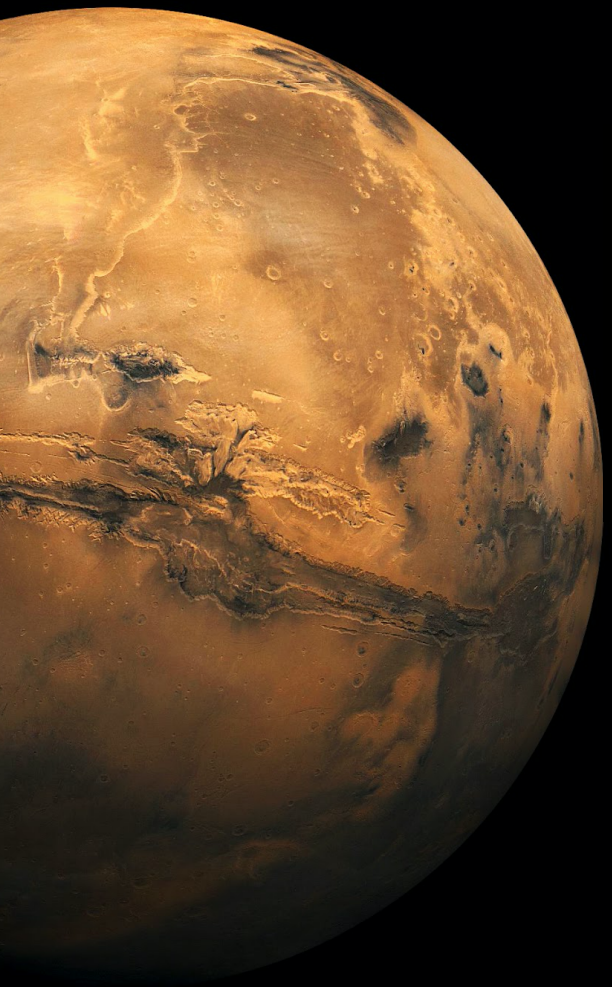
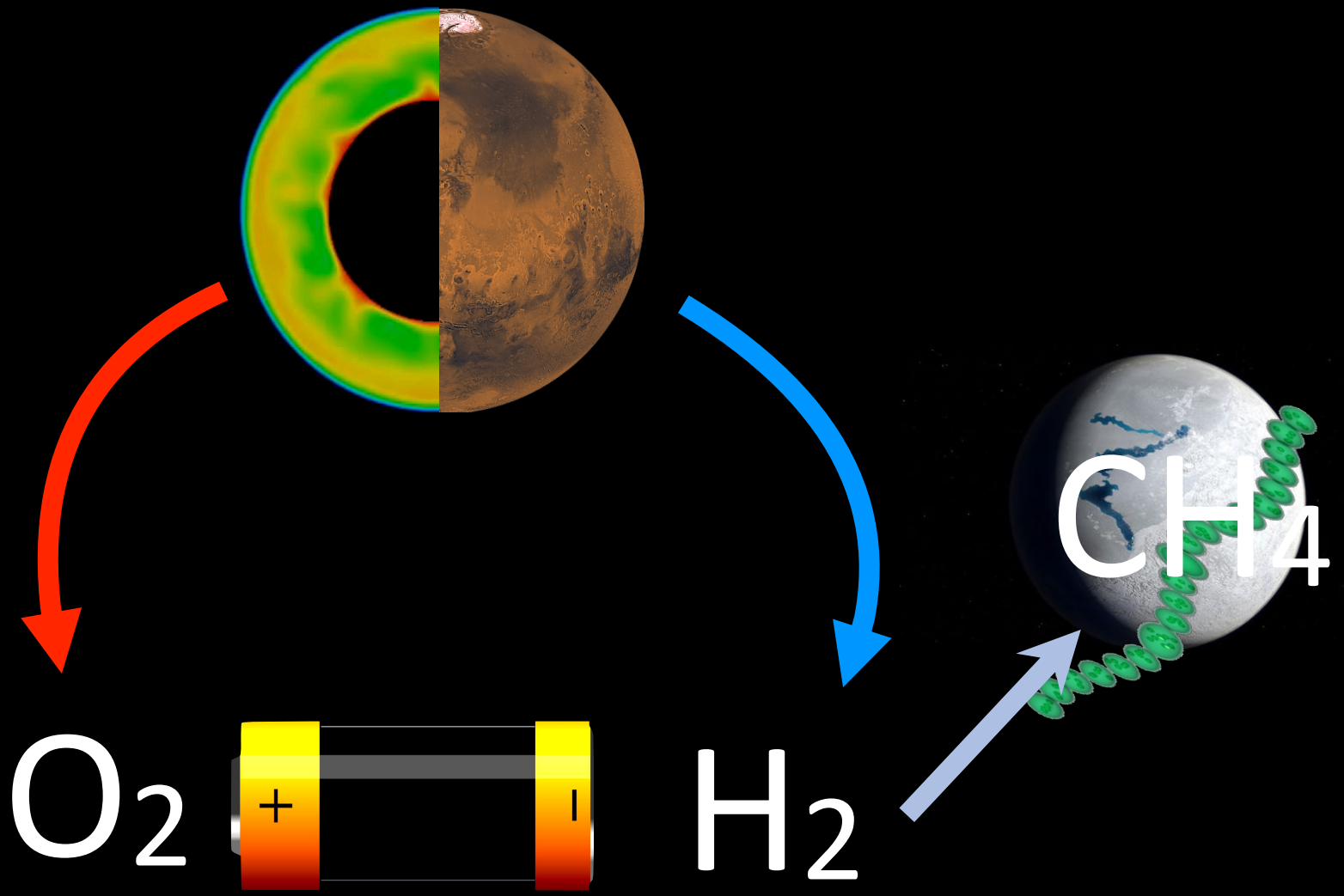


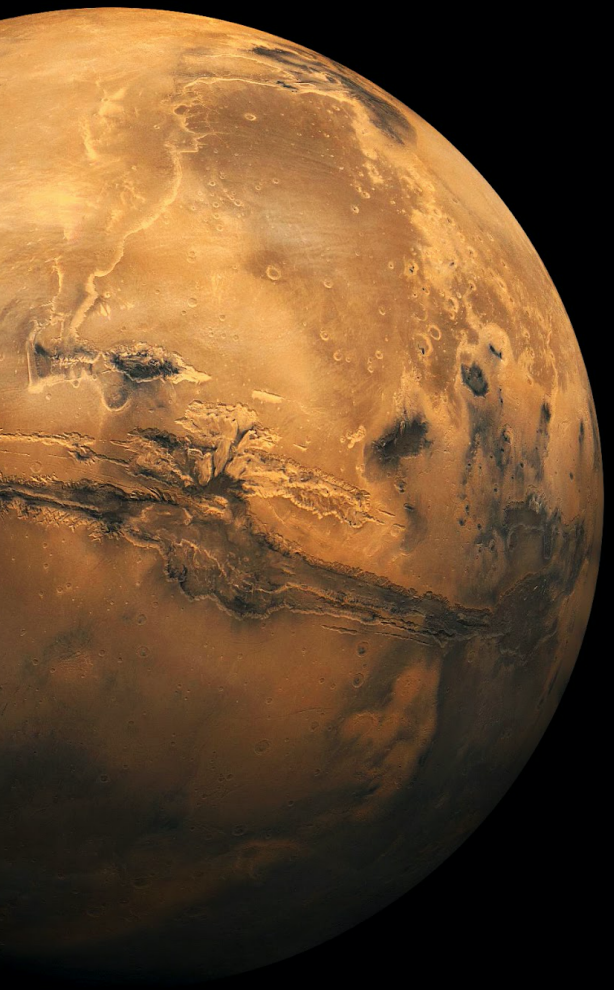
THE AGE OF MODELING THE MARTIAN HABITABILITY IN 4D (IN SPACE & TIME)

Vlada Stamenković

Jet Propulsion Laboratory, California Institute of Technology

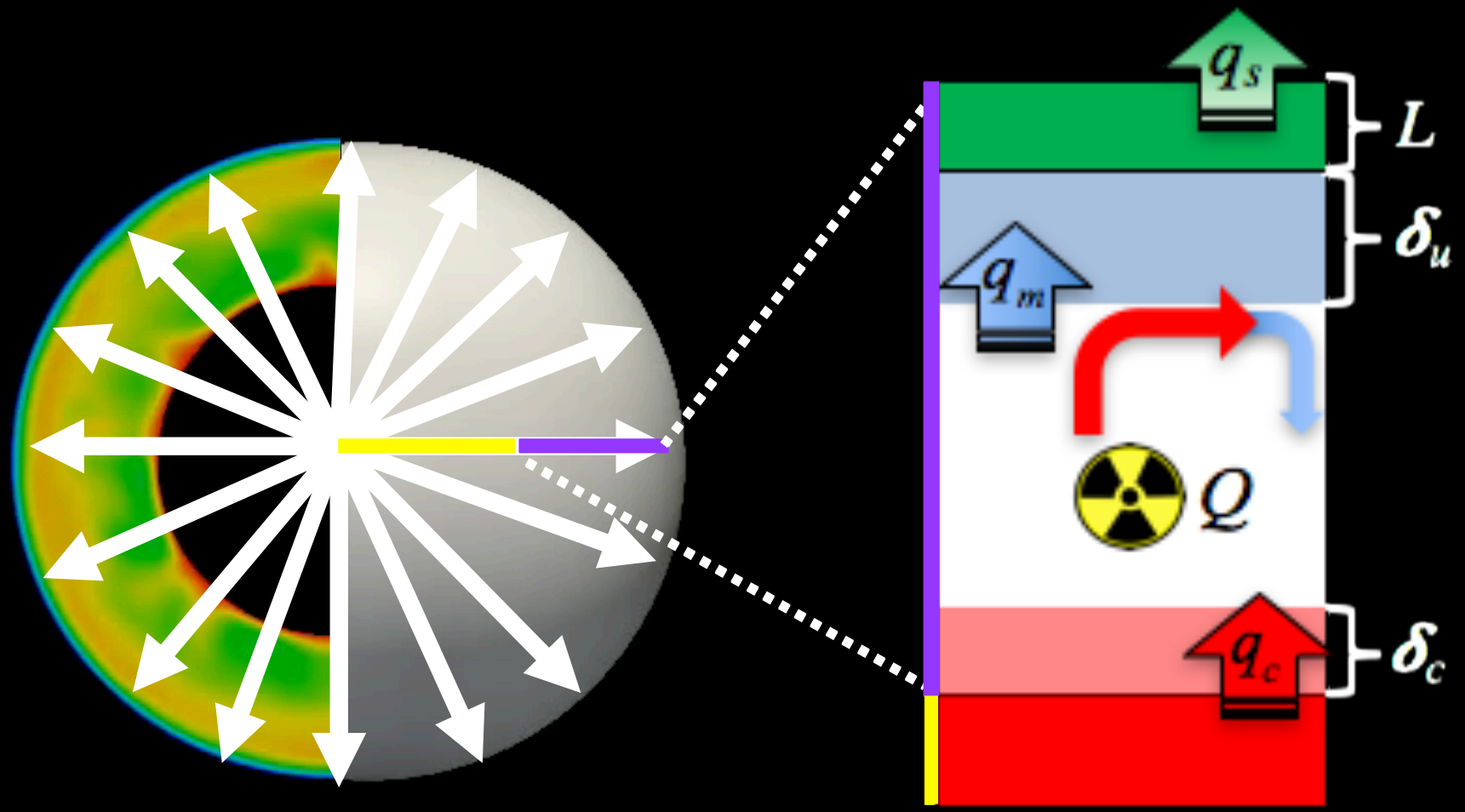
Mars in 4D





Hydrogen

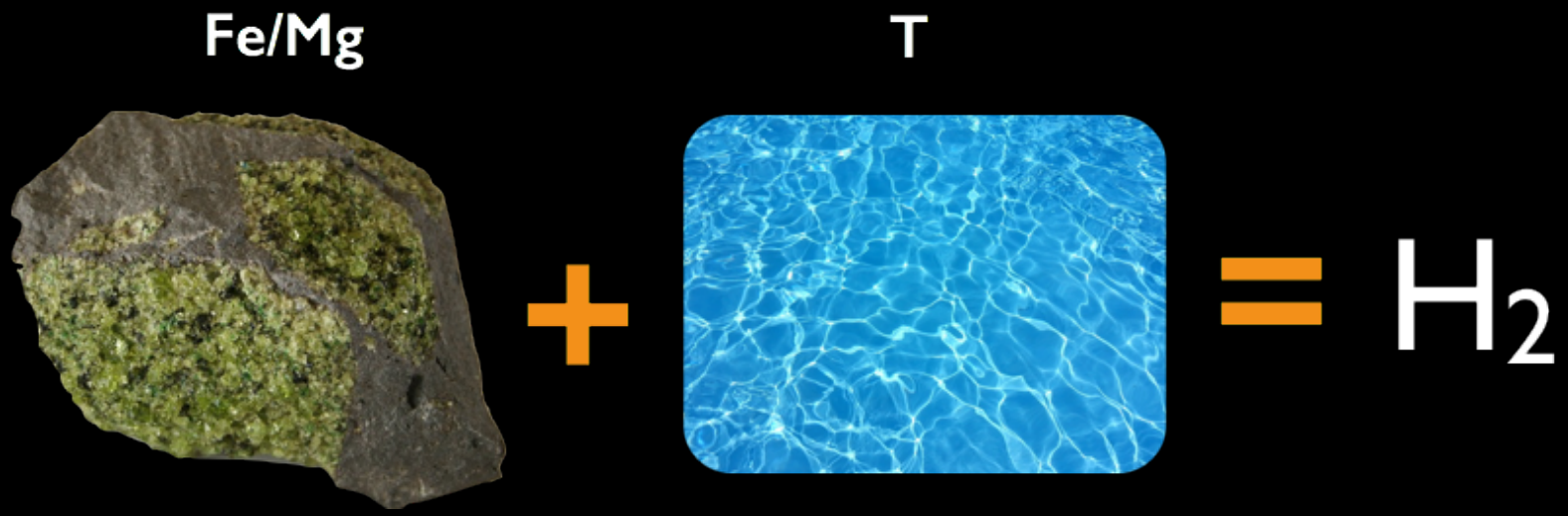
Interior Model



3D Parameterized Mantle Convection Model
Stamenković + (2018, in prep)

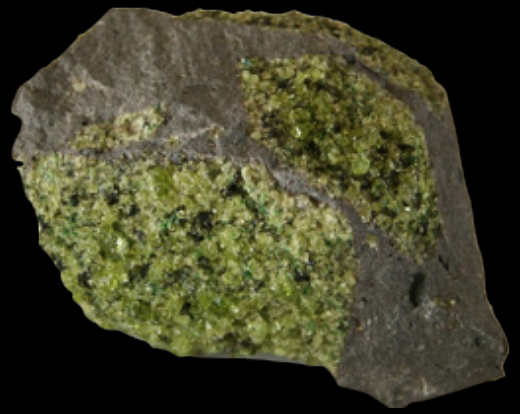
1D Parameterized Model
Stamenković + (2012, 2016),
Stamenković & Breuer (2014)

Hydrogen Production via Serpentinization - Reactions



Hydrogen Production via Serpentinization - Reactions

Fe/Mg



olivine, f(Fe/Mg)

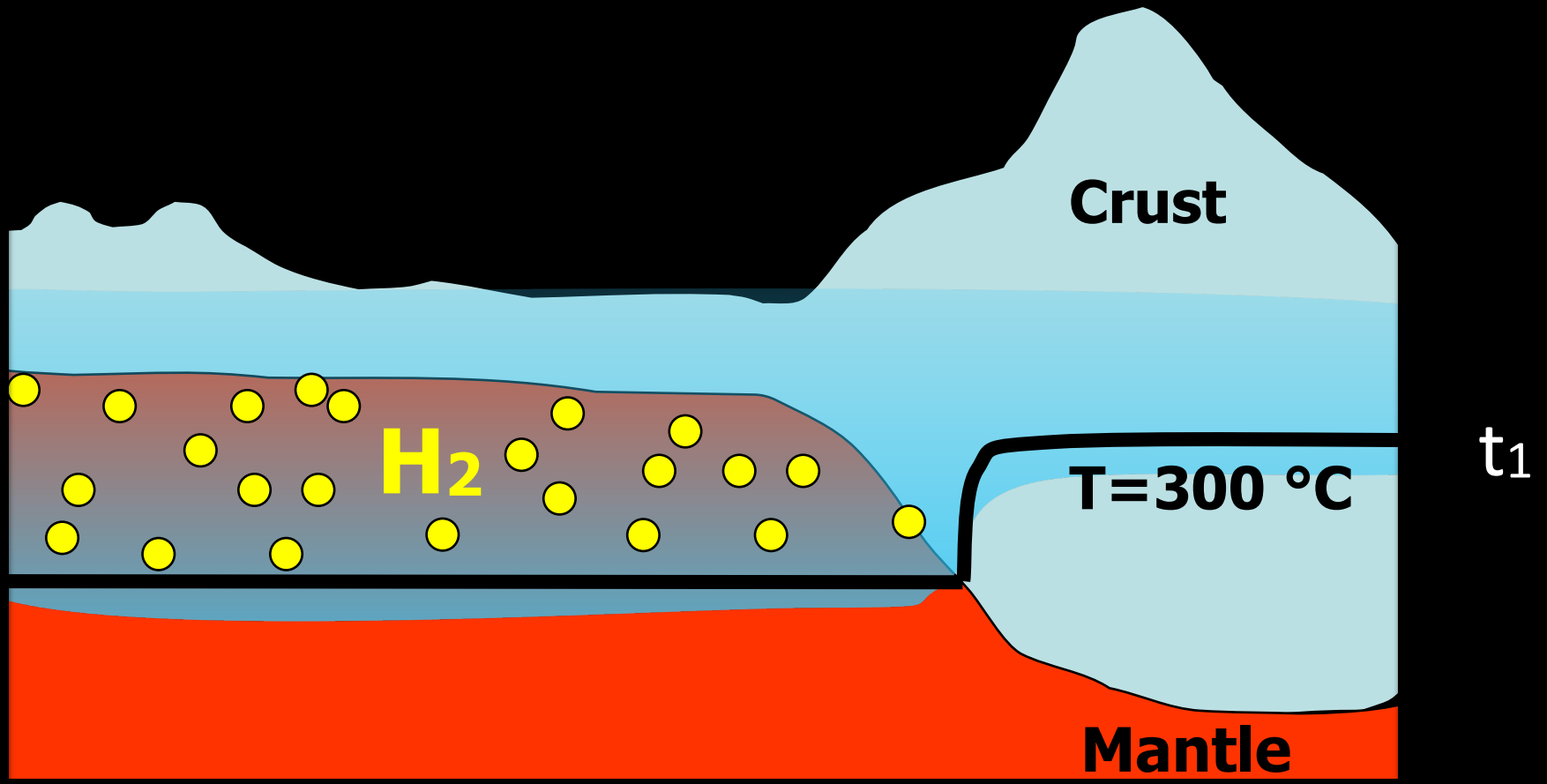
+

T

T~300 °C

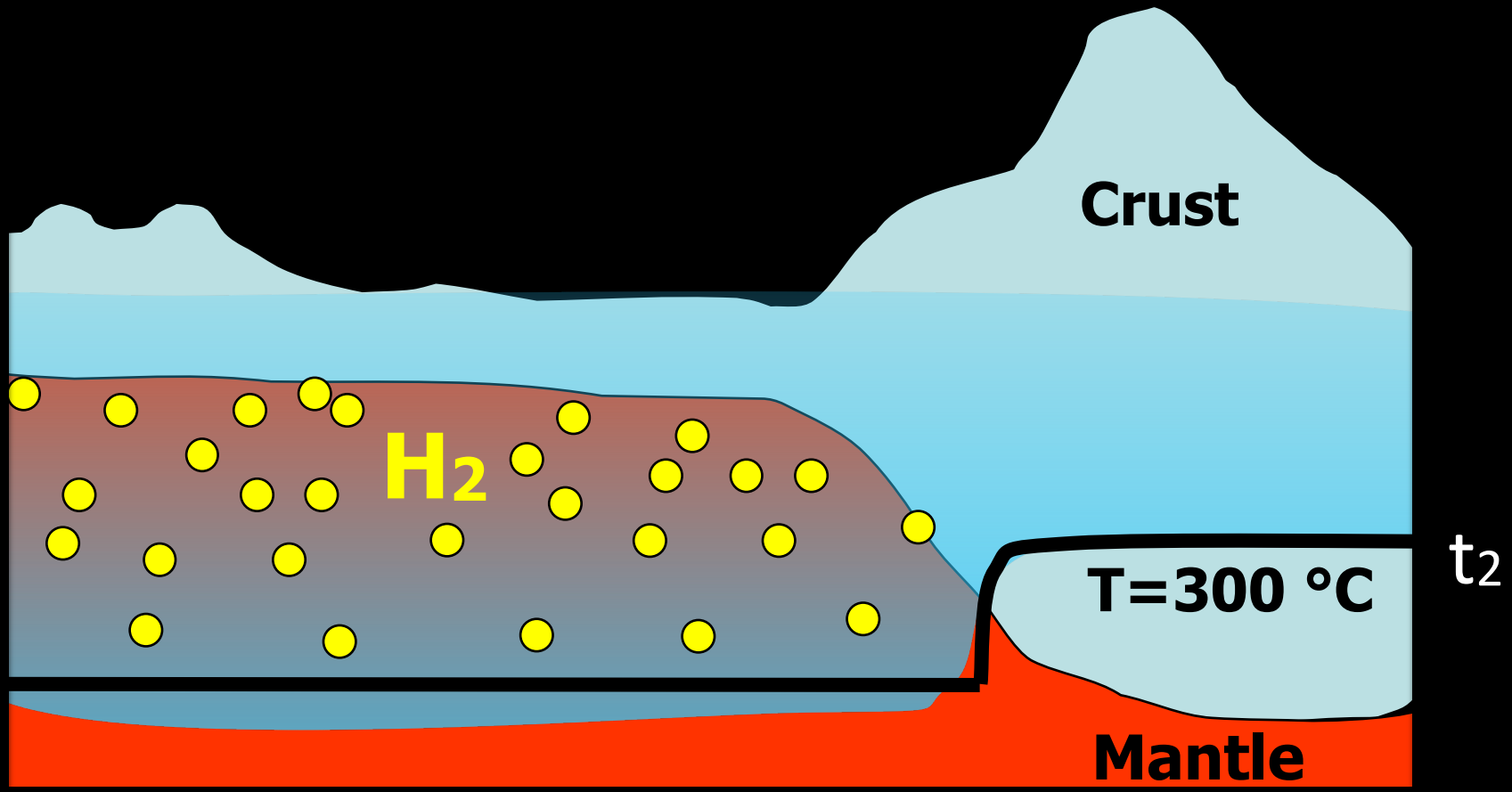
= H_2 +dQ

Hydrogen Production via Serpentinization – Thermal Model Concept

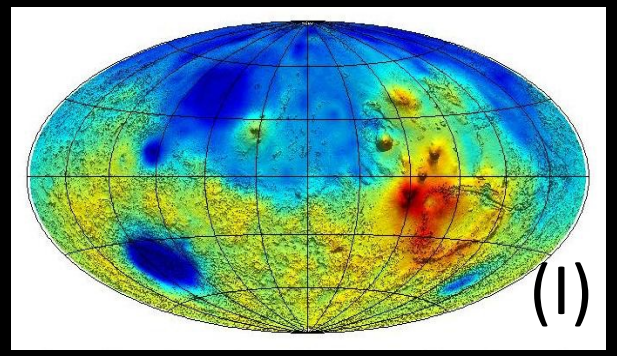


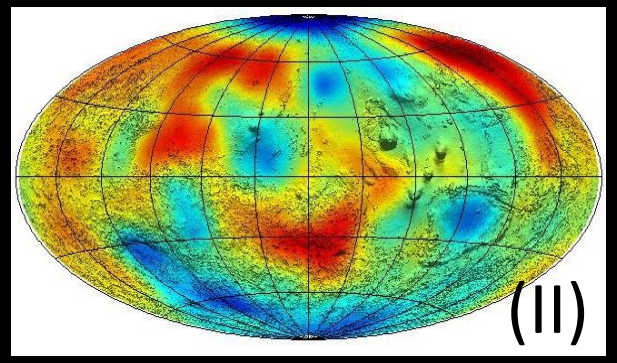
t_1

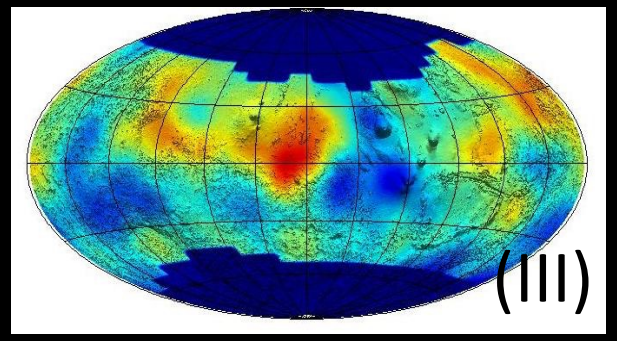
Hydrogen Production via Serpentinization – Thermal Model Concept



Hydrogen Production via Serpentinization – Used Data



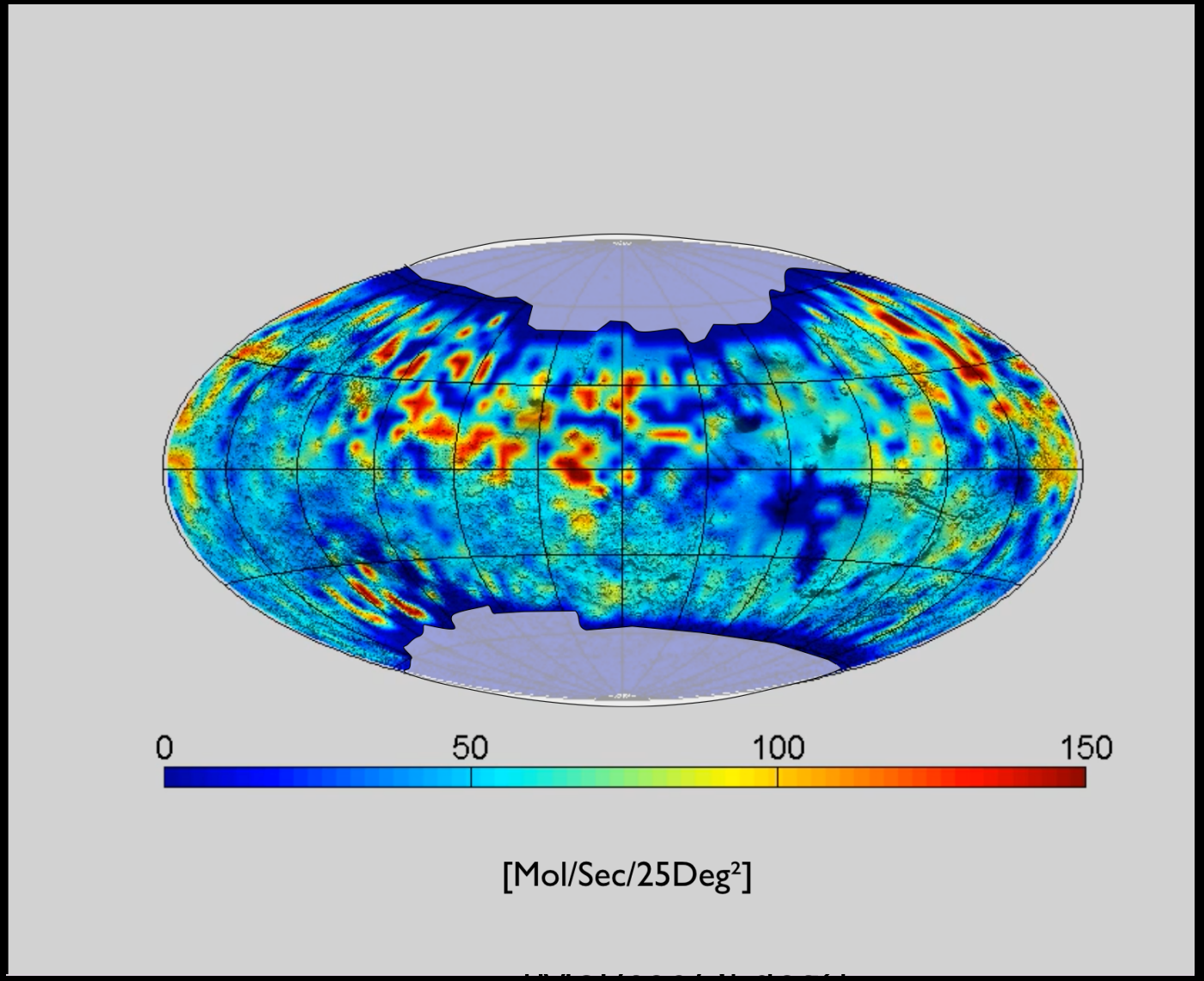




- Connect 4D thermal evolution model to data.
- Use **today**'s data of Mars as constraints for our evolution.
- Data is read in from **Mars Odyssey** (GRS, II, III) **and Mars Global Surveyor** (MOLA, I)
  - Crustal thicknesses (1)
  - Crustal radiogenic heat sources (Th, K) (II)
  - Crustal iron weight ratio (III)

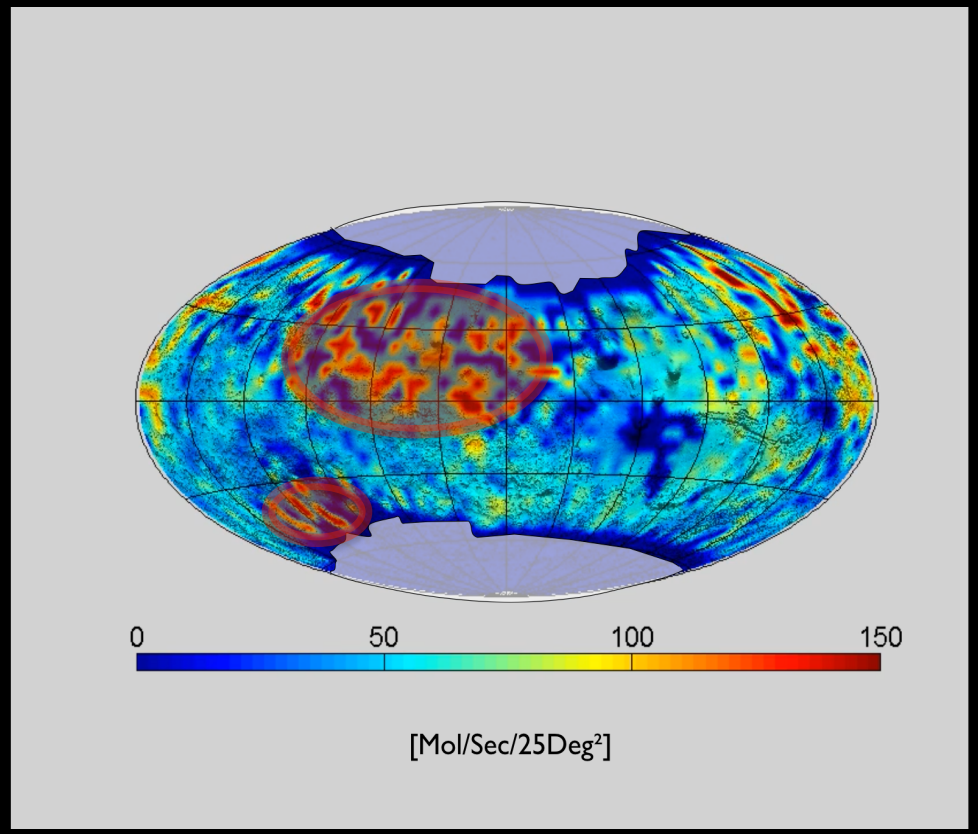
Hydrogen Production via Serpentinization – Evolution Model

LOCALLY VARIABLE MAGNESIUM NUMBER
Only fastest processes accounted for (high T, mantle)

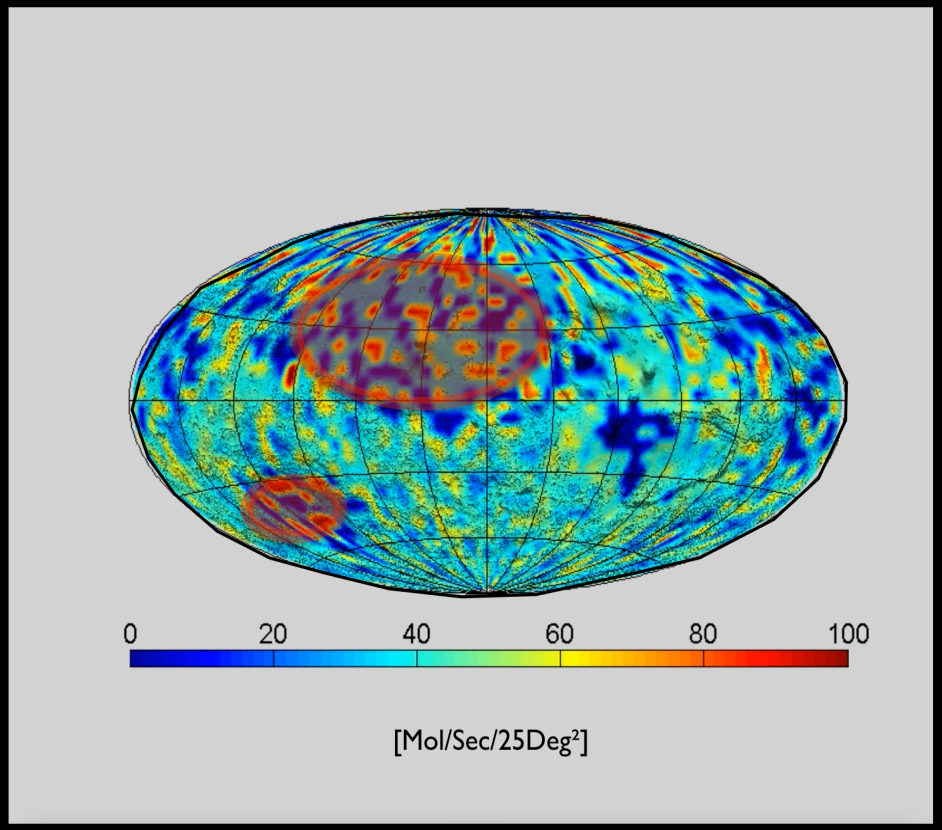


Stamenković + (2018), in prep

Hydrogen Production via Serpentinization - Robustness

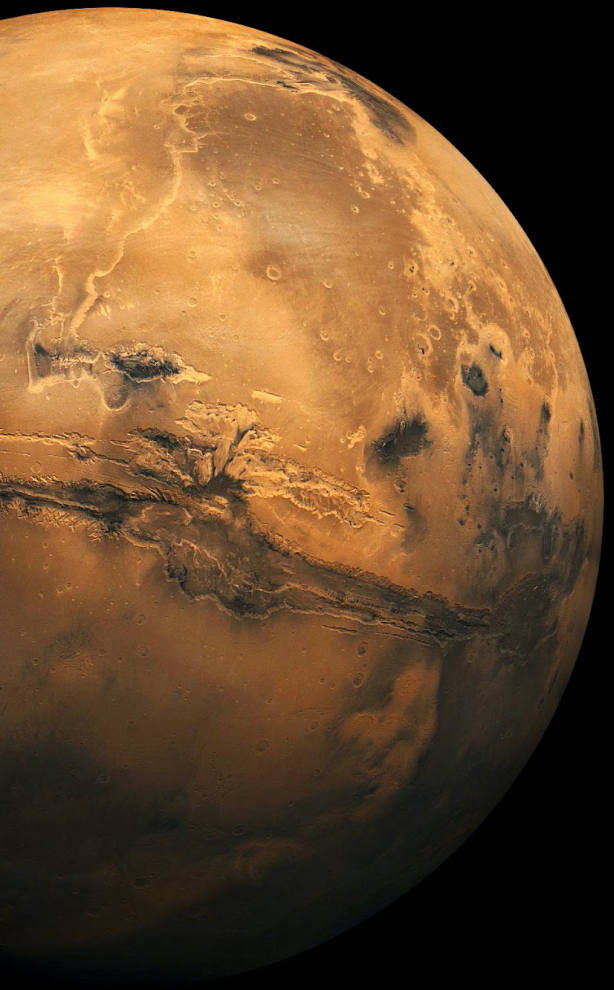


LOCALLY VARIABLE MAGNESIUM NUMBER
Only fastest processes accounted for (high T, mantle)



CONSTANT MAGNESIUM NUMBER
Only fastest processes accounted for (high T, mantle)

Stamenković + (2018), in prep



Oxygen

Mars and Oxygen

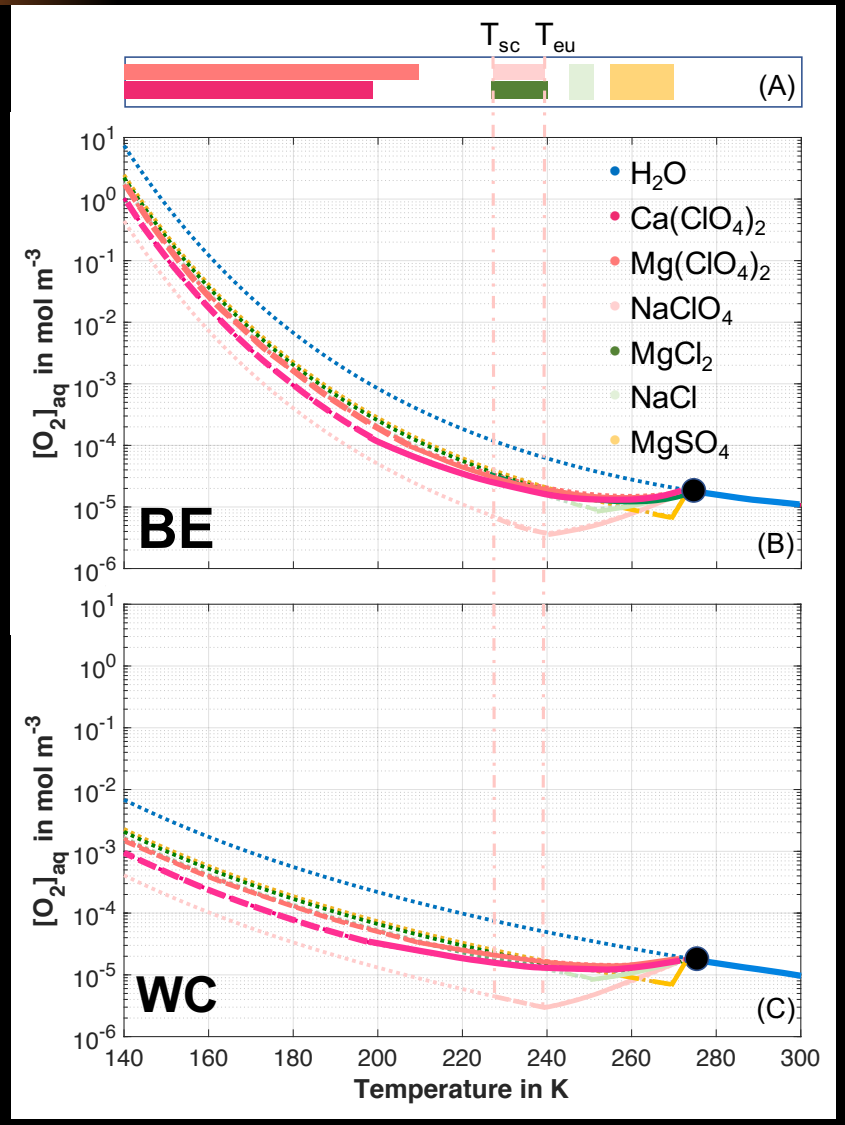
Evidence of large $[O_2]_{aq}$ from MnO

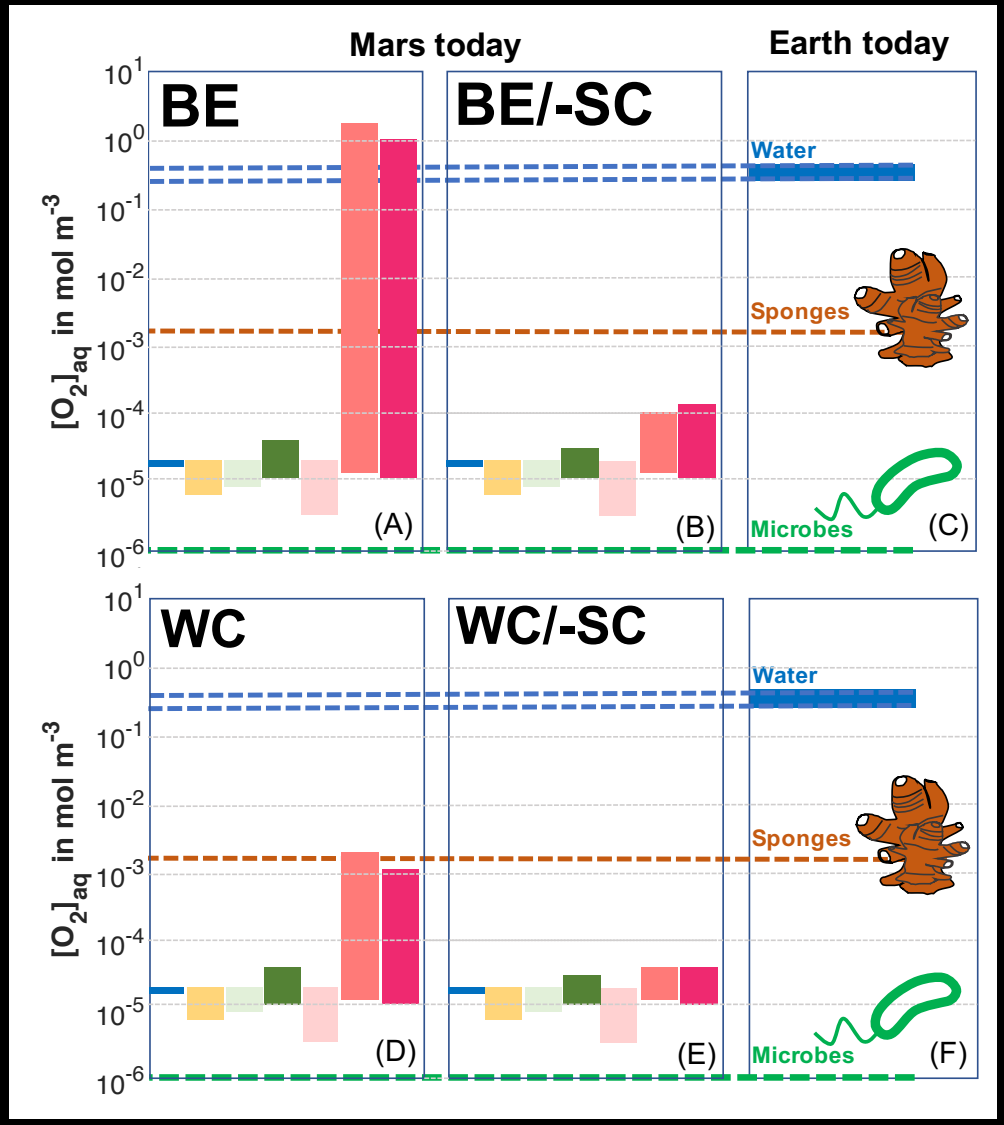
MARS

- P = 6 mbar
- T = 140-300 K
- f_{O_2} = 0.146 %

MAHLI image mosaic from April 27, 2014 (Sol 613)
Credit: NASA/JPL-Caltech/MSSS
Edited by Jason Major

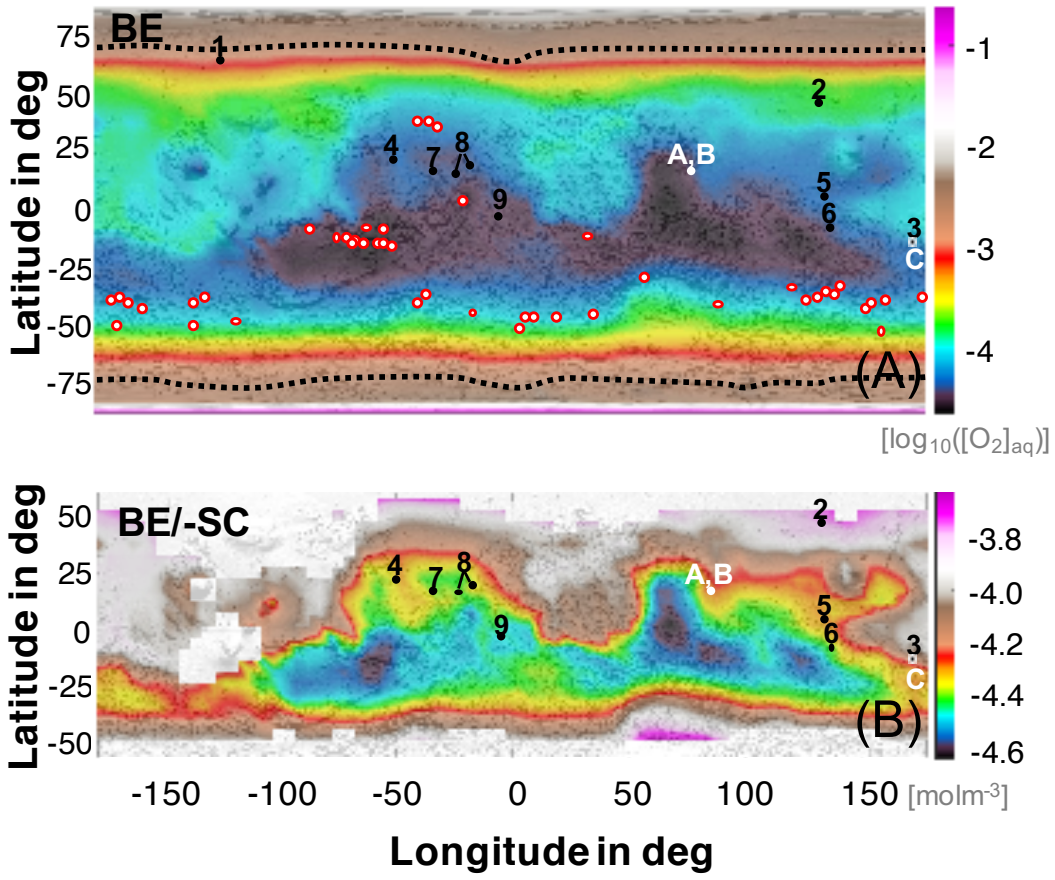
Solubility in Brines

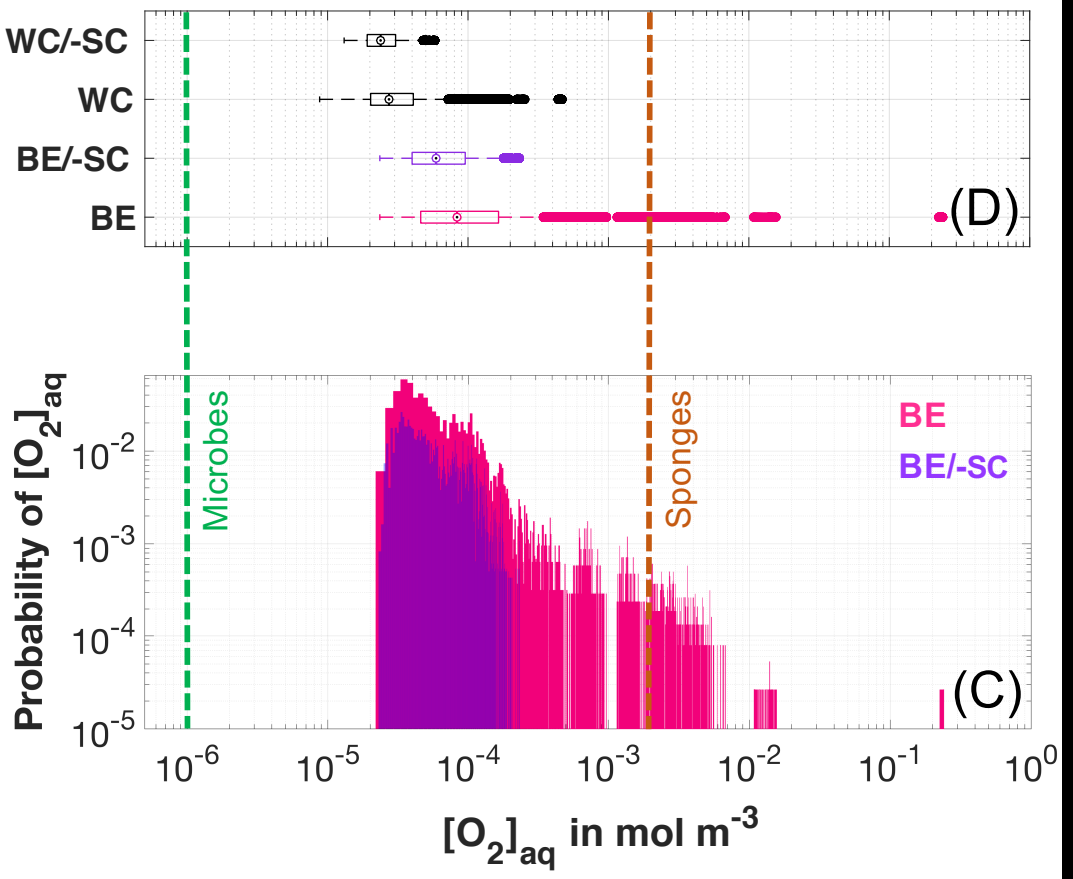




3D Implications for Near Surface Brines

1 Phoenix
2 Viking 2
3 Spirit
4 Viking 1
5 InSight
6 Curiosity
7 Pathfinder
8 ExoMars
9 Opportunity
A Jezero Crater
B NE Syrtis
C Columbia Hills
RSL[17]





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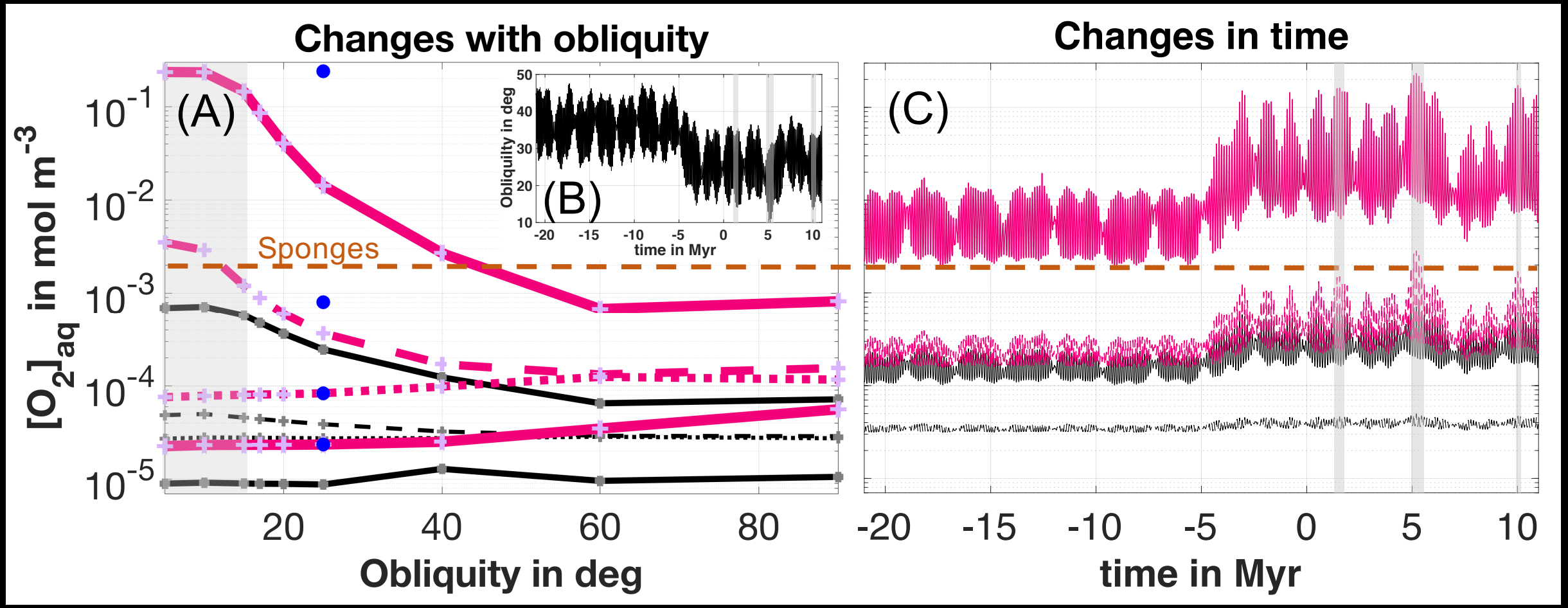
California Institute of Technology

4D Implications for Near Surface Brines



Conclusions

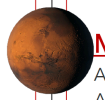
- We have sufficient knowledge and data to start exploring the Martian habitability (surface + subsurface) from a 4D (3D and time) perspective.
- This is due to the more predictable interior thermal evolution of Mars (in a stagnant lid mode) in relation to Earth (plate tectonics), where mainly thermal differences today are caused by crustal & lithospheric variability.
- Various but specific locations on Mars were and are still supportive of large hydrogen fluxes and oxygen solubilities in brines, opening the doors to explore the Martian habitability from a 4D point of view.

More Info/Meetings

- Astrobiology Decadal White Paper is out.
- KISS marsX workshop paper in Nature Astronomy and report out soon.
- **AGU Session**: "*New Mars Underground*".
- Upcoming: "*NewMarsUnderground.com*"
- *Vlada.Stamenkovic@jpl.nasa.gov*"

AGU 100 ADVANCING EARTH AND SPACE SCIENCE **FALL MEETING**
Washington, D.C. | 10-14 Dec 2018

Session ID: 51671
Session Title: P046. "The New Mars Underground": Science and Exploration of a New Deep Frontier
Section/Focus Group: Planetary Sciences
View Session Details: https://agu.confex.com/agu/fm18/gateway.cgi



Mars Subsurface Access: From Sounding to Drilling

A White Paper Submitted to The National Academies of Sciences, Engineering and Medicine's Astrobiology Science Strategy for the Search for Life in the Universe Meeting January 2018

Authors

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Organizations

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