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Opportunity Title: Exploring the Astrobiology and Organic Chemistry Potential of Enceladus, Europa, Titan and/or Mars
Opportunity Reference Code: 0318-NPP-MAR25-JPL-Astrobio

Organization National Aeronautics and Space Administration (NASA)

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How to Apply All applications must be submitted in Zintellect

Please visit the NASA Postdoctoral Program website for application instructions and requirements: How to Apply | NASA Postdoctoral Program (orau.org)

A complete application to the NASA Postdoctoral Program includes:

1. Research proposal
2. Three letters of recommendation
3. Official doctoral transcript documents

Application Deadline 3/1/2025 6:00:59 PM Eastern Time Zone

Description **About the NASA Postdoctoral Program**

The NASA Postdoctoral Program (NPP) offers unique research opportunities to highly-talented U.S. and non-U.S. scientists to engage in ongoing NASA research projects at a NASA Center, NASA Headquarters, or at a NASA-affiliated research institute. These one- to three-year fellowships are competitive and are designed to advance NASA's missions in space science, Earth science, aeronautics, space operations, exploration systems, and astrobiology.

Description:

The search for biosignatures and interesting organic chemistry throughout the solar system has accelerated with recent advancements in laboratory techniques, and the current and future discoveries by missions such as the Mars 2020 Perseverance rover, the Europa Clipper mission, and the Dragonfly mission to Titan. Our group's research in the Planetary Science Section at JPL focuses on groundbreaking, largely laboratory-based work to help interpret measurements made by these and other missions, as well as deepen our understanding of the organic chemistry and potential biochemistry occurring on these planetary bodies.

Project proposals may address one or a combination of the research areas below, and may include laboratory investigations, modeling, field work, mission data analysis, or any combination. Current funded research areas:

- **Hypervelocity impacts of ice grains for Enceladus and/or Europa.** Ocean worlds such as Enceladus and Europa likely meet all criteria for habitability, and represent high-priority targets for astrobiology-focused missions. Cassini demonstrated the detection of salts and organics in hypervelocity plume flythroughs using impact ionization mass spectrometry with its Cosmic Dust Analyzer (CDA) instrument, and current and future payloads under development could search for biosignatures in plume and ejected particles with the same

technique. However, until recently no equivalent laboratory measurements have reproduced the physics of an ice grain impact onto a spaceborne dust detector such as CDA or Europa Clipper's Surface DUst Analyzer (SUDA) instrument using relevant compositions. At JPL/Caltech we have a new experimental system called the Hypervelocity Ice grain Impact Validation Experiment (HIIVE) that more closely replicates the hypervelocity sampling process, and will set the standard for SUDA data interpretation by establishing a direct link between the observed mass spectra and ice grain composition. Current HIIVE experiments involve generating a mass spectral library of various salt and organic mixtures in ice grains for the SUDA instrument, and generating hypervelocity ice grain impacts of microbes for the first time to test whether organisms from different habitats in Ocean World analogue environments will generate chemically distinct fatty acid fingerprints when analyzed via impact ionization mass spectrometry. Project proposals are invited that might explore novel ways that our HIIVE ice grain accelerator instrument could be utilized, not only to trace back impact mass spectra to the composition of ice grains, but also whether impacts can generate new compounds if the impacted surface has a contamination layer or coating to replicate a planetary surface.

- **Titan surface organic cryominerals and chemistry.** The Dragonfly mission will explore Titan's diverse terrains through multi-kilometer flying hops and perform measurements to understand the unique organic chemistry and composition of Titan's surface and atmosphere. At JPL we use micro-Raman spectroscopy, cryogenic powder X-ray diffraction and other techniques to characterize cryogenic minerals (aka 'cryominerals') in Titan-relevant conditions. These cryominerals are typically co-crystals comprised of organic molecules known or believed to be present on Titan such as ethane, benzene and acetylene, and due to their unique properties may help shape the unique geomorphology of Titan's varied terrains. So far about a dozen cryominerals have been discovered to date, with the potential to explore many more, including ternary systems and co-crystal mixtures. Project proposals are encouraged that might explore prebiotic or biochemical implications of Titan cryominerals and other organic molecular assemblies, including but not limited to: (a) moving reactants into close proximity via co-crystal formation or other intermolecular associations to facilitate prebiotic chemical reactions, or (b) sequestration of biologically-relevant compounds (either molecules that can be easily metabolized or precursors to biological building blocks like amino acids) in co-crystals where putative microbial communities could access them.

- **Potential biosignatures on Mars.** The Perseverance rover has recently discovered features in rocks at the Bright Angel outcrop in the Margin Unit of Jezero crater, called Poppy Seeds and Leopard Spots, that are enriched in ferrous iron and phosphorus and appear to be

consistent with in-situ reaction fronts. These features are colocated with organic carbon and meet the criteria for potential biosignatures. Project proposals are invited to support interpretation of these measurements, in particular those made with the Planetary Instrument for X-ray Lithochemistry (PIXL), by exploring both biotic and abiotic analogues of these systems.

Field of Science: Astrobiology

Advisor:

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This opportunity may require the following: 1- Mandatory drug testing; 2-Random drug testing; 3- Testing prior to initiation of fellowship appointment.

Questions about this opportunity? Please email npp@orau.org

Qualifications Interested candidates should have a recent Ph.D. in chemistry, geochemistry, physics or a related discipline in planetary science or astrobiology. Candidates are encouraged to develop a project proposal that enables them to gain experience in a new or tangential field to their previous expertise. Depending on the project proposal, candidates with a background in analytical chemistry, organic chemistry, mass spectrometry, IR/Raman spectroscopy, cryogens and/or vacuum systems may be preferred but not required.

Point of Contact Mikeala

Eligibility Requirements

- **Citizenship:** LPR or U.S. Citizen
- **Degree:** Doctoral Degree.