

Name: Marc Neveu

Code: 699

Home institution: University of Maryland, College Park

Name of task: Ocean Worlds Astrobiology

Role in Task/What do you do for CRESST: To quantify the habitability and search for life on icy worlds of the solar system, I do fundamental research and am involved in the development of life detection instruments and missions. My research consists in modeling the geophysical and geochemical evolution of ocean worlds ranging from large asteroids, to icy moons, to Earth-like exoplanets using a suite of codes: <https://github.com/MarcNeveu>. I am also kicking off two lab projects in bldg. 37 to understand what happens to subsurface ocean samples ejected to space and collected by spacecraft. I was Deputy PI of the Enceladus Orbilander study, a large-class mission concept under consideration by the ongoing Planetary Science & Astrobiology Decadal Survey, and I am helping develop smaller-scale concepts as well. Finally, part of my work involves working with the astrobiology community on formalizing what constitutes evidence for life and infusing that knowledge into mission development.



What is your background: I grew up in France and studied there up to my Master's in Aerospace Engineering and in Astrophysics, Space Sciences and Planetology in Toulouse. In 2009 I came to Goddard as a NASA Academy intern developing an instrument to measure methane in the Martian atmosphere as a potential sign of life. I fell in love with astrobiology and went on to learn other disciplines involved in understanding life as a planetary process: prebiotic chemistry through an internship at the Foundation for Applied Molecular Evolution in 2011, and biology and geology through my PhD projects at Arizona State Univ. on measuring the elemental composition of extremophile microbes in Yellowstone hot springs and modeling the physical and chemical evolution of icy world interiors. I came to the DC area in 2017 to work at NASA HQ in the Astrobiology Program, and then to Goddard. During that early 2009 internship I met my wife, Svetlana, who also undertook PhD studies at ASU on fossil signs of life, and after two postdocs informing the Mars 2020 mission, now works with CRESST on managing astrobiology community inputs into a common life detection knowledge base. We've come full circle!

Favorite part of being a CRESST Scientist: I love my job. Being part of the small group of people in the world who is directly shaping the science and development of spacecraft to search for life beyond Earth is a privilege that, to me, justifies the challenges of balancing the demands of many projects and endeavors, at work and at home.

Highlight of research as a CRESST Scientist: Generally speaking, having an impact on other scientists and hopefully, in the long term, society. On scientists through mentoring students and seeing them grow and become part of the community, as well as having my work impact decisions on the formulation of NASA's future astrobiology missions. On society by doing my best to implement and communicate principles of equity, inclusion, diversity and accessibility. And down the road, hopefully, by helping understand where and why there is life elsewhere in the solar system, or why not.

Selected list of recent publications:

- Green, J., T. Hoehler, M. Neveu, et al. 2021. "Call for a framework for reporting evidence for life beyond Earth." *Nature*, 598 (7882): 575-579
- Vernazza, P., M. Ferrais, L. Jorda, et al. 2021. "VLT/SPHERE imaging survey of the largest main-belt asteroids: Final results and synthesis." *Astronomy & Astrophysics*, 654: A56
- Cable, M. L., C. Porco, C. R. Glein, et al. 2021. "The Science Case for a Return to Enceladus." *The Planetary Science Journal*, 2 (4): 132
- Canup, R. M., K. M. Kratter, and M. Neveu. 2021. "On the Origin of the Pluto System." *The Pluto System After New Horizons*, Tucson, AZ, USA: 475-506
- Cartwright, R. J., C. B. Beddingfield, T. A. Nordheim, et al. 2021. "The Science Case for Spacecraft Exploration of the Uranian Satellites: Candidate Ocean Worlds in an Ice Giant System." *PSJ*, 2 (3): 120
- Carry, B., P. Vernazza, F. Vachier, et al. 2021. "Evidence for differentiation of the most primitive small bodies." *A&A* 650:A129
- MacKenzie, S. M., M. Neveu, A. F. Davila, et al. 2021. "The Enceladus Orbilander Mission Concept: Balancing Return and Resources in the Search for Life." *PSJ*, 2 (2): 77
- Renaud, J. P., W. G. Henning, P. Saxena, et al. 2021. "Tidal Dissipation in Dual-body, Highly Eccentric, and Nonsynchronously Rotating Systems: Applications to Pluto–Charon and the Exoplanet TRAPPIST-1e." *PSJ*, 2 (1): 4
- Lisse, C., L. Young, D. Cruikshank, et al. 2020. "On the origin & thermal stability of Arrokoth's and Pluto's ices." *Icarus*, 114072
- Neveu, M., A. D. Anbar, A. F. Davila, et al. 2020. "Returning Samples From Enceladus for Life Detection." *Frontiers in Astronomy and Space Sciences*, 7: 26
- Neveu, M., C. H. House, and S. T. Wieman. 2020. "Phoebe's carbon isotope composition as evidence for self-shielding in the solar nebula." *Icarus*, 345: 113714
- Cable, M. L., M. Neveu, H.-W. Hsu, and T. M. Hoehler. 2020. "Enceladus." *Planetary Astrobiology*, Tucson, AZ: 217-246
- Castillo-Rogez, J. C., M. Neveu, J. E. Scully, et al. 2020. "Ceres: Astrobiological Target and Possible Ocean World." *Astrobiology*, 20: 269-291
- Neveu, M., and P. Vernazza. 2019. "IDP-like Asteroids Formed Later than 5 Myr After Ca–Al-rich Inclusions." *The Astrophysical Journal*, 875 (1): 30
- Neveu, M., and A. R. Rhoden. 2019. "Evolution of Saturn's mid-sized moons." *Nature Astronomy*, 3 (6): 543-552

Awards won:

2020 Scialog Fellow, Research Corporation for Science Advancement

2018 US Antarctica Service Medal

2017 NASA Postdoctoral Management Program Fellowship

2016 NASA Early Career Fellowship

2015, 2014 Graduate Excellence Award, ASU College of Liberal Arts and Sciences

2014 NASA Earth and Space Science Fellowship

2014 Ultra-Disciplinary Student Award, ASU School of Earth & Space Exploration

2014 Career Development Award, Lunar & Planetary Institute

2013 Outstanding Student Poster Award, American Geophysical Union

2013 David S. Miller Young Scientist Scholarship, American Geophysical Union

2011 3rd Mayoux-Dauriac Aeronautics Prize, Inst. Sup. Aéronautique & Espace Alumni Association

2011 University Graduate Fellowship, Arizona State University

2011 Vocation Prize, French Aerospace Society [3AF] Space Exploration & Observation Section

2009 John Mather Nobel Scholarship