## Dr. Steven D. Vance

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**Education**

Ph.D. Astrobiology and Geophysics, University of Washington, 2007
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

B.S. Physics (with Honors), University of California, Santa Cruz, 2000
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

**Refereed Publications**

**Vance, S.**, M. Bouffard, M. Choukroun, and C. Sotin. Ganymede's Internal Structure Including Thermodynamics of Magnesium Sulfate Oceans in Contact with Ice. *Planetary and Space Science*, revision submitted.

**Vance, S.** and J. C. Goodman, Numerical simulations of $MgSO_4$-bearing hydrothermal plumes for Europa and other icy worlds, *JGR-Planets*, under revision.

Pappalardo, R. T., **S. Vance**, F. Bagenal, B. G. Bills D. L. Blaney, D. D. Blankenship, W. B. Brinckerhoff, J. E. P. Connerney, K. P. Hand, T. M. Hoehler, J. S. Liesner, W. S. Kurth, M. A. McGrath, M. T. Mellon, J. M. Moore, G. W. Patterson, L. M. Prockter, D. A. Senske, B. E. Schmidt, E. L. Shock, D. E. Smith, K. M. Soderlund. Science potential from a Europa lander. *Astrobiology*, **13**(8):740-773, 2013.

Etiope, G., **S. Vance**, L.E. Christensen, J.M. Marques, R. da Costa, I, 2013. Abiotic methane in serpentinized ultramafic rocks in Portugal. *Marine and Petroleum Geology*, **45**, 12-16.

**Vance, S.** and J.M. Brown, 2013. Equations of State for Aqueous $MgSO_4$ to 800 MPa at Temperatures from -20 to 100 $^oC$ and Concentrations to 2.5 mol $kg^{-1}$ from Sound Velocities with Applications to Icy Ocean Worlds. *Geochim. Cosmochim. Acta* **110**, 176189.

Allwood A., D. Beaty, D. Bass, C. Conley, G. Kminek, M. Race, **S. Vance**, and F. Westall, 2013. Conference Summary: Life Detection in Extraterrestrial Samples. *Astrobiology* **13**, 203-216.

**Vance, S.**, L. E. Christensen, C. R. Webster and K. Sung, 2011. Volatile Organic Sulfur Compounds as Biomarkers Complementary to Methane: Infrared Absorption Spectroscopy of $CH_3SH$ Enables in Situ Measurements on Earth and Mars. *Planetary and Space Science* **59**, 299-303.

Sohl, F., M. Choukroun, J. Kargel, J. Kimura, R. Pappalardo, **S. Vance** and M. Zolotov, 2010. Subsurface Water Oceans in Icy Satellites: Chemical Composition and Exchange Processes. *Space Science Reviews, Europlanet Volume on Icy Satellites* 126, DOI 10.1007/s11214-010-9646-y.

**Vance, S.** and J.M. Brown, 2009. Sound Velocities and Thermodynamic Properties of Water to 700 MPa and -20 to 100 $^o$C. *JASA* **127**(1), 174-180.

**Vance, S.** and J. Goodman, 2009. Oceanography of an Ice-covered Moon. *EUROPA*, University of Arizona Press.

Som, S. M., Z. R. Adam and **S. Vance**, 2009. Use the Water: In-Situ Resource Technology for Icy-Surface Landers. *Acta Astronautica* **64**, 1006-1010.

**Vance, S.**, and J.M. Brown 2008. The Icy Satellite Interior Simulator, an Apparatus for Optical Measurements in Aqueous Systems in the range -20 to 100 $^o$C and 700 MPa. *Rev. Sci. Inst.* **79**(1), 105105.

**Vance, S.**, J. Harnmeijer, J. Kimura, H. Hussmann, B. de Martin and J. M. Brown, 2007. Hydrothermal Systems in Small Ocean Planets. *Astrobiology* **7**(6), 987-1005.

**Vance, S.** 2005. Exploration & Characterization of Europa. *in* The Astrobiology Primer: An Outline of General Knowledge—Version 1, 2006. *Eds.* L.J. Mix, J.C. Armstrong, A.M. Mandell, A.C. Mosier, J. Raymond, S.N. Raymond, F.J. Stewart, K. von Braun, and O. Zhaxybayeva *Astrobiology* **6**, 735-813.

**Vance, S.** and J. M. Brown, 2005. Layering and Double-Diffusion Style Convection in Europa's Ocean. *Icarus* **177**, 506-514.

**Patents and New Technology Reports**

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

**Funded Proposals (Lead)**

CubeSat Hydrometric Atmospheric Radiometric Mission (CHARM). Training Opportunity (TO) response to NASA's Hands-On Project Experience (HOPE) initiative, in coordination with JPL's Phaeton Program, $2.8M, 2012-2014.

**Funded Proposals (Co-I)**

Thermochemistry of Solutions Relevant to Icy Satellites and Planets. NASA Outer Planets Research, $156K, 2013-2016.

Mapping the Ice Layer of Europa Using Radio Detection of Ultra-High Energy Cosmic Rays (UHECRs). JPL Spontaneous Concept, $30K, 2013.

Astrobiology of Icy Worlds: Habitability, Survivability and Detectability, NASA Astrobiology Institute Cooperative Agreement Notice 5 (08-NAI5-0021), $8.18M, 2009–2014.

Thermochemistry of solutions relevant to icy satellites, NASA Outer Planets Research (NNX08AQ51G), $408K, 2009–2012.

**Flight Project Experience**

Europa Project — October 2013 to Present
JPL Planetary Science Project Office — Jet Propulsion Laboratory, Pasadena
Acting Staff Scientist: Participating in Europa Clipper mission concept formulation activities.

CubeSat Hydrometric Atmospheric Radiometric Mission (CHARM) — October 2011 to July 2012
JPL Phaeton Program — Jet Propulsion Laboratory, Pasadena
Project Manager and PI for a training project to measure radiance temperatures from low-Earth orbit for atmospheric science and rapid TRL advancement.

Europa Habitability Mission Study — October 2009 to 2013
JPL Planetary Science Project Office — Jet Propulsion Laboratory, Pasadena
Science Study Team Member: Participated in studies of Flagship class missions to Europa, particularly in aspects related to habitability and composition. Science Definition Team member 2012-2013

**Research Experience**

Habitability Lead, Icy Worlds — 2008–present
Astrobiology Team
Dr. Isik Kanik — Jet Propulsion Laboratory, Pasadena
Coordinated multiple research efforts, by self and others, relating to the origin, sustenance and detectability of life in icy worlds.

Caltech Postdoctoral Fellow — 2009–2010
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 instrument on the Jupiter Europa Orbiter for EJSM.

NASA Postdoctoral Fellow 2007–2009
Dr. Chris 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 new insights in physical chemistry to the structure and evolution of habitable planets.

Research Assistant 2001–2007
Prof. J. Michael Brown and Dr. Evan Abramson 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.

Research Associate 2003–2004
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.

Research Associate 2003
Prof. Tilman Spohn Institut für Planetologie, Münster
Reviewed hydrothermal systems literature and investigated means for modeling permeability of extraterrestrial seafloors.

Research Associate 2001
Dr. Remington Stone UCO/Lick Observatory
Operated Nickel reflector telescope for acquisition of optical SETI data.

Research Assistant 1998-2001
Prof. Frank Bridges University of California, Santa Cruz
Performed experiments investigating impact sticking of water- and methanol-frosted ices. Applied results understanding accretion of large-particles ($> cm$-size) in the early solar nebula.

**Student Mentoring**

Shelly Shaul, 2009 (CSU STAR, Cal Poly Pomona, Masters student)

Noemie Pochat, 2009 (Undergraduate summer fellow, Wheaton College)

Roshan Nanu, 2010 (Undergraduate summer fellow, Caltech)

Patricia Gavin, 2011 (Graduate summer fellow, U Arkansas)

Oamawa Shields, 2011 (Graduate summer fellow, UW Seattle)

Mathieu Bouffard, 2012 (Graduate JVSRP fellow, ENS Lyon)

Eliav Maas, 2013 (JPL SIRI research intern, Santa Monica Community College)

Rana Abdel Sattar, 2013 (JPL SIRI intern, Glendale Community College)

Adam Hoffmann, 2013 (JPL SIRI intern, Mt. San Antonio Community College)

Bruno Pereira, 2013 (Graduate JVSRP fellow, Brazil, U. Federal de Uberlândia)

Elena Amador, 2014 (Graduate JVSRP fellow, UW, Seattle)

Nina Bothamy, 2014 (Graduate JVSRP fellow, ENS Lyon)

**Teaching Experience**

Founder and Facilitator — 2005-Present
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 and extra-solar system objects.

Teaching Assistant — Winter 2004
Physics — University of Washington, Seattle
114 and 121: Waves and Mechanics. Taught three sections, approximately 20 students per section.

Visiting Scientist — 2002-2003
Project AstroBio — Seattle
Presented two guest lectures for a Seattle fifth grade class of approximately 30 students.

Tutor — 2002-2005
University Tutoring Service — Seattle
Taught three undergraduate or high-school students per year on average. Topics included algebra, trigonometry, calculus, physical chemistry and introductory physics.

Teaching Assistant — Spring-Summer, 2001
Physics Department — University of California, Santa Cruz
5B Labs: Wave motion in matter, including sound waves. Taught two sections, approximately 20 students per section

Mathematics and Physics Tutor — 1998-2001
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.

**Community Service and Outreach Activities**

Contributing author in ongoing Astrobiology Strategy development (astrobiologyfuture.org)

Organizer, Outer Planets Colloquium Series (outerplanets.jpl.nasa.gov), 2008-present

Participant and Advocate, AAS Division for Planetary Science Congressional Visits, April 2012

Lead Author, "Icy Satellite Processes in the Solar System: A plurality of worlds," white paper prepared for the 2009-2010 Planetary Sciences Decadal Survey.

NASA Outer Planets Research Program, 2009: Panel Reviewer

Participant and Advocate, AGU Congressional Geosciences Visits, September 2008

**Conference Honors and Duties**

Asia Oceania Geosciences Symposium, 2014: Convener, PS03 Outer Solar System Satellites With an Atmosphere Convener, PS02 Icy Satellites and Rings Astrobiology: Habitable Worlds in the Solar System and Beyond, and the Quest for Life's Origins

Conference on the Habitability of Icy Worlds, 2014: Member of Local Organizing Committee, Oral Session Chair, Ocean Physics and Chemistry

Asia Oceania Geosciences Symposium, 2013: Convener, PS04 Quest for Habitable Worlds. Convener, PS13 Active Satellites in the Solar System.

Lunar and Planetary Sciences Conference, 2013: Oral Session Chair, License to Chill (or, the solar system's icy moons)

Asia Oceania Geosciences Symposium, 2012: Convener, PS09 Active Satellites in the Outer Solar System. Convener, PS10 Exploring Habitability in the Solar System and Beyond.

Astrobiology Science Conference, 2012: Convener, Serpentinization in Astrobiology: From Molecular to Cosmic Scales.

Asia Oceania Geosciences Symposium, 2011: Convener, PS06 Outer Planets and Icy Worlds. Convener, PS14 Astrobiology - Life in the Universe.

Fall AGU, 2010: Convener, Icy Ocean Worlds.

Asia Oceania Geosciences Symposium, 2010: Convener, PS03 Astrobiology and Ices. Convener, PS11 Satellites and Rings in the Outer Solar System.

American Geophysical Union, Fall Meeting, 2009: Convener, Session P18: Potential Biomarkers on Mars: Detection, Characterization and Earth Analogue Systems

Lunar and Planetary Sciences Conference, 2009: Oral Session Chair, Special Session: Icy Satellites of Jupiter and Saturn: Cosmic Gymnasts

Asia Oceania Geosciences Symposium, 2009: Convener, Astrobiology

Lunar and Planetary Sciences Conference, 2009: Convener, Oral Session Chair, Icy Ocean Worlds

Asia Oceania Geosciences Symposium, 2008: Convener, Oral Session Chair, PS08 Satellites and Rings in the Outer Solar System.

Astrobiology Science Conference, 2008:

- Convener, Oral Session Chair, Session 13. The Deep Cold Biosphere? Interior Processes of Icy Satellites and Dwarf Planets

- Convener, Session 2. Advances in Astrobiological Instrumentation Development

Lunar and Planetary Sciences Conference, 2008: Oral Session Chair, Titan

Lunar and Planetary Sciences Conference, 2007: Oral Session Chair, Astrobiology

**Media Involvement**

Participant, The Science and Entertainment Exchange, 2011-present

Panelist, Exploration of Europa, Comic-Con 2013

Science Advisor, "Europa Report", a feature film, 2011-2013

**Awards and Honors**

NASA Postdoctoral Fellowship, 2007-2009

Misch Fellowship, 2007

Stephens Graduate Support Grant, 2006

National Science Foundation IGERT/NASA Astrobiology Institute Grant, 2002-2005

Research support, University of Washington Alumni Grant, Winter / Spring, 2003-2004

Elks National Foundation Scholarship, 1996-2000 / Kern County Elks Scholarship, 1996

Howard and Mamie Nichols Scholarship, 1996-2000

Texaco Foundation Scholarship, 1996-2000

David Wayne Christensen Memorial Scholarship, 1997

**Recent Oral Presentations**

**Vance, S.**, J. M. Brown, M. Choukroun, C. Sotin, 2014. Thermodynamic Constraints on Ocean Structure and Water-Rock Chemistry in the Large Icy Satellites. *Conference on the Habitability of Icy Worlds*, Pasadena, CA.

**Vance, S.** 2013. Thermodynamic Constraints on Ocean Structure and Water-Rock Chemistry in the Large Icy Satellites. *International Astrobiology Workshop*, Institute of Space and Astronautical Science, Japan.

**Vance, S.**, 2013. Mysteries of Europa. American Institute of Aeronautics and Astronautics, San Gabriel Valley Section Dinner Meeting. **INVITED**

**Vance, S.**, 2013. Constraints on the habitability of Europa and Ganymede through time from chemistry and ocean dynamics. Northwest Geological Society Symposium. **INVITED**

**Vance, S.** and L. Christensen, 2013. In situ characterization of naturally occurring methane and ethane at sites of active serpentinization by tunable diode laser spectroscopy. 245th ACS Meeting, Abstract 93. New Orleans, LA.

**Vance, S.**, M. Bouffard, M. Choukroun, C. Sotin, 2013. Aqueous and Solid-Phase Equations Of State For The $H_2O$-$MgSO_4$ System: Prediction Of Ocean And Ice Thicknesses For Ganymede and Other Icy Worlds. LPSC XLIV, Abstract 1563. Woodlands, TX

**Vance, S.**, 2013. Oceanography of Icy Worlds. Colloquium presentation to Georgia Tech Department of Earth and Atmospheric Sciences. **INVITED**

**Vance, S.**, 2012. In Situ Investigations Detection of Methane and Ethane at Sites of Serpentinization, Implications for Life Detection and Geological Characterization. Special seminar: "The Cedars (EUA) vs. Cabeço de Vide (Portugal)" Technical Institute of Portugal, **INVITED**

**Vance, S.**, C. Sotin, M. Choukroun, and K. Mitchell, 2012. Titan's Subsurface Alkanology. Asia Oceania Geosciences Symposium, Singapore

**Vance, S.**, R.T. Pappalardo, L. Prockter, D. Senske, W. Patterson, and the Europa Science Definition Team, 2012. Mission Options For Exploring Europas Habitability: Orbiter and Flyby Concepts. Asia Oceania Geosciences Symposium, Singapore, ST16-PS07-A018

**Vance, S.**, 2012. Insights into the Habitability of Icy Worlds from Snazzy Equations of State. Colloquium presentation to Georgia Tech Department of Earth and Atmospheric Sciences. **INVITED**

**Vance, S.**, R.T. Pappalardo, L. Prockter, D. Senske, W. Patterson, and the Europa Science Definition Team, 2012. Mission Options For Exploring Europa's Habitability. Astrobiology Science Conference, Atlanta, GA

**Vance, S.**, 2012 In Situ Investigations of Serpentine Settings for Habitability Characterization and Life Detection. Astrobiology Science Conference, Atlanta, GA

**Vance, S.**, C. Sotin, M. Choukroun, and K. Mitchell, 2012. Titans Subsurface Alkanology. LPSC XLIII, Abstract 2939. Woodlands, TX

**Vance, S.**, 2011. Equations of State for Very Deep Icy World Ocean Fluids. Colloquium for University of California, Los Angeles, Department of Earth and Space Sciences. **INVITED**

**Vance, S.** and J. M. Brown, 2011. Laboratory Simulations of Ammonia-Rich Oceans in Icy Worlds. LPSC XLII, Abstract 1563. Woodlands, TX

**Vance, S.** 2011. High-Pressure Aqueous Geochemistry for Studies of Icy World Interior Oceans. Keynote Presentation for Second Annual Gala Event, University of Washington, Seattle, WA

**Vance, S.**, 2011. Habitability of Mars, Europa, and Other Icy Worlds. Public

scientific presentation for the University of Arkansas, Fayetteville. **INVITED**

**Vance, S.** and R. T. Pappalardo, D. Senske, L. Prockter, and the JJSDT, 2010. Europa Jupiter System Mission Opportunities at Io. Io Workshop, Provo Utah. **INVITED**

**Vance, S.**, L. E. Christensen, O. J. Johnson, M. J. Russell and C. R. Webster, 2009. Laser Absorption Biosignatures on Mars and Earth. *Eos Trans. AGU, Fall Meet. Suppl.*, Abstract P41B-07

**Vance, S.**, N. Goff-Pochat, G.C. Collins, 2009. Thermal Weathering and Erosion on Planetary Surfaces Asia Oceania Geosciences Symposium, Singapore

**Vance, S.** 2009. Habitability of Icy Worlds: Electrochemical Capacitance of Serpentinizing Hydrothermal Systems. LPSC XL, Abstract 1994. Woodlands, TX

**Vance, S.**, 2009. Serpentinization and the Habitability of Ocean-Bearing Worlds. Colloquium for Virginia Tech, Geosciences Department. **INVITED**

**Vance, S.**, 2009. Habitability of Icy Worlds. Colloquium for University of Southern California, Biology Department. **INVITED**

**Vance, S.**, 2009. Habitability of Icy Worlds. Colloquium for University of Minnesota, Mankato, Geology Department. **INVITED**

**Vance, S.**, 2009. Habitability of Icy Worlds. Planetary Sciences Seminar for Science Division, Jet Propulsion Laboratory, Caltech. **INVITED**

**Vance, S.**, 2009. Serpentinization and the Habitability of Ocean-Bearing Worlds. Colloquium for Case Western Reserve University, Department of Geological Sciences. **INVITED**

**Vance, S.**, 2008. Serpentinization and the Habitability of Ocean-Bearing Worlds. Colloquium for the University of California Irvine, Department of Earth System Sciences. **INVITED**

**Vance, S.**, R.T. Pappalardo and J. Baross 2008. Pressure-induced Limits to Hydrothermal Activity in Small Ocean Worlds. Asia Oceania Geosciences Conference, Busan, South Korea.

**Vance, S.**, 2008. Deep Cold Biospheres? Icy Worlds as Cool Places for Life Under Pressure. JPL Director's Seminar. **INVITED**

**Vance, S.**, R.T. Pappalardo and J. Baross 2008. Long-Lived Serpentinization Activity in Habitable Icy Worlds. Astrobiology Science Conference, Santa Clara, CA. **INVITED**

J. Castillo-Rogez, **S. Vance**, T. McCord, D. Matson 2008. Hydrothermal Activity: Effects On Evolution of Icy Worlds Focus on Ceres. Astrobiology Science Conference

**Vance, S.**, J. M. Brown and C. Sotin 2008. Laboratory Simulations of Titan's Internal Ocean. LPSC XXXIX, Abstract 2136. Houston, TX.

**Vance, S.**, 2008. Improving our understanding of very deep oceans: $MgSO_4$ chemistry to 700 MPa from -20 to 100 $^oC$. UCLA Earth and Space Sciences Seminar. **INVITED**

**Recent Poster Presentations**

**Vance, S.**, J. M. Brown, M. Choukroun, C. Sotin, 2013. Oceans and Internal Structures of the Large Icy Satellites,*Eos Trans. AGU, Fall Meet. Suppl.*, Abstract P41E-1974

**Vance, S.** and J. C. Goodman, 2013. The Structure and Evolution of Europa's Ocean and Ice Shell in the Presence of Aqueous $MgSO_4$ LPSC XLIV, Abstract 1563. Woodlands, TX

**Vance, S.**, and J. M. Brown, 2011. Exploring Deep Icy World Oceans through New Experimental Equations of State for Aqueous $MgSO_4$ and $NH_3$ *Eos Trans. AGU, Fall Meet. Suppl.*, Abstract P23D-1735

**Vance, S.**, L. Christensen, O. Johnson, C. Webster, 2009. Mars Analog Tunable Laser Spectroscopy at a Site of Active Serpentinization. LPSC XV, Abstract 2005. Woodlands, TX

**Vance, S.**, L. Christensen, O. Johnson, P. Morrill and C. R. Webster, 2008. Mars Analog Tunable Laser Spectroscopy at a Site of Active Serpentinization *Eos Trans. AGU, Fall Meet. Suppl.*, Abstract P53C-1461

**Vance, S.**, R.T. Pappalardo and J. Baross, 2008. Tidal Evolution and Hydrothermal Activity in Habitable Icy Worlds. Gordon Research Conference on the Origin of Life, Ventura, CA

**Vance, S.**, J. Harnmeijer, and J. M. Brown, 2006. The Depth of Fluid Circulation in Icy-Moon Hydrothermal Systems: Implications for Production of Heat and $H_2$ from Serpentinization. *Astrobiology* **6**, 217

**Vance, S.**, J. Harnmeijer, and J. M. Brown, 2005. Serpentinization-Driven Systems in the Seafloors of Icy Moons, *Eos Trans. AGU*, 86(52), Fall Meet. Suppl. Abstract P51D-0970

**Vance, S.** and J. M. Brown 2004. Layering and Double-Diffusion Style Convection in Europa's Ocean. *Eos Trans. AGU*, **85**(47), Fall Meet. Suppl., Abstract P31A-0966

Harnmeijer, J., and **S. Vance**, 2004. The Biopotential of Europa's Ocean: Contribution from Exogenous Sources. Bioastronomy Conference, Reykjavik, Iceland. *Astrobiology* **4**, 302.

Vance, S., J. M. Brown, and J. Kargel, 2002. The Pressure Factor in Europa's Aqueous Evolution. *Eos Trans. AGU*, **83**(47), Fall Meet. Suppl. Abstract P72B-0508.

**Recent Coauthored Conference Presentations**

R. Pappalardo, B. Goldstein, L. Prockter, D. Senske, B. Paczkowski, **S. Vance**, W. Patterson, T. Magner, and B. Cooke, 2014. The Europa Clipper Mission Concept: Exploring Europa to Investigate Its Habitability, IAA Space Exploration Conference.

R. T. Pappalardo, D. Senske, L. Prockter, B. Paczkowski, G. W. Patterson, **S. Vance**, B. Goldstein, T. Magner, B. Cooke, and the Europa Study Team, 2013. The Europa Clipper Mission Concept to Explore Europa and Investigate its Habitability. Institute of Space and Astronautical Science, Conference Proceeding, poster presented by K. Sayanagi.

*Marques, J., **S. Vance** , L. Christensen, G. Etiope, P. Carreira, S. Suzuki, 2013. Methane and Ethane in Hyperalkaline Mineral Waters in the Alter-Do-Chão Ultramafic Intrusive Massif (Cabeço de Vide - Portugal). 10th Annual Applied Isotope Geochemistry Conference, Budapest, Hungary.

*Wang, W., B. Ayhan, C. Kwan, H. Qi, **S. Vance**, 2013. A Novel and Effective Multivariate Method for Compositional Analysis using Laser Induced Breakdown Spectroscopy. 35th International Symposium on Remote Sensing of Environment. Beijing, China.

*Senske, D. A., L. Prockter, R. T. Pappalardo, W. G. Patterson, **S. Vance**, B. Cooke and the Europa Science Definition and Technical Teams, 2012. The Europa Clipper and Orbiter Mission Concepts: Innovative Approaches for Exploring Europas Habitability. AAS Division for Planetary Sciences Meeting, Reno, NV

*Prockter, L., R.T. Pappalardo, D. Senske, W. Patterson, **S. Vance** and the Europa Science Definition Team, 2012. Mission Options For Exploring Europas Habitability: Lander Concept. Asia Oceania Geosciences Symposium, Singapore, ST16-PS07-A017

*Gavin, P. and **S. Vance** 2012. Modeling Hydrothermal Vents on Europa. LPSC XLIII, Abstract 1683. Woodlands, TX

*Castillo-Rogez, J., D. Matson, J. Kargel, **S. Vance**, T. McCord, T. Johnson 2008.Role of Hydrothermal Geochemistry in the Geophysical Evolution of Icy Bodies. LPSC XXXIX, Houston, TX.

*presented by

**Vance, S.**, and *H. Hussmann 2008. Tidal Evolution and Hydrothermal Activity in Icy Worlds. European Planetary Sciences Conference, Muenster, Germany.