

Thermophysical Properties of Lunar Red Spots

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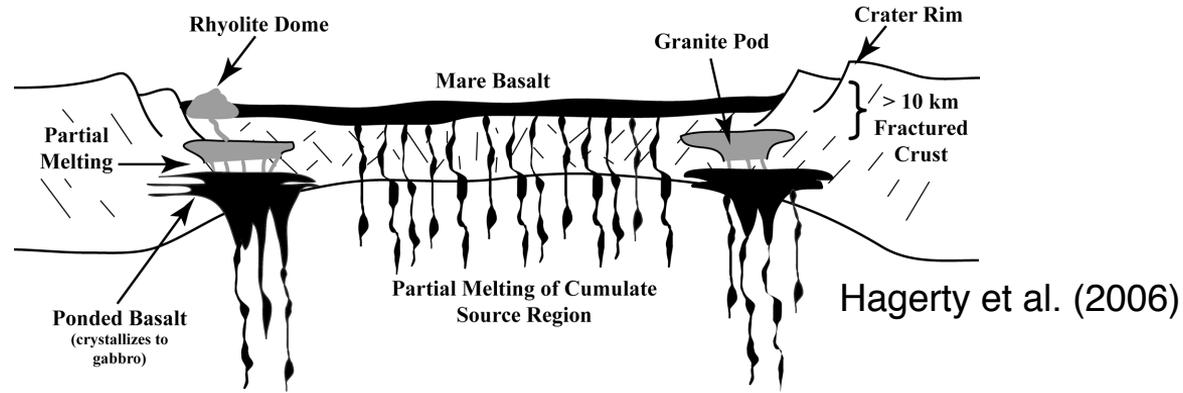
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Lunar 'Red Spots'



- Spectrally red
- Domes (with steep slopes and high albedos), smooth plains, shields, or rugged patches of highland material
- Generally pre-date mare volcanism

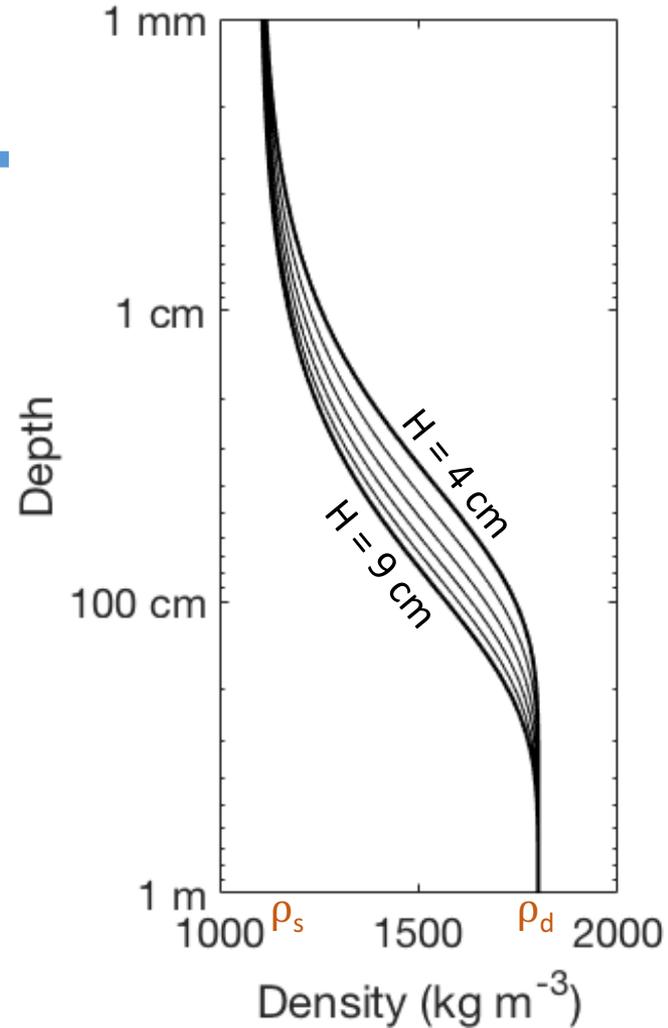
Lunar 'Red Spots'

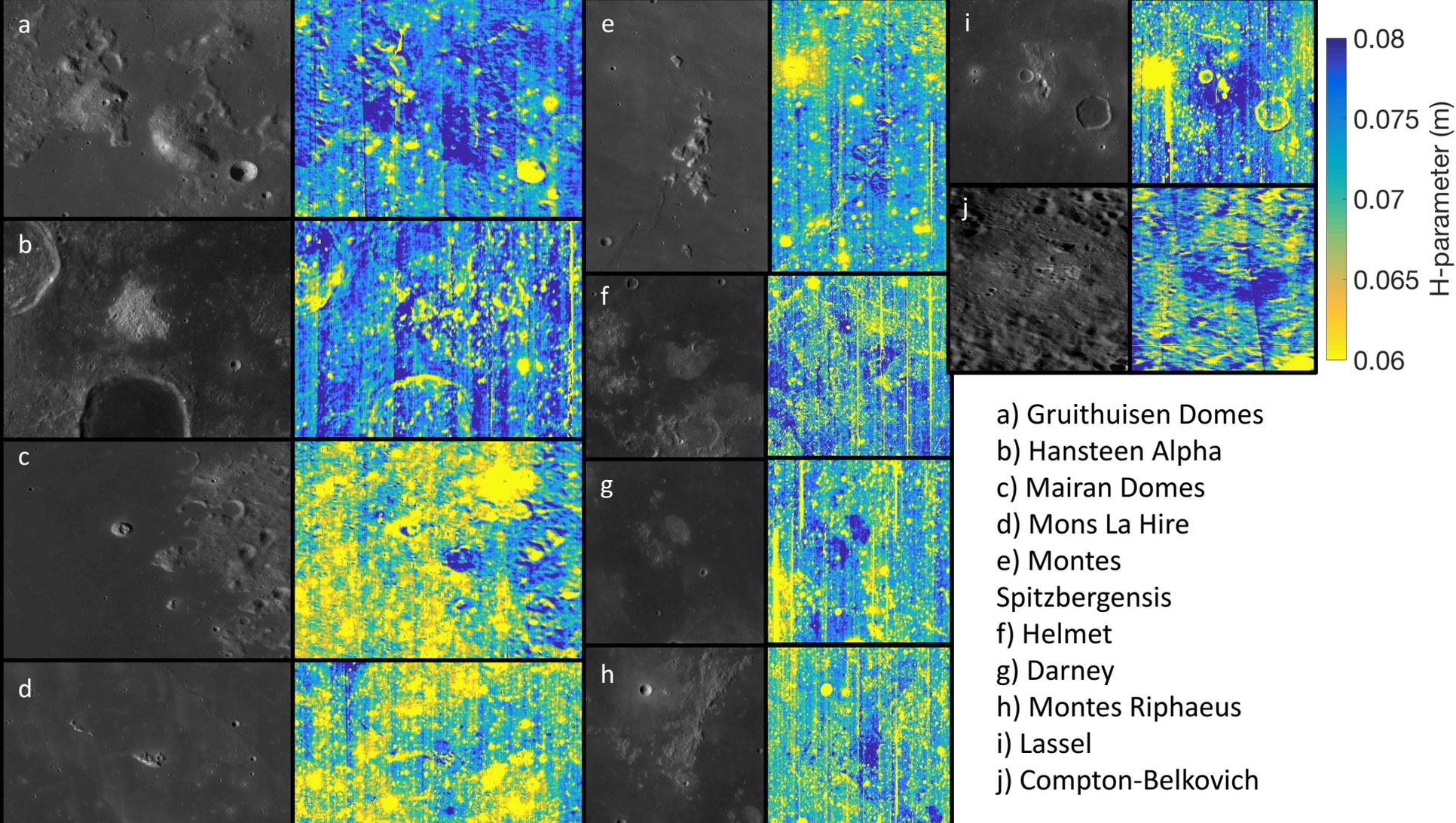


- Created by viscous lava similar to terrestrial dacites, basaltic andesites, or rhyolites
- Some are highly silicic, Th anomaly → 'evolved' composition
- Leading hypothesis: basaltic underplating
- Steep slopes should be rocky → high thermal inertia

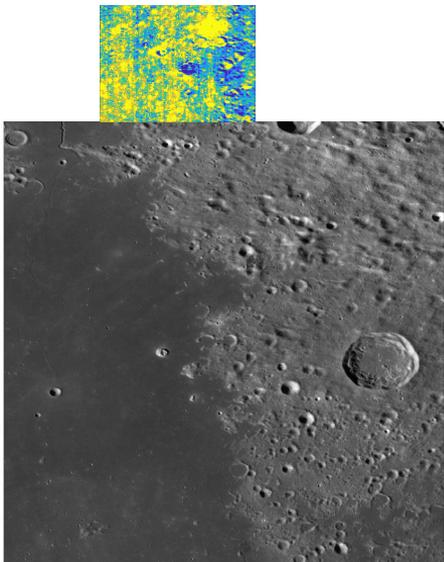
Methods

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

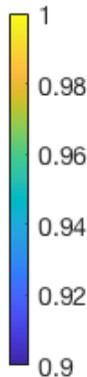
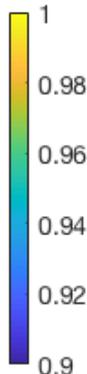
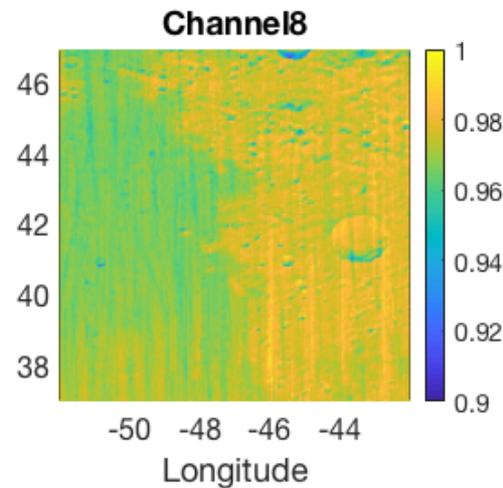
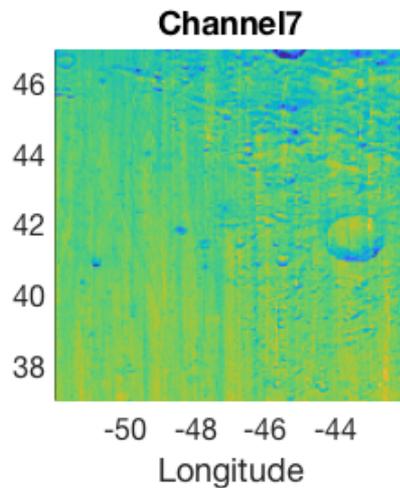
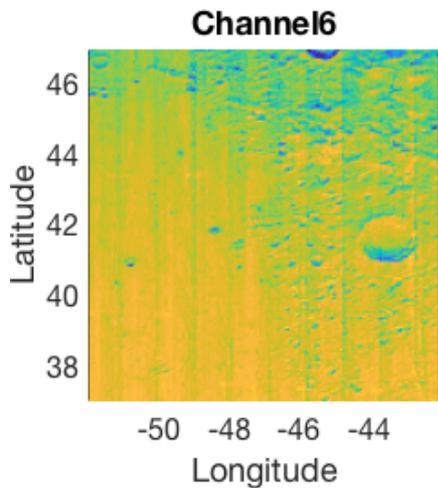
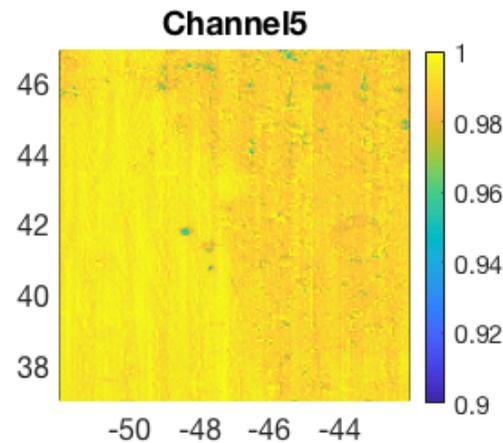
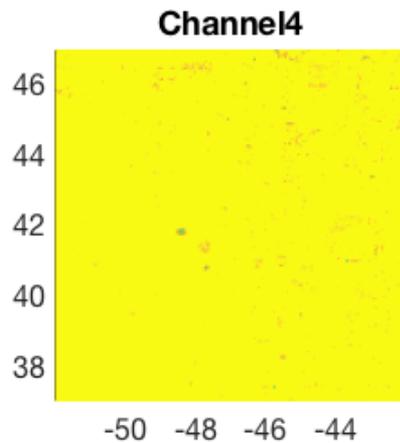
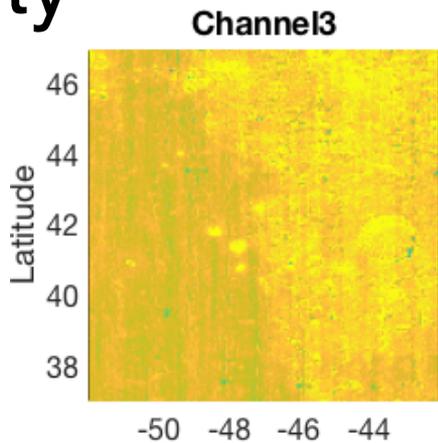




Emissivity

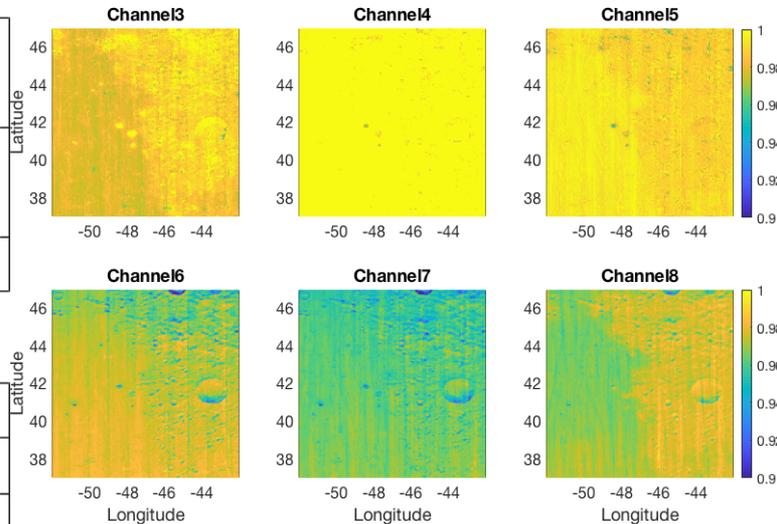
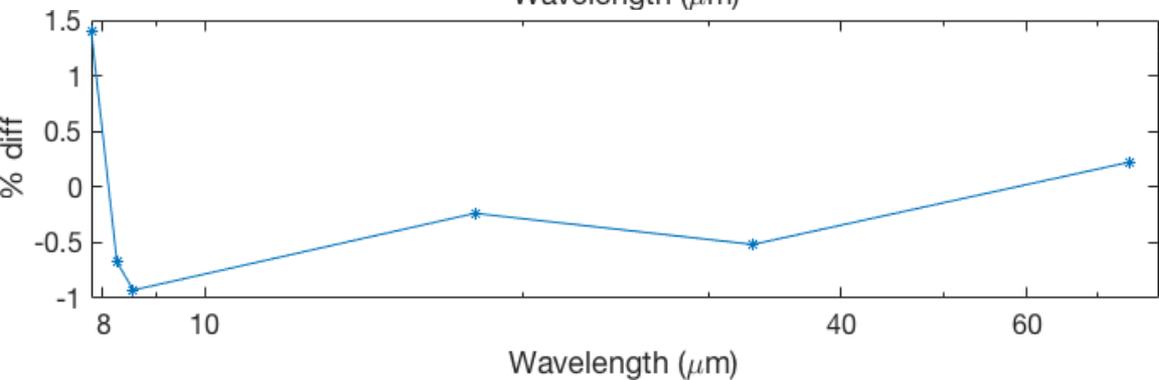
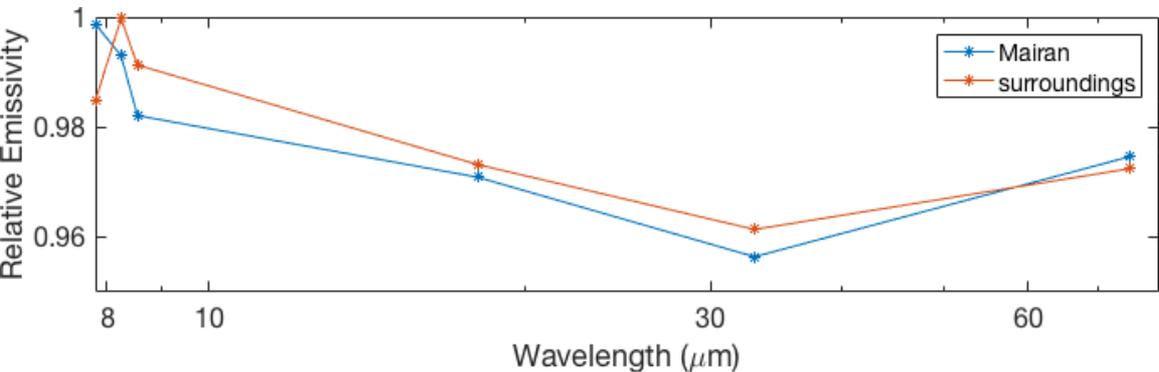


Mairan

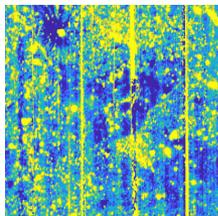


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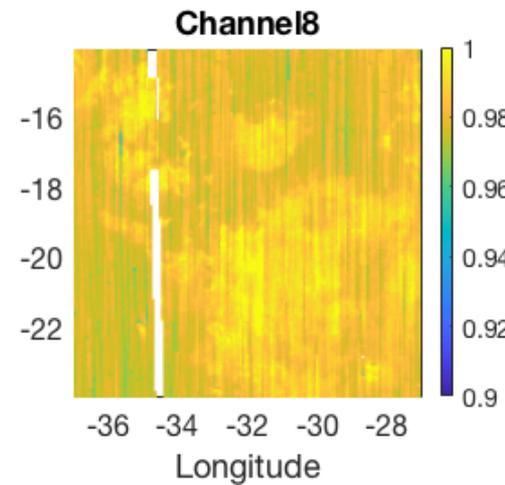
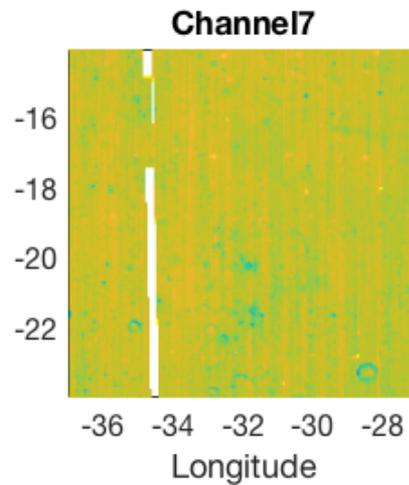
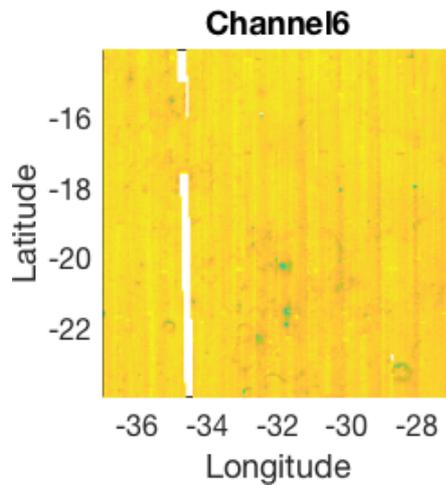
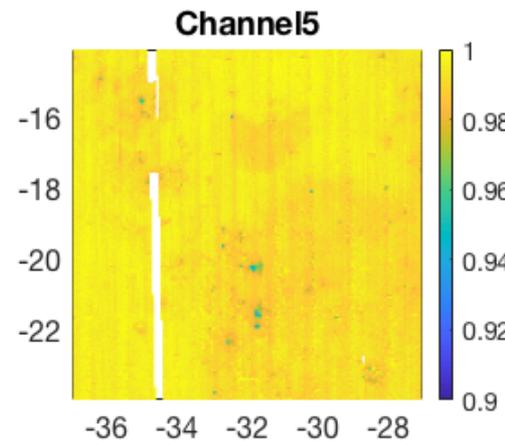
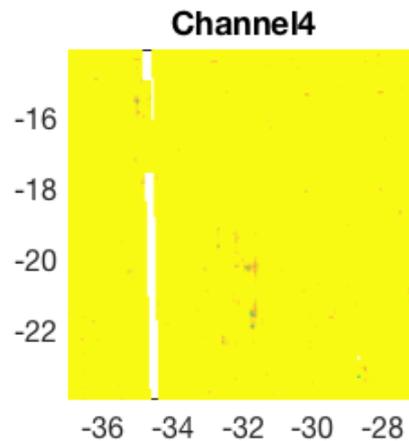
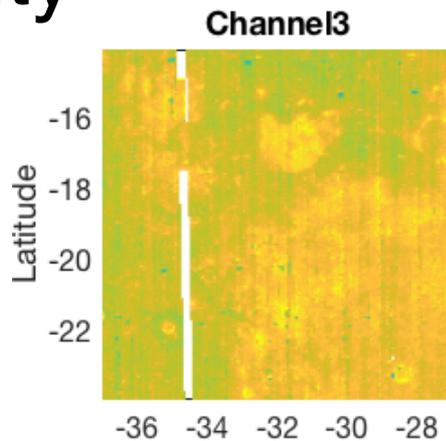
Mairan



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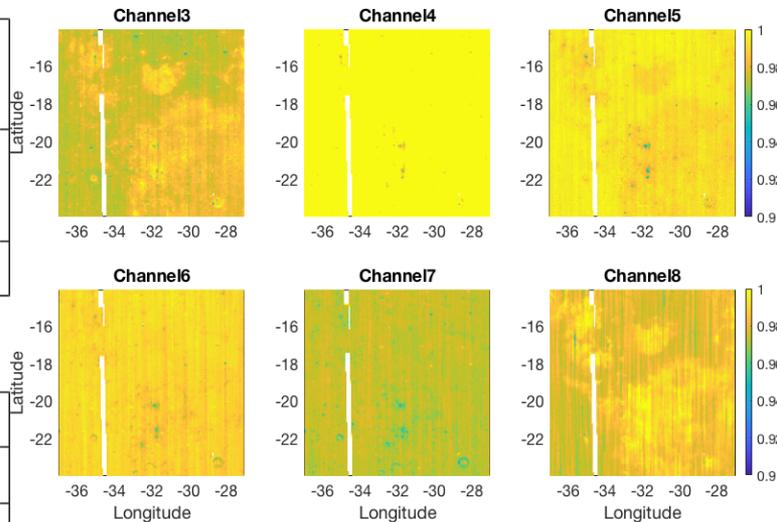
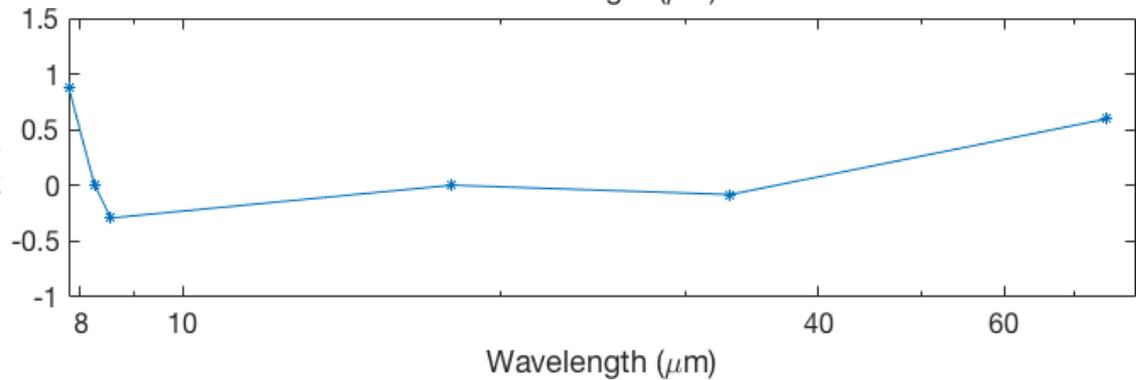
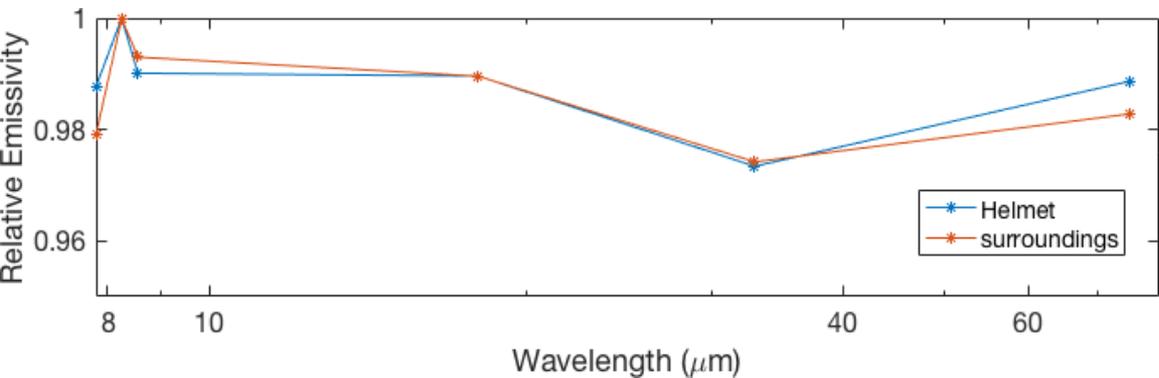


Helmet

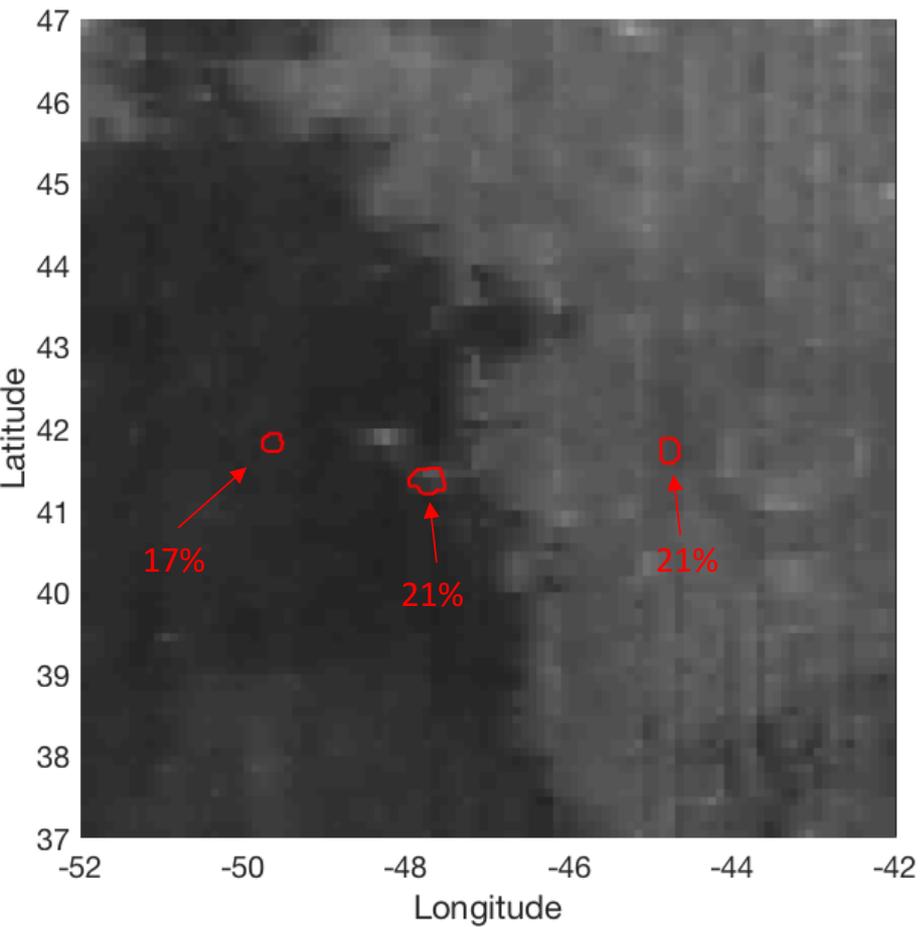


Emissivity

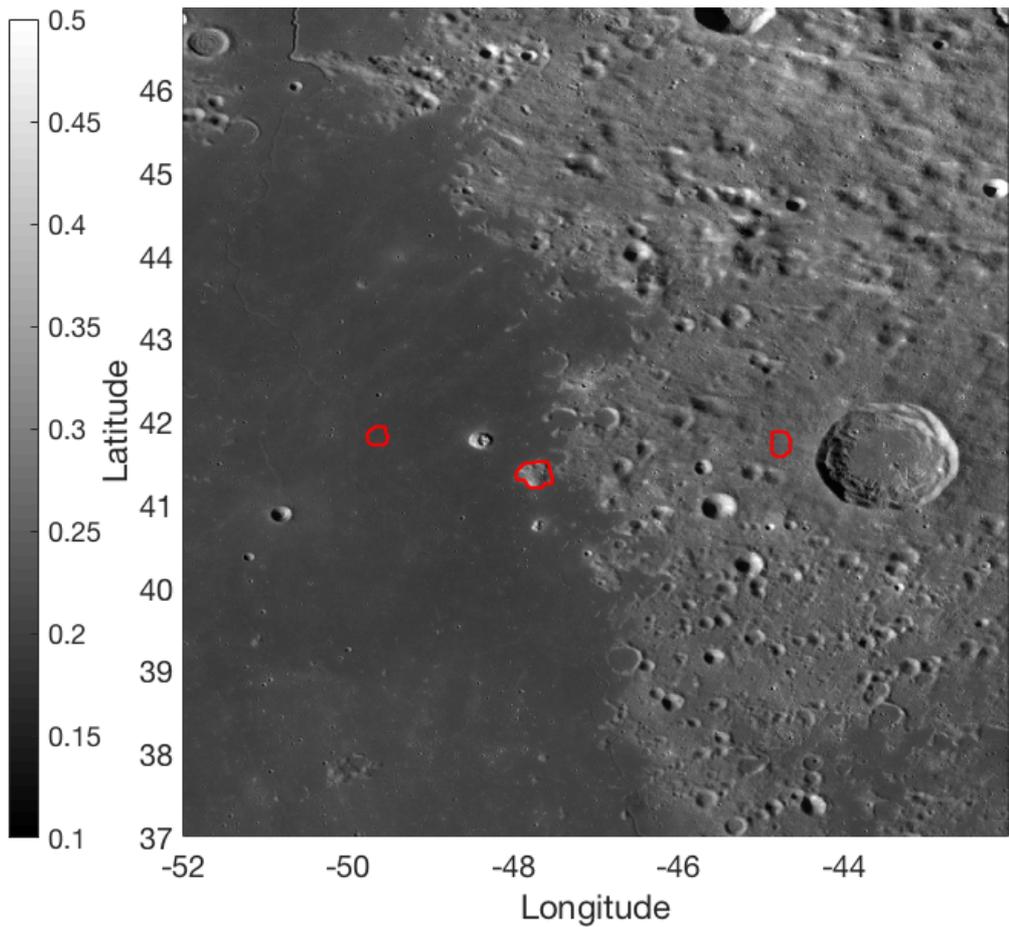
Helmet



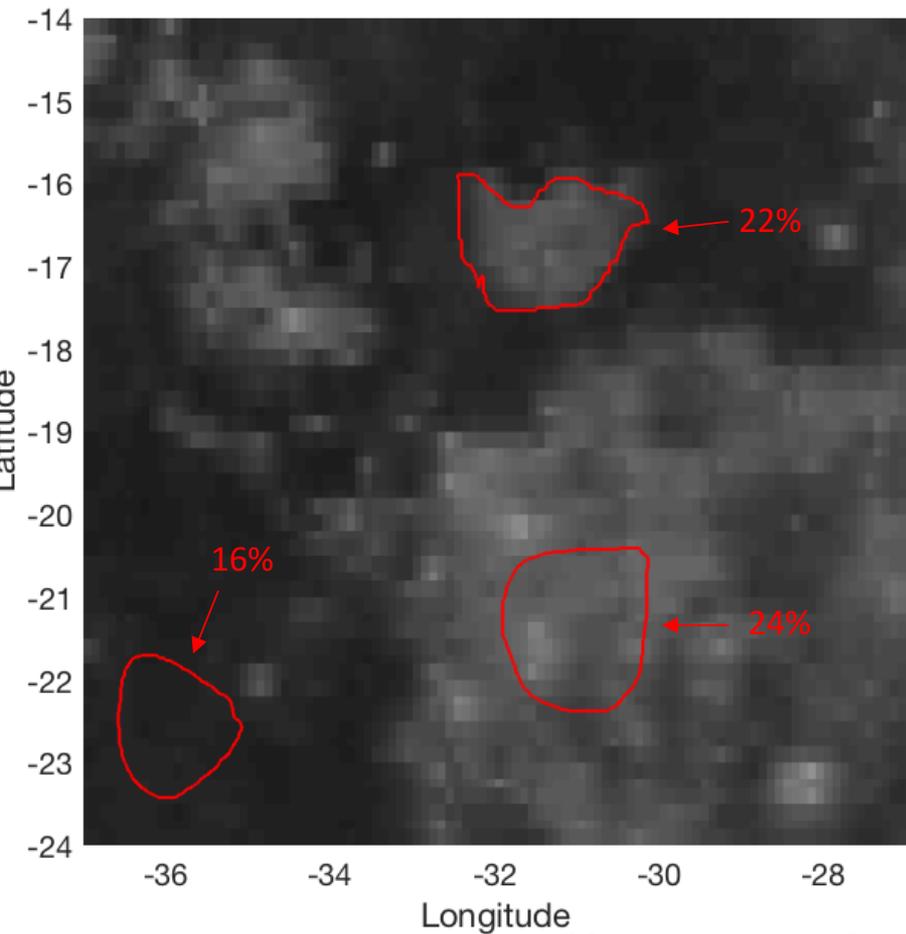
Albedo



WAC

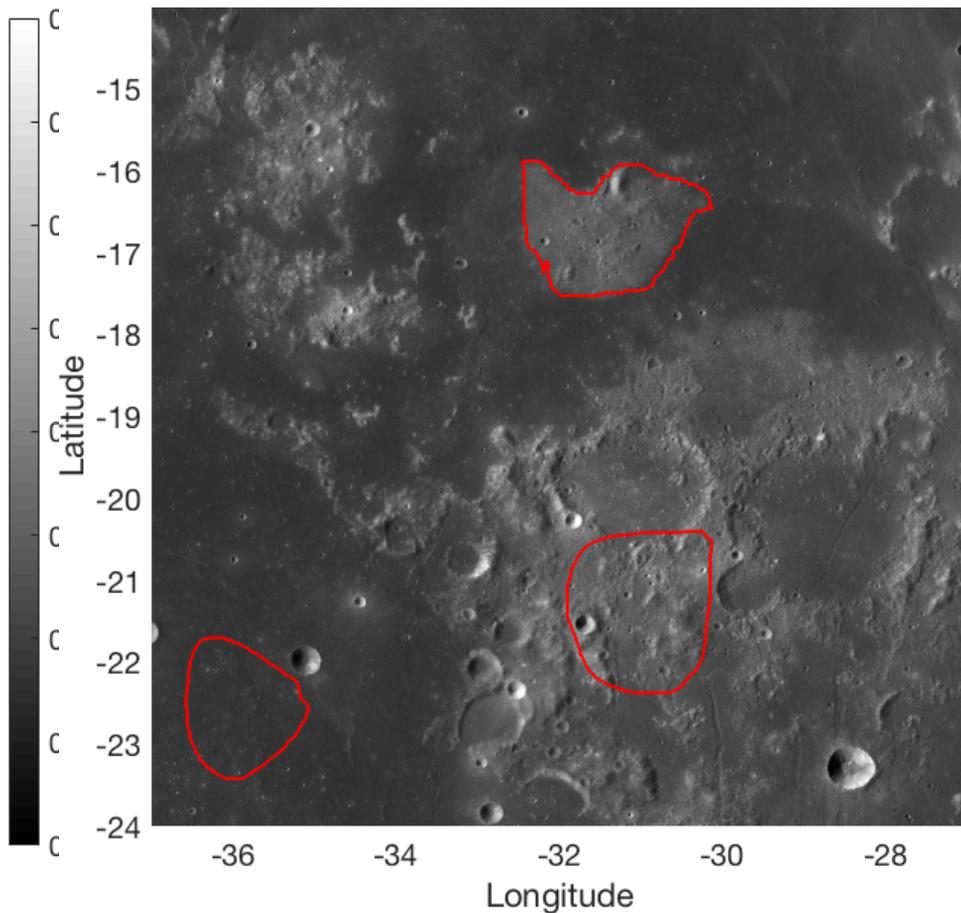


Albedo



Maria average = 19%

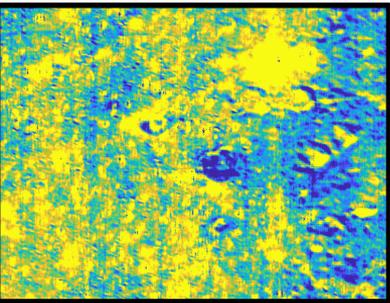
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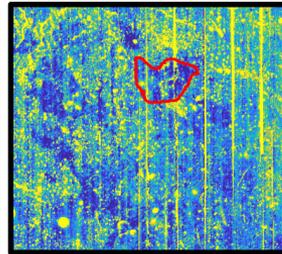
Highlands average = 30%

Albedo Uncertainty

- $\partial H / \partial T \approx 0.5 - 1 \text{ cm K}^{-1}$ (Hayne et al., submitted)
- $\partial T / \partial A \approx 0.2 \text{ K/\%}$ (Hayne et al., submitted)
- $\delta H = \left(\frac{\partial H}{\partial T} \right) \left(\frac{\partial T}{\partial A} \right) \delta A$



- Albedo uncertainty:
 - $\delta H_{Mairan} < 0.8 \text{ cm}$
- Observed anomaly
 - $\Delta H = 1.5 \text{ cm}$



- Albedo uncertainty:
 - $\delta H_{Helmet} < 1.2 \text{ cm}$
- Observed anomaly
 - $\Delta H = 0.7 \text{ cm}$

Preliminary conclusions

- High H at red spots could be due to albedo difference and/or a lower density
- Red spots are worst case scenario for the effects of albedo variation on H
 - small high albedo features surrounded by low albedo material

Future Work

- Generate a 128 ppd albedo map to use in H calculations
- Look at nighttime temperature curves instead of H
- Model effects of variation in albedo, H, and regolith thickness
- H-parameter anomaly due to pyroclastic deposits at Lassell massif?

