Theoretical Underpinnings on Aeolian Transport on 2014 MU69 “Ultima Thule.”

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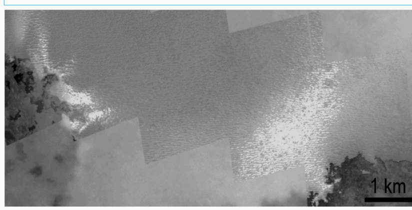
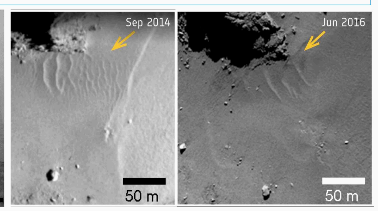
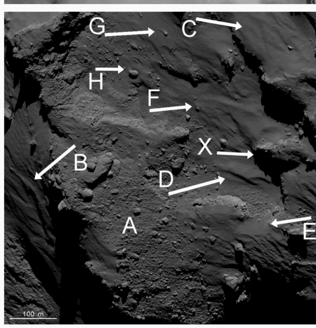
In Brief:

- No aeolian bedforms or other landforms (windtails, moats, yardangs) were observed on MU69 at or above the pixel scale of 35 m/px.
- Aeolian transport and landforms are possible on small worlds with transient atmospheres.
- Aeolian features, if any, likely formed very early in MU69’s history during its de-volitization.
- Any aeolian features on MU69 are likely to be on or near the Neck.







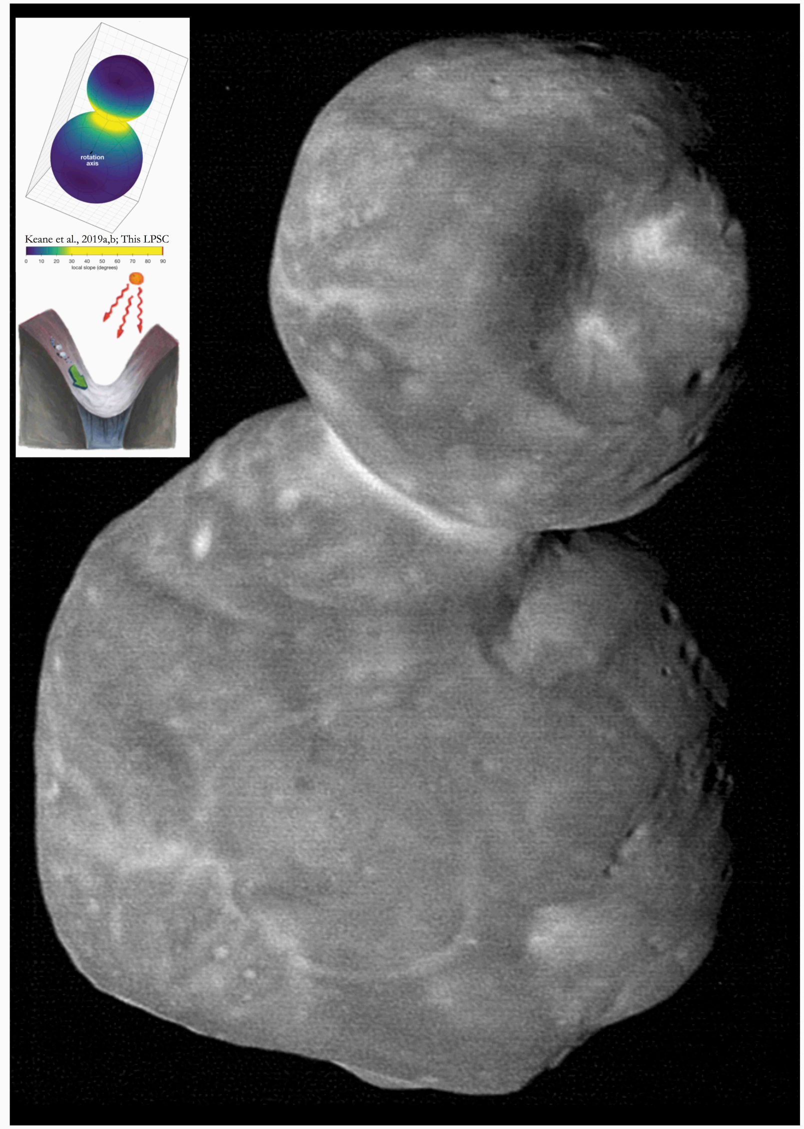
Io (top left) and Comet 67P (top right and bottom)—worlds with transient atmospheres—have shown aeolian ripples and wind tails and even movement. In the case of Io, tidal heating with resultant exogenic volcanic outgassing drives sediments. For Comet 67P, solar heating drives outgassing which drives sediment movement. We thus hypothesized it was not unreasonable to expect aeolian features on MU69 (Moore et al., 2018). Io image credit: NASA PIA21566. Comet 67P image credit: Thomas et al., 2015.

- The wind friction speed equation from Shao and Lu (2000) describes the wind speed necessary to initiate and sustain grain movement via saltation.
- On Comet 67P (as an analog to MU69), gas friction speeds in excess of 300 m/s are needed to mobilize 100 µm cohesive grains.
- Initial grain lofting, however, can occur via sublimation-driven “popping” of material into wind stream, as has been invoked to explain dune-like features on Pluto (Telfer et al., 2018) and 67P (Thomas et al., 2015). This popping mechanism requires far slower wind speeds to allow grain saltation.

Shao and Lu (2000) threshold friction speed equation applied to comets, KBOs, and Pluto:

$$u_t^* = \sqrt{A_N\left(\sigma g d + \frac{\gamma}{\rho d}\right)}$$

u^*_t	Threshold wind friction speed required to move sand via saltation
A_N	Parameterizes effects of interparticle cohesion.
σ	Ratio of particle to gas density
g	Gravitational acceleration
d	Average grain diameter
γ	Related to grain cohesion
ρ	Grain density



Main Image: Highest resolution image of MU69 acquired by New Horizons at 35 m/px.The world is 35 km in the long axis. Several images have been stacked and deconvolved by Tod Lauer. *Top Inset:* Keane et al. (2019; this LPSC) show the neck to be a gravitational low, suggesting lose granular debris should accumulate here. Early devolitization could have produced aeolian landforms from this material, and, in comparison with Comet 67P, most aeolian features, if any, would likely to be here.

We gratefully acknowledge support from NASA and the New Horizons Project for enabling our front-line work conducting the furthest planetary exploration ever in our Solar Sytem.

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