zintellect
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Opportunity Title: ICAR - Tracing Rocky Exoplanet Compositions
Opportunity Reference Code: 0039-NPP-NOV24-ABProg-Astrobio

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0039-NPP-NOV24-ABProg-Astrobio

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 11/1/2024 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:

What is the range of chemical compositions on rocky exoplanets, especially their surfaces?

Which chemical variations matter most for climate, habitability, and detectability of life?

These questions form the unifying intellectual focus of our TREC (Tracing Rocky Exoplanet Compositions) team. To answer them, our team is engaged in a research program designed to determine the starting compositions of stellar systems, and the chemical changes that occur within the protoplanetary disk, during planetary differentiation, magma ocean crystallization, and mantle-surface interactions over geologic time. We will synthesize these results to derive statistical distributions of surface abundances of key elements that matter for climate, habitability, or detectability of life. These include rock-forming elements (Fe, Mg, Si, Ca, Al, Na, K, S, O), radionuclides that drive heat flux (40K, U, Th), volatiles and bioessential elements (H2O, C, N, S, P). https://www.trec-nexss.org/

Our proposed work comprises five main research Tasks.

Task 1 focus on astronomical controls. We are supplementing catalogs of key elemental abundances of Sunlike stars, including rarely-measured elements like P, Th, and U, and refining stellar ages to < 1 Gyr precision. We are testing whether chemical fractionations occur during cloud core

collapse.

Task 2 involves modeling of protoplanetary disks, including radial pebble fluxes and condensation fronts, and testing models against meteoritic data.

Task 3 is to determine the changes in mantle compositions as elements sequester in cores, removing them from interaction with a planet's surface. We are compiling and calculating metal-silicate partition coefficients. We are modeling mineralogy and structure of mantles following magma ocean crystallization. We are calculating shifts in abundances due to giant impacts. We are testing these models against meteorites, Mercury, Venus, Earth/Moon, and Mars.

Task 4 is to determine changes in compositions as planets' upper mantles evolve and emplace melts on their surfaces, outgassing volatiles and forming crusts. We are calculating these rates over geologic time as heat fluxes decline, building state-of-the-art coupled thermodynamic and geodynamical codes for stagnant-lid planets. We are carrying out petrologic experiments to determine melting curves and solubilities for 'bulk silicate exoplanet' compositions.

Our fifth task is to synthesize these results to map out the likely range of rocky exoplanet mantle and surface compositions as functions of age, mass, and host-star abundances. Our goal is to determine which elements habitability and detectability of life are most sensitive to. We will interface with the larger NExSS community to promote interdisciplinary research.

Applicants interested in working in any of these themes, and especially with the Co-Investigators listed below, can contact the PI Steve Desch and the Co-Investigator of interest. Applicants who apply for this research opportunity and are subsequently selected for an NPP award are expected to attend the Astrobiology Graduate Conference (AbGradCon) and/or the Astrobiology Science Conference (AbSciCon) using the travel funds that are conferred as part of the NPP award.

Field of Science: Astrobiology

Advisors:

Steven Desch
steven.desch@asu.edu
480-965-7742

Brad Foley
bjf5382@psu.edu

Stephen Kane
skane@ucr.edu

Larry Nittler
lnittler@asu.edu

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Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

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

Eligibility Requirements

- **Degree:** Doctoral Degree.