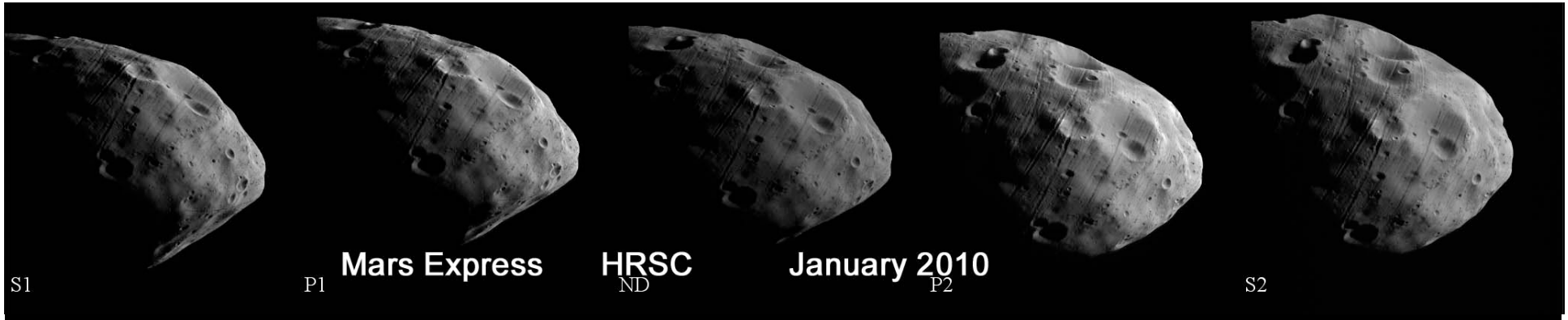


Implications of the Color of Phobos

C. M. Pieters

Brown University

Moscow October 2010

Topics

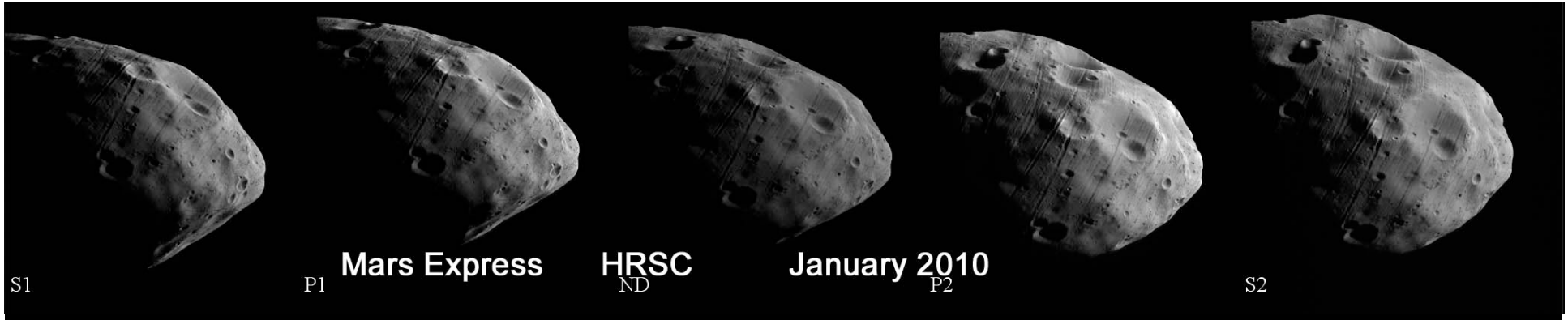
- Origin of Phobos Review
- Color of Phobos Review
- New Data (HRSC and HIRISE)
- Origin of Phobos color properties
- Implications for exploration
- Recommendations

General Properties of Phobos

- Low albedo (but not lowest)
- Tidally locked with Mars
- Extensive grooves and furrows across surface
- Large crater Stickney on leading edge
- Low density: 1876 ± 20 kg/m^3 [Andert et al., 2010]

Origin of Phobos (Review)

1. Captured asteroid/comet
2. Re-accretion of Mars debris
3. Co-accretion with Mars

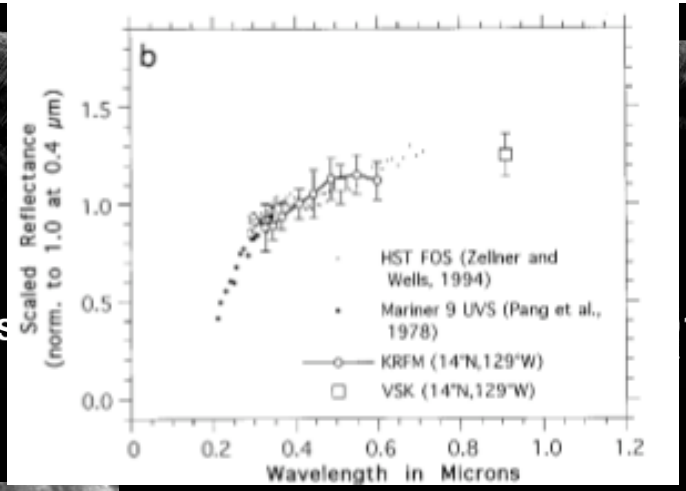


Color of Phobos (Review)

The Early Years……

S1 P1

Mars



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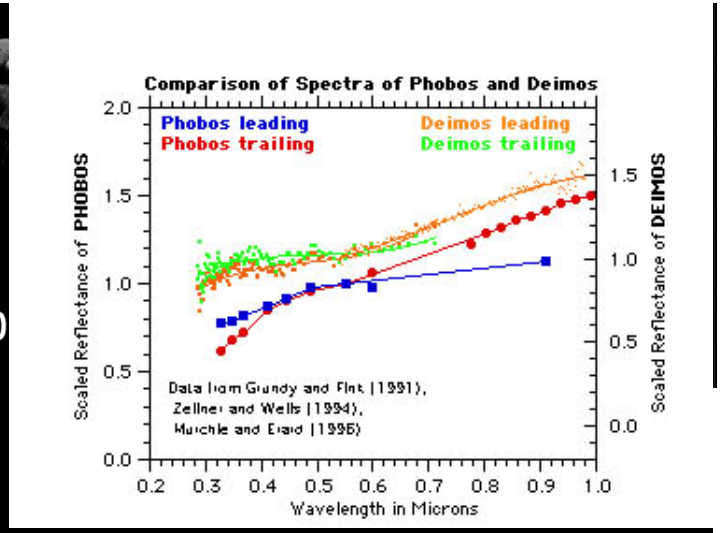
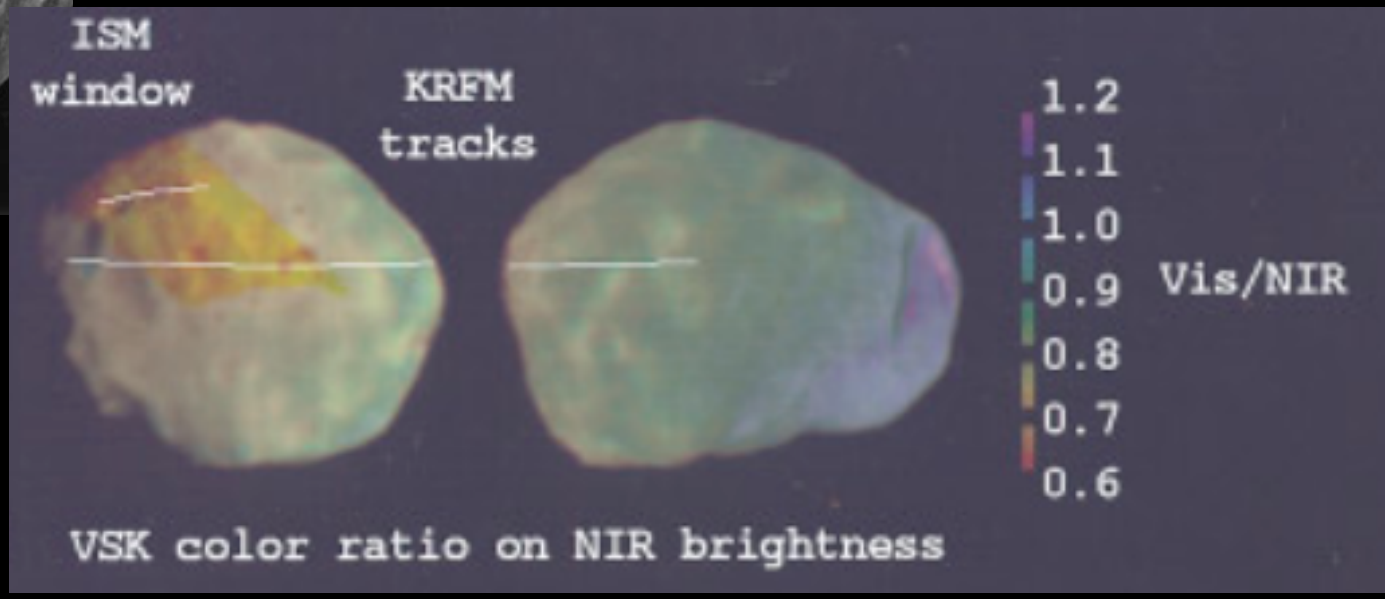


Viking Images

Phobos 2 clearly distinguished **two** color units: "Redder" and "Bluer".
[Murchie and Erard 1996]

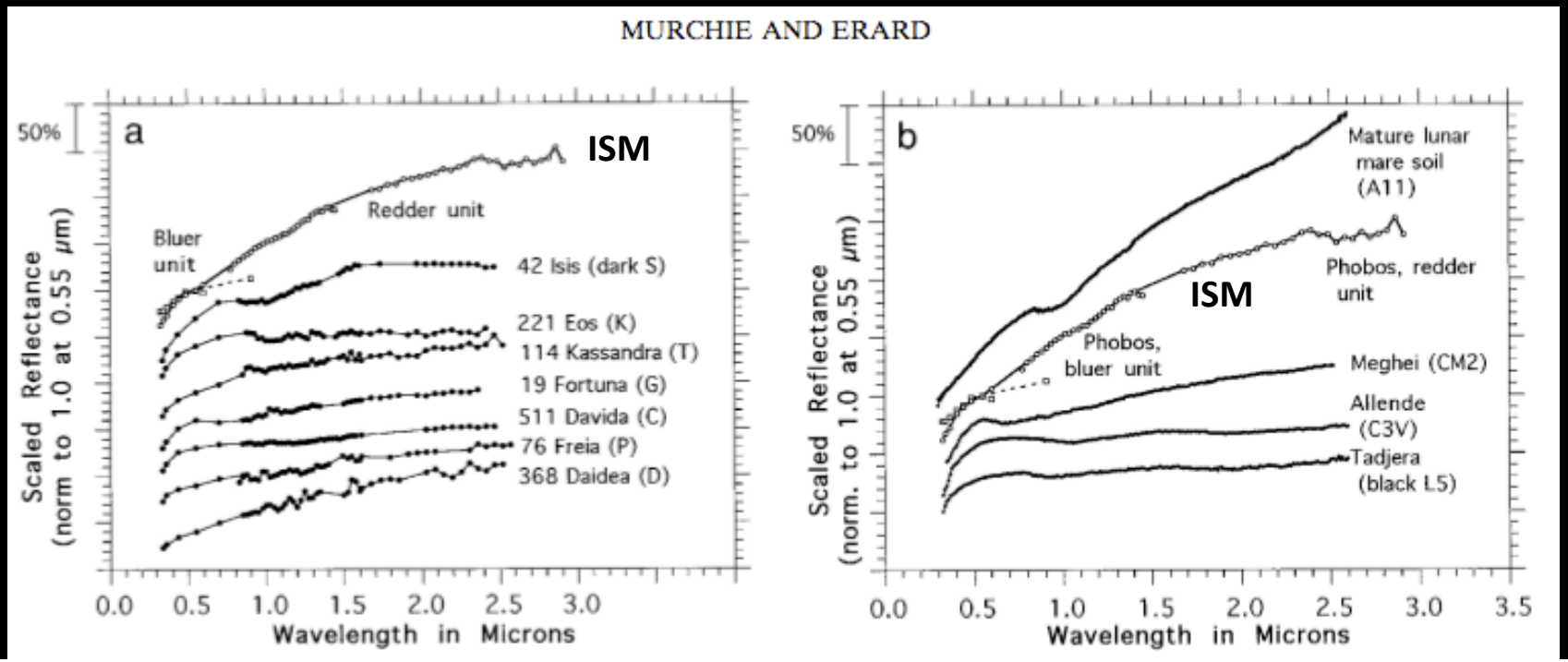


Phobos' Perplexing Properties

What is Phobos' true color?

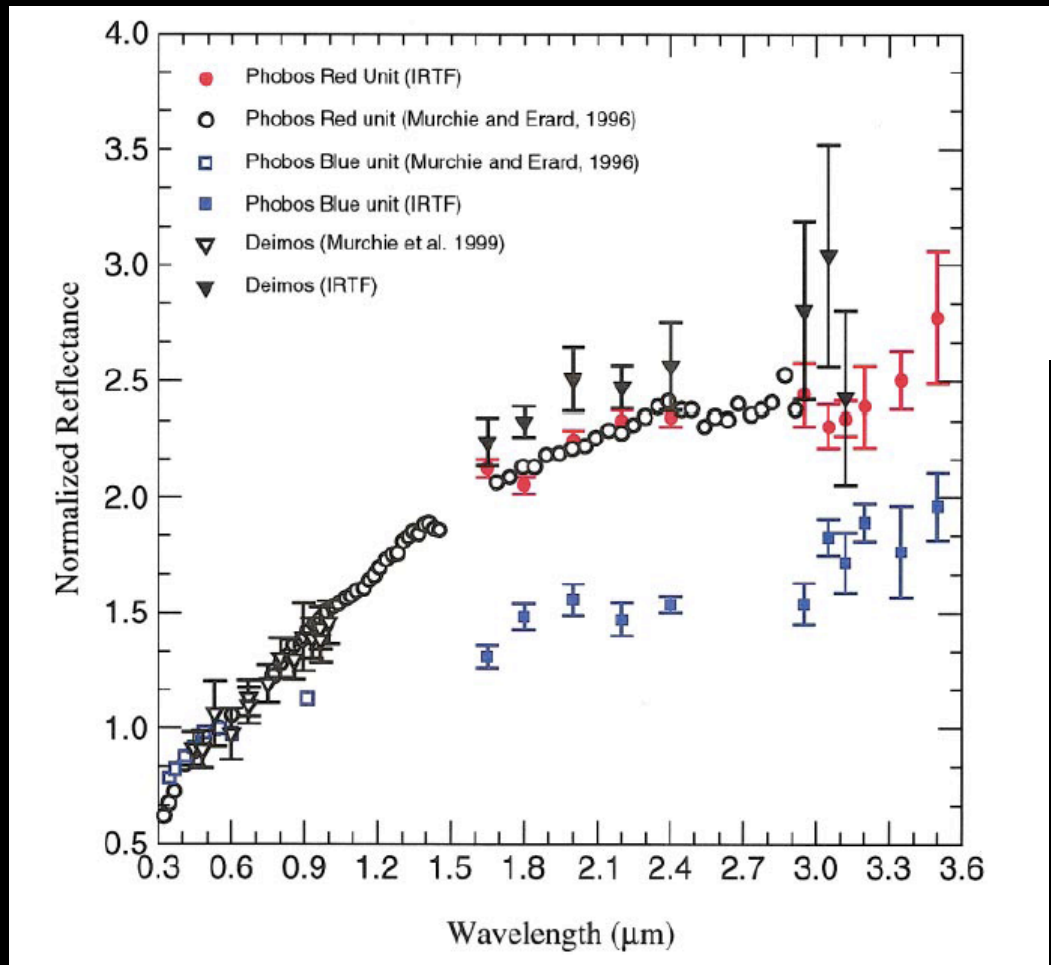
- The "bluer" unit is associated with Stickney.
- The "redder" unit is similar to Deimos.

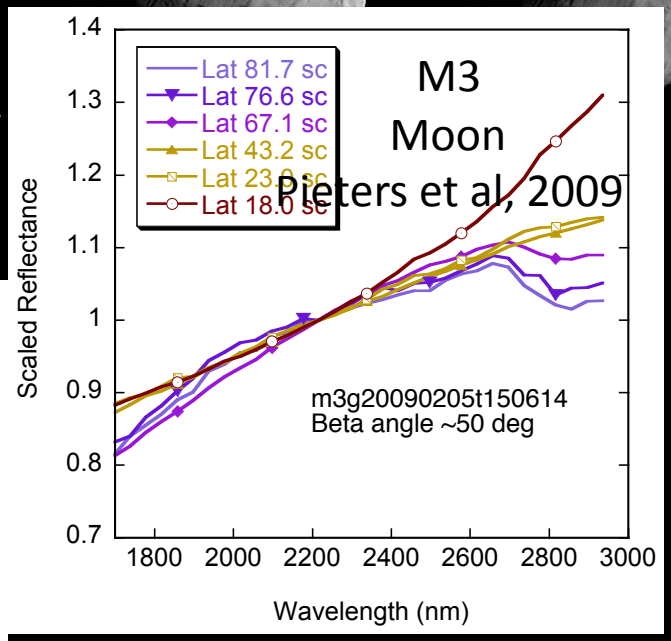
[Neither have clear interpretations…. meteorites, asteroids, spaceweathering]

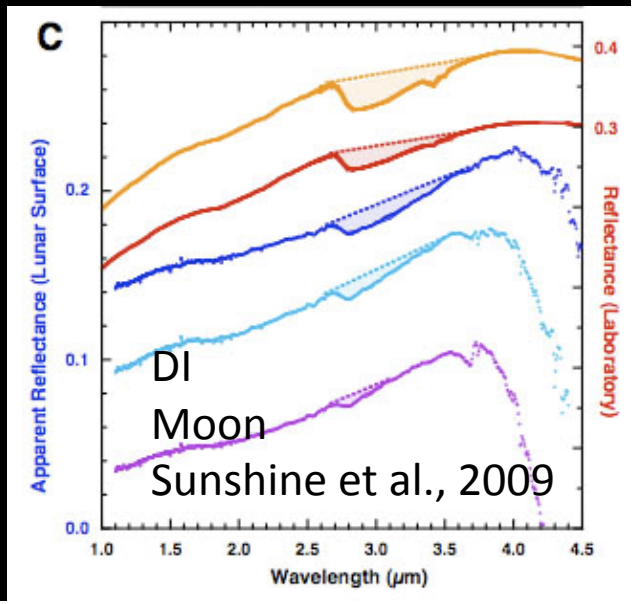


ISM and IRTF: No detectible Water

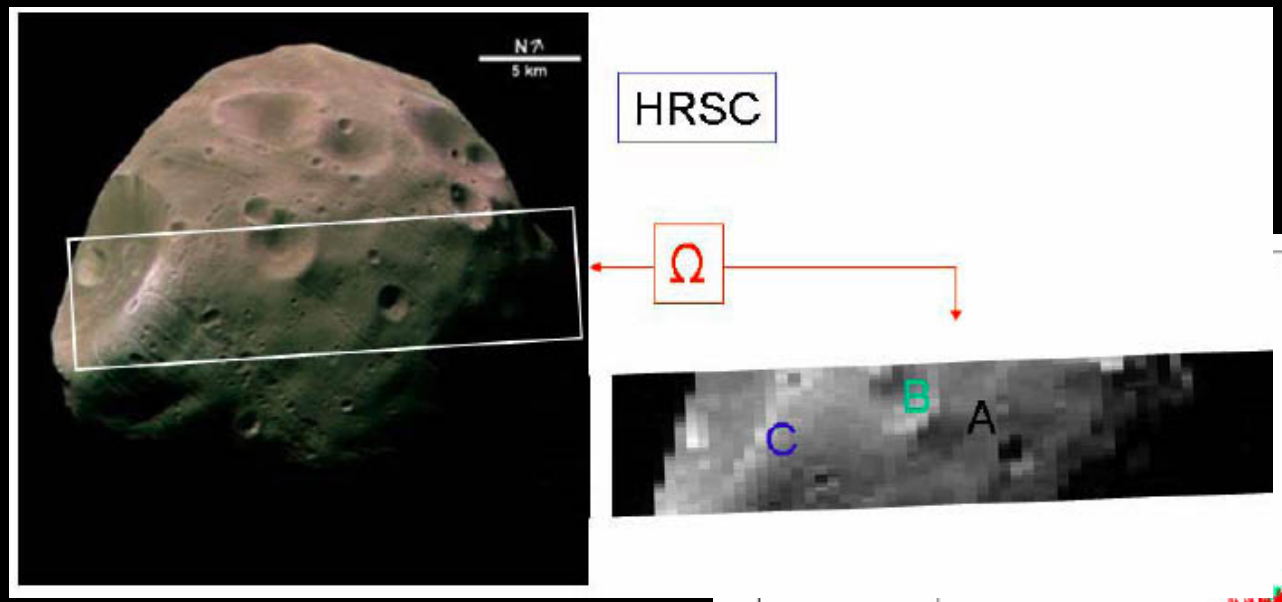
Rivkin et al., 2002

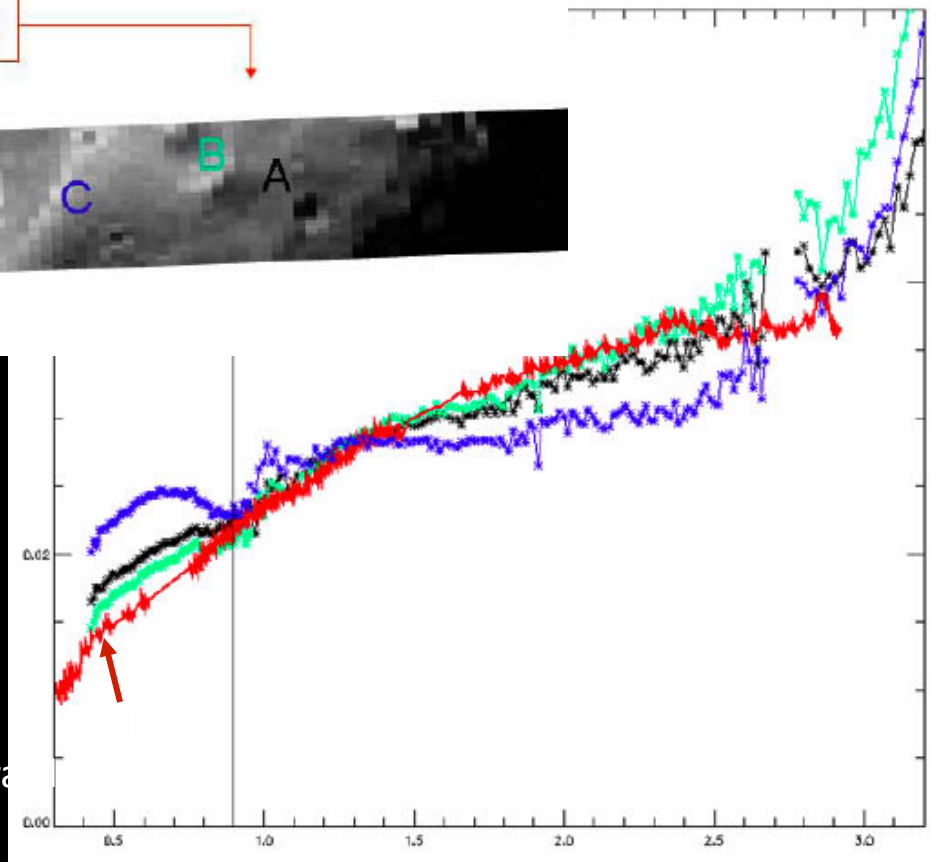






OMEGA data confirm Red and Blue Units

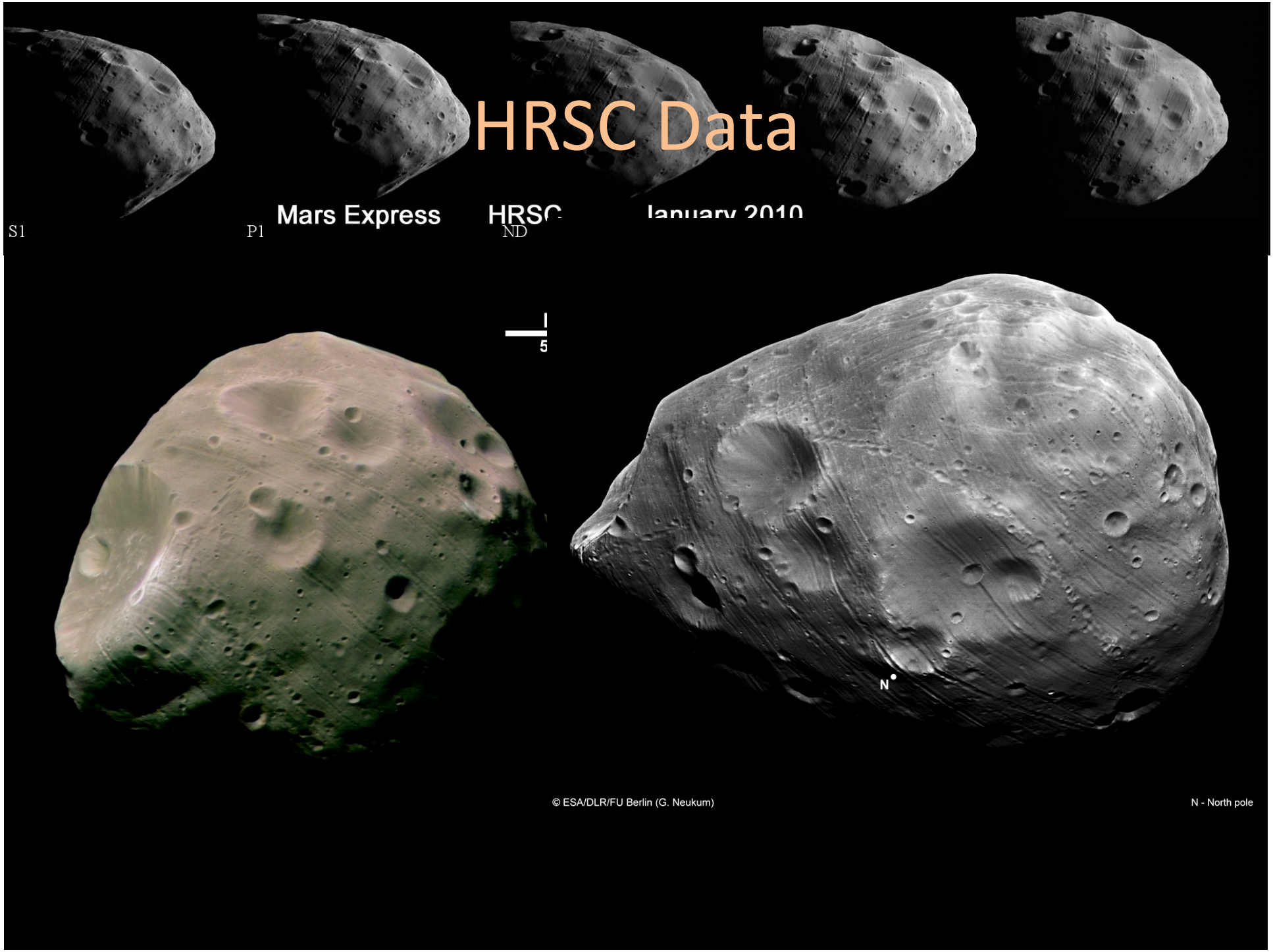




OMEGA
Gondet et al., 2008

Murchie and Era

HRSC Data


S1
P1
Mars Express
HRSC
ND
5
N
© ESA/DLR/FU Berlin (G. Neukum)
N - North pole

HIRISE Data

PSP_007769_9015-irb

PSP_007769_9010-irb

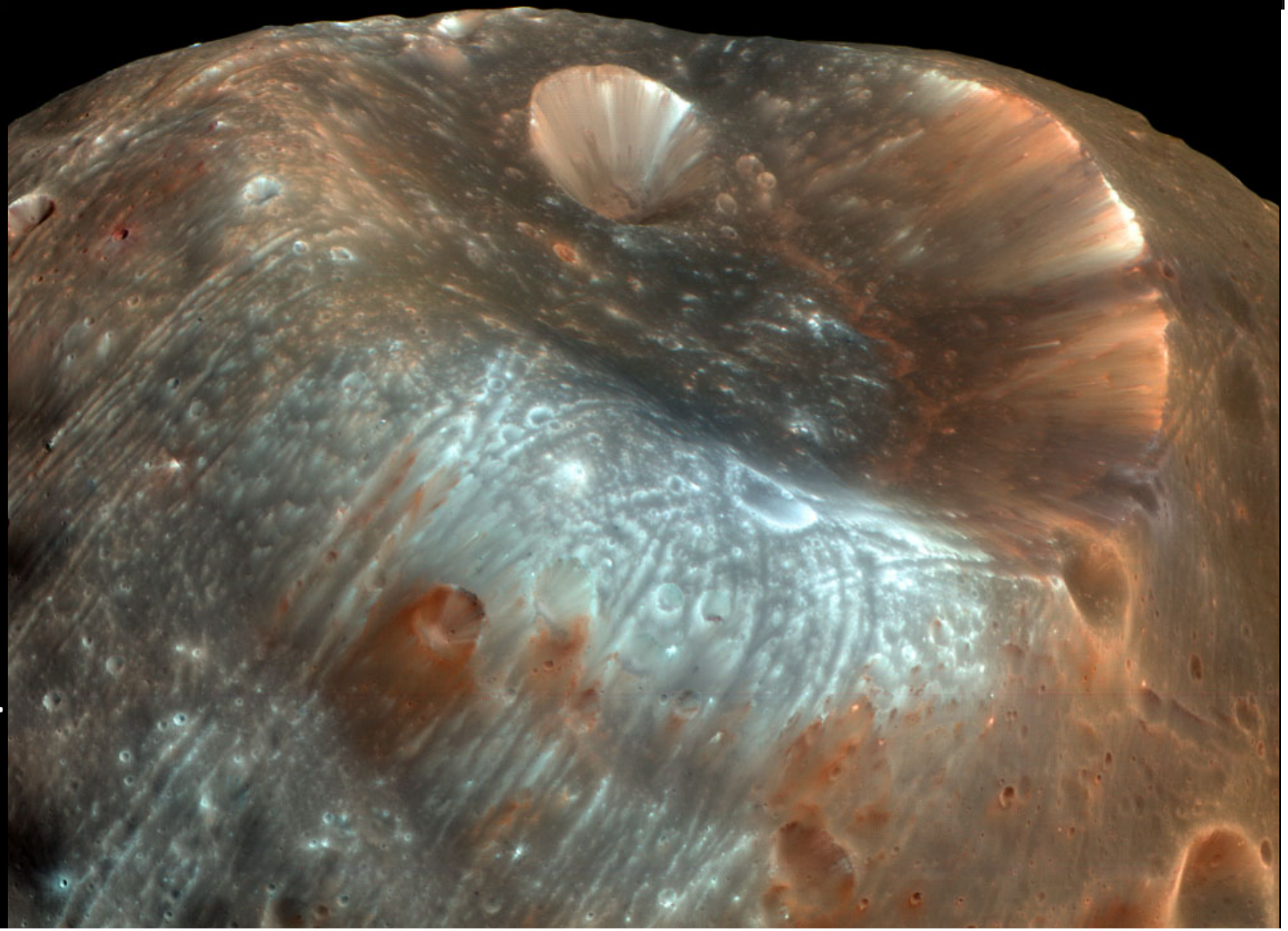
HIRISE cont.

1. Red and Blue units are spatially distinct.

2. It appears either: Red unit is deposited ON TOP of Blue unit.

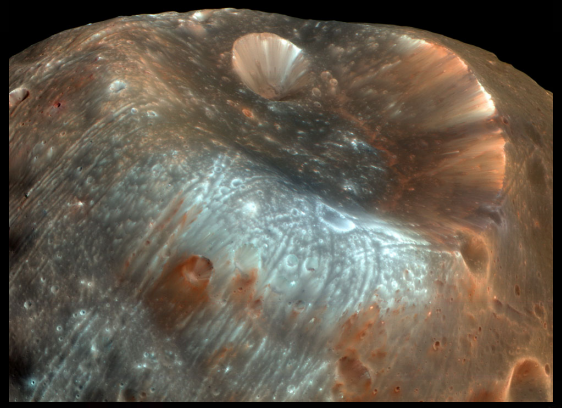
Or

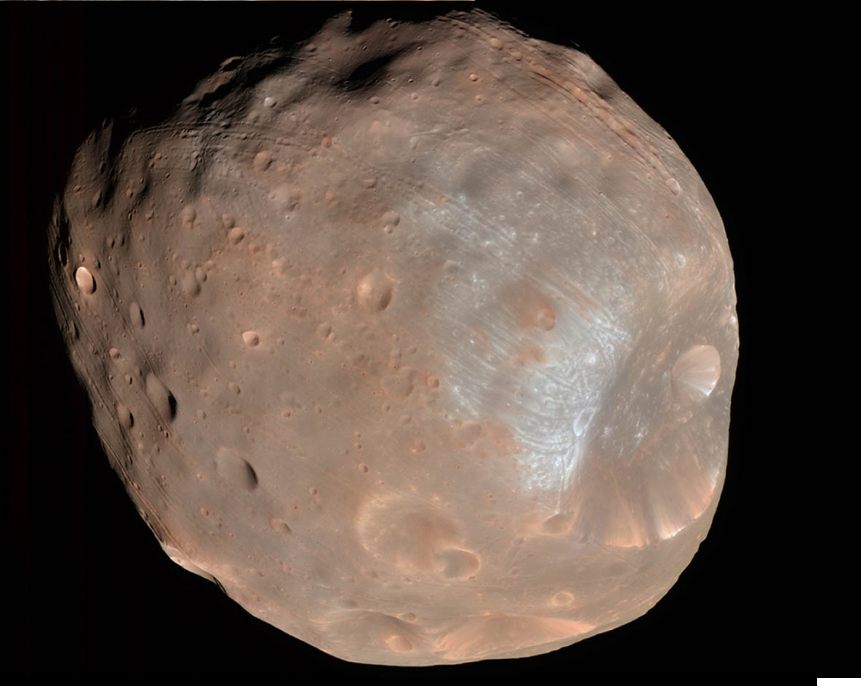
Red unit is excavated from below the Blue unit.



Origin of Phobos Color Properties

A. Inherent heterogeneity
   - Blue and Red units are two different materials.
B. Spaceweathering
   - The Blue unit has been altered to the Red unit in the space environment.
C. Accumulation of circum-Mars dust
   - The Red unit is fine-grain dust that has accumulated on the Blue unit.





How is the Origin of Color Related to the Origin of Phobos?

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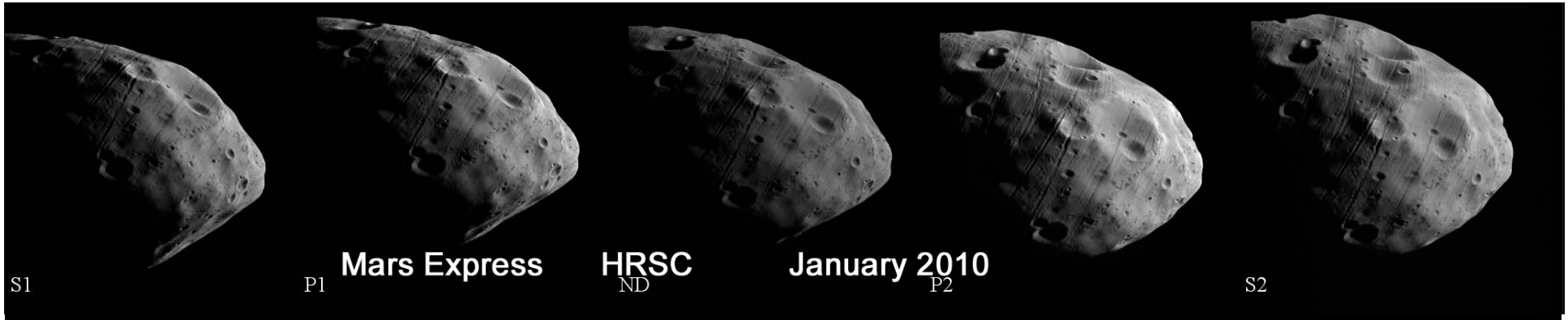
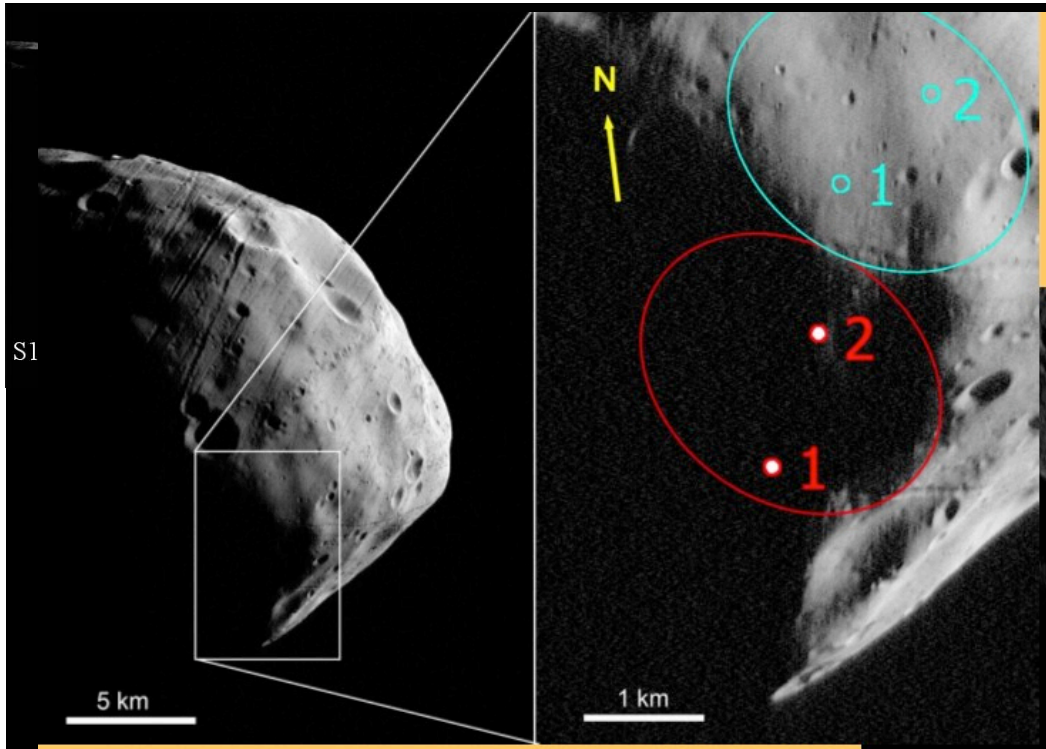
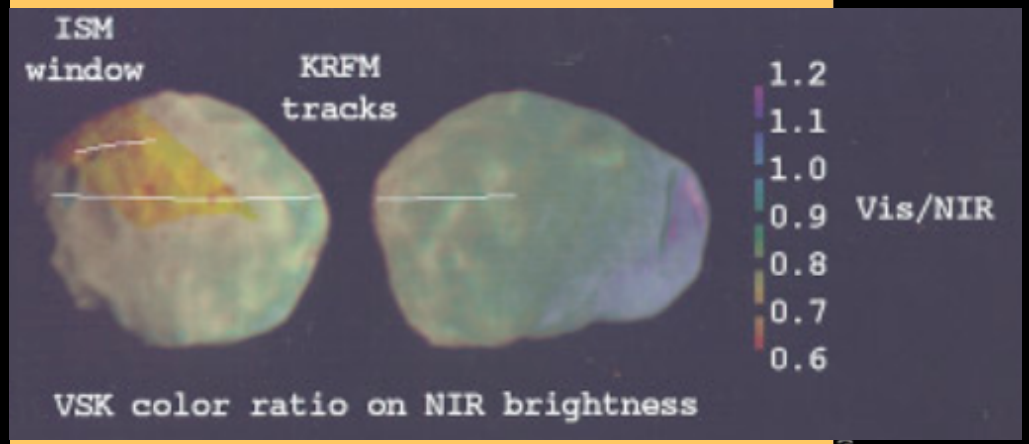
Dangerous! => C. Implies Red unit is Foreign Material



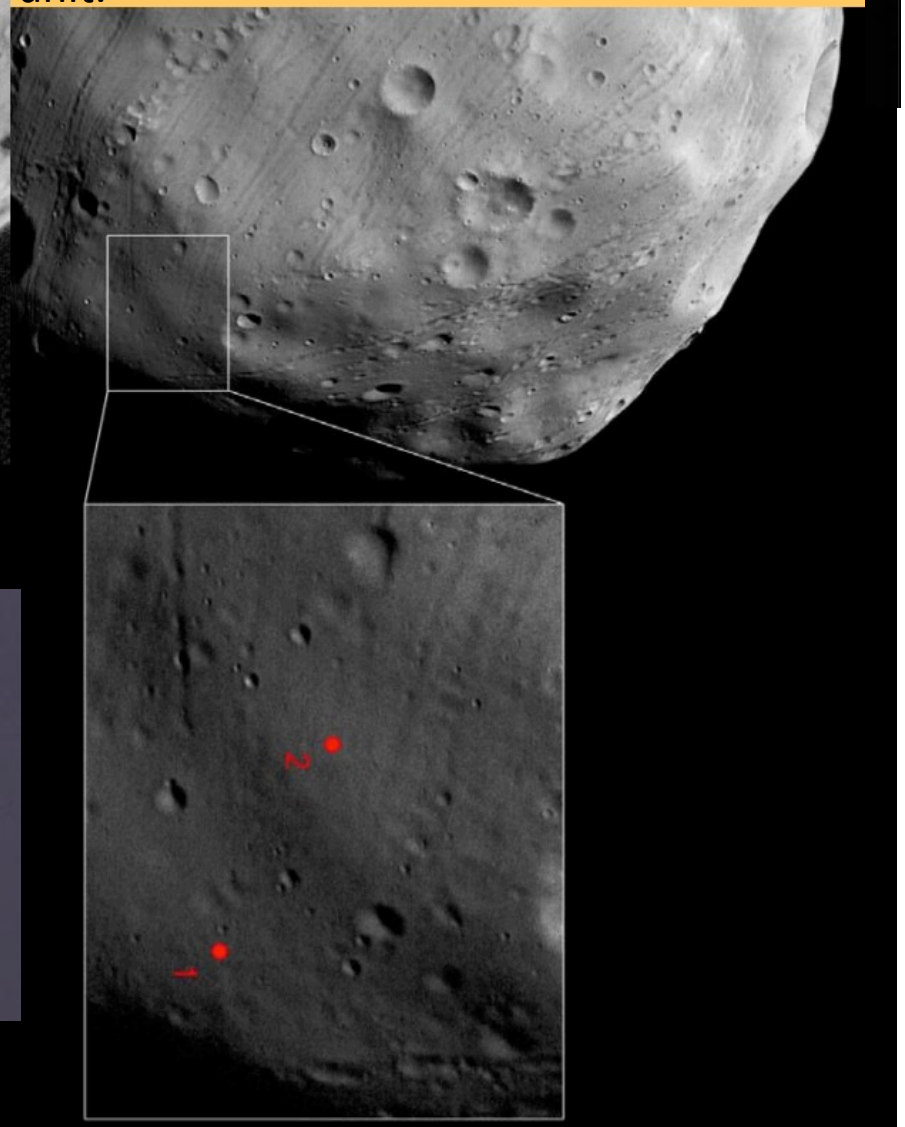
Implications

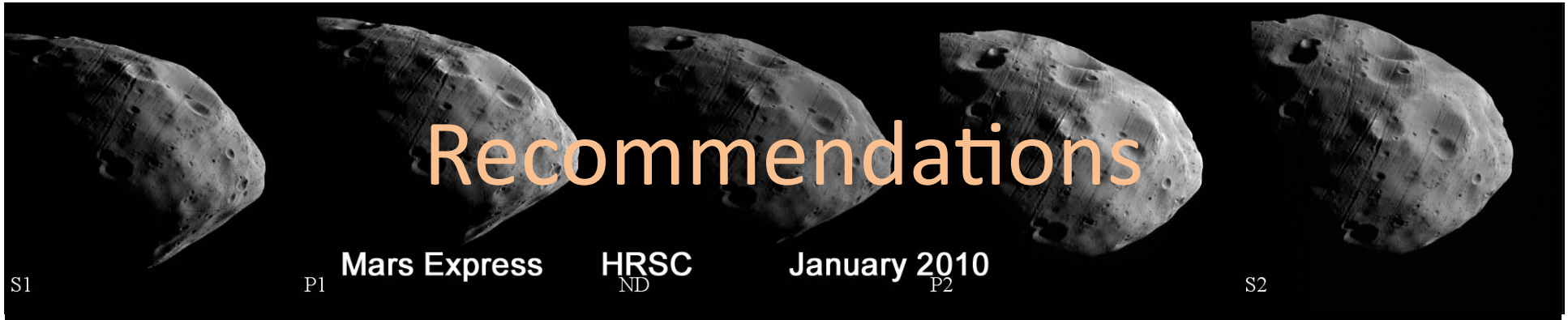
Phobos Grunt will be landing on the "Farside" of Phobos. Very little is known of the regional color – but from Phobos II it is expected to share properties of the Red unit.





(G. Neukum)





Recommendations

- Since Mars Express is the only spacecraft currently operating at Mars that can view the Farside of Phobos, we urge priority be given to acquiring multispectral data for the Farside of Phobos.
  - This will place the potential sampling sites in context with the primary units of Phobos.
  - This will allow any late engineering decisions to be made with better knowledge of science implications.