Planets: Earth, Mars, & Beyond Research

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Planetary Science

Dr. Christopher Adcock
Assistant Research Professor
Department of Geoscience
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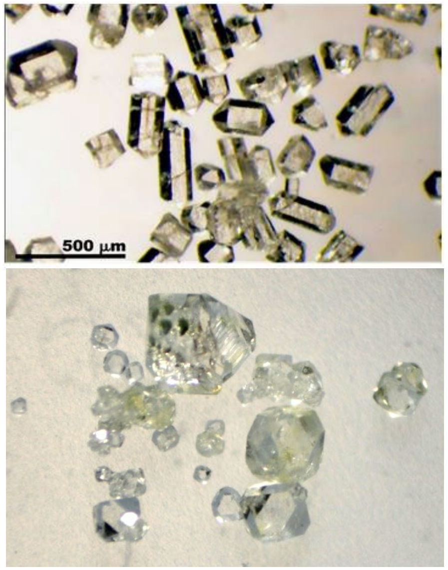
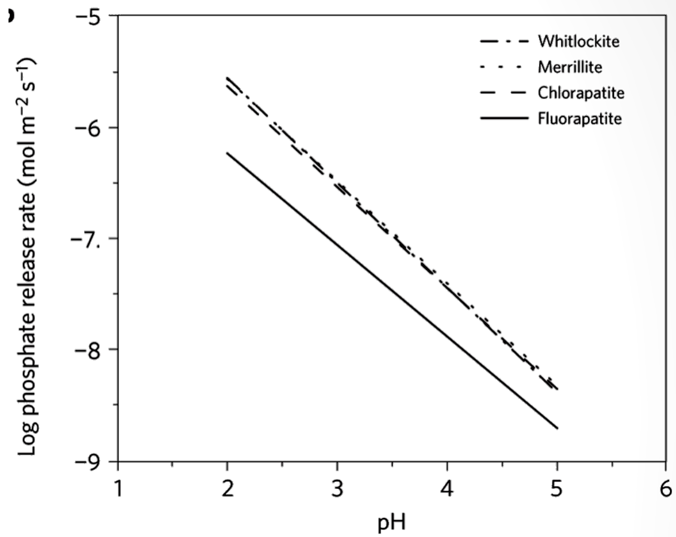
Expertise:

Planetary Surface Processes | Extraterrestrial Habitability

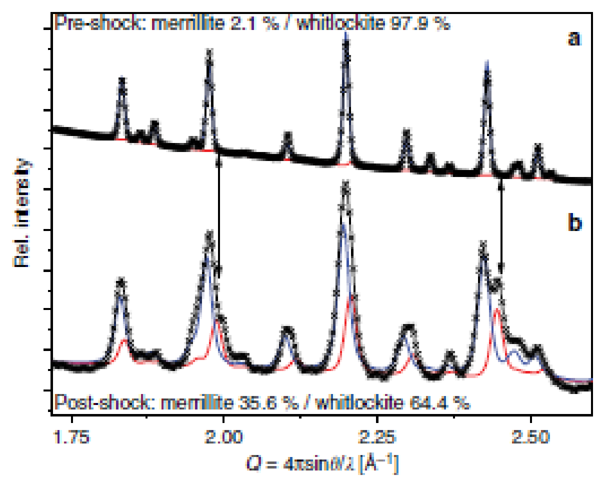
Planetary Surface Processes / Low Temperature Geochemistry: Mars



Left: Synthesized chlorapatite (top) and whitlockite used in experiments. Same scale for both images. The ability to synthesize these Mars-relevant minerals in quantity is a specialty of Dr. Adcock and the Hausrath Lab. Physical sample allow for experiments that cannot be done by calculation.

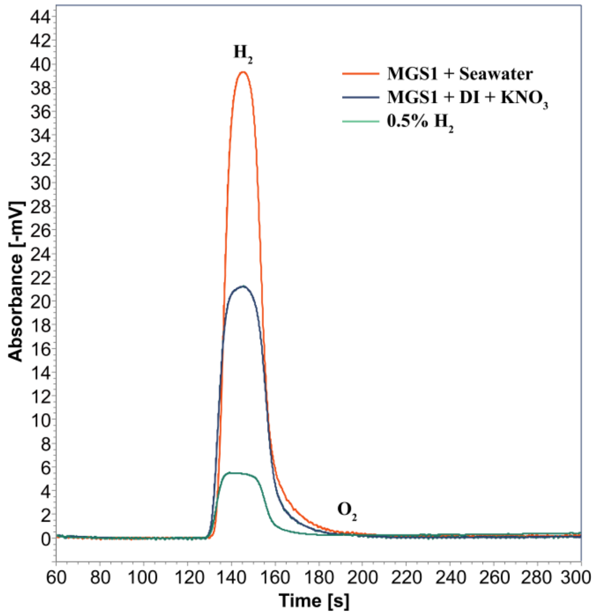


Above: Empirical Dissolution rates of terrestrial (fluorapatite / whitlockite) and more Mars-relevant phosphate minerals (chlorapatite and merrillite). 25 °C , variable pH. Higher rates mean potentially higher phosphate availability in past Martian environments – with positive implications for past life. *Adcock et al., (2013) Nature Geoscience 6 (10), 824-827.*

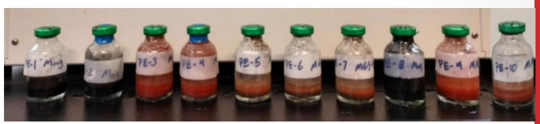


Left: Shock induced metamorphism of whitlockite (a) to merrillite/whitlockite mix (b). Shock removes the water from whitlockite to make merrillite. Since all of our current samples of Mars come from shocked meteorites, this has implications for the past hydrologic cycle of Mars. *Adcock et al., (2017) Nature communications 8 (1), 1-8.*

Extraterrestrial Habitability | *In Situ* Resources and Environments on Mars

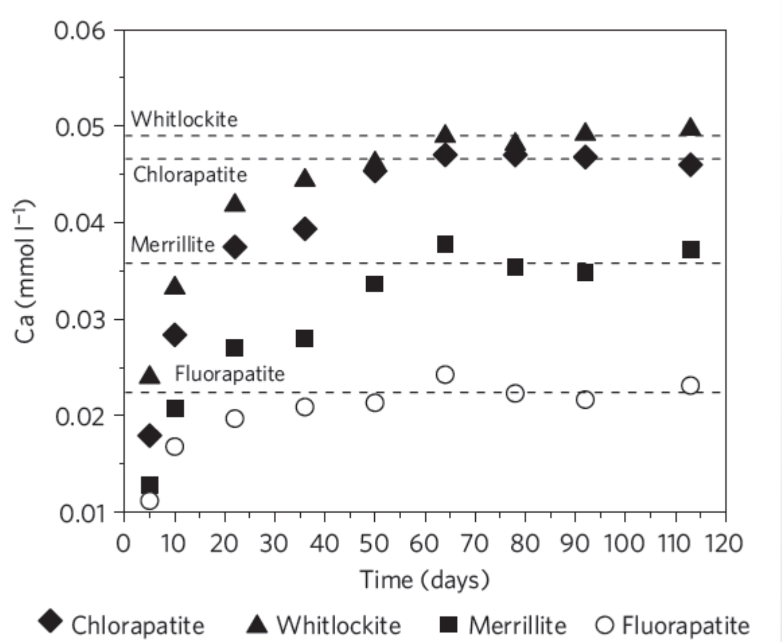


Left: Results of low temperature hydrogen generation experiments using Martian soil simulants. These experiments show it is possible to use Martian materials and a low energy system to generate H_2 for fuel, energy, or water for future human missions to Mars. *Adcock et al., (2020), 51st LPSC.*



Above: A typical set of hydrogen generation experiments. Simulants and solution are slowly shaken at 25 °C to produce hydrogen.

Right: Solubility of terrestrial and more Mars-relevant minerals. Along with dissolution rates, the increased solubility of the more Mars-relevant minerals merrillite and chlorapatite over terrestrial fluorapatite suggest bio-essential phosphorus may be a recoverable resource for future missions to Mars. *Adcock et al., (2013) Nature Geoscience 6 (10), 824-827.*



Aqueous Geochemistry and Astrobiology

- **Dr. Elisabeth (Libby) Hausrath**
- Professor
- Department of Geoscience
- Email: Elisabeth.Hausrath@unlv.edu
- Website: https://hausrath.faculty.unlv.edu/

Expertise

- Using laboratory experiments, field work, and modeling to interpret water-rock interactions and soil-forming processes on Earth and Mars
- Interpreting the signatures of past aqueous and biological impacts on minerals
- Participating Scientist on the Mars Science Laboratory Curiosity and the Mars2020 rover Perseverance and member of the Network for Life Detection (NFOLD) Steering Committee..

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Holes made by sampling soil on Mars

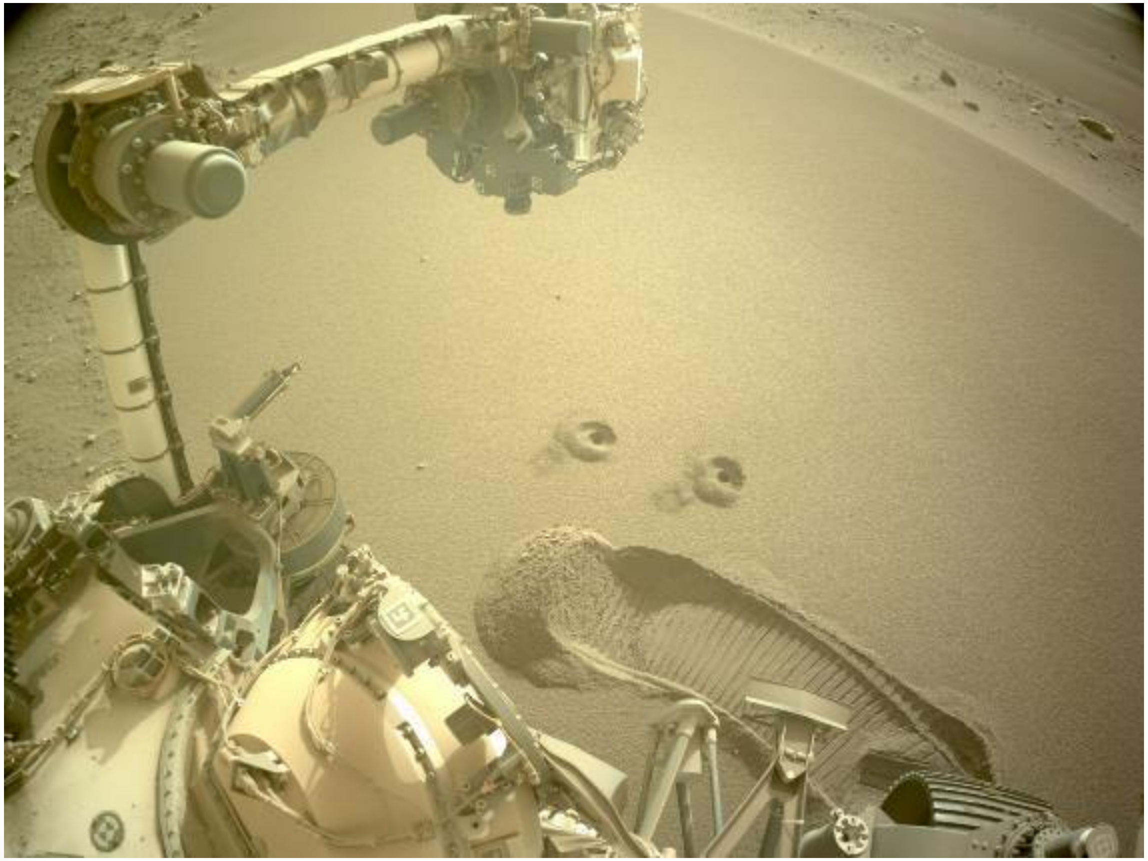

Image credit: NASA/JPL-Caltech

https://mars.nasa.gov/news/9311/nasas-perseverance-rover-gets-the-dirt-on-mars/#:~:text=The%20mission's%20first%20two%20samples,prepare%20for%20future%20missions%20there.

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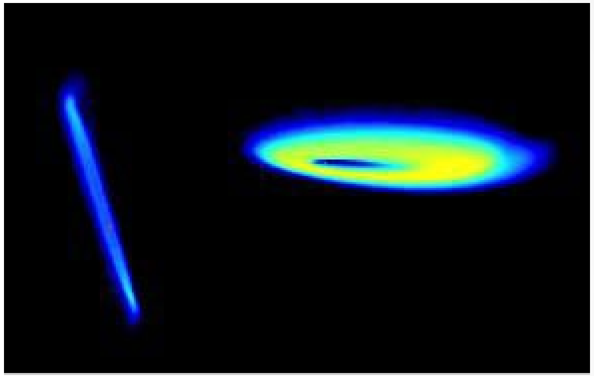
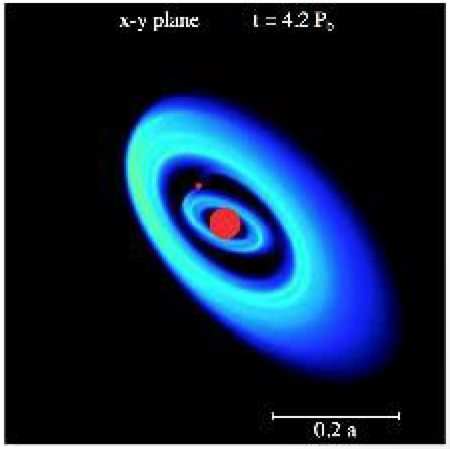
Rebecca Martin

- Assistant Professor of Astronomy, Department of Physics and Astronomy
- Ph.D., BPB 233, Rebecca.Martin@unlv.edu
- http:/www.physics.unlv.edu/~rgmartin/Rebecca_G._Martin.html





Areas of Expertise

- Star and planet formation
- Astrophysical Fluids
- Binary Star Systems
- Planetary System Dynamics

Research Summary:

- My research deals with highly topical questions in astrophysics, such as how star and planetary systems form. I use analytic and numerical methods to study the theory of accretion disc dynamics, few body dynamics and planet-disc interactions.

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Geomicrobiology

Dr. Aude Picard

Assistant Research Professor

School of Life Sciences

audeamelie.picard@unlv.edu

Expertise

- Anaerobic microbiology
- Microbial physiology
- Biomineralization
- Astrobiology and biosignatures
- Microscopy & spectroscopy

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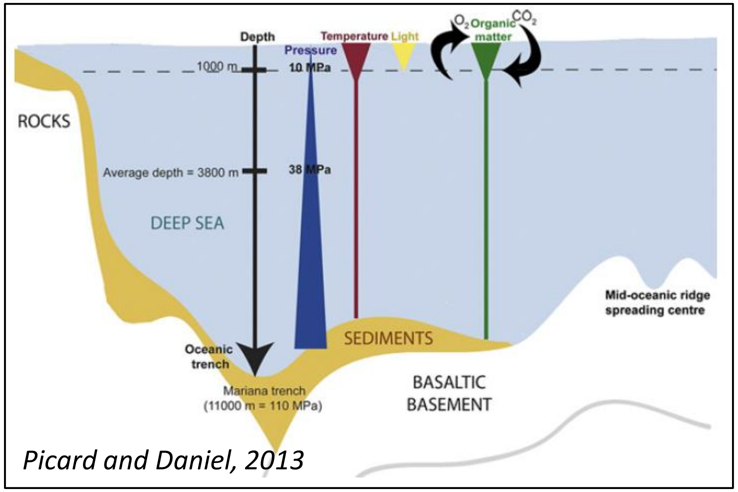
Microbial life in extreme conditions

① Microbial life under high pressure

- What are the pressure limits for microbial life?

High-pressure environments represent the largest habitat for microbial life on Earth



Picard and Daniel, 2013

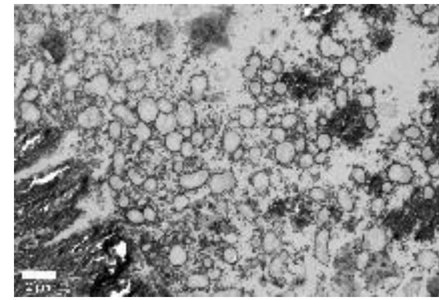
Oceans on icy moons (e.g. Europa) are potential habitats for microbial life in the outer Solar System

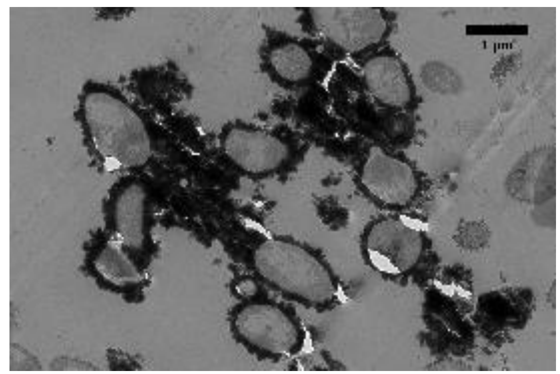

Europa (image credits: NASA)

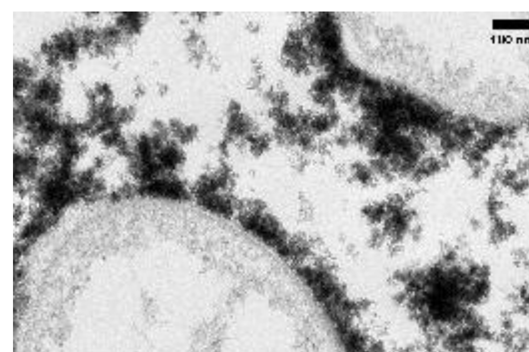
② Microbe-mineral interactions

- How do bacteria cope with mineral encrustation?
- Do minerals play a role in long-term survival of bacteria?

Transmission electron microscopy images of bacteria encrusted in iron sulfide minerals







Research Group of Dr. Steffen

- **Dr. Jason H. Steffen**
- Associate Professor
- Department of Physics and Astronomy
- Email: jason.steffen@unlv.edu
- Website: jasonhsteffen.com

Expertise

- Understanding the properties of extrasolar planets and planetary systems
- Planetary dynamics
- Planet interior modeling
- Composition of planet-forming materials

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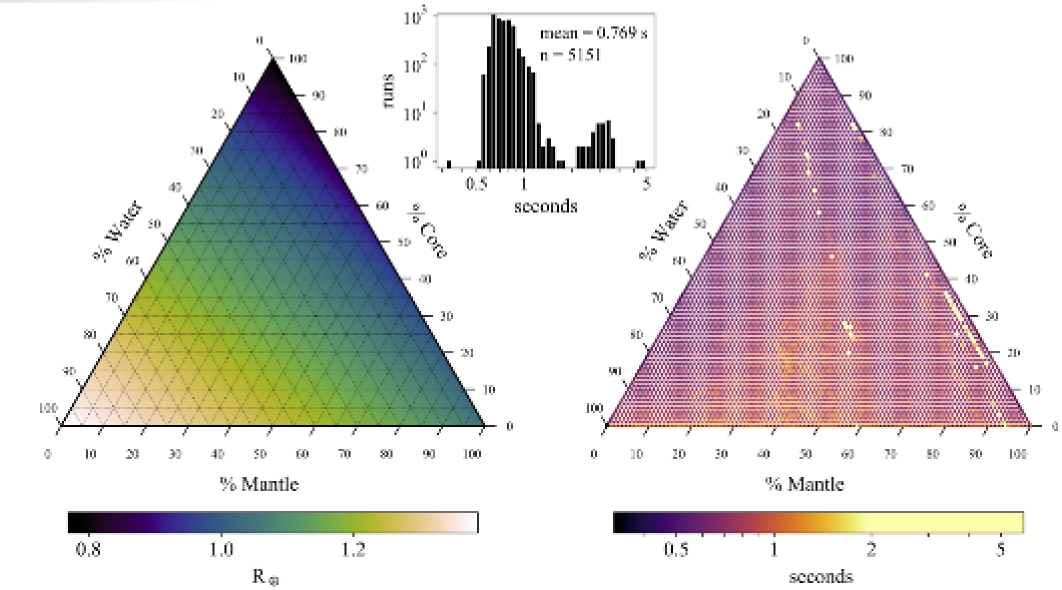
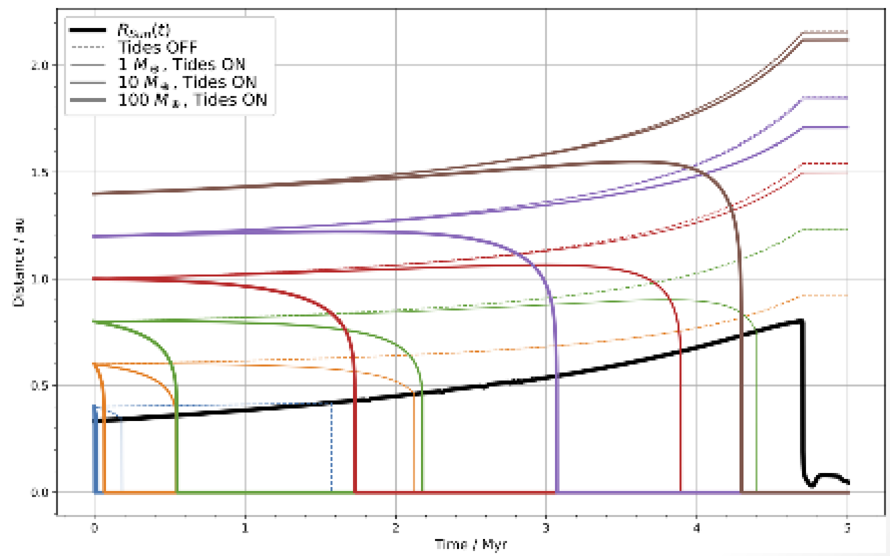


Timing results for planet models using the MAGRATHEA code, developed by our group at UNLV.



Future of planets in a system during the late stages of stellar evolution, including the effects of tides and stellar mass loss.

Planetary petrology

Dr. Arya Udry

- Department of Geoscience
- Phone: (702) 895-1239
- Email: arya.udry@unlv.edu
- Website: aryaudry.com

Expertise:

Planetary petrology

Martian igneous geology

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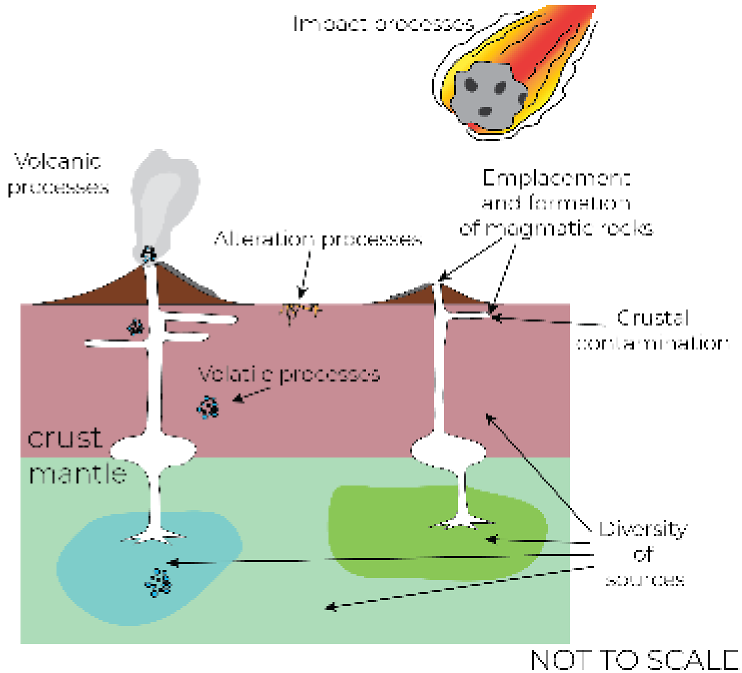
Martian geologic evolution using meteorites

Polarized thin section image of nakhlite meteorite MIL 090030

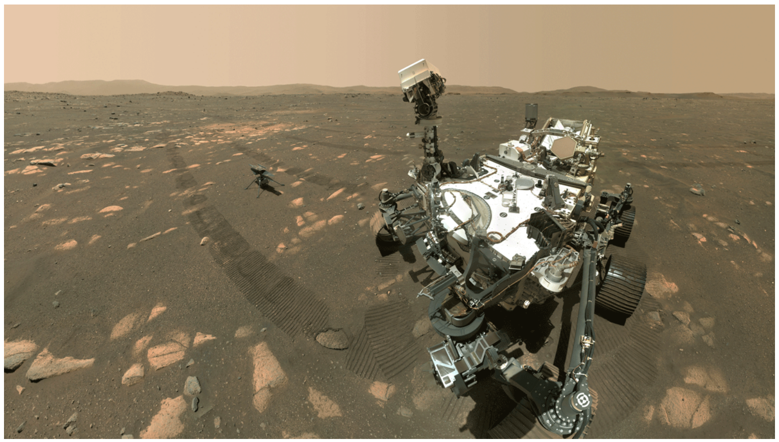


Processes that can be understood using meteorites (Udry et al. 2020)

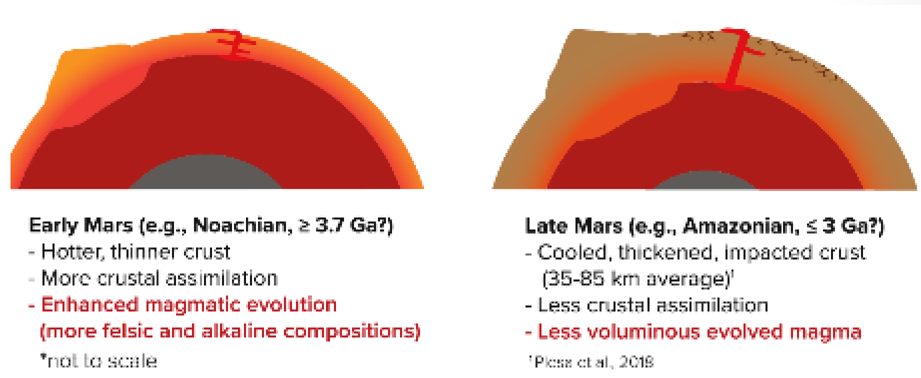
193 nm Excimer laser ablation system – Installed in 2021 to analyze mineral trace elements

- I use meteorites, the only samples that we possess from Mars, to better constrain the interior composition and evolution of this planet
- Bulk rock and mineral geochemical down to the ppm scale

Martian geologic evolution using rover analyses



Mars 2020 Perseverance and Ingenuity on Jezero crater – JPL/NASA image



Models of magma on Mars (Ostwald et al., 2022)

- ❑ Thermodynamical modeling to understand formation of unique compositions of martian surface
- ❑ I am a participating scientist on the Mars2020 mission and I conduct modeling analyses to help understand the formation of magmatic rocks at Jezero crater

Astrophysical Fluid Dynamics

Dr. Zhaohuan Zhu

Department of Physics and Astronomy

Phone: (702) 895- 3563

Email: zhaohuan.zhu@unlv.edu

Expertise:

Fluid dynamics for astronomical project

Star and planet formation

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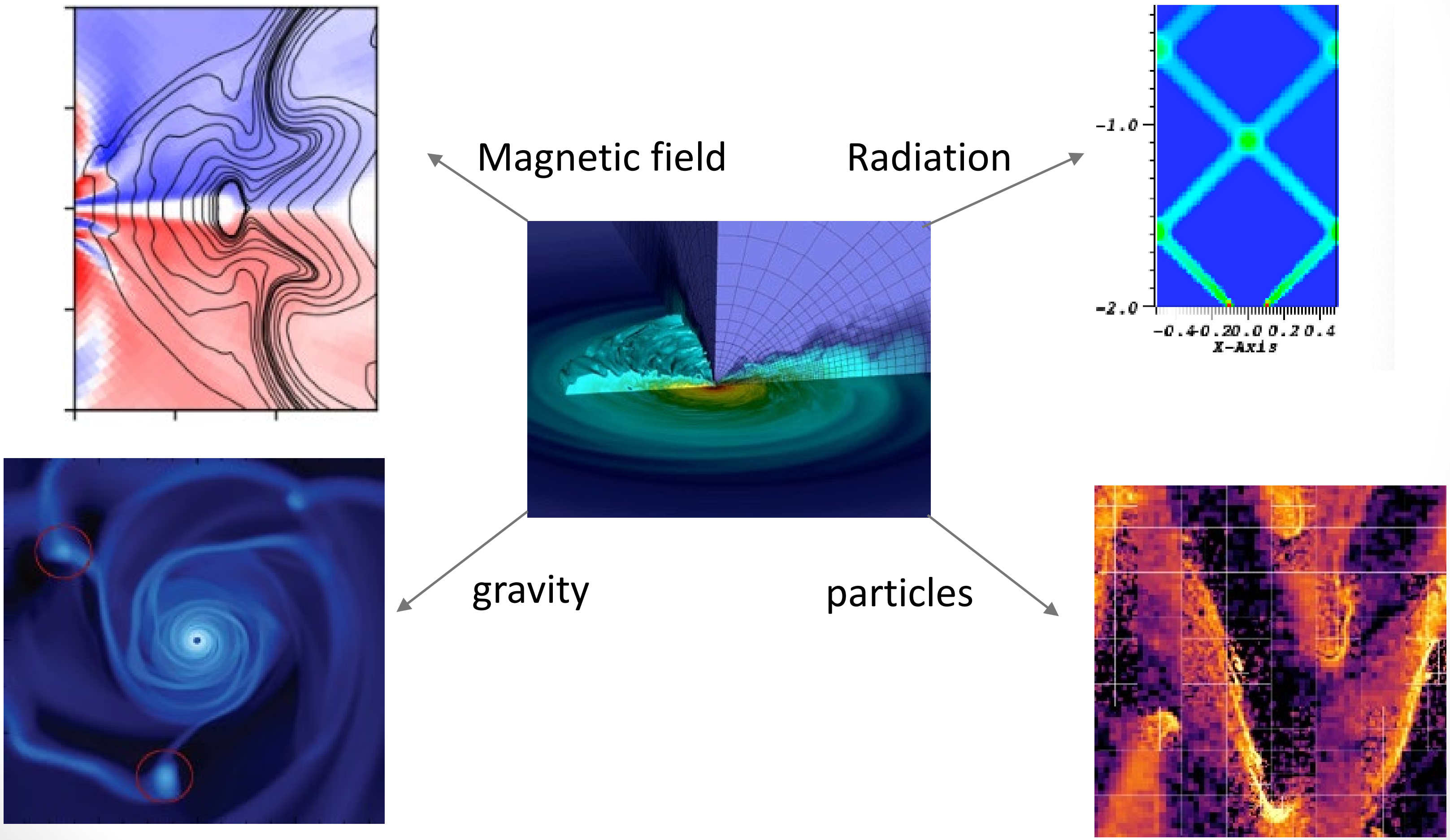
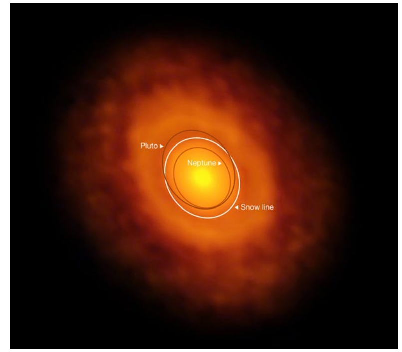
Fluid dynamics:

- Developing and using the state of the art numerical code to solve astrophysical fluid problem.



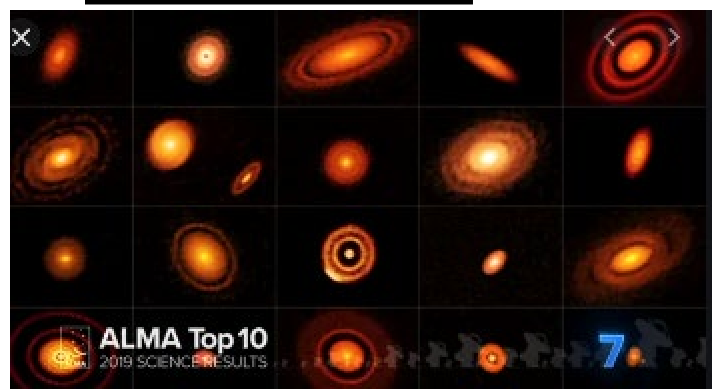
Star and planet formation:

- Protoplanetary disk dynamics:



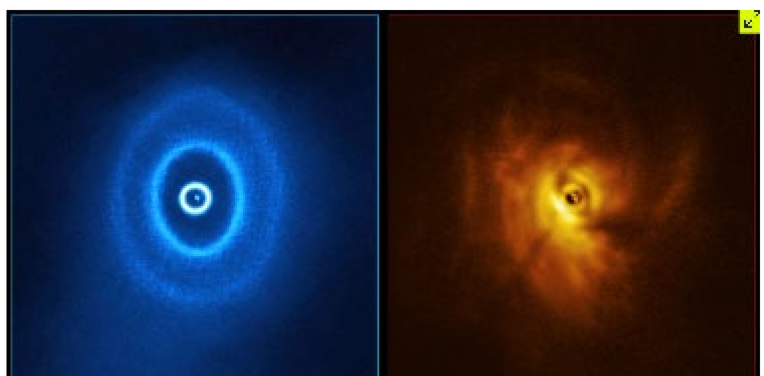
V883 Ori, *Nature*

- Planet formation



DSHARP

- Planet-disk interaction



GW Ori, *Science*