Spectroscopic and Numerical Evaluation of Solar Protons as Lunar OH Source

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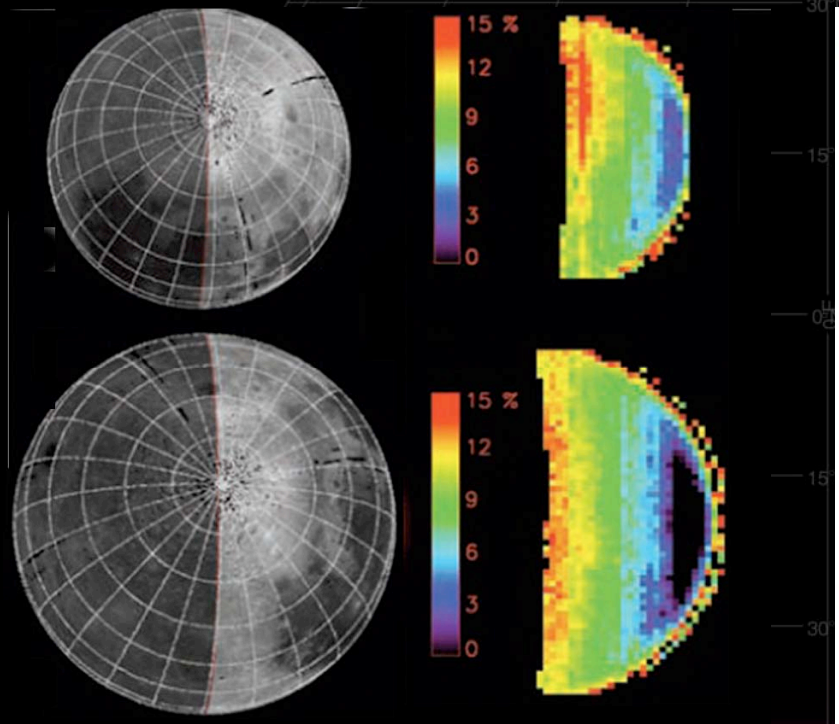
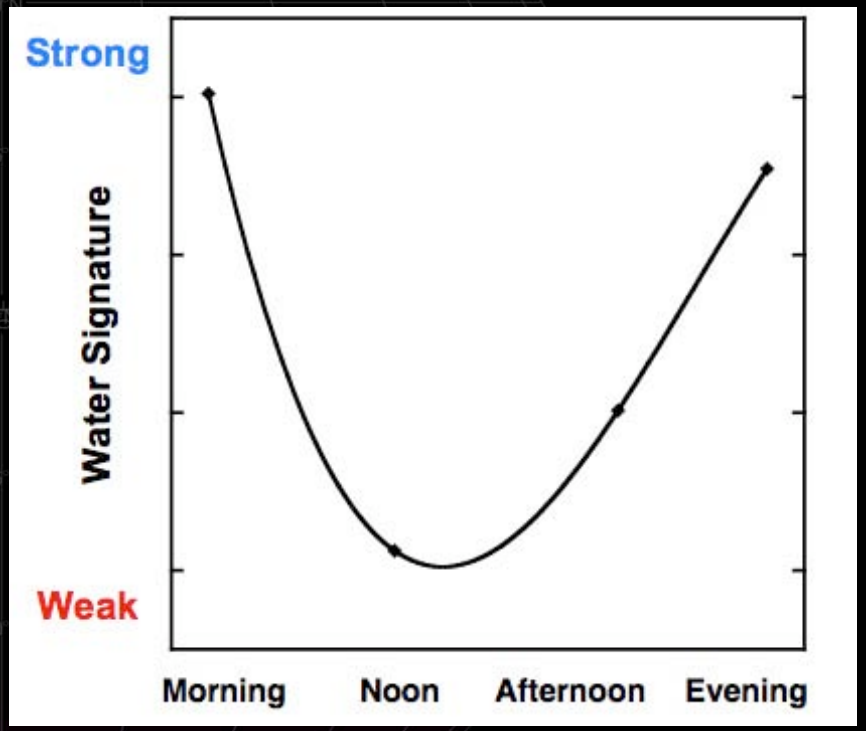
OH signature observed at 2.7 - 3.1 μm.

Strongest at high latitude - diurnally variable at low latitude



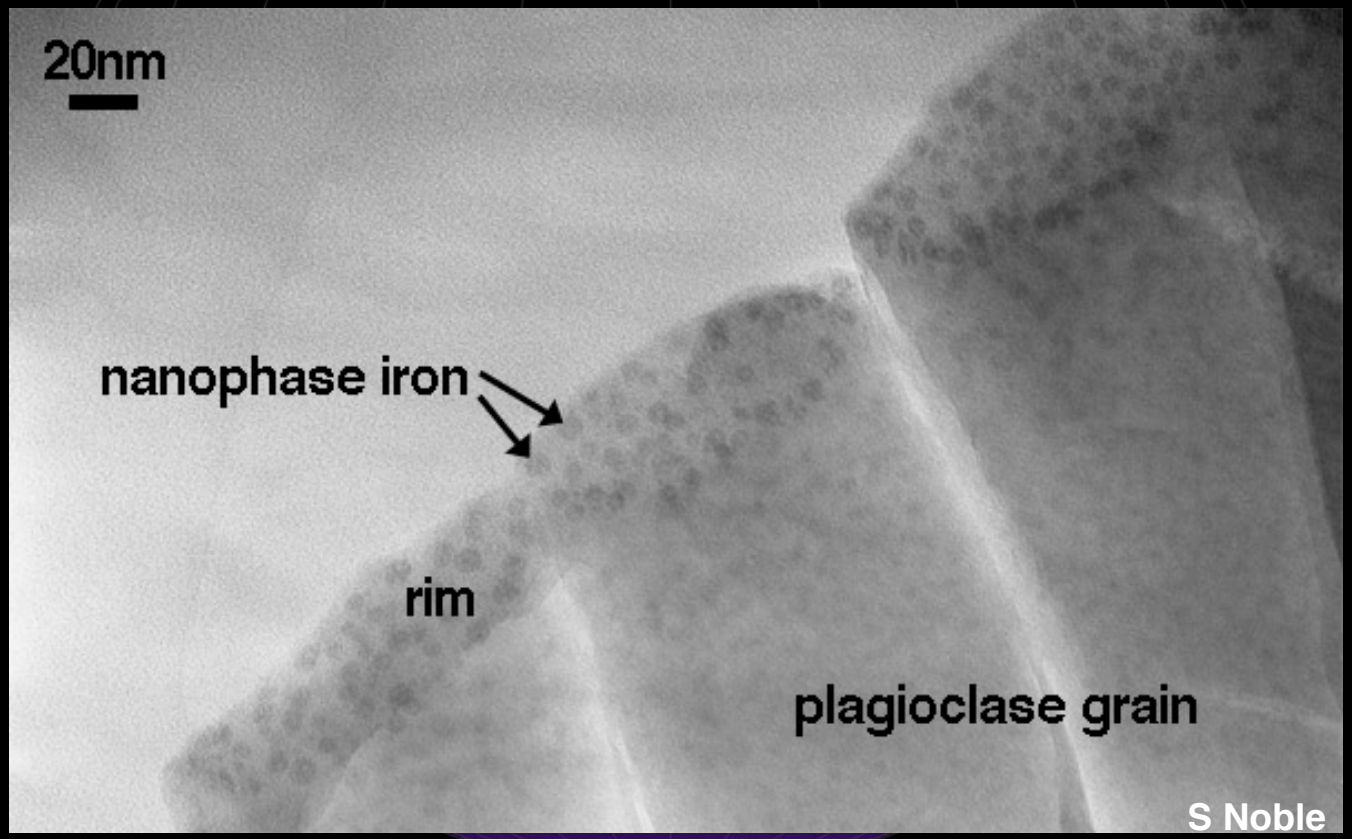


Sunshine *et al.*, 2009 Deep Impact Data; Qualitative diurnal variation in band depth

Hypothesis: Solar wind H^+ implantation; diurnal escape related to regolith temperature.

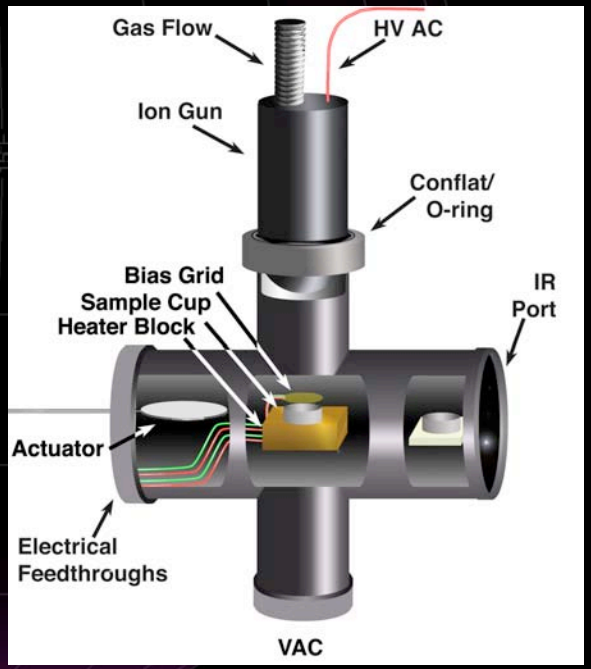
Most OH within O-depleted rims.

Laboratory and model study of hypothesis



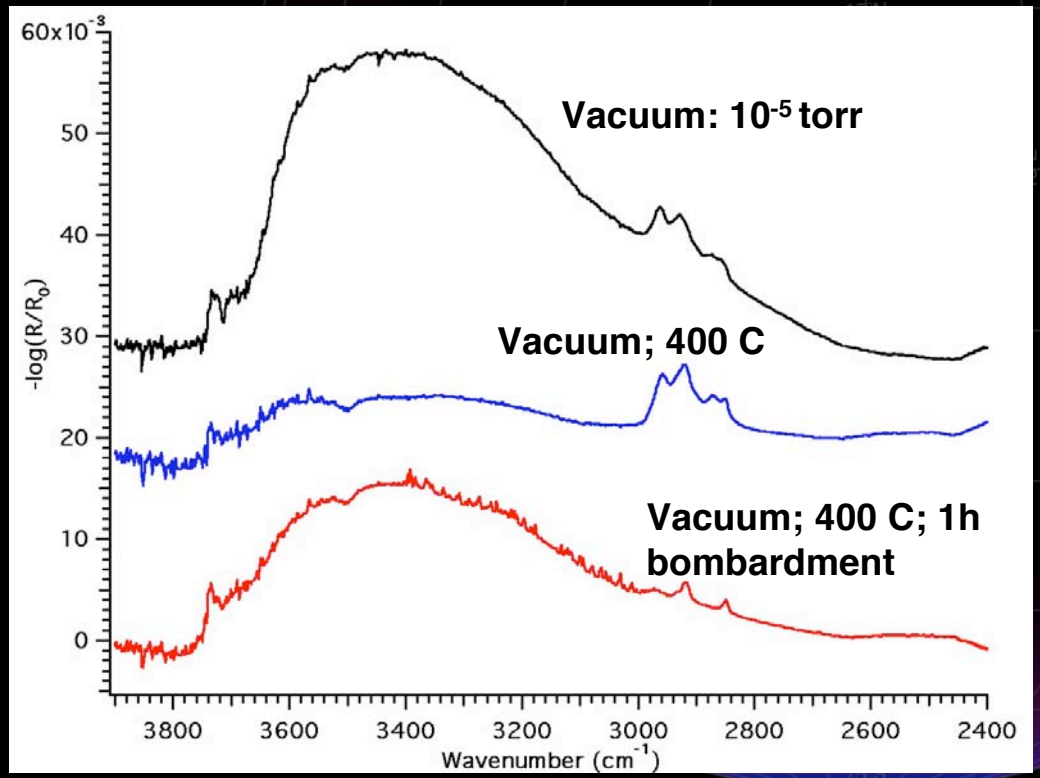
Iterative attempts to remove OH signature, and re-create via proton bombardment

H_2 ion gun; ~3 keV bias; 270 μA current



IR Apparent Absorbance measured after vacuum at room temperature; vacuum at 500°C, and after H_2 plasma treatment.

Elimination and recovery of OH signature - uncertainties due to initial spectral subtraction & problems dehydroxlating the quartz sample holder

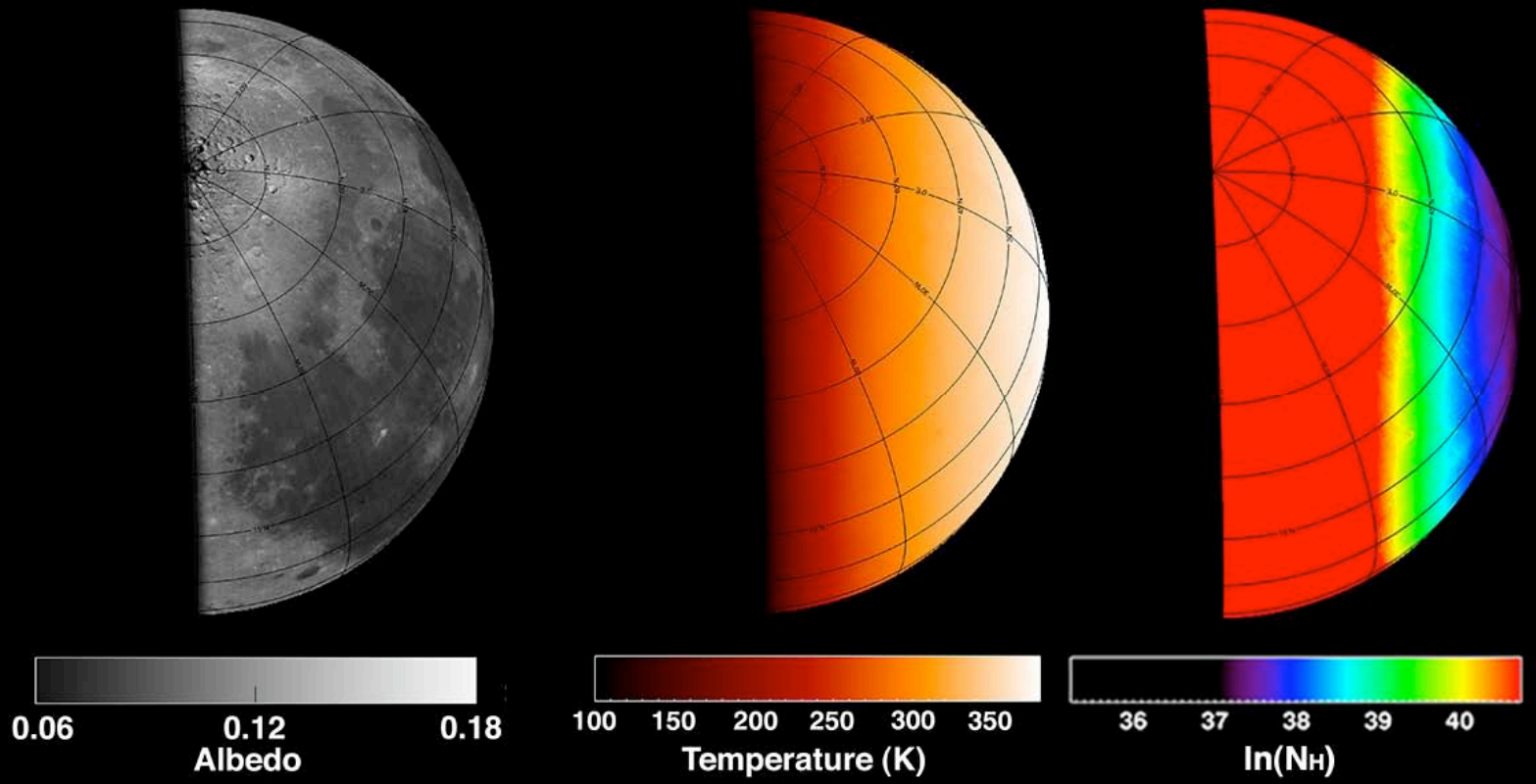


Apollo 17 soil

Can a simple model begin to reproduce the observations? Start with instantaneous equilibrium

Clementine 750 nm albedo map

$$T = \sqrt[4]{S(1-A)/\varepsilon\sigma} \qquad N_{OH} = j\tau_D$$



Introduce time-marching - can yield asymmetric OH abundance - dependent on D_V - an important measurement objective

$$N_{OH}^{t} - N_{OH}^{0} = Jt - D_v \frac{\partial OH}{\partial t} t; \quad D_v = Ae^{-E_a/RT}$$