

# CURRICULUM VITAE FOR PROFESSIONAL ACTIVITIES, 2017 - 2019

## PROFESSOR JACK D. FARMER

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### Full Education

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Ph.D. Geology/Paleobiology, University of California, Davis (1978)

M.S. Geology, University of Kansas, Lawrence (1971)

B.A. Geology, California State University, Chico (1969)

### Full Professional History

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#### CURRENT POSITION

##### Professor of Geological Sciences (1998 –Present)

Arizona State University, Professor, Geological Sciences Department (1998-2006) and School of Earth and Space Exploration (2006-present), PO Box 871404, Tempe, AZ 85287-1404; Director, ASU Astrobiology Program (1998-2003). Research: Microbial biosedimentology of extreme environments (hydrothermal, hypersaline, etc.), early biosphere development, evolution of the Precambrian benthos and the origins of multicellular life. The search for extraterrestrial life in the Solar System, especially the astrobiological exploration of Mars, including payload development and site selection for future landed missions to explore for past, or present Martian life. Freshman courses taught include: Introduction to Physical and Historical Geology. Upper Division course taught include: Principles of Paleontology and Essentials of Astrobiology. Graduate courses include Advanced Paleontology, Advanced Sedimentology, Advanced Field Geology and Special Topics in Astrobiology.

#### PREVIOUS EMPLOYMENT HISTORY

##### Research Scientist (Civil Servant) 1994-1998.

Exobiology Branch, NASA Ames Research Center, Moffett Field, CA.

Activities: Landing site studies to support exploration for Martian life, microbial fossilization and the biosedimentology of extreme environments, role of microbial processes in early diagenesis, morphogenesis of modern and ancient microbial stromatolites, role of metazoan grazers in stromatolite morphogenesis, developing criteria for the recognition of biogenicity in ancient rocks, including Martian meteorite, ALH84001.

##### Research Scientist (Contractor) 1993-1994.

SETI Institute and NASA Ames Research Center, (Exobiology Branch), Moffett Field, CA.

Activities: Site selection strategies for Mars “exopaleontology”, microbial fossilization processes in modern and ancient thermal springs and alkaline/saline evaporitic lakes.

##### Senior Post-doctoral Fellow (National Research Council) 1991-1993.

Exobiology Branch, NASA Ames Research Center, Moffett Field, CA.

Research included: Morphogenesis of microbialites (e.g. stromatolites) and microbial fossilization processes in modern and ancient hydrothermal springs.

**Visiting Assistant Professor**, Dept. of Geological Sciences, Cal. State University, Long Beach, 1990-1991. Activities: Taught undergraduate courses in Physical Geology and Oceanography.

**Adjunct Assistant Professor** Department of Earth and Space Sciences, University of California Los Angeles, 1987-1990. Teaching assignments: "Principles of Paleontology", "Introduction to Oceanography", "Introduction to the Earth Sciences", "Principles of Earth Science", "Seminar in Biosedimentology", and supervision of student research.

**Visiting Assistant Professor** Department of Earth and Space Sciences, University of California Los Angeles, 1986-1987. Teaching assignments: "Introduction to Oceanography", "Introduction to the Earth Sciences", "Principles of Earth Science".

**Senior Geologist**, Exxon Co., Western Division Production, Thousand Oaks, CA. 1981-1985. Activities: Subsurface geological mapping, estimation of petroleum reserves, evaluation of reservoir quality for offshore fields of the Santa Barbara Basin; development and management of computer data bases; logging, coring, and testing of wells. Analysis of regional facies relationships, depositional environments, and diagenesis of the Miocene Monterey Formation, and younger sandstone reservoirs of the offshore Santa Barbara Basin, onshore Ventura Basin and adjacent Santa Ynez Mountains. (Individual projects listed under "Proprietary Research for Exxon").

**Senior Museum Scientist and Research Associate**, Department of Geology, University of California, Davis, CA. 1975-1980. Duties: Supervision of curatorial staff, development and management of teaching and research collections for mineralogy, petrology, and paleontology. Research activities: Sedimentology of submarine fan environments, organism-substrate interactions and the benthic ecology/paleoecology of modern and Neogene intertidal and shallow subtidal marine environments, northern and central CA. Shipboard biological sampling and description of marine faunas from the Ross Sea, Antarctica (support scientist for NSF-funded Ross Ice Shelf Drilling Project). SCUBA surveys of subtidal marine communities of Bodega Marine Life Refuge and Catalina Island, CA., with an emphasis on the ecology and paleoecology of the Bryozoa.

**Lecturer**, Department of Geology, University of California, Davis, 1973-1974. Teaching assignments: "Evolution of the Earth", "Field Studies in Marine Paleoecology" (Bodega Marine Lab, Bodega Bay, CA), "Special Studies in Sedimentology", and supervision of student research.

## **Overview of Research**

**Co-Investigator, CheMin instrument team, Mars Science Laboratory Mission (2004-present).** (CheMin is an X-ray diffractometer/X-ray fluorescence experiment for the *in situ*, identification of minerals in rocks and soils. This mission was launched in November of 2011 and landed at Gale Crater in August of 2012). Responsibilities during instrument development included operations training, landing site selection and evaluation. Following landing, responsibilities shifted to CheMin instrument operations, Geology-Mineralogy Science Theme Group lead, observation planning and data analysis, team publications and Education and Public Outreach.

**Participating Scientist, NASA Mars Exploration Rover Mission (2003-present).** Long-term planning lead and Geology Theme Group member. Responsibilities include operations and science observation planning, data analysis and interpretation, team reporting and publication, Education and Public outreach.

**Co-Principal Investigator,** Research grants from the Mars Instrument Development (MIDP) and Astrobiology Science Technology Instrumentation Development (ASTID) Programs, NASA Office of Solar System Exploration (2003-present). Research to develop a Multispectral Microscopic Imager (MMI) for the *in situ* robotic visualization of rock and soil microtextures, as well as the spectral identification of minerals and their paragenesis. In addition, we worked to develop an integrated MMI-laser Raman Spectrometer for determinative mineralogy and the detection of organic materials (kerogen and other geopolymers) preserved in rocks. My role as PI of this project involved the testing of instrument capabilities using suites of well-characterized test samples from primarily hydrothermal and evaporite environments (two priority targets for Mars exploration), helping with the field deployment of a prototype MI and laser Raman spectrometer on JPL robotic rover platforms and supervising the synergistic use of these instruments during lab and field studies. This project was developed in collaboration with technologist, Dr. Glenn Sellar (JPL) under a ASU-JPL MOU.

### **Principle Investigator, NASA's Exobiology Program (1993-present)**

Funded projects included studies of the biosedimentology, geochemistry and paleontology of extreme environments, including: 1) Silica-, carbonate- and iron oxide-precipitating hot-springs, Yellowstone National Park (WY) and Steamboat Springs (NV) and Hot Creek, Long Valley Caldera (CA), Plio-Pleistocene travertine hydrothermal systems of Death Valley and Miocene siliceous sinters of New Zealand; 2) Perennial alkaline, saline lake cold-spring carbonates (tufas) of the Mono Basin and the Owens Valley (eastern CA), saltern microbial mat systems, Guerrero Negro, Baja Sur, Mexico and calcareous stromatolites of Walker and Pyramid Lakes (NV) and the Cuatro Ciénegas basin, central Mexico; 3) Jurassic methane cold seep carbonates, northern California. 4) Playa evaporites, Searles and Bristol dry lakes; Lake Lucero, White Sands National Monument (NM) and Miocene evaporites and travertines of the Cady Mts (NV).

### **Principle Investigator, NASA's Astrobiology Program (1998-2003)**

Individually funded projects supporting microbial fossilization processes in extreme sedimentary environments (hydrothermal, alkaline, saline lake, methane seep); landing site selection for Mars Astrobiology; NASA Education and Public Outreach.

## Activities 2017-2019

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### Awards

- Elected Fellow Geological Society of America, Fall National Meeting, 2017
- Nominated for the 2017 Zebulon Pearce Distinguished Teaching Award, ASU

### Service

- SESE Graduate Committee 2019-Present
- SESE Colloquium Committee 2017-2019
- National Academy of Science, Committee on the State of the Science of Astrobiology 2017-2019
- ASU, University Promotion and Tenure Committee, 2014-2017.
- Member, Joint NASA-ESA Science Working Group for the Mars 2020 Mission (May 2011-present). This international team defined scientific and operational requirements for a joint rover mission to explore for signs of life and to cache samples for return to Earth.
- Member, Mars Science Laboratory mission science team and CheMin instrument teams (2005-present).
- Participating Scientist, Mars Exploration Rover mission; long-term planning lead for Spirit and member of Geology Theme Group, representing Astrobiology (2003-present).
- School of Earth and Space Exploration Annual Open House. "Dr. Rock". Developed as a family oriented activity, to communicate and interact with the public about the nature of Earth materials, and how to identify rocks, minerals and fossils (annually from 1998 – 2017)

### Teaching

#### 2017 Spring

- GLG 455/598 Advanced Field Geology: Sedimentary Facies & Environments
- SES 493 Honors Thesis

#### 2017 Fall

- Sabbatical leave

#### 2018 Spring

- GLG 455/598: Advanced Field Geology: Sedimentary Facies & Environments

#### 2018 Fall

- GLG 430/598: Paleontology
- GLG 492: Honors Directed Study

#### 2019 Spring

- GLG 101: Intro to Geology 1
- GLG 493: Honors Thesis

#### 2019 Fall

- GLG 430/599: Paleontology

## Advising & Mentoring

### Undergraduate Faculty Mentor – 2019-2020

- Christian Kroemer
- Amanda Rosenberg
- John Sutorka

### Undergraduate Faculty Mentor – 2018-2019

- Megan Bromley
- Larissa Cameron
- Collin Ganser
- Christian Kroemer
- Rachel Roland
- Connor Rosenbaum
- Amanda Rosenberg
- John Sutorka
- Harrison Tamayo
- Joshua Tokunaga

### Undergraduate Honors Students

- Tkacik, Stephanie M. Fall 2017 - Spring 2018
- Howard, Cheyenne.W. Fall 2016 - Spring 2017

### Graduate Students

- **Jonathan Zaloumis**, PhD Program. Research interests: Biosignature preservation in sulfate evaporites, with applications to Mars exploration (**NSF Fellowship**) (Primary Advisor: Jack Farmer)
- **Marisol Rivera**, PhD program. Interest area: Microbialite Morphogenesis and Preservation of Biosignatures in Siliceous Hot Spring Systems. (Primary Advisor: Jack Farmer)
- **Daniel Roush** (PhD., School of Life Sciences, Microbiology Program). Committee Member. Dissertation Topic: Endolithic communities in marine environments.
- **Jonathan Hill** (School of Earth and Space Exploration). Mentor for second project in preparation for PhD exam. Topic: Remote sensing detection of mineral transitions in silica-rich hydrothermal deposits in Saline Valley, CA.
- **Sean Czarnecki** (School of Earth and Space Exploration). External examination committee member for PhD. Topic: Testing a Global Lunar Stress Field Model.

### Post-Docs

- Charlene Estrada – Hydrothermal origins of filamentous fabrics in silica-Fe oxide mineral assemblages.

**Publications – 49** (1-Book, 1-Book Chapter, 13-Peer Reviewed, 37-Abstracts)

Total Citations (Google Scholar, 1/30/20): **12664**

h-index (Google Scholar, 1/30/20): **59**

i10-index (Google Scholar, 1/30/20): **115**

1. Blacksberg, J.; Alerstam, E.; Cochrane, C. J.; Maruyama, Y.; Farmer, J. D., Miniature high-speed, low-pulse-energy picosecond Raman spectrometer for identification of minerals and organics in planetary science. *Applied Optics* **2020**, *59* (2), 433-444.
2. Board, S. S.; National Academies of Sciences, E., and Medicine; LOLLAR, B. S.; ATREYA, S. K.; BOSS, A. P.; FALKOWSKI, P. G.; FARMER, J. D.; GUYON, O.; JOYCE, G. F.; KASTING, J. F.; NECHES, P. M.; PILCHER, C. B.; RENNÓ, N. O.; ROGERS, K. L.; SCHMIDT, B. E.; SUMMONS, R.; WESTALL, F.; WRIGHT, S. A., *An Astrobiology Strategy for the Search for Life in the Universe*. National Academies Press: 2019.
3. Chan, M. A.; Hinman, N. W.; Potter-McIntyre, S. L.; Schubert, K. E.; Gillams, R. J.; Awramik, S. M.; Boston, P. J.; Bower, D. M.; Des Marais, D. J.; Farmer, J. D.; Jia, T. Z.; King, P. L.; Hazen, R. M.; Léveillé, R. J.; Papineau, D.; Rempfert, K. R.; Sánchez-Román, M.; Spear, J. R.; Southam, G.; Stern, J. C.; Cleaves, H. J., Deciphering Biosignatures in Planetary Contexts. *Astrobiology* **2019**, *19*, 1075-1102.
4. Team, I.; Beaty, D. W.; Grady, M. M.; McSween, H. Y.; Sefton-Nash, E.; Carrier, B. L.; Altieri, F.; Amelin, Y.; Ammannito, E.; Anand, M.; Benning, L. G.; Bishop, J. L.; Borg, L. E.; Boucher, D.; Brucato, J. R.; Busemann, H.; Campbell, K. A.; Czaja, A. D.; Debaille, V.; Des Marais, D. J.; Dixon, M.; Ehlmann, B. L.; Farmer, J. D.; Fernandez-Remolar, D. C.; Filiberto, J.; Fogarty, J.; Glavin, D. P.; Goreva, Y. S.; Hallis, L. J.; Harrington, A. D.; Hausrath, E. M.; Herd, C. D. K.; Horgan, B.; Humanyun, M.; Kleine, T.; Kleinhenz, J.; Mackelprang, R.; Mangold, N.; Mayhew, L. E.; McCoy, J. T.; McCubbin, F. M.; McLennan, S. M.; Moser, D. E.; Moynier, F.; Mustard, J. F.; Niles, P. B.; Ori, G. G.; Raulin, F.; Rettberg, P.; Rucker, M. A.; Schmitz, N.; Schwenzer, S. P.; Sephton, M. A.; Shaheen, R.; Sharp, Z. D.; Schuster, D. L.; Siljestrom, S.; Smith, C. L.; Spry, J. A.; Steele, A.; Swindle, T. D.; Ten Kate, I. L.; Tosca, N. J.; Usui, T.; van Kranendonk, M. J.; Wadhwa, M.; Weiss, B. P.; Werner, S. C.; Westall, F.; Wheeler, R. M.; Zipfel, J.; Zorzano, M. P., The potential science and engineering value of samples delivered to Earth by Mars sample return. *Meteoritics and Planetary Science* **2019**, *54*, 667-671.
5. Millan, M.; Campbell, K. A.; Van Kranendonk, M. J.; Sriaporn, C.; Handley, K. M.; Dobson, M.; Camp, S.; Teece, B.; Guido, D. M.; Djokic, T.; Farmer, J. D.; Johnson, S. S., Detection and Preservation of Biosignatures in Mars Analogs Hot Spring Deposits from the Taupo Volcanic Zone, New Zealand. *EPSC* **2019**, *2019*, EPSC-DPS2019-656.
6. Millan, M.; Campbell, K.; Ruff, S. W.; Van Kranendonk, M. J.; Sriaporn, C.; Handley, K. M.; Teece, B.; Mardónez, D.; Djokic, T.; Dobson, M.; Camp, S.; Teece, B.; Guido, D. M.; Djokic, T.; Farmer, J. D.; Johnson, S. S. In *Detection and Preservation of*

*Biosignatures in Hot Spring Siliceous Deposits, New Zealand, as Analogs for Mars*, 2019 Astrobiology Science Conference, AGU: 2019.

7. Rivera, M. J.; Farmer, J. D.; Ruff, S. W. In *SEEKING SIGNS OF LIFE THROUGH THE LENS OF DIAGENESIS IN SILICEOUS HOT SPRING DEPOSITS*, GSA Annual Meeting in Phoenix, Arizona, USA-2019, GSA: 2019.
8. Ruff, S. W.; Campbell, K. A.; Van Kranendonk, M. J.; Rice, M. S.; Farmer, J. D., The case for ancient hot springs in Gusev crater, Mars. *Astrobiology* **2019**.
9. Ruff, S. W.; Campbell, K.; Van Kranendonk, M. J.; Rice, M. S.; Farmer, J. D. In *Recognizing Hot Spring Silica Sinter on Mars via Terrestrial Analog Studies*, 2019 Astrobiology Science Conference, AGU: 2019.
10. Skok, J.; Gaskin, J.; Edmunson, J.; Zacny, K.; Blank, J.; Williams, A.; Cannon, K.; Parente, M.; Farmer, J.; Karunatillake, S., SPRING Mission: Exploring the Past and Enabling the Future of Mars. *LPI Contributions* **2019, 2089**.
11. Wright, S. A.; Sherwood Lollar, B.; Atreya, S.; Boss, A. P.; Falkowski, P.; Farmer, J. D.; Guyon, O.; Joyce, G. F.; Kasting, J. F.; Meadows, V.; Neches, P. M.; Pilcher, C. B.; Rennó, N. O.; Rogers, K.; Schmidt, B. E.; Summons, R. E.; Westall, F., Astrobiology Science Strategy for the Search for Life in the Universe. In *American Astronomical Society Meeting Abstracts #233*, 2019; Vol. 233.
12. Beaty, D. W.; Grady, M. M.; McSween, H. Y.; Sefton-Nash, E.; Carrier, B. L.; Altieri, F.; Amelin, Y.; Ammannito, E.; Anand, M.; Benning, L. G.; Bishop, J. L.; Borg, L. E.; Boucher, D.; Brucato, J. R.; Busemann, H.; Campbell, K. A.; Czaja, A. D.; Debaille, V.; Des Marais, D. J.; Dixon, M.; Ehlmann, B. L.; Farmer, J. D.; Fernandez-Remolar, D. C.; Filiberto, J.; Fogarty, J.; Glavin, D. P.; Goreva, Y. S.; Hallis, L. J.; Harrington, A. D.; M. Hausrath, E.; Herd, C. D. K.; Horgan, B.; Humanyun, M.; Kleine, T.; Kleinhenz, J.; Mackelprang, R.; Mangold, N.; Mayhew, L. E.; McCoy, J. T.; McCubbin, F. M.; McLennan, S. M.; Moser, D.; Moynier, F.; Mustard, J. F.; Niles, P. B.; Ori, G. G.; Raulin, F.; Rettberg, P.; Rucker, M. A.; Schmitz, N.; Schwenzer, S. P.; Sephton, M. A.; Shaheen, R.; Sharp, Z. D.; Schuster, D. L.; Siljestrom, S.; Smith, C. L.; Spry, J. A.; Steele, A.; Swindle, T. D.; Ten Kate, I. L.; Tosca, N. J.; Usui, T.; Van Kranendonk, M. J.; Wadhwa, M.; Weiss, B. P.; Werner, S. C.; Westall, F.; Wheeler, R. M.; Zipfel, J.; Zorzano, M. P. In *Introduction to the 2018 iMOST Study*, Second International Mars Sample Return, 2018.
13. Craig, P. I.; Rudolph, A.; Morris, R. V.; Achilles, C. N.; Rampe, E. B.; Treiman, A. H.; Bristow, T. F.; Ming, D. W.; Blake, D. F.; Vaniman, D. T.; Downs, R. T.; Morrison, S. M.; Yen, A. S.; Farmer, J.; Des Marais, D. J.; Castle, N.; Chipera, S. J.; Hazen, R.; Peretyazhko, T. S.; Tu, V., Collapsed Smectite in Gale Crater: Martian Clay Minerals May Have Been on Acid. In *Lunar and Planetary Science Conference*, 2018.

14. Farmer, J. D., Habitability as a tool in astrobiological exploration. In *From Habitability to Life on Mars*, Elsevier: 2018; pp 1-12.
15. National Academies of Sciences, E., and Medicine; LOLLAR, B. S.; ATREYA, S. K.; BOSS, A. P.; FALKOWSKI, P. G.; FARMER, J. D.; GUYON, O.; JOYCE, G. F.; KASTING, J. F.; NECHES, P. M.; PILCHER, C. B.; RENNÓ, N. O.; ROGERS, K. L.; SCHMIDT, B. E.; SUMMONS, R.; WESTALL, F.; WRIGHT, S. A., An Astrobiology Strategy for the Search for Life in the Universe. **2018**.
16. Team, i.; Bishop, J. L.; Horgan, B.; Benning, L. G.; Carrier, B. L.; Hausrath, E. M.; Altieri, F.; Amelin, Y.; Ammannito, E.; Anand, M.; Beaty, D. W.; Borg, L. E.; Boucher, D.; Brucato, J. R.; Busemann, H.; Campbell, K. A.; Czaja, A. D.; Debaille, V.; Des Marais, D. J.; Dixon, M.; Ehlmann, B. L.; Farmer, J. D.; Fernandez-Remolar, D. C.; Fogarty, J.; Glavin, D. P.; Goreva, Y. S.; Grady, M. M.; Hallis, L. J.; Harrington, A. D.; Herd, C. D. K.; Humayun, M.; Kleine, T.; Kleinhenz, J.; Mangold, N.; Mackelprang, R.; Mayhew, L. E.; McCubbin, F. M.; Mccoy, J. T.; McLennan, S. M.; McSween, H. Y.; Moser, D. E.; Moynier, F.; Mustard, J. F.; Niles, P. B.; Ori, G. G.; Raulin, F.; Rettberg, P.; Rucker, M. A.; Schmitz, N.; Sefton-Nash, E.; Sephton, M. A.; Shaheen, R.; Shuster, D. L.; Siljestrom, S.; Smith, C. L.; Spry, J. A.; Steele, A.; Swindle, T. D.; ten Kate, I. L.; Tosca, N. J.; Usui, T.; Van Kranendonk, M. J.; Wadhwa, M.; Weiss, B. P.; Werner, S. C.; Westall, F.; Wheeler, R. M.; Zipfel, J.; Zorzano, M. P. In *Potential High Priority Subaerial Environments for Mars Sample Return*, Second International Mars Sample Return, April 01, 2018; 2018.
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E. M.; Herd, C. D. K.; Horgan, B.; Humayun, M.; Kleine, T.; Kleinhenz, J.; Mangold, N.; Mackelprang, R.; Mayhew, L. E.; McCubbin, F. M.; McCoy, J. T.; McLennan, S. M.; McSween, H. Y.; Moser, D. E.; Moynier, F.; Mustard, J. F.; Niles, P. B.; Ori, G. G.; Raulin, F.; Rettberg, P.; Rucker, M. A.; Schmitz, N.; Sefton-Nash, E.; Sephton, M. A.; Shuster, D. L.; Siljestrom, S.; Smith, C. L.; Spry, J. A.; Swindle, T. D.; ten Kate, I. L.; Tosca, N. J.; Usui, T.; Van Kranendonk, M. J.; Wadhwa, M.; Weiss, B. P.; Werner, S. C.; Wheeler, R. M.; Zipfel, J.; Zorzano, M. P. In *Seeking the Signs of Life: Assessing the Presence of Biosignatures in the Returned Sample Suite*, Second International Mars Sample Return, April 01, 2018; 2018.

19. Team, i.; Ehlmann, B. L.; Mayhew, L. E.; Mustard, J. F.; Altieri, F.; Amelin, Y.; Ammannito, E.; Anand, M.; Beaty, D. W.; Benning, L. G.; Bishop, J. L.; Borg, L. E.; Boucher, D.; Brucato, J. R.; Busemann, H.; Campbell, K. A.; Carrier, B. L.; Czaja, A. D.; Debaille, V.; Des Marais, D. J.; Dixon, M.; Farmer, J. D.; Fernandez-Remolar, D. C.; Fogarty, J.; Glavin, D. P.; Goreva, Y. S.; Grady, M. M.; Hallis, L. J.; Harrington, A. D.; Hausrath, E. M.; Herd, C. D. K.; Horgan, B.; Humayun, M.; Kleine, T.; Kleinhenz, J.; Mangold, N.; Mackelprang, R.; McCubbin, F. M.; McCoy, J. T.; McLennan, S. M.; McSween, H. Y.; Moser, D. E.; Moynier, F.; Niles, P. B.; Ori, G. G.; Raulin, F.; Rettberg, P.; Rucker, M. A.; Schmitz, N.; Sefton-Nash, E.; Sephton, M. A.; Shaheen, R.; Shuster, D. L.; Siljestrom, S.; Smith, C. L.; Spry, J. A.; Steele, A.; Swindle, T. D.; ten Kate, I. L.; Tosca, N. J.; Usui, T.; Van Kranendonk, M. J.; Wadhwa, M.; Weiss, B. P.; Werner, S. C.; Westall, F.; Wheeler, R. M.; Zipfel, J.; Zorzano, M. P. In *High Priority Samples to Characterize the Habitability of Groundwaters and Search for Rock-Hosted Life on Mars*, Second International Mars Sample Return, April 01, 2018; 2018.

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