Dr. Brian Michael Hynek hynek@lasp.colorado.edu

Full Professor in the Department of Geological Sciences and
Research Scientist at the Laboratory for Atmospheric and Space Physics (*since 2003*)
Director, CU Center for Astrobiology (*since 2013*)
University of Colorado Boulder, CO

Professional Preparation:

Ph.D. in Earth and Planetary Sciences, Washington University, St. Louis, MO, *2003*
M.A. in Earth and Planetary Sciences, Washington University, St. Louis, MO, *2001*
B.A. in Earth Science, Earth Science Education, and All Sciences Education,
University of Northern Iowa, Cedar Falls, IA *1998*

Profile: Dr. Brian M. Hynek is a *planetary scientist and field geologist*. He is a world expert on the study of modern terrestrial analogs to understand geological processes that operated on early Mars and the Moon, with recent field-based projects spanning five continents. Brian has worked extensively with NASA conducting EVA, rover, and UAV simulations in preparation for in situ exploration of the Moon and Mars. He runs a ~$250-$350K/yr research program and currently mentors four graduate students. Brian has published over 80 peer-reviewed scientific papers, multiple book chapters, and hundreds of conference abstracts.

Expertise: field geology, planetary surfaces, remote sensing, planetary mapping, GIS, volcanology, astrobiology, microbiology, geochemistry, mineralogy, mission ops, VNIR spectroscopy, UAVs

Mission and Instrument Experience

Desert-Research And Technology program (*2009-2013*), NASA JSC

- Role: Science Backroom Team member; assisted planning astronaut EVAs and rover traverses, communicated with astronauts during EVAs, helped test the impact of comm. delays during EVAs. *E.g., Eppler et al., 2013*

Structured Light Imaging Module (*2008-present)*, NASA PIDDP × 2 and SBIR × 2

- Role: Science Lead; Provided scientific guidance on instrument specifications and calibration throughout fifteen years of development, led scientific data analysis from laboratory and JPL field tests.

GeoHeuristic Operational Strategies Tests (*2012-present*), NASA SMD PSTAR Program

- Role: Site Expert; Reconnoitered and led "roverless roving" field tests for six separate weeklong field campaigns in Iceland, Utah, and Alaska. Tested science operational strategies, traverse planning, and instruments/data necessary for rover exploration of the Moon and Mars. *E.g., Yingst et al., 2014; 2017; 2022; 2022*

Planetary Geologic Mapping Experience

- Drafted a 1:2,000,000-scale United States Geological Survey geologic map of the broader Meridiani Planum region of Mars to place the Opportunity rover results in the broader context. *Hynek and di Achille, 2017*.
- Currently have lead-author USGS geologic maps in revision for Coprates Chasma, Mars and the Rembrandt region, Mercury. *E.g., Hynek et al., 2017, Chojnacki et al., 2017*

Field Geology Experience

Volcano/Hydrothermal Studies as Analogs for Ancient Mars (*2006-present*), NASA SMD Exobiology and Habitable Worlds programs, National Geographic Explorers Grantee

- Planned and led field expeditions to characterized the geochemistry, mineralogy, and (often) the microbiology of acid-sulfate hydrothermal systems inside of active volcanic

environments in Iceland (7×), Nicaragua (5×), Costa Rica (4×), and Hawaii (2×) as volcanic analogs for early Mars. *E.g., Hynek et al., 2013, 2018; Wang et al., 2022*

- Organized and led the highest-ever research on hydrothermal systems on the world's tallest active volcano, Ojos del Salado (22,615'), (*2021*).

Antarctica Search for Meteorites (ANSMET) (*2009-2010, 2016, 2018-2019*), NASA

- Part of NASA's elite team to recover meteorites in remote regions of Antarctica. Up to 60 days at a time living and working in extreme conditions. Recovered 10 Moon rocks.

Fluviodeltaic Systems in Patagonia as Analogs for a Warm-Wet Mars (*2017-2019*), NASA

- Conducted UAV operations to map the morphometry of stepped deltas along Lake General Carrera as analogs for Martian examples. *E.g., Williams and Hynek, 2022*

List of Most Relevant Publications (author = supervised student/postdoc):

Mission Planning/Operations:

Lotto, M., D., Klaus, and **B. M. Hynek,** In-situ resources and environmental conditions for surface exploration missions on Mars, *Advances in Space Research*, 6(4), DOI: 10.1089/space.2018.0019, 2018.

El-Maarry, M. R., **B. M. Hynek,** S. R. Black, and A. Yingst, Testing operational strategies for a Mars helicopter using an unmanned aerial vehicle (UAV), *Planetary and Space Science,* in review.

Eppler, D. et al., Desert Research and Technology Studies (D-RATs) 2010 science operations: Operational approaches and lessons learned for managing science during human planetary surface missions, *Acta Astronautica*, 2012.

Yingst R. A., et al.,Testing Mars Exploration Rover-inspired operational strategies for semi-autonomous rovers on the Moon II: The GeoHeuristic operational Strategies Test in Alaska. *Acta Astronautica, 99,* 24-36, 2014.

Yingst, R. A. et al., Determining best practices in reconnoitering sites for habitability potential on Mars using a semi-autonomous rover: A GeoHeuristic Operational Strategies Test, *Acta Astronautica, 132*, 268–281, 2016.

Yingst, R. A., et al., Testing the efficiency of rover science protocols for robotic sample selection: A GeoHeuristic Operational Strategies Test, *Acta Astronautica,* 146, 300-315, 2018.

Yingst, R. A., et al., Using rover-analogous methodology to discriminate between volcanic and sedimentary origins in successions dominated by igneous composition, *The Planetary Science Journal, 3(10),* 2022

Planetary Remote Sensing:

Hynek, B. M., Osterloo, M. K., and Young, K. S., Late stage formation of martian chlorides, *Geology*, doi:10.1130/G36895.1, 2015.

Black, S. R., and **Hynek, B. M**., Characterization of terrestrial hydrothermal alteration products with Mars analog instrumentation: Implications for current and future rover investigations. *Icarus, 307,* 235-259, 2018.

R. J. Thomas, **B. M. Hynek**, D. A. Rothery, and S. J. Conway, Mercury's low-reflectance material: Constraints from hollows. *Icarus, 277*, 455-465, 2016.

Herrick, R. R., and **Hynek, B. M**., Investigating target versus impactor influences on Martian crater morphology at the simple-complex transition, *Meteoritics & Planetary Science, 52(8),* 1722-1743, 2017.

Hynek, B. M., Extraterrestrial digital elevation models: constraints on planetary evolution, with focus on Mars, *International Journal of Remote Sensing, 31:23,* 6259-6274, 2010.

Robbins, S.J., and **B.M. Hynek**, Utility of laser altimeter and stereoscopic terrain models to derive complex morphology: Application to Martian craters, *Planetary and Space Science, 86,* 57-

65, doi: 10.1016/j.pss.2013.06.019, 2013.

Hynek, B. M., McCollom, T. M., and Szynkiewicz, A., Sulfur cycling and mass balance at Meridiani, Mars, *Geophysical Research Letters*, DOI: 10.1029/2019GL085115, 2019.

Hynek, B. M., Extensive bedrock throughout Terra Meridiani, Mars: Implications for hydrologic processes, *Nature, 431*, doi:10.1038/nature02902, 2004.

Di Achille, G., and **B. M. Hynek**, Ancient ocean on Mars supported by global distribution of deltas and valleys, *Nature Geoscience, 3*, 459-463, doi:10.1038/ngeo891, 2010.

Planetary Geologic Mapping:

Hynek, B. M. and G. Di Achille, Geologic map of Meridiani Planum, Mars: *U.S. Geological Survey Scientific Investigations Map 3356*, pamphlet 9 p., scale 1:2,000,000, https://doi.org/10.3133/sim3356, 2017.

Hynek, B. M. and Chojnacki, M., Geologic map of the Coprates Chasma Quadrangle (MTM – 15057), Mars, *U.S. Geological Survey Scientific Investigations Map*, scale 1:500,000, in technical review, 2023.

Hynek, B. M., Gemperline, J. D., Robbins, S. J., and Mueller, K. J., Geologic map of the Rembrandt basin, Mercury, *U.S. Geological Survey Scientific Investigations Map*, scale 1:2,000,000, in technical review, 2023.

Impact Craters and Volcanism:

Robbins, S. J. and **B. M. Hynek**, A new global database of Mars impact craters ≥1 km: 1. Database creation, properties, and parameters, *Journal of Geophysical Research - Planets, 117*, doi: 10.1029/2011JE003966, 2012.

Robbins, S. J. and **B. M. Hynek**, A new global database of Mars impact craters ≥1 km: 2. Global and regional properties and their implications to gravity scaling, *Journal of Geophysical Research - Planets, 117*, doi:10.1029/2011JE003967, 2012.

Robbins, S. J., **B. M. Hynek**, R. J. Lillis, and W. K. Bottke, The large impact crater history of Mars, *Icarus*, 225, 173-184, doi: 10.1016/j.icarus.2013.03.019, 2013.

Robbins, S. J. and **B. M. Hynek**, Distant secondary craters from Lyot crater, Mars, and implications for surface ages of planetary bodies, *Geophysical Research Letters*, *38,* doi:10.1029/2010GL046450, 2011.

Robbins, S. J. and **B. M. Hynek**, Secondary crater fields from 24 large primary craters on Mars: Insights into nearby secondary crater production. *Journal of Geophysical Research - Planets, 116*, doi:10.1029/2011JE003820, 2011.

Robbins, S. J., G. Di Achille, and **B. M. Hynek**, The volcanic history of Mars: High-resolution crater-based studies of the calderas of 20 volcanoes, *Icarus*, *211*, 1179–1203, 2011.

Hynek, B. M., S. J. Robbins, O. Sramek, S. J. Zhong, Geological evidence for a migrating Tharsis plume on early Mars, *Earth and Planetary Science Letters, 310,* 327–333, 2011.

Hynek, B. M., et al., Lack of microbial diversity in extreme Mars analog settings: Poás volcano, Costa Rica, *Astrobiology, 18*, DOI: 10.1089/ast.2017.1719, 2018.

McCollom T. M. and **Hynek B. M.**, A volcanic environment for bedrock diagenesis at Meridiani Planum, Mars. *Nature*, *438*, 1129-1131, 2005.

Robbins, S. J., and **B. M. Hynek**, The secondary crater population of Mars, *Earth & Planetary Science Letters, 400,* 66-76, doi: 10.1016/j.epsl.2014.05.005, 2014.

Skjetne, H. L., Singer, K. N., **Hynek, B. M.**, *et al.*, Morphological comparison of blocks in chaos terrains on Pluto, Europa, and Mars, *Icarus*, https://doi.org/10.1016/j.icarus.2020.113866, 2020.