Stanford

Mathieu Lapôtre

Assistant Professor of Geological Sciences and, by courtesy, of Geophysics

Bio

BIO

Prof. Lapôtre leads the Earth & Planetary Surface Processes group. His research focuses on the physics behind sedimentary and geomorphic processes that shape planetary surfaces (including Earth's), and aims to untangle what landforms and rocks tell us about the past hydrology, climate, and habitability of planets.

ACADEMIC APPOINTMENTS

- Assistant Professor, Geological Sciences
- Assistant Professor (By courtesy), Geophysics

ADMINISTRATIVE APPOINTMENTS

- Assistant Professor, Stanford University, (2019- present)
- John Harvard Distinguished Science Fellow, Harvard University, (2017-2019)
- Mars Science Laboratory Special Expert Consultant, NASA/JPL-Caltech, (2017-2018)
- Mars Science Laboratory Science & Operations Team Collaborator, NASA/JPL-Caltech, (2013-2017)

HONORS AND AWARDS

- Luna B. Leopold Early Career Award, American Geophysical Union (2021)
- Robert P. Sharp Lecturer, American Geophysical Union (2021)
- Scialog Fellow, Heising-Simons Foundation, Research Corporation for Science Advancement (2021)
- Kavli Fellow, U.S. National Academy of Sciences (2020)
- John Harvard Distinguished Science Fellowship, Harvard University (2017-2019)
- NASA Group Achievement Award, MSL Extended Mission-1 Science & Operations Team, NASA (2017)
- John C. Crowell Best PhD Dissertation Award, 2nd place, SEPM Pacific Section (2017)
- Dwornik Award, graduate oral presentation, honorable mention, Planetary Geology Division, Geological Society of America (2016)
- SETI/NASA Astrobiology Institutes Travel Award, SETI/NASA (2016)
- Best overall, best in theme, PEACH award, NASA-NIA RASC-AL Space Design (2016)
- NASA Group Achievement Award, MSL Prime Mission Science & Operations Team, NASA (2015)
- AGU Outstanding Student Paper Award, American Geophysical Union (2014)
- NASA Earth & Space Science Fellowship, NASA (2012-2015)
- Robert P. Sharp Graduate Student Fellowship, California Institute of Technology (2012-2013)

PROFESSIONAL EDUCATION

- Ph.D., California Institute of Technology , Geology (2017)
- M.S., California Institute of Technology , Planetary Science (2014)
- M.S. (Ingenieur), Ecole & Observatoire des Sciences de la Terre , Geophysical Engineering (2011)
- M.S., Universite de Strasbourg , Environmental Science & Engineering (2011)
- B.S., Universite de Strasbourg , Geophysics with minor in Astrophysics (2009)

LINKS

- Earth & Planetary Surface Processes Lab: https://epsp.stanford.edu/

Teaching

COURSES

2022-23

- Earth and Planetary Processes and Mechanics: GEOLSCI 3 (Win)
- Planetary Surface Processes: Shaping the Landscape of the Solar System: GEOLSCI 120, GEOLSCI 220, GEOPHYS 119, GEOPHYS 219 (Spr)

2021-22

- Deciphering Depositional Environments in the Pre-Vegetation Rock Record: GEOLSCI 249 (Aut)
- Earth and Planetary Processes and Mechanics: GEOLSCI 3 (Win)
- Rivers: The Arteries of Earth's Continents: GEOLSCI 224 (Spr)

2020-21

- INTRODUCTION TO PLANETARY SCIENCE: ESS 125, GEOLSCI 124, GEOPHYS 124 (Spr)
- Planetary Surface Processes: Shaping the Landscape of the Solar System: GEOLSCI 120, GEOLSCI 220, GEOPHYS 119, GEOPHYS 219 (Spr)

2019-20

- Rivers: The Arteries of Earth's Continents: GEOLSCI 224 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Travis Clow

Postdoctoral Faculty Sponsor

Carlos Alvarez Zambrano

Doctoral (Program)

Michael Hasson, M. Colin Marvin

Publications

PUBLICATIONS

- **A distinct ripple-formation regime on Mars revealed by the morphometrics of barchan dunes.** *Nature communications*
  Rubanenko, L., Lapotre, M. G., Ewing, R. C., Fenton, L. K., Gunn, A.
  2022; 13 (1): 7156
- **The Role of Seasonal Sediment Transport and Sintering in Shaping Titan's Landscapes: A Hypothesis.** *Geophysical research letters*
  Lapôtre, M. G., Malaska, M. J., Cable, M. L.

2022; 49 (8): e2021GL097605

- **Mars as a time machine to Precambrian Earth** *Journal of the Geological Society*
  Lapotre, M., Bishop, J., Ielpi, A., Lowe, D., Siebach, K., Sleep, N., Tikoo, S.
  2022

- **Ancient Winds, Waves, and Atmosphere in Gale Crater, Mars, Inferred From Sedimentary Structures and Wave Modeling** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Rubin, D. M., Lapotre, M. G., Stevens, A. W., Lamb, M. P., Fedo, C. M., Grotzinger, J. P., Gupta, S., Stack, K. M., Vasavada, A. R., Banham, S. G., Bryk, A. B., Caravaca, G., Christian, et al
  2022; 127 (4)

- **The impact of vegetation on meandering rivers** *Nature Reviews Earth & Environment*
  Ielpi, A., Lapôtre, M., Gibling, M., Boyce, C.
  2022

- **Accumulation of windblown sand in impact craters on Mars** *Geology*
  Gunn, A., Rubanenko, L., Lapotre, M.
  2022; 50 (9): 981-985

- **Drainage initiation, expansion, and channel-head arrest in heterogenous bedrock landscapes of the Colorado Plateau** *GSA Bulletin*
  Steelquist, A., Lapôtre, M., Hilley, G.
  2022

- **Linking sediment flux to river migration in arid landscapes through mass balance** *Journal of Sedimentary Geology*
  Ielpi, A., Lapotre, M.
  2022; 92 (8): 695-703

- **An evolving understanding of enigmatic large ripples on Mars** *Journal of Geophysical Research: Planets*
  Lapôtre, M. G., Ewing, R. C., Lamb, M. P.
  2021

- **Martian dunes: A crucial record of present and past Mars surface environment and aeolian processes** *Treatise on Geomorphology*
  Diniega, S., Burr, D. M., Chojnacki, M., Lapôtre, M. G., Swann, C.
  2021

- **Automatic detection and segmentation of barchan dunes on Mars and Earth using a convolutional neural network** *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*
  Rubanenko, L., Pérez-López, S., Schull, J., Lapôtre, M.
  2021

- **Modern Mars' geomorphological activity, driven by wind, frost, and gravity** *Geomorphology*
  Diniega, S., Bramson, A. M., Buratti, B., Buhler, P., Burr, D. M., Chojnacki, M., Conway, S. J., Dundas, C. M., Hansen, C. J., McEwen, A. S., Lapôtre, M. G., Levy, J., Mc Keown, et al
  2021

- **Planform-asymmetry and backwater effects on river-cutoff kinematics and clustering** *EARTH SURFACE PROCESSES AND LANDFORMS*
  Ielpi, A., Lapotre, M. A., Finotello, A., Ghinassi, M.
  2020

- **Channel mobility drives a diverse stratigraphic architecture in the dryland Mojave River (California, USA)** *EARTH SURFACE PROCESSES AND LANDFORMS*
  Ielpi, A., Lapotre, M. A., Finotello, A., Ghinassi, M., D'Alpaos, A.
  2020

- **The pace of fluvial meanders on Mars and implications for the western delta deposits of Jezero crater** *AGU Advances*
  Lapôtre, M. G., Ielpi, A.
  2020; 1 (2)

- **Probing space to understand Earth** *Nature Reviews Earth & Environment*
  Lapôtre, M. G., O'Rourke, J. G., Schaefer, L. K., Siebach, K. L., Spalding, C., Tikoo, S. M., Wordsworth, R. D.

2020; 1: 170-181

- **A probabilistic approach to determination of Ceres' average surface composition from Dawn VIR and GRaND data** *Journal of Geophysical Research: Planets*
  Kurokawa, H., Ehlmann, B. L., De Sanctis, M. C., Lapôtre , M. G., Usui, T., Stein, N. T., Prettyman, T. H., Raponi, A., Ciarniello, M.
  2020
- **A tenfold slowdown in river meander migration driven by plant life** *Nature Geoscience*
  Ielpi, A., Lapotre, M. G.
  2020; 13: 82-86
- **Biotic forcing militates against river meandering in the modern Bonneville Basin of Utah** *SEDIMENTOLOGY*
  Ielpi, A., Lapotre, M. A.
  2019; 66 (5): 1896–1929
- **BARREN MEANDERING STREAMS IN THE MODERN TOIYABE BASIN OF NEVADA, USA, AND THEIR RELEVANCE TO THE STUDY OF THE PRE-VEGETATION ROCK RECORD** *JOURNAL OF SEDIMENTARY RESEARCH*
  Ielpi, A., Lapotre, M. A.
  2019; 89 (5): 399–415
- **Model for the Formation of Single#Thread Rivers in Barren Landscapes and Implications for Pre#Silurian and Martian Fluvial Deposits** *Journal of Geophysical Research - Earth Surface*
  Lapotre, M. G., Ielpi, A., Lamb, M. P., Williams, R. E., Knoll, A. H.
  2019; 124 (12): 2757-2777
- **Curiosity's Investigation of the Bagnold Dunes, Gale Crater: Overview of the Two-Phase Scientific Campaign and Introduction to the Special Collection** *GEOPHYSICAL RESEARCH LETTERS*
  Lapotre, M. A., Rampe, E. B.
  2018; 45 (19): 10200–10210
- **Morphologic Diversity of Martian Ripples: Implications for Large-Ripple Formation** *GEOPHYSICAL RESEARCH LETTERS*
  Lapotre, M. A., Ewing, R. C., Weitz, C. M., Lewis, K. W., Lamb, M. P., Ehlmann, B. L., Rubin, D. M.
  2018; 45 (19): 10229–39
- **Sand Grain Sizes and Shapes in Eolian Bedforms at Gale Crater, Mars** *GEOPHYSICAL RESEARCH LETTERS*
  Weitz, C. M., Sullivan, R. J., Lapotre, M. A., Rowland, S. K., Grant, J. A., Baker, M., Yingst, R.
  2018; 45 (18): 9471–79
- **Sand Mineralogy Within the Bagnold Dunes, Gale Crater, as Observed In Situ and From Orbit** *GEOPHYSICAL RESEARCH LETTERS*
  Rampe, E. B., Lapotre, M. A., Bristow, T. F., Arvidson, R. E., Morris, R. V., Achilles, C. N., Weitz, C., Blake, D. F., Ming, D. W., Morrison, S. M., Vaniman, D. T., Chipera, S. J., Downs, et al
  2018; 45 (18): 9488–97
- **The Bagnold Dunes in Southern Summer: Active Sediment Transport on Mars Observed by the Curiosity Rover** *GEOPHYSICAL RESEARCH LETTERS*
  Baker, M. M., Lapotre, M. A., Minitti, M. E., Newman, C. E., Sullivan, R., Weitz, C. M., Rubin, D. M., Vasavada, A. R., Bridges, N. T., Lewis, K. W.
  2018; 45 (17): 8853–63
- **Ancient Martian aeolian processes and palaeomorphology reconstructed from the Stimson formation on the lower slope of Aeolis Mons, Gale crater, Mars** *SEDIMENTOLOGY*
  Banham, S. G., Gupta, S., Rubin, D. M., Watkins, J. A., Sumner, D. Y., Edgett, K. S., Grotzinger, J. P., Lewis, K. W., Edgar, L. A., Stack-Morgan, K. M., Barnes, R., Bell, J. F., Day, et al
  2018; 65 (4): 993–1042
- **Substrate controls on valley formation by groundwater on Earth and Mars** *GEOLOGY*
  Lapotre, M. A., Lamb, M. P.
  2018; 46 (6): 531–34
- **Coarse Sediment Transport in the Modern Martian Environment** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Baker, M. M., Newman, C. E., Lapotre, M. A., Sullivan, R., Bridges, N. T., Lewis, K. W.
  2018; 123 (6): 1380–94

- **Compositional variations in sands of the Bagnold Dunes, Gale crater, Mars, from visible-shortwave infrared spectroscopy and comparison with ground truth from the Curiosity rover** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Lapotre, M. A., Ehlmann, B. L., Minson, S. E., Arvidson, R. E., Ayoub, F., Fraeman, A. A., Ewing, R. C., Bridges, N. T.
  2017; 122 (12): 2489–2509

- **Sedimentary processes of the Bagnold Dunes: Implications for the eolian rock record of Mars** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Ewing, R. C., Lapotre, M. A., Lewis, K. W., Day, M., Stein, N., Rubin, D. M., Sullivan, R., Banham, S., Lamb, M. P., Bridges, N. T., Gupta, S., Fischer, W. W.
  2017; 122 (12): 2544–73

- **Chemistry, mineralogy, and grain properties at Namib and High dunes, Bagnold dune field, Gale crater, Mars: A synthesis of Curiosity rover observations** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Ehlmann, B. L., Edgett, K. S., Sutter, B., Achilles, C. N., Litvak, M. L., Lapotre, M. A., Sullivan, R., Fraeman, A. A., Arvidson, R. E., Blake, D. F., Bridges, N. T., Conrad, P. G., Cousin, et al
  2017; 122 (12): 2510–43

- **Martian aeolian activity at the Bagnold Dunes, Gale Crater: The view from the surface and orbit** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Bridges, N. T., Sullivan, R., Newman, C. E., Navarro, S., van Beek, J., Ewing, R. C., Ayoub, F., Silvestro, S., Gasnault, O., Le Mouelic, S., Lapotre, M. A., Rapin, W.
  2017; 122 (10): 2077–2110

- **Advanced concept for a crewed mission to the martian moons** *ACTA ASTRONAUTICA*
  Conte, D., Di Carlo, M., Budzyn, D., Burgoyne, H., Fries, D., Grulich, M., Heizmann, S., Jethani, H., Lapotre, M., Roos, T., Castillo, E., Schermann, M., Vieceli, et al
  2017; 139: 545–63

- **A probabilistic approach to remote compositional analysis of planetary surfaces** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Lapotre, M. A., Ehlmann, B. L., Minson, S. E.
  2017; 122 (5): 983–1009

- **What sets the size of current ripples?** *GEOLOGY*
  Lapotre, M. A., Lamb, M. P., McElroy, B.
  2017; 45 (3): 243–46

- **Regularization of Mars Reconnaissance Orbiter CRISM along-track oversampled hyperspectral imaging observations of Mars** *ICARUS*
  Kreisch, C. D., O'Sullivan, J. A., Arvidson, R. E., Politte, D. V., He, L., Stein, N. T., Finkel, J., Guinness, E. A., Wolff, M. J., Lapotre, M. A.
  2017; 282: 136–51

- **Canyon formation constraints on the discharge of catastrophic outburst floods of Earth and Mars** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Lapotre, M. A., Lamb, M. P., Williams, R. E.
  2016; 121 (7): 1232–63

- **Large wind ripples on Mars: A record of atmospheric evolution** *SCIENCE*
  Lapotre, M. A., Ewing, R. C., Lamb, M. P., Fischer, W. W., Grotzinger, J. P., Rubin, D. M., Lewis, K. W., Ballard, M. J., Day, M., Gupta, S., Banham, S. G., Bridges, N. T., Des Marais, et al
  2016; 353 (6294): 55–58

- **Hydraulics of floods upstream of horseshoe canyons and waterfalls** *JOURNAL OF GEOPHYSICAL RESEARCH-EARTH SURFACE*
  Lapotre, M. A., Lamb, M. P.
  2015; 120 (7): 1227–50

- **Mars Reconnaissance Orbiter and Opportunity observations of the Burns formation: Crater hopping at Meridiani Planum** *JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS*
  Arvidson, R. E., Bell, J. F., Catalano, J. G., Clark, B. C., Fox, V. K., Gellert, R., Grotzinger, J. P., Guinness, E. A., Herkenhoff, K. E., Knoll, A. H., Lapotre, M. A., McLennan, S. M., Ming, et al
  2015; 120 (3): 429–51

- **The root of branching river networks** *NATURE*
  Perron, J., Richardson, P. W., Ferrier, K. L., Lapotre, M.
  2012; 492 (7427): 100-+