Geophysical Research Abstracts
Vol. 17, EGU2015-13804, 2015
EGU General Assembly 2015

Intrusive Magmatism on Venus can lead to a weak crust and episodic overturn events: Spherical 2D and 3D Simulations

Paul Tackley
ETH Zurich, Institute of Geophysics, Earth Sciences, Zurich, Switzerland (ptackley@erdw.ethz.ch)

Here we extend the numerical convection models of Venus models of [1], which included melting, magmatism, decaying heat-producing elements, core cooling, realistic temperature-dependent viscosity and either stagnant lid or episodic lithospheric overturn. In [1] it was found that for stagnant lid convection the dominant mode of heat loss is magmatic heat pipe, which requires massive magmatism and produces very thick, cold crust, inconsistent with observations. In contrast, episodic lid overturn interspersed by periods of quiescence effectively loses Venus's heat while giving lower rates of volcanism and a thinner crust. Calculations predict 5–8 overturn events over Venus's history, each lasting $\sim$150 Myr, initiating in one place and then spreading globally. Venus-like amplitudes of topography and geoid can be produced in either stagnant or episodic modes, with a viscosity profile that is Earth-like but shifted to higher values. Here we extend [1] by considering intrusive magmatism as an alternative to the purely extrusive magmatism previously assumed. Intrusive magmatism warms and weakens the crust, resulting in substantial surface deformation and a thinner crust. This is further enhanced by using a basaltic rheology for the crust instead of assuming the same rheological parameters as for the mantle. In some cases massive intrusive magmatism can even lead to episodic lithospheric overturn events without plastic yielding. Here we quantitatively analyse the resulting surface deformation and other signatures, and compare to observations in order to constrain the likely ratio of intrusive to extrusive magmatism.
[1] Armann, M., and P. J. Tackley (2012), Simulating the thermochemical magmatic and tectonic evolution of Venus's mantle and lithosphere: Two-dimensional models, J. Geophys. Res., 117, E12003, doi:10.1029/2012JE004231.