# Venus as a model for hot, stagnant lid regime exoplanets: constraining the importance of diffusion as a mechanism for mantle degassing

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Earth is unique within our solar system for having a convective regime dominated by plate tectonic processes. More typical of rocky, 'terrestrial' planets is a stagnant lid type regime, where the entire lithosphere is a single plate, punctured by volcanic processes. Based on this limited sample set, therefore, we might expect 'Earth-like' exoplanets to be more 'Venus-like' in terms of planet-wide geological processes and mantle-atmosphere interaction.

For planets like Venus and Mars, volcanism, assumed to be related to plume activity, is considered the main agent for flux of material out of the planetary deep interior. For hot stagnant lid planets, however, high temperatures throughout the lid raise the possibility that diffusion provides an additional mechanism for flux of volatile elements. Although diffusion driven 'degassing' of the interior would be of limited importance in terms of atmospheric evolution, it is conceivable that over geological periods of time this could have an important effect on lid properties and geological processes.

I will present results of a 1-d model of diffusive loss of volatile elements across a hot stagnant lid. Using a simple conceptual model based on the interior structure of Venus, I constrain the extent to which diffusion drives element flux from a convecting mantle into the overlying lid. As expected, diffusion only results in signficant flux of H. For modelled Venusian geotherms, H diffusion fronts progress a limited distance (10s of km) into the lid even after 2 Gyr. For a stable stagnant lid, however, this flux of H could have an influence on lid recycling, as partial hydration can promote melting of the lowermost lid, or promote lid recycling. Exploration of parameter space is used to explore the dependence of H flux on temperature profiles across stable lids, and the distance at which diffusion fronts stagnate. For even a small relative increase in temperature across the geotherm (i.e. a slightly hotter than Venus exoplanet), H flux into the lid becomes considerable. Although flux H alone does not induce lid melting, it signficantly lowers solidii, promoting lid melting and rejuvination due to plume-realted activity. As such, the importance of diffusion in terms of lid stability in hot, terrestrial exoplanets cannot be ignored.