From Atom to Universe

Planets: Earth, Mars, & Beyond Research
Planetary Science

Dr. Christopher Adcock
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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.

**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 H₂ 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.
Astrobiology and Geomicrobiology

Dr. Elisabeth Hausrath
Associate Professor
Department of Geoscience
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Expertise
• Geomicrobiology
• Biological impacts on water-rock interactions
• Astrobiology
Biological Impacts on water-rock interactions

Field studies (e.g. Baumeister et al., 2014)

Nutrient release (e.g. Adcock et al., 2013)

Laboratory studies (e.g. Phillips-Lander et al., 2020)

Signatures of biological alteration (e.g. Hausrath et al., 2009)
Habitability

Hays et al., 2017

Potential biosignatures

Phillips-Lander et al., 2020

Mars 2020 and Mars Sample Return

NASA.gov
High Temperature Geochemistry

Dr. Shichun Huang
Department of Geoscience
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Expertise:
Chemistry of earth's mantle and early solar systems
Non-traditional stable isotopes
UNLV Inductively Coupled Plasma Mass Spectrometer (ICP-MS) lab

- elemental and isotopic measurements for almost all non-volatile elements
- solution mode: detection limits at \(10\text{s of ppq } (10^{-15})\) level for lanthanides and actinides
- in situ measurement: spatial resolution at < 5 micron

Multi-Collector ICP-MS (to be installed in 2021, funded by NSF MRI)

iCAP Qc ICP-MS from ThermoFisher (installed in 2015)

wet chemistry lab under positive air pressure

193 nm excimer laser ablation system (to be installed in 2020, funded by NASA PME)
I use elemental and isotopic tracers to study the solid Earth and the early solar systems. 

Applied science: trace metals in local aqua systems; Cr remediation.
Rebecca Martin

- Assistant Professor of Astronomy, Department of Physics and Astronomy
- Ph.D., BPB 233, Rebecca.Martin@unlv.edu

Areas of Expertise
- Star and plant 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.
Geomicrobiology

Dr. Aude Picard
Assistant Research Professor
School of Life Sciences
audeamelie.picard@unlv.edu

Expertise
• Anaerobic microbiology
• Biomineralization
• Astrobiology and biosignatures
• Microscopy & spectroscopy
Biogeochemistry of Fe, S and C in anoxic environments

Iron sulfide mineral formation in anoxic environments

1. Properties of biominerals

Minerals produced with microorganisms have unique physical and chemical properties

- What is the reactivity of biominerals?
- What are the applications of biominerals?

2. Microbe-mineral interactions in anoxic environments

- Do minerals play a role in the physiology of bacteria?
- How do bacteria cope with mineral encrustation?

3. Can we use biominerals for the search of life on Mars?

- Are properties of biominerals unique enough to record life in anoxic environments?

Credits: NASA/JPL-Caltech/MSSS
Extrasolar Planets

Dr. Jason Steffen
Assistant Professor of Physics
Department of Physics and Astronomy
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Expertise:
• Data Analysis
• Computer Modeling
Planetary Petrology

Dr. Arya Udry
Department of Geoscience
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Email: ary.a.udry@unlv.edu

Expertise:
• Meteorite petrology
• Martian igneous geology
Martian geologic evolution using meteorites

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

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

193 nm Excimer laser ablation system – To be installed in 2020 to analyze in situ trace elements
Martian geologic evolution using rover analyses

Models of magma composition evolution for SiO$_2$ versus Mg/Mg+Fe compared to Gale crater felsic (i.e., Si-rich) rocks (Udry et al. 2018)

- Thermodynamical modeling to understand formation of unique compositions of martian surface
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
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

- Planet-disk interaction
  - GW Ori, *Science*