Revealing Venus Interior from Coronae Analysis

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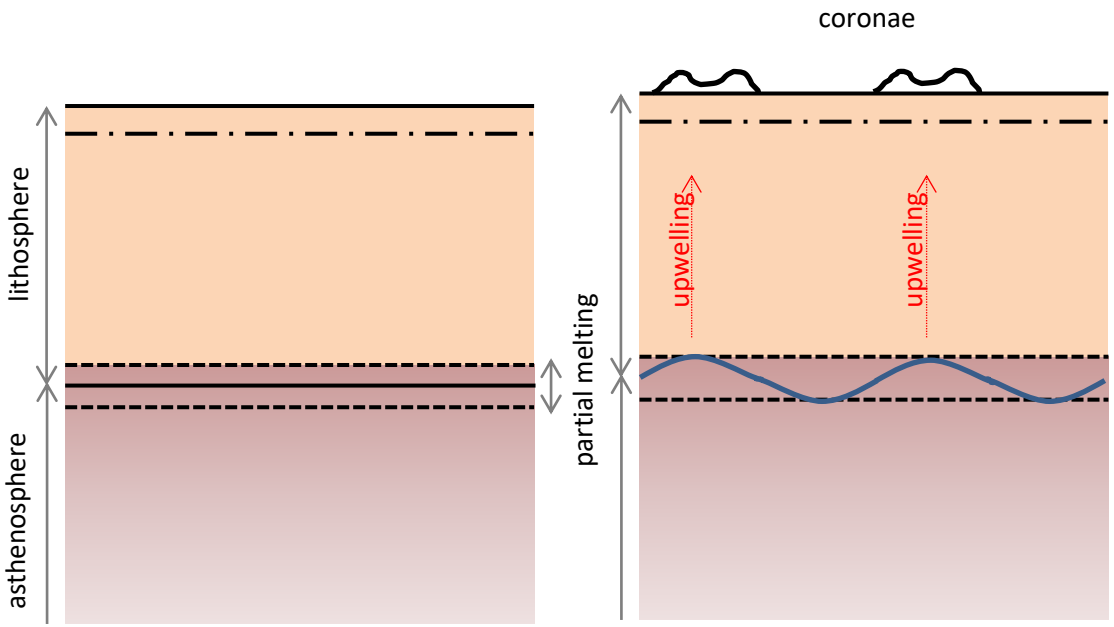
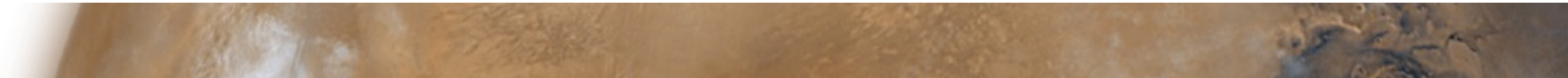
- The venusian widespread volcano population suggests the presence of a significant number of subcrustal/crustal magma reservoirs formed by magmatic upwelling.

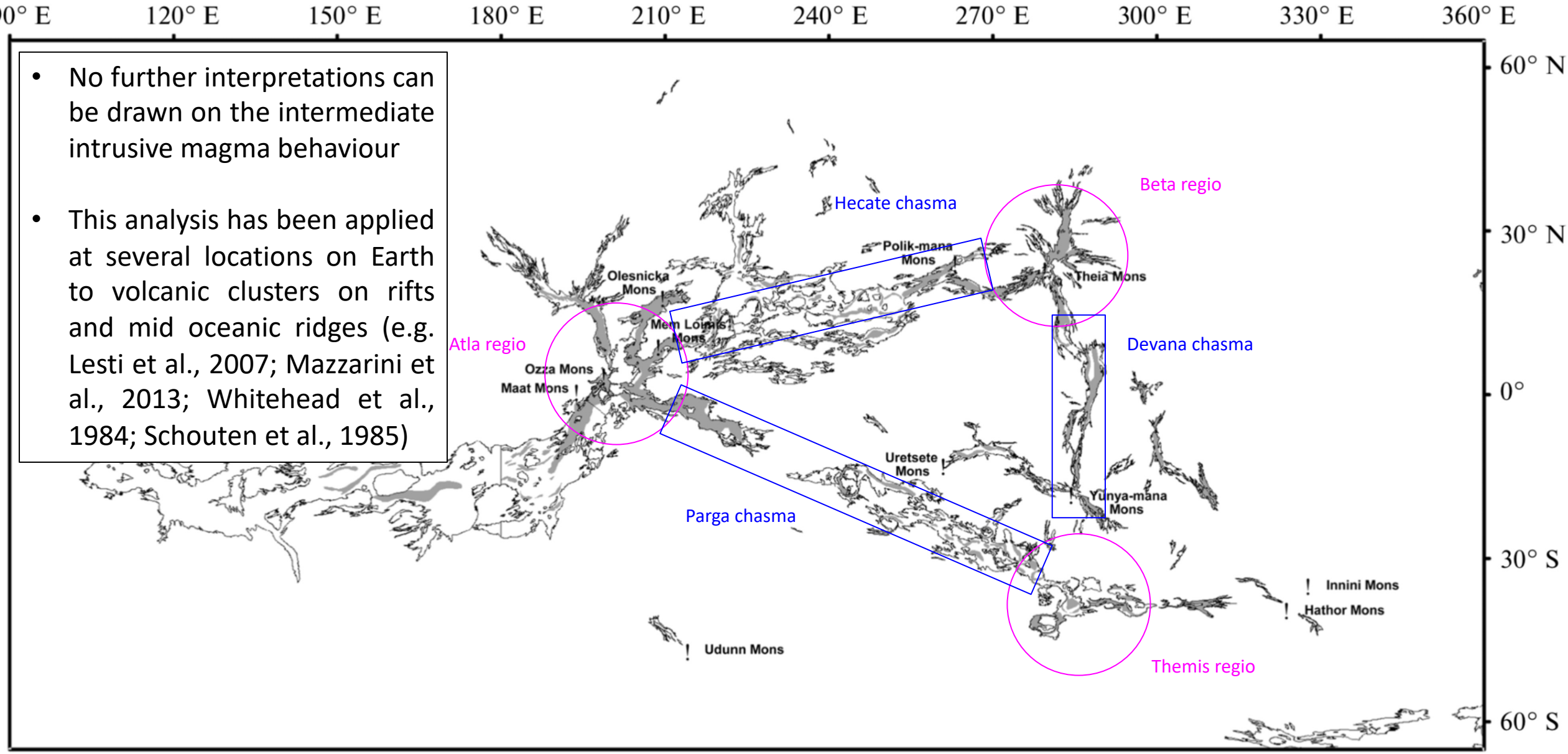
- In order to produce the buoyancy a gravitational instability occurs and leads to the vertical spread of material.

- The Rayleigh Taylor gravitational instability theory can be used to draw a relationship between the spacing of volcanic structures and edifices at the surface and the depth of the magmatic reservoirs beneath the volcanic fields.





- No further interpretations can be drawn on the intermediate intrusive magma behaviour
- This analysis has been applied at several locations on Earth to volcanic clusters on rifts and mid oceanic ridges (e.g. Lesti et al., 2007; Mazzarini et al., 2013; Whitehead et al., 1984; Schouten et al., 1985)



Guseva, 2016

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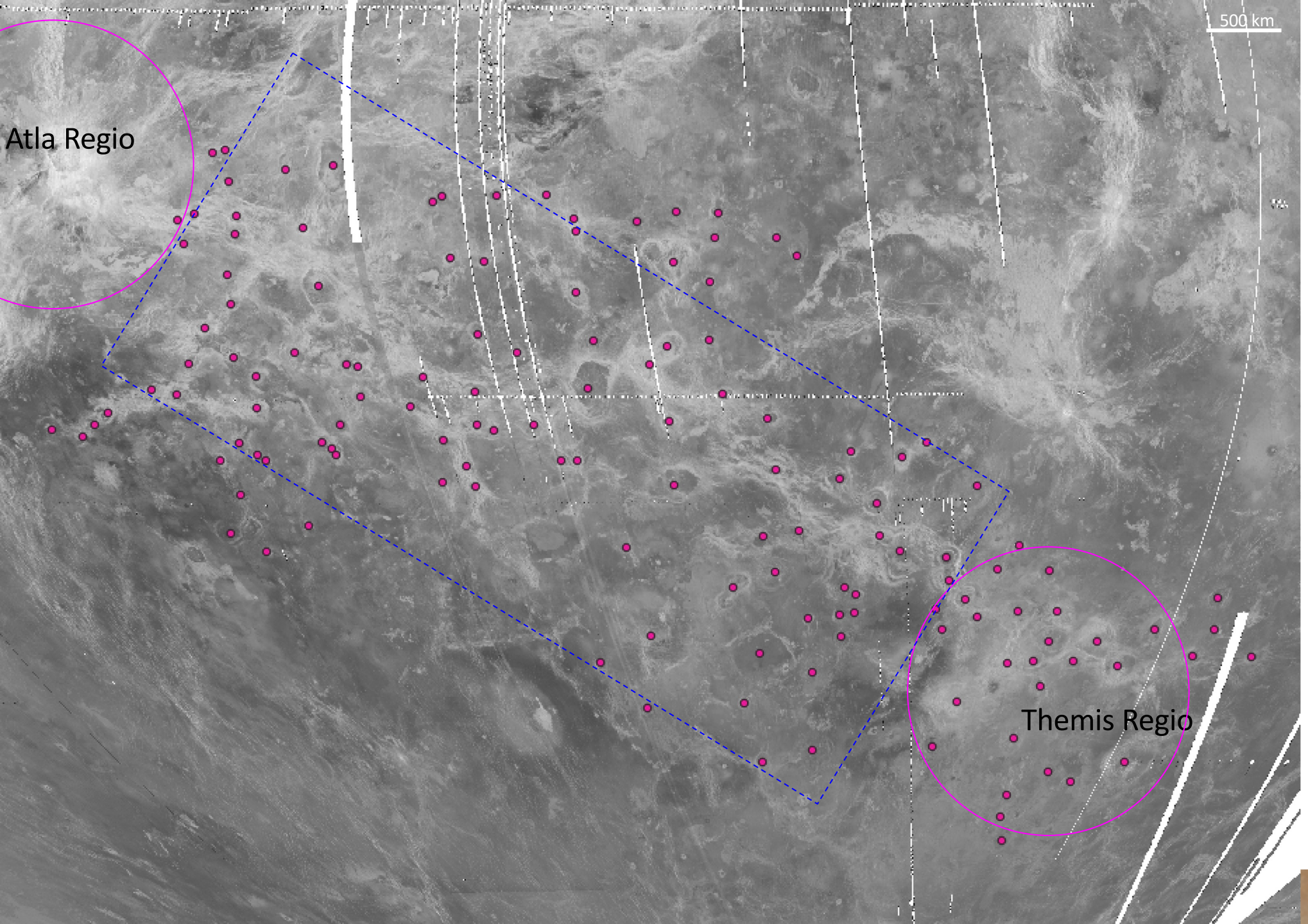

Collecting all known coronae on the area:
141 coronae from Martin et al., 2007 + USGS repository

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Coordinates in sinusoidal projection centered on the Parga Chasmata to minimize spatial distortion

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Nearest Neighbor analysis

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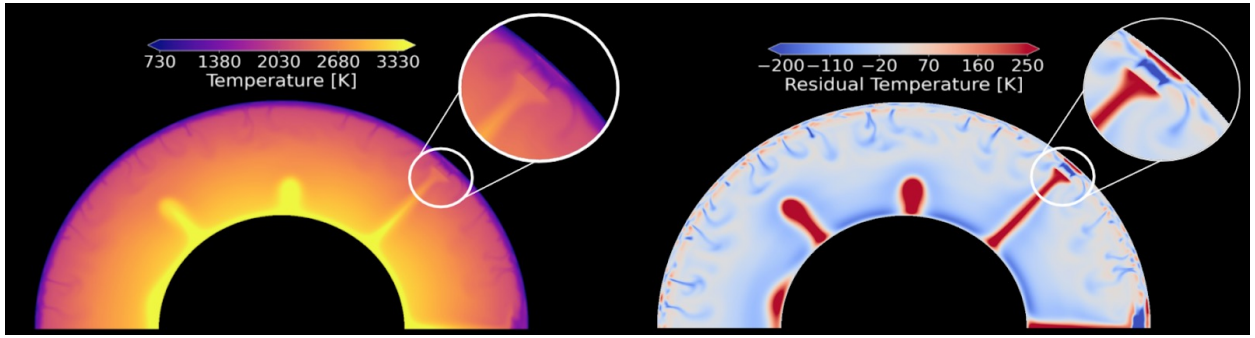
Rayleigh-Taylor instability function

↓

Depth of the thermal anomaly (= base of the thermal lithosphere or stagnant lid) is located at **117 ± 10 km** underneath Parga

We test reference viscosity of 1e21 Pa s and 1e20 Pa s (poorly constrained parameter for the interior)

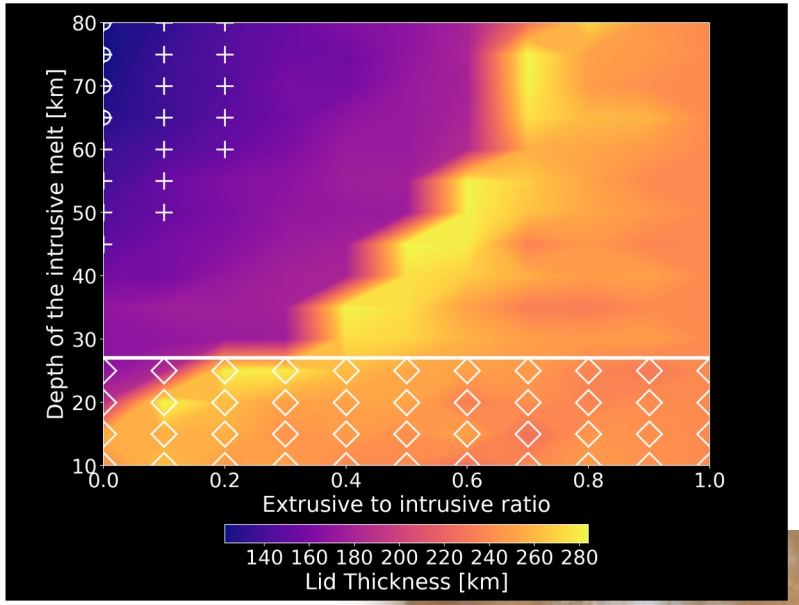
Thermal Evolution Models:



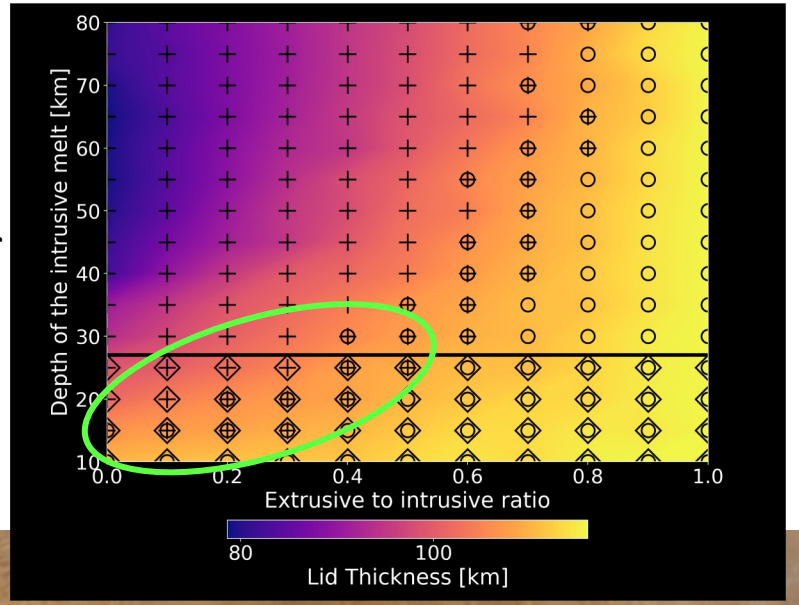
Overview on reference viscosity constraining:

- Circles: cases compatible with stagnant lid thickness 117 ± 10 km
  - Crosses: cases compatible with mechanical thickness ≤ 60 km
- Diamonds: cases where melt intrusions are placed at the base of the crust

Reference viscosity: 1e21 Pa s



Reference viscosity: 1e20 Pa s



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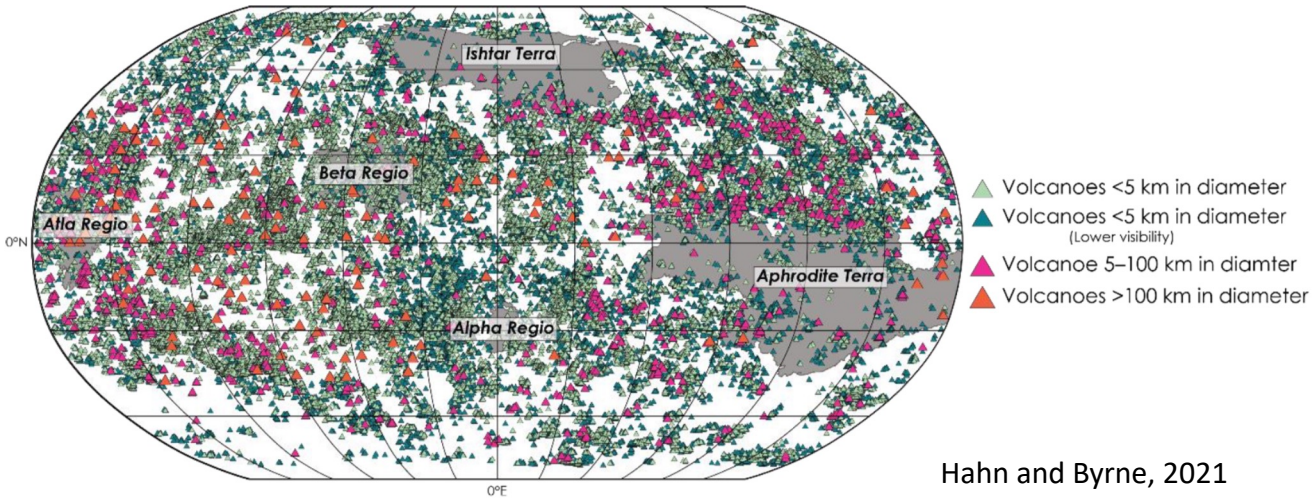
Take home messages

- Estimate of the depth of thermal anomaly where partial melting triggers gravitational instability that initiates the upwelling

- Geodynamical models implementation taking into account thermal lithosphere thickness allowed to constrain interior viscosity on Venus

- Future observations at higher resolution will allow to:

    - observe stratigraphic relationship between rises, rifts, coronae, and volcanoes
    - reconstruct the event sequence
    - perform more detailed estimates on smaller volcano populations to refine inner layering
    - refine the estimate of the erupted magma volumes.



Hahn and Byrne, 2021