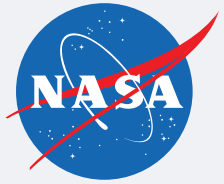
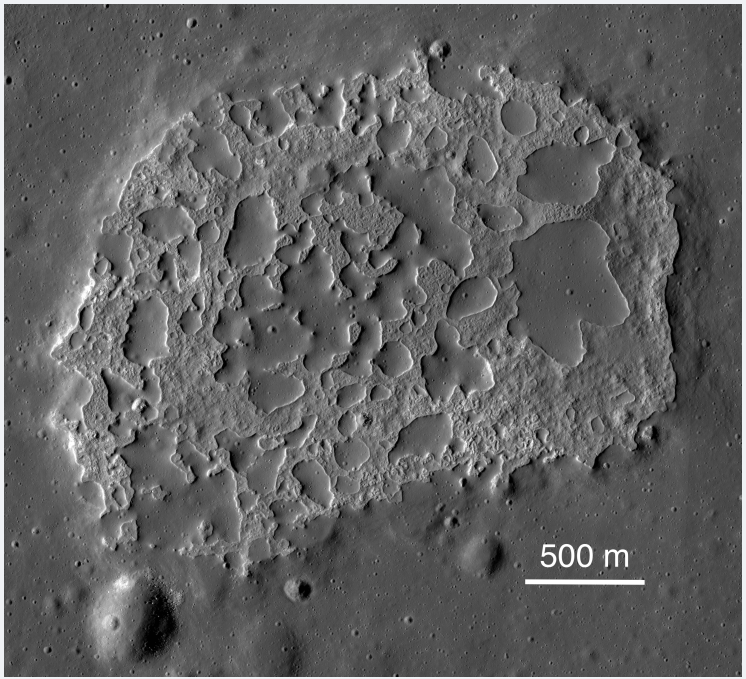


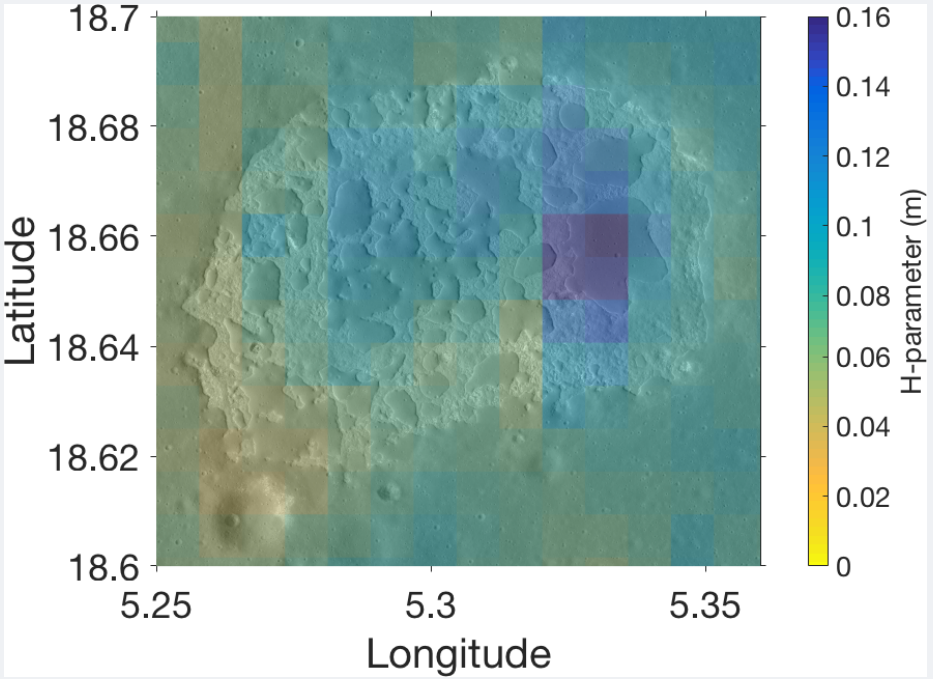
Thermophysical Properties of Lunar Volcanic Deposits

Catherine M. Elder[1], Paul O. Hayne[1], and Tim Glotch[2]

[1]Jet Propulsion Laboratory, California Institute of Technology; [2]Stony Brook University

Motivation





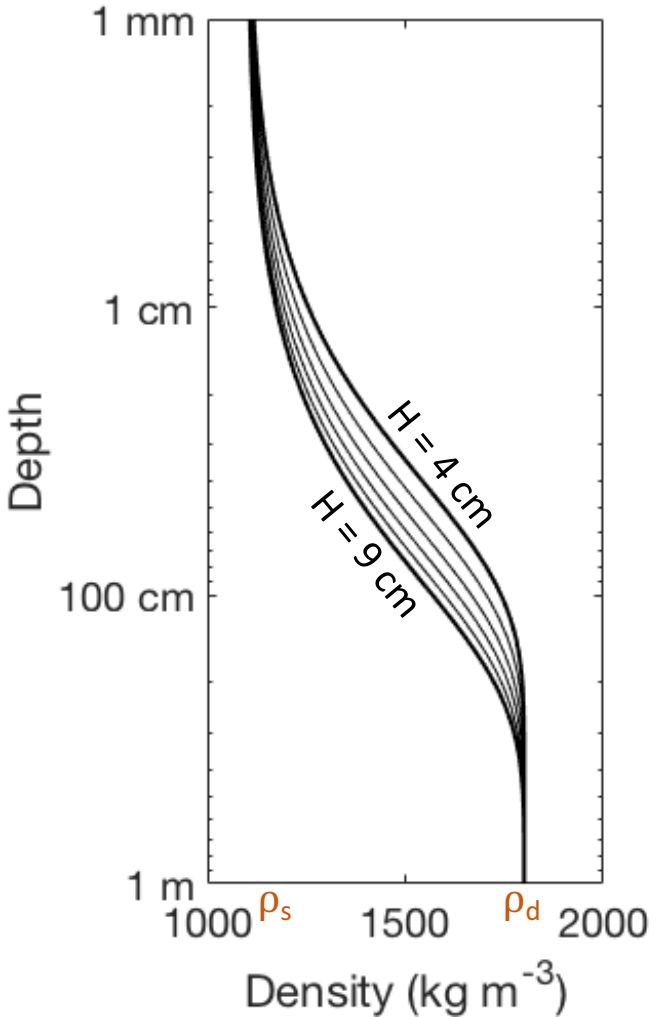
Elder et al. (2017)

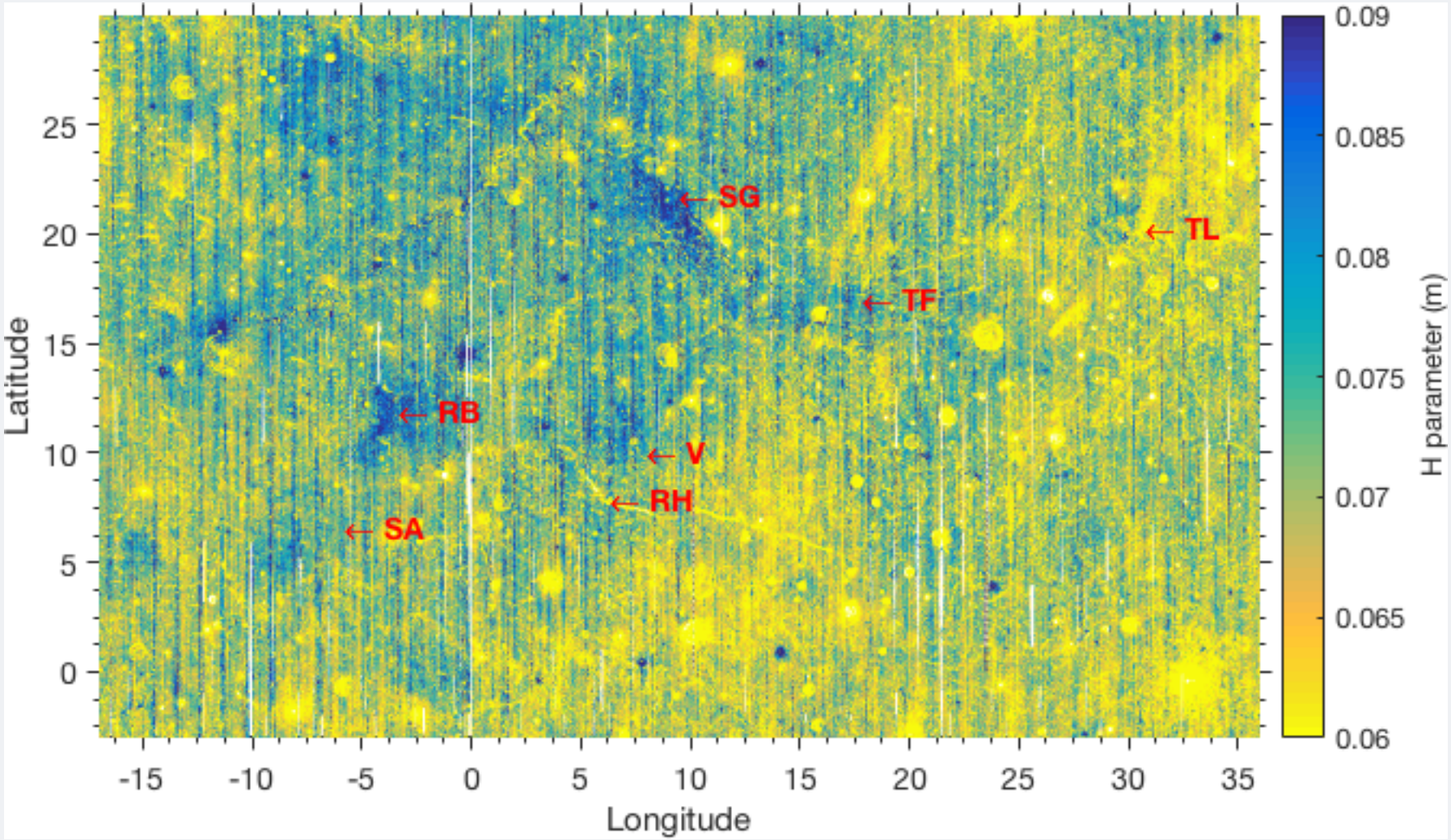
Pyroclastic Deposits

- Regional deposits:
  - formed through fire-fountain eruptions
  - composed of crystalline beads and/or glass beads
- Localized deposits:
  - formed through Vulcanian-style eruptions
  - incorporate a higher fraction of country rock
- Deposits of glass beads → lower thermal inertia than regolith
- Country rock would increase the thermal inertia

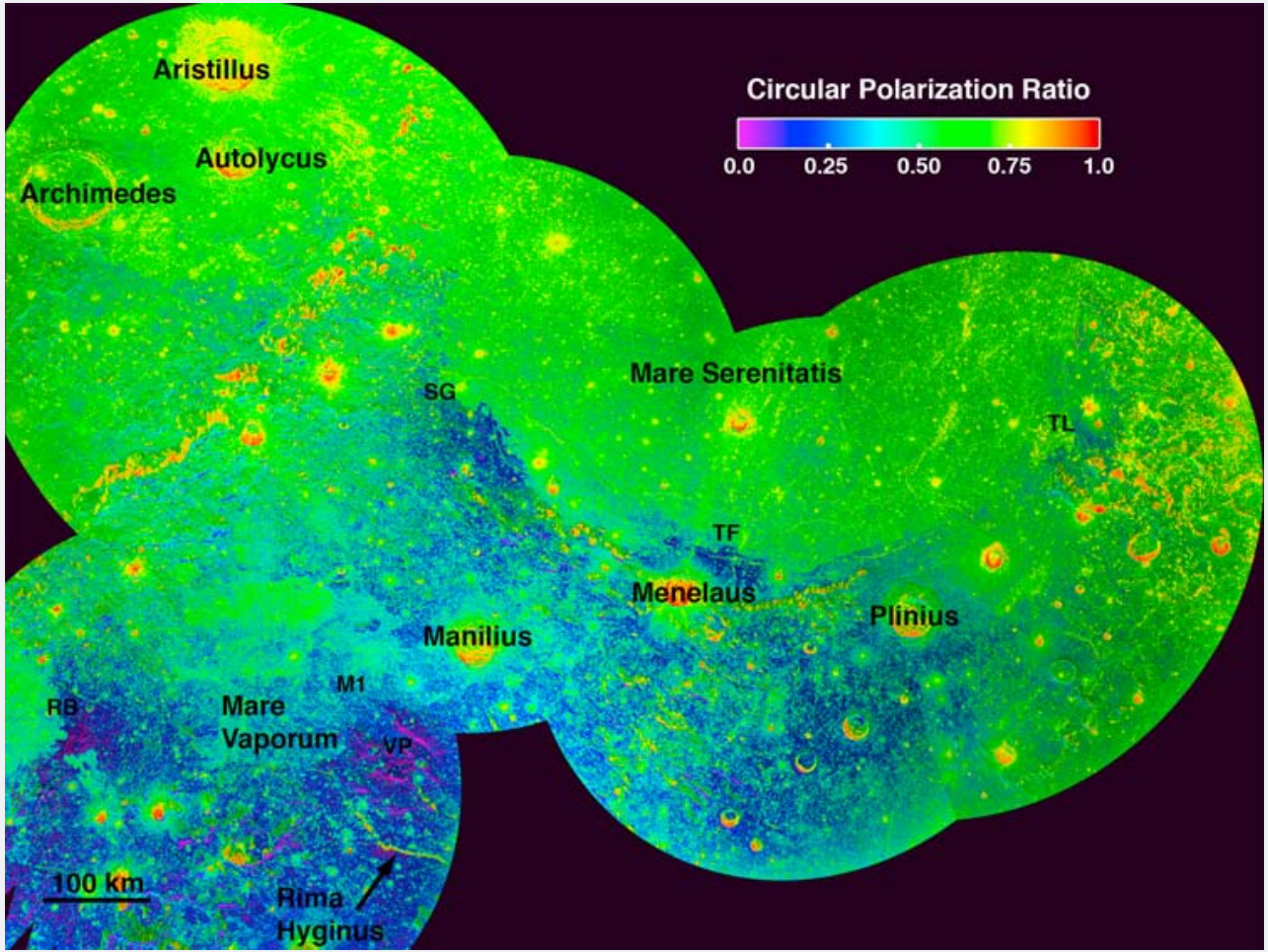
Methods

- Assume regolith density:
  $\rho(z) = \rho_d - (\rho_d - \rho_s)e^{-z/H}$
- Fit Diviner nighttime regolith temperature measurements from Bandfield et al. (2011)
- Temperatures exclude rocks >1 m
- Thermal inertia proportional to density
- Low H → high thermal inertia
- High H → low thermal inertia



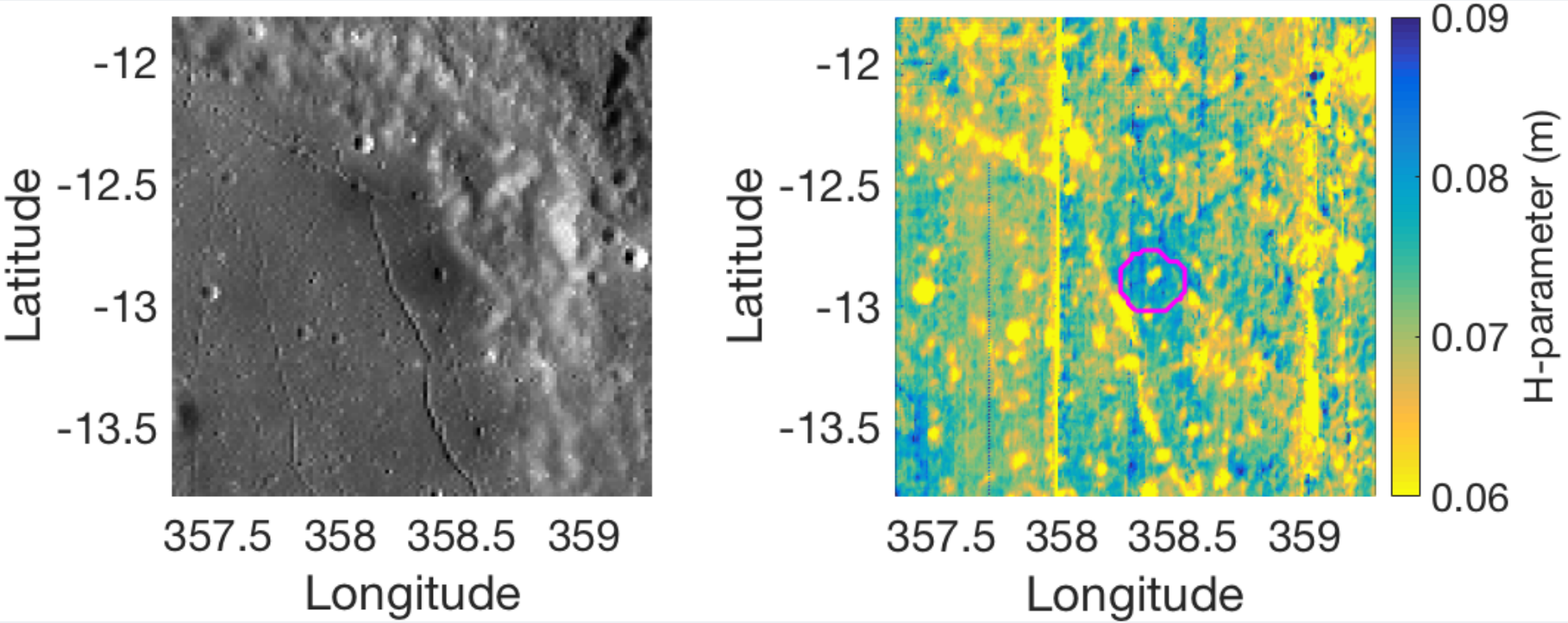

SG
TL
TF
RB
V
RH
SA
Latitude
Longitude
H parameter (m)
25
20
15
10
5
0
-15
-10
-5
0
5
10
15
20
25
30
35
0.09
0.085
0.08
0.075
0.07
0.065
0.06

Carter et al. (2009)



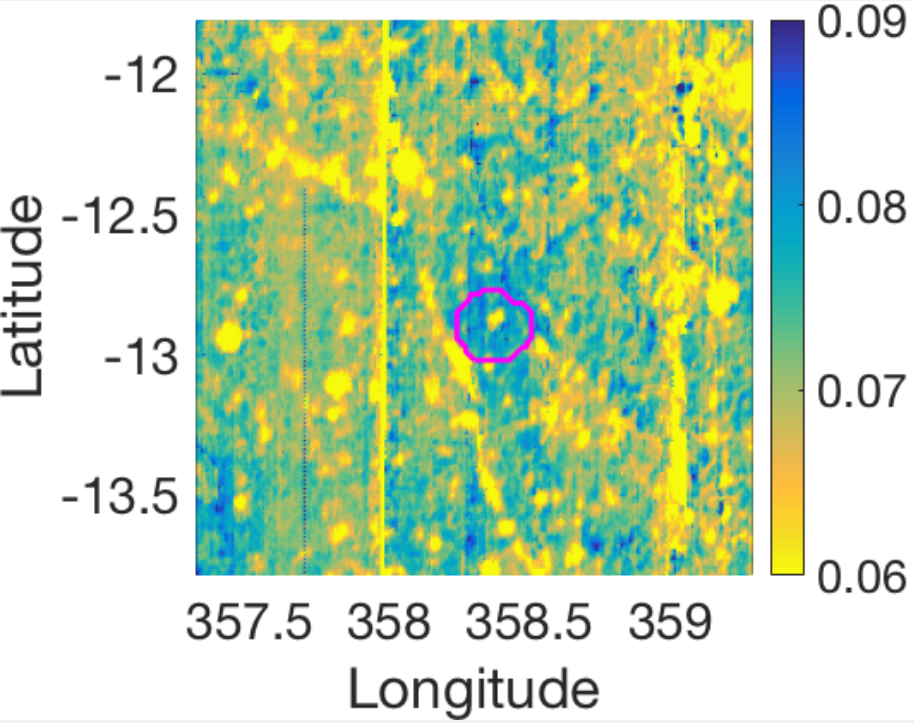
Localized Pyroclastic Deposits:

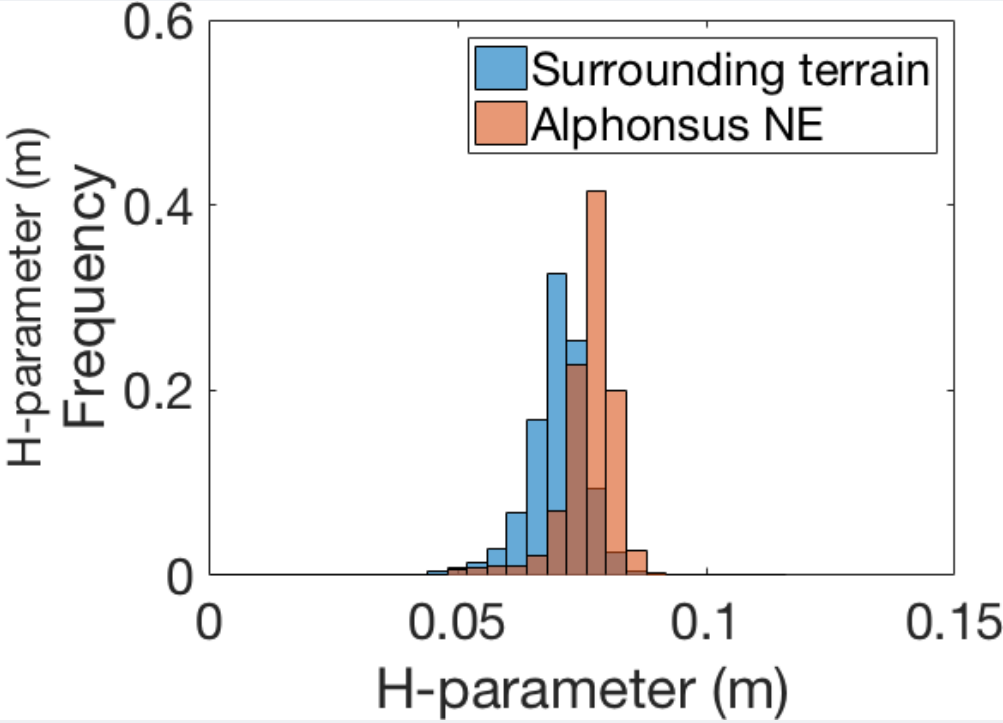
Alphonsus NE



Localized Pyroclastic Deposits:

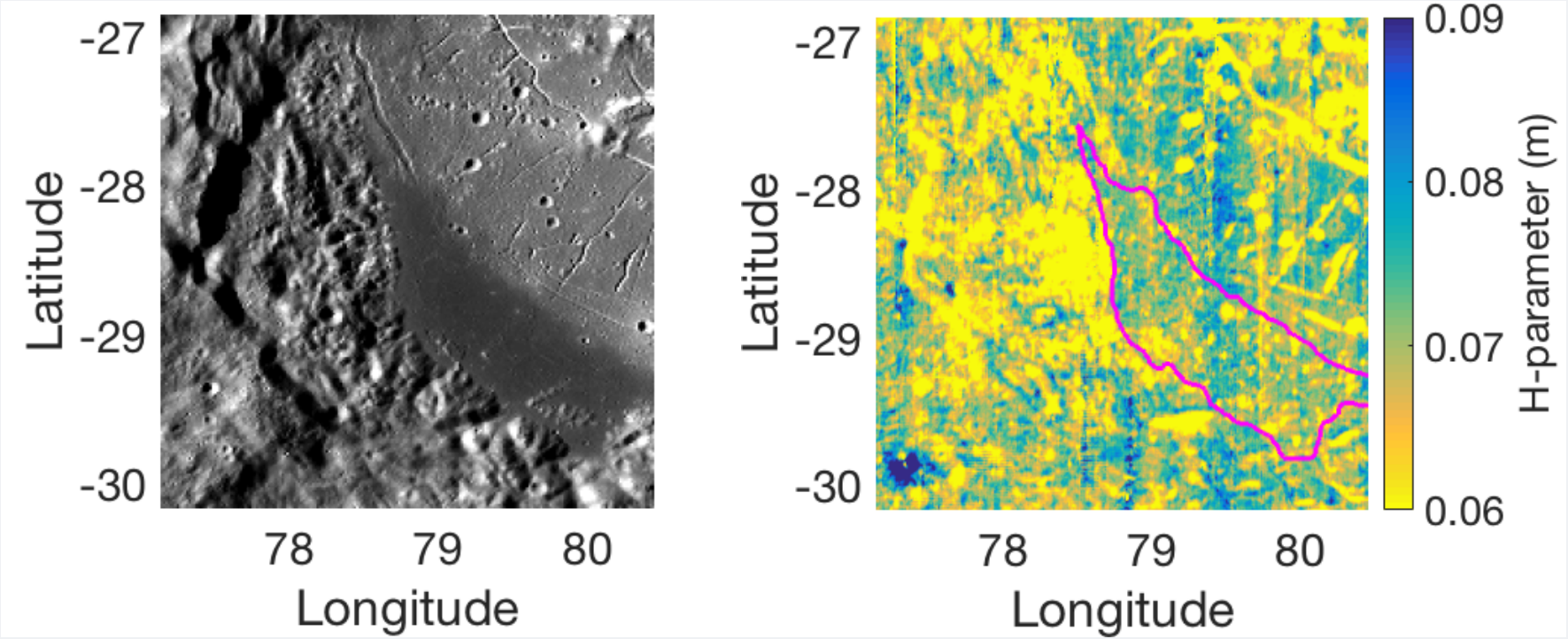
Alphonsus NE





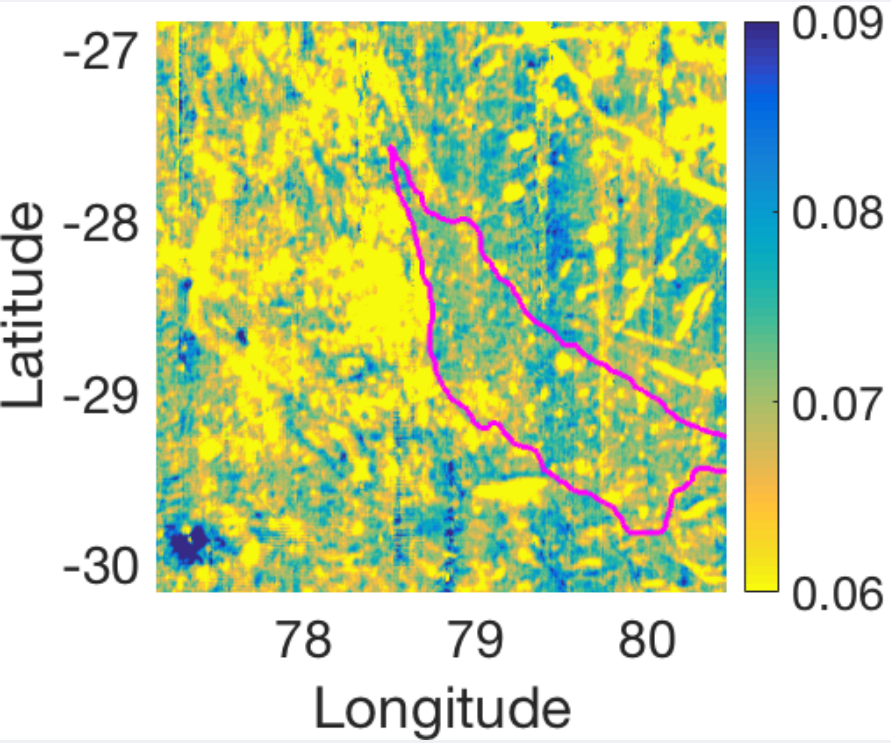
Localized Pyroclastic Deposits:

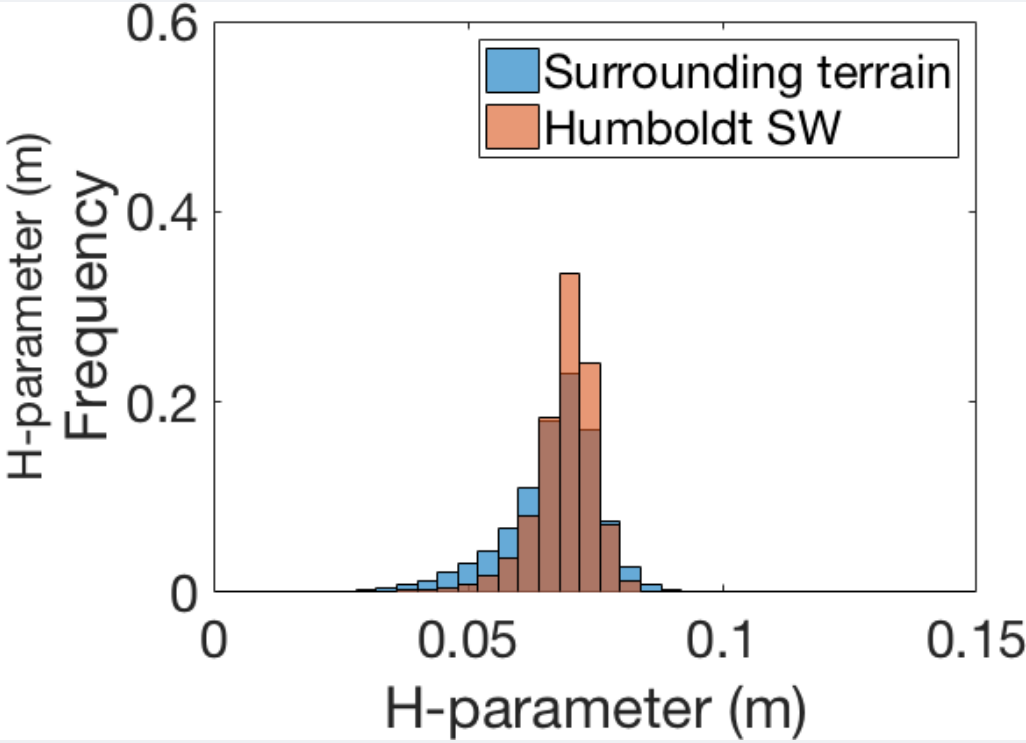
Humboldt SW



Localized Pyroclastic Deposits:

Humboldt SW





Localized Pyroclastic Deposits

Lack of thermal inertia anomaly means:

a) Thin; easily punctured by impacts

b) Small (in area); easily covered in rocks by nearby impacts or mass wasting of nearby slopes

– or –

c) Original eruption incorporated a significant amount of country rock

Implications for Ina

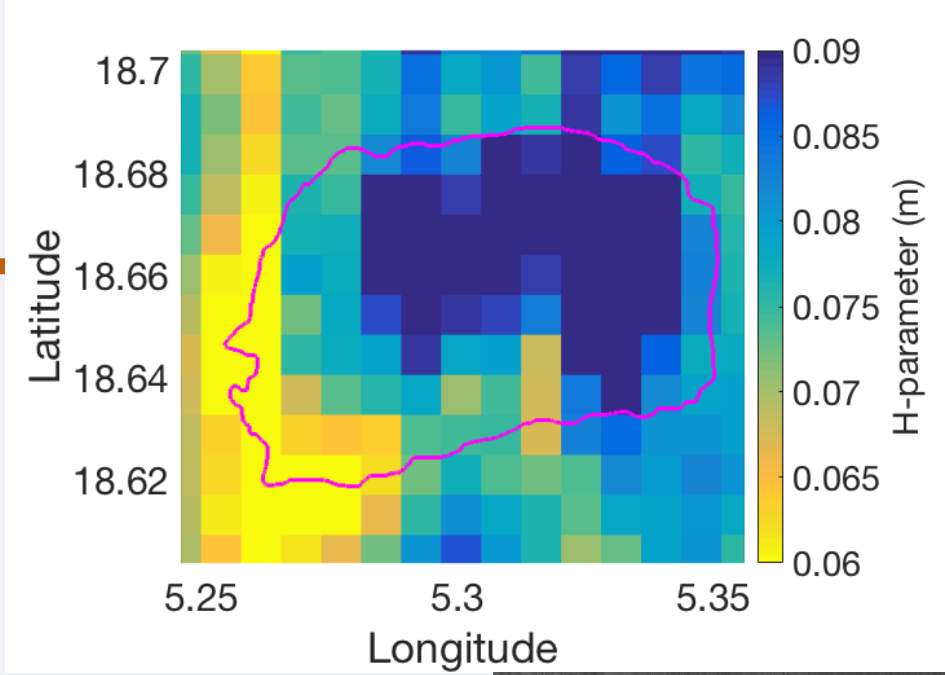
- Ina is younger than most localized pyroclastic deposits

  – or –

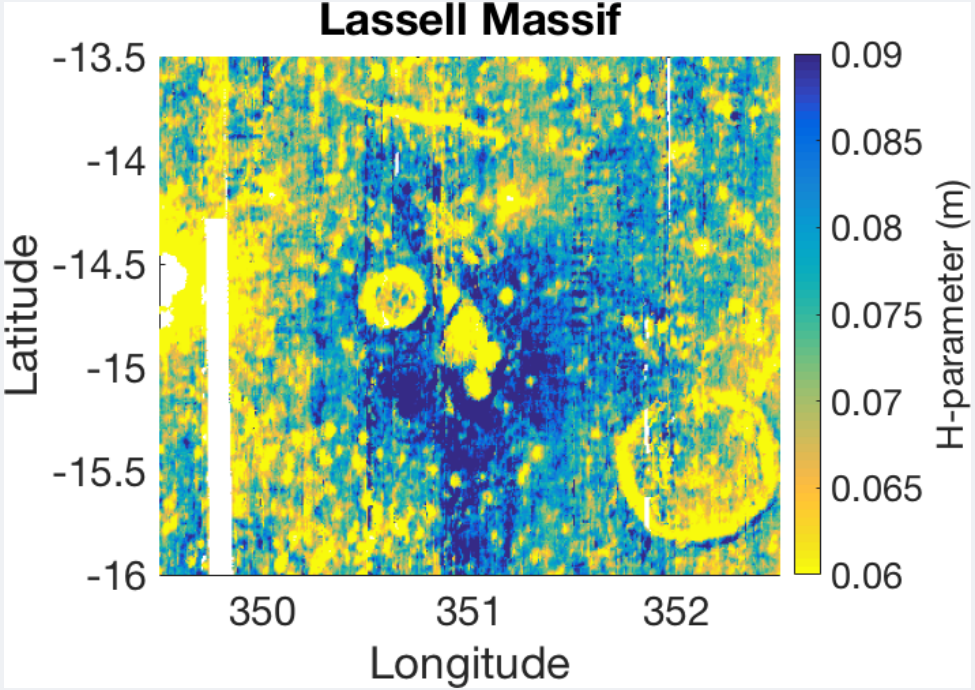
- Deposit at Ina is thicker

  – or –

- Deposit at Ina incorporated less country rock

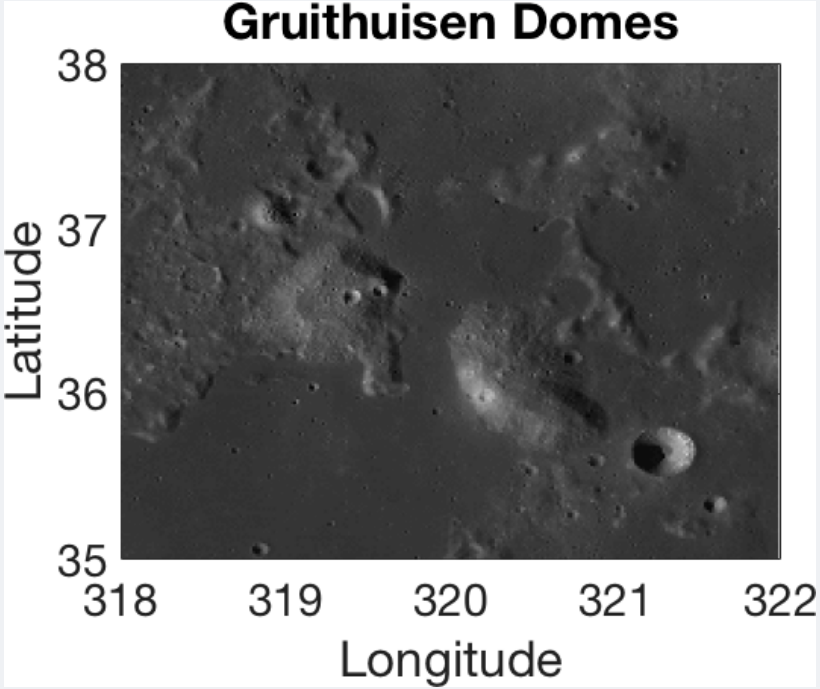


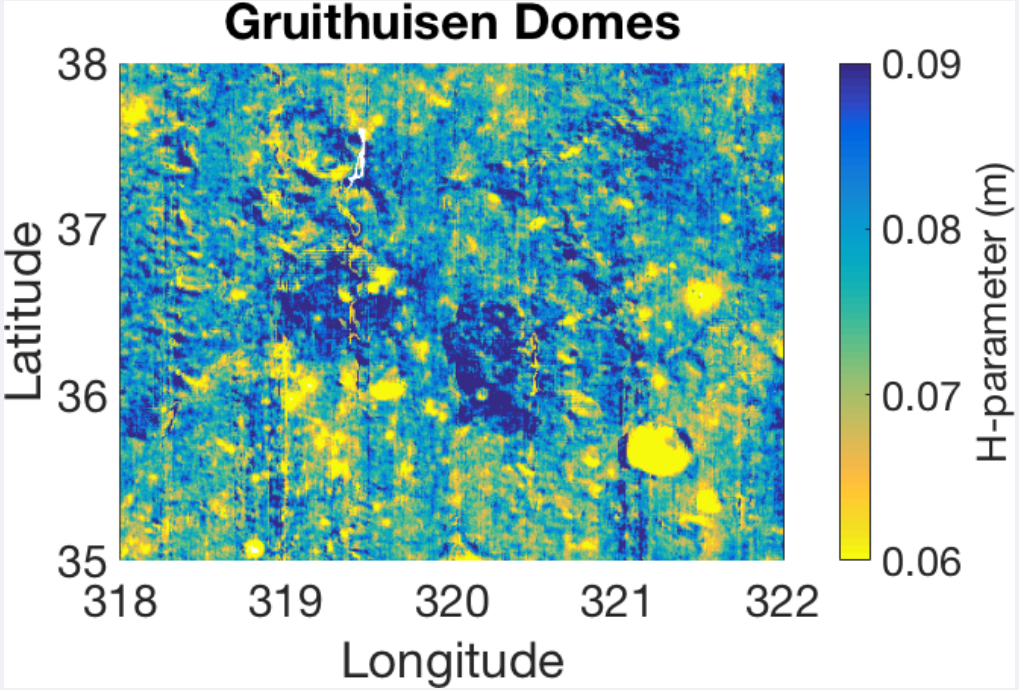
Lunar Red Spots



- Silicic (Glotch et al., 2010)
- Pyroclastic activity? (Ashley et al., 2016)
- Thermal inertia data – further evidence for pyroclastic activity

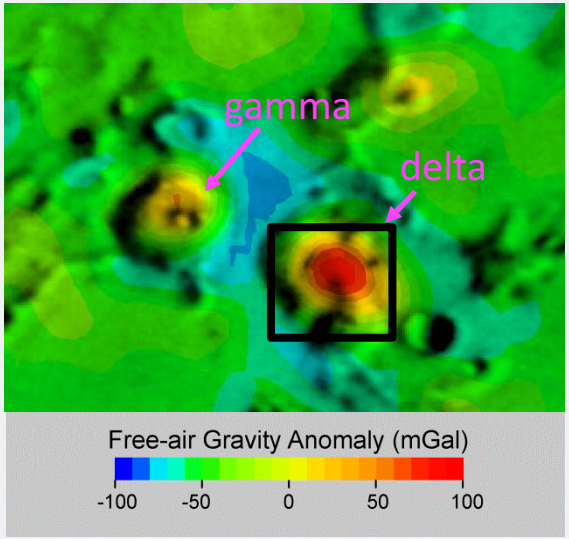
Lunar Red Spots





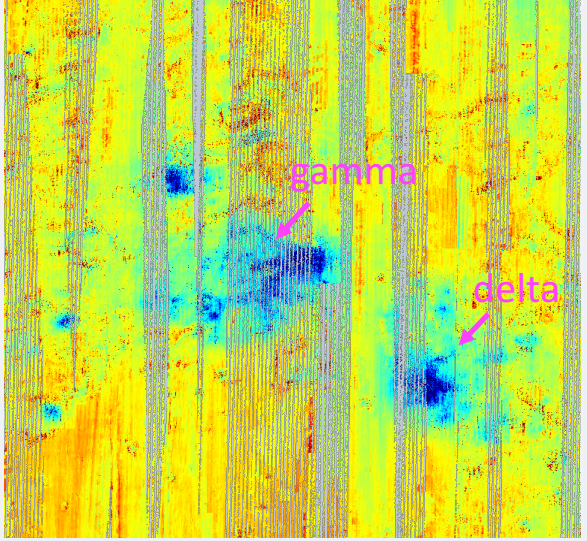
Free-air Gravity Anomaly (Kiefer et al., 2016):

Bulk density = 2150 kg m^{-3}

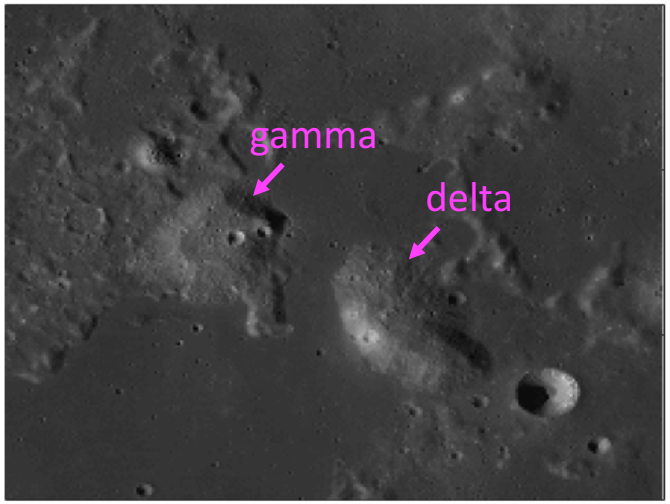


Christiansen Feature (CF) map:

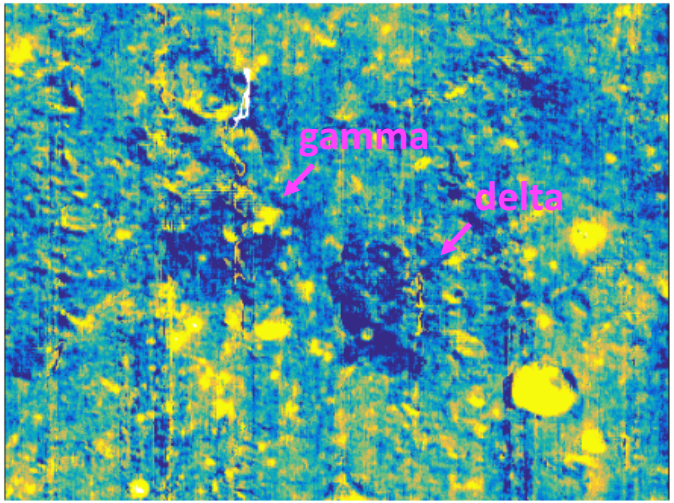
Blue = more silicic



LROC WAC:



Thermal Inertia:

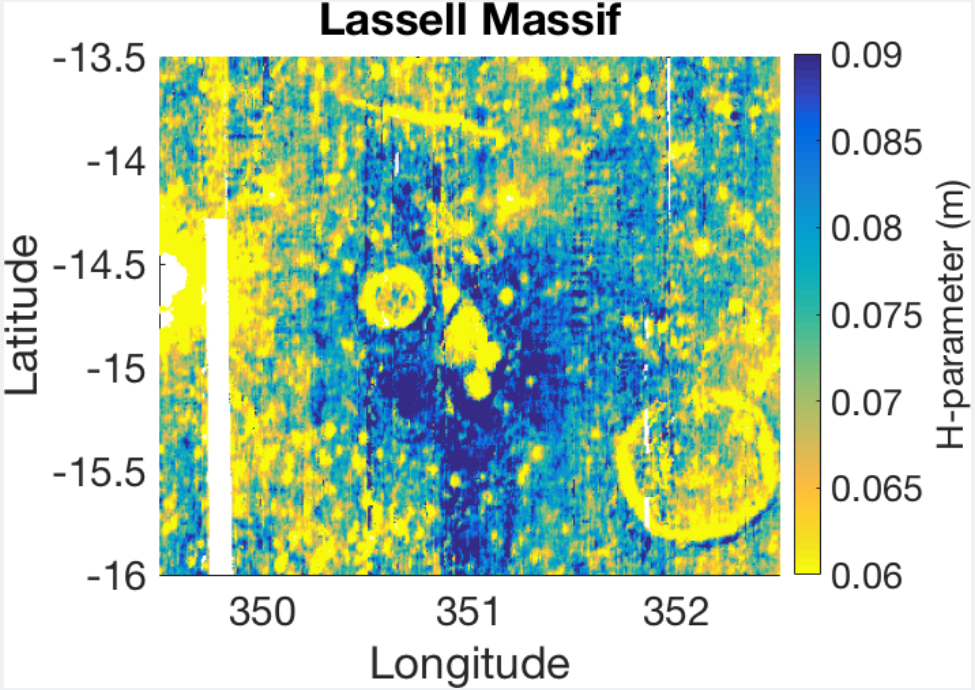


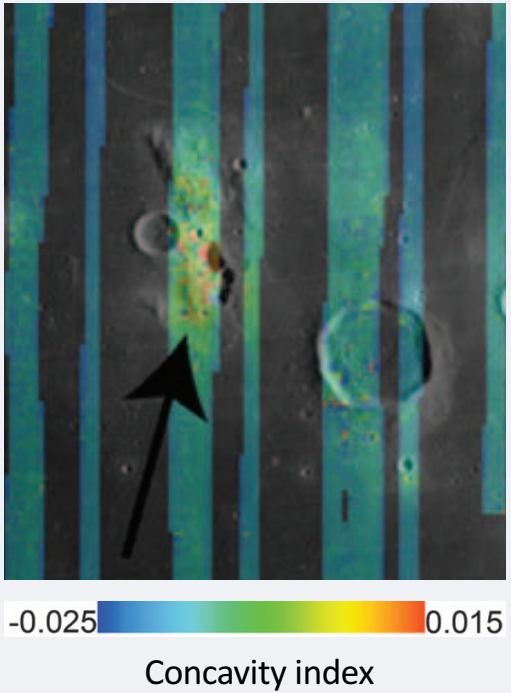
Conclusions

- Regional pyroclastic deposits have a lower thermal inertia than regolith
- Some localized pyroclastic deposits also have a lower thermal inertia than regolith, but some do not
  - Difficult to separate effects of eruption conditions from post emplacement modification
- Lunar red spots have a low thermal inertia – pumice?

Back up slides

Lunar Red Spots





Glotch et al. (2010)