Lunar Highland Domes

Wagner et al. (2002); Wilson and Head (2003); Glotch et al. (2010); Jolliff et al. (2011)
Domes

• Gruithuisen and Mairen
  – Steep sides (15-30°)
  – Northern Oceanus Procellarum
  – High albedo, strong absorption in UV
  – Low FeO and TiO₂, high Th
  – Volcanic

• Compton-Belkovitch
Domes

- NW-SE chain
- Look like viscous lava
- Contain flows or landslides

Wagner et al. (2002)
Longer duration for mare volcanism, short duration for silicic volcanism

Wagner et al. (2002)
Rheology and mode of emplacement

- Yield strength=$10^5$ Pa
- Plastic viscosity=$10^9$ Pa s
- Effusion rate=50 m$^3$/s
- Dikes: $\sim$50 m wide, 15 km long
- Magma rise speed: $\sim7\times10^{-5}$ m/s
- Reynolds number $\sim2\times10^{-8}$ (laminar flow)
- Domes took 10-50 years to form

Results consistent with rhyolites, dacites, and basaltic andesites on Earth

Wilson and Head (2003)
Glotch et al. (2010): Diviner results
Diviner: Christiansen Feature position

- More silicic: shorter wavelength CF
- Less silicic: longer wavelength CF
- Some redspots have short wavelength CF, correlates with high Th and low FeO

Glotch et al. (2010)
Models

• Silicate liquid immiscibility: fractional crystallization, then melt separates
  – Unlikely to produce large extrusive silicic deposits but could form plutons when magma ocean cooled

• Basaltic underplating: melt anorthositic crust and produce silicic magma
  – Heat producing elements, thin crust, basaltic magmatism all support this

Glotch et al. (2010)
Farside silicic volcanism

- High reflectance, high Th anomaly
- Formed after heavy bombardment and Belkovich and Compton craters
  - Possibly Copernican age

Jolliff et al. (2011)
Possible origins

• Secondary ejecta, but unlikely because deposits are not correlated with secondary craters and different composition from Imbrium ejecta

• Alkali intrusive/extrusive complex (granite or alkali anorthosite) that has been exposed

Jolliff et al. (2011)
Near-surface volcanic complex?

• Intrusion caused uplift and dome formation, lava solidified and differentiated to form silicic compositions, later pyroclastic eruptions could have spread material further

• KREEP-basalt intruded, differentiated to silica melt
Discussion questions

• How do you think these domes formed?
• What is the relationship between the silicic volcanism at Compton-Belkovitch and Gruithuisen and Mairan domes? Did they form through similar processes? How would that work with the different crustal thicknesses in the two regions?
• What implications do these units have for the evolution and history of volcanism on the moon?
• Why was the period of silicic volcanism so short? Why did it stop?