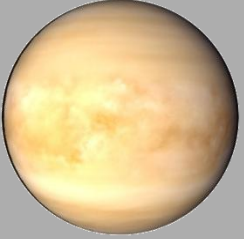




# Modeling Venus Surface Conditions Evolution and the Effects of Early Large Impacts

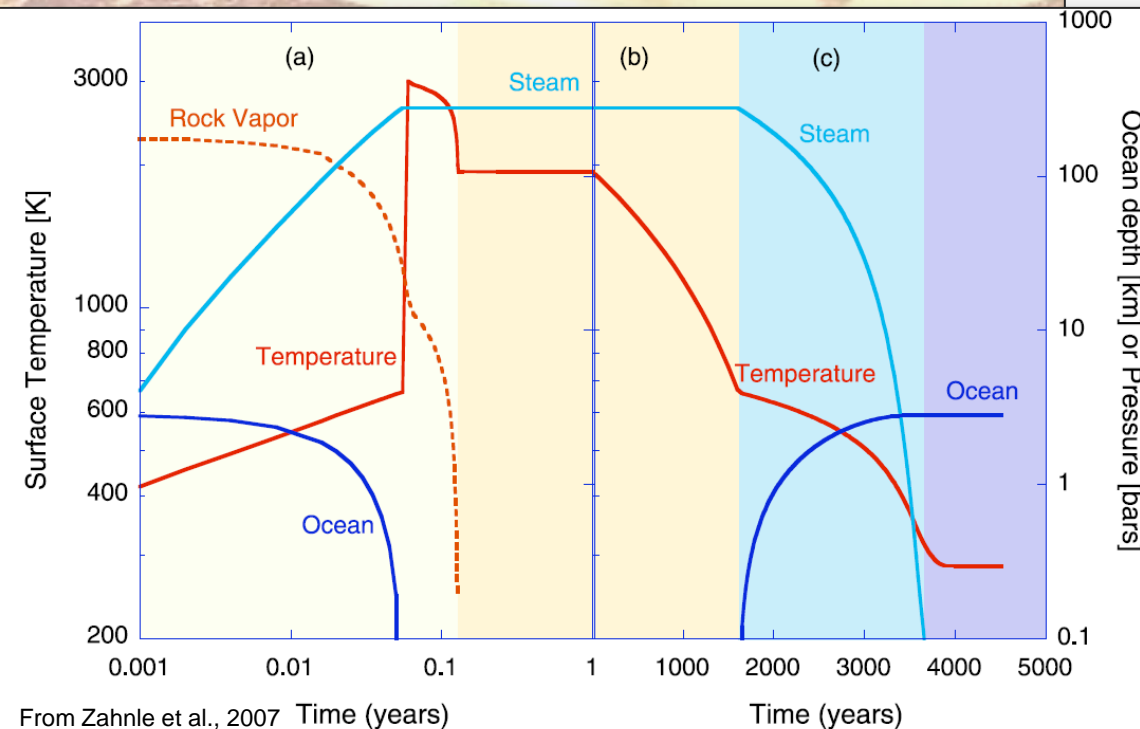
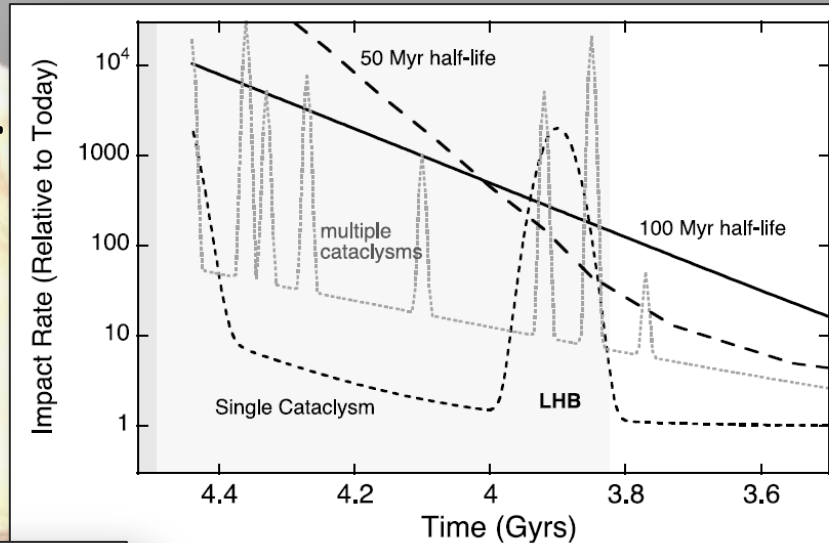
Cedric Gillmann, Gregor Golabek and Paul Tackley





# So, why the Impacts?

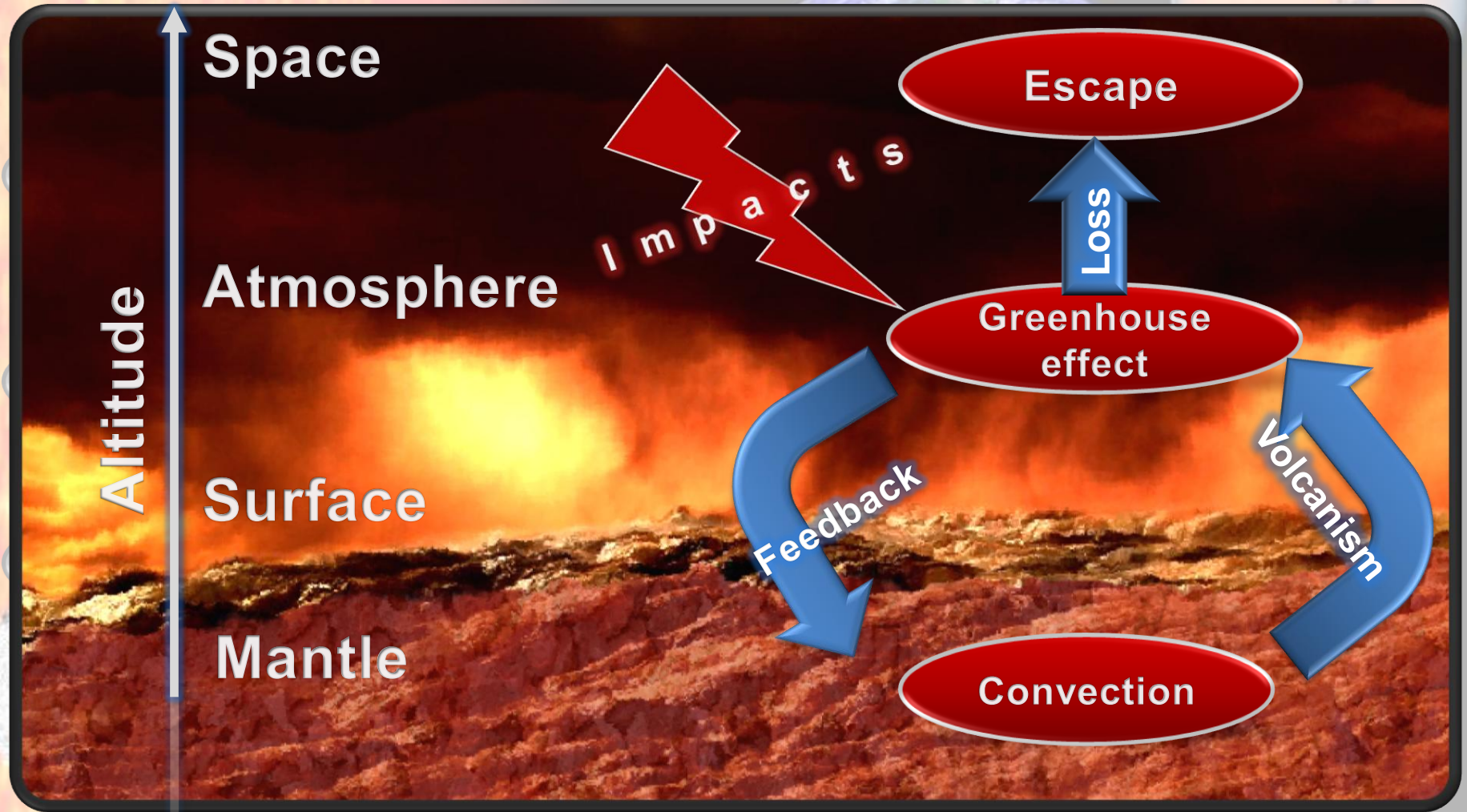
- Early history is marked by impacts.
- Large impacts could affect both the atmosphere and mantle of planets.

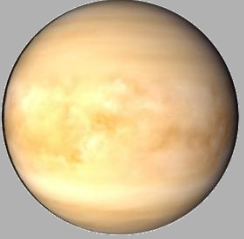


Could it have been a reason for some differences between Earth and Venus ?



# Global Model

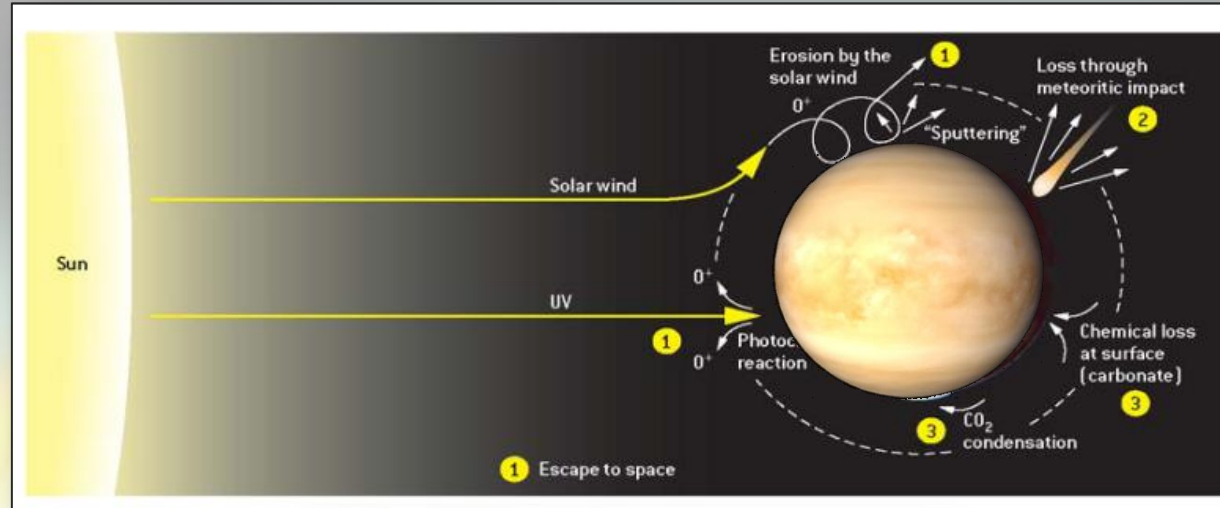




# Atmospheric modeling

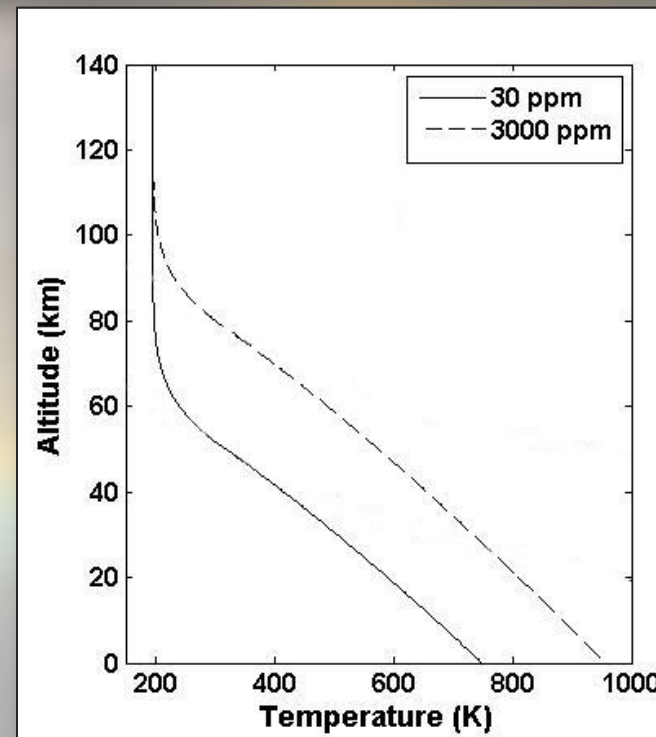
## I/ Escape

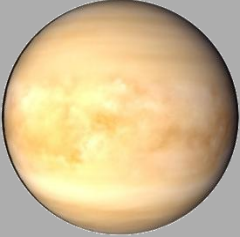
- Early thermal escape
- Late non-thermal
- Impact erosion
- No surface interactions.



## II/ Atmosphere

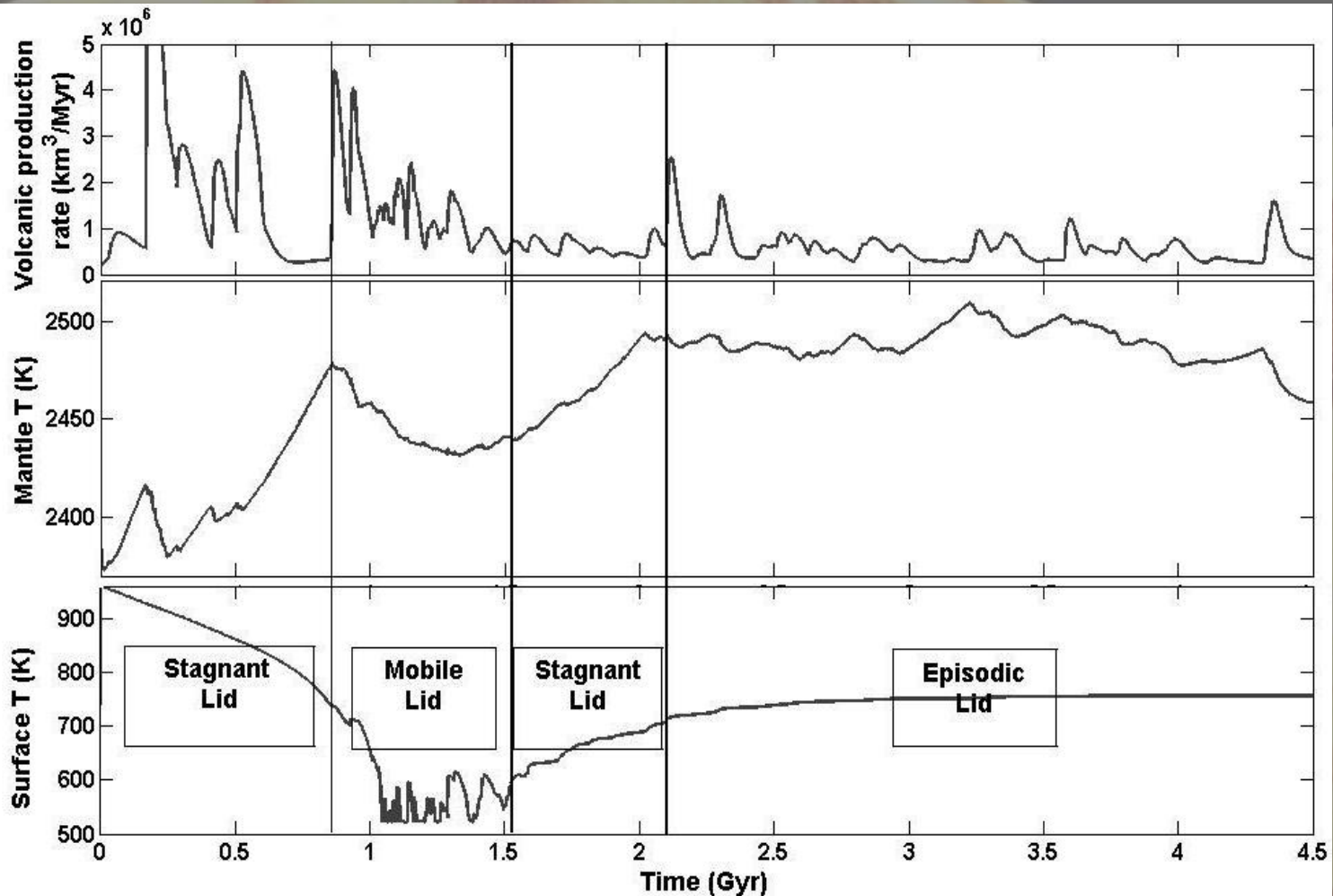
- Gray radiative convective model
- CO<sub>2</sub> and H<sub>2</sub>O as greenhouse gases
- Faint Young Sun



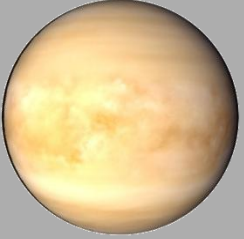


# Mantle modeling

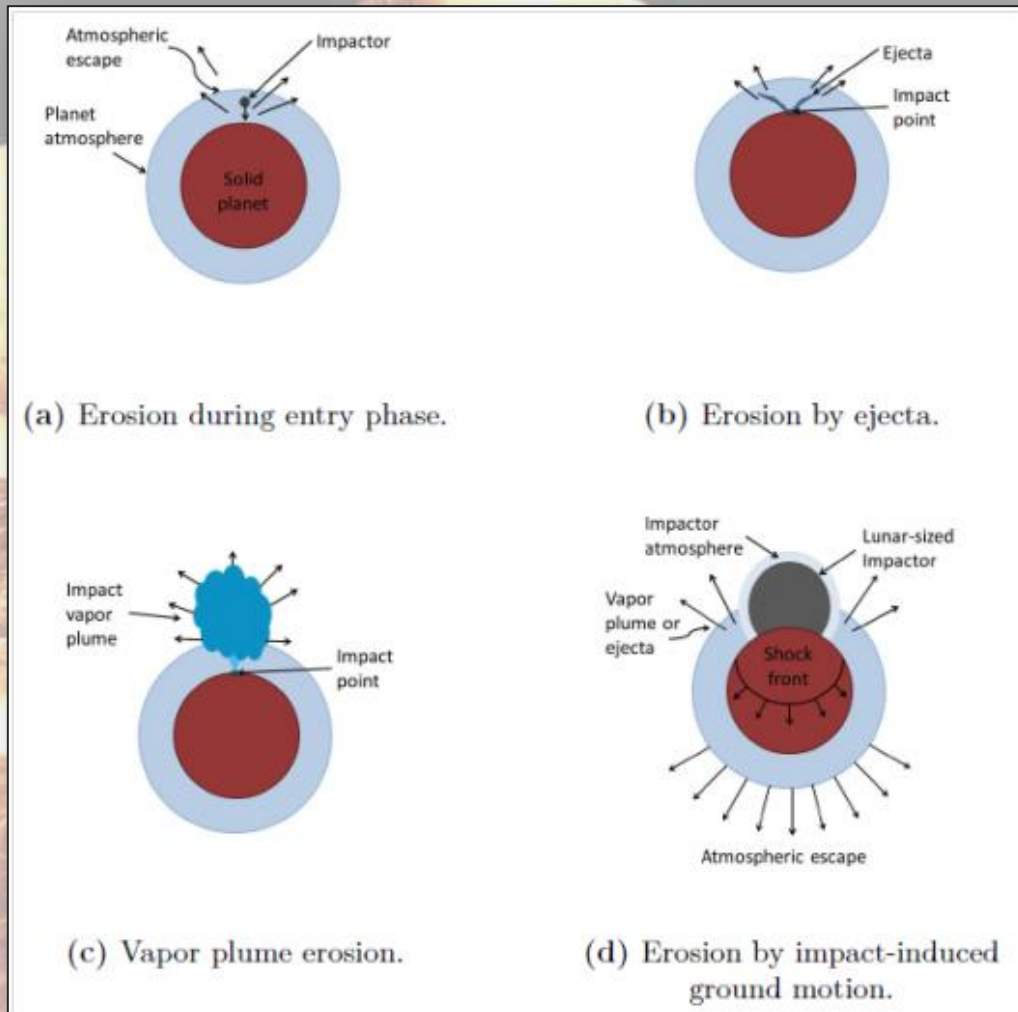
- Using the StagYY code with Plastic Yielding.
- Resurfacing events and realistic volcanism.
- Clear effects of coupling on evolution.



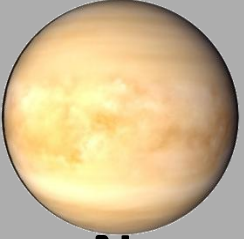




# Impact erosion

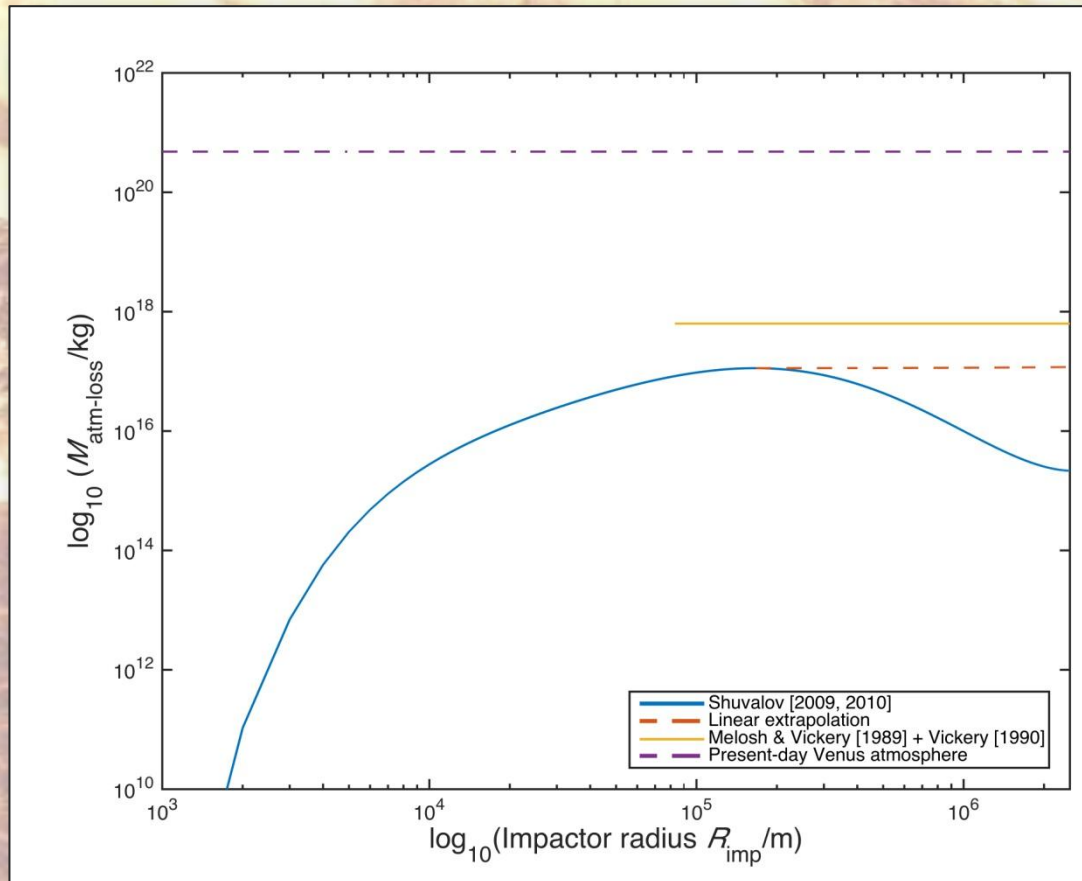


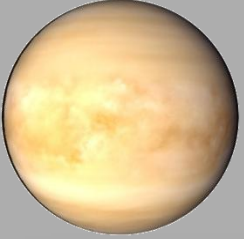
- Old studies predict massive erosion but recent ones are more conservative.



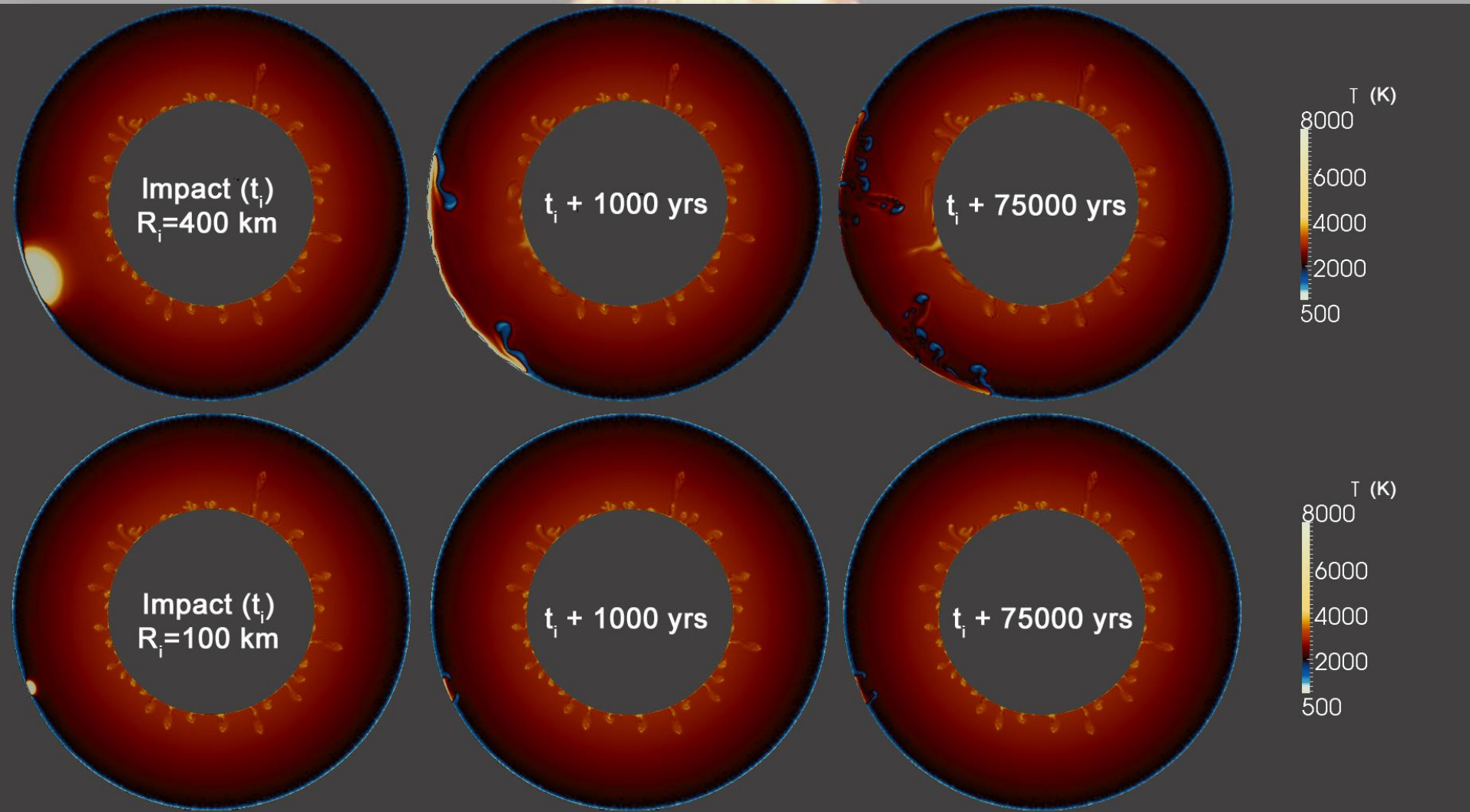
# ...or weak?

- Numerical simulations using the SOVA Hydrocode.
- Total erosion amounts to only a fraction of the atmosphere.



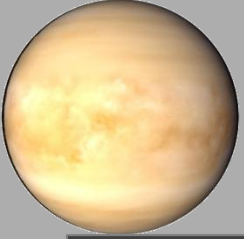


# Impacts : in the mantle

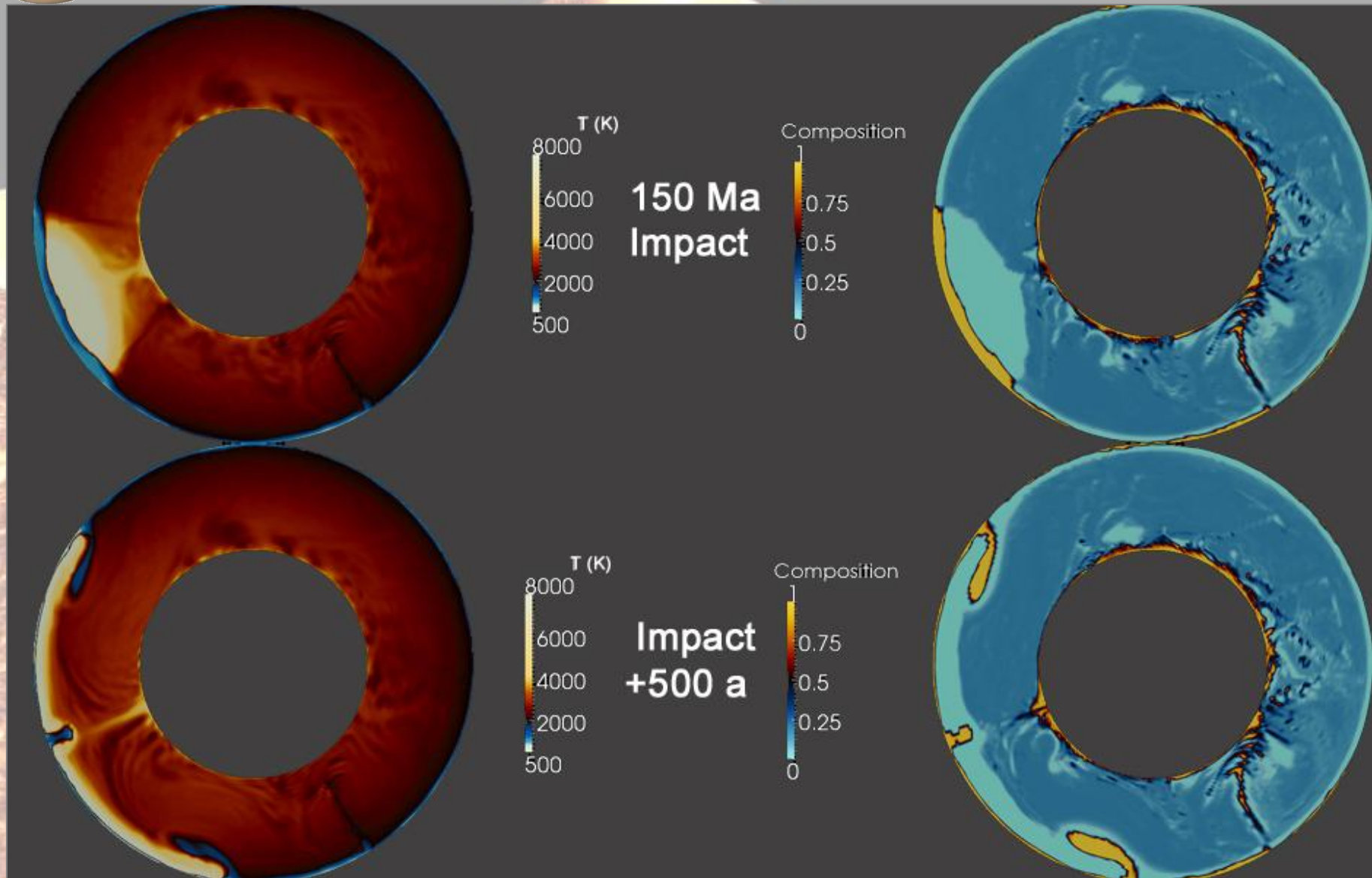


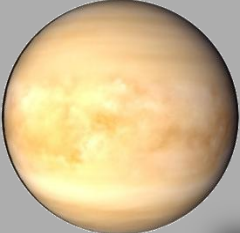
Large impacts affect a wide area. A **400km** object leads to global events.



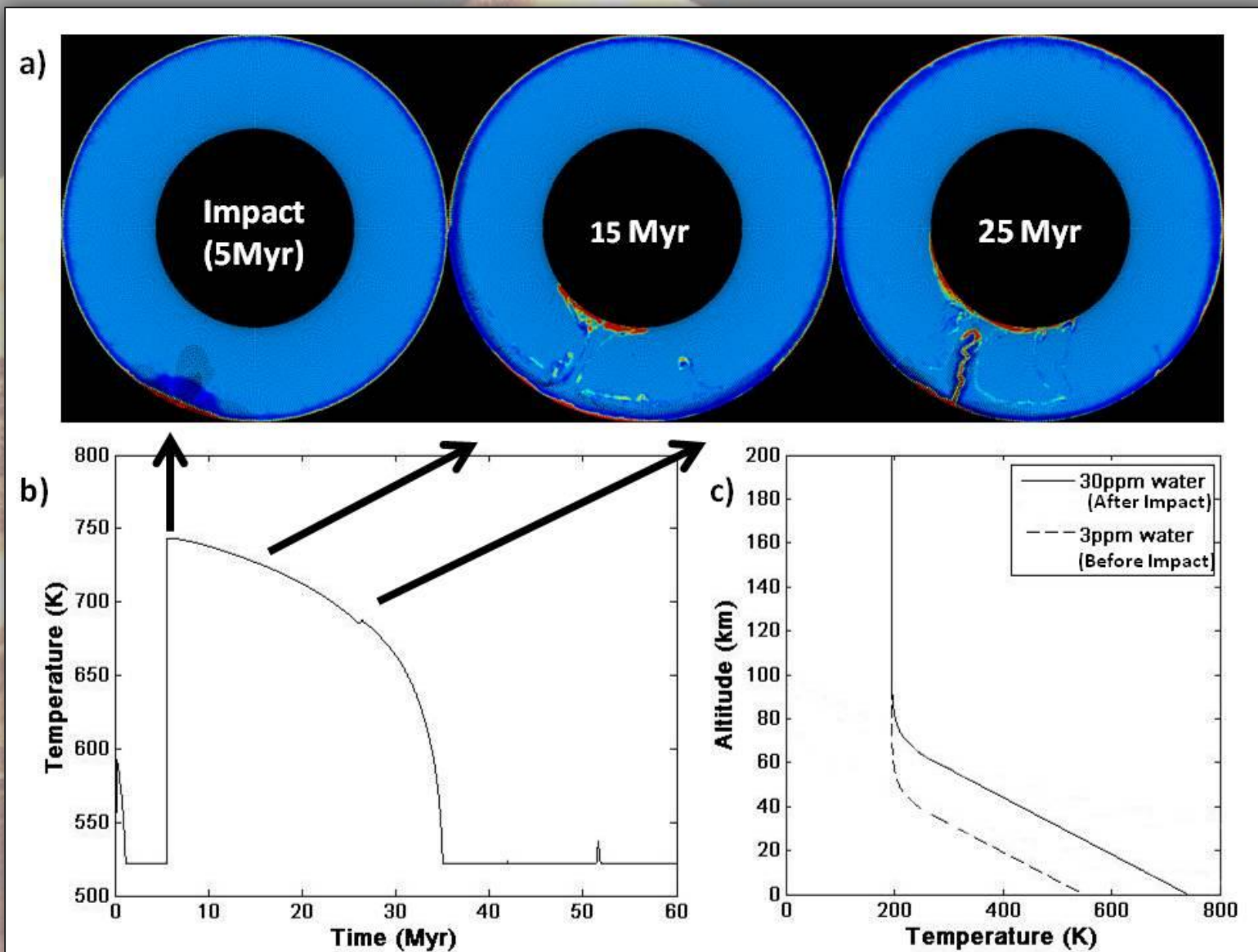


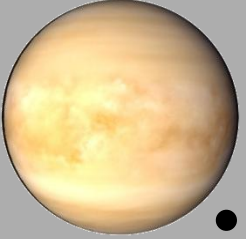
# Impacts : mantle depletion





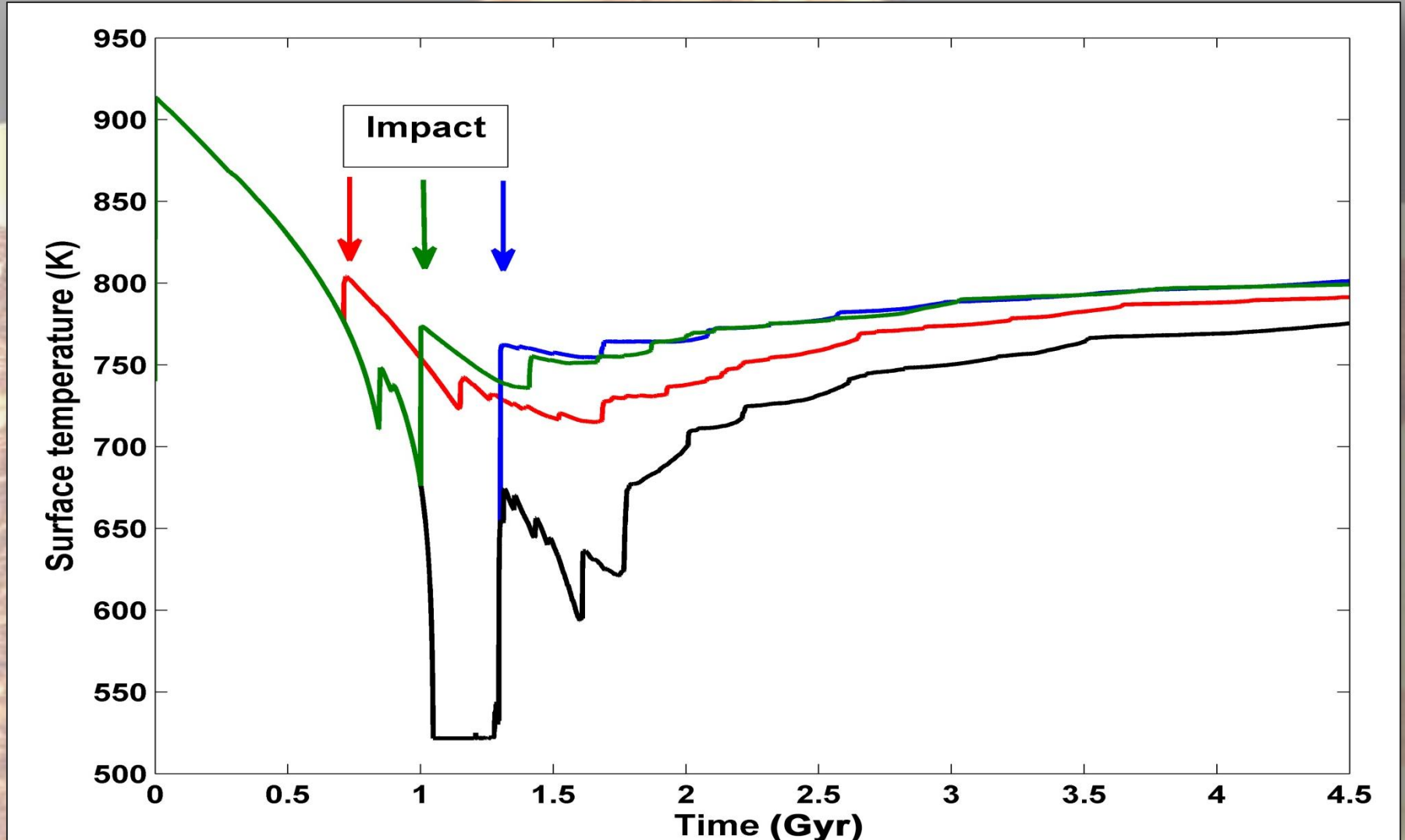
# Short term consequences on surface conditions





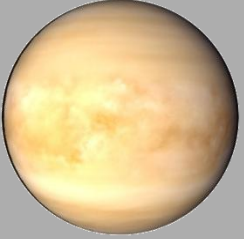
# Long Term: Degassing at the Impact?

- 500 km radius impactor









# Conclusions

- Atmosphere/mantle interactions are important for Venus. And Impacts clearly affect both... As long as they are big ( $R > 200$  km).
- Large Impacts have dramatic effects on the surface conditions due to volatile release. ( up to  $\sim 200$  K)
- They also affect the mantle on the global scale: volatile depletion.
- We also provide evolutionary pathways that lead to present Venus conditions either **with** or **without** impact.
- The problem is, however, to distinguish between these possible histories. At present, we lack data or definite proof.