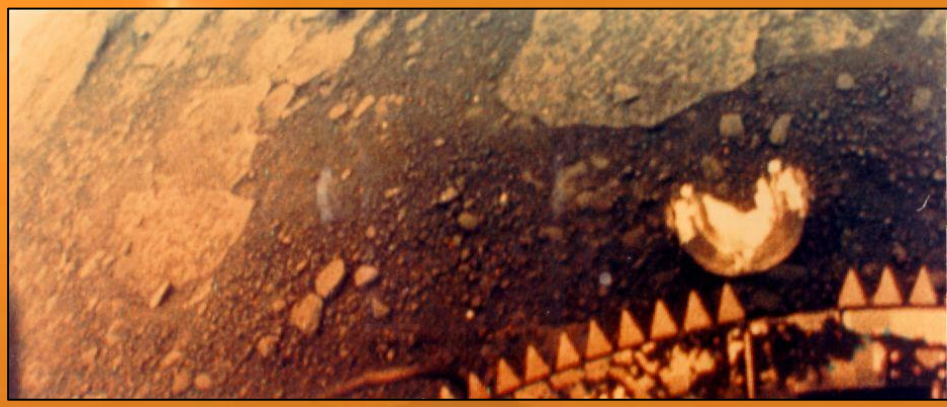
Planet TOPERS: Habitability…. And Venus.

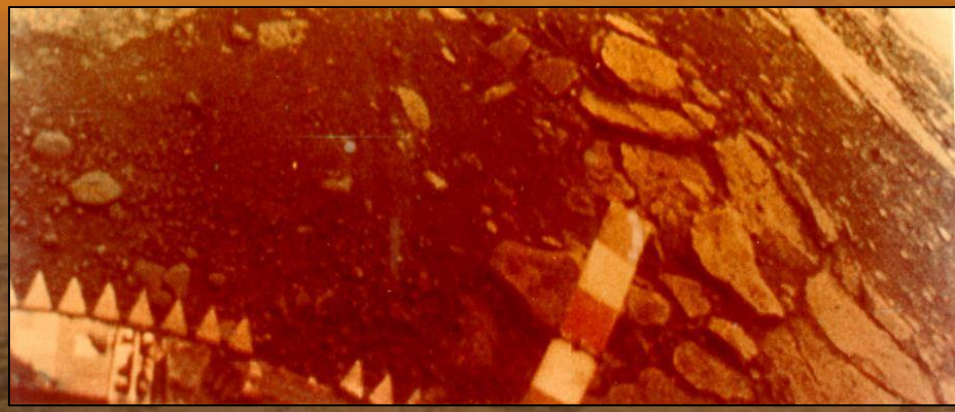
By Cédric Gillmann

Habitability of Venus: A first guess.

- What we thought we'd find

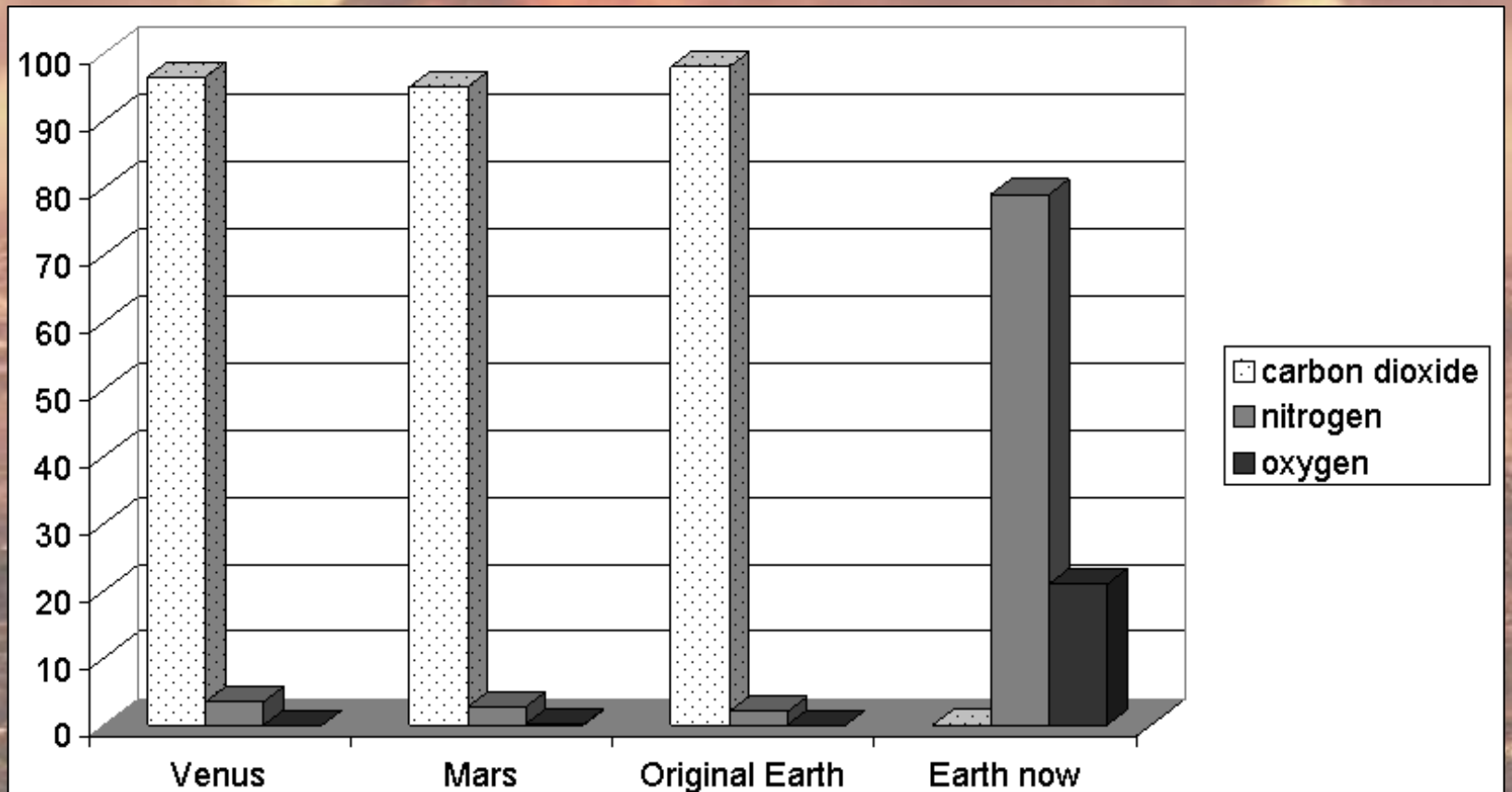
- What we did find…





So, what about trying something else ?

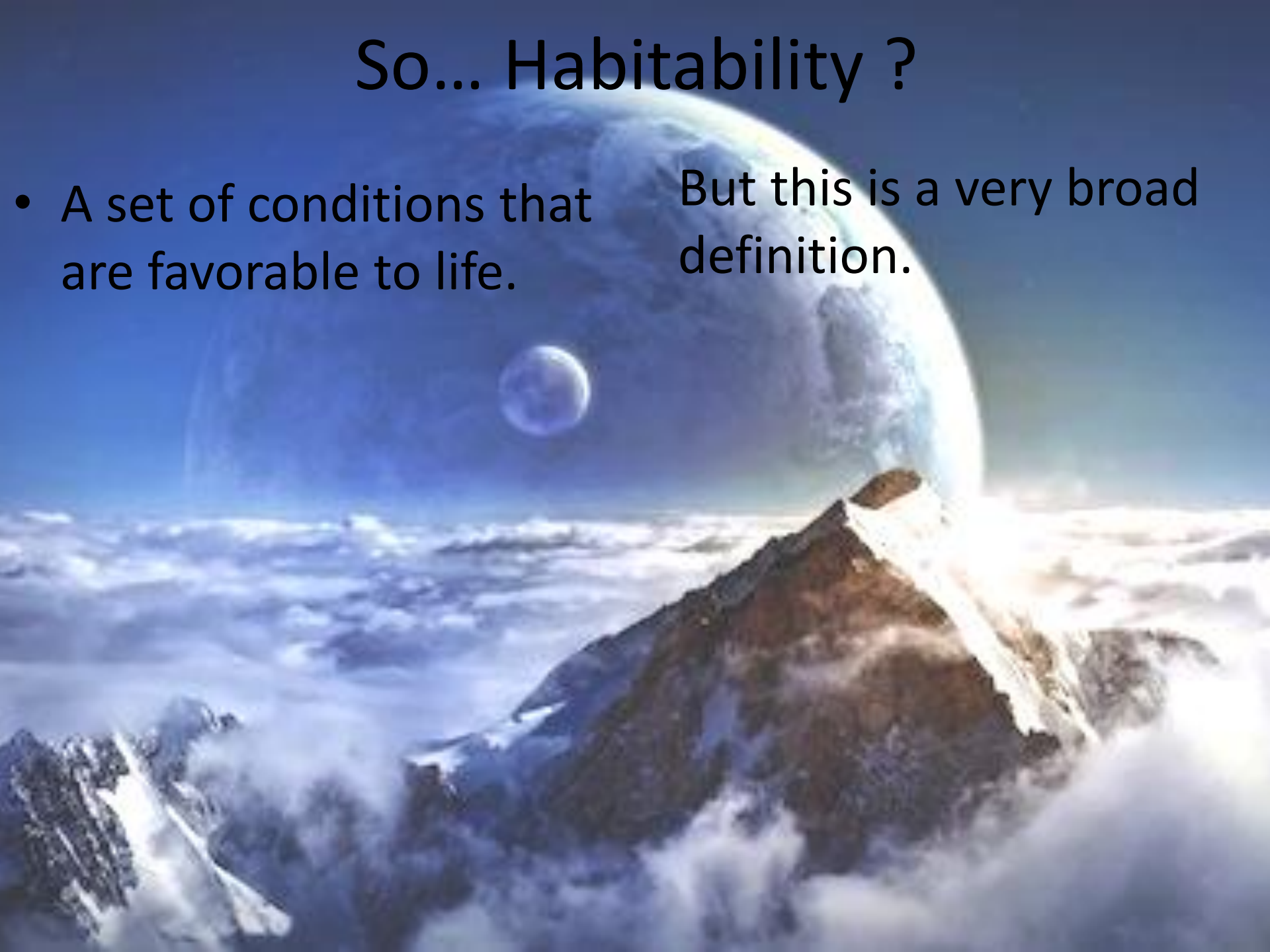
Why Venus?


100
90
80
70
60
50
40
30
20
10
0
Venus
Mars
Original Earth
Earth now
carbon dioxide
nitrogen
oxygen

So… Habitability ?

- A set of conditions that are favorable to life.

But this is a very broad definition.



So… Habitability ?

- A set of conditions that are favorable to life.

- A set of conditions that are favorable to “life as we know it”.

But this is a very broad definition.

Now we know what we are talking about but…

So… Habitability ?

- A set of conditions that are favorable to life.

- A set of conditions that are favorable to “life as we know it”.

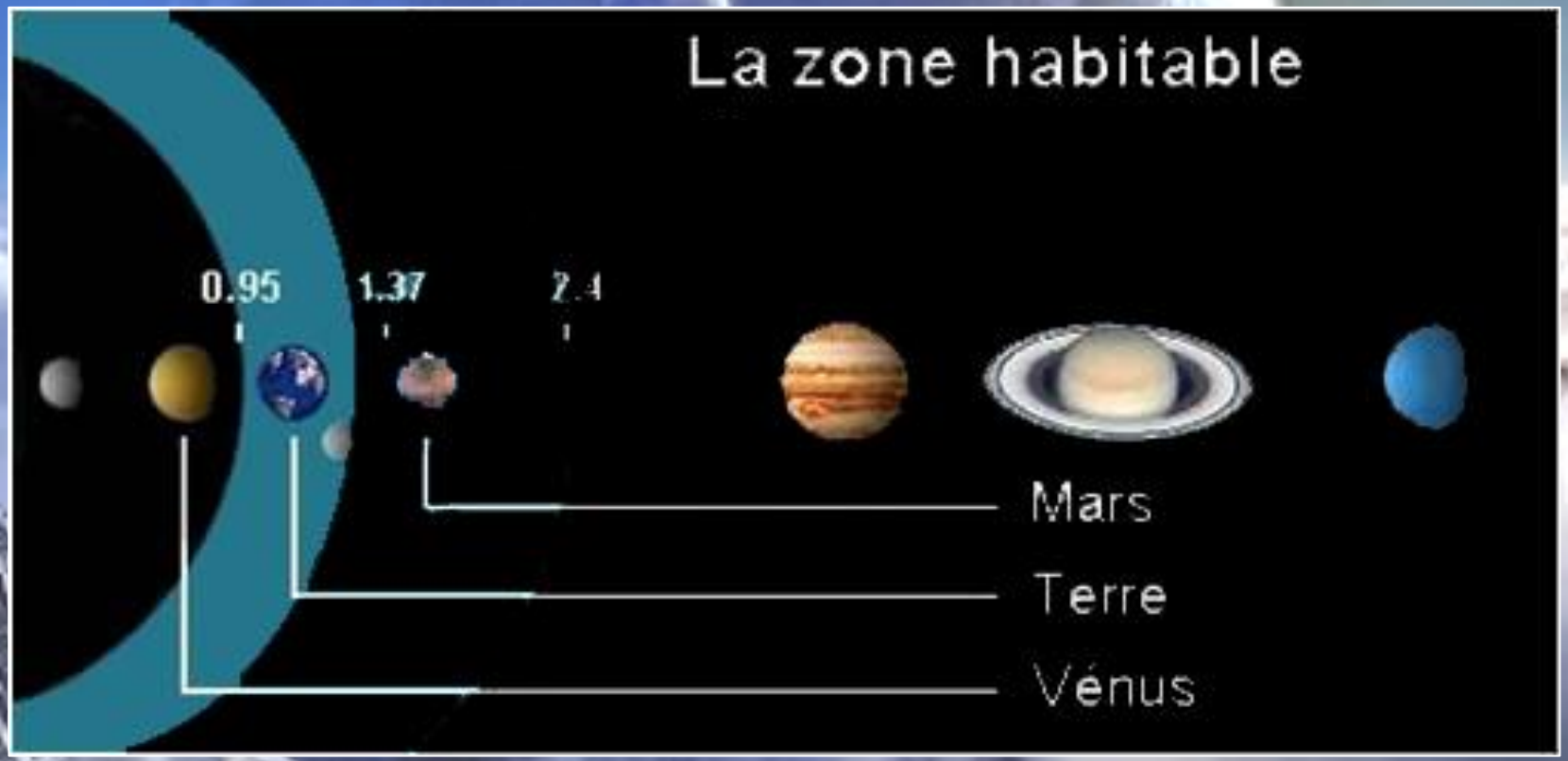
- In the end, we mainly look for water and Earth-like conditions

But this is a very broad definition.

Now we know what we are talking about but…

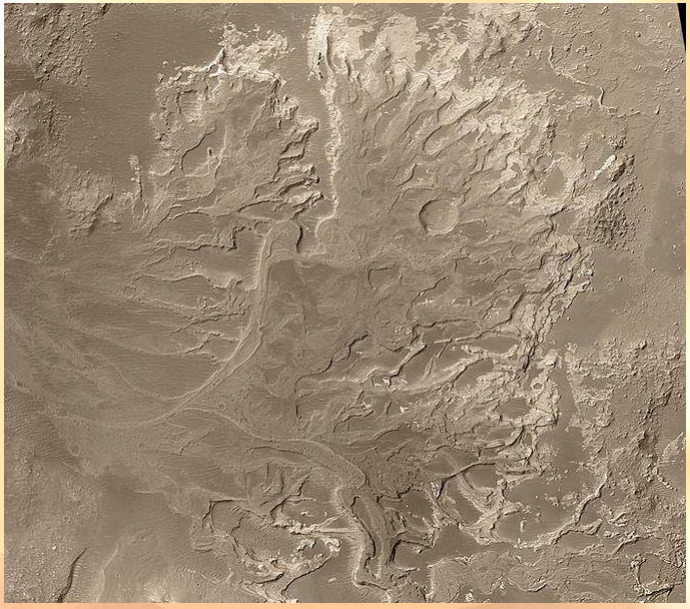
THE habitable zone?

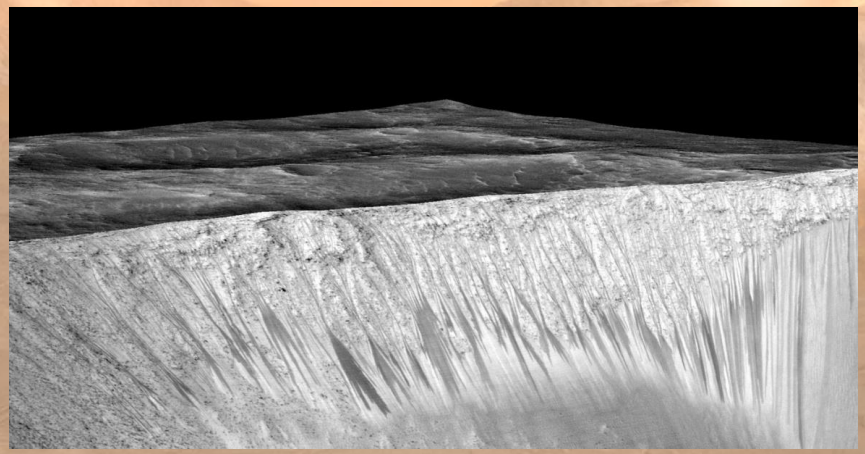
- Defining habitability by the presence of liquid water at the surface at present leaves us with a lonely Earth...



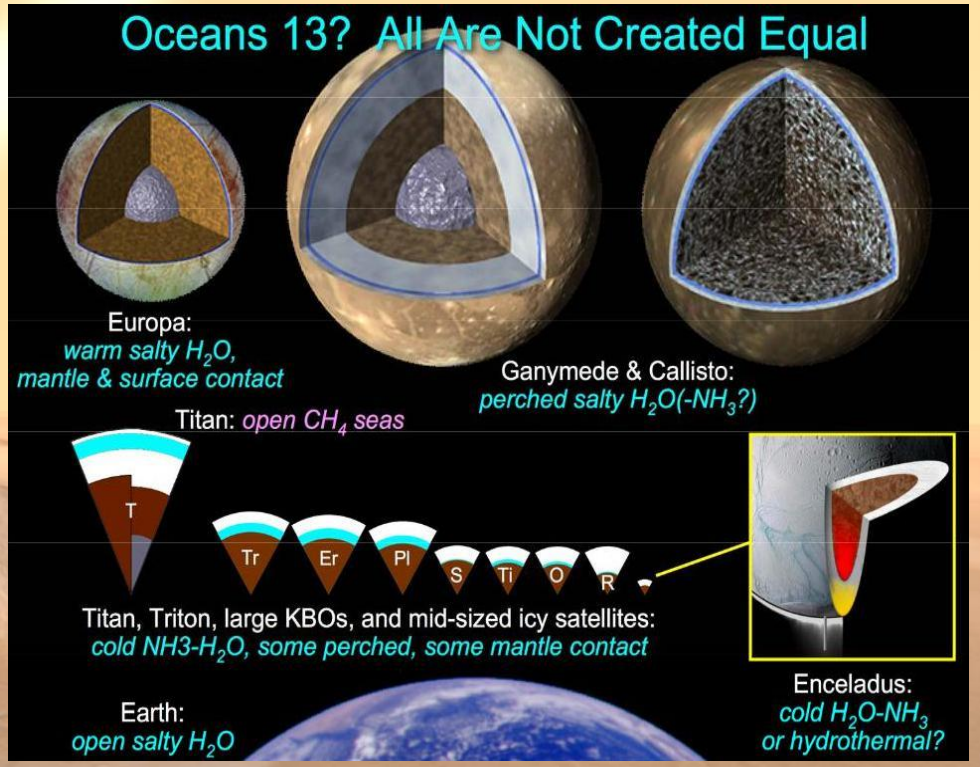
Moving the Outer limit around

Mars:



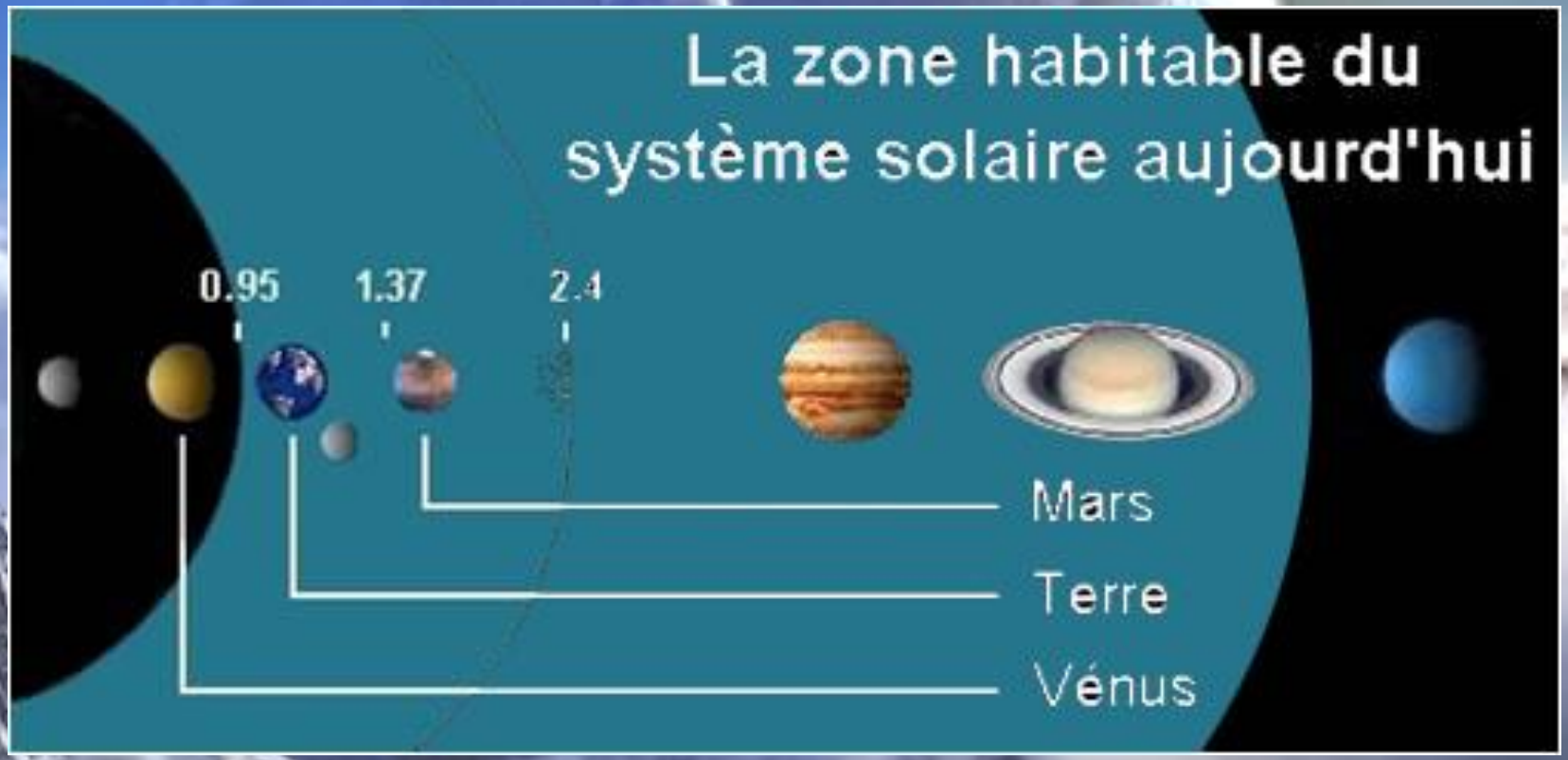


Icy Satellites:



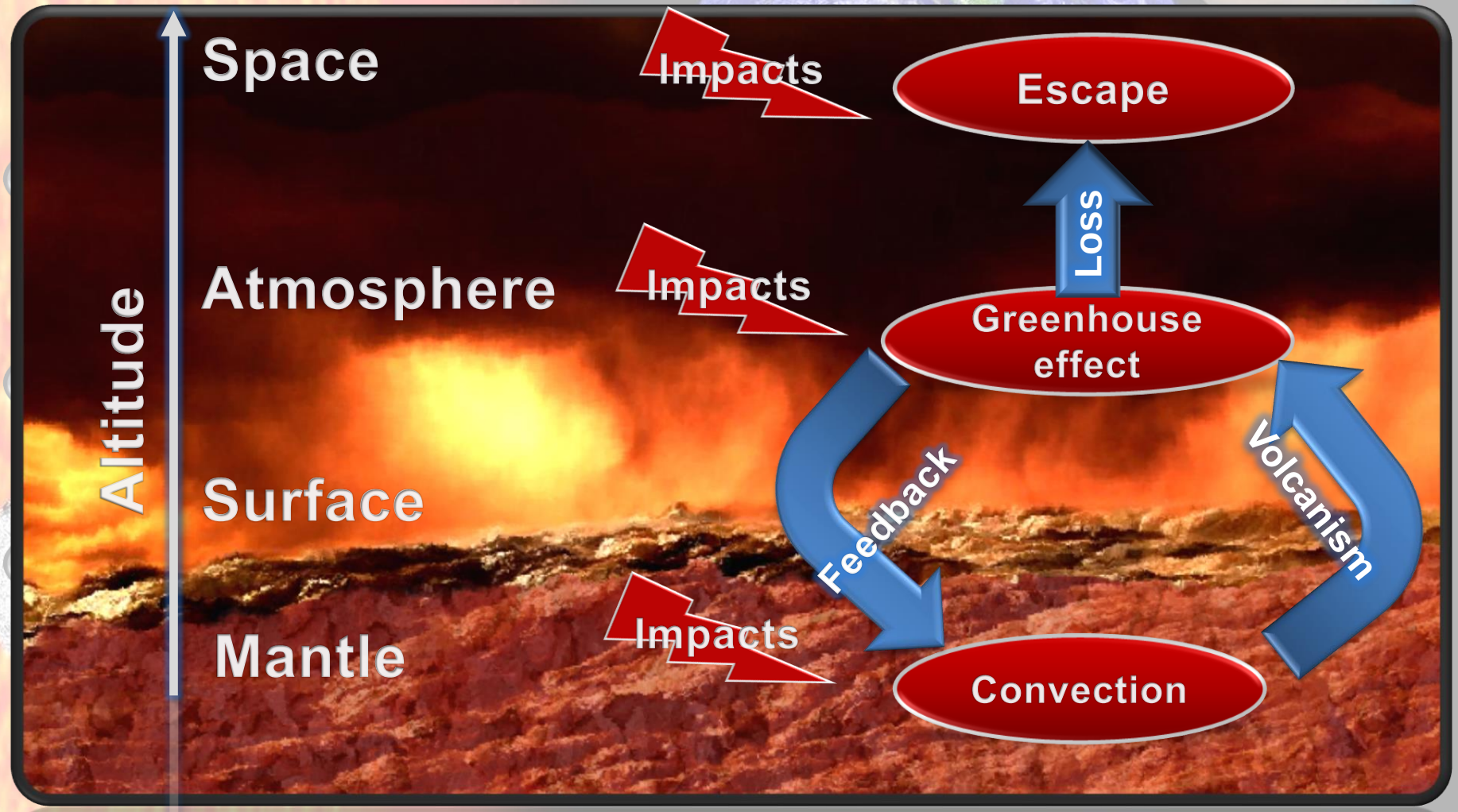
THE habitable zone?

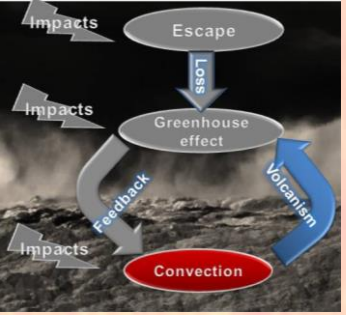
- The state of the atmosphere is important.
- So it depends on time: «When?», «How long?»
- The surface is not the only place to look for



A general, simplified outline of how it works.

Understanding planets means looking at the interactions.

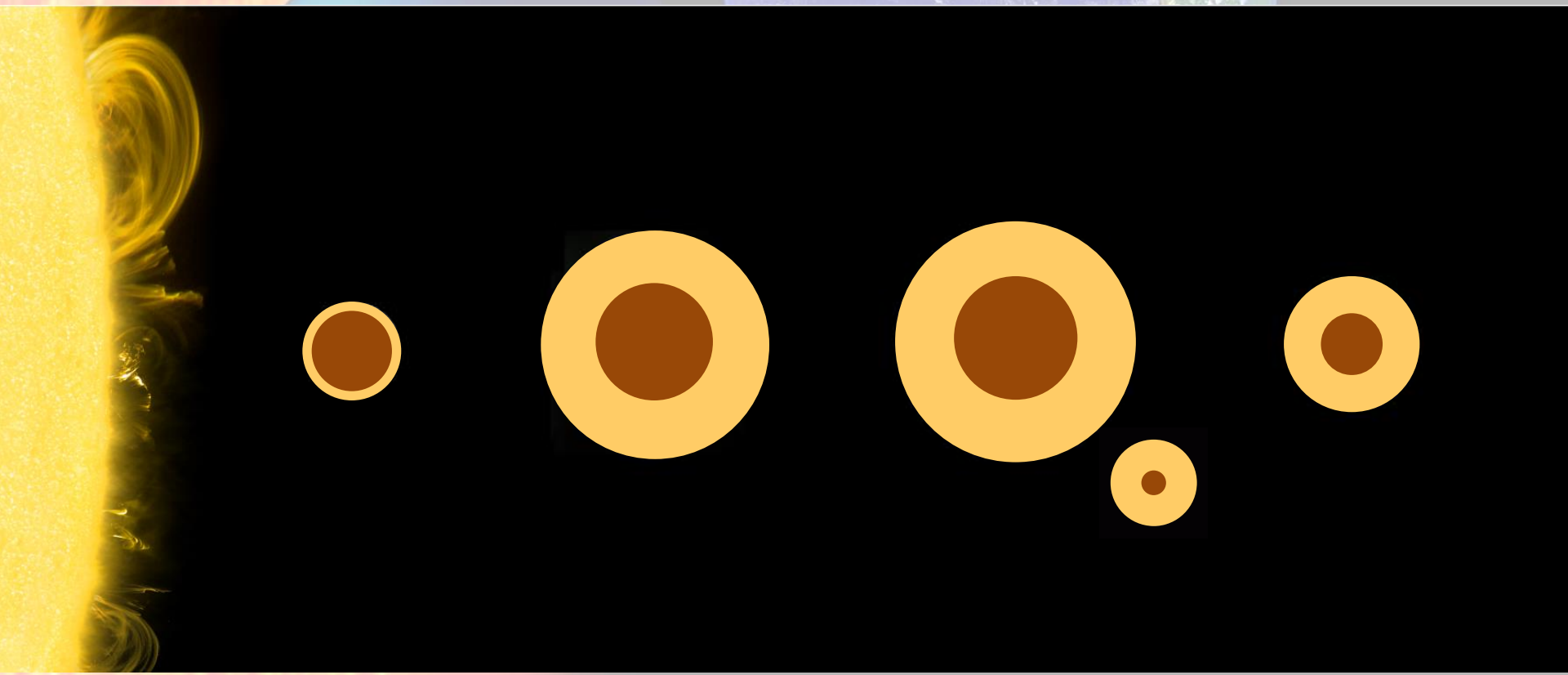




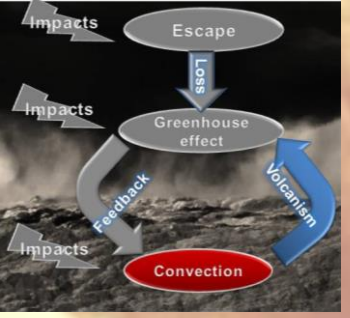
The interior of terrestrial planets

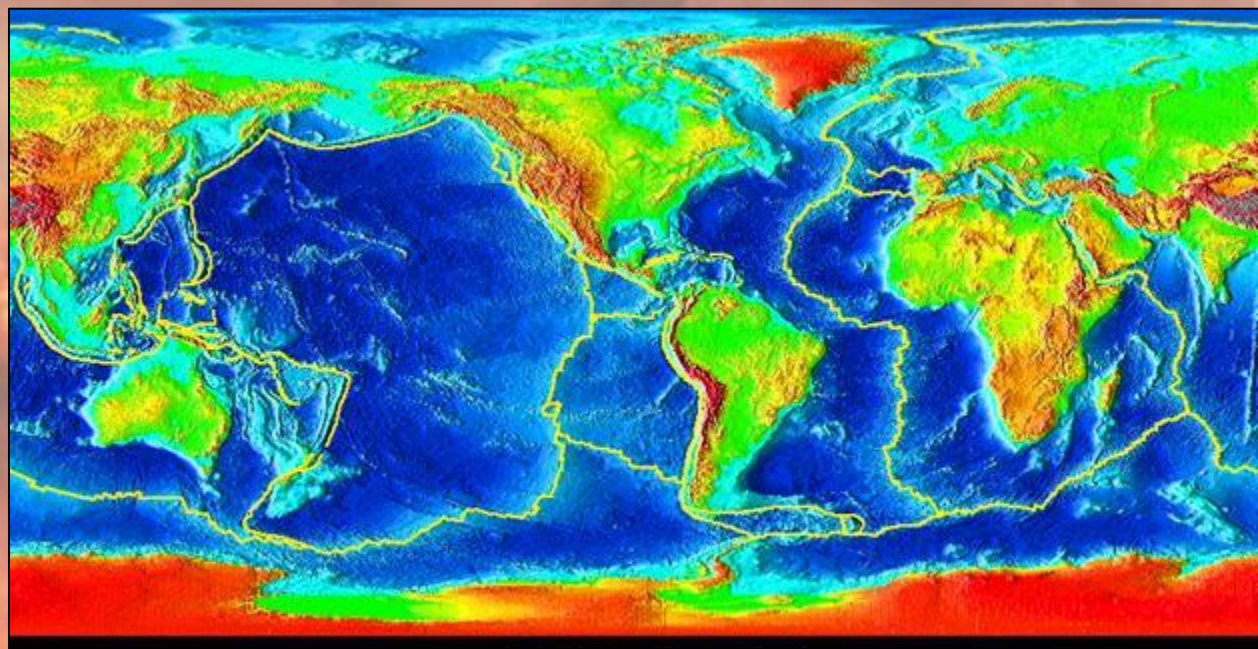
Why bother?

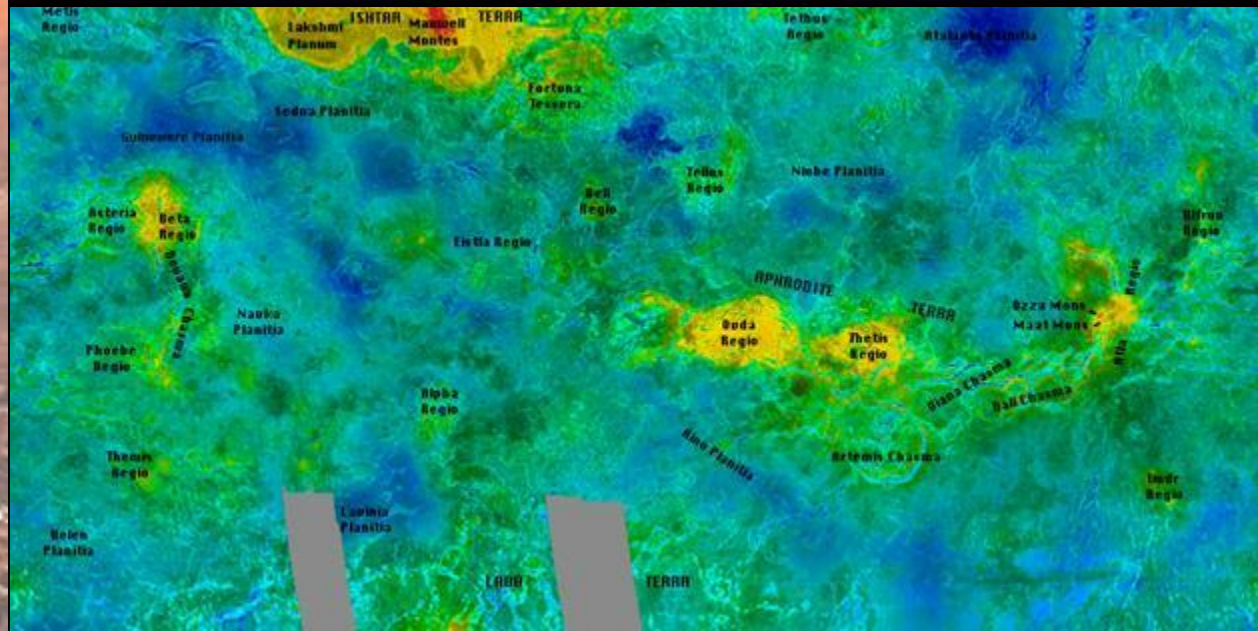
The interior structure is linked to convection regime and, ultimately, volcanism and degassing.



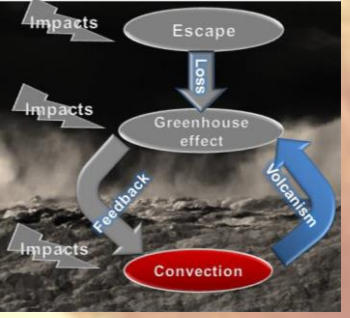
Volcanism on Earth and Venus

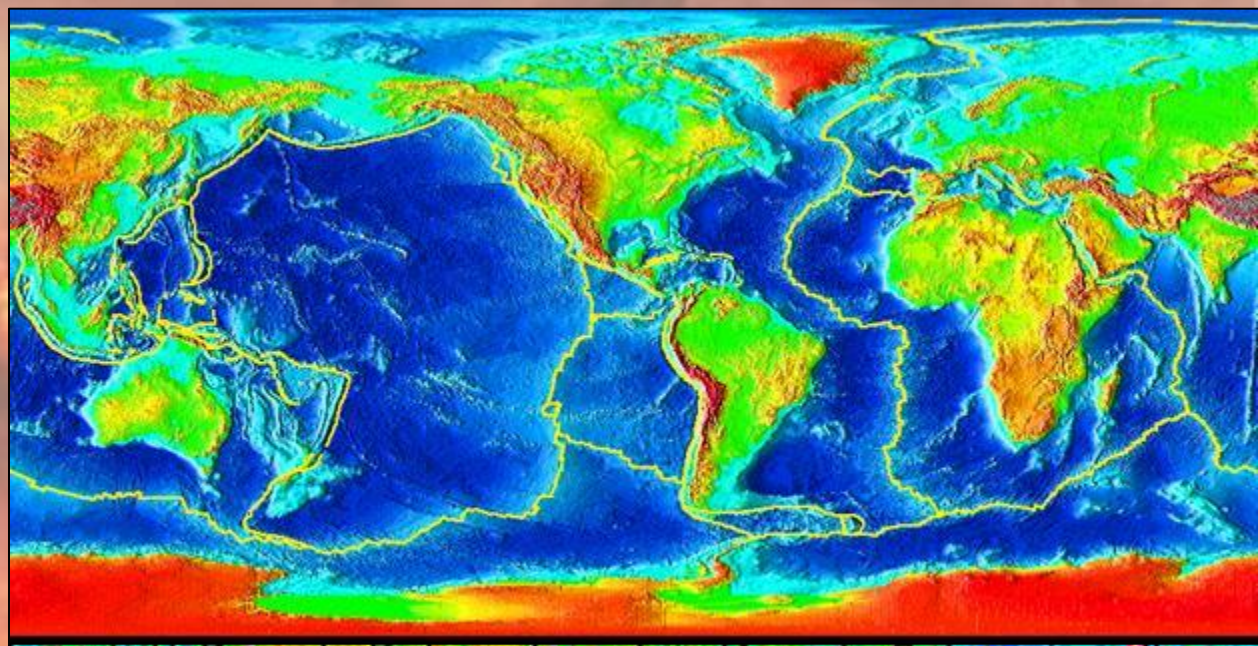


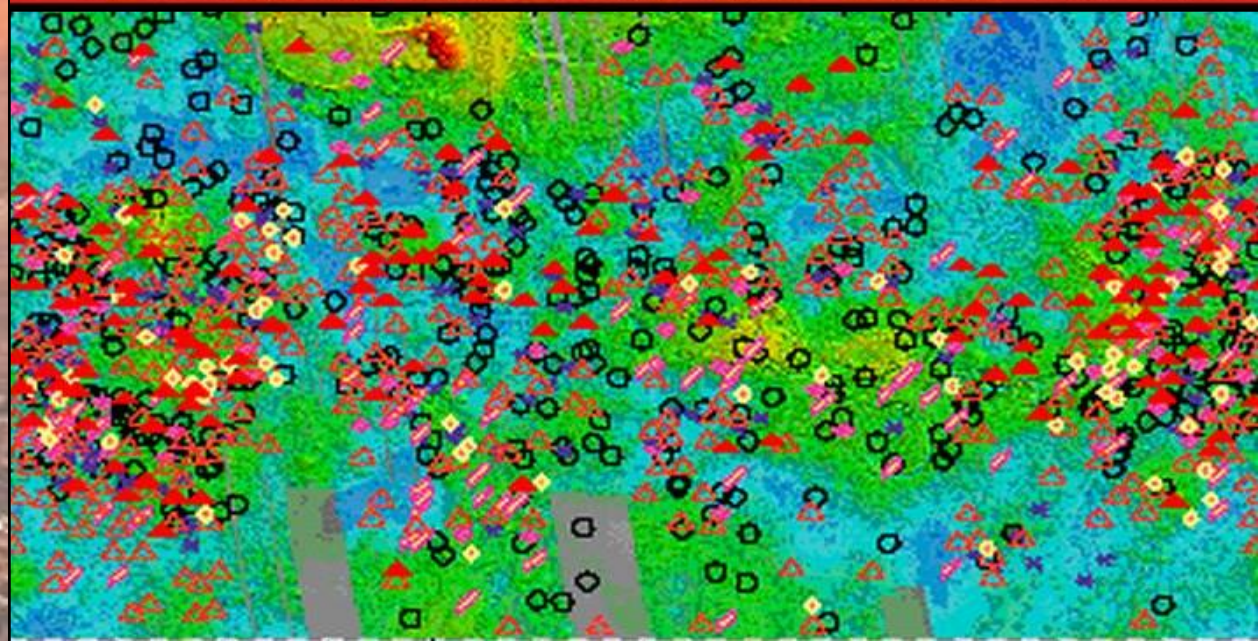


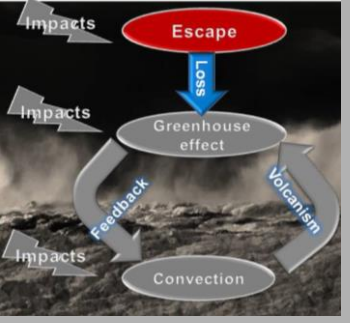


Volcanism on Earth and Venus



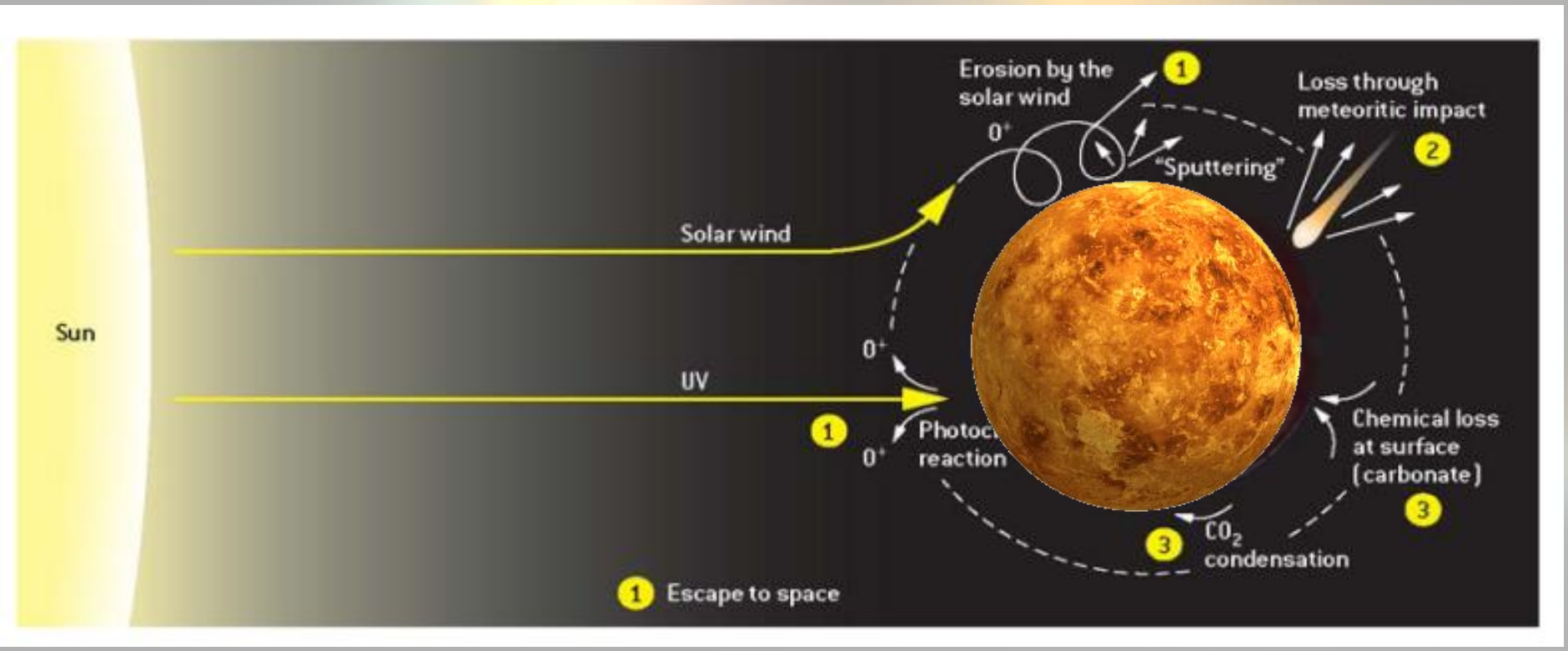


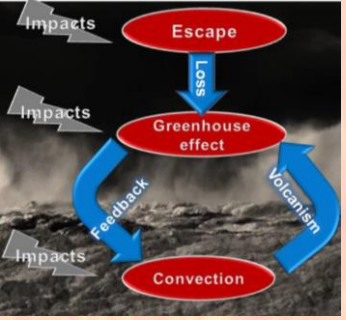




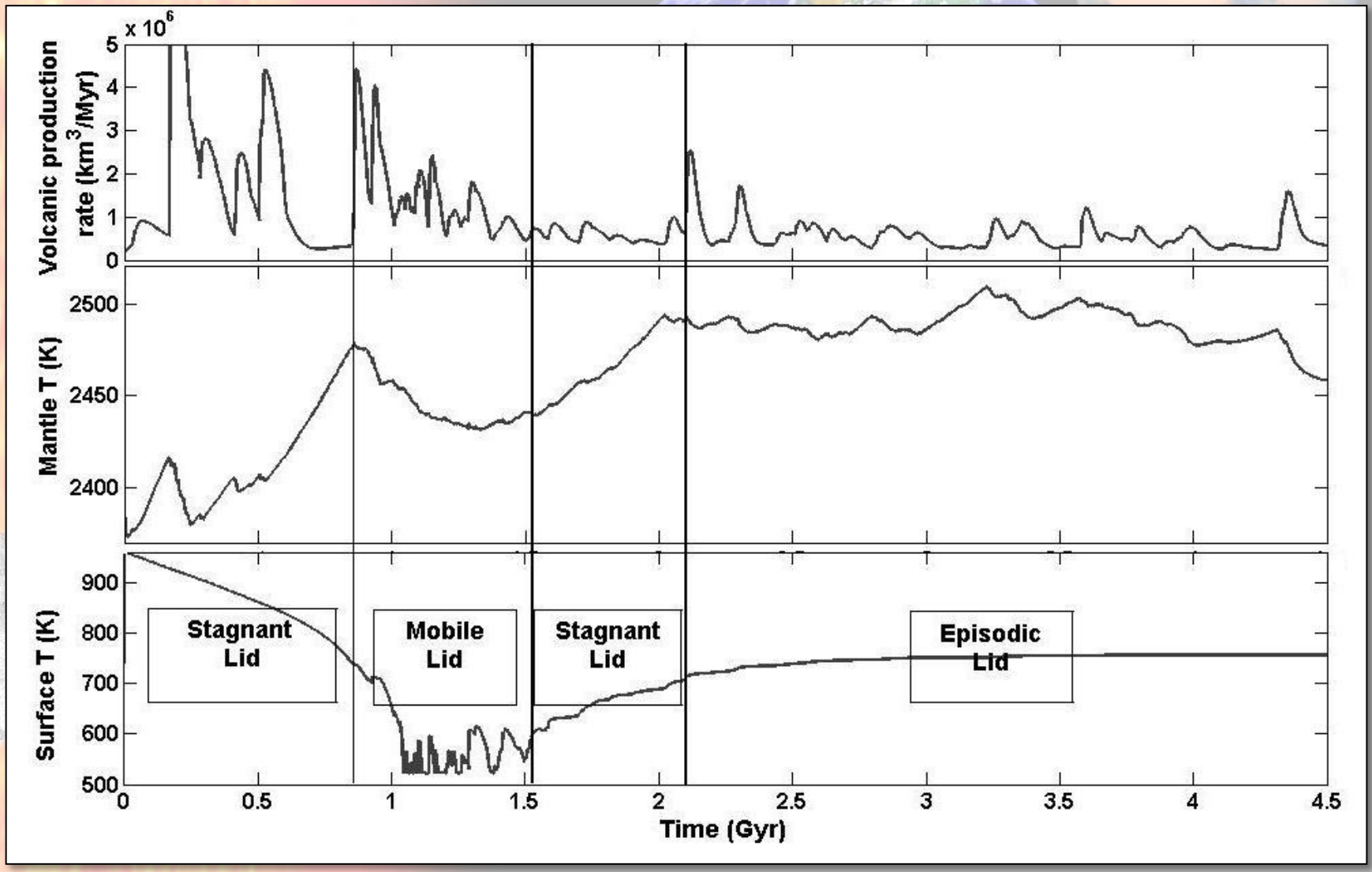
Second volatile flux: atmospheric escape.

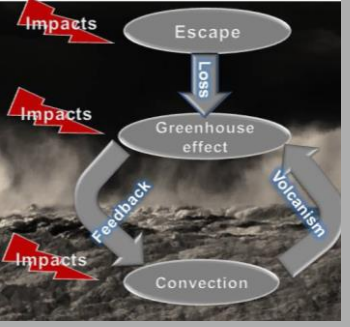
- Many different types of escape to consider.
- They vary with time.





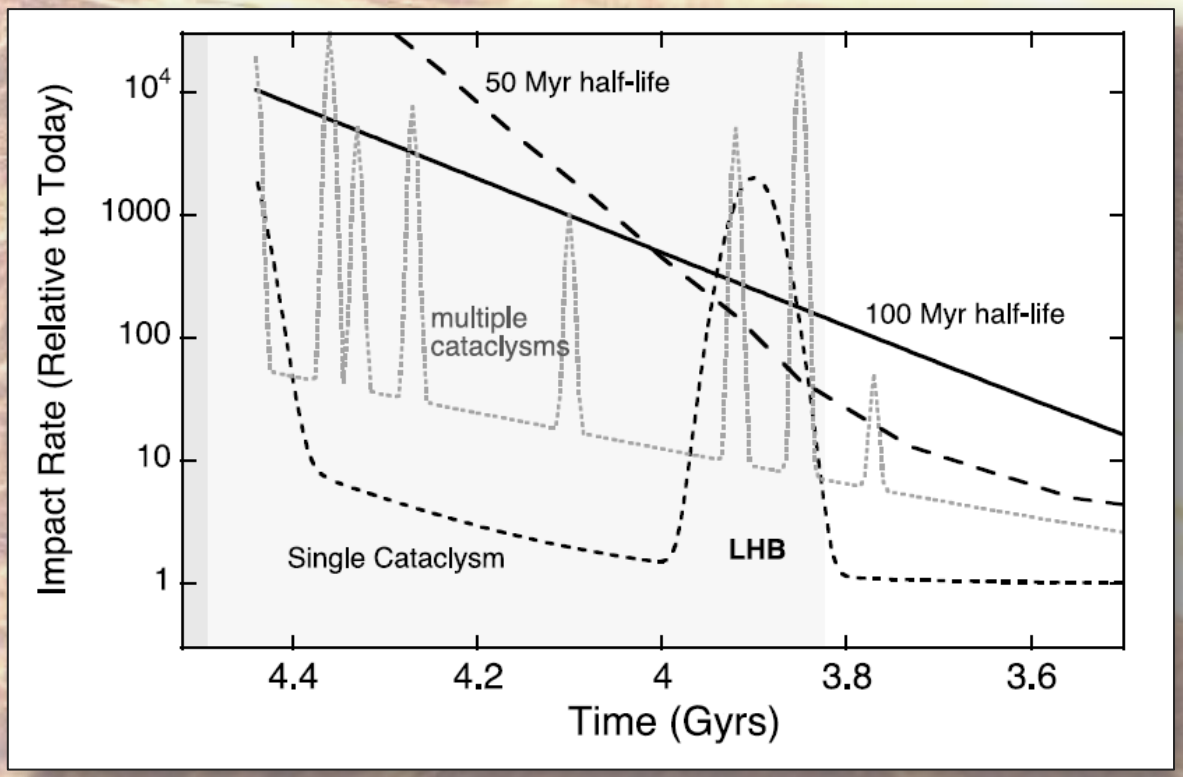
The example of Venus
The evidence of feedbacks



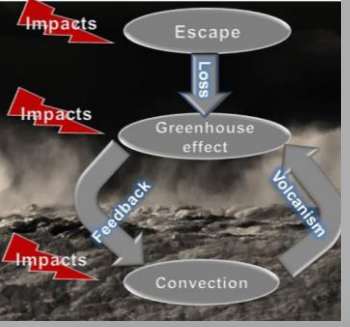


Impacts!

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



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



Impacts : in the mantle

Impact (t_i)
R_i=400 km

t_i + 1000 yrs

t_i + 75000 yrs

T (K)
8000
6000
4000
2000
500

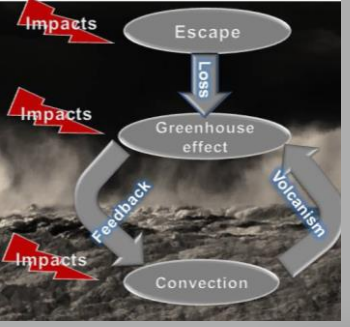
Impact (t_i)
R_i=100 km

t_i + 1000 yrs

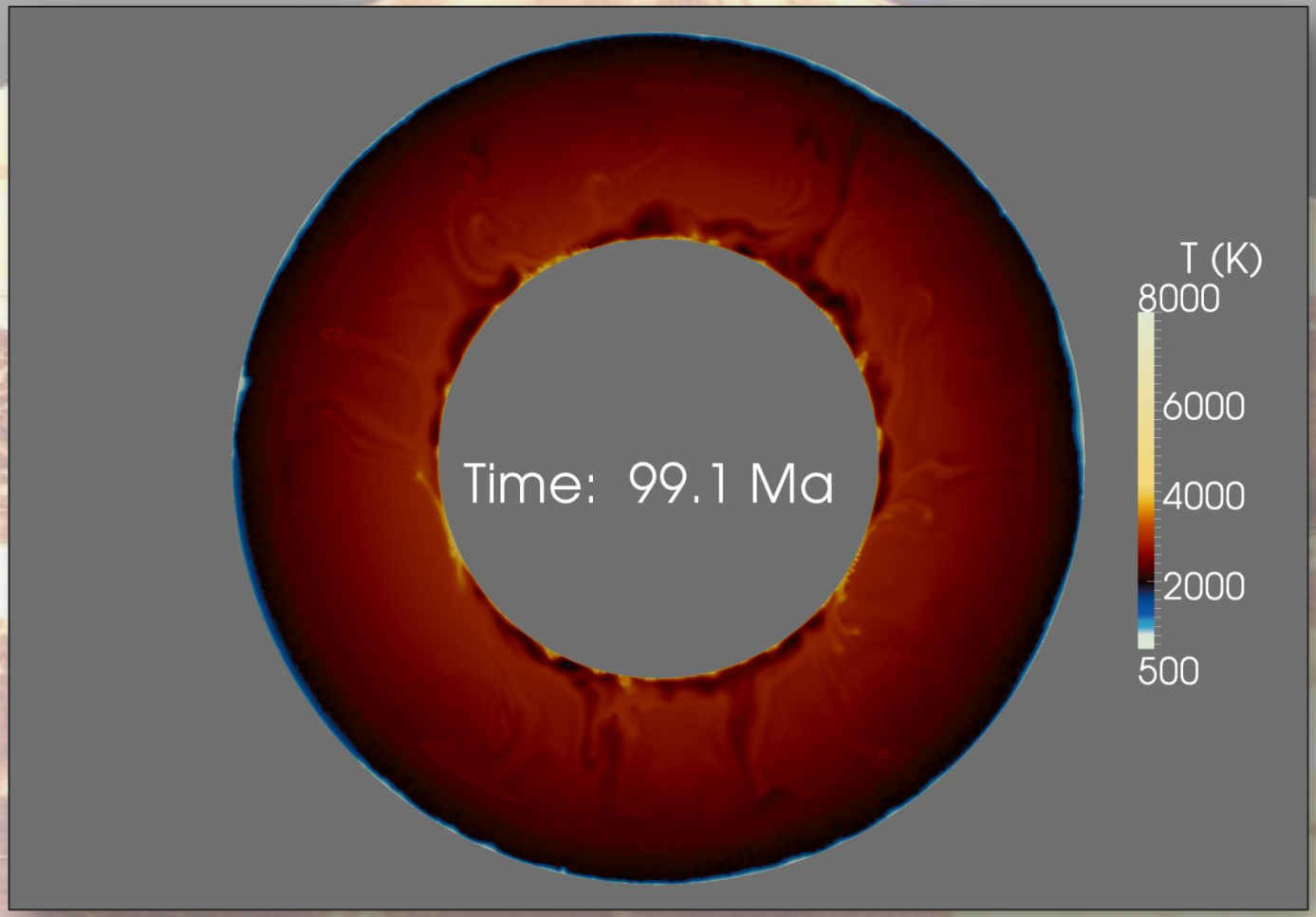
t_i + 75000 yrs

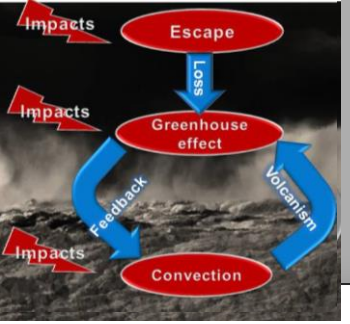
T (K)
8000
6000
4000
2000
500

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

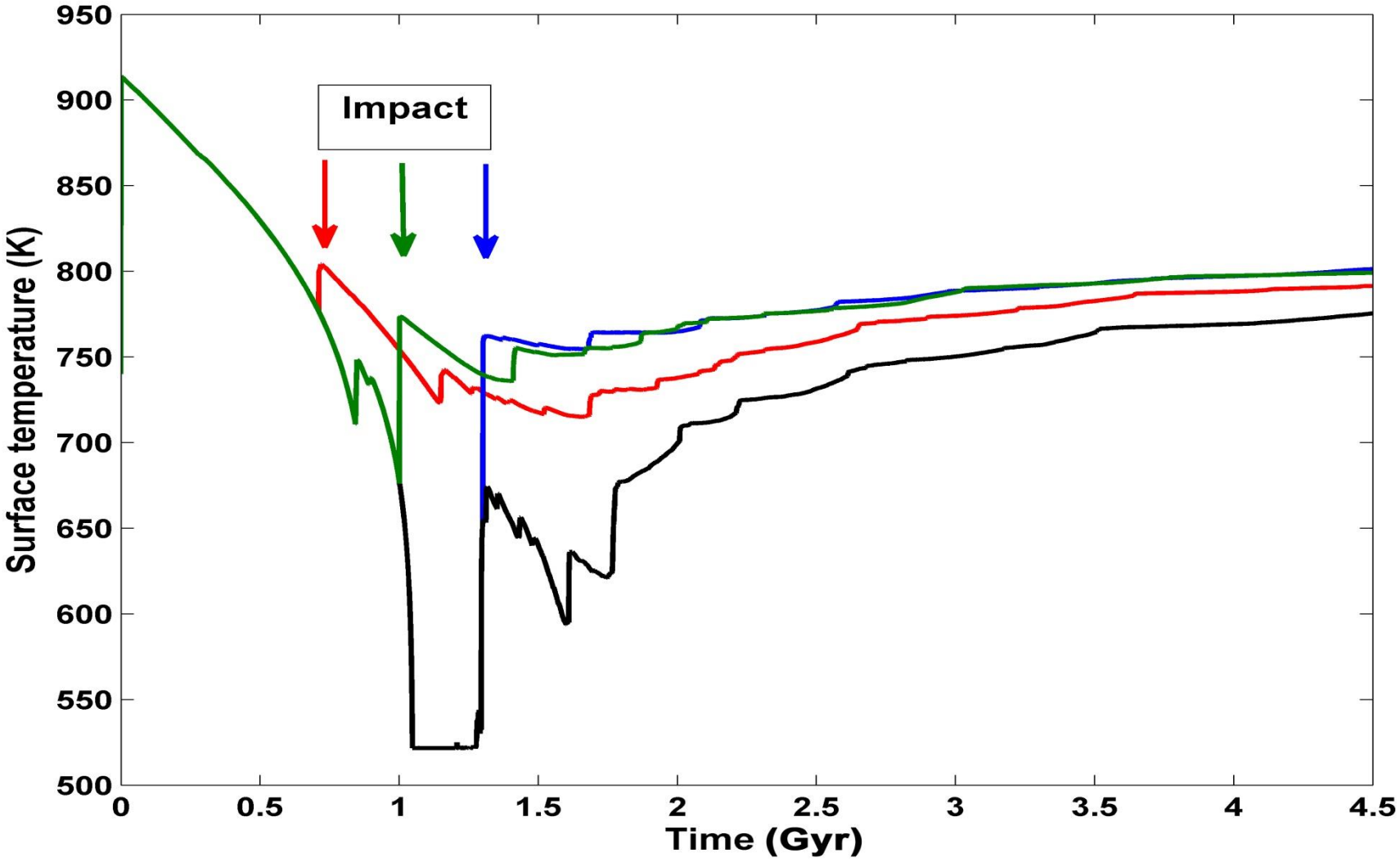


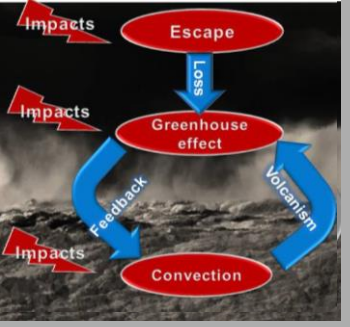
Effects on the mantle





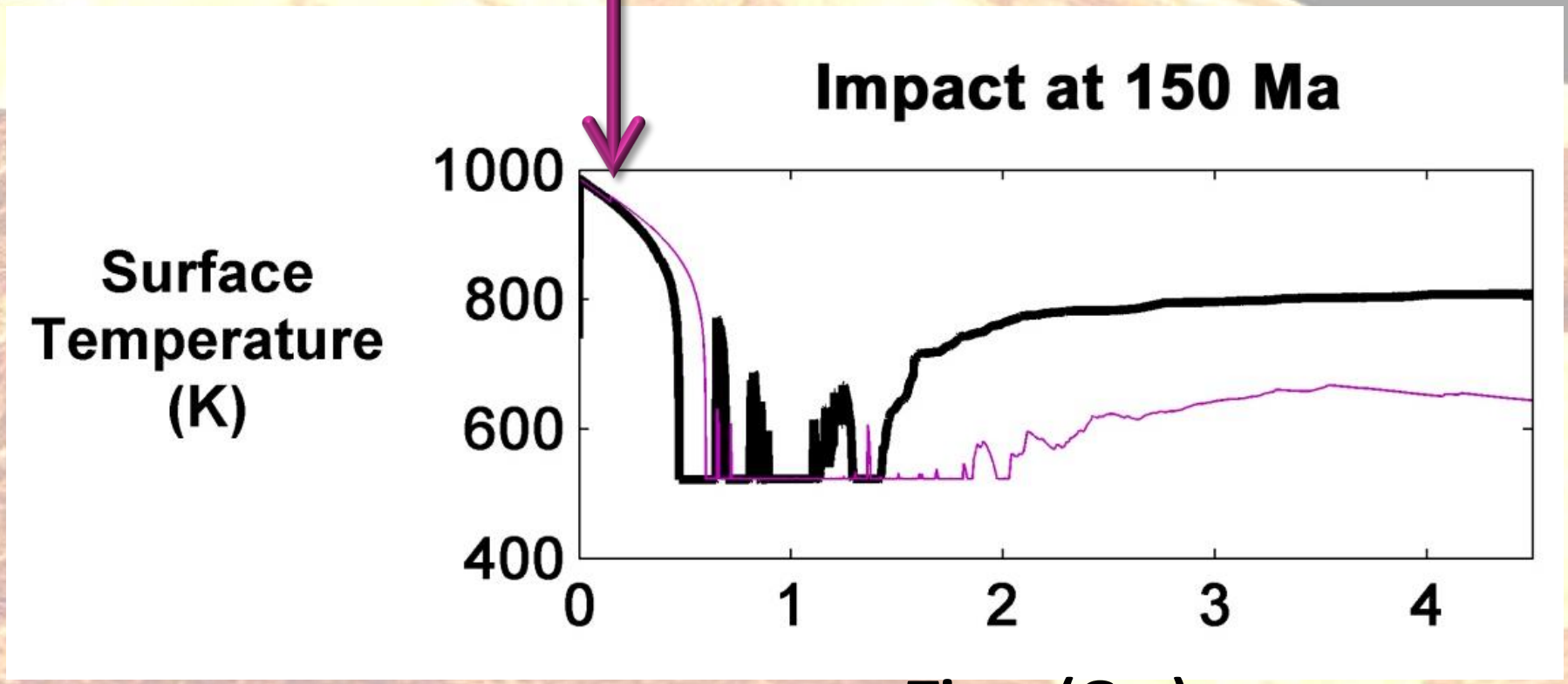
Long Term: Degassing at the Impact?





Long Term: volatile depletion

Late Veneer Impact: 800 km radius



Summary

- Habitability is a complex beast that hates guess work and relies on feedbacks.
- At the moment:
  - We show the importance of interactions.
  - The timing of Impacts affects the whole evolution.
  - We suspect the low temperature periods to be crucial for habitability.