Mars Mineral Analysis Using OMEGA Data

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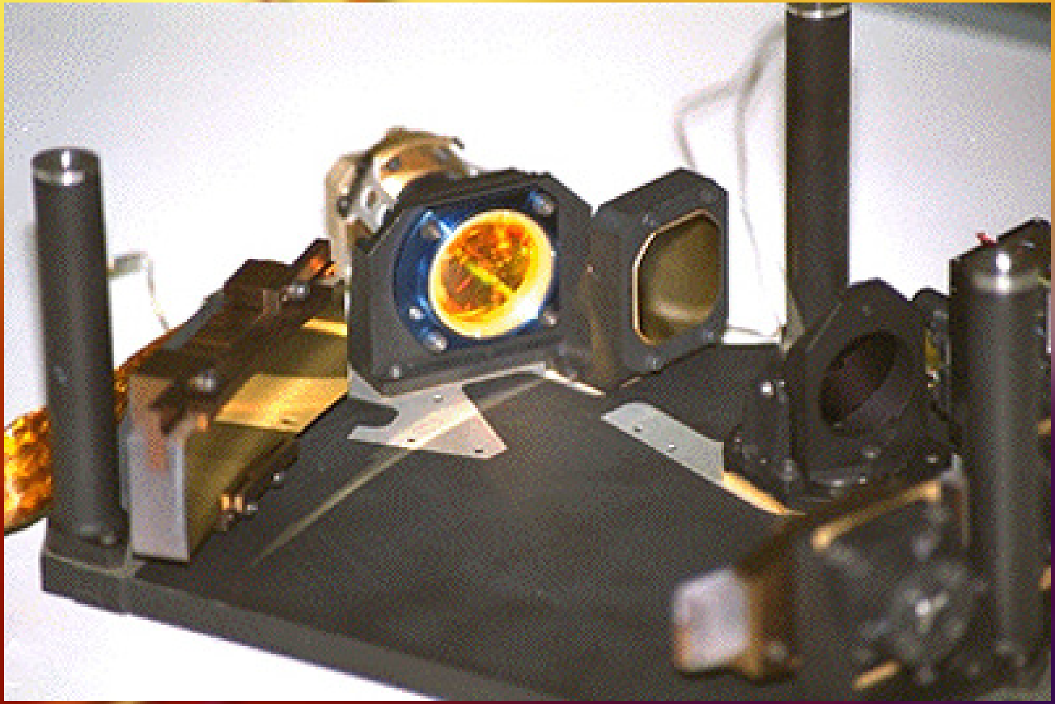
Presentation Outline

- Objective
- Satellite/Sensor Information
- Geographic Locating
- Literary Review
- Spectrum Analysis
- Statistical Analysis
- Challenges to Research
- Conclusions

Objective

- Determine mineral content of Martian impact craters.
  - Is there a difference in mineral content on the outside of the crater versus the inside of the crater?
  - Is there a difference in the mineral content of impact craters in between the two major regions?
  - Minerals of interest: gypsum, olivine, and nontronite.

OMEGA

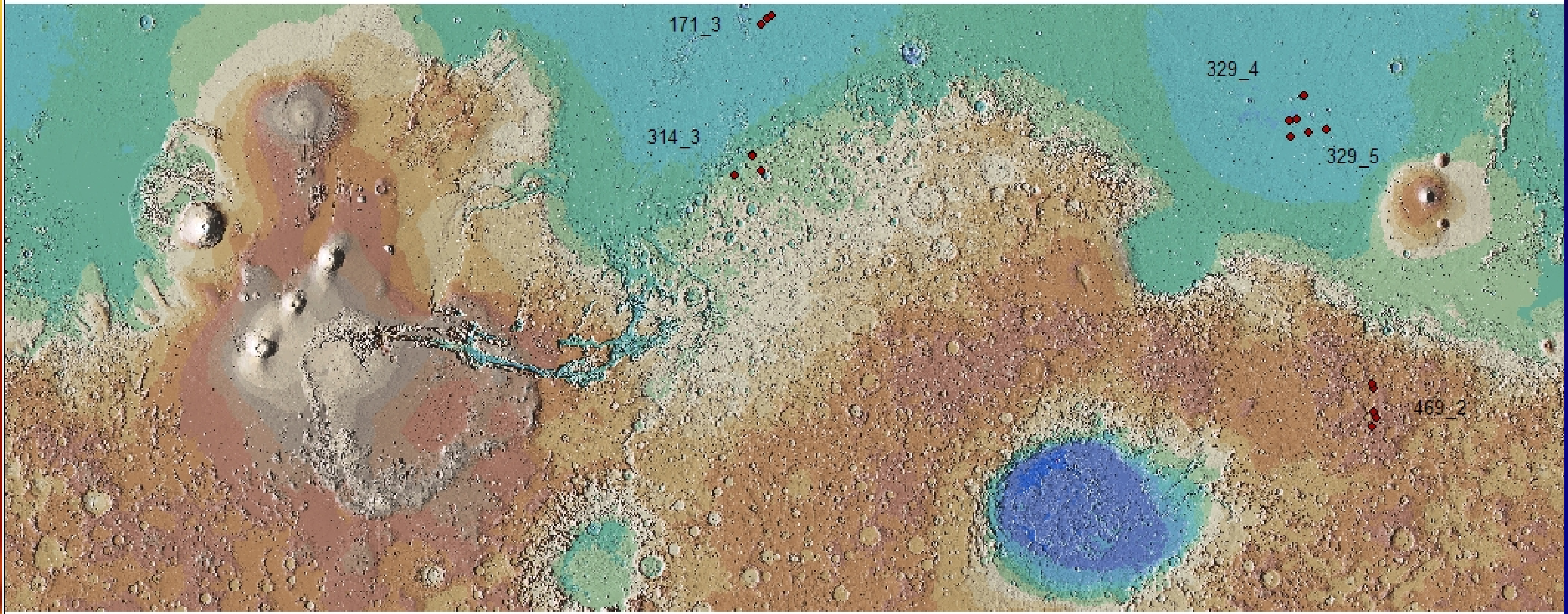


- Visible and Infrared Mineralogical Mapping Spectrometer
- Scales of 100 to 500m
- Spectral resolution of 7-20 nm per band
- Wavelength 0.35 to 5.1 microns
- 352 contiguous band
- Inclination 86°
- IFOV of 1.2mrad

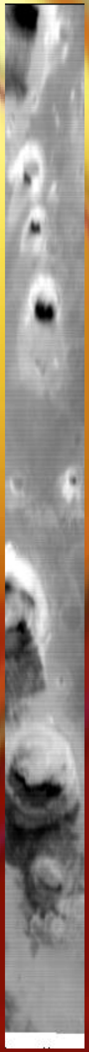
Dichotomy Boundary

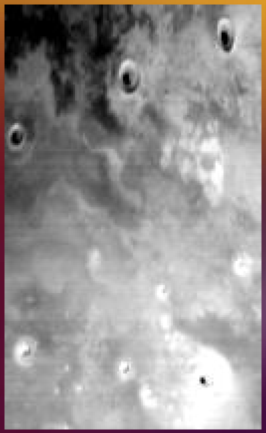
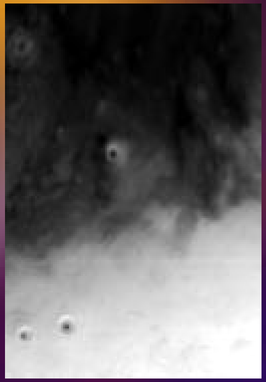
- Glaciation
- Impact crater
- Tectonics and erosion

Locations of Tested Craters

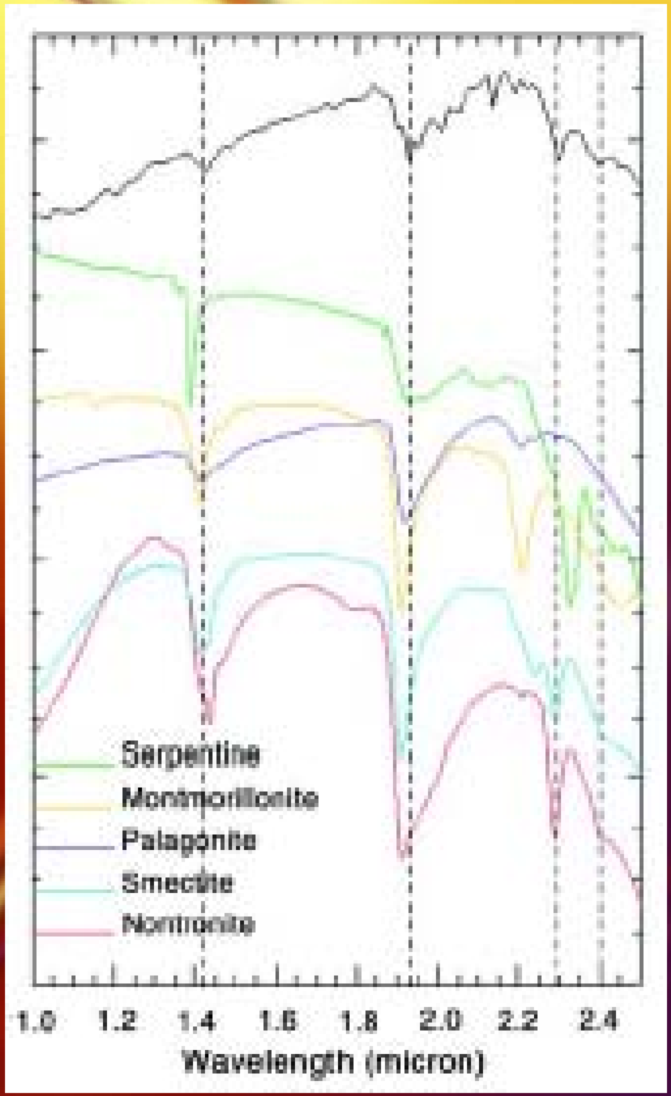


Crater Satellite Images



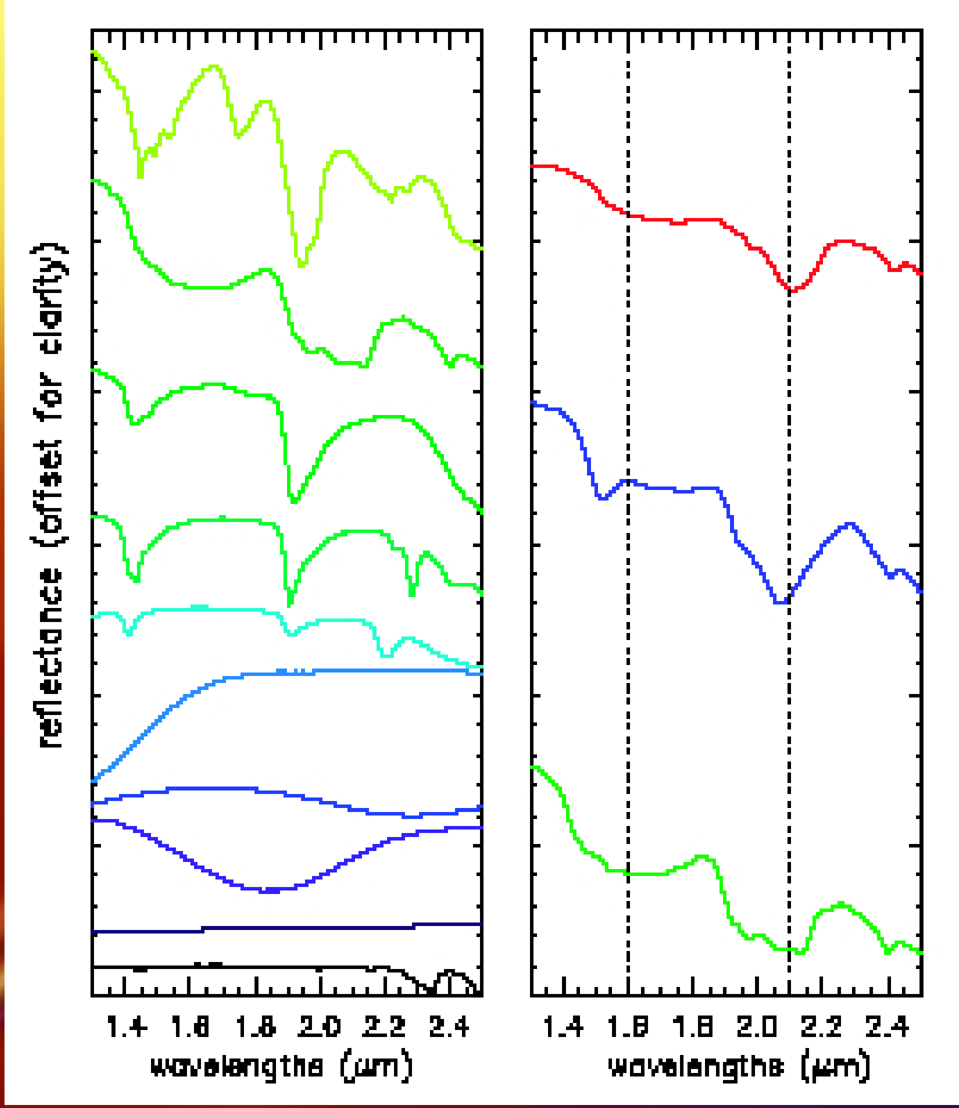




Mars Surface Diversity as Revealed by the OMEGA/Mars Express Observations



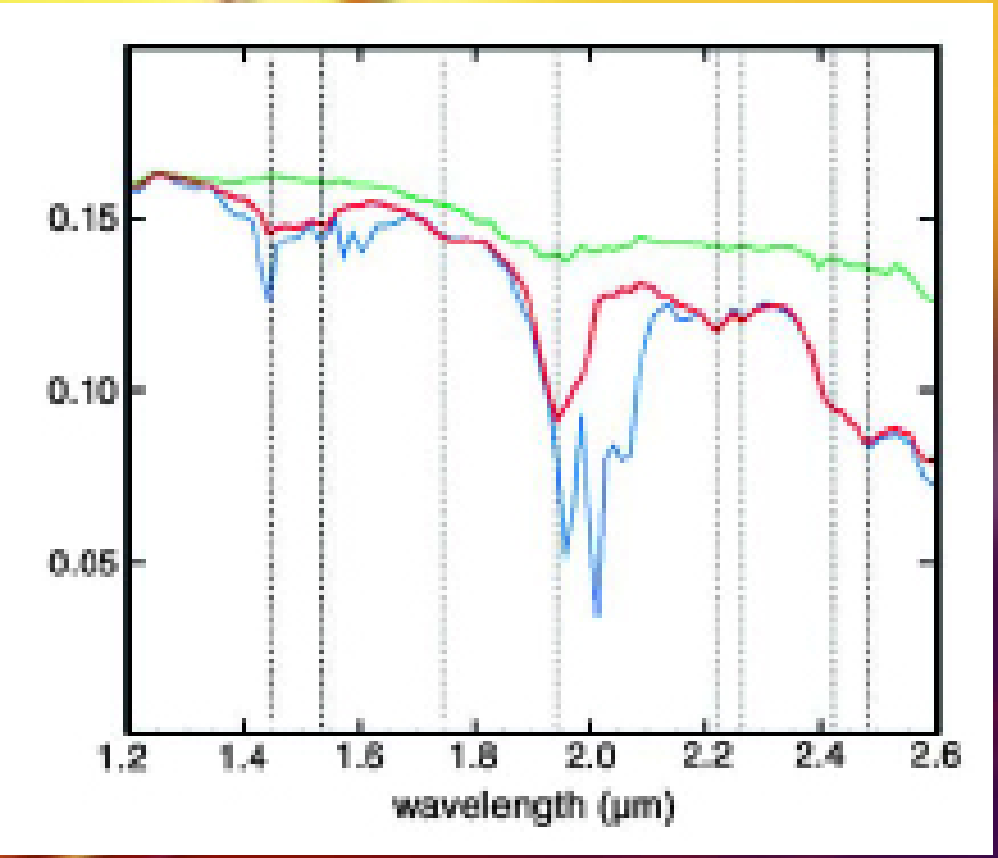
- Bibring, et al, *Science Magazine*, Vol. 307, March 2005.
- Discussion of Nontronite and Olivine absorption spectra.
- Discussion of High Calcium (HCP) and Low Calcium Pyroxines (LCP).

Sulfates in Martian Layered Terrains:The OMEGA/Mars Express View



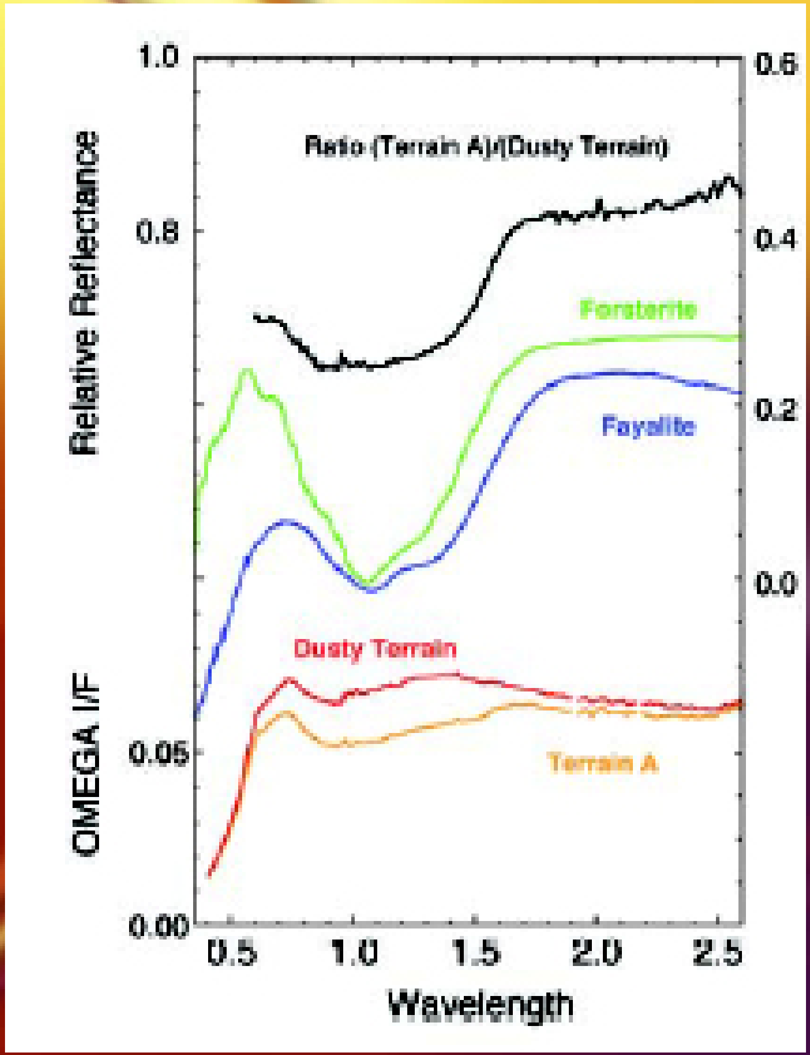
- Glendrin, et al, *Science Magazine*, Vol. 307, March 2005.
- Discussion of Gypsum and other sulfate minerals, and the resulting spectra.

Sulfates in the North Polar Region of Mars Detected by OMEGA/Mars Express



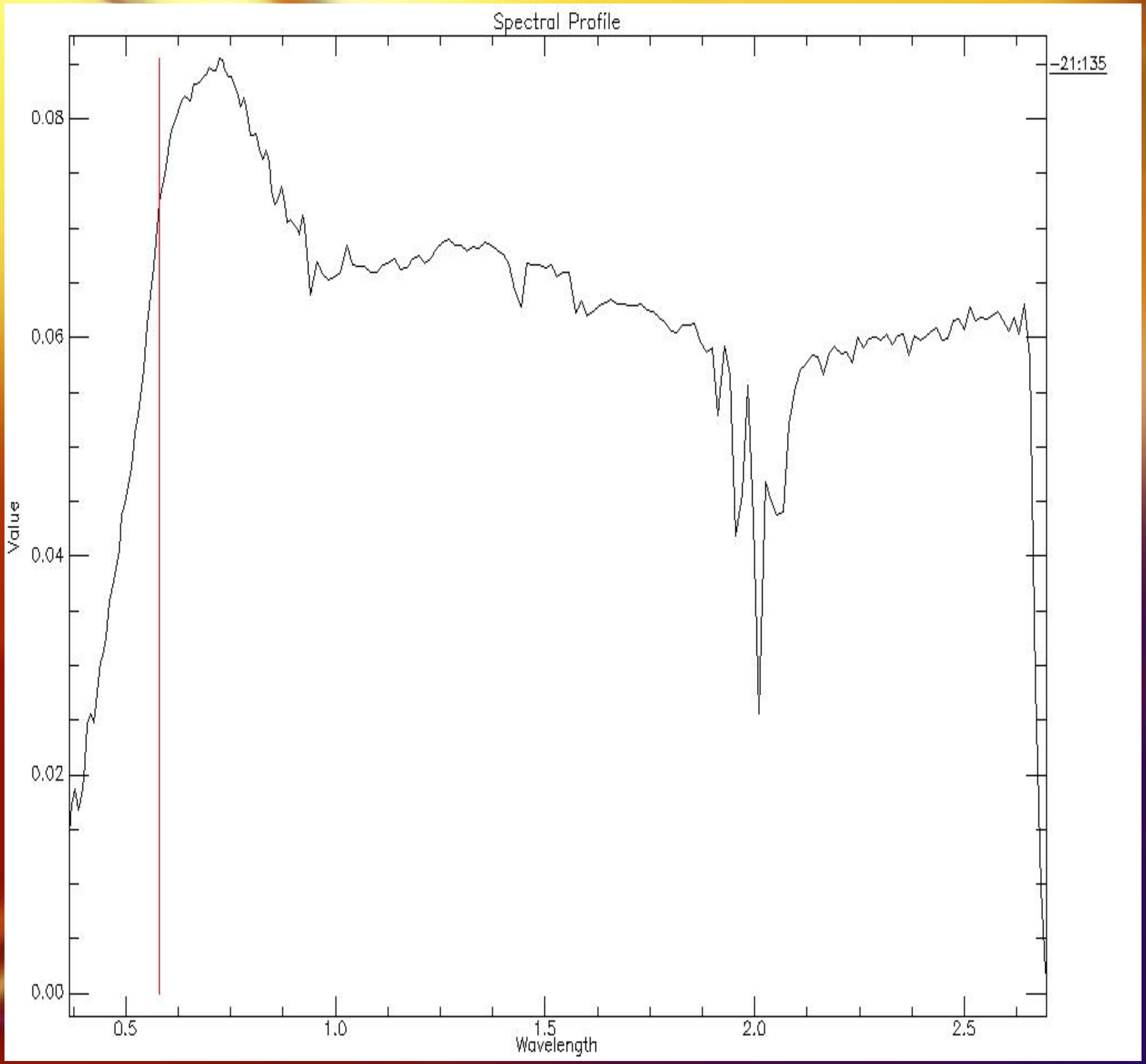
- Langevin, et al, *Science Magazine*, Vol. 307, March 2005.
- Example of processed signal, corrected for atmospheric interference.

Olivine and Pyroxene Diversity in the Crust of Mars



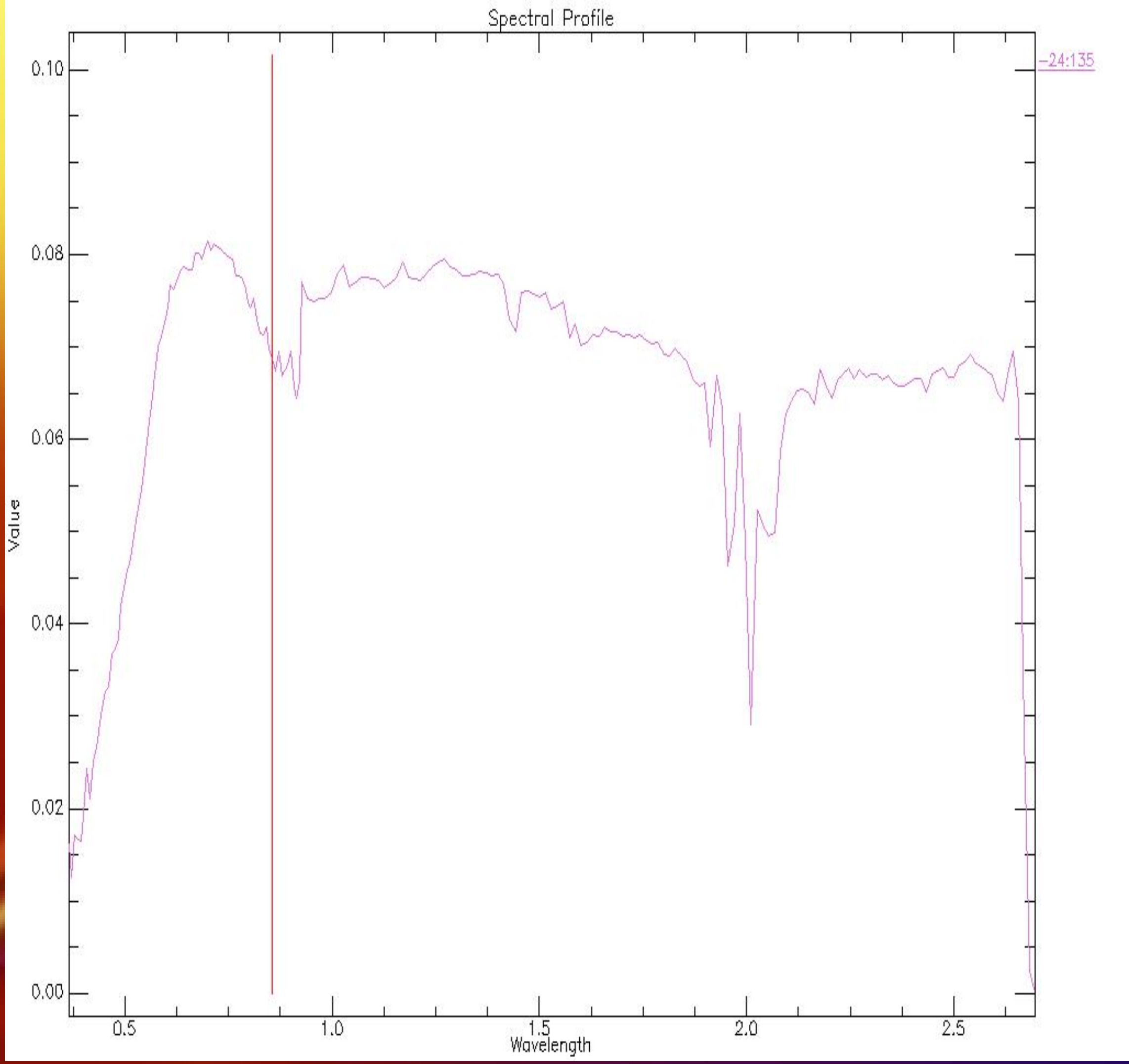
- Mustard, et al, *Science Magazine*, Vol. 307, March 2005.
- Spectra of characteristic olivine signal.
- Discussion and examples of HCP and LCP signals.

Gypsum Spectrum



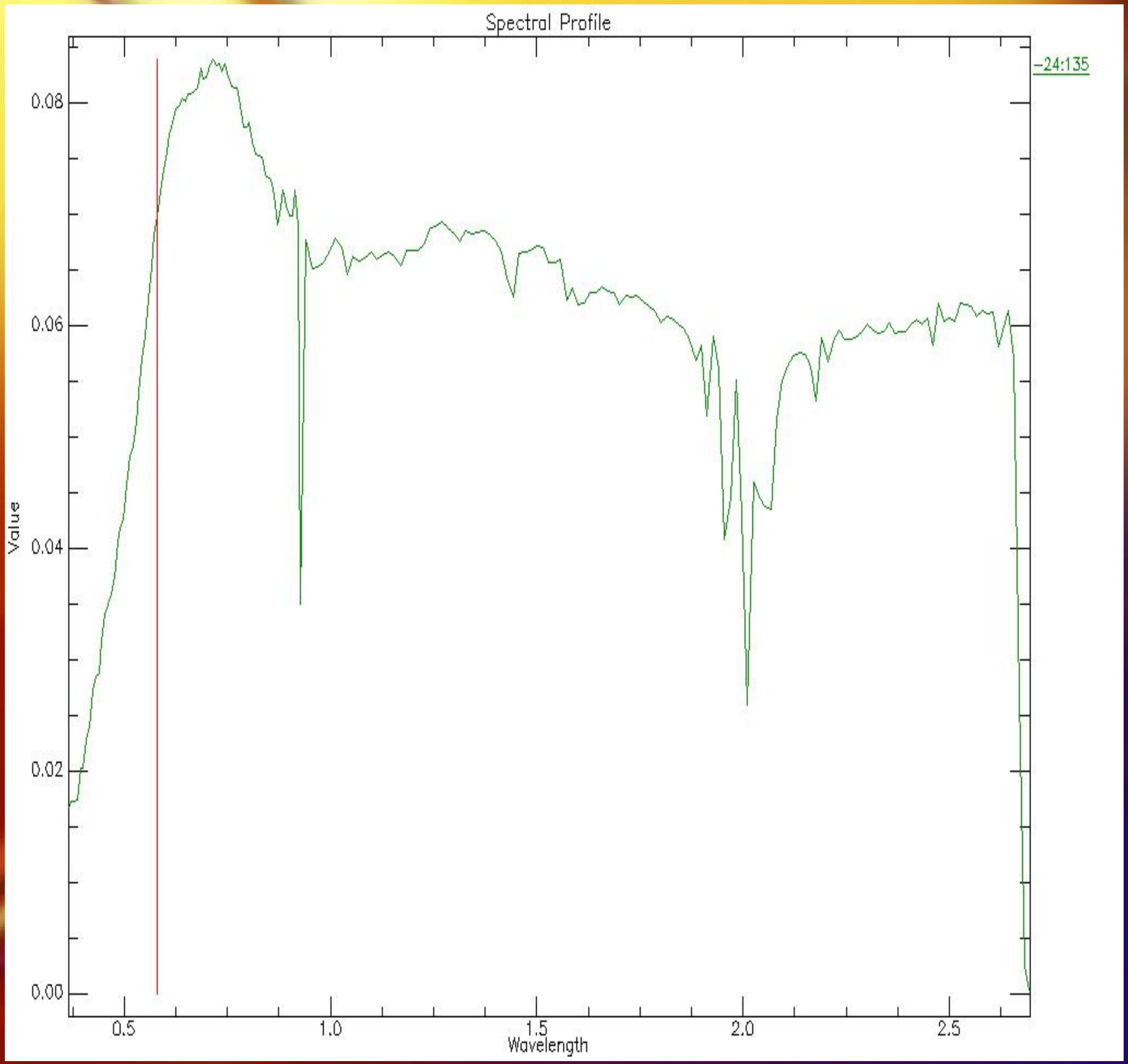
- Note the downward sloping spectrum, characteristic of sulfates, with absorption features at 1.42 μm and 1.9 μm.

Olivine Spectrum



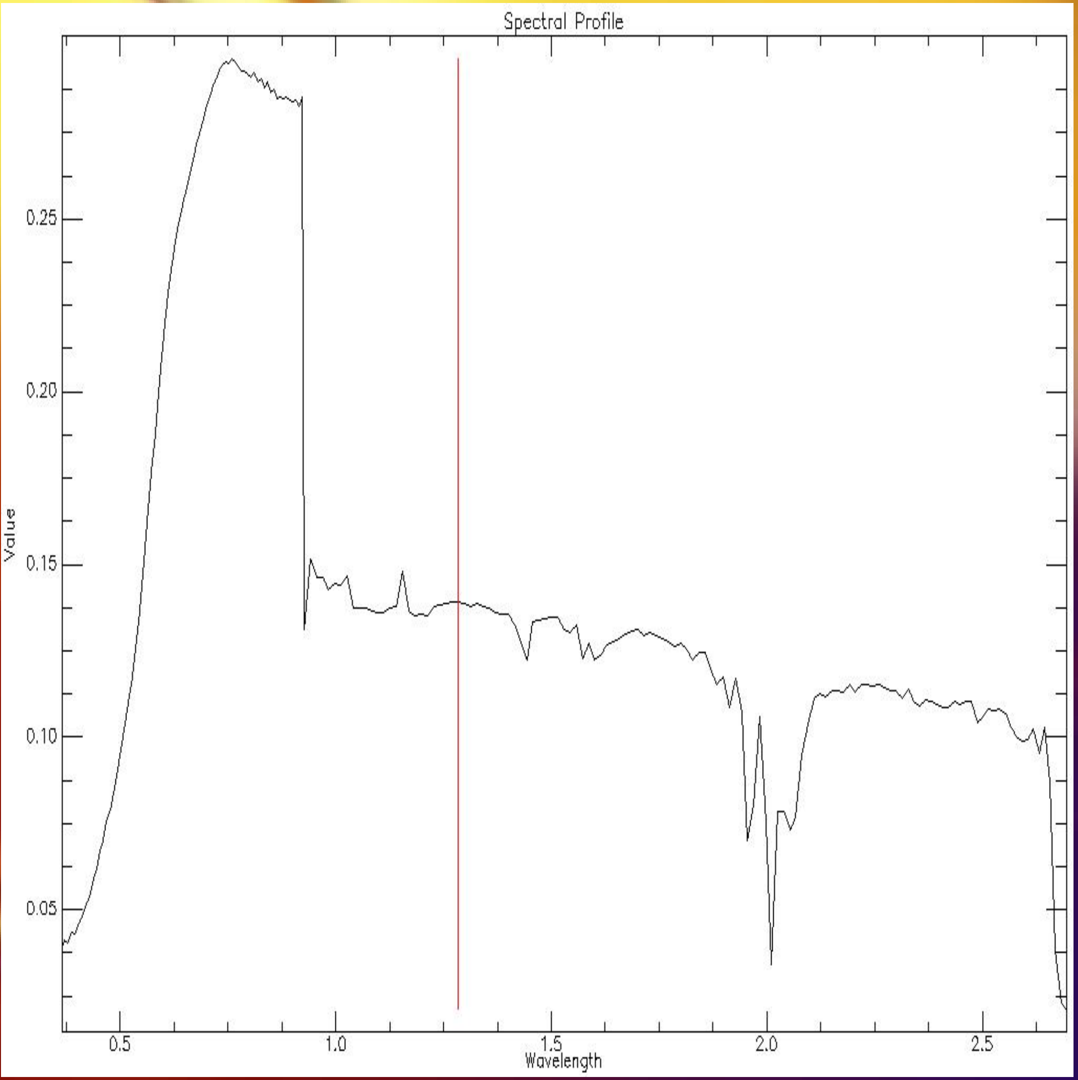
- Note the U-shaped absorption feature from 0.8 μm to 1.1 μm.

Nontronite Spectrum



- Note the absorption spike feature at 0.9 μm.

Mineral X



- We also found a spectrum at the center of some of the craters that seems to be for a mineral which we have not yet been able to identify.

Statistical Analysis

Mineral	Variable	P-value
Gypsum	Hemisphere	-
Gypsum	Location	-
Olivine	Hemisphere	0.7654
Olivine	Location	0.4875
Nontronite	Hemisphere	<0.0001
Nontronite	Location	0.0076
Mineral X	Hemisphere	0.5205
Mineral X	Location	0.0003

Statistical Analysis

- Gypsum was present in all areas sampled.
- Olivine showed no pattern in either hemisphere, or sample location.
- Nontronite showed up more preferentially outside the craters in the Northern hemisphere but both inside and outside in the Southern hemisphere.
- Mineral X was found inside craters, and in both hemispheres

Challenges to Research

- ☞Availability of Satellite Imagery
- ☞Image Processing
- ☞Not able to isolate certain spectral features in spectral profile
- ☞Lack of ability to “check for accuracy”

Conclusions

- The Martian impact craters we studied are composed primarily of olivine, nontronite, and an unknown mineral. All of the surfaces tested were coated with gypsum.
  - Nontronite was found outside craters in the Northern Hemisphere more, but in the Southern Hemisphere it was found both inside and outside of impact craters.
  - The unknown mineral (mineral X) was found inside craters.
  - Olivine and gypsum showed no pattern in location.