Lithospheric Structure of Venusian Crustal Plateaus

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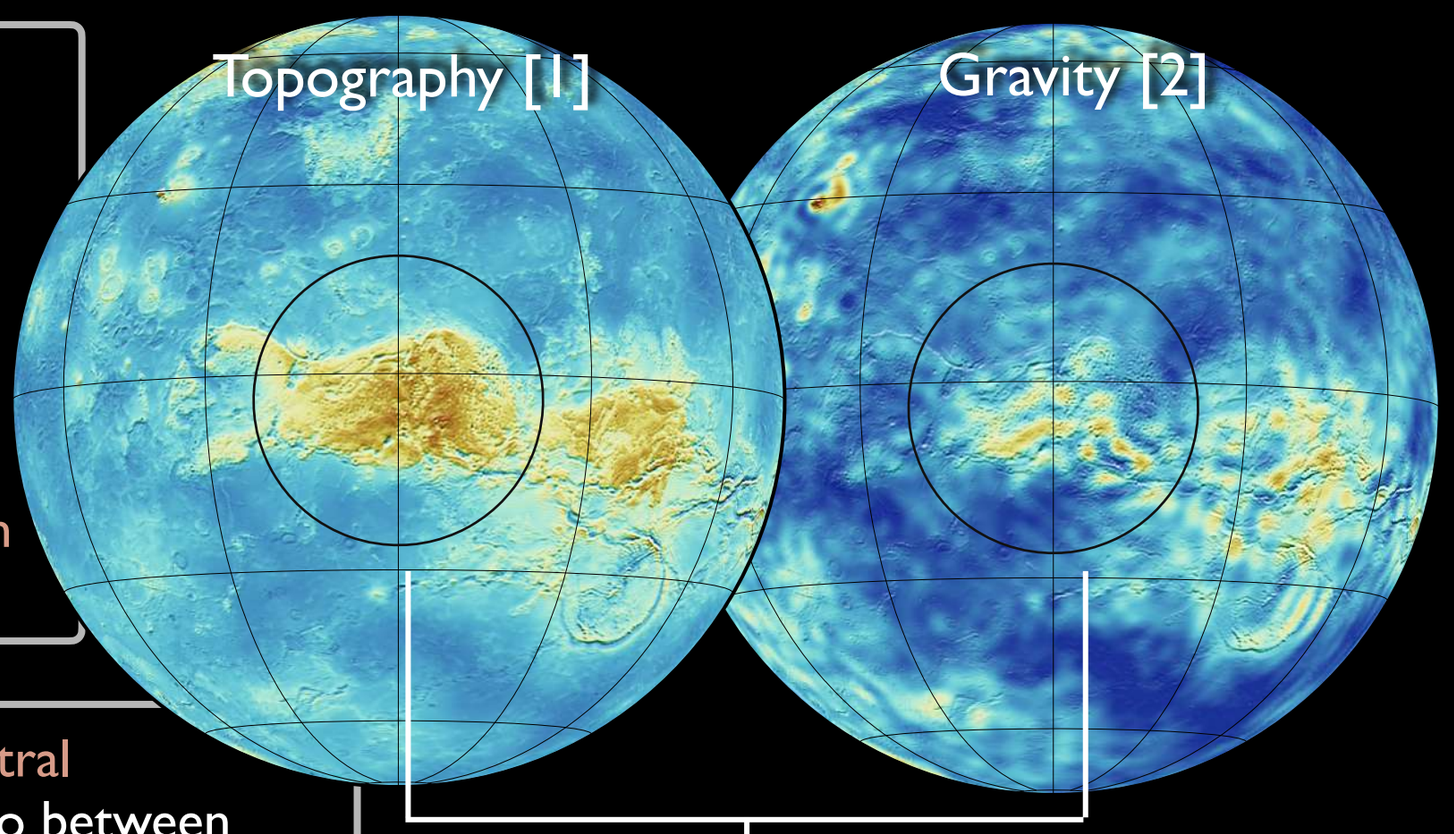
Julia Maia & Mark Wieczorek
Laboratoire Lagrange - Observatoire de la Côte d'Azur

Introduction

Crustal plateaus are prominent tectonized highlands interpreted as some of the oldest surfaces on Venus.

Although several gravity studies have been done in the 1990s, recent developments of lithospheric models and analysis techniques motivated us to perform a new gravity-topography study, aiming to better constrain the internal structure of these regions.

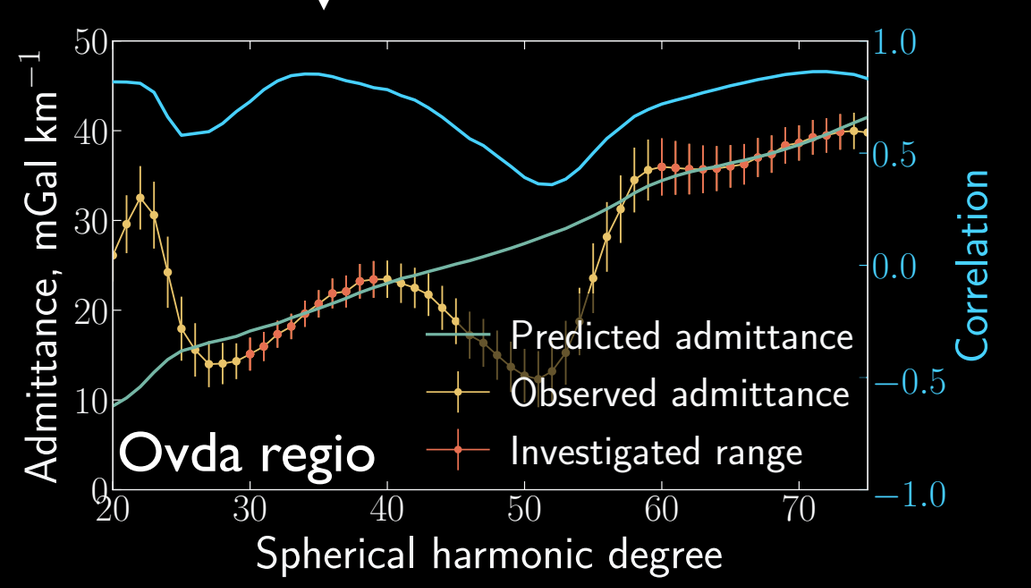


Methods

For each plateau, we compute the spectral admittance (wavelength-dependent ratio between gravity and topography) using the localization technique from [3].

Using a flexural model of the lithosphere that includes both surface and subsurface loads [4], we generate theoretical admittance curves and compare them to the observations based on rms misfits.

Free parameters: elastic thickness T_e, crustal thickness T_c, ratio between surface top and internal loads L.



Results

Overall, the inclusion of internal loads is not necessary to fit the data and $L = 0$ correspond to the best-fit in several regions.

The average crustal thickness of the plateaus is constrained between 15 to 35 km, although locally the crust can reach depths of more than 40 km.

The best-fitting elastic thickness varies from 5 to 25 km, with Airy isostasy ($T_e = 0$) being consistent with the uncertainties in most cases.

Elastic thickness constraints can then be used to estimate the heat flow during load emplacement [5].

Discussion

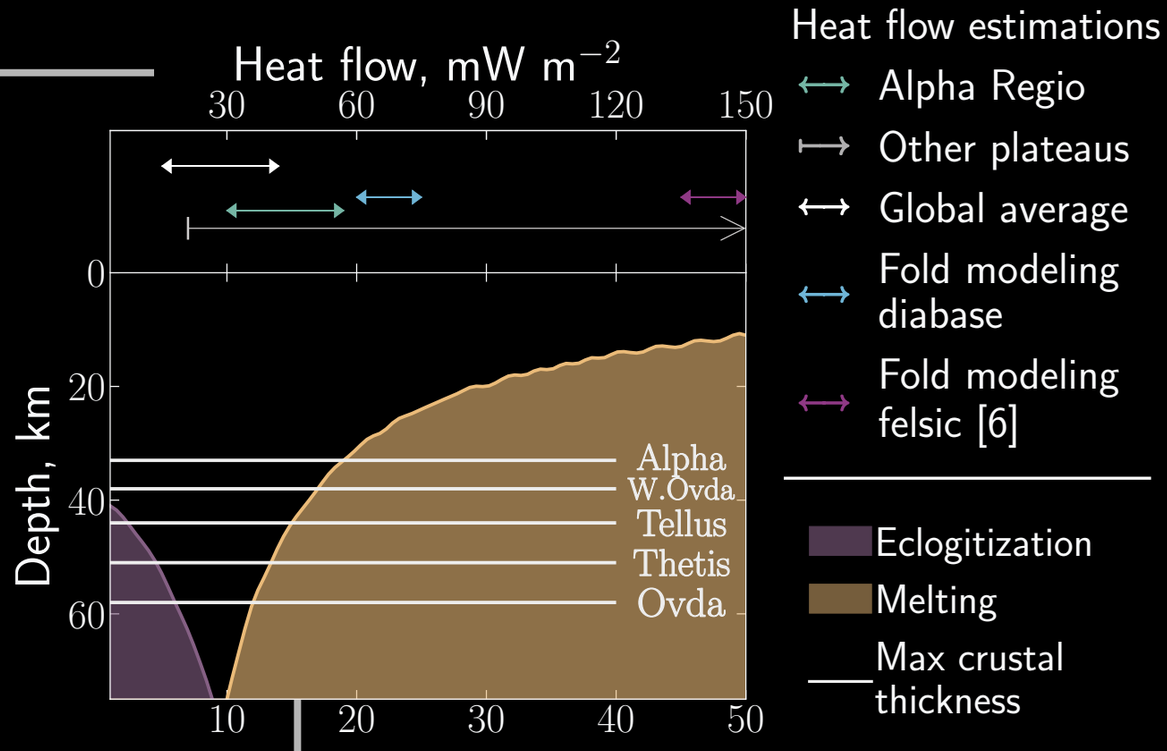
Insights on the thermal and geological evolution

Depending on the depth and temperature at the base of the crust, crustal material can go through phase transitions or melt.

Using the crustal thickness and heat flow estimations we find that magmatic processes may have played an important role in the formation of plateaus. It is also possible that under the highest plateaus crustal materials are currently going through eclogitization.

Future work

Study gravity and topography of volcanic rises and plains using dynamic flow models. Investigate stress regimes and correlate with surface geology.



[1] Wieczorek (2015), [2] Konopliv et al. (1999), [3] Wieczorek & Simons (2007), [4] Broquet & Wieczorek (2019), [5] McNutt (1984), [6] Resor et al. (2021)