

Dr. Samuel M. Howell
Research Scientist III, Planetary Interiors and Geophysics
Project Staff Scientist, Europa Clipper Mission
NASA Jet Propulsion Laboratory

EDUCATION

PhD	2017	Geology and Geophysics <i>Faulting and Deformation at Divergent and Transform Plate Boundaries</i>	University of Hawai'i at Mānoa	Honolulu, Hawai'i
MS	2013	Geology and Geophysics <i>The Origin of the Asymmetry in the Iceland Hotspot</i>	University of Hawai'i at Mānoa	Honolulu, Hawai'i
BS	2010	Engineering Physics <i>(Thermal Fluid Mechanics)</i>	Rose-Hulman Institute of Technology	Terre Haute, Indiana

PROFESSIONAL EXPERIENCE

2019 – Pres.	Research Scientist, Ocean Worlds Strategic Hire, Planetary Interiors and Geophysics, JPL
2019 – Pres.	Project Staff Scientist, NASA Europa Clipper Mission
2018 – Pres.	Steering Committee, Network for Ocean Worlds (NOW), NASA Astrobiology Program
2018 – 2019	JPL Postdoctoral Fellow, Ocean Worlds, JPL/Caltech
2016 – 2018	Caltech Postdoctoral Scholar, Planetary Chemistry and Astrobiology, JPL/Caltech
2017 – 2019	Project Science Affiliate, Europa Clipper Science Team

FUNDED PROJECTS (PI = Principal Investigator, D-PI = Deputy Principal Investigator, Co-I = Co-Investigator)

PI	(2022-2026) <i>ORCAA: Ocean Worlds Reconnaissance of Astrobiological Analogues</i> , NASA PSTAR
PI	(2023-2025) <i>How many cracks does it take to get to the ocean of Enceladus?</i> JPL TRTD
PI	(2021-2025) <i>Europa's Icy Tectonics: First-Principles and High-Order Modeling</i> , SSW
Co-I	(2022-2024) <i>SWIM - Sensing with Independent Microswimmers</i> , NIAC Phase II
Co-I	(2021-2024) <i>Thermal Measurements of Icy European Analog Materials</i> , NASA SSW
Co-I	(2021-2024) <i>Enabling through deep-ice communication on Europa (CryoComm)</i> , NASA COLDTech.
Co-I	(2020-2024) <i>Did Solid Tides Prevent the Thermodynamic Death of Europa?</i> NASA Habitable Worlds.
Co-I	(2020-2024) <i>Compositions of Ice Shells on Ocean Worlds</i> , NASA Solar System Workings.
Co-I	(2020-2021) <i>SWIM - Sensing with Independent Microswimmers</i> , NIAC Phase I
Co-I	(2019-2023) <i>Search for Life Using Submersible Heated Drill (SLUSH)</i> , NASA SESAME
D-PI	(2019-2021) <i>Probe Using Radioisotopes for Icy Moons Exploration (PRIME)</i> , JPL NEXT

SELECTED ACTIVITIES

2024	Primary Convener, <i>Planetary Ocean Access: A Near-term Path to Extant Life Detection</i> , AbSciCon
2024	Convener, <i>Accessing Ocean Worlds: Challenges and Technologies</i> , AbSciCon
2023	Primary Convener, <i>Ocean Worlds and Search for Life</i> , American Geophys. Union Fall Meeting (AGU)
2022	Session Co-chair, <i>Ocean Worlds and Icy Volcanism</i> , Lunar and Planetary Science Conference (LPSC)
2022	Primary Convener, <i>The diverse Ocean Worlds</i> , Astrobiology Science Conference (AbSciCon)
2022	Co-convener, <i>Ocean Science for Ocean Worlds</i> , Ocean Sciences Meeting (OSM)
2021	Program Committee, 52nd Lunar and Planetary Science Conference (LPSC)
2021	Primary Convener, <i>Special Session on The Next Two Decades of Ocean Worlds Exploration</i> (LPSC)
2020	Co-convener, <i>Icy Satellite Surfaces and Below</i> , AAS Division of Planetary Sciences (DPS) Meeting
2020	Study Scientist, <i>Radioisotope Power Systems for Pressure Vessels</i> , NASA RPS Program
2020	Selected Participant, NASA Principal Investigator Launchpad (Mission-focused). NASA SMD
2019	Study Scientist, <i>Radioisotope Power System Considerations for Ocean Worlds</i> , NASA RPS Program
2017	Subject Matter Expert, <i>Accessing Subsurface Oceans of Icy Worlds</i> , Keck Institute for Space Studies

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AWARDS

- 2024 Voyager Award for leading COLDTech field demonstration of through-ice communications, JPL
- 2024 Voyager Award for Europa Clipper Phase E internal funding program (Work-MoRE), JPL
- 2023 Voyager Team Award for Europa Clipper Strategic Science Plan development, JPL
- 2022 Voyager Award for Europa Clipper science visualization tool development, JPL
- 2021 Voyager Award for Europa Clipper Lecture Series, JPL
- 2021 Team Award for contributions to the Decadal Survey in Planetary Science and Astrobiology, JPL
- 2017 Outstanding Postdoctoral Research in Planetary Science and Life Detection, JPL
- 2016 *Popular Mechanics* Breakthrough Award for innovative method to study San Andreas Fault motions

SELECTED PUBLICATIONS

- Pappalardo et al., *incl. S. Howell* (2024, *in prod.*). *Ganymede's Geology*, in *Ganymede*, Cambridge Press.
- Pappalardo et al., *incl. S. Howell* (2024). *Science Overview of the Europa Clipper Mission*. *Space Sci Rev.*, doi:10.1007/s11214-024-01070-5.
- Schroeder et al., *incl. S. Howell* (2024). Constraining the Thickness of the Conductive Portion of Europa's Ice Shell Using Sparse Radar Echoes. *Geophys Res Lett (GRL)*, doi:10.1029/2024GL110635.
- Becker et al., *incl. S. Howell* (2024). *Exploring the Composition of Europa with the upcoming Europa Clipper mission*. *Space Sci Rev.*, doi:10.1007/s11214-024-01069-y.
- Howell, S.**, C. J. Bierson, K. Kalousová, E. J. Leonard, G. Steinbrügge, N. Wolfenbarger (2024). *Jupiter's Ocean Worlds: Dynamic Ices and the Search for Life*, in *Ices in the Solar System*, Elsevier, ISBN:9780323993241, doi:10.1016/B978-0-323-99324-1.00003-1.
- Lee et al., *incl. S. Howell* (2024). *Through-Ice Acoustic Communication for Ocean Worlds Exploration*. *Sensors*, doi:10.3390/s24092776.
- Bar-Cohen et al., *incl. S. Howell* (2024). Acoustics and RF communication through deep ice for application to ocean worlds exploration. *SPIE Smart Structures*, doi:10.1117/12.3023942.
- Howell, S.**, E. J. Leonard (2023). *Ocean Worlds: Interior Processes and Physical Environments*. In *Handbook of Space Resources*. Springer. ISBN:9783030979126, doi:10.1007/978-3-030-97913-3_26.
- Schaler et al., *incl. S. Howell* (2024). *Design and Development of SWIM—Miniature Underwater Robots for Exploring Ice-Ocean Interfaces*. *IEEE Aerospace*, 2194 (5.0501).
- Daubar et al., *incl. S. Howell* (2024). *Planned Geological Investigations of the Europa Clipper Mission*. *Space Sci Rev* 220, 18. doi:10.1007/s11214-023-01036-z.
- Roberts et al., *incl. S. Howell* (2023). *Exploring the Interior of Europa with the Europa Clipper*. *Space Sci Rev* 219, 46. doi:10.1007/s11214-023-00990-y.
- Becker et al., *incl. S. Howell* (2024). *Exploring the Composition of Europa with the upcoming Europa Clipper mission*. *Space Sci Rev.*, doi:10.1007/s11214-024-01069-y.
- Vance et al., *incl. S. Howell* (2023). *Investigating Europa's Habitability with the Europa Clipper*. *Space Sci Rev* 219, 81. doi:10.1007/s11214-023-01025-2
- Naseem, M., Neveu, M., **Howell, S.**, Lesage, E., Daswani, M. M., & Vance, S. D. (2023). *Salt Distribution from Freezing Intrusions in Ice Shells on Ocean Worlds: Application to Europa*. *PSJ*, doi:10.3847/PSJ/ace5a2.

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- Mills, M. M. et al., *incl. Howell, S. M.* (2023). Moonquake-triggered mass wasting processes on icy satellites. *Icarus*, doi:10.1016/j.icarus.2023.115534.
- Howell, S.** (2022), *The likely thickness of Europa's icy shell*. *PSJ*, doi:10.3847/PSJ/abfe10.
- Lesage, E., H. Massol, **S. Howell**, F. Schmidt. (2022). *Viscoelastic deformation of freezing cryomagma reservoirs: Application to Europa*. *The Planetary Science Journal*.
- Leonard, E. J., **S. Howell** et al. (2022). *Finding order in chaos: Quantitative predictors of chaos terrain morphology on Europa*. *Geophysical Research Letters*, doi:10.1029/2021GL097309.
- DiNicola, M., **S. Howell**, et al. (2022). *Resurfacing: An Approach to Planetary Protection for Geologically Active Ocean Worlds*. *The Planetary Science Journal*, doi:10.3847/PSJ/ac642d.
- Howell, S.**, et al. (2021). *Ocean Worlds Exploration and the Search for Life*, *Bulletin of the American Astronomical Society*, doi:10.3847/25c2cfcb.8920f9ae.
- Ermakov et al., *incl. S. Howell*, (2021). *A Recipe for the Geophysical Exploration of Enceladus*, *The Planetary Science Journal*, doi:10.3847/PSJ/ac06d2.
- Bairstow, B. Y. Lee, **S. Howell**, B. Donitz, M. Choukroun, S. Perl (2021). *Thermal Analysis of Landers using Radioisotope Power Systems on Ice Worlds*, *IEEE*, doi:10.1109/AERO50100.2021.9438303.
- Howell, S.**, R. T. Pappalardo (2020). *NASA's Europa Clipper—a mission to a potentially habitable ocean world?* *Nature Communications*, doi:10.1038/s41467-020-15160-9.
- Zacny, K. et al., *incl. S. Howell* (2020). *Extraterrestrial Drilling and Excavation*, in *Advances in Terrestrial and Extraterrestrial Drilling: Ground, Ice, and Underwater*, CRC Press, ISBN 9781138341500.
- Howell, S.**, R.T. Pappalardo (2019). *Can Earth-like plate tectonics occur in the outer ice shells of icy satellites?* *Icarus*, doi:10.1016/j.icarus.2019.01.011.
- Howell, S.**, J-A. Olive, G. Ito, M. D. Behn, J. Escartin, B. Kaus (2019), *Seafloor expression of oceanic detachment faults reflects gradients in mid-ocean ridge magma supply*, *Earth and Planetary Science Letters*, doi:10.1016/j.epsl.2019.04.001.
- Howell, S.**, L. Chou, 18 others (2018). *Centaur reconnaissance mission concept: Chariklo flyby and impact*, *Planetary and Space Science*, doi:10.1016/j.pss.2018.07.008.
- Howell, S.**, R.T. Pappalardo (2018). *Band formation and ocean-surface interaction on Europa and Ganymede*, *Geophysical Research Letters*, doi:10.1029/2018GL077594.
- Howell, S.**, B. Smith-Konter, N. Frazier, X. Tong, D. Sandwell (2016). *The vertical fingerprint of earthquake cycle loading in Southern California*, *Nature Geoscience*, doi:10.1038/ngeo2741.
- Howell, S.**, G. Ito, M. D. Behn, F. Martinez, J.-A. Olive, and J. Escartín (2016), *Magmatic and tectonic extension at the Chile Ridge: Evidence for mantle controls on ridge segmentation*, *Geochem. Geophys. Geosyst.*, doi:10.1002/2016GC006380.
- Olive, J.-A., M. D. Behn, G. Ito, W. R. Buck, J. Escartín, **S. Howell** (2015), *Sensitivity of seafloor bathymetry to climate-driven fluctuations in mid-ocean ridge magma supply*, *Science*, doi:10.1126/science.aad0715.
- Howell, S.**, G. Ito, A.J. Breivik, A. Rai, R. Mjelde, B. Hanan, K. Sayit, P. Vogt (2014), *The origin of the asymmetry in the Iceland hotspot along the Mid-Atlantic Ridge from continental breakup to present-day*, *Earth Planet. Sci. Lett.*, doi:10.1016/j.epsl.2014.02.020.

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INVITED TALKS & LECTURES

- (2024) *NASA's Europa Clipper*, National Museum of the Air Force
- (2024) *Plate tectonics and the search for life*, Woods Hole Oceanographic Institution
- (2024) *Geophysical constraints on the exploration of Europa*. Department of Earth, Brown University DEEPS
- (2023) *Europa: Jupiter's Habitable Moon?* Smithsonian Institute, Grand Tour of the Solar System
- (2023) *Europa Clipper and Beyond: Geophysical constraints on the search for life at Europa*, USC Astrobio.
- (2022) *Powering Fire and Ice with Iron: The role of metal core dissipation in the Galilean satellites*. Geology and Geophysics of Active Satellites and Small Bodies, AGU Fall Meeting
- (2022) *Core activity in the Galilean satellites*. NASA Europa Clipper Mission Geodesy Focus Group
- (2022) *Going Under the Ice with Dr. Samuel Howell*. Universe Today.
- (2022) *Exploring Europa with the Europa Clipper Mission*. Princeton Center for Theoretical Science.
- (2022) *Panelist: Habitability and Astrobiology*. Princeton Center for Theoretical Science.
- (2021) *Early Career Panelist*, 12th annual Lunar and Small Bodies Graduate Forum (LunGradCon). (2020) *The Likely Thickness of Europa's Icy Shell*, Europlanet Science Congress (EPSC).
- (2020) *Linking ice shell deformation to Europa's habitability*. Earth Life Science Institute (ELSI) Second Annual Winter School on Aquaplanetology (Aso, Japan).
- (2020) *The Exploration of Europa, an Alien Ocean World*, University of Hawai'i at Mānoa.
- (2019) *Europa's habitability: Dynamic ice processes and future Ocean World exploration*. Alternative Earths Astrobiology Seminar, University of California, Riverside.
- (2019) *Exploring Europa: A dynamic ocean world*. Boise State / KBSX. Astronomy Lecture Series.
- (2019) *Ocean world ice shell transport processes*. NASA Astrobiology Institute Titan Meeting (JPL).
- (2018) *Facilitating ocean-surface exchange through ice shell tectonics*. NASA Astrobiology Institute.
- (2018) *Simulating tectonic windows into ocean worlds*, Caltech, Dix Planetary Science Seminar.
- (2018) *Extensional Terrains: Tectonic windows into ocean worlds*. UCLA.

NEWS & MEDIA

- (2024) *NOVA - Solar System: Icy Worlds*, PBS.
- (2024) *Solar System*, BBC.
- (2024) *The NASA Mission Searching for Life On Jupiter's Moon*, BBC Science.
- (2024) *Why NASA is sending a probe to Europa – and what it's looking for*, NewScientist.
- (2024) *Europa Clipper media day*. Misc. local and national outlets/articles/appearances.
- (2023) *Digging Deeper to Find Life on Ocean Worlds*, NASA Feature, Space.com, Gizmodo.
- (2022) *Io may have an underworld magma ocean or a hot metal heart*, ScienceNews.
- (2022) *Swarm of Tiny Swimming Robots Could Look for Life on Distant Worlds*, Multiple outlets.
- (2020) *NASA's Europa Clipper Will Find Out if Europa is Habitable*, Discover Magazine.
- (2020) *Diving into Ocean Worlds*, ECO Magazine.
- (2020) *Alien-life hunters are eyeing icy ocean moons Europa and Enceladus*, Space.com.
- (2018) *Europa's Ocean Ascending*, NASA Feature Article, Phys.org.
- (2016) *A Better Understanding of Earthquakes*, Popular Mechanics Magazine, EOS, LA Times, Forbes, Snopes, Hawaii Public Radio, All Things Considered (KCRW, NPR member station).