

## CURRICULUM VITAE

### Kirby D. Runyon

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#### Education

**PhD** in Planetary Geology, The Johns Hopkins University. 2017

**Dissertation title:** Agents of Planetary Geomorphic Change: Martian Aeolian Morphodynamics and the Emplacement of Crater Ejecta

**Master of Science** in Planetary Geology, Temple University. 2011

**Thesis title:** Structural Characterization of the Cerberus Fossae and Implications for Paleodischarge of Athabasca Valles, Mars.

**Bachelor of Arts in Physics;** Mathematics minor, Houghton College, 2008

#### Research Interests

I seek to understand how planetary landscapes evolve using remote sensing of planetary surfaces, lab experiments of crater ejecta, and analog terrestrial field geology. I am particularly interested in lunar impact melt ages and compositions and planetary aeolian geology from Venus to Pluto. I am also interested in mission formulation and mission operations. Finally, public engagement and **astronaut-enabled science in orbit and on the Moon**, Mars, and around Venus round out my interests. A few highlights:

- **Microgravity research** in planetary science, exploration systems, and human physiology
- **Mission concept formulation** for the outer Solar System and Kuiper Belt.
- **Geologic mapping** on Mars, Earth, the Moon, and Pluto
- Constraining the early **lunar impactor flux rate** as it relates to the emergence of life on Earth
- **Education and Public Outreach**

#### Mission Experience

**Lunar Avatar (Concept)** concept for a tele-operated robotic field geology assistant for lunar surface astronauts: **Geology lead**, 2020-present

**Lunar Surface** Innovation Consortium. In-Situ Resource Utilization (**ISRU**) **co-facilitator**, 2020-present.

**Neptune** Odyssey Mission Concept to orbit Neptune and perform multiple flybys of Triton, **Project Scientist**, 2019-2020.

**Interstellar Probe** Mission Concept to fly past a dwarf planet and out of the heliosphere, planetary science working group lead, 2018-present.

**New Horizons** mission to Pluto and the Kuiper Belt, 2014-present.  
Geology and Geophysics Imaging group affiliate: I interpret and discuss the

photographed geology of Pluto and Charon and have been a co-author on two high profile publications.

- **Awarded NASA Group Achievement Award** for contributions to the New Horizons reconnaissance of the Pluto System, 2016.

**Mars Reconnaissance Orbiter/HiRISE Camera at Mars, 2013-present.**

Collaborator: I assist in image planning and targeting, participate in science team discussions and telecons, and promote education and public outreach.

**Lunar Reconnaissance Orbiter (LRO)/Camera (LROC) at the Moon, 2017-2020.**

Post-doctoral fellow: I mapped the distribution of basin impact melt locations to inform future sample sites for constraining the early lunar impactor flux. See publication, Runyon et al., 2020.

**Concurrent mission concept design** at APL iteratively integrating science and engineering constraints for conceptual robotic mission, 2013, 2017.

### Occupational Experience

#### *Community Service*

- **Course Taught: Lunar Exploration and Geology**, Johns Hopkins University Dept. of Earth and Planetary Sciences, 2020-present.
  - Included Jan., 2020 field trip to **Cima Volcanic Field to simulate lunar geology EVAs.**
- **Co-advisor for JHU graduate student** geologically mapping possible lunar landing sites
- **Lunar Surface Innovation Consortium ISRU** focus group assistant, 2020
- **Pluto System after New Horizons** local organizing committee, 2019
- **Lunar & Planetary Science Conference program committee**, aeolian geology lead, 2018.
- **Executive secretary** for a NASA grant review panel, 2017
- **Peer-reviewer** for planetary science journals, 2015-present.
- **Co-supervisor** for undergraduate intern in planetary geology, 2015, 2018-present.
- **Aeolian session chair** for the Lunar and Planetary Science Conference aeolian geology session, 2015, 2016.

#### *Human Spaceflight*

- **Microgravity, lunar, and martian gravity** experience in parabolic flight, 2020-present.
- **Spacesuit** test subject volunteer with NASA/JSC, 2015-2020.
- **Test subjects volunteer** for NASA's Human Exploration Research Analog (HERA) program (pending).
- **Spaceflight** medical centrifuge test subject with University of Texas Medical Branch and the National Aerospace Training and Research Center (NASTAR), 2016.
- **Medical test subject** with the Johns Hopkins School of Medicine evaluating perturbations on astronaut performance, 2017-present.

- **Executive secretary** with the Lunar Exploration Analysis Group Geologic Astronaut Training Special Action Team (GAT-SAT), 2016.

*Policy*

- **APL business development**, NASA Headquarters, 2019.
- **Space policy activist** speaking with Congressional staffers in the House of Representatives and the Senate, 2014-present.

*Other*

- **Science consultant**, Mohawk Games: Martian and planetary geologic and spaceflight realism, 2014-2017.
- **Exploration Intern**, Lunar and Planetary Institute, 2011.

*Awards*

- Named **Young Alumnus of the Year**, Houghton College, 2018

## Publications

### Peer-Reviewed Papers

- Runyon, K. D., Nelson, L., & Moriarty III, D. P.** (2022). Identifying Impact Melt from the Smythii Basin: Toward an Improved Chronology for Lunar Basin Formation. *The Planetary Science Journal*, 3(2), 48. Doi: 10.3847/PSJ/ac51e2.
- Metzger, P. T., Grundy, W. M., Sykes, M. V., Stern, A., Bell III, J. F., Detelich, C. E., **Runyon, K.D.**, & Summers, M. (2021). Moons are planets: Scientific usefulness versus cultural teleology in the taxonomy of planetary science. *Icarus*, 114768.
- Lauer, T.R., Spencer, J.R., Bertrand, T., Beyer, R.A., **Runyon, K.D.**, White, O.L., Young, L.A., Ennico, K., McKinnon, W.B., Moore, J. M., Olkin, C.B., Stern, S.A., Weaver, H.A. (2021). The Dark Side of Pluto. *The Planetary Science Journal*, 2, 5.
- Schenk, P.M.; Beddingfield, C.B.; Bertrand, T.; Bierson, C.; Beyer, R.; Bray, V.J.; Cruikshank, D.; Grundy, W.M.; Hansen, C.; Hofgartner, J.; et al. (2021). Triton: Topography and Geology of a Probable Ocean World with Comparison to Pluto and Charon. *RemoteSens.*2021,13,3476. <https://doi.org/10.3390/rs13173476>
- Hood, D.R., Ewing, R.C., Roback, K.P., **Runyon, K.D.**, Avouac, J.-P., McEnroe, M. (2021). Inferring Airflow across Martian Dunes from Ripple Patterns and Dynamics, *Frontiers in Earth Science*, section Quaternary Science, Geomorphology and Paleoenvironment.
- Roback, K., **Runyon, K.D.**, Newman, C., Avouac, J.-P., (submitted 2021). Multi-year Measurements of Ripple and Dune Migration on Mars: Implications for the Wind Regime and Sand Transport. *Icarus*.
- Runyon, K.D.**, Viviano, C.E., Day, M. (2021). Abraded pyroclastic linear paleodunes in Syria and Daedalia Plana, Mars. *Earth and Planetary Science Letters* 557. <https://doi.org/10.1016/j.epsl.2020.116719>
- Nelson, L., **Runyon, K.D.**, Moriarty III, D.P. (in revision 2021). Identifying impact melt from Smythii Basin: Towards an improved chronology for lunar basin formation. In revision: *The Planetary Science Journal*, special issue on lunar landing sites for optimized science.
- Kollmann, P., Cohen, I., Allen, R.C., Clark, G., Roussos, E., Vines, S., Dietrich, W., Wicht, J., de Pater, I., **Runyon, K.D.** and Cartwright, R., (2020). Magnetospheric Studies: A Requirement for Addressing Interdisciplinary Mysteries in the Ice Giant Systems. *Space Science Reviews*, 216(5), pp.1-26.
- Skjetne, H. L., Singer, K. N., Hynes, B. M., Knight, K. I., Schenk, P. M., Olkin, C. B., ... & Ennico, K. (2021). Morphological comparison of blocks in chaos terrains on Pluto, Europa, and Mars. *Icarus*, 113866.
- Stern, S. A., White, O. L., McGovern, P. J., Keane, J. T., Conrad, J. W., Bierson, C. J., ... & Team, T. N. H. (2021). Pluto's far side. *Icarus*, 113805.
- Roback, K. P., **Runyon, K. D.** (concept maturation, measurement, writing, editing, consulting), & Avouac, J. P. (2020). Craters as sand traps: Dynamics, history, and morphology of modern sand transport in an active Martian dune field. *Icarus*, 342, 113642.
- Runyon, K. D.**, Moriarty III, D. P., Denevi, B. W., Greenhagen, B. T., Morgan, G., Young, K. E., ... & Jozwiak, L. M. (2020). Impact Melt Facies in the Moon's Crisium Basin: Identifying, Characterizing, and Future Radiogenic Dating. *Journal of Geophysical Research: Planets*, 125(1), e2019JE006024.

- Robbins, S. J., Schenk, P. M., Riggs, J. D., Parker, A. H., Bray, V. J., Beddingfield, C. B., ... & Runyon, K. D. (2021). Depths of Pluto's and Charon's craters, and their simple-to-complex transition. *Icarus*, 113902.
- Cardinale, M., Pozzobon, R., Tangari, A. C., **Runyon, K.**, Di Primio, M., & Marinangeli, L. (2020). Reconstruction of the sand transport pathways and provenance in Moreux crater, Mars. *Planetary and Space Science*, 181, 104788.
- Brandt, P.C., et al. (**K. Runyon**: 8/20 authors – led planetary science section), (2019). Humanity's First Explicit Step in Reaching Another Star: The Interstellar Probe Mission. *JBIS*, 72, p. 202–212.
- Stern, S.A., et al. (including **K. Runyon**), 2019, Initial results from the first spacecraft exploration of a Kuiper Belt Object: 2014 MU69. *Science*, 364, DOI: 10.1126/science.aaw9771.
- Cruikshank, D.P., et al., (including **K. Runyon** 6/29 authors – structural and hydrogeology considerations), 2019, Recent Cryovolcanism in Virgil Fossae on Pluto. *Icarus*, 330, 155-168, doi: 10.1016/j.icarus.2019.04.023.
- Cruikshank, D.P., et al., (including **K. Runyon** 8/19 authors – structural and hydrogeology consideration), 2019, Prebiotic Chemistry of Pluto, *Astrobiology*, 19, 7, doi: 10.1089/ast.2018.1927.
- Cruikshank, D. P., Dalle Ore, C. M., Scipioni, F., Beyer, R. A., White, O. L., Moore, J. M., ... & Ennico, K. (2021). Cryovolcanic flooding in Viking Terra on Pluto. *Icarus*, 113786.
- Metzger, P.T., Sykes, M.V., Stern, A., **Runyon, K.** (contributed heavily to the conclusion, abstract, and arguments throughout), 2019, The reclassification of asteroids from planets to non-planets, *Icarus*, 319, 21-32, doi: 10.1016/j.icarus.2018.08.026.
- Robbins, S. J., **Runyon, K.**, (Crater classification) Singer, K. N., Bray, V. J., Beyer, R. A., Schenk, P., ... Stern, S. A. (2018). Investigation of Charon's craters with abrupt terminus ejecta, comparisons with other icy bodies, and formation implications. *Journal of Geophysical Research: Planets*, 123, 20–36. <https://doi.org/10.1002/2017JE005287>.
- Runyon, K.D.**, Barnouin, O.S., 2018, Preliminary laboratory investigations of ejecta emplacement dynamics and morphology with planetary applications, *Planetary and Space Science*, 160, 39-55, doi:10.1016/j.pss.2018.03.014
- Banks, M. (**including K. Runyon** – contributed bedform mobility data and words to the description of results) (2018), Patterns in Mobility and Modification of Middle and High Latitude Southern Hemisphere Dunes on Mars. *Journal of Geophysical Research*, 123, 3205-3219, DOI:10.1029/2018JE005747.
- Conrad, J., (**K. Runyon** 8/13 co-authors; streamlined geophysical discussion), An upper bound on Pluto's heat flux from the flexural response of normal faults. *Icarus*, 328, 210-217, doi:10.1016/j.icarus.2019.03.028.
- Beddingfield, C., and 15 others (including **K. Runyon** – contributions to landslide runout efficiency), 2019, Landslides on Charon, *Icarus* 335, doi: 10.1016/j.icarus.2019.07.017.
- Moore, J.M., et al., (including **K. Runyon** – aeolian geology predictions), 2018, Great expectations: Plans and predictions for New Horizons' encounter with Kuiper Belt Object 2014 MU<sub>69</sub> ('Ultima Thule'), *Geophysical Research Letters*, 45, doi: 10.1029/2018GL078996.

- Telfer, M.W., et al., (including **K. Runyon** – initial identification and considerations), 2018, Dunes on Pluto, *Science*, 360, 992-997, doi: 10.1126/science.aao2975.
- Beyer, R. et al. (including **K. Runyon** – considerations), 2018, The Nature and Origin of Charon's Smooth Plains. *Icarus*, 323, 16-32, doi: 10.1016/j.icarus.2018.12.036.
- Runyon, K.D.**, Bridges, N.T., and Newman, C.E., 2017. Martian sand sheet characterization and implications for formation: A Case Study, *Journal of Aeolian Research*, 29, 1-11, <http://dx.doi.org/10.1016/j.aeolia.2017.09.001>.
- Runyon, K.D.**, Bridges, N.T., Ayoub, F., Newman, C.E., and Quade, J.J., 2017, An integrated model for dune morphology and sand flux on Mars, *Earth and Planetary Science Letters*, 457, 204-212, doi:10.1016/j.epsl.2016.09.054.
- Robbins, S.J., **Runyon, K.D.**, Singer, K., Bray, V., Schenk, P., McKinnon, W.B., et al. 2017, Investigation of Charon's Craters with Abrupt Terminus Ejecta, Comparisons with Other Icy Bodies, and Formation Implications, *Journal of Geophysical Research Planets*, DOI: 10.1002/2017JE005287.
- Moore, J.M. and 40 others (including **K. Runyon** – geological considerations), 2016, The Geology of Pluto and Charon through the eyes of New Horizons: *Science*, 351, 1284-1293, DOI: 10.1126/science.aad7055.
- Robins, S.J. and 28 others (including **Runyon, K.**), 2017, Craters of the Pluto-Charon system: *Icarus*, 287, 187-206, <https://doi.org/10.1016/j.icarus.2016.09.027>.
- Stern, A.S., and 150 others (including **Runyon, K.** – geological considerations), 2015, The Pluto system: Initial results from its exploration by New Horizons: *Science*, 350, 1815-1:1815-8, DOI: 10.1126/science.aad1815.
- Lemelin, M., Blair, D.M., Roberts, C.E., **Runyon, K.D.**, Nowka, D., Kring, D.A., 2015, High-priority lunar landing sites for in situ and sample return studies of polar volatiles: *Planetary and Space Sciences*, 101, 149-161, DOI: 10.1016/j.pss.2014.07.002.

#### Technical Publications/"Gray Literature"

- Olsen, S., Schmitz, P.C., **Runyon, K.D.**, Bussey, B., Ostdiek, P., Colozza, A.J., Packard, T.W., Gyekenyesi, J.Z., ... Fittje, J.E., (2021) Dynamic Radioisotope Power System (DRPS) Permanently Shadowed Region (PSR) Demonstrator Rover. NASA Technical Report TM-20210020132, <https://ntrs.nasa.gov/search?q=20210020132>.