Samuel Patrick Dennis Birch

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PROFESSIONAL HIGHLIGHTS

Published 8 first author papers, co-authored 17 more. NESSF Fellow (2015). 51 Pegasi b Fellow (2020). Cassini RADAR Associate Team Member. Rosetta OSIRIS Graduate Student Collaborator. CAESAR Co-Investigator. AGU Planetary Sciences Section Early Career Representative (2019-2021). Advisor for 14 graduate, undergraduate and high school students (6 presently).

CURRENT AFFILIATION

Cornell Center for Astrophysics and Planetary Science, Cornell University

EDUCATION

- **Ph.D.** – *Cornell University, Ithaca NY* May 2018
  - Concentration: Planetary Science (Minors: Geophysics/Astronomy)
- **B.A. (High Honors)** – *University of California Berkeley*, *Berkeley, CA* May 2014
  - Concentration: Geophysics

ACADEMIC AWARDS AND FELLOWSHIPS

- Heising-Simons Foundation 51 Pegasi b Postdoctoral Fellowship 2020
- Department of Earth and Atmospheric Sciences Excellence in Research Award 2018
- NASA Earth and Space Science Fellowship 2015
- Berkeley Distinguished Honors in Geophysics 2014
- Berkeley International Undergraduate Student Tuition Grant 2013

PROFESSIONAL APPOINTMENTS

- Massachusetts Institute of Technology – *51 Pegasi b Postdoctoral Fellow* 2020 – 2023
- Cornell University – *Research Associate* 2018 – 2020
- Cornell University – *Ph.D. Student* 2014 – 2018
- Cornell University – *REU Summer Intern* 2013
- University of California Berkeley – *Geological Fluid Dynamics Lab Manager* 2013 – 2014

CURRENT RESEARCH INTERESTS

- Titan Geomorphology & Surface Processes
- Cometary (and Small Body) Geology & Surface Processes
- Numerical Landscape Evolution Modeling
- Sublimation Erosion & Surface Processes in the Outer Solar System

JOURNAL PUBLICATIONS (*Indicates paper was led by a student advisee)

h-index: 11 i10-index: 12 Citations: 261 Researcher ID: L-1249-2017

[25] **S.P.D. Birch**, O.M. Umurhan, A.D. Howard, J.M. Moore, O. White, A.G. Hayes, and M.J. Malaska. Simulating the Evolution of Titan's Surface Through Fluvial & Dissolution Erosion. *Icarus*, in review (2020).

[24] J-B. Vincent, **S.P.D. Birch,** A. Jindal, K. Zacny, A.G. Hayes, N. Oklay, and P. Cambianica. Bouncing boulders on Comet 67P. *MNRAS*, in review (2020).

[23] B. Davidsson, **S.P.D. Birch**, G. Blake, D. Bodewits, J. Dworkin, D. Glavin, Y. Furukawa, J. Lunine, J. Mitchell, A. Nguyen, S. Squyres, A. Takigawa, J-B. Vincent, and K. Zacny. Airfall on Comet 67P/Churyumov-Gerasimenko. *Icarus*, in review (2020).

[22] J.D. Hofgartner, A.G. Hayes, D.B. Campbell, J.I. Lunine, G.J. Black, S.M. MacKenzie, **S.P.D. Birch**, C. Elachi, R.D. Kirk, and S.D. Wall. The Root of Specular Reflections from Solid Surfaces on Saturn's moon Titan. *Nature Communications*, in review (2020).

[21] M.J. Malaska, J. Radebaugh, R. Lopes, K.L. Mitchell, T. Verlander, A.M. Schoenfeld, M.F. Florence, A. Le Gall, A. Solomonidou, A.G. Hayes, **S.P.D. Birch**, M.A. Janssen, L. Schurmeier, T. Cornet, C. Ahrens, T.G. Farr, and the Cassini RADAR Team. Labyrinth Terrain on Titan. *Icarus*, in review (2020).

[20] **S.P.D. Birch**, A.G. Hayes, and 10 others. Migrating Scarps as a Mechanism for Recycling Material on Comet 67P/Churyumov-Gerasimenko. *GRL* 49, 12794-12804 (2019).

[19] R.M.C. Lopes, M.J. Malaska, A.M. Schoenfeld, A. Solomonidou, **S.P.D. Birch**, M. Florence, A.G. Hayes, D.A. Williams, J. Radebaugh, T. Verlander, E.P. Turtle, A. Le Gall, S. Wall, and the Cassini RADAR Team. A Global Geomorphologic Map of Saturn's Moon Titan. *Nature Astronomy*, in press (2019).

[18] A. Solomonidou, A. Le Gall, M. Malaska, **S.P.D. Birch**, and 17 others. Spectral and emissivity analysis of the raised ramparts around Titan's northern lakes. *Icarus*, in press (2019).

[17] R.M.C. Lopes, S.D. Wall, C. Elachi, **S.P.D. Birch**, and 44 others. Titan as Revealed by the Cassini RADAR. *Space Science Reviews*, 215:33 (2019).
[16] V. Poggiali, M. Mastrogiuseppe, A.G. Hayes, R. Seu, J.P. Mullen, **S.P.D. Birch**, and M.C. Raguso. High-resolution Topography of Titan Adapting the Delay/Doppler Algorithm to the Cassini RADAR Altimeter Data. *IEEE Transactions on Geoscience and Remote Sensing* 57, 7262-7268 (2019).
[15] Y. Tang*, **S.P.D. Birch**, A.G. Hayes, R. Kirk, N. Kutsop, J-B. Vincent, and S. Squyres. Generation of Photoclinometric DTMs for Application to Transient Changes on the Surface of Comet 67P/Churyumov-Gerasimenko. *Astronomy & Astrophysics* 630, A10 (2019).
[14] S.M. MacKenzie, J.W. Barnes, J.D. Hofgartner, **S.P.D. Birch**, M.M. Hedman, A. Lucas, S. Rodriguez, E.P. Turtle, and C. Sotin. The case for seasonal surface changes at Titan's lake district. *Nature Astronomy* 3, 506-510 (2019).
[13] **S.P.D. Birch**, A.G. Hayes, and 7 others. Raised Rims around Titan's Sharp-Edged Depressions. *GRL* 46, 5846-5854 (2018).
[12] **S.P.D. Birch**, A.G. Hayes, and 9 others. Morphological evidence that Titan's southern hemisphere basins are paleoseas. *Icarus* 310, 140-148 (2017).
[11] A.G. Hayes, **S.P.D. Birch**, and 12 others. Topographic constraints on the evolution and connectivity of Titan's lacustrine basins. *GRL* 44, 11745-11753 (2017).
[10] P. Corlies, A.G. Hayes, **S.P.D. Birch**, R.D. Lorenz, B. Stiles, R.L. Kirk, V. Poggiali, H. Zebker, and L. Iess. Titan's topography and shape at the end of the Cassini mission. *GRL* 44, 11754-11761 (2017).
[9] M. Mastrogiuseppe, A.G. Hayes, V. Poggiali, J.I. Lunine, R.D. Lorenz, R. Seu, A. Le Gall, C. Notarnicola, K. Mitchell, M. Malaska, and **S.P.D. Birch**. Bathymetry and Composition of Titan's Ontario Lacus derived from Monte Carlo-based waveform inversion of Cassini RADAR altimetry data. *Icarus* 300, 203-209 (2017).
[8] **S.P.D. Birch**, Y. Tang, A.G. Hayes, and 10 others. Geomorphology of Comet 67P/Churyumov-Gerasimenko. *MNRAS* 469, S50-S67 (2017).
[7] **S.P.D. Birch**, A. Hayes, and 19 others. Geomorphologic Mapping of Titan's polar terrains: Constraining Surface Processes and Landscape Evolution. *Icarus* 282, 214-236 (2017).
[6] V. Poggiali, M. Mastrogiuseppe, A.G. Hayes, R. Seu, **S.P.D. Birch**, R. Lorenz, C. Grima, and J.D Hofgartner. Liquid-filled canyons on Titan. *Geophysical Research Letters* 43, 7887-7894 (2016).
[5] M.J. Malaska, R.M.C. Lopes, D.A. Williams, C.D. Neish, A. Solomonidou, J. Soderblom, A.M. Schoenfeld, **S.P.D. Birch**, A.G. Hayes, A. Le Gall, M.A. Janssen, T.G. Farr, R.D. Lorenz, J. Radebaugh, and E. Turtle. Geomorphologic map of the Afekan Crater region, Titan: Terrain relationships in Titan's blandlands. *Icarus* 270, 130-161 (2016).
[4] **S.P.D. Birch**, A. Hayes, A.D. Howard J. Moore, and J. Radebaugh. Alluvial Fan Morphology, Distribution and Formation on Titan. *Icarus* 270, 238-247 (2016).
[3] Radebaugh, J., D. Ventra, R.D. Lorenz, T. Farr, R. Kirk, A. Hayes, M.J. Malaska**, S. Birch**, and 8 others. Alluvial and fluvial fans on Saturn's moon Titan reveal processes, materials and regional geology. *In, Ventra, D. & Clarke, L. E. (eds) Geology and Geomorphology of Alluvial and Fluvial Fans: Terrestrial and Planetary Perspectives. Geological Society, London, Special Publications* 440 (2016).
[2] R.M.C. Lopes, M. J. Malaska, A. Solomonidou, A. Le Gall, M. A. Janssen, C.D. Neish, E.P. Turtle, **S.P.D. Birch**, A. G. Hayes, J. Radebaugh, A. Coustenis, B. W. Stiles, R. L. Kirk, K.L. Mitchell, and K. J. Lawrence. Nature, Distribution, and Origin of Titan's Undifferentiated Plains, *Icarus* **270**, 162-182 (2015).
[1] **S.P.D. Birch**, M. Manga, B. Delbridge, and M. Chamberlain. Penetration of spherical projectiles into wet granular media, *Physical Review E* 90, 032208 (2014).

TECHNICAL/MANAGEMENT PERFORMANCE

Funding Proposals:

- Co-I* of Rosetta Data Analysis Program (0.5 FTE) 2019 – 2022
- Co-I of Discovery Data Analysis Program (0.17 FTE) 2019 – 2022

Cornell does not allow postdocs to be a PI

Journal Reviewer:

- Monthly Notices of the Royal Astronomical Society (2); Planetary and Space Science (1); Journal of Geophysical Research (3); Astronomy & Astrophysics (2); Journal of Geophysical Research-Planets (1); Nature Communications (1)

Community Service/Engagement:

- AGU Planetary Sciences Section Early Career Representative (2019 – 2021); AGU Fall Meeting OSPA Judge (2018-2020), LPSC Dwornik Award Judge (2019)
- Co-Chair Titan Surface Workshop (2016); Co-Chair AGU (2018); Chair AGU (2019)

White Papers:

- Titan Science (2020); Science Case for a Titan Orbiter (2020); Comet Surface Sample Return (2020)

MISSION PARTICIPATION

- NEAT [NASA SIMPLEx 2] – Nucleus Geology Lead; *Co-Investigator* — Current
- CAESAR [NASA New Frontiers 5] – Comet Surface Science Co-Lead; *Co-Investigator* — Current
- Rosetta [ESA] – OSIRIS; *Graduate Student Collaborator* — 2017 – 2019
- Cassini [NASA/ESA/ASI] – RADAR Team; *Associate Team Member* — 2016 – 2019
- Oceanus (Not Selected) [NASA New Frontiers 4] – Science Team; *Graduate Student Co-I* — 2016 – 2017
- CAESAR (Not Selected) [NASA New Frontiers 4] – Science Team; *Graduate Student Co-I* — 2015 – 2019
- Mars 2020 Rover [NASA Flagship] – MastcamZ; *Landing Site Selection/Mapping* — 2015 – 2019

PUBLIC OUTREACH & EDUCATION

- Invited speaker for Cornell's *Frontiers of Cornell Astronomy* event — November 2019
- Creator of the *Winnipeg Planet Walk* in Winnipeg MB, Canada — 2018 – Current
- Keynote speaker at *AstroFest*, Kopernik Observatory, Vestal NY — October 2018
- Cornell Astronomy "Ask an Astronomer" Team Member — 2015 – Current
- Volunteer with Cornell's Spacecraft Planetary Imaging Facility — 2014 – Current
- Named "Winnipeg Lacus" on Titan

INVITED TALKS & COLLOQUIA

2019:

- Evolution of Cometary Surfaces. Department of Geological Sciences Colloquium, University of Idaho, June
- The Lakes and Seas of Titan. Geology & Geophysics Seminar, Woods Hole Oceanographic Institute, April

2018:

- Sediment Transport and Landscape Evolution on Comet 67P/C-G. PICS Seminar, Massachusetts Institute of Technology, April
- Investigating the Morphology and Topography of Titan's Polar Lacustrine Features. PALS Seminar, University of Maryland, March

SELECTED RECENT CONFERENCE TALKS

2019:

- Deposition and Detectability of Deltas on Titan. *AGU Fall Meeting*, San Francisco, CA, December
- Local Migration of Smooth Terrain Material in Imhotep on Comet 67P. *EPSC-DPS*, Geneva, Switzerland, September
- A Precise, Fast & Versatile Numerical Landscape Evolution Tool with Applications to Titan. *Titan After Cassini*, Madrid, Spain, September
- Migrating Scarps on Comet 67P. *LPSC*, Woodlands TX, March

2018:

- Raised Rims around Titan's Small Lakes. COSPAR 2018, Pasadena, CA, July
- Numerical Landscape Evolution Simulations Applied to Comet 67P. Rosetta SWT 49, Rhodes, Greece, June
- The Raised Rims of Titan's Small Lakes. *LPSC*, Woodlands TX, March

TEACHING EXPERIENCE

Cornell University; *Lead Lecturer & Course Designer*

- EAS/Astro3150: "Geomorphology" — Spring 2019
  - Average Evaluation: 4.6/5 (n=14)

Cornell University; *Guest Lecturer*

- Astro1102: "Our Solar System" — (2x) Spring 2018
- Astro2202: "A Spacecraft Tour of the Solar System" — (2x) Fall 2016 & (4x) Fall 2017 – 2019
- Astro2212: "The Solar System: Planets, Small Bodies, New Worlds" — (1x) Fall 2017 & 2018
- Astro6577: "Planetary Surface Processes" — (2x) Spring 2017 & 2020

Cornell University; *Teaching Assistant*

- Astro1102: "Our Solar System" — Spring 2015 & 2016
- Astro6577: "Planetary Surface Processes" — Spring 2017

University of California Berkeley; *Grader*

- EPS 3: "The water planet" — Spring 2014
- EPS 20: "Earthquakes in your backyard" — Fall 2013

ADVISING

Graduate (*on auxiliary projects related to work with their primary advisor):

- Megan Barrington; Cornell University; 04/2019 – Current
  - A Comprehensive Catalog of Change Detection on Comet 67P

- Ngoc Truong; Cornell University; 01/2019 – Current
    - Modeling Volatile Entrapment in Cometary Ices
    - *Finalizing a manuscript that will form a thesis chapter (expected May 2020)*
- Abhinav Jindal; Cornell University; 06/2018 – Current
    - Measuring Fallback on Comet 67P using High Resolution Topography
    - *Finalizing a manuscript that will form a thesis chapter (expected April 2020)*

Undergraduate:

- Cece Thieberger; Cornell University; 07/2019 – Current
    - Modeling Cometary Smooth Terrains using High Resolution Topography
- Alexandro Ochoa (Summer REU); 05/2019 – 08/2019
    - Evolution of 67P's Imhotep Region
- Samantha Moruzzi; Cornell University; 07/2018 – Current
    - Photometric modeling of smooth terrains on 67P
    - *Finalizing a manuscript (expected June 2020)*
- Julia Miller; Cornell University; 08/2017 – Current
    - A Complete Mapping of Titan's Hydrology
    - *Finalizing a manuscript (expected June 2020)*
- Alexandra Dobbs (Summer REU); 05/2018 – 08/2018
    - Photometric modeling of smooth terrains on 67P
- Andrew Nowak (Summer REU); 05/2018 – 08/2018
    - SAR Backscatter Modeling of Representative Terrains on Titan
- Harry Tang; Cornell University; 04/2015 – 08/2018
    - Photoclinometry on 67P to Understand Transient Changes
    - *Published a paper in Astronomy & Astrophysics in August 2018*
- Ian Cullings; Cornell University; 01/2017 – 12/2018
    - The longevity of the Jezero crater delta using DTMs
- Ryan de Freitas Bart; Cornell University; 04/2015 – 04/2017
    - Generating a fully three-dimensional model of Comet 67P/C-G

High School:

- Leslie VanDeMark; Ithaca High School; New Visions Program; 11/2014 –05/2015
    - Hydraulic mapping on Titan
- Nathan Degree; Regeneron STS Competition; 05/2018 –05/2019
    - An intercomparison of Titan & Terrestrial Geology in Cassini SAR