

Kathryn M. Stack Morgan

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EDUCATION

Ph.D. Caltech, Geology, June 2014

(Thesis advisor: John Grotzinger)

M.Sc. Caltech, Geology, 2011

B.A. *cum laude*, Williams College, 2008

(Thesis advisor: Reinhard Wobus)

Majors: Geosciences (*with honors*), Astronomy

AWARDS AND FELLOWSHIPS

Mars Science Laboratory JPL Voyager Award (2015)

Finalist for MIT Technology Review Innovators Under 35 (2013)

Forbes 30 Under 30 in Science and Healthcare (2013)

NASA Group Achievement Award, MSL Science Office Development and Operations Team (2013)

Caltech Division of Geological and Planetary Sciences Jahns Teaching Prize (2012)

GSA/ExxonMobil Bighorn Basin Field Award (2012)

ExxonMobil Geoscience Grant (2011)

Mars Exploration Program Student Travel Grant (2010)

Mineralogical Society of America's American Mineralogist Undergraduate Award (2008)

Williams College Freeman Foot Prize in Geology (2008)

NSF-REU Keck Geology Consortium Fellowship (2007)

NSF-REU Keck Northeast Astronomy Consortium Fellowship (2006)

RESEARCH AND WORK EXPERIENCE

Research Scientist, Geophysics and Planetary Geology, Jet Propulsion Laboratory (2014-present)

Campaign Scientist, Mars Science Laboratory, Curiosity Rover Science Team (2014-present)

Student collaborator, Mars Science Laboratory, Curiosity Rover Science Team (2012-2014)

Big Horn Basin Field Program, GSA/ExxonMobil (2012)

Agouron Institute, Advanced Geobiology Field Course, Spain (2010)

Caltech Carbonate Sedimentology Short Course (2010)

UH-YBRA Geology Field Camp, Red Lodge, MT (2008)

NSF-REU Student Researcher, Union College, Schenectady, NY (2007)

NSF-REU Student Researcher, Wellesley College, Wellesley, MA (2006)

PEER REVIEWED PUBLICATIONS

STACK, KM, CS Edwards, JP Grotzinger, S Gupta, DY Sumner, FJ Calef, III, LA Edgar, KS Edgett, AA Fraeman, SR Jacob, LL Le Deit, KW Lewis, MS Rice, D Rubin, R Williams, KH Williford (submitted). Comparing orbiter and rover image-based mapping of an ancient sedimentary environment, Aeolis Palus, Gale crater, Mars, *Icarus*, *Special Issue: MicroMars to MegaMars*.

- STACK, KM** and RE Milliken (2015). Reflectance spectroscopy of clay-sulfate Mixtures and implications for quantifying hydrated minerals on Mars, *Icarus*, 250, 332-356, doi:10.1016/j.icarus.2014.12.009.
- STACK, KM**, JP Grotzinger, LC Kah, ME Schmidt, N Mangold, KS Edgett, DY Sumner, KL Siebach, M Nachon, R Lee, DL Blaney, LP Deflores, LA Edgar, AG Fairen, LA Leshin, S Maurice, DZ Oehler, MS Rice, RC Wiens (2014). Diagenetic origin of nodules in the Sheepbed member, Yellowknife Bay formation, Gale Crater, Mars, *J. Geophys. Res.*, doi:10.1002/2014JE004617.
- STACK, KM**, JP Grotzinger, RE Milliken (2013). Bed Thickness Distributions on Mars: An Orbital Perspective., *J. Geophys. Res.*, 118(6), 1323-1349.
- GROTZINGER, JP, S Gupta, DM Rubin, J Schieber, **KM Stack**, AR Vasavada, RE Arvidson, F Calef III, L Edgar, WF Fischer, JA Grant, LC Kah, MP Lamb, KW Lewis, N Mangold, ME Minnitti, M Palucis, M Rice, K Siebach, RME Williams, RA Yingst, D Blake, D Blaney, P Conrad, J Crisp, WE Dietrich, G Dromart, KS Edgett, RC Ewing, R Gellert, J Griffes, JA Hurowitz, G Kocurek, P Mahaffy, MC Malin, MJ McBride, SM McLennan, M Mischna, D Ming, R Milliken, H Newsom, D Oehler, TJ Parker, D Vaniman, RC Wiens, SA Wilson (accepted). Deposition, exhumation, and paleoclimate of an ancient lake deposit, Gale Crater, Mars, *Science*.
- MANGOLD, N, O Forni, G Dromart, **K Stack**, R Wiens, O Gasnault, D Sumner, M Nachon, P-Y Meslin, R Anderson, B Barraclough, J Bell, G Berger, D Blaney, J Bridges, F Calef, B Clark, S Clegg, A Cousin, L Edgar, K Edgett, B Ehlmann, C Fabre, M Fisk, J Grotzinger, S Gupta, K Herkenhoff, J Horowitz, J Johnson, L Kah, N Lanza, J Lasue, S Le Mouelic, R Leveille, E Lewin, MC Malin, S McLennan, S Maurice, N Melikechi, A Mezzacappa, R Milliken, HE Newsom, A Ollila, S Rowland, V Sautter, M Schmidt, S Schroder, C d'Uston, D Vaniman, R Williams (2015), Chemical variations of Yellowknife Bay Formation sediments analyzed by the Curiosity Rover on Mars, *J. Geophys. Res.*, accepted.
- SIEBACH KL, JP Grotzinger, LC Kah, **KM Stack**, M Malin, R Leveille, DY Sumner (2014). Subaqueous Shrinkage Cracks in the Sheepbed Mudstone: Implications for Early Fluid Diagenesis, Gale Crater, Mars, *J. Geophys. Res.*, doi:10.1002/2014JE004623.
- BLANEY, D, RC Wiens, S Maurice, SM Clegg, RA Anderson, LC Kah, S Le Mouelic, A Ollila, N Bridges, R Tokar, G Berger, JC Bridges, A Cousin, B Clark, MD Dyar, PL King, N Lanza, N Mangold, P-Y Meslin, H Newsom, S Schroder, S Rowland, J Johnson, L Edgar, O Gasnault, O Forni, M Schmidt, W Goetz, **K Stack**, D Sumner, M Fisk, MB Madsen (2014), Chemistry and texture of the rocks at Rocknest, Gale Crater: Evidence for sedimentary origin and diagenetic alteration, *J. Geophys. Res.*, 119(9), 2109-2131, doi:10.1002/2013JE004590.
- NACHON, M. SM Clegg, N Mangold, S Schroder, LC Kah, G Dromart, AM Ollila, JR Johnson, D Oehler, JC Bridges, S Le Mouelic, O Forni, RC Wiens, RB Anderson, D Blaney, JF Bell III, BC Clark, A Cousin, DM Darby, B Ehlmann, C Fabre, O Gasnault, JP Grotzinger, J Lasue, E Lewin, R Leveille, SM McLennan, S Maurice, P-Y Meslin, MS Rice, SW Squyres, **KM Stack**, DY Sumner, DT Vaniman, D Wellington (2014). Calcium sulfate veins characterized by ChemCam/Curiosity at Gale Crater, Mars, *J. Geophys. Res.*, accepted.
- LITVAK, M, IG Mitrofanov, AB Sanin, D Lisov, A Behar, WV Boynton, L Deflores, F Fedosov, D Golovin, C Hardgrove, K Harshman, I Jun, AS Kozyrev, RO Kuzmin, A Malakhov, R Milliken, M Mischna, J Moersch, M Mokrousov, S Nikiforov, VN Shvetsov, **K Stack**, R Starr, C Tate, VI Tret'yakov, A Vostrukhin, and the MSL Team (2014). Local variations of bulk hydrogen and chlorine content measured at the contact between the Sheepbed and Gillespie Lake units in Yellowknife Bay,

Gale crater, using the DAN instrument onboard Curiosity, *J. Geophys. Res.*, doi:10.1002/2013JE004556.

- GROTZINGER JP, DY Sumner, LC Kah, **K Stack**, S Gupta, L Edgar, D Rubin, K Lewis, J Schieber, N Mangold, R Milliken, PG Conrad, D DesMarais, J Farmer, K Siebach, F Calef III, J Hurowitz, SM McLennan, D Ming, D Vaniman, J Crisp, A Vasavada, KS Edgett, M Malin, D Blake, R Gellert, P Mahaffy, RC Wiens, S Maurice, JA Grant, S Wilson, RC Anderson, L Beegle, R Arvidson, B Hallet, RS Sletten, M Rice, J Bell III, J Griffes, B Ehlmann, RB Anderson, TF Bristow, WE Dietrich, G Dromart, J Eigenbrode, A Fraemen, C Hardgrove, K Herkenhoff, L Jandura, G Kocurek, S Lee, LA Leshin, R Leveille, D Limonadi, J Maki, S McCloskey, M Meyer, M Minitti, H Newsom, D Oehler, A Okon, M Palucis, T Parker, S Rowland, M Schmidt, S Squyres, A Steele, E Stolper, R Summons, A Treiman, R Williams, A Yingst, MSL Science Team (2014). A Habitable Fluvio-Lacustrine Environment at Yellowknife Bay, Gale Crater, Mars, *Science*, doi: 10.1126/science.1242777.
- MCLENNAN, SM, RB Anderson, JF Bell III, JC Bridges, F Calef III, JL Campbell, BC Clark, S Clegg, P Conrad, A Cousin, DJ DesMarais, G Dromart, MD Dyar, LA Edgar, BL Ehlmann, C Fabre, O Forni, O Gasnault, R Gellert, S Gordon, JA Grant, JP Grotzinger, S Gupta, KE Herkenhoff, JA Horowitz, PL King, S Le Mouelic, LA Leshin, R Leveille, KW Lewis, N Mangold, S Maurice, DW Ming, RV Morris, M Nachon, HE Newsom, AM Ollila, GM Perrett, MS Rice, ME Schmidt, SP Schwenzer, **K Stack**, EM Stolper, DY Sumner, AH Treiman, S VanBommel, DT Vaniman, A Vasavada, RC Wiens, RA Yingst, MSL Science Team (2014). Elemental Geochemistry of Sedimentary Rocks in Yellowknife Bay, Gale Crater, Mars, *Science*, doi: 10.1126/science.1244734.
- VANIMAN, DT, DL Bish, DW Ming, TF Bristow, RV Morris, DF Blake, SJ Chipera, SM Morrison, AH Treiman, EB Rampe, M Rice, CN Achilles, JP Grotzinger, SM McLennan, J Williams, JF Bell III, HE Newsom, RT Downs, S Maurice, P Sarrazin, AS Yen, JM Morookian, JD Farmer, **K Stack**, RE Milliken, BL Ehlmann, DY Sumner, G Berger, JA Crisp, JA Horowitz, R Anderson, DJ Des Marais, EM Stolper, KS Edgett, S Gupta, N Spanovich, MSL Science Team (2014). Mineralogy of a Mudstone on Mars, *Science*, doi: 10.1126/science.1243480.
- WILLIAMS, RME, JP Grotzinger, WE Dietrich, S Gupta, DY Sumner, RC Wiens, N Mangold, MC Malin, KS Edgett, S Maurice, O Forni, O Gasnault, A Ollila, HE Newsom, G Dromart, MC Palucis, RA Yingst, RB Anderson, KE Herkenhoff, S Le Mouelic, W Goetz, MB Madsen, A Koefoed, JK Jensen, JC Bridges, SP Schwenzer, KW Lewis, **KM Stack**, D Rubin, LC Kah, JF Bell III, JD Farmer, R Sullivan, T Van Beek, DL Blaney, O Pariser, RG Deen, MSL Science Team (2013). Martian Fluvial Conglomerates at Gale Crater, *Science*, 340(6136), 1068-1072.
- SCHMIDT, M, JL Campbell, R Gellert, GM Perrett, AH Treiman, DL Blaney, A Olilla, FJ Calef III, L Edgar, BE Elliott, J Grotzinger, J Horowitz, PL King, ME Minitti, V Sautter, **K Stack**, JA Berger, JC Bridges, BL Ehlmann, O Forni, LA Leshin, KW Lewis, SM McLennan, DW Ming, H Newsom, I Pradler, SW Squyres, EM Stolper, L Thompson, S VanBommel, RC Wiens (2013). Volatile element enrichment and geochemical diversity in rocks examined by the MSL Alpha Particle X-Ray Spectrometer (APXS) along Bradbury Rise, Gale Crater, *J. Geophys. Res.*, doi: 10.1002/2013JE004481.
- FRAEMAN AA, RE Arvidson, JG Catalano, JP Grotzinger, RV Morris, SL Murchie, **KM Stack**, DC Humm, JA McGovern, FP Seelos, KD Seelos, CE Viviano (2013). Detection and Mapping of a Hematite Capping Ridge in Gale Crater, Mars and Implications for Past Aqueous Conditions, *Geology*, doi:10.1130/G34613.1.
- CREVELING, JR, D Fernandez-Remolar, M Rodriguez-Martinez, S Menendez, KD Bergmann, BC Gill, J Abelson, R Amils, BL Ehlmann, DC Garcia-Bellido, JP Grotzinger, C Hallmann, **KM Stack**, AH Knoll

(2013). Geobiology of a Lower Cambrian carbonate platform, Pedroche Formation, Ossa Morena Zone, Spain., *Palaeo-3*, 386, 459-478.

BEYER, R, **K Stack**, JL Griffes, RE Milliken, KE Herkenhoff, S Byrne, JW Holt, JP Grotzinger (2011). An atlas of Mars sedimentary rocks as seen by HiRISE, *Sedimentary Geology of Mars*, eds. JP Grotzinger and RE Milliken, *SEPM Special Publication No. 102*.

PUBLICATIONS IN PREP

STACK, KM, JP Grotzinger, RE Milliken, RN Farley, The Global Distribution of Layered Deposits on Mars, in prep for submission to *Geophysical Research Letters*.

JACOB, S, S Rowland, J Boyce, M Day, S Fagents, C Glenn, J Grant, H Newsom, **KM Stack**, Crater density as an aid to understanding substrate resistance to erosion on Mars: Case study in Gale Crater, Mars, in prep for submission to *Icarus, Special Issue: MicroMars to MegaMars*.

LASUE, J, SM Clegg, O Forni, A Cousin, RC Wiens, N Lanza, N Mangold, L LeDeit, C Fabre, O Gasnault, S Maurice, D Blaney, J Johnson, S Le Mouelic, J Berger, V Payre, M Nachon, W Goetz, **KM Stack**, Zn Detection with ChemCam LIBS at Gale Crater Mars, in prep for submission to *J. Geophys. Res.-Planets, Special Issue: Mars Science Laboratory Investigations of the Kimberley Waypoint*.

LITVAK ML, IG Mitofanov, C Hardgrove, AB Sanin, D Lisov, WV Boynton, F Fedosov, D Golovin, K Harshman, I Jun, AS Kozyrev, RO Kuzmin, A Malakhov, R Milliken, M Mischna, J Moersch, M Mokrousov, S. Nikiforov, VN Shvetsov, **KM Stack**, R Starr, C Tate, VI Tret'yakov, A Vostrukhin, and the MSL Team, Hydrogen and Chlorine Abundances in the Kimberley Formation of Gale Crater Measured by the DAN Instrument Onboard the Mars Science Laboratory Curiosity Rover, in prep for submission to *J. Geophys. Res.-Planets, Special Issue: Mars Science Laboratory Investigations of the Kimberley Waypoint*.

FIRST-AUTHOR PRESENTATIONS AND CONFERENCE PUBLICATIONS

STACK, KM and JP Grotzinger, "Constraining the Timing and Duration of an Ancient Fluvio-Lacustrine System in Gale Crater Using MSL Curiosity Rover Observations," LPSC 46, The Woodlands, Texas, March 16-20, 2015, Abstract #2012 (Invited Talk).

STACK, KM, JP Grotzinger, S Gupta, LC Kah, KW Lewis, MJ McBride, ME Minitti, DM Rubin, J Schieber, DY Sumner, LM Thompson, J Van Beek, AR Vasavada, RA Yingst, "Sedimentology and Stratigraphy of the Pahrump Hills Outcrop, Lower Mount Sharp, Gale Crater, Mars," LPSC 46, The Woodlands, Texas, March 16-20, 2015, Abstract #1994 (Talk).

STACK, KM, JP Grotzinger, DY Sumner, F Calef, L Edgar, S Gupta, K Lewis, M Rice, D Rubin, RME Williams, "Synthesizing MSL Curiosity Rover Observations and Orbital Geologic Mapping to Build a Regional Stratigraphy for Aeolis Palus, Gale Crater," 126th Annual Meeting of the Geological Society of America, Vancouver, British Columbia, October 19-22, 2014, Paper #202-4 (Talk).

STACK, KM, JP Grotzinger, RE Milliken, RN Farley, "Global Distribution of Stratified Deposits on Mars," Eighth International Conference on Mars, Pasadena, California, July 14-18, 2014, Abstract #1192 (Talk).

STACK, KM and the MSL Science Team (invited). "An Overview of Past Depositional Environments Explored by the Curiosity Rover at Bradbury Landing and Yellowknife Bay, Gale crater, Mars," 125th Annual Meeting of the Geological Society of America, Denver, Colorado, October 27-31, 2013, Paper #6-4 (Talk).

STACK, KM, J Grotzinger, L Kah, D Sumner, L Edgar, M Rice, D Oehler, A Fairen, K Siebach, and the MSL Science Team, "The distribution and origin of nodules and minibowls within the Sheepbed

member: Implications for early diagenesis in Yellowknife Bay, Gale Crater, Mars," 125th Annual Meeting of the Geological Society of America, Denver, Colorado, October 27-31, 2013, Abstract #227794 (Poster).

STACK, KM, JP Grotzinger, JL Griffes, RN Farley, "Global Distribution of Layered Deposits on Mars," STRATI 2013: 1st International Congress on Stratigraphy, Lisbon, Portugal, July 1-7, 2013, Abstract #180 (Talk).

STACK, KM, JP Grotzinger, DY Sumner, BL Ehlmann, RE Milliken, JL Eigenbrode, S Gupta, RME Williams, LC Kah, KW Lewis, and the MSL Team, "Using outcrop exposures on the road to Yellowknife Bay to build a stratigraphic column, Gale Crater, Mars." LPSC 44, The Woodlands, Texas, March 18-22, 2013, Abstract #1431 (Talk)

STACK, KM and RE Milliken. "Reflectance Spectroscopy of Clay-Sulfate Mixtures: Implications for quantifying hydrated minerals and determining depositional environments on Mars." LPSC 42, The Woodlands, Texas, March 7-11, 2011, Abstract #2024 (Poster)

STACK, KM and JP Grotzinger, "Beds, bed thickness, and bed thickness distributions on Mars: An orbital perspective. HiRISE Team Meeting, Flagstaff, Arizona, August 16-18, 2011 (Talk)

STACK, KM, JP Grotzinger, RE Milliken. "Statistical analysis of bed thickness distributions in layered deposits on Mars." First International Conference on Mars Sedimentology and Stratigraphy, El Paso, Texas, April 19-21, 2010, Abstract #6013 (Poster)

STACK, KM, M Lamb, RE Milliken, S Leprince, JP Grotzinger, "Movement and grain size distribution of Bahamian sand shoals from remote sensing." KISS Workshop- Monitoring Earth Surface Changes from Space II, March 29-31, 2010 (Talk)

SCIENCE OUTREACH

Chevron Fellows Workshop, Keynote Speaker, October 27, 2014.

Chevron Reservoir Management Forum, Keynote Speaker, September 4, 2014.

JPL Open House, Volunteer, October 10, 2014.

Science Saturdays, Presenter, Space Race Supermen: The Heroes of Early Human Spaceflight, Caltech, April 2014.

NASA Spacefest, California Science Center, Volunteer, October 31, 2011.

Pasadena Unified School District Middle School Science Day, Presenter, Caltech, April 9, 2012.

Guest Presenter for 6th-8th graders, Averson Charter School, February 22, 2010.

TEACHING EXPERIENCE

Graduate Teaching Assistant for Sedimentology, Caltech (2013)

Graduate Teaching Assistant for Igneous and Metamorphic Petrography, Caltech (2011, 2013)

Graduate Teaching Assistant for Advanced Field and Structural Geology, Caltech (2010, 2012)

Teaching Assistant for Mineralogy, Williams College (2007-2008)

Teaching Assistant for Global Warming and Natural Disasters, Williams College (2007)

Planetarium Presenter, Hopkins Observatory, Williams College (2006)

Teaching Assistance for Introduction to Astronomy, Williams College (2005)

EQUIPMENT USED

Fourier Transform Infrared (FTIR) spectrometer, scanning electron microscope, XRD, Cameca IMS-7f GEO secondary ion mass spectrometer (SIMS), microprobe, inductively coupled plasma mass spectrometer (PerkinElmer, Elan 6100 DRC), transmitted and reflected light polarizing microscopes, thin section and sample preparation equipment: thin section grinders, diamond polishing laps, shatterbox ring mill, hydraulic rock crusher, diamond saws

COMPUTER EXPERIENCE

Programming with MATLAB, Mathematica, R, Interactive Data Language (IDL), and Perl; experience with ArcGIS (9.3-10.1), ENVI, Kaleidagraph, Microsoft Office, Adobe Creative Suite

PROFESSIONAL ASSOCIATIONS

American Association of Petroleum Geologists (since 2012)
American Geophysical Union (since 2008)
Geological Society of America (since 2007)
SEPM- Society for Sedimentary Geology (since 2012)

COMMITTEES AND SERVICE

NASA Proposal Panel and External Reviewer, Mars Data Analysis Program and Lunar Data Analysis Program
Reviewer for Icarus
Caltech Identity Project, cabinet member, 2013-present
Caltech Alumni Association, student consultant and representative, 2012
Geoclub (graduate student organized seminar series), 2010