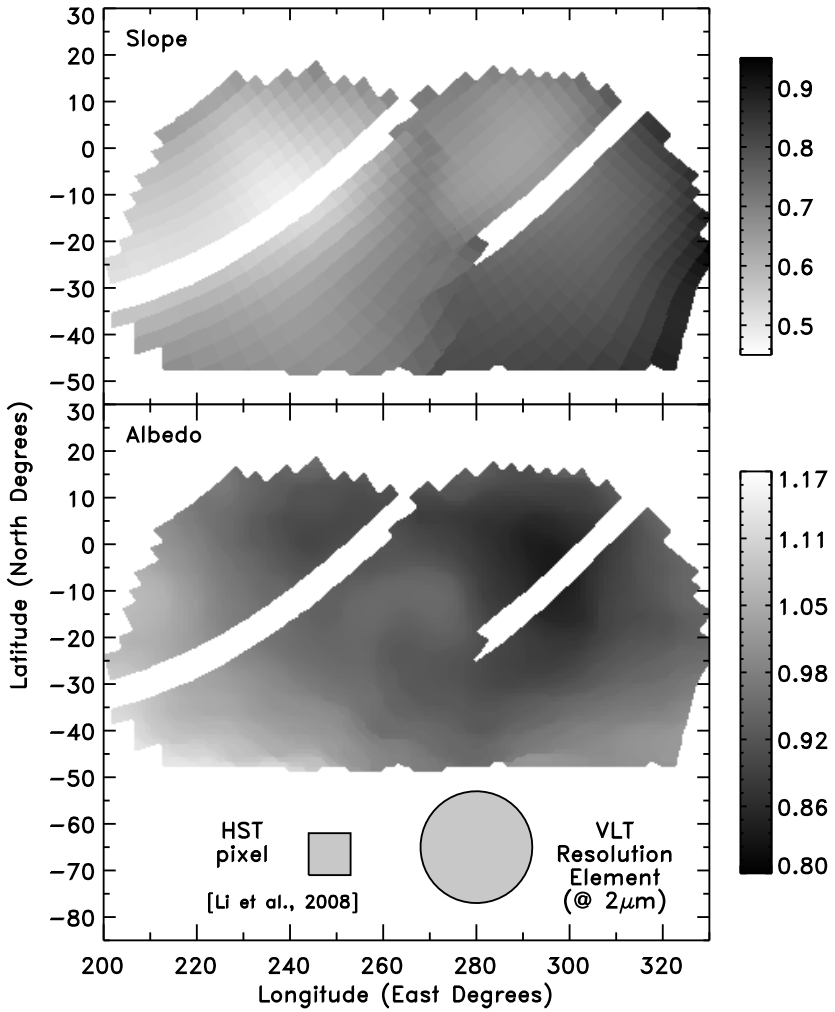

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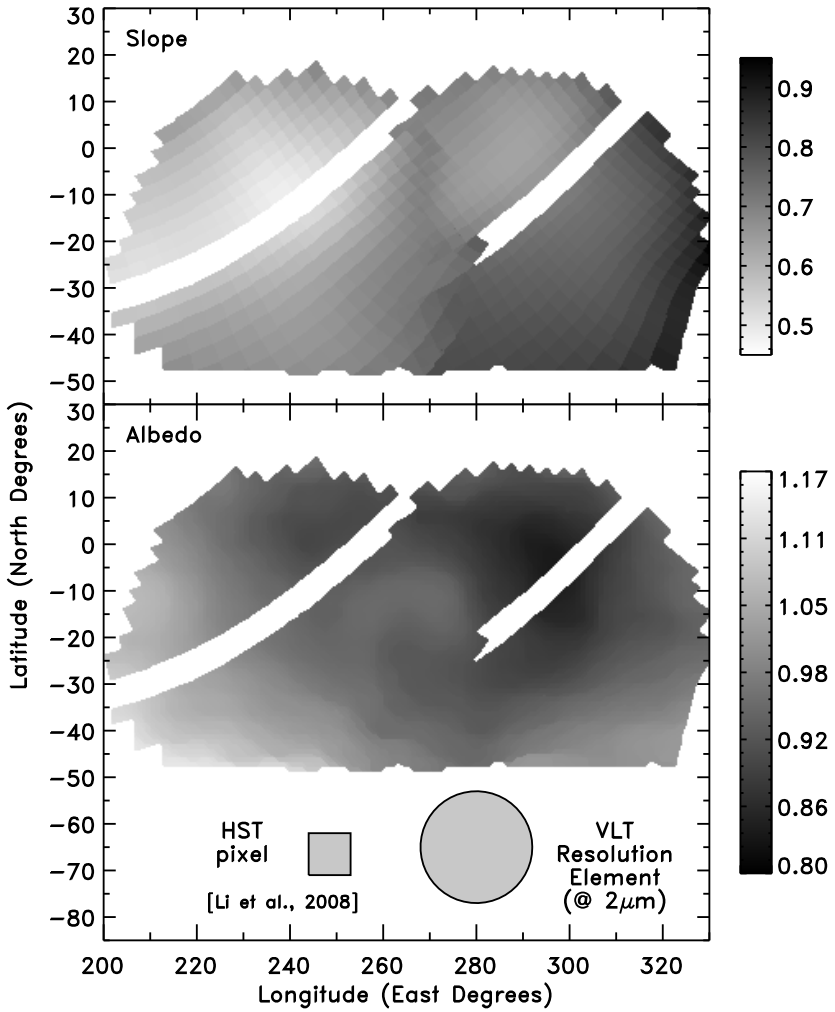

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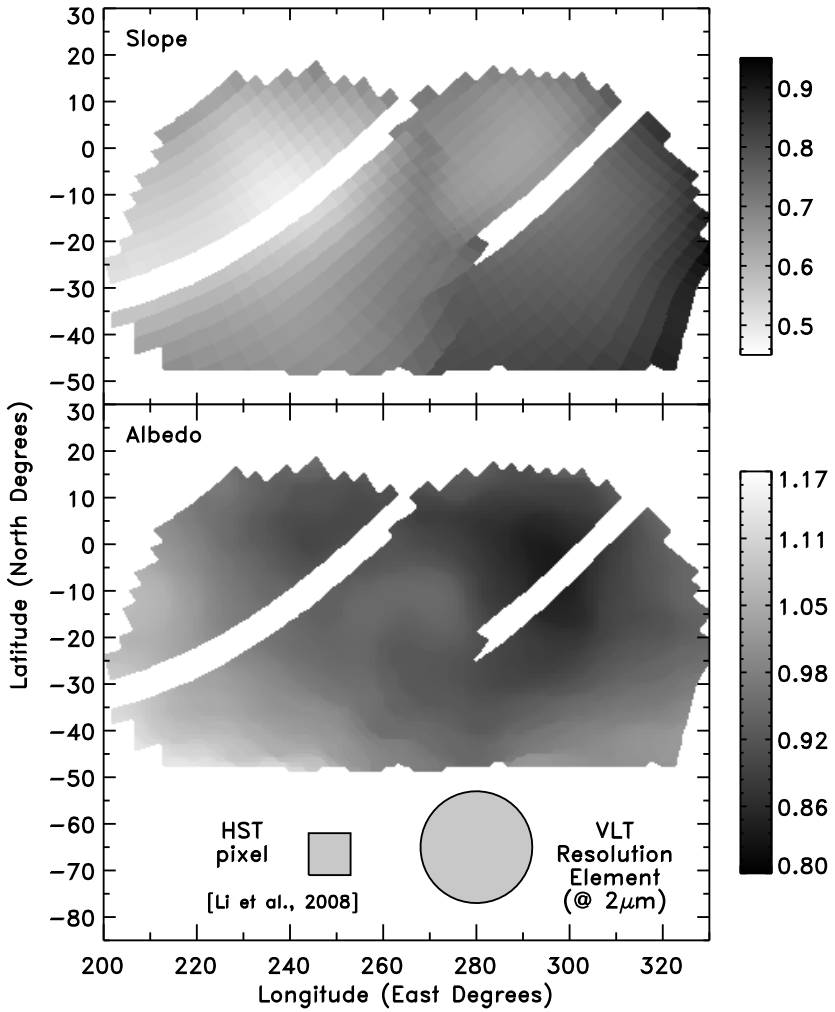

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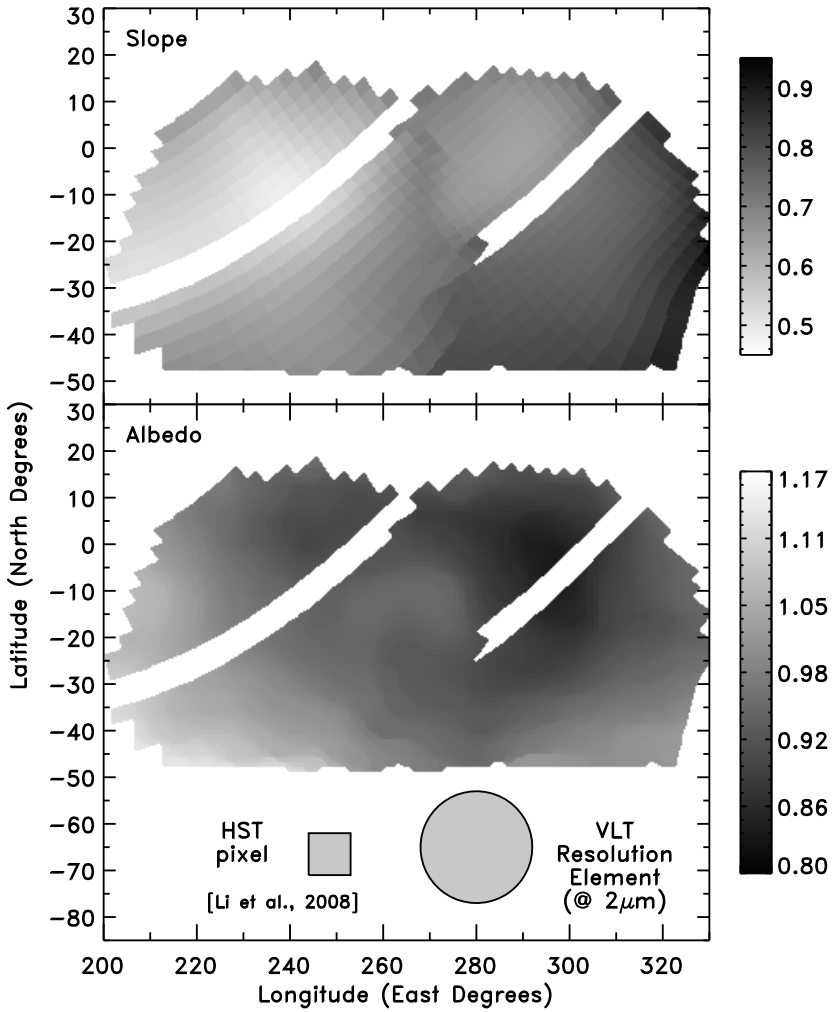

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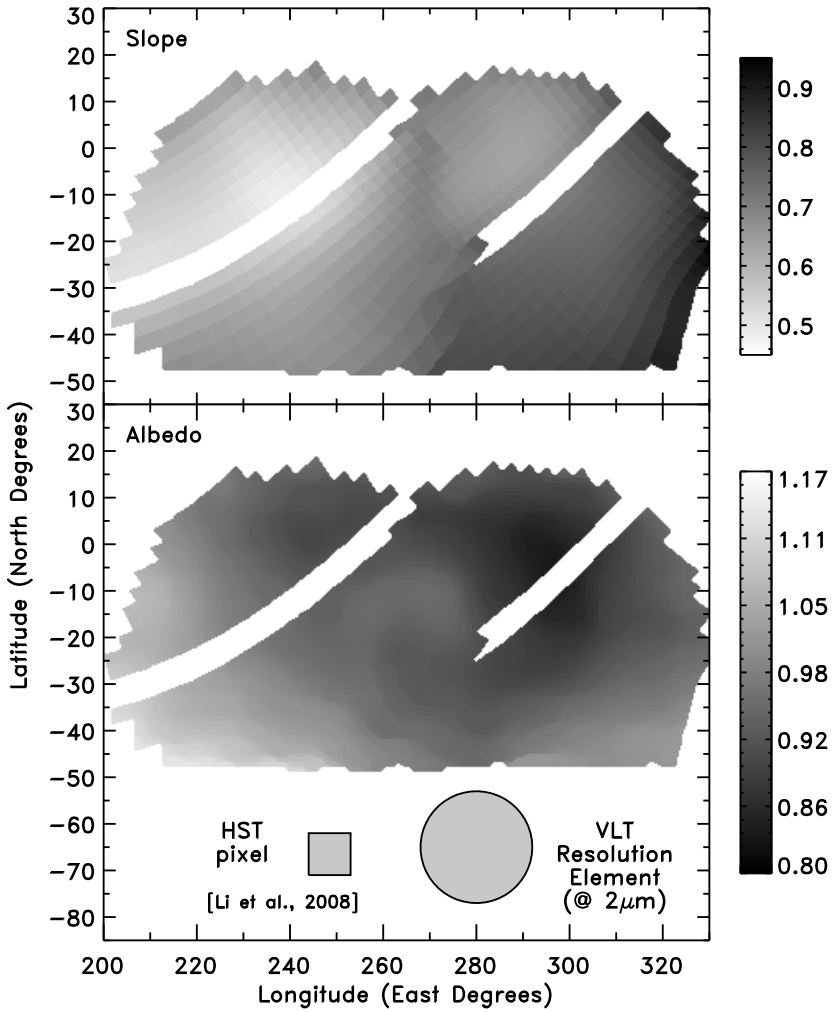
  - Slope - Topo: so so
- Resume
  a. Unweathered
  b. Strong albedo variations
  c. Correlation Slope-Albedo



Several scenarios

1. Composition or grain size inhomogeneity
   - ⊕ Albedo variations
   - ⊖ Unweathered aspect

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3. Vestaquake from large crater relaxation
   - ⊕ Unweathered aspect
   - ⊖ Lack of correlation between topography & spectral slope
   - ⊖ Albedo variations

Magnetic field scenario

Blewett et al. (2007)

- Surface magnetism
  - Crustal / Localized
  - Remnant
  - 0.2 nT
  - 10^{-3} Moon's & 10^{-5} Earth's

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  - Albedo variation
  - Unweathered

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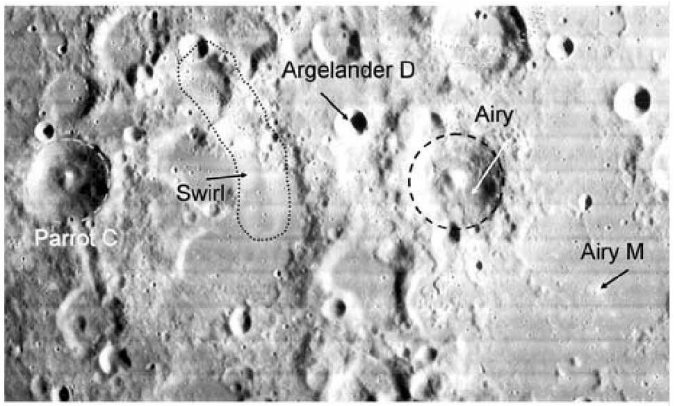

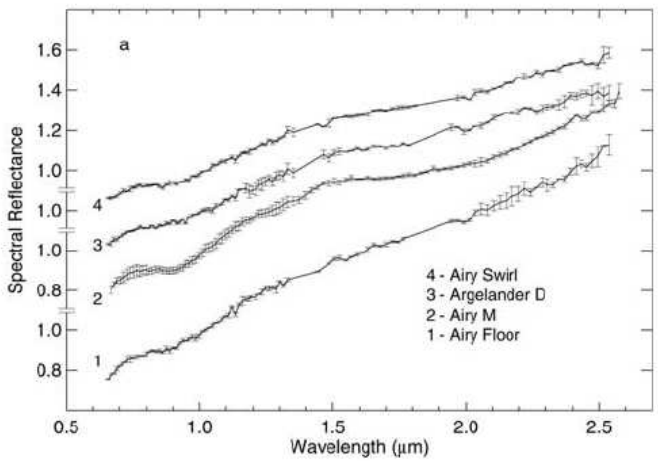

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  - Albedo variation
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- Detection
  - Slope-Albedo
  - w/o Topography
  - w/o Mineralogy

Observing limitations

1. Spectral range
   - Slope: J= 1.17-1.32 μm
   - Mineral: H+K= 1.5-2.4 μm
   - Limited to pyroxexes
   - Other compounds?

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3. Spatial coverage
   - 14% of total surface
   - Dark hemisphere

Conclusions

- Fist disk-resolved spectroscopy of an asteroid ever!
  - Spatial resolution is the key
  - Deconvolution algorithm ?
- Magnetic field scenario
  - Explain both albedo and spectral slope
  - Suggested by current data
  - Require more observations
- NASA Dawn mission
  - Arrival 2011
  - No magnetometer
  - Spatial resolution $\sim$100 m
  - Spectral range 1-5 μm