



# Steven D. Vance

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## Research Focus

My research focuses on using geophysical and geochemical methods to understand ocean worlds: how oceans couple to the thermal evolution and composition, and what this might mean for life. I am also interested in the global geochemical fluxes in ocean worlds, by analogy to biogeochemical fluxes in the Earth system. My experimental research involves collecting thermodynamic equations of state for fluids and ices. I have applied these equations of state to evaluating oceanic heat transport and double diffusive convection in Europa, and to the geophysical constraints imposed by ocean composition on the radial structures of Europa, Ganymede, Callisto, Enceladus, and Titan. In recent years I have used these models to explore the parameter space of possible geophysical signals—seismic, magnetic, and gravitational—to improve the fidelity of returned science from investigations of ocean composition and habitability.

## Education

2001–2007 **Ph.D.**, *University of Washington*, Seattle, Geophysics and Astrobiology.

1996–2000 **B.S.**, *University of California*, Santa Cruz, Physics (*with honors*).

## Ph.D. Thesis

title *Thesis title: High Pressure and Low Temperature Equations of State for Aqueous Sulfate Solutions: Applications to the Search for Life in Extraterrestrial Oceans, with Particular Reference to Europa*

advisor Prof. J. Michael Brown

## Bachelor Thesis

title *The Role of Methanol Frost in Particle Sticking and the Formation of Planets in the Early Solar Nebula*

advisor Prof. Frank G. Bridges

## Current Appointments

**Research Scientist:** Jet Propulsion Laboratory (JPL), Caltech

**Co-Chair:** Europa Clipper Habitability Assessment Board

**Supervisor** Planetary Interiors and Geophysics Group (3226), JPL, Caltech

**President** Planetary Science Section, Asia Oceania Geosciences Society, Singapore

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## PI'd Grants; by submittal year

- 2020-2022 **Laboratory Electrical Conductivity Measurements for Exploring Ocean Worlds**, *JPL Topical Research and Technology Development*, \$330K.
- 2018-2020 **Enceladus Distributed Geophysical Explorer (EDGE)**, *JPL Strategic Research and Technology Development*, \$400K.
- 2018 **Overturning Circulation in Icy Ocean Worlds**, *JPL Researchers on Campus*, \$14K.
- 2017–2020 **Vital Signs: Seismic Investigation of Icy Ocean Worlds**, *NASA ROSES Habitable Worlds*, \$772K.
- 2015–2018 **Science Drivers for Icy Moon Seismology**, *JPL Strategic Research and Technology Development*, \$355K.
- 2011-2013 **CubeSat Hydrometric Atmospheric Radiometric Mission (CHARM)**, *NASA Hands-On Project Experience (HOPE)*, \$2.8M.

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## Co-I and Collaborator Grants; by submittal year

- 2020-2023 **Experimental and Computational Thermodynamics, Organics, and Planetary Structure Modeling (ECTOPlaSM)**, *NASA ROSES Early Career Award*, \$199K.
- 2019-2022 **Did Solid Tides Prevent the Thermodynamic Death of Europa?**, *NASA ROSES Habitable Worlds*, \$882K.
- 2019-2022 **Tectonic history, thermal evolution, and interior structure of the Uranian satellites Miranda and Ariel**, *NASA ROSES Solar System Workings*, PI: Tom Nordheim, \$591K.
- 2019-2022 **Compositions of Ice Shells on Ocean Worlds**, *NASA ROSES Solar System Workings*, PI: Marc Neveu, \$352K (JPL portion).
- 2019-2023 **Elastic wave analyzer for icy sub-surfaces (EWAIS) in the solar system**, *NASA ROSES PICASSO*, PI: Yoseph Bar-Cohen, \$900K.
- 2019-2022 **Flagship Concepts for Astrobiology at Enceladus**, *NASA ROSES Planetary Mission Concept Studies*, PI: Shannon MacKenzie, \$-discreet.
- 2018–2020 **Europa Seismic Package**, *Instrument Concepts for Europa Exploration-2*, PI: Mark Panning, \$2.3M.
- 2017–2022 **Habitability of Hydrocarbon Worlds: Titan and Beyond**, *NASA Astrobiology Institute, CAN 8*, PI: Rosaly Lopes, \$8.3M.
- 2017–2019 **Universal MEMS Seismometer**, *NASA ROSES PICASSO*, PI: Karl Yee, \$4M.
- 2017–2020 **Planetary Solution Chemistry**, *NASA ROSES Solar System Workings*, PI: J. Michael Brown, \$636K.
- 2016–2017 **Magnetic Induction Responses from Icy Satellites with Conductive Oceans**, *JPL Spontaneous Concepts*, PI: Bruce Bills, \$30K.
- 2016–2019 **A Planetary Broadband Seismometer for the Lunar Geophysical Network and the Ocean Worlds**, *NASA ROSES MATISSE*, PI: Talso Chui, \$4M.

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- 2016–2018 **Water and Hydrate Isotopes via a Rapid Laser Sensor**, *NASA ROSES PI-CASSO (discretionary selection)*, PI: Max Coleman, \$429K.
- 2014–2019 **ICY WORLDS: Astrobiology at the Rock-Water Interface and Beyond?**, *NASA Astrobiology Institute, CAN 7*, PI: Isik Kanik, \$8.08M.
- 2013 **Mapping the Ice Layer of Europa Using Radio Detection of Ultra-High Energy Cosmic Rays (UHECRs)**, *JPL Spontaneous Concepts*, PI: Andrew Romero Wolf, \$30K.
- 2012–2015 **Solution Thermochemistry Relevant to Outer Planets and Satellites**, *NASA ROSES Outer Planets Research*, PI: J. Michael Brown, \$156K.
- 2009–2014 **Astrobiology of Icy Worlds: Habitability, Survivability and Detectability**, *NASA Astrobiology Institute, CAN5*, PI: Isik Kanik, \$8.18M.

## Refereed Publications

- Castillo-Rogez, J., Melwani Daswani, M., Glein, C., **Vance, S.**, Cochrane, C. Contribution of Non-Water Ices to Ocean Salinity and Electrical Conductivity in Ocean Worlds, *GRL*, revised.
- Marusiak, A. G., **Vance, S. D.**, Panning, M. P., Bryant, A. S., Hesse, M. A., Carnahan, E., Journaux, B. (2022) The effects of methane clathrates on the thermal and seismic profile of Titan's icy lithosphere. *Planetary Science Journal*, in press.
- Marusiak, A. G., Panning, M. P., **Vance, S. D.**, Nunn, C., Stähler, S. C., Tharimena, S. (2022) Seismic detection of euroquakes originating from Europa's silicate interior. *Earth and Space Science* [2021EA002041](#).
- Carnahan, E., **Vance, S. D.**, Hesse, M., Journaux, B., Sotin, C. (2022) Dynamics of clathrate-ice shells on ocean worlds, *GRL* 49, [e2021GL097602](#).
- Hesse, M. A., Jordan, S., **Vance, S. D.**, Oza, A. V. (2021) Downward oxidant transport through Europa's ice shell by density-driven brine percolation, *GRL*, 49, [e2021GL095416](#).
- Cochrane, C. J., Persinger, R. R., **Vance, S. D.**, Midkiff, E. L., Castillo-Rogez, J., Luspay-Kuti, A., Liuzzo, L., Paty, C., Mitchell, K. L., Prockter, L. M. Single- and multi-pass magnetometric subsurface ocean detection and characterization in icy worlds using Principal Component Analysis (PCA): Application to Triton. *Earth and Space Science*, 9, [e2021EA002034](#).
- Cochrane, C. J., **Vance, S. D.**, Nordheim, T. A., Styczinski, M., Master, A. Regoli, L. H. (2021) In Search of Subsurface Oceans within the Uranian Moons, *JGR-Planets*, 126, [e2021JE006956](#).
- Styczinski, M. J., **Vance, S. D.**, Harnett, E. M., and Cochrane, C. J. (2022). A perturbation method for evaluating the magnetic field induced from an arbitrary, asymmetric ocean world analytically. *Icarus*, 114840, [10.1016/j.icarus.2021.114840](#).
- Liuzzo, L., Paty, C., Cochrane, C., Nordheim, T., Luspay-Kuti, A., Castillo-Rogez, J., Mandt, K., Mitchell, K. L., Holmstrom, M., Addison, P., Simon, S., Poppe, A. R., **Vance, S. D.**, and Prockter, L. (2021) Triton's Variable Interaction with Neptune's Magnetospheric Plasma, *JGR-Space Physics*, [10.1029/2021JA029740](#).
- Marusiak, A. G., **Vance, S.**, Panning, M. P., Běhouňková, M., Byrne, P. K., Choblet, G., Daswani, M. M., Hughson, K., Journaux, B., Lobo, A. H., Schmidt, B. E., Sládková, K. P., Soderlund, K. M., Song, W., Souček, O., Steinbrügge, G., Thompson, A. F., and Wang, S. (2021). Exploration of icy ocean worlds using geophysical approaches. *The Planetary Science Journal*, 2(4):150.
- Crósta, A.P., Silber, E.A., Lopes, R.M.C., Johnson, B.C., Bjonnes, E., Malaska, M.J., **Vance, S.D.**, Sotin, C., Solomonidou, A., Soderblom, J.M. (2021) Modeling the formation of Menrva impact crater on Titan: Implications for habitability, *Icarus*, [10.1016/j.icarus.2021.114679](#).

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12. Melwani Daswani, M. **Vance, S. D.**, Mayne, M. J., Glein, C. R. (2021) A metamorphic origin for Europa's ocean. *GRL*, 48, [10.1029/2021GL094143](https://doi.org/10.1029/2021GL094143).
13. Lobo, A. H., Thompson, A. F., **Vance, S. D.**, Tharimena, S. (2021) A pole-to-equator ocean overturning circulation on Enceladus. *Nature Geoscience*, [10.1038/s41561-021-00706-3](https://doi.org/10.1038/s41561-021-00706-3).
14. **Vance, S. D.**, Journaux, B., Hesse, M., and Steinbrügge, G. (2021). The salty secrets of icy ocean worlds. *JGR-Planets*, 126, [10.1029/2020JE006736](https://doi.org/10.1029/2020JE006736).
15. Béhounková, M., Tobie, G., Kervazo, M., Melwani Daswani, M., Dumoulin, C. **Vance, S. D.** (2021) Tidally-induced magmatic pulses on the oceanic floor of Jupiter's moon Europa. *GRL*, [10.1029/2020GL090077](https://doi.org/10.1029/2020GL090077).
16. **Vance, S. D.**, Bills, B. G., Cochrane, C. J., Soderlund, K. M., Gómez-Pérez, N., Styczinski, M., Paty, C. (2021) Magnetic Induction Responses of Jupiter's Ocean Moons Including Effects from Adiabatic Convection. *JGR-Planets*, [10.1029/2020JE006418](https://doi.org/10.1029/2020JE006418).
17. Wang, S., Panning, M. P., **Vance, S. D.**, Song, W. (2021). Underground microseismic event monitoring and localization within sensor networks. *Sensors*, 21(8):2830.
18. Wang, S., Li, F., Panning, M., Tharimena, S., **Vance, S.**, and Song, W. (2020). Ambient noise tomography with common receiver clusters in distributed sensor networks. *IEEE Transactions on Signal and Information Processing over Networks*, 6:656-666, [10.1109/TSIPN.2020.3019328](https://doi.org/10.1109/TSIPN.2020.3019328).
19. Steinbrügge, G. Voigt, J. R. C., Wolfenbarger, N. S., Hamilton, C. W., Soderlund, K. M., Young, D. A., Blankenship, D. D., **Vance, S. D.**, Schroeder, D. M. (2020) Brine Migration and Impact-Induced Cryovolcanism on Europa. *GRL*, 47, [10.1029/2020GL090797](https://doi.org/10.1029/2020GL090797).
20. Blanc, M., Prieto-Ballesteros, O., André, N., Gomez-Elvira, J., Jones, G., ... **Vance, S. D.**, et al. (2020) Joint Europa Mission (JEM): a multi-scale study of Europa to characterize its habitability and search for extant life, *Planetary and Space Science*, 193, [10.1016/j.pss.2020.104960](https://doi.org/10.1016/j.pss.2020.104960).
21. White, L. M., Shibuya, T., **Vance, S. D.**, Christensen, L. E., Bhartia, R., Kidd, R., Hoffmann, A., Stucky, G. D., Kanik, I., and Russell, M. J. (2019). Simulating Serpentinization as It Could Apply to the Emergence of Life Using the JPL Hydrothermal Reactor. *Astrobiology*, [10.1089/ast.2018.1949](https://doi.org/10.1089/ast.2018.1949). Cover of March issue.
22. Taubner, R.S., Olsson-Francis, K., **Vance, S. D.**, Ramkissoon, N. K., Postberg, F., de Vera, J.-P., Antunes A., et al. (2020). Experimental and Simulation Efforts in the Astrobiological Exploration of Exooceans. *Space Sci. Rev.*, 216, [10.1007/s11214-020-0635-5](https://doi.org/10.1007/s11214-020-0635-5).
23. Journaux, B., Kalousová, K., Sotin, C., Tobie, G., **Vance, S.**, Saur, J., Bollengier, O., et al. (2020). Large Ocean Worlds with High-Pressure Ices. *Space Sci. Rev.*, 216, [10.1007/s11214-019-0633-7](https://doi.org/10.1007/s11214-019-0633-7).
24. Stähler, S. C., Panning, M. P., Hadziioannou, C., Lorenz, R. D., **Vance, S.**, Klingbeil, K., Kedar, S. (2019). Seismic signal from waves on Titan's seas. *Earth and Planetary Science Letters* 520, 250-259
25. Journaux, B., Brown, J., Pakhomova, A., Collings, I., Petitgirard, S., Espinoza, P., Boffa Ballaran, T., **Vance, S.**, et al. (2019). Holistic approach for studying planetary hydrospheres: Gibbs representation of ices thermodynamics, elasticity and the water phase diagram to 2300 MPa. *Journal of Geophysical Research: Planets*, [10.1029/2019JE006176](https://doi.org/10.1029/2019JE006176).
26. **Vance, S. D.**, Barge, L. M., Cardoso, S. S., and Cartwright, J. H. (2019). Self-assembling ice membranes on Europa: Brinicle properties, field examples, and possible energetic systems in icy ocean worlds. *Astrobiology*, 19(5), 685-695.
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- Singer, K. N., Soderblom, J. M. and **Vance, S. D.** (2019). The NASA Roadmap to Ocean Worlds. *Astrobiology*, 19(1), [10.1089/ast.2018.1955](https://doi.org/10.1089/ast.2018.1955).
28. Marques, J. M., Etiope, G., Neves, M. O., Carreira, P. M., Rocha, C., **Vance, S. D.**, Christensen, L., Miller, A. Z. Suzuki, S. (2018). Linking serpentinization, hyperalkaline mineral waters and abiotic methane production in continental peridotites: an integrated hydrogeological-bio-geochemical model from the Cabeço de Vide CH<sub>4</sub>-rich aquifer (Portugal). *Applied Geochemistry*, 96, [287-301](https://doi.org/10.1016/j.apgeochem.2018.08.011).
  29. Ozgurel, O., Mousis, O., Pauzat, F., Ellinger, Y., Markovits, A., **Vance, S.**, and Leblanc, F. (2018). Sodium, potassium, and calcium in Europa: An atomic journey through water ice. *Astrophys. J. Lett.*, 865(2), [L16](https://doi.org/10.1088/1538-4357/865/2/L16).
  30. Glein C. R., Postberg, F., and **Vance, S. D.** (2018). The geochemistry of Enceladus: Composition and controls. In *Enceladus and the Icy Moons of Saturn* (P. M. Schenk et al., eds.), Univ. of Arizona, Tucson, pp. [39-56](https://doi.org/10.1017/9781009107000.003).
  31. **Vance, S. D.** (2018). Solar System exploration: Icy ocean worlds and their habitability In: V. Kolb (ed.) *Handbook of Astrobiology*. CRC Press. [orcid.org/0000-0002-2081-5771](https://orcid.org/0000-0002-2081-5771).
  32. **Vance, S. D.** (2018). The Habitability of Icy Ocean Worlds in the Solar System. In: Deeg H., Belmonte J. (eds) *Handbook of Exoplanets*. Springer, Cham, [1-23](https://doi.org/10.1007/978-3-319-91128-1_1).
  33. **Vance, S. D.**, Kedar, S. Panning, M. P., Stähler, S. C., Bills, B. G., Lorenz, R. D. Huang, H.-H., Pike, W. T., Castillo, J. C., Lognonne, Tsai, P. V. C., Rhoden, A. R. (2018). Vital Signs: Seismology of Icy Ocean Worlds. *Astrobiology*, 18(1) [37-53](https://doi.org/10.1007/s12018-017-0161-2). [ast.2016.1612](https://doi.org/10.1007/s12018-017-0161-2)
  34. **Vance, S. D.**, Panning, M. P., Stähler, S., Cammarano, F., Bills, B. G., Kedar, S., Sotin, C., Pike, W. T., Lorenz, R., Tsai, V., Huang, H.-H., Jackson, J. M., Banerdt, B. (2018). Geophysical investigations of habitability in ice-covered ocean worlds, *JGR-Planets*, **123**. [10.1002/2017JE005341](https://doi.org/10.1002/2017JE005341)
  35. Stähler, S., Panning, M. P., **Vance, S. D.**, Lorenz, R., van Driel, M., Nissen-Meyer, T., Kedar, S. (2018). Seismic wave propagation in icy ocean worlds, *JGR-Planets*, **123**. [10.1002/2017JE005338](https://doi.org/10.1002/2017JE005338)
  36. Panning, M. P., Stähler, S. C., Huang, H.-H., **Vance, S. D.**, Kedar, S., Tsai, V., Pike, W. T., Lorenz, R. D. (2018). The seismic noise environment of Europa, *JGR-Planets*, **123**. [10.1002/2017JE005332](https://doi.org/10.1002/2017JE005332)
  37. Zhu, P., Manucharyan, G. E., Thompson, A. F., Goodman, J. C., **Vance, S. D.** (2017). The influence of meridional ice transport on Europa's ocean stratification and heat content. *Geophys. Res. Lett.*, **44**, [10.1002/2017GL072996](https://doi.org/10.1002/2017GL072996)
  38. Aglyamov, Y., Schroeder, D. M., **Vance, S. D.** (2017). Bright prospects for radar detection of Europa's ocean. *Icarus*, **281**, [334-337](https://doi.org/10.1016/j.icarus.2017.03.011).
  39. Romero-Wolf, A., Schroeder, D. M., Ries, P., Bills, B. G., Naudet, C., Scott, B. R., Treuhaft, R. **S. Vance** (2016). Prospects of Passive Radio Detection of a Subsurface Ocean on Europa with a Lander. *Planetary and Space Sciences*, **15**, [118-121](https://doi.org/10.1016/j.pss.2016.08.011).
  40. **Vance, S. D.**, Hand, K. P., Pappalardo, R. T. (2016). Geophysical controls of chemical disequilibria in Europa and other wet, rocky worlds, *Geophys. Res. Lett.*, [10.1002/2016GL068547](https://doi.org/10.1002/2016GL068547).
  41. **Vance, S. D.** Loerting, T., Stern, J., Kropf, M., Journaux, B., Jamieson, C., Cable, M. L., and Bollengier, O. (2016). Solids and fluids at low temperatures, in *Low Temperature Materials and Mechanisms*, CRC Press
  42. Castillo, J. C., Bar-Cohen, Y., **Vance, S. D.**, Choukroun, M., Lee, H. J., Bao, X., Badescu, M., Sherritt, S., Trainer, M. G., and Getty, S. (2016). Sample handling and instruments for the in-situ exploration of ice-rich planets, in *Low Temperature Materials and Mechanisms*, CRC Press.
  43. Romero-Wolf, A., **Vance, S.**, Maiwald, F., Heggy, E., Ries, P., Liewer, K. (2015). A Passive Probe for Subsurface Oceans and Liquid Water in Jupiter's Icy Moons, *Icarus*, **248**, [463-477](https://doi.org/10.1016/j.icarus.2015.07.011).

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44. **Vance, S.**, Bouffard, M., Choukroun, M., and Sotin, C. (2014). Ganymede's Internal Structure Including Thermodynamics of Magnesium Sulfate Oceans in Contact with Ice. *Planetary and Space Science*, **96**, 62-70.
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46. Pappalardo, R. T., **Vance, S.**, Bagenal, F., Bills, B. G. Blaney, D. L., Blankenship, D. D., Brinckerhoff, W. B., Connerney, J. E. P., Hand, K. P., Hoehler, T. M., Liesner, J. S., Kurth, W. S., McGrath, M. A., Mellon, M. T., Moore, J. M., Patterson, G. W., Prockter, L. M., Senske, D. A., Schmidt, B. E., Shock, E. L., Smith, D. E., Soderlund, K. M. (2013). Science potential from a Europa lander. *Astrobiology*, **13**(8), 740-773.
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48. **Vance, S.** and Brown, J.M. (2013). Thermodynamic properties of aqueous MgSO<sub>4</sub> to 800 MPa at temperatures from -20 to 100 °C and concentrations to 2.5 mol kg<sup>-1</sup> from sound speeds, with applications to icy ocean world oceans. *Geochim. Cosmochim. Acta* **110**, 176-189.
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53. **Vance, S.** and Goodman, J. (2009). Oceanography of an Ice-covered Moon. *EUROPA*, University of Arizona Press
54. Som, S. M., Adam, Z. R. and **Vance, S.** (2009). Use the Water: In-Situ Resource Technology for Icy-Surface Landers. *Acta Astronautica* **64**, 1006-1010.
55. **Vance, S.**, and Brown, J.M. (2008). The simulator for icy world interiors: A 700 MPa pressure system for impulsive stimulated scattering and other optical measurements, with thermal control from -20 to 100 °C. *Rev. Sci. Inst.* **79**(1), 105.
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58. **Vance, S.** and Brown, J. M. (2005). Layering and Double-Diffusion Style Convection in Europa's Ocean. *Icarus* **177**, 506-514.

## Patents and New Technology Reports

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Vance, S., L. E. Christensen, A. Aubrey, 2013. Carbon Responsive Isotope Laser Spectrometer (CRILS). NTR-49291.

## Flight Project Experience

- 2020–present **Europa Clipper: Co-Chair, Habitability Assessment Board (HAB)**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Lead for planning science observations and synthesis to meet the mission's overarching mission Goal to investigate Europa's habitability.
- 2019–present **Europa Clipper: Subject Matter Expert**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Science expert on Europa's geophysics and habitability.
- 2015–2020 **Europa Clipper: Facilitator, Habitability Thematic Working Group**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Technical interface between the Habitability Working Group and Project Science team.
- 2015–2019 **Europa Clipper: MASPEX Investigation Scientist**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Science and technical interface between the MASPEX instrument team at the Southwest Research Institute and the Europa Project Science team.
- 2013–2018 **Europa Clipper: Staff Scientist**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Participating in Europa Clipper mission concept formulation activities.
- October 2009 to 2013 **Europa Habitability Mission Study, Science Study Team Member, Science Definition Team member (2012-2013)**, *JPL Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Participated in studies of Flagship class missions to Europa, particularly in aspects related to habitability and composition.
- 2020–2021 **Trident Discovery Mission Concept: Subject Matter Expert**, *Planetary Science Project Office*, Jet Propulsion Laboratory, Pasadena.  
Provided key modeling data sets for statistical investigation of magnetic induction sounding. Participated in Discovery Review final Site Visit
- 2018–2020 **Joint Europa Mission Concept: Science Definition Team Member**, *ESA-NASA Study*.
- 2015–Present **JPL Team A Participant**, Jet Propulsion Laboratory, Pasadena.  
Mission concept target bodies considered: Ceres, Europa, Enceladus, ocean world subsurfaces, Saturn moons
- 2013, 2014 **Planetary Science Summer School Review Board Member**, Jet Propulsion Laboratory, Pasadena.  
Critiqued studies of Io and ice giants mission concepts.
- October 2011–July 2012 **Project Manager and PI: CubeSat Hydrometric Atmospheric Radiometric Mission (CHARM)**, *JPL Phaeton Program*, Jet Propulsion Laboratory, Pasadena.  
Developed the early stages of a small Earth-orbiting satellite project to measure radiance temperatures from low-Earth orbit for atmospheric science and rapid TRL advancement. Required hiring, schedule and budget management, and negotiating and documenting requirements according to NASA and JPL project practices.

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Summer 2008 **JPL Planetary Science Summer School**, *JPL Planetary Science Project Office*,  
Jet Propulsion Laboratory, Pasadena.  
Participated in development of a mission concept to impact trojan asteroids: SHOTPUT.



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## Prior Research Experience

- 2009–2010 **Caltech Postdoctoral Fellow**, *supervisor: Dr. Isik Kanik*, Jet Propulsion Laboratory, Pasadena, Developed applications of diffusion mobility spectroscopy. Participated in astrobiology related work as part of the Europa Jupiter System Mission science definition team. Developed the science rationale for instrumentation on the Jupiter Europa Orbiter for EJSM.
- 2007–2009 **NASA Postdoctoral Fellow**, *supervisor: Dr. Christopher R. Webster*, Jet Propulsion Laboratory, Pasadena, Developed scientific applications for the Mars Science Laboratory Tunable Laser Spectrometer using comparable laboratory and field instruments developed at JPL. Investigated applications of physical chemistry to the structure and evolution of habitable planets.
- 2001–2007 **Research Assistant**, *supervisor: Prof. J. Michael Brown*, University of Washington, Seattle, Constructed and operated high-pressure instrumentation; collected and analyzed sound velocity data for aqueous solutions obtained by the method of impulsive stimulated scattering (ISS). Applied results to understanding physical processes in deep extraterrestrial oceans and hydrothermal systems.
- 2003–2004 **Research Associate**, *supervisor: Prof. Jody Deming*, Canadian Arctic Shelf Exchange Study, Prepared and inventoried shipboard laboratory on CCGS Amundsen while frozen into Franklin Bay, Northwest Territories, Canada; collected and preserved ice core samples for characterizing winter intra-ice bacterial populations.
- 2003 **Research Associate**, *supervisor: Prof. Tilman Spohn*, Institut für Planetologie, Münster, Reviewed hydrothermal systems literature and investigated means for modeling permeability of extraterrestrial seafloors.
- 2001 **Research Associate**, *supervisor: Dr. Remington Stone*, UCO/Lick Observatory, Operated Nickel reflector telescope for acquisition of optical SETI data.
- 1998–2001 **Research Assistant**, *supervisor: Prof. Frank Bridges*, University of California, Santa Cruz, Built apparatus and performed experiments investigating impact sticking of water- and methanol-frosted ices. Applied results to understanding accretion of large-particles (> cm-size) in the early solar nebula.

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## Science Community Service

- Lead Author on white papers for the 2023-2032 Planetary Sciences Decadal Survey:
  - “Addressing Mental Health in Planetary Science”
  - “Distributed Geophysical Exploration of Enceladus and Other Ocean Worlds”
  - “Planetary Seismology: The Solar System’s Ocean Worlds”
- President, AOGS Planetary Sciences Section, 2019-present
- Secretary, AOGS Planetary Sciences Section, 2014–2019
- Participant, AGU Congressional Geosciences Visits, September 2008, November 2018
- Lead Author, “Geophysical Investigations of Habitability in Icy Ocean Worlds,” white paper for the 2018 NRC Astrobiology panel.
- Participant, NASA Roadmap for Ocean Worlds, 2016
- Contributor and lead author, Astrobiology Strategy (astrobiologyfuture.org), 2013–2015
- NASA Panel Reviewer, 2009, 2014–2018
- NASA Panel Review Chair, 2016

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- Participant, AAS Planetary Science Congressional Visits, April 2012
- Organizer, Outer Planet Colloquium Series (outerplanets.jpl.nasa.gov), 2008-2011
- Lead Author, "Icy Satellite Processes in the Solar System: A plurality of worlds," white paper for the 2009-2010 Planetary Sciences Decadal Survey (Appendix B).

## Conference Honors and Duties; C=Convener, SC=Session Chair

- **American Geophysical Union Fall Meeting**
  - 2021: Ice and Ocean Worlds: Geology, Oceanography, Chemistry, Habitability, **C,SC**
  - 2020: Ice and Ocean Worlds: Geology, oceanography, chemistry, habitability, **C, SC**
  - 2019: Ice and Ocean Worlds: Geology, Oceanography, Chemistry, Habitability, **C, SC**
  - 2018: P42B, From the Earth to the Moons: Unraveling the Geologic, Oceanographic, and Chemical Mysteries of Ice and Ocean Worlds **C, SC**
  - 2015: P026, Science from Current and Future Planetary Missions **C, SC**
  - 2014: P52A, Icy World Eruptions and Their Analogs **C, SC**
  - 2010: P17, Icy Ocean Worlds **C**
  - 2009: P18, Potential Biomarkers on Mars: Detection, Characterization and Earth Analogue Systems **C**
  - 2006: P31D, Once in a Blue Moon: The Surprising Diversity of Outer Planet Satellites I **SC**  
P23E, Satellites, Rings, and Ices Posters **SC**
- **Asia Oceania Geosciences Society Meeting**
  - 2018: Lead for PS18 Understanding Icy Worlds, Ocean Worlds, and Habitability **C**
  - 2015: US Secretary for Planetary Science; PS07 Icy Satellites and Rings **C**
  - 2014: PS03 Outer Solar System Satellites With an Atmosphere **C**, PS02 Icy Satellites and Rings, PS09-10 Astrobiology: Habitable Worlds in the Solar System and Beyond, and the Quest for Life's Origins **C**
  - 2013: PS04 Quest for Habitable Worlds, PS13 Active Satellites in the Solar System **C**
  - 2012: PS09 Active Satellites in the Outer Solar System, PS10 Exploring Habitability in the Solar System and Beyond **C**
  - 2011: PS06 Outer Planets and Icy Worlds, PS14 Astrobiology - Life in the Universe **C**
  - 2010: PS03 Astrobiology and Ices **C**, PS11 Satellites and Rings in the Outer Solar System **C**
  - 2009: PS09-15 Planetary Ices and Astrobiology **C**
  - 2008: PS08 Satellites and Rings in the Outer Solar System **C, SC**
- **Astrobiology Science Conference (AbSciCon)**
  - 2022: Deep Dive into the Geophysics of Ocean Worlds **C, SC**
  - 2020: Interiors of habitable planets: influence of deep processes and new sub-surface habitats **C**; The Many Layers of Titan **C** (CANCELLED)
  - 2015: Panelist: Where, why, and how of places to search for life in the Solar System
  - 2012: Serpentinization in Astrobiology: From Molecular to Cosmic Scales **C**
  - 2008: Session 13. The Deep Cold Biosphere? Interior Processes of Icy Satellites and Dwarf Planets **C, SC**, Session 2. Advances in Astrobiological Instrumentation Development **C**
- **Division of Planetary Science (DPS), Online October 2020**, Tuesday Plenary Moderator
- **Titan After Cassini-Huygens, ESAC September 2019**, Science Organizing Committee member
- **First Billion Years: Habitability, Big Sky, Montana, September 2019**, Science Organizing Committee member
- **Cryovolcanism in the Solar System, LPI June 2018**, Science Organizing Committee member

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- **Conference on the Habitability of Icy Worlds, 2014** Member of Local Organizing Committee; Ocean Physics and Chemistry **SC**
- **Japanese Geoscience Union Meeting**  
2019: P-PS01 Outer Solar System Exploration Today, and Tomorrow **C, SC** 2018: P-PS01 Outer Solar System Exploration Today, and Tomorrow **C** 2017: P-PS01 Outer Solar System Exploration Today, and Tomorrow **C** 2016: P-PS01 Outer Solar System Exploration Today, and Tomorrow **C** 2015: P-PS01 Outer Solar System Exploration **C, SC**, P-P04 International Collaboration **C, SC**
- **Lunar and Planetary Sciences Conference**
  - 2015: Pluto, Kuiper Belt Objects, and New Horizons: Casting Light on Dark Worlds **SC**
  - 2013: License to Chill (or, the solar system's icy moons), **SC** Dornik Awards Judge
  - 2009: Special Session: Icy Satellites of Jupiter and Saturn: Cosmic Gymnasts **SC**
  - 2008: Titan **SC**
  - 2007: Astrobiology **SC**
- **Ocean Worlds 4, USRA May 2019**, Science Organizing Committee member
- Graduate Student Representative at Graduate Preliminary Examinations, Department of Earth and Space Sciences, University of Washington, Seattle, 2005-2006
- Graduate Student Representative to Faculty, Department of Earth and Space Sciences, University of Washington, Seattle, 2004-2005

## Media Involvement

- Science Consultant, undisclosed video game project 2020-2021
- Panelist, Europa Clipper, Long Beach Comic Con, 2018/09/07
- Guest, The Pestle podcast, 2017/12/19
- Speaker, Oregon Eclipse Festival, 2017/08/19
- Panelist, Long Beach Aquarium World Oceans day, 2015/06/08
- Lead Artist, *Interstellar Emissary*, inspired by the Voyager Disc and Record, 2015-present:
  - Mind Field, 2018, Guest S3 E6 "How to Talk to Aliens"
  - Yuri's Night Los Angeles, 2015 and 2018
  - Dr. Mae Jemison - 25 Strong, 2017
  - Burning Man, 2015, 2017, 2019
  - Further Future, 2015
- Guest, Bill Carroll Show, KFI AM 640, 2015/03/31
- Consultant, The Science and Entertainment Exchange, 2011-present
- Panelist, Exploration of Europa, San Diego Comic-Con 2013
- Scientific Advisor, "Europa Report", a feature film, 2011-2013
- Musical Director, "Piled Higher and Deeper," a feature film, 2011

## Blog Contributions and Popular Articles

- "How the Solar System's Largest Ocean Worlds Compare in Size", Business Insider, 2016/10
- "My History with the Proposed Europa Clipper Mission," ELSI Blog, 2015/03/12
- "My Month in Japan," ELSI Blog, 2014/09/18
- Europa Multiple Flyby Mission schematic caption, National Geographic, 2014/07
- "Scientific Inspiration in Tokyo," ELSI BLog, 2014/01/21
- "Destination: Europa!" Planetary Society, 2013/12/16
- "Europa Is The New Mars: How Sci Fi Follows Science", Popular Science online, 2013/06

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## Select Invited Public Lectures

- "Exploring Icy Ocean Worlds in the Solar System and Beyond", U St. Andrews, UK, 2018/11.
- "The Europa Clipper Mission", Explore Your Universe, UCLA, 2018/11
- "Exploring Icy Ocean Worlds in the Solar System and Beyond", Rothney Astronomical Observatory, Calgary, 2018/09.

## Mentoring

- Recruitment to Planetary Interiors and Geophysics Group
  1. Space Physicist (internal move) 2022—Corey Cochrane
  2. Lunar Seismologist 2021—Ceri Nunn
  3. Geochemist 2020—Mohit Melwani Daswani
- Postdoctoral
  1. Marshall Styczinski, 2021-present (NASA Postdoctoral Scholar, JPL)
  2. Angela Marusiak, 2020-present (JPL Postdoc)
  3. Saikiran Tharimena, 2018-2020 (JPL Postdoc)
  4. Mohit Melwani Daswani, 2018-2020 (JPL Postdoc)
  5. Baptiste Journaux, 2016-2020 (NASA Postdoctoral Scholar, UW Seattle)
  6. Olivier Bollengier, 2014-2019 (UW Seattle)
- Graduate
  1. Catherine Psarakis, 2021-present (SURF-YIP, UCLA)
  2. Evan Carnahan, 2020-present (YIP, UT Austin) **Masters thesis reading committee member**
  3. Ana Helena de Oliveira Lobo, 2018-2021 (YIP, Caltech)
  4. Marshall Styczinski, 2018-2021 (NASA SG/NESSF, UW Seattle) **PhD committee member**
  5. Bruno Jacob, 2016 (JVS RP, UC Santa Barbara; returning)
  6. Nguyen Nguyen, 2015 (SIRI, CSU Long Beach)
  7. Rodolfo Batista Negri, 2015 (JVS RP, George Washington U.)
  8. Elena Amador, 2014 (JVS RP, UW, Seattle)
  9. Jonathan Bapst, 2014 (JVS RP, UW, Seattle)
  10. Nina Bothamy, 2014 (JVS RP, ENS Lyon)
  11. Amira Elsenousy, 2014 (JVS RP, U Arkansas)
  12. Bruno Pereira, 2013 (JVS RP, Brazil, U. Federal de Uberlândia)
  13. Mathieu Bouffard, 2012 (JVS RP, ENS Lyon)
  14. Aomawa Shields, 2011 (JVS RP, UW Seattle)
  15. Shelly Shaul, 2009 (CSU STAR, Cal Poly Pomona)
- Undergraduate
  1. Mara Niesyt 2021 (CSU STAR, Cal Poly San Luis Obispo)
  2. Artyom Lisitsyn, 2021 (YIP, U Edinburgh)
  3. Samentha Dumervil, 2020-2021 (MSP, Howard U)
  4. Andrew Chan, 2020-2021 (SURF, YIP, Caltech)
  5. Jeremy Engels, 2019 (YIP, UCLA)
  6. Nikhil Pawar, 2019 (YIP, UCLA)
  7. Katherine Vega, 2018 (SIP, CU Boulder)
  8. Lacy Schneemann, 2018 (YIP, USC)
  9. Eduardo Salazar, 2017-2018 (YIP, Cal Poly Pomona)
  10. Elise Cutts, 2016 (SURF, Caltech)
  11. Riley James, 2016 (SURF, Occidental College)

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12. Peiyun Zhu, 2016 (Caltech SURF, U. Michigan)
13. Jesse Mendoza, 2016 (UCR MIRO, UC Riverside)
14. Kimberly Lykens, 2015 (CSU STAR, Stebbins High School)
15. Leila Chang, 2015 (YIP, Yale)
16. Garrett Levine, 2015 (SURF, Caltech)
17. Yury Aglyamov, 2015 (SURF, Caltech)
18. Cauê Borlina, 2015 (YIP, U-Michigan)
19. Jessica Williams, 2014-2016 (SIRI-YIP, Cal Poly Pomona)
20. Natalie Cobian, 2015 (SIRI, East LA College)
21. Hohvannes Gregorchuk, 2014-2015 (SIRI-YIP, Glendale Community College)
22. Marika Leitner, 2014 (YIP, CSU Humboldt)
23. Eliav Maas, 2013-2014 (SIRI-YIP, Santa Monica Community College)
24. Rana Abdel Sattar, 2013 (SIRI, Glendale Community College)
25. Adam Hoffmann, 2013 (SIRI, Mt. San Antonio Community College)
26. Roshan Nanu, 2010 (SURF, Caltech)
27. Noemie Pochat, 2009 (Undergraduate Summer Fellow, Wheaton College)
28. Nicholas Castle, 2007 (incoming graduate student, UW Seattle)
29. Hoku West-Foyle, 2006-2007 (MinPhys lab intern, UW Seattle)
30. Virginia Player, 2006 (MinPhys lab intern, UW Seattle)

## Teaching Experience

- 2021 **Guest Lecturer**, *Spring Summer School*, European Astrobiology Network Association, Lecture on hydrothermal systems and habitability of Europa.
- 2017, 2019, **Guest Lecturer**, *Geobiology & Astrobiology, BISC 483*, University of Southern California, Discussion of ocean worlds and mission concepts for exploring them..
- 2021
- 2005-2007 **Founder and Facilitator**, *UWAB Planetology Discussion Group*, University of Washington, Seattle, Organized weekly reviews among fellow astrobiology graduate students of selected journal articles pertaining to the formation and evolution of solar system objects and exoplanets.
- Winter 2004 **Teaching Assistant**, *Physics Department*, University of Washington, Seattle, 114 and 121: Waves and Mechanics. Taught three sections, approximately 20 students per section.
- 2002-2003 **Visiting Scientist**, *Project AstroBio*, Seattle, Presented two guest lectures for a Seattle fifth grade class of approximately 30 students.
- 2002-2005 **Tutor**, *University Tutoring Service*, Seattle, Three undergraduate or high-school students per year. Topics included algebra, trigonometry, calculus, physical chemistry, and introductory physics.
- Spring-Summer, 2001 **Teaching Assistant**, *Physics Department*, University of California, Santa Cruz, 5B Labs: Wave motion in matter, including sound waves. Taught two sections, approximately 20 students per section.
- 1998-2001 **Mathematics and Physics Tutor**, *Self-employed*, University of California, Santa Cruz, Taught two undergraduate or high-school students per year on average. Topics included econometrics, calculus, and introductory physics.

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## Awards and Honors

- JPL Team Award, "For extraordinary [group leadership] during the COVID pandemic," 2021
- JPL Team Award, "For contributions on the Trident Discovery Class Mission....", 2021
- JPL Voyager Award, "Acting Group Supervisor for Planetary Chemistry and Astrobiology," 2019
- JPL Team Award, "For leadership & development of the Titan Astrobiology Institute node," 2018
- JPL Voyager Award, "For significant contributions to the Europa Mission," 2016
- JPL Voyager Award, "For refurbishments of the Planetary Ices Laboratory," 2015
- JPL Group Achievement Award, "For significantly advancing our understanding of the habitability, survivability, and detectability of life on icy worlds through transdisciplinary astrobiological investigations," 2015
- NASA Postdoctoral Fellowship, 2007-2009

## Recent Oral Presentations

**Vance, S.D.** 2023. Hydrothermal systems and cryovolcanism in Jupiter's moons. *ISSI Workshop Exploring the Jovian satellite system: from formation to habitability*. **INVITED** (Beijing (delayed from 2022 due to Covid)).

**Vance, S.D.**, B. Journaux, M. Melwani Daswani, B. G. Bills, J. M. Brown, E. Abramson, S. Howell, M. Styczinski, H. Hay, 2022. Using Gravity to Distinguish Features of Habitable Ocean Worlds. *AbSciCon* (Atlanta).

**Vance, S.D.** 2022. Electrical Conductivity Data for Investigating Ocean World Habitability. *COSPAR*. **INVITED** (Athens).

**Vance, S.D.** 2022. Revealing the Salty Secrets of Icy Ocean Worlds. *Workshop on Ice-Ocean Interactions in Moons in the Solar System*. **INVITED** (Princeton).

**Vance, S.D.** 2021. **INVITED** participant, "Next Generation Planetary Geodesy", Keck Institute for Space Studies.

**Vance, S.D.** 2020. Using Geophysics to Investigate the Habitability of Ocean Worlds. *ISAS Planetary Exploration Workshop*. **INVITED** (online only).

**Vance, S.D.** B.G. Bills, M.P. Panning, C. Cochran, K. Soderlund, T. Nordheim, J.M. Brown, B. Journaux, M. Styczinski, C. Paty, S. Tharimena, M. Melwani Daswani, M. Neveu, K. Chin 2020. Coupling Geochemistry to Magnetic Induction, Gravity, and Seismology in Icy Ocean Worlds. *Joint JpGU-AGU Meeting*. (withdrawn due to COVID-19).

**Vance S.D.**, R.T. Pappalardo, D.A. Senske, H. Korth, K. Craft, S. Howell, R. Klima, E.J. Leonard, C.B. Phillips, C. Richey, and the Europa Clipper Science Team 2020. The Europa Clipper Mission: Investigating an Ocean World's Habitability. *Joint JpGU-AGU Meeting*. **INVITED** (withdrawn due to COVID-19).

**Vance, S.D.** and J. Green 2020. Current and Future Prospects for International Cooperation in Planetary Sciences *Joint JpGU-AGU Meeting*. **INVITED** (cancelled due to COVID-19).

**Vance, S. D.**, G. Tobie, M.M. Daswani, and G. Choblet (2019). Tidal signatures of geochemically rigorous interior structure for Ganymede. *EPSC Abstracts*, 3(EPSC-DPS2019):1149-1.

**Vance, S.**, R. Barnes, B. Journaux, 2020. Our solar system's ocean worlds as analogue habitable ice-covered exoplanets. *Exoplanets in our Backyard*. Woodlands, TX. **INVITED**.

**Vance, S.D.** and M. Melwani Dawani 2019. Hydrothermal Activity in the Solar System's Ocean Worlds. *Fall AGU Meeting*. **INVITED**.

**Vance, S.D.**, 2019. Exploring Icy Ocean Worlds in the Solar System and Beyond. *Earth Science Colloquium*, University of Oregon, Eugene. **INVITED**.

**Vance, S.D.**, 2018. Exploring Icy Ocean Worlds in the Solar System and Beyond. *Physics*

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*Colloquium*, University of Calgary. **INVITED.**

**Vance, S.D.**, 2018. Serpentin(it)e and the search for life beyond Earth. *Serpentinite in the Earth System*, Royal Society, London. **INVITED.**

**Vance, S.D.**, 2018. Exploring Icy Ocean Worlds in the Solar System and Beyond. *Physics Colloquium*, University of Calgary. **INVITED.**

**Vance, S.D.**, J. M. Brown, O. Bollengiar, B. Journaux, E. H. Abramson, G. Shaw, M. Malaska, 2018. Delving Into Ocean World Interiors. *Experimental Analysis of the Outer Solar System*, U. Arkansas, Fayetteville. **INVITED.**

**Vance, S.D.**, 2018. Habitability of Icy Moons. *Pop-Up Institute on Planetary Habitability*, UT Austin. **INVITED.**

**Vance, S.D.**, 2018. Deep Oceans in Large Icy Moons. *Workshop on "ExoOceans: Space Exploration of the Outer Solar System Icy Moons Oceans"*, ISSI, Bern. **INVITED.**

**Vance, S.D.**, C. Glein, A. Bouquet, F. Cammarano, W. B. McKinnon, 2017. Europa's Compositional Evolution and Ocean Salinity. *Eos Trans. AGU, Fall Meet. Suppl.* Abstract P31E-03.

**Vance, S. D.**, S. Kedar, W. B. Banerdt, M. P. Panning, W. T. Pike, S. C. Stähler, 2017. Geophysical Tests for Habitability in Europa and Other Ocean Worlds. AbSciCon, Abstract 3283.

**Vance, S.D.**, 2016. DIY Thermodynamics: Developing flexible equations of state for fluids and using them to understand planetary interiors. *Georgia Tech Earth and Atmospheric Sciences Geophysics Seminar*. Atlanta. **INVITED.**

**Vance, S.D.**, 2016. Atmosphere disequilibrium in different planetary contexts. *Georgia Tech Earth and Atmospheric Sciences Seminar*. Atlanta. **INVITED.**

**Vance, S.D.**, 2016. Atmosphere disequilibrium in different planetary contexts. *Earth-Life Science Institute Annual Symposium*. Tokyo. **INVITED.**

**Vance, S.D.**, K. P. Hand, R. T. Pappalardo, 2015. Geophysical Controls on the Habitability of Icy Worlds: Focus on Europa. *Japanese Geosciences Union*. Makuhari Messe, Chiba City.

**Vance, S.**, 2015. Europa and other icy worlds: Astrobiology at the water rock interface and beyond. Natural History Museum of Los Angeles, staff seminar, **INVITED.**

**Vance, S.**, 2015. Thermodynamic and Geophysical Constraints on the Habitability of Icy World and Exoplanet Oceans, Canadian Astrobiology Training Program Seminar. **INVITED.**

**Vance, S.**, J. M. Brown, R. Barnes, M. Choukroun, and C. Sotin. Thermodynamic Equations of State for Aqueous Ammonia and Sodium Chloride Applied to Deep Icy World and Exoplanet Oceans. *Eos Trans. AGU, Fall Meet. Suppl.* Abstract P41E-07.

**Vance, S.**, 2015. Thermodynamic and Geophysical Constraints on the Habitability of Icy World and Exoplanet Oceans, Canadian Astrobiology Training Program Seminar. **INVITED.**

## Recent Poster Presentations

**Vance, S. D.**, C. Elder, A. Hofmann, S. Howell, M. Milazzo, R. T. Pappalardo, J. L. Noviello, et al. (2021) Addressing Mental Health in Planetary Science. LPSC LII, Abstract 2548, Woodlands, TX (online only).

**Vance, S.**, R. T. Pappalardo, D. A. Senske, H. Korth, K. Craft, R. Klima, C. B. Phillips, C. Richey, and the Europa Clipper Science Team, 2018. The Europa Clipper Mission, Exploring the Habitability of an Icy Ocean World. *Asia Oceania Geosciences Society Meeting*. Honolulu, HI.

**Vance, S.**, C. R. Glein, A. Bouquet, W. B. McKinnon, F. Cammarano, 2017. Permeability and Hydration State of Europa's Rocky Interior, 49th DPS, Abstract 214.05.

**Vance, S.**, R. Barnes, J. M. Brown, C. Sotin and M. Choukroun, 2015. Interior Structure and Habitability of Super-Europas and Super-Ganymedes. LPSC XLVI, Abstract 2717. Woodlands, TX

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**Vance, S.**, J. M. Brown, C. Choukroun, O. Bollengier, B. Journaux, C. Sotin, and R. Barnes, 2015. Thermodynamic Equations of State for Ammonia and Sodium Chloride Solutions Applied to Exoplanet Oceans and Interiors. *Physics of Exoplanets: From Earth-Sized to Mini Neptunes*. Santa Barbara.

**Vance, S.**, J. M. Brown, R. Barnes, C. Choukroun, and C. Sotin, 2015. Thermodynamic Equations of State for Ammonia and Sodium Chloride Solutions Applied to Deep Icy World and Exoplanet Oceans. *ELSI Symposium*. Tokyo, Japan.

## Recent Coauthored Conference Presentations

\*Marusiak, A. G., M. P. Panning, **S. D. Vance**, C. Nunn, S. Stähler, S. Tharimena, 2021. Can a Seismometer Detect Events from Europa's Silicate Interior? Yes, if..., *Eos Trans. AGU, Fall Meet. Suppl.*, New Orleans, LA.

\*Marusiak, A. G., M. P. Panning, **S. D. Vance**, 2020. The Influence and Detectability of Methane Clathrates on Seismic Velocity Structure: Applications to Titan and Icy Ocean Worlds, 52nd DPS, online only.

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