



Parallel Session #3:  
**Dynamic Surface Processes**  
(on the Moon)

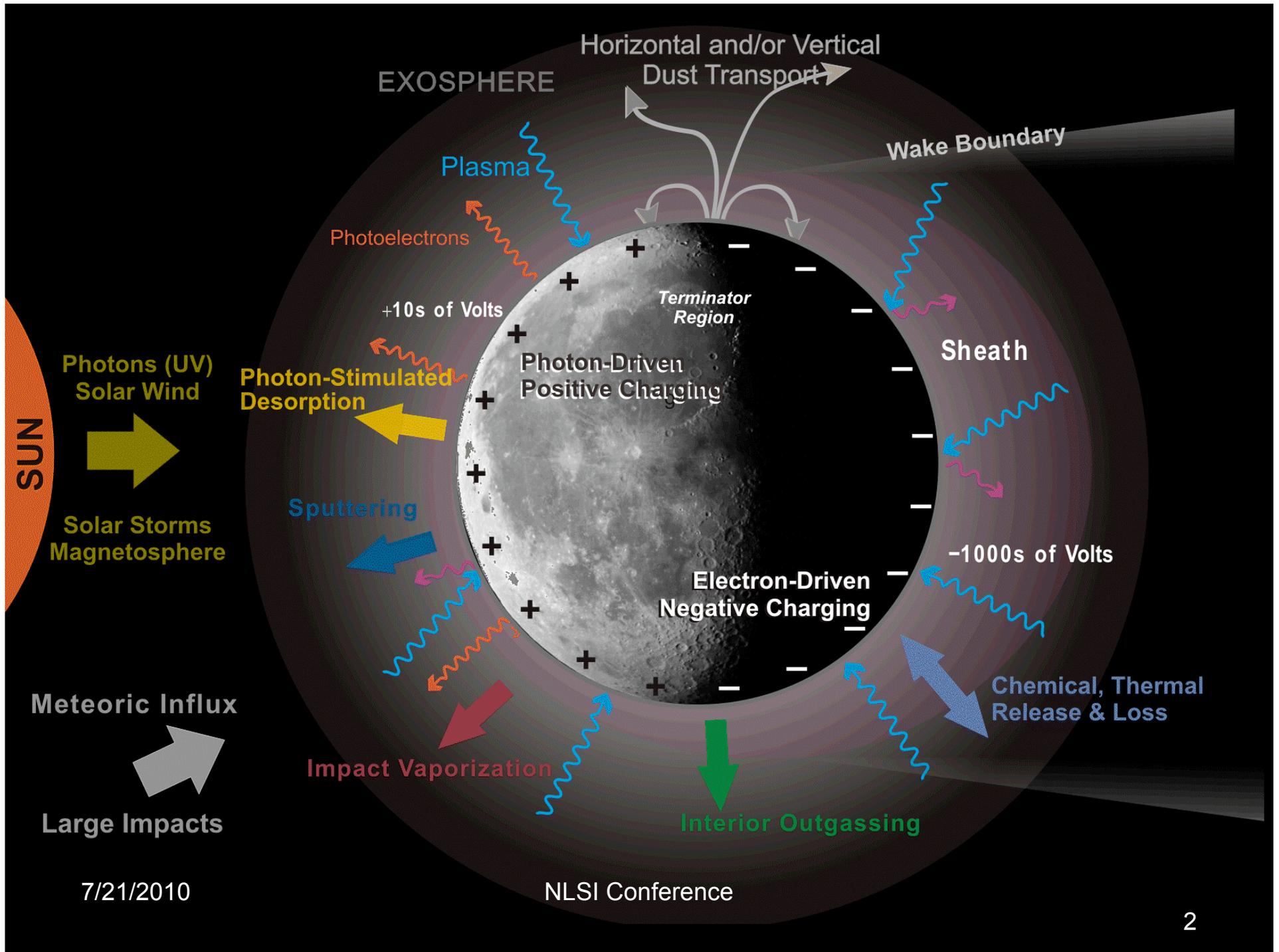
Conference Center (Bldg. 3) Ballroom 9:30-11:30 a.m.

**Gregory T. Delory**

UC Berkeley Space Sciences Laboratory

NASA Ames

NASA Lunar Science Institute



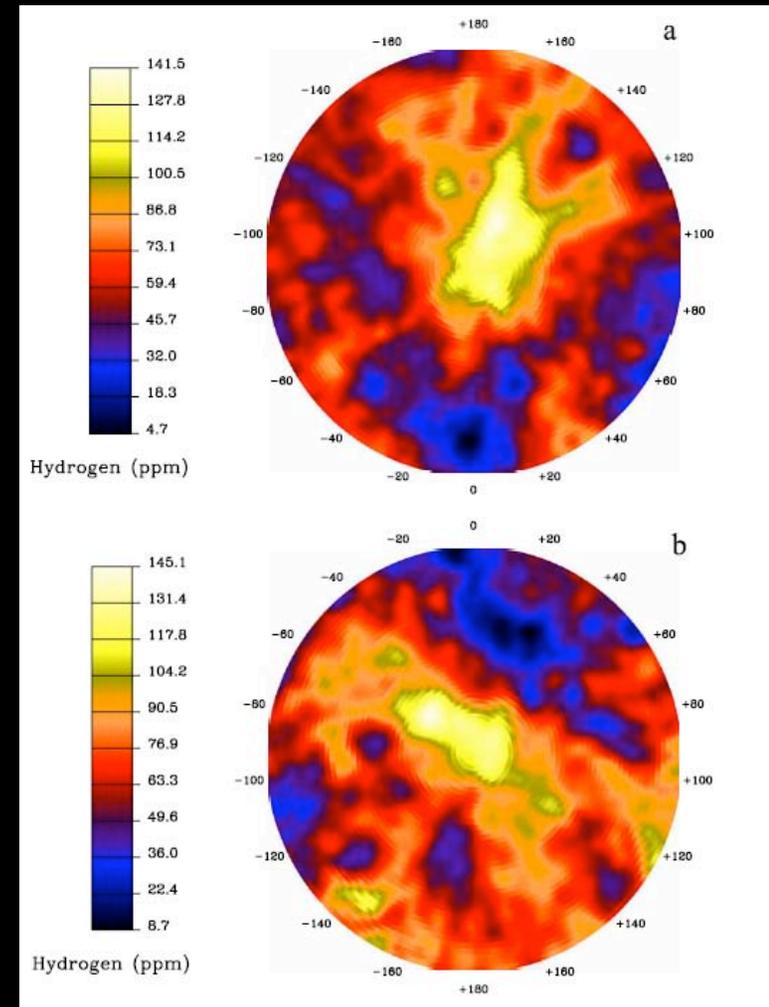
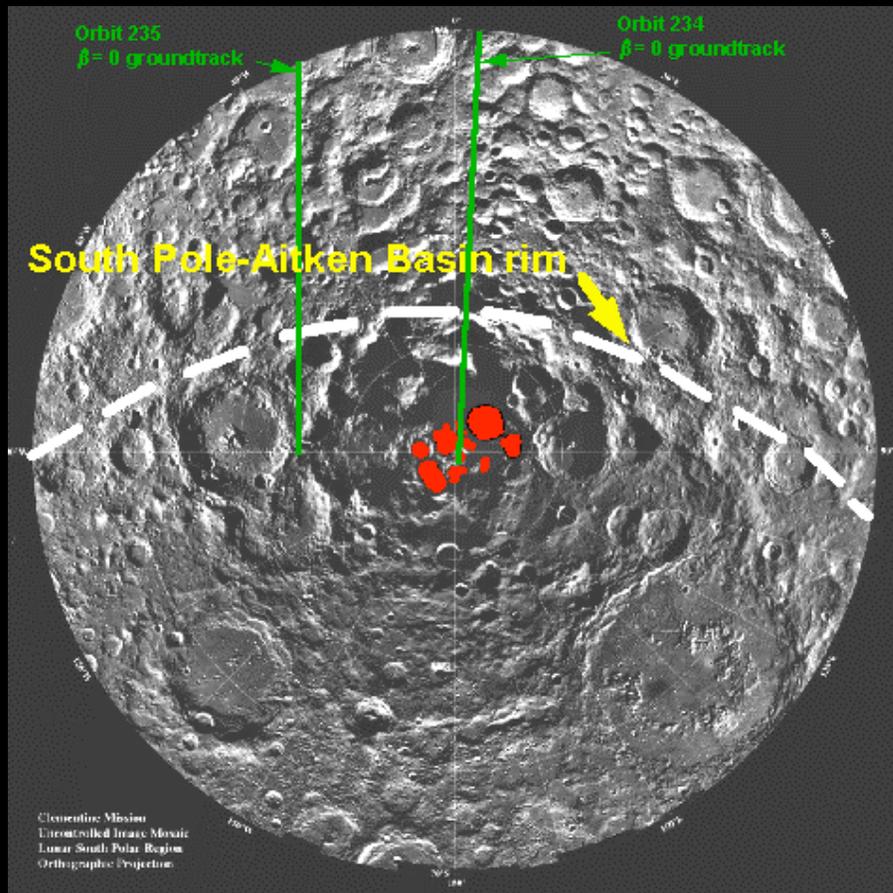


## Dynamic Surface Processes

### Parallel Session 3 Topics

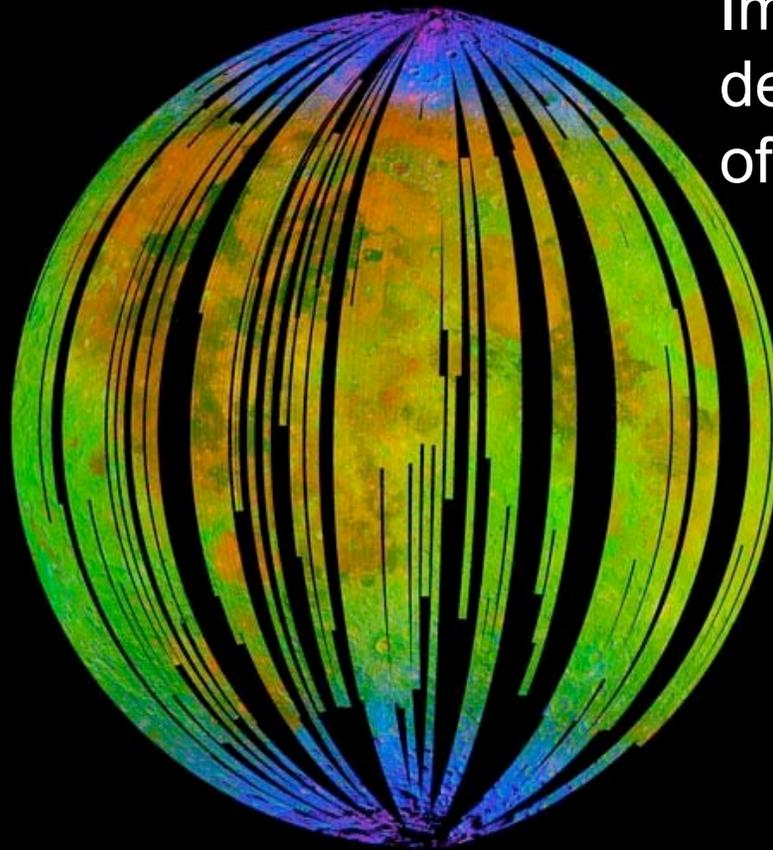
- Volatiles (water, hydroxyl) as part of the dynamic lunar exosphere
- Dynamic dust activity generated by electric fields on the lunar surface
- Impacts – ranging from micro-meteorites to planetesimal-sized objects

# Lunar Water - History



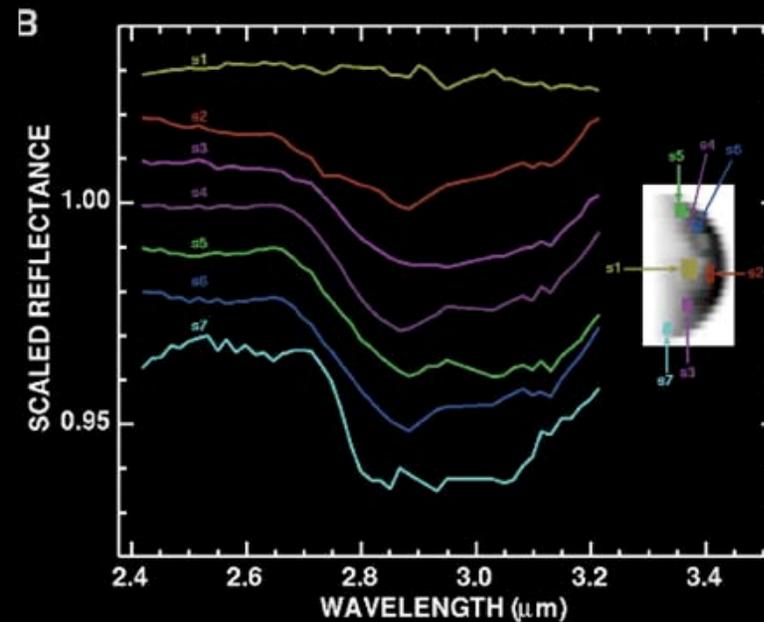
# Lunar Water

Pieters et al *Science* 2009

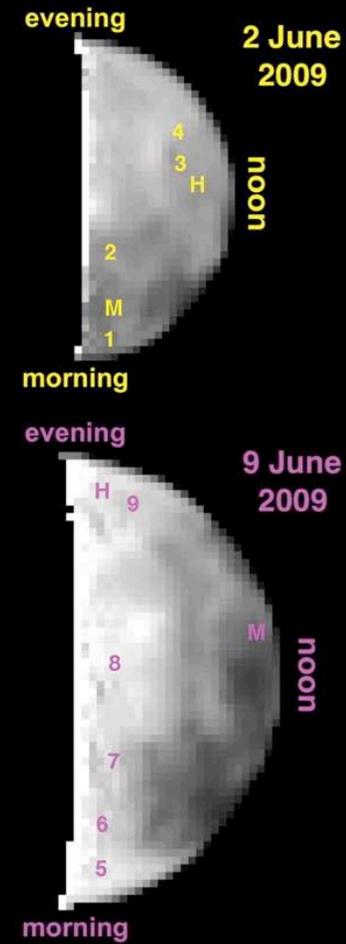
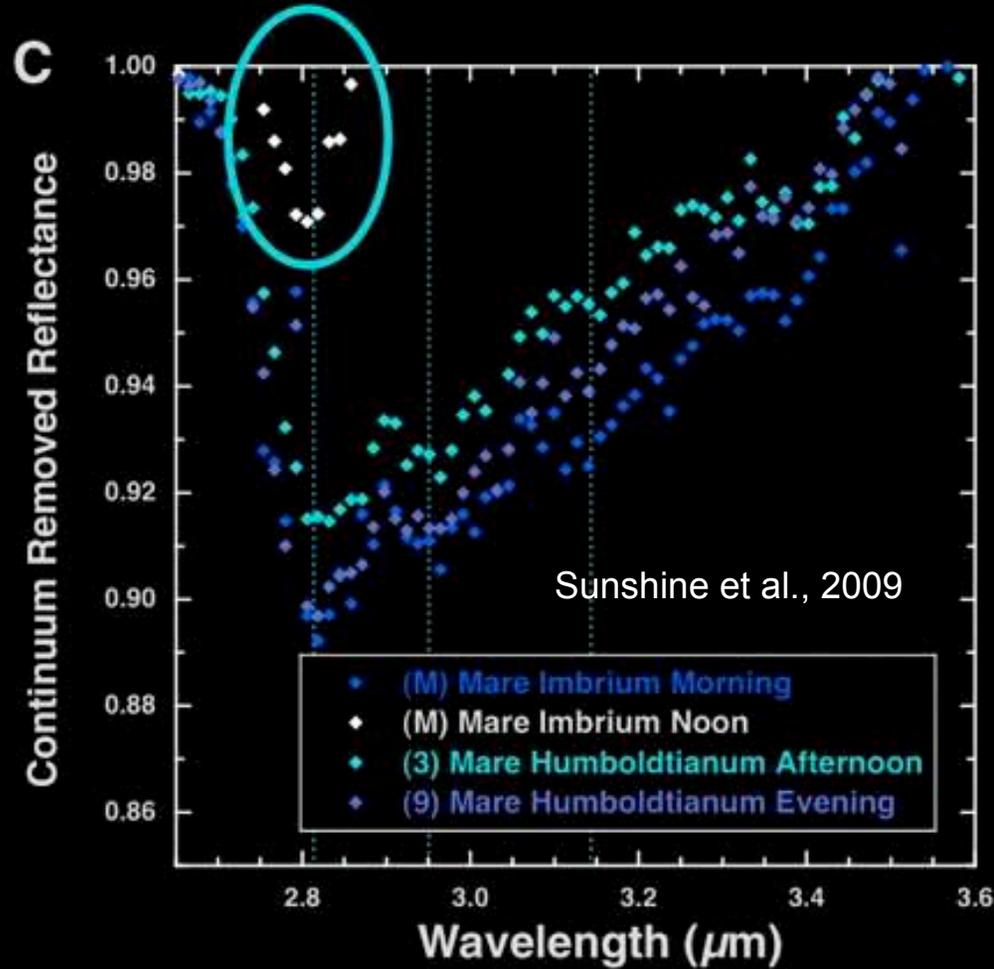


M<sup>3</sup> (Chandrayaan-1), EPOXI (Deep Impact), and VIMS (Cassini) detections of water over large areas of the lunar surface

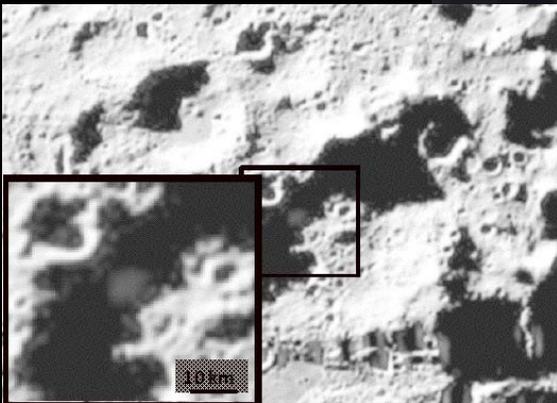
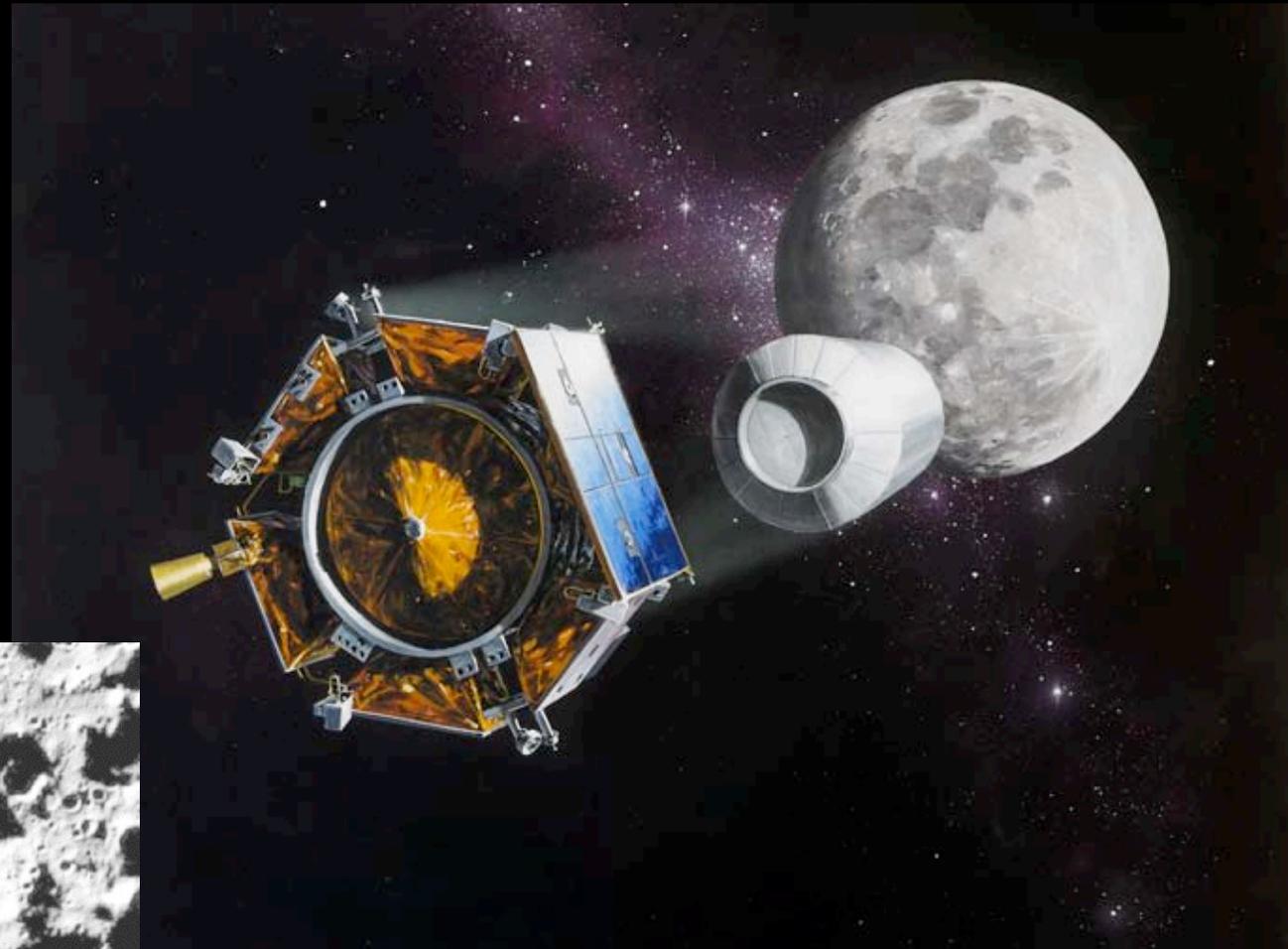
Clark et al *Science* 2009



# Lunar Water – Diurnal Variation?



# LCROSS – Polar Volatiles (Water)



# Current Problems - Lunar Volatile Cycle

**D. Hurley** - *Modeling the Production, Delivery, and Maintenance of OH/H<sub>2</sub>O on the Lunar Surface*

- Losses**
- Sublimation
  - UV ionization
  - Sweeping
  - Sputtering
  - Micrometeorite impact vaporization



**A. Zent et al** - *Spectroscopic and Numerical Evaluation of Solar Protons as Lunar OH Source*

- by alteration to refractory phase:
- Organics
  - Hydrated minerals
  - Clathrates

Lucey, 2009

7/21/2010

NLSI Conference

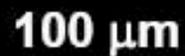
## Current Problems - Surface Interactions

H<sub>2</sub>O, OH can be  
contained within  
minerals  
inclusion

**K. Hibbitts et al - *Thermal stability and migration of water and OH on the surface of the Moon***

H<sub>2</sub>O, OH can adsorb  
onto surfaces

Physics of adsorption  
not completely  
understood...



100 μm

# Lunar Dust Activity

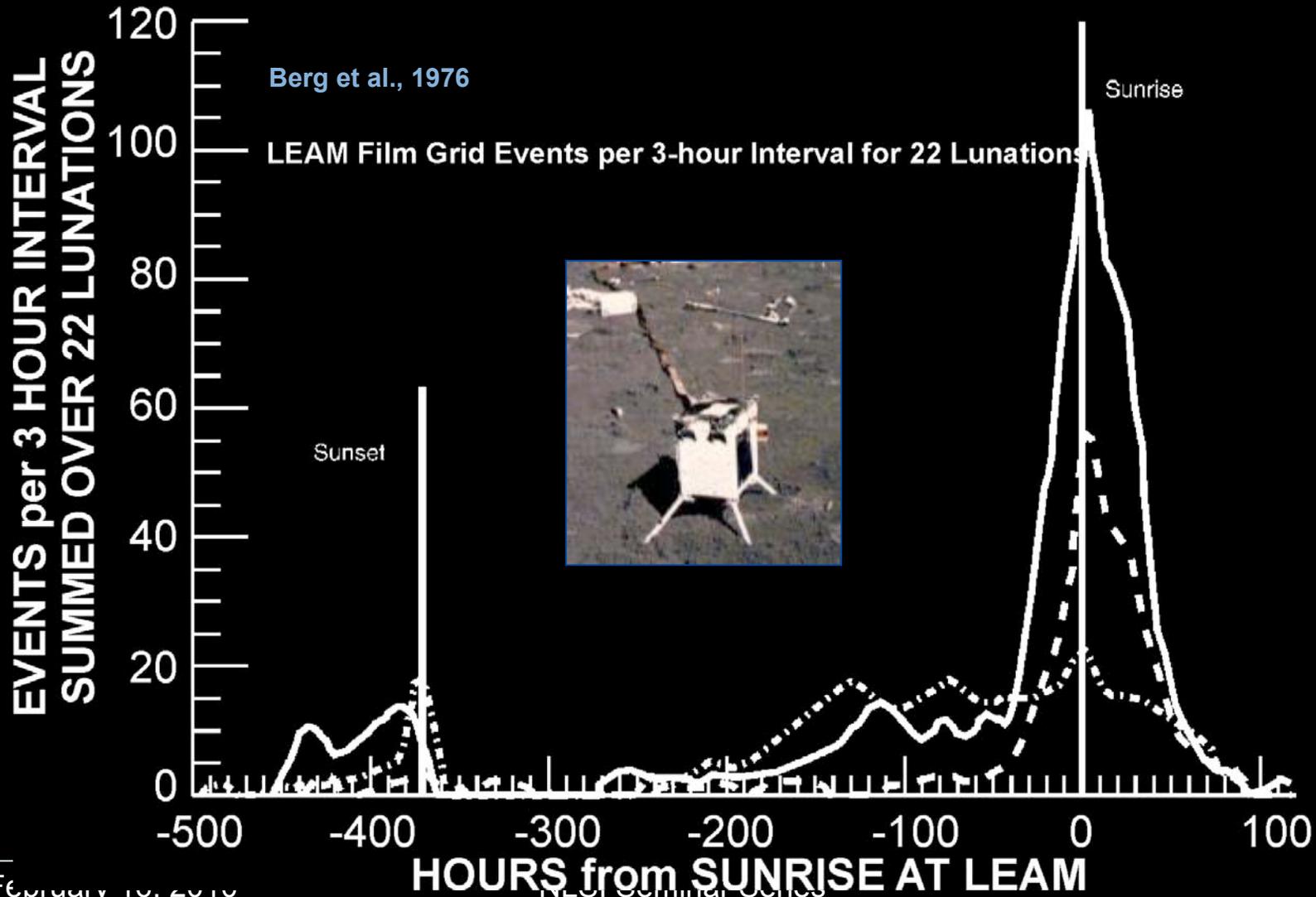
Criswell, 1973;  
Rennilson and Criswell, 1974



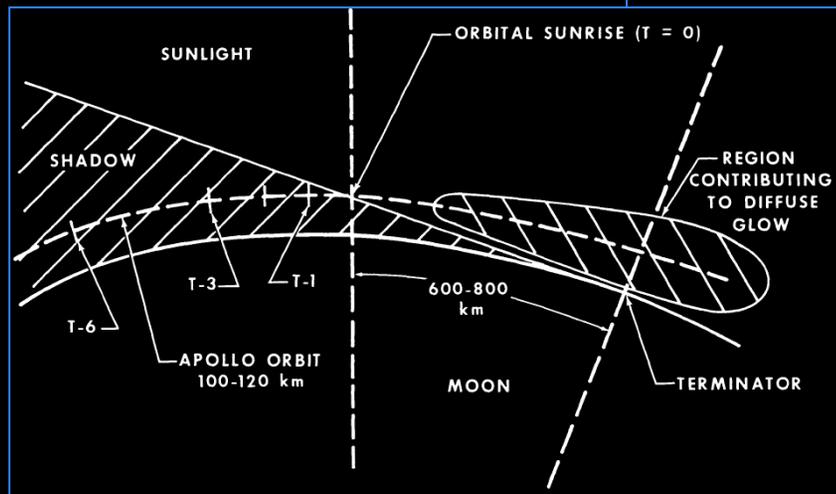
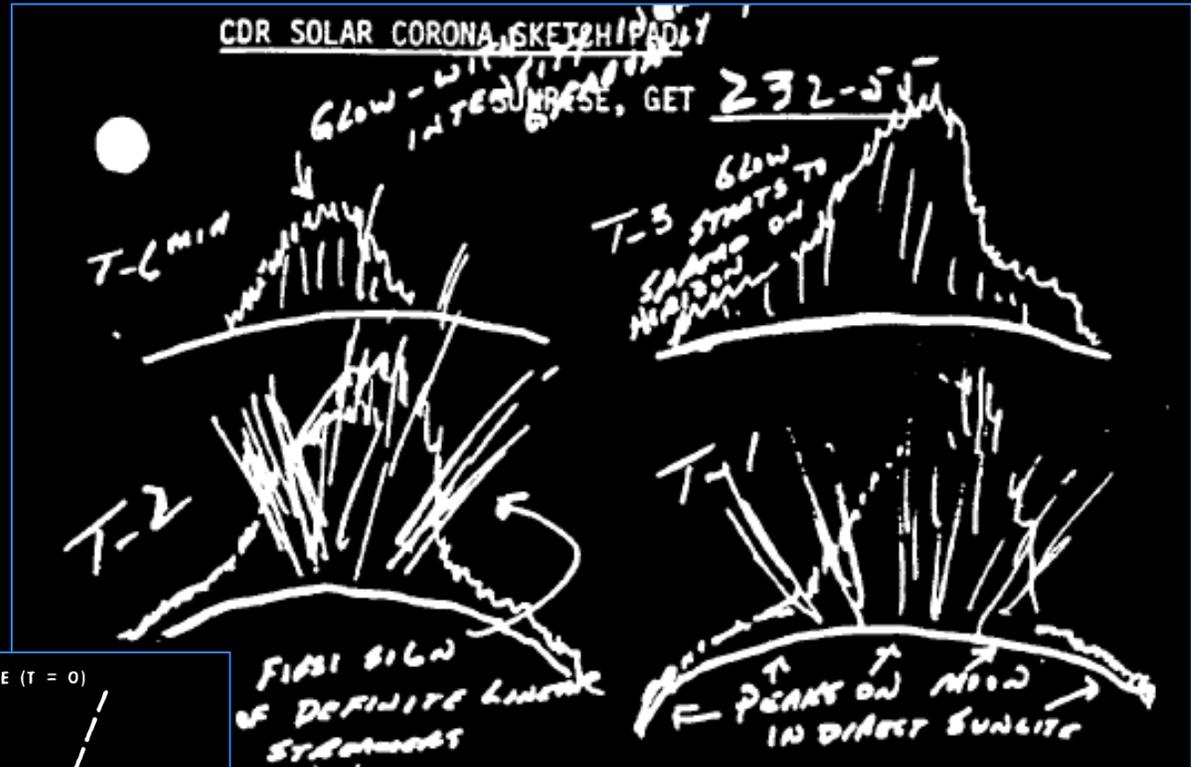
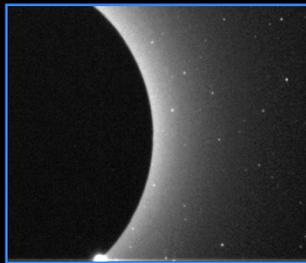
Surveyor 7: 1968-023T06:21:37

Consistent with dust <1m off the ground, 5-10 um in size, ~150 m away on the sunset horizon. Event lasted ~3 hours.

# Measurements of Dust Activity: LEAM



# Lunar Dust – High Altitude?

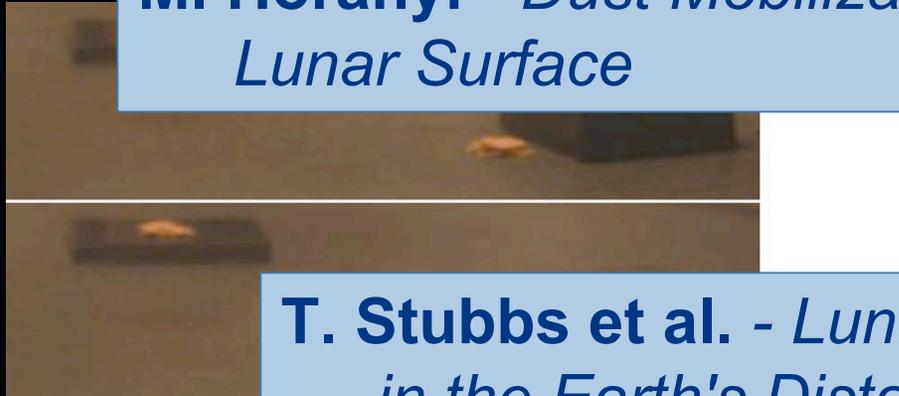


Apollo Astronaut sketch (G. Cernan)

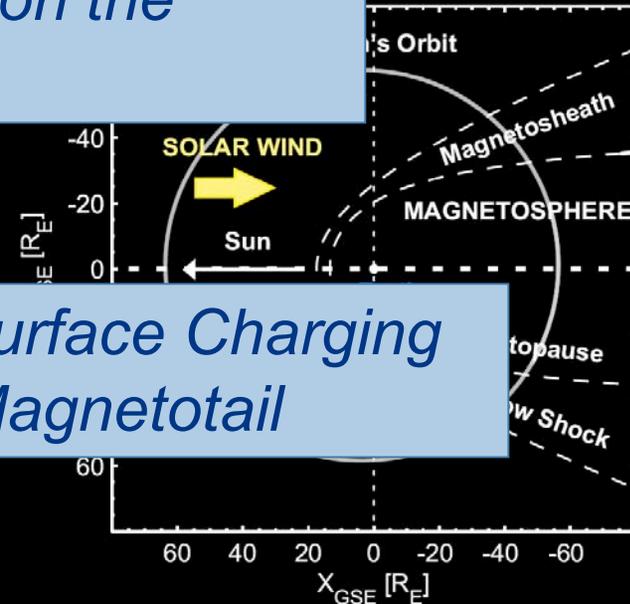
# Current Status

Modeling of the variable environment

**M. Horanyi** - *Dust Mobilization on the Lunar Surface*



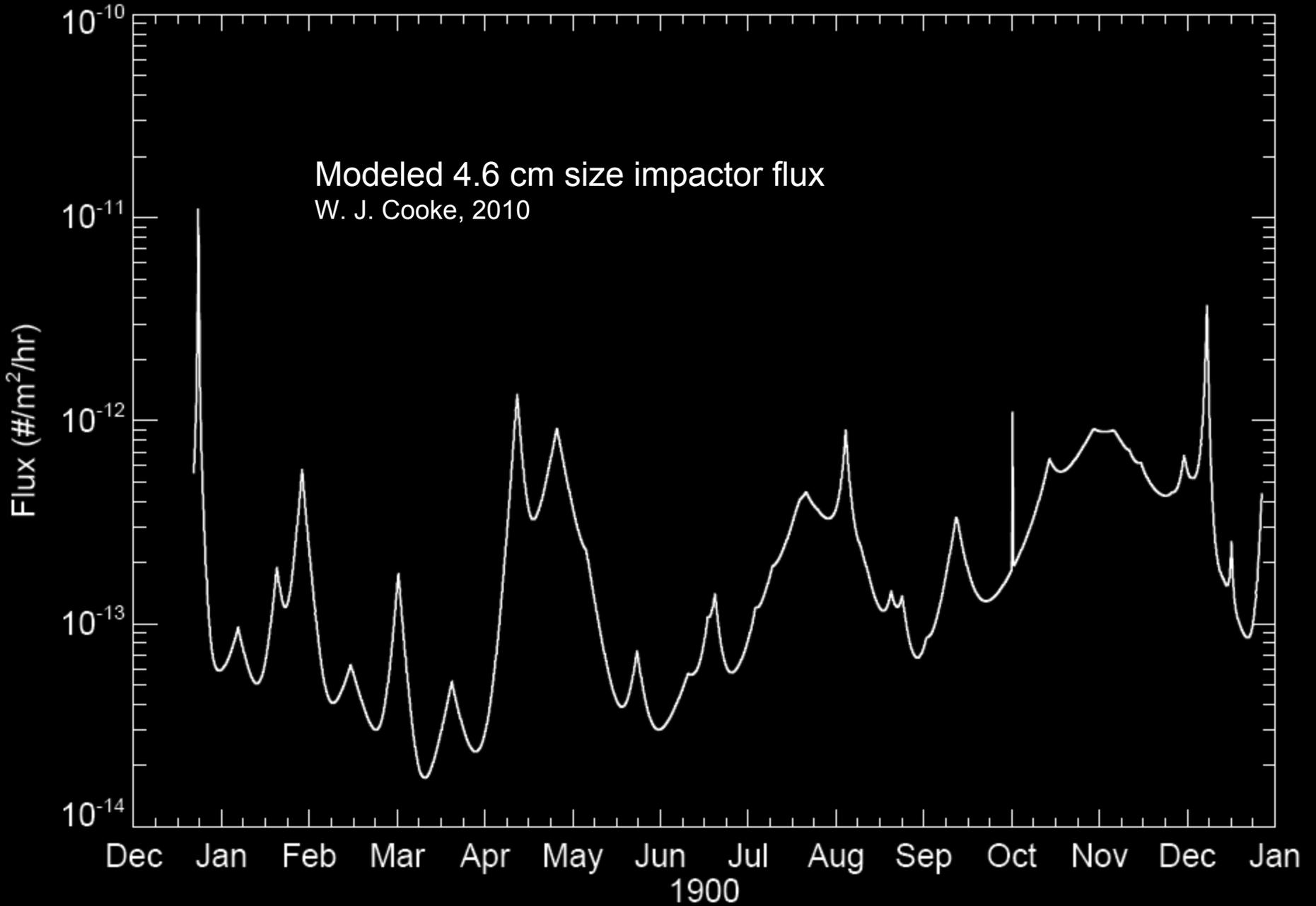
**T. Stubbs et al.** - *Lunar Surface Charging in the Earth's Distant Magnetotail*



Lunar Atmosphere and

**D. T. Richard et al.** *Modeling of light scattering by non-spherical lunar dust grains*

# 1900 Shower Fluxes for the Moon



## The “Late Veneer”



The presence of highly siderophile elements (“iron loving”) in the Terrestrial mantle can be explained by the delivery of materials through impacts after the Moon formation event.

**W. Bottke et al. - *The “Late Veneer” Added to the Earth and Moon May Be Characterized by a Shallow Size Distribution of Large Planetesimals***



## E/PO Presentation

# *Money, and How to Get it!*

Doris Daou

NASA Lunar Science Institute E/PO