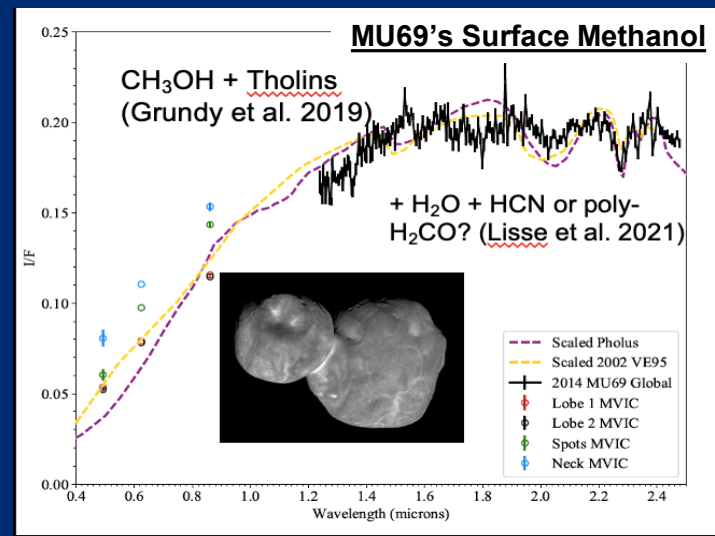
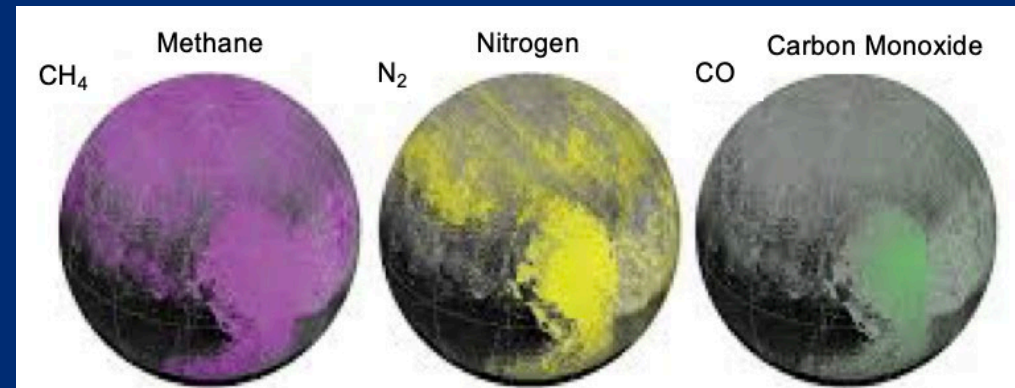


On the Origin & Thermal Stability of Ices on Pluto & MU69

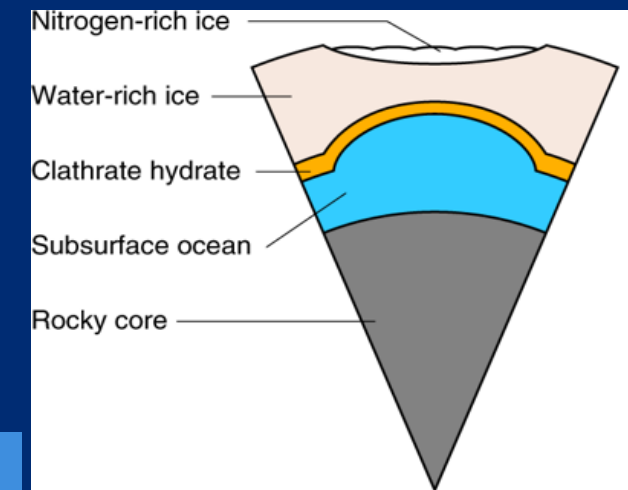
Simple thermodynamic arguments show that hypervolatiles shouldn't be present after a few Myr in small, low gravity, no-atmosphere KBOs at Kuiper Belt temperatures. So for a Pluto built "bottom-up" out of smaller MU69-like KBOs, we can conclude:

1. Pluto **formed FAST, in < 10 Myr**, so hypervolatiles were still available in small building block KBOs or the proto-planetary disk.
2. Pluto **is COMPLETELY DIFFERENTIATED** & expressing all its %-level minority impurity volatiles on its surface.
3. Strong, refractory **methanol and water ices** **should be UBIQUITOUS** in the Kuiper Belt (including Pluto & its moons).

Pluto's Surface Hypervolatile Ices



Cross section through a completely differentiated Pluto, including an ocean.



The *New Horizons* flybys found abundant, hyper-volatile CO, N₂, and CH₄ at Pluto, but none at MU69, which is super-rich in CH₃OH.