

RACHEL Y. SHEPPARD

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PROFESSIONAL APPOINTMENTS

Jet Propulsion Laboratory, Caltech
Postdoctoral Fellow

August 2020 - present
Pasadena, CA

EDUCATION

Brown University, Providence, RI

♦ **2020 Ph.D.**, Earth, Environmental & Planetary Sciences

Spatial and temporal variations in the chemistry and mineralogy of mafic lacustrine systems on Earth and Mars. Advisor: Ralph Milliken

♦ **2017 M.Sc.**, Earth, Environmental & Planetary Sciences

Spectroscopic analysis of iron cycling in a terrestrial ultramafic lake and its implications for martian sedimentary systems. Advisor: Ralph Milliken

Columbia University, New York, NY

♦ **2013 B.A.**, Earth Science

Extractable organic molecules are an effective thermometer of both naturally and artificially heated fault rocks. Advisors: Pratigya Polissar & Heather Savage

PUBLICATIONS

2021 R. Y. Sheppard, R. E. Milliken, J. M. Russell, M. D. Dyar, E. Sklute, H. Vogel, M. Melles, S. Bijaksana, A. K. M. Hasberg, & M. A. Morlock. Iron mineralogy and sediment color in a 100 m drill core from Lake Towuti, Indonesia reflect catchment and diagenetic conditions. In press, *Geochemistry, Geophysics, Geosystems*.

2020 R. Y. Sheppard, R. E. Milliken, Y. Itoh, & M. Parente. Updated Perspectives and Hypotheses on the Mineralogy of Lower Mt. Sharp, Mars, as seen from Orbit. *Journal of Geophysical Research: Planets*. 26.

2020 J. Russell, H. Vogel, S. Bijaksana, M. Melles, A. Deino, A. Hafidz, A. Hasberg, M. Morlock, T. von Rintelen, **R. Y. Sheppard**, B. Stelbrink, & J. Stevenson. The Late Quaternary tectonic, biogeochemical, and environmental evolution of ferruginous Lake Towuti, Indonesia. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 556, pp. 109905.

2019 R. Y. Sheppard, R. E. Milliken, J. M. Russell, M. D. Dyar, E. Sklute, H. Vogel, M. Melles, S. Bijaksana, A. K. M. Hasberg, & M. A. Morlock. Characterization of iron in Lake Towuti sediment. *Chemical Geology*. 512, pp. 11-30.

2017 B. C. Johnson, **R. Y. Sheppard**, A. C. Pascuzzo, E. A. Fisher, & S. E. Wiggins. Porosity and salt content determine if subduction can occur in Europa's ice shell. *Journal of Geophysical Research: Planets*. 122.

2015 R. E. Sheppard, P. J. Polissar, & H. M. Savage. Organic thermal maturity as a proxy for frictional fault heating: experimental constraints on methylphenanthrene kinetics at earthquake timescales. *Geochimica et Cosmochimica Acta*. 151, pp. 103-116.

2014 H. M. Savage, P. J. Polissar, **R. Sheppard**, C. D. Rowe, & E. E. Brodsky. Biomarkers heat up during earthquakes: New evidence of seismic slip in the rock record. *Geology*. 42(2), pp. 99-102.

PUBLICATIONS IN PREPARATION (DRAFT AVAILABLE)

R. Y. Sheppard, M. Thorpe, V. Fox, A. Fraeman, R. E. Milliken. Gale crater secondary minerals from different perspectives: A review of the inferred history of water-rock interaction from the orbital and in situ mineral record, with implications for other martian missions. Invited submission to *Minerals*.

R. Y. Sheppard, R. E. Milliken, K. M. Robertson. Presence of clay minerals can obscure spectral evidence of Mg sulfates: Implications for orbital observations of Mars.

R. Y. Sheppard, J. Frydenvang, A. A. Fraeman, R. E. Milliken. Comparison of orbital and *in situ* subtleties in the chemostratigraphy of Mt. Sharp: a statistical approach.

INDUSTRY PUBLICATIONS

2015 R. E. Sheppard, U. D’Haenens-Johansson, K. S. Moe, & W. Wang. HPHT synthetic diamond melee in high-quality mounted jewelry piece. *Gems & Gemology*. 51(1).

2015 R. E. Sheppard, W. Wang, & T. Moses. Analysis of melee diamonds using FTIR spectroscopy. *Gems & Gemology*. 51(1).

2014 W. Wang, M. Altobelli, C. Dieck, & **R. E. Sheppard**. Screening of small yellow melee for treatment and synthetics. *Gems & Gemology*. 50(4).

RELEVANT EXPERIENCE

Mars Science Laboratory Team <i>Science Team member</i>	May 2016 - present
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Gemological Institute of America <i>Research Laboratory, diamond color origin and spectroscopy</i>	October 2013 - June 2015 <i>New York, NY</i>
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Lamont-Doherty Earth Observatory <i>Research Assistant</i>	May 2011 - August 2013 <i>Palisades, NY</i>
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RESEARCH GRANTS

2020-2022 Research and Technology Development Program, Jet Propulsion Laboratory. **Science PI**. “Experimental constraints on groundwater driven redox gradients on Mars.” (\$300,000.)

AWARDS & FELLOWSHIPS

2019 Dissertation Fellowship, Brown University Graduate School, full stipend support (1 semester).

2017, 2015 NASA Group Achievement Award, MSL Science and Operations Team.

2015-2018 Presidential Fellowship, Brown University Graduate School, enhanced stipend support (6 semesters).

2013 Walter C. Pitman III Award for excellence in thesis research and presentation, Columbia University Department of Earth and Environmental Sciences.

CONFERENCE PRESENTATIONS: FIRST AUTHOR (*ORAL PRESENTATIONS)

2021 R. Y.* Sheppard, R. E. Milliken, & K. M. Robertson. Presence of clay minerals can obscure spectral evidence of Mg sulfates: Implications for orbital observations of Mars. Lunar and Planetary Science Conference, The Woodlands, TX. (*Remote due to COVID-19.*)

2020 R. Y. Sheppard, R. E. Milliken, & K. M. Robertson. Reflectance measurements of clays and sulfates under Mars-like temperature and relative humidity cycles and implications for clay-sulfate assemblages in Gale crater. Lunar and Planetary Science Conference, The Woodlands, TX. (*Canceled due to COVID-19.*)

2020 R. Y. Sheppard, R. E. Milliken, J. M. Russell, M. D. Dyar, E. C. Sklute, S. Bijaksana, M. Melles, & H. Vogel. Mineral and chemical changes in a 100 m long sediment core from Lake Towuti, Indonesia and implications for mafic lacustrine sediments in Gale crater, Mars. Lunar and Planetary Science Conference, The Woodlands, TX. (*Canceled due to COVID-19.*)

2019 R. Y.* Sheppard, R. Milliken, & K. M. Robertson, Cycling of hydrous minerals and implications for the martian hydrological cycle. American Geophysical Union Fall Meeting, San Francisco, CA.

2019 R. Y. Sheppard, R. Milliken, Y. Itoh, & M. Parente. Mineral stratigraphy around Mt. Sharp suggests aqueous processes affected the entire mound: directions for upcoming rover observations from orbital data. Ninth International Conference on Mars, Pasadena, CA.

2019 R. Y. Sheppard, R. Milliken, Y. Itoh, & M. Parente. Lateral continuity of mineralogical and morphological contacts in Mt. Sharp: linking upcoming rover observations and orbital data. Lunar and Planetary Science Conference, The Woodlands, TX.

2018 R. Y.* Sheppard, R. Milliken, Y. Itoh, & M. Parente. Assessing Lateral Variations in the Mineralogical Stratigraphy of Mt. Sharp: Linking Rover and Orbital Observations. American Geophysical Union Fall Meeting, Washington, D.C.

2018 R. Y.* Sheppard, R. Milliken, J. Russell, H. Vogel, M. Melles, & S. Bijaksana. Signatures of iron cycling in a terrestrial redox-stratified lake and implications for Gale Crater, Mars. Lunar and Planetary Science Conference, The Woodlands, TX.

2017 R. Y. Sheppard, R. Milliken, & J. Russell. Tracking changes in iron mineralogy through time in a terrestrial analogue for Gale Crater. American Geophysical Union Fall Meeting, New Orleans, LA.

2017 R. Y. Sheppard, R. Milliken, & J. Russell. Iron oxidation state and cycling in sediments of Lake Towuti, Indonesia and implications for chemistry and mineralogy of Martian mudstones. Lunar and Planetary Science Conference, The Woodlands, TX.

2013 R. E. Sheppard, P. J. Polissar, & H. M. Savage. Organic thermal maturity as a proxy for frictional fault heating: experimental constraints on biomarker kinetics at earthquake timescales. American Geophysical Union Fall Meeting, San Francisco, CA.

2012 R. E. Sheppard, P. J. Polissar, & H. M. Savage. Rapid heating experiments demonstrate the usefulness of organic molecules as an earthquake thermometer. American Geophysical Union Fall Meeting, San Francisco, CA.

INVITED EXTERNAL TALKS & TEAM MEETINGS

2020 R. Y. Sheppard. Geoclub Seminar Series, Caltech, Pasadena, CA. (*Remote due to COVID-19*)

2020 R. Y. Sheppard. Research Colloquium, Jet Propulsion Laboratory, Pasadena, CA. (*Canceled due to COVID-19*)

2020 R. Y. Sheppard. Geochemistry Colloquium, Lamont-Doherty Earth Observatory, Palisades, NY.

2019 R. Y. Sheppard, R. Milliken, Y. Itoh, & M. Parente. Updated orbital view of mineral stratigraphy of Mount Sharp and implications for Curiosity's traverse. Mars Science Laboratory team meeting, NASA Goddard, Greenbelt, MD.

2018 R. Y. Sheppard, R. Milliken, & J. Russell. Sedimentation in Lake Towuti & martian planetary processes. Towuti Drilling Project team meeting, Makassar, Indonesia.

2017 R. Y. Sheppard, R. Milliken, & J. Russell. Lake Towuti as an analogue for trends seen in Gale Crater, Mars. Towuti Drilling Project team meeting, Bandung, Indonesia.

2016 R. Y. Sheppard, R. Milliken, & J. Russell. Terrestrial analogs for chemical trends in Gale Crater: Ultramafic lakes in Indonesia and Iceland. NASA Astrobiology Institute team meeting, Williamstown, MA.

PRESENTATIONS: CONTRIBUTING AUTHOR

2020 R. E. Milliken, J. P. Grotzinger, **R. Sheppard,** R. Wiens, R. Gellert, L. M. Thompson, A. Vasavada, T. Bristow, & N. Mangold. The chemistry and mineralogy of an ancient lacustrine sequence on Mars: observations, interpretations, and future prospects. Lunar and Planetary Science Conference, The Woodlands, TX. (*Canceled due to COVID-19*)

2019 R. E. Milliken, J. P. Grotzinger, R. Wiens, R. Gellert, L. M. Thompson, **R. Sheppard,** A. Vasavada, T. Bristow, & N. Mangold. The chemistry and mineralogy of an ancient lacustrine sequence on Mars: lessons learned from integrating rover and orbiter datasets. Ninth International Conference on Mars, Pasadena, CA.

2018 D. Morriss, C. B. Sanders, J. P. Grotzinger, J. Busch, L. F. Cury, P. Daoust, W. W. Fischer, B. Howes, D. S. Jones, **R. Sheppard,** L. L. Nelson, J. P. Pu, D. P. Quinn, J. Wilcots, & R. Swart. Cap Sequence Post-dating Marinoan Glacial Deposits, Naukluft Mountains, Namibia. American Geophysical Union Fall Meeting, Washington, D.C.

2017 A. C. Pascuzzo, B. C. Johnson, **R. Y. Sheppard,** E. A. Fisher, & S. E. Wiggins. Porosity and salt content determine if subduction can occur in Europa's ice shell. Europa Deep Dive 1: Ice-Shell Exchange Processes, Houston, TX.

2015 H. Savage, P. J. Polissar, H. Rabinowitz, & **R. Sheppard.** Some like it hot: the spectrum of temperature rise during earthquakes. American Geophysical Union Fall Meeting, San Francisco, CA.

2012 H. Savage, P. J. Polissar, **R. Sheppard,** C. Rowe, & J. Kirkpatrick. Organic geochemical evidence for frictional heating of the NE Japan décollement in drillcores from Expedition 343: JFAST. American Geophysical Union Fall Meeting, San Francisco, CA.

2011 H. Savage, P. J. Polissar, **R. Sheppard,** E. Brodsky, & C. Rowe. Do faults stay cool under stress? American Geophysical Union Fall Meeting, San Francisco, CA.

2011 P. J. Polissar, H. Savage, **R. Sheppard,** C. Rowe, & E. Brodsky. What's Cooking? Evaluating frictional stress using extractable organic material in fault zones. American Geophysical Union Fall Meeting, San Francisco, CA.

TEACHING EXPERIENCE

2018 Instructor, summer course, Brown University's STEM II program.

2018 Teaching Assistant, *Planetary Geology* (GEOL0810), Brown University.

2017 Teaching Assistant, summer course, Brown University's STEM II program.

MENTORING EXPERIENCE

2021 Undergraduate advisees hosted by Caltech/JPL: Henry Manelski, Jordan Ando.

2016-2020 Undergraduate advisees hosted by Brown University: Ana Colón (*now a PhD student at U. of Oregon*), Christopher Yen (*now a PhD student at WashU*), Sarah Martinez, Grant Rutherford, Catherine Miranda.

2018 Leadership Alliance Summer Program Coordinator, Brown University.

OTHER SERVICE & OUTREACH

2020 Panelist, NASA review panel.

2019 Session Convener and Chair, American Geophysical Union Fall Meeting, "*Evidence of water-rock interaction throughout the Solar System*," oral and poster session.

2019 Executive Secretary, NASA review panel.

2019 Workshop Leader, Girl Scout Senior Leadership Conference, Salve Regina University. "*Craters, spacecraft, and the surfaces of our Solar System*."

2019-present Participant, semiannual Skype a Scientist program.

2018-2020 GeoW+ Co-Founder, Graduate Student Leader, Brown University. Intersectional mentoring group for geoscience undergraduates.

2018-2020 Graduate Student Representative, Department Diversity and Inclusion Action Committee, Brown University. Invited.

2018-2020 Graduate Student Faculty Representative, Brown University. Liaison between faculty and graduate students, invited attendee to faculty meetings. Elected.

2018-2019 Planetary Climate Task Force Representative, Brown University. Elected.

FIELD WORK & SHORT COURSES

2021 Revolutionizing Access to the Martian Surface, **Keck Institute for Space Studies**, Caltech. (6 day short course, invited.)

2018 Agoumon Institute Advanced Geobiology Field School, Caltech, **Naukluft Mountains, Namibia** (12 days in the field).

2016 Sedimentary Cycle of Earth and Mars course field work, Brown University, **Guadalupe Mountains, TX** (5 days in the field).

2013 Research sample collection from the Punchbowl Fault, **San Gabriel Mountains, CA** (3 days in the field).

2012 Geologic Mapping intensive course, Columbia University, **Catskill Mountains, NY** (12 days in the field).

2011 Research sample collection from the Champlain Thrust Fault, **Adirondack Mountains, VT** (2 days in the field).