



O₂ SOLUBILITY IN MARTIAN NEAR-SURFACE ENVIRONMENTS AND IMPLICATIONS FOR AEROBIC LIFE ON MARS

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MARS

Predecisional information, for planning and discussion only
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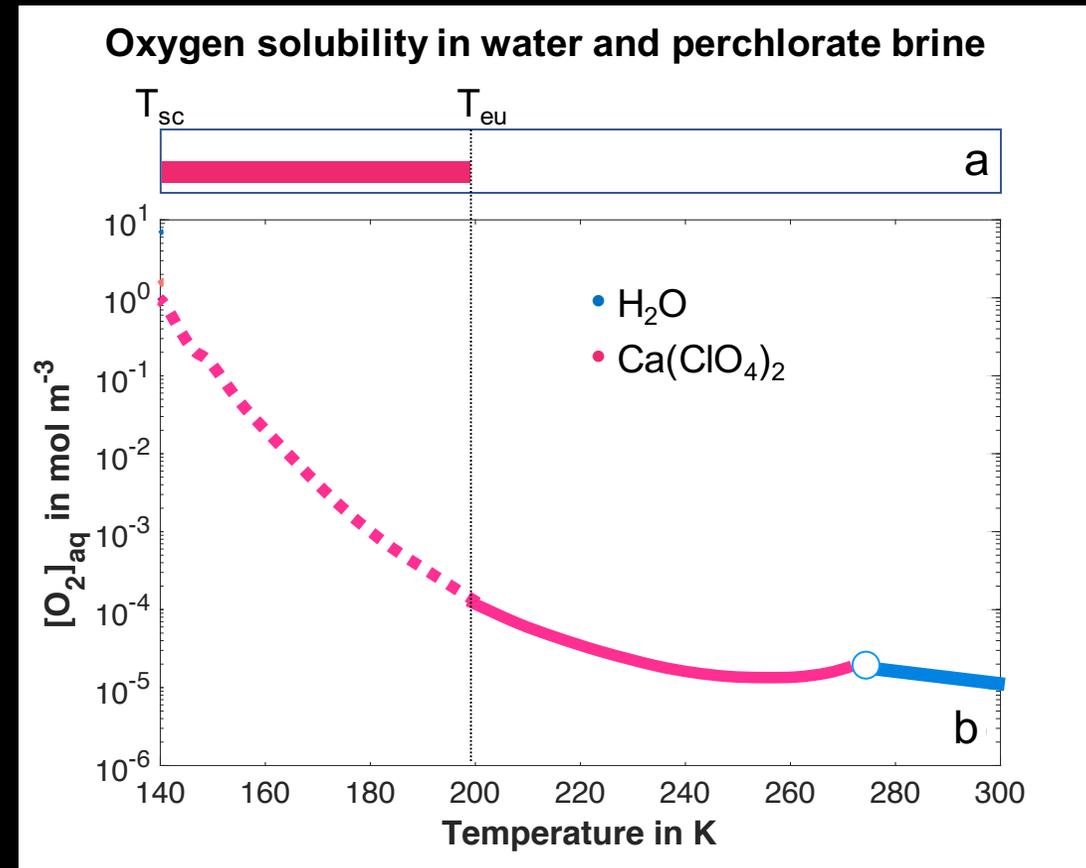
Jet Propulsion Laboratory
California Institute of Technology

Brines and O₂

- Liquid brines on modern and geologically recent Mars can contain very large amounts of dissolved O₂—sourced either from the atmosphere or radiolysis.
- The amounts are orders of magnitude greater than aerobes need on the Earth for breathing.
- We see evidence of this in the rock record.
- The potential for aerobic life on Mars?



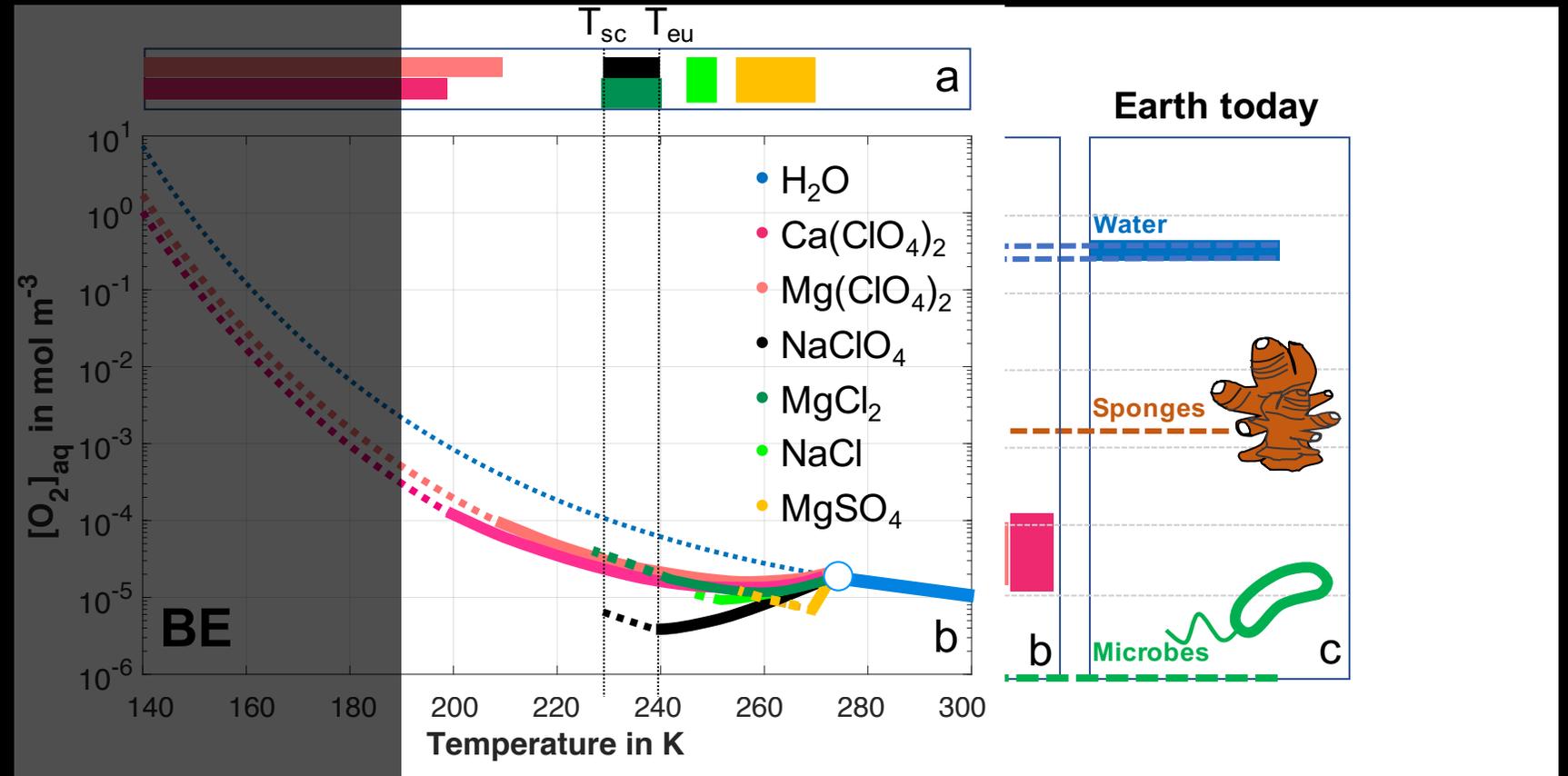
Brines and O₂: Solubility as a function of temperature



Stamenković + (2018)

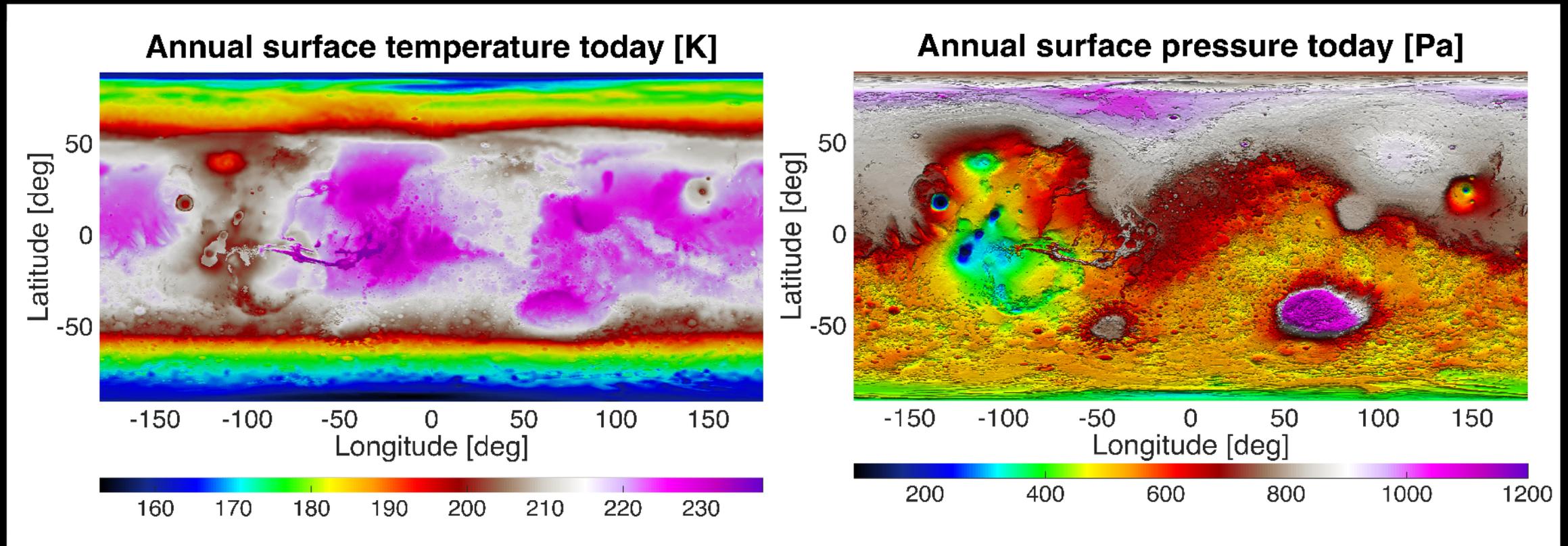
- **P = 6 mbar**
- **f_{O₂} = 0.146 %**
- **T = 140-300 K**

Brines and O₂: Implications for aerobic life



Stamenković + (2018)

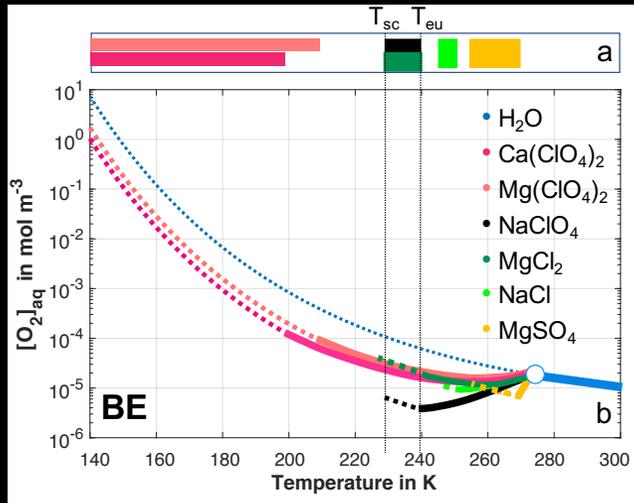
Brines and O₂: TODAY in 3D



Stamenković + (2018)

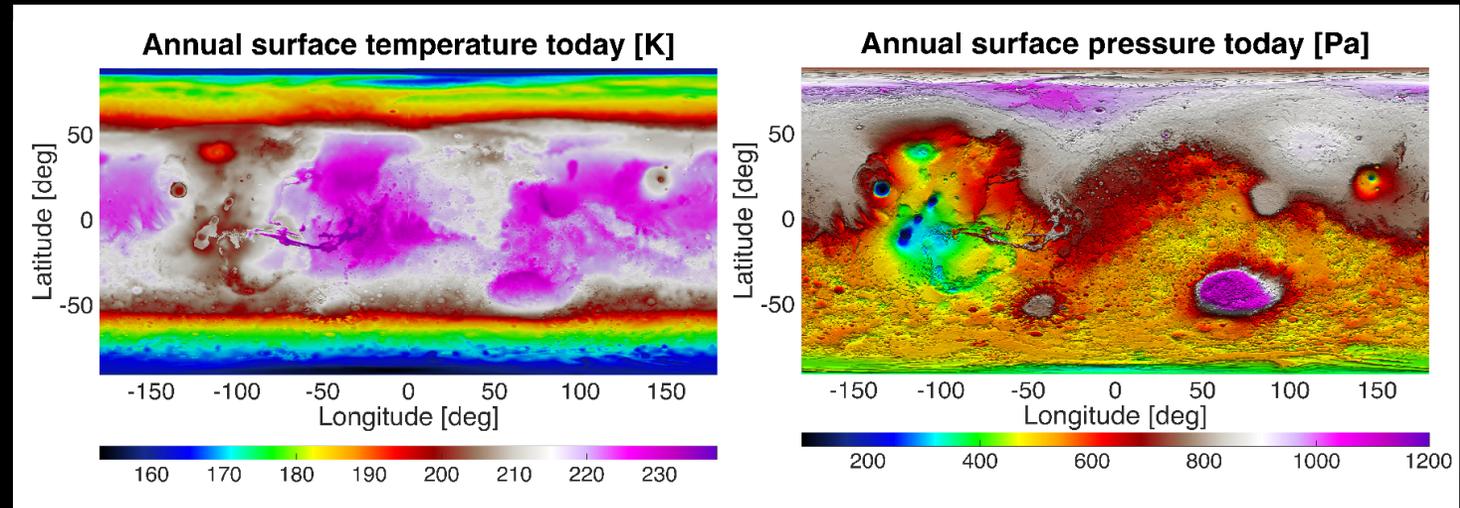
Brines and O₂: TODAY in 3D

Solubility(T,P)



+

T,P (3D)

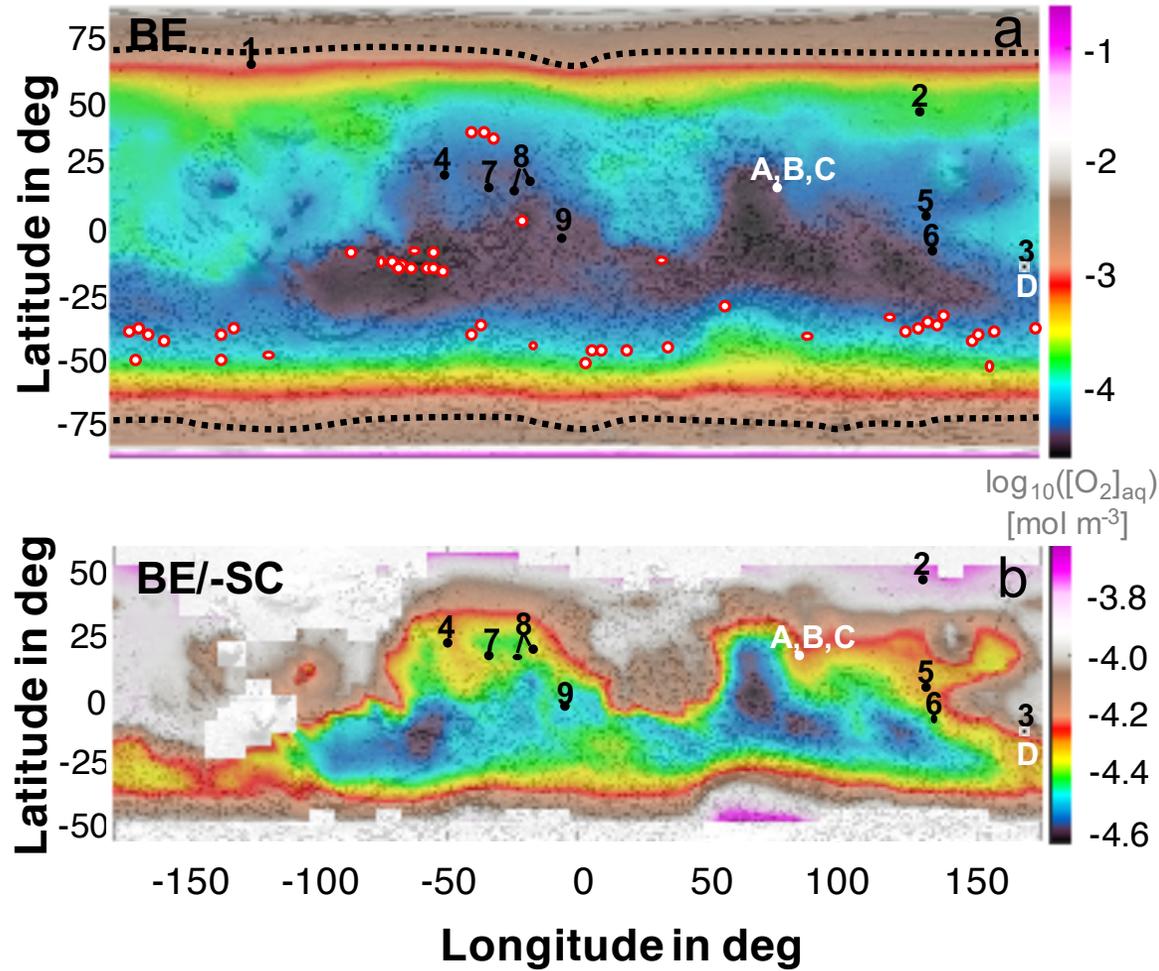


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Brines and O₂: TODAY in 3D

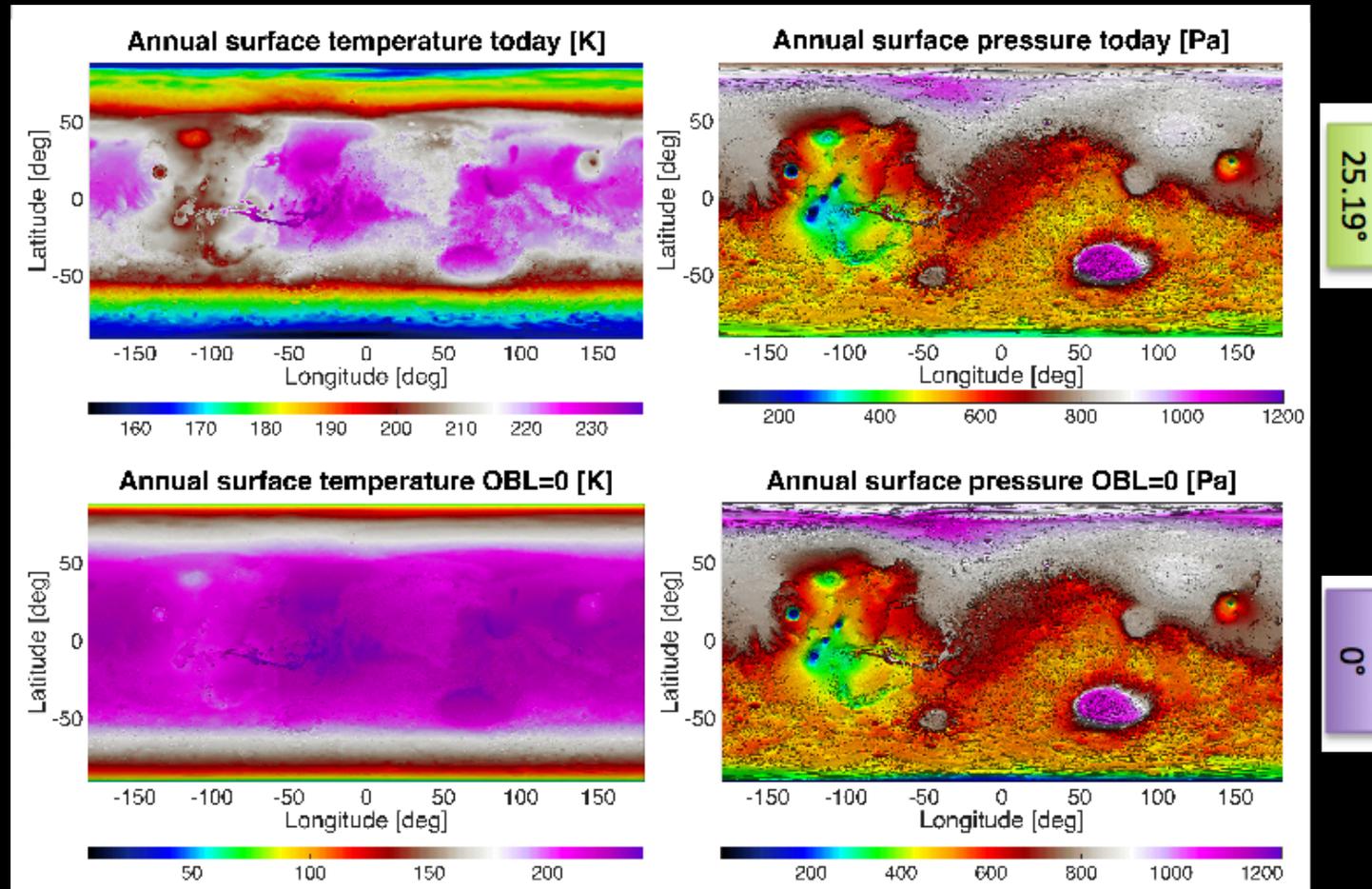
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- 1 Phoenix
- 2 Viking 2
- 3 Spirit
- 4 Viking 1
- 5 InSight
- 6 Curiosity
- 7 Pathfinder
- 8 ExoMars
- 9 Opportunity
- A Jezero
- B Midway
- C NE Syrtis
- D Columbia Hills
-  RSL¹³



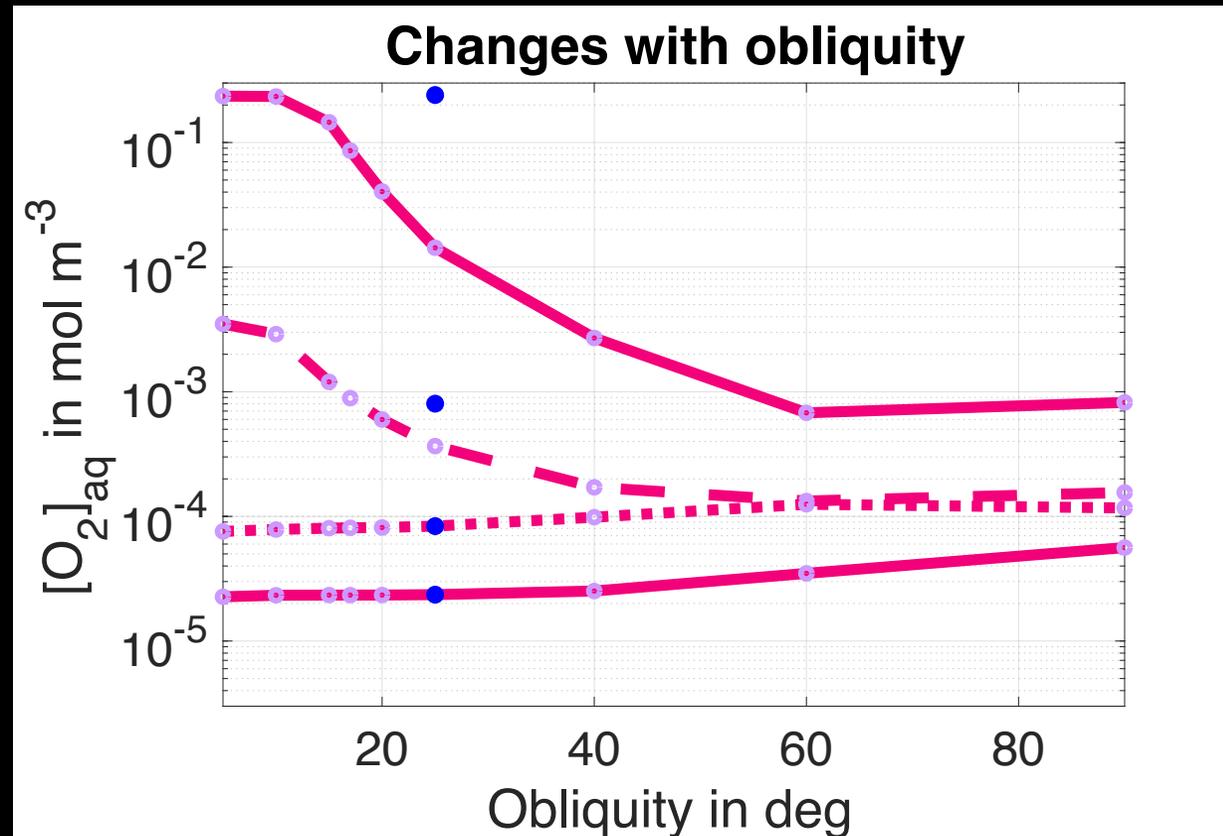
Stamenković + (2018)

Brines and O₂: With Obliquity Change



Stamenković + (2018)

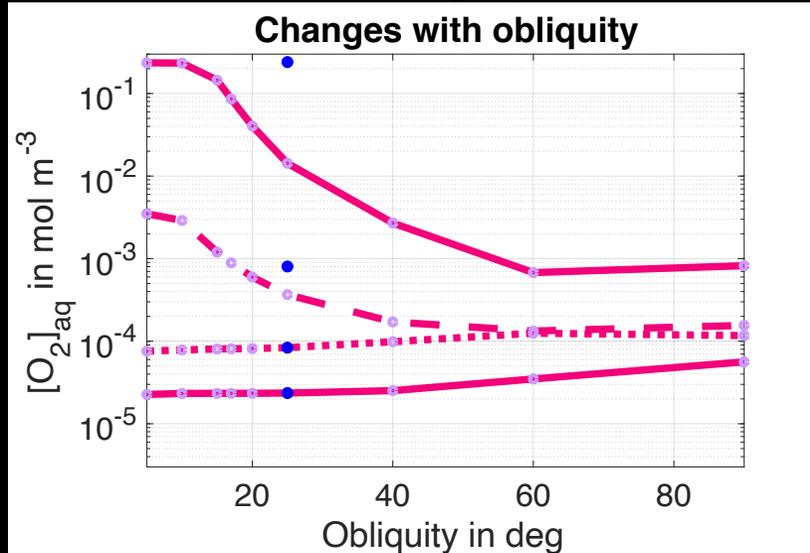
Brines and O₂: With Obliquity Change



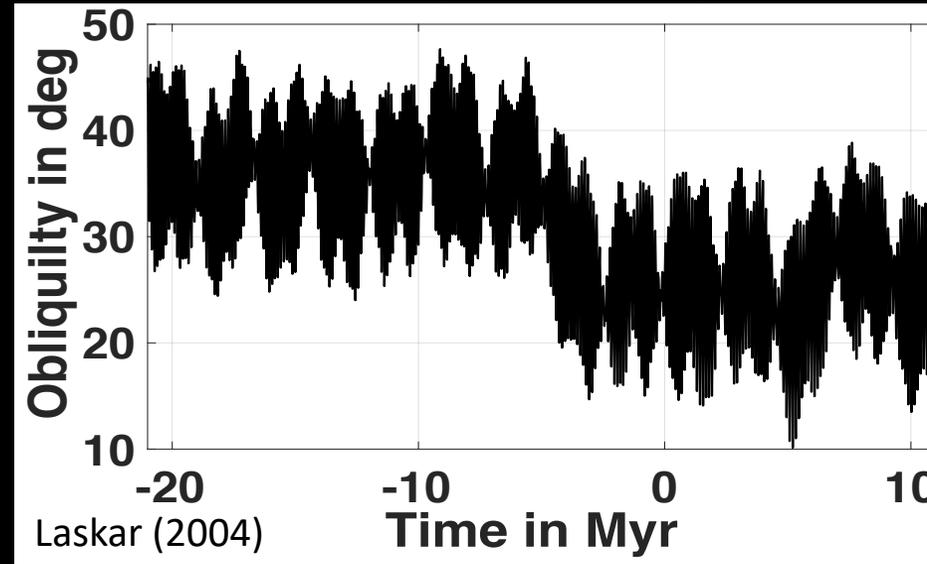
Stamenković + (2018)

Brines and O₂: With Time

Solubility(OBL)

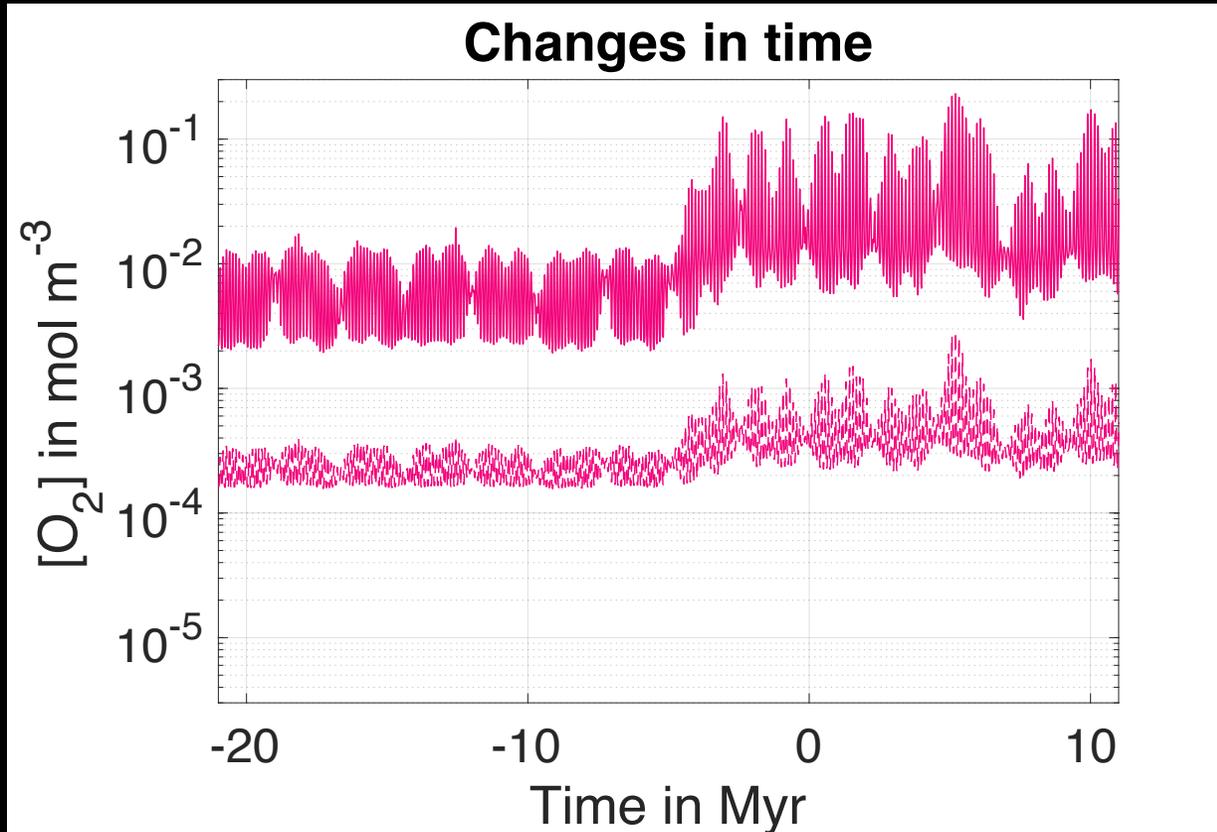


OBL(Time)



Brines and O₂: With Time

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Stamenković + (2018)

Brines and O₂: Evidence in the rock record

Evidence of large [O₂]_{aq} from MnO₂

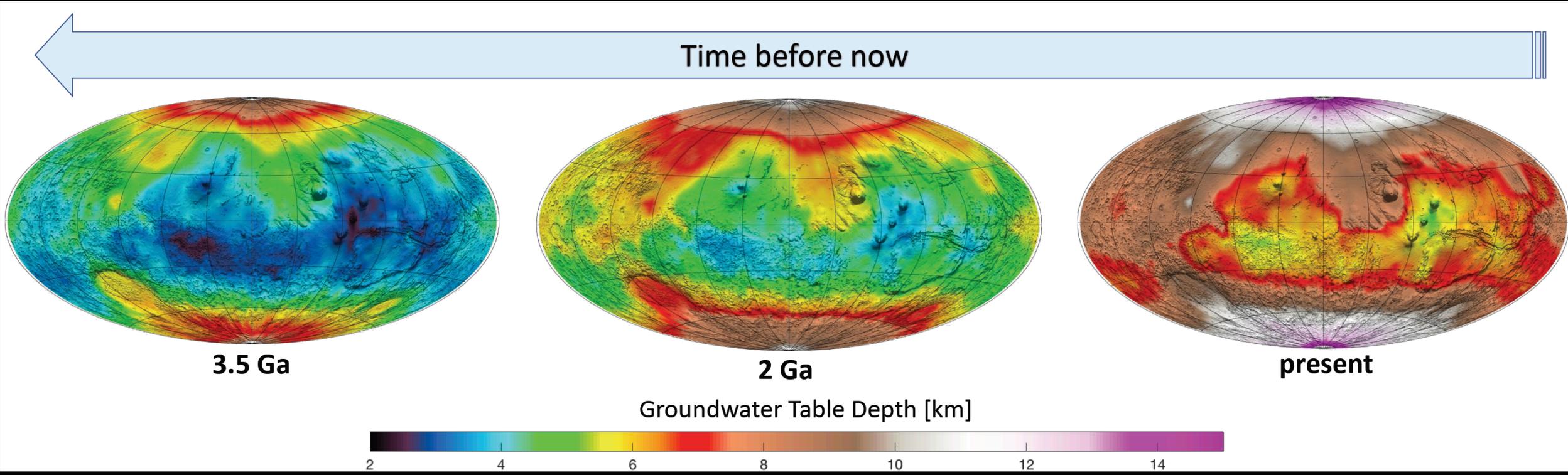


Brines and O₂

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- **But are there water/brines at all today?**



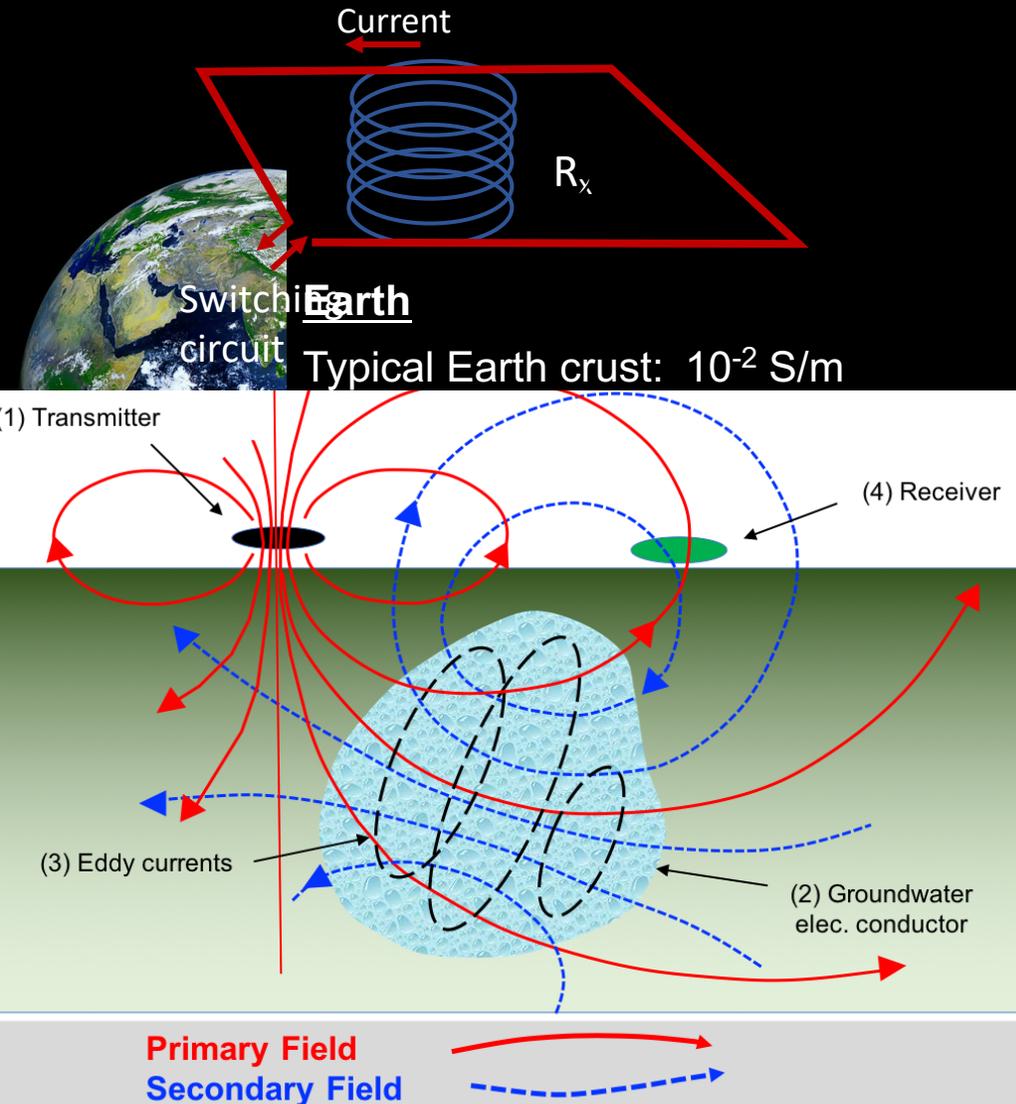
Ad Ares: Where is the water with Mars_x-4D?



Ad Ares: TH₂OR (Transmissive H₂O Reconnaissance) SRTD

Objectives

Demonstrate that we can uniquely sound from the Martian surface for groundwater, expected to be at depths as large as 1-10 km, using a low-mass (<5 kg) and low-power (<10 W average) EM system and to determine its salinity.



Ad Ares: Dynamics

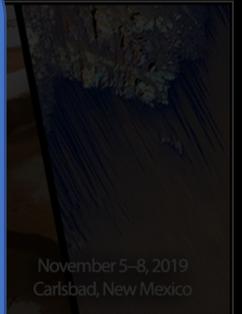
- Brines/O₂:
 - Dynamics of gas dissolution? What timescales?
 - What are atmospheric and geophysical fluxes?
 - Aerobic respiration at low temperature?

- New Mars Underground community wants to reach out (AbSciCon, WWW, and Mars Extant Life Workshop)

THANK YOU 😊!



WWW



Community wants to connect...

- Subsurface Biospheres on Mars and how to find them, AbSciCon 2019 (Goddard, AMES, JPL).
- NAI Workshop Without Walls (WWW): Mars Extant Life & Subsurface Exploration (AMES, Georgia Tech, JPL).
- Mars Extant Life Workshop (Dave Beaty, MPO)