Explaining Bright Radar Reflections Below The Martian South Polar Layered Deposits Without Liquid Water

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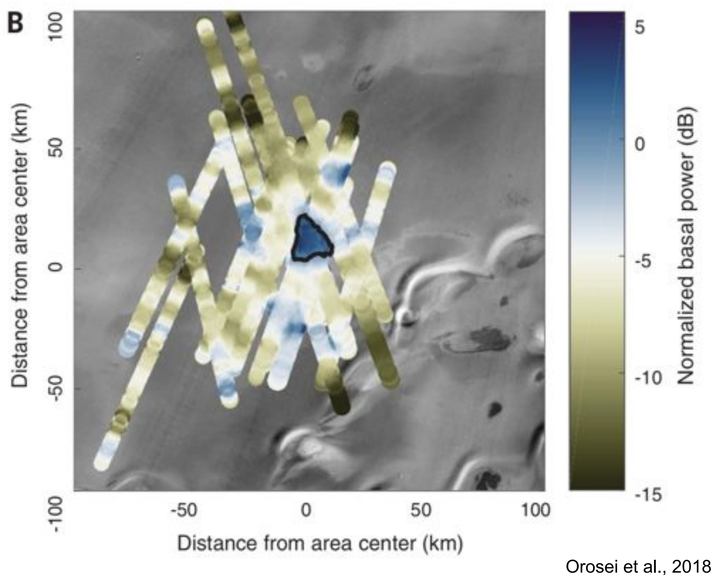
Zoom Link

Summary

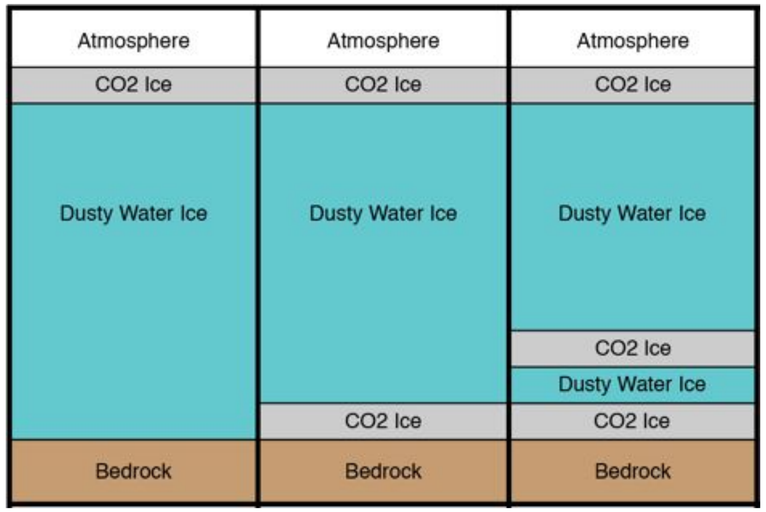
- Bright radar reflections were discovered below the Martian South Polar Layered Deposits (SPLD) using the MARSIS radar sounder
- Originally, the bright reflections were interpreted as evidence for liquid water
- However, that interpretation is not consistent with other evidence
- We suggest an alternative hypothesis, that bright basal reflections are caused by interference between thin layer boundaries



Orosei et al., 2018

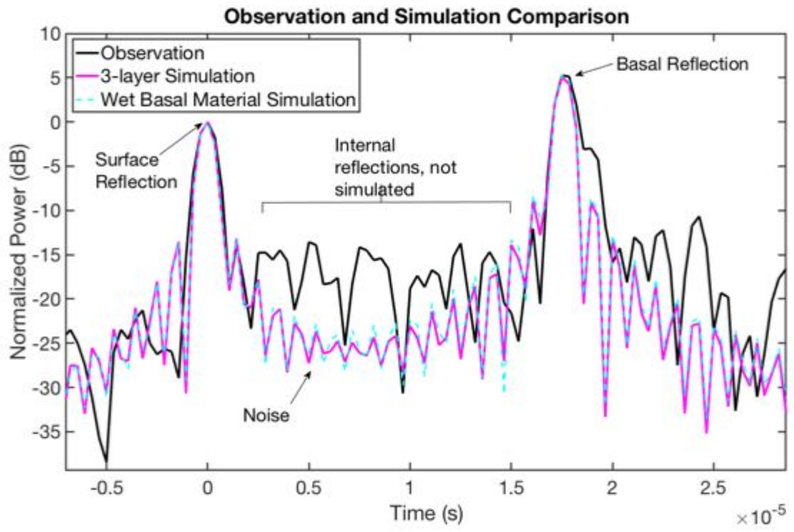
Observations and Previous Interpretation

- A localized area of the SPLD below ~1.5 km of ice was found to exhibit bright radar reflections at the basal interface
- Given the thickness of the ice cap, this should not have been possible with common dry materials, but could be explained by basal melting and liquid water
- Geothermal models do not predict temperatures capable of causing melt, even for brines
- Bright area is not consistent with lake locations predicted by basal topography



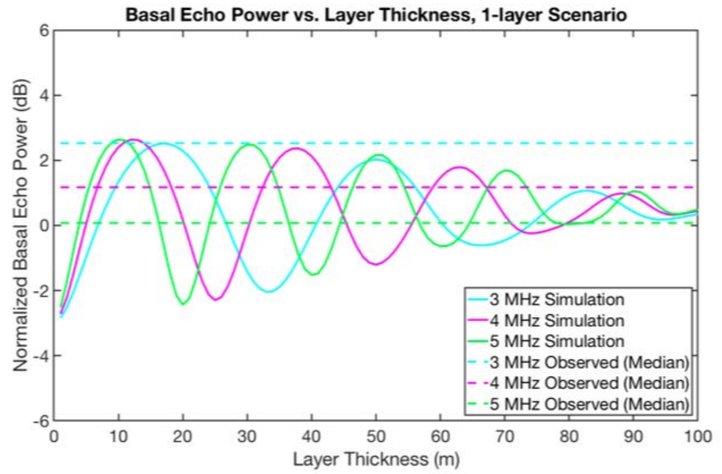
A New Hypothesis

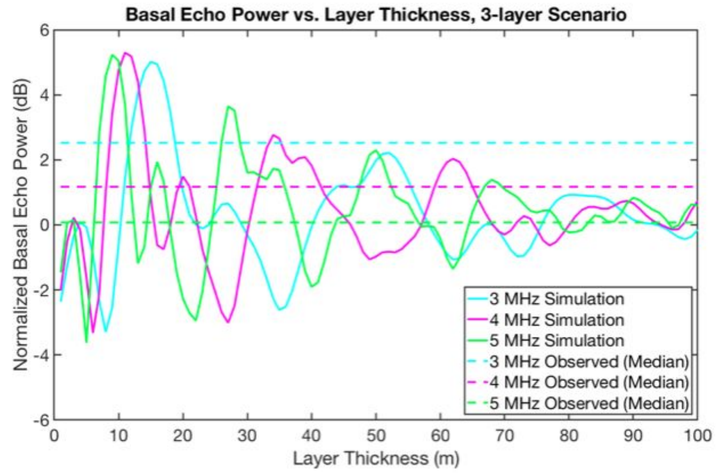
- Visible layers in outcrops tend to be much thinner than MARSIS resolution
- Sub-resolution interfaces can constructively interfere, resulting in reflections that are much brighter than would normally occur for the given materials
- To test if constructive interference could cause the observed reflections, we simulated three basal stratigraphy scenarios (see above) allowing basal layer thickness to vary
- We found that both scenarios with basal layering were capable of reproducing observed echoes



Results

- To compare our simulations to observations, we measured the subsurface to surface power ratio
- We found that thin subsurface layering could reproduce observed echoes at each MARSIS frequency





Supporting Evidence

- All materials used in simulations are already known to exist in the SPLD
- Observed reflection power is frequency-dependent, which is a predicted result of interference but not for liquid water
- Reflections caused by interfering layers have been discovered elsewhere in both the North and South Polar Layered Deposits

Reference: Orosei, R. et al. Radar evidence of subglacial liquid water on Mars. Science 361, 490–493 (2018).