

Christopher Howard House
Professor of Geosciences
The Pennsylvania State University
chrishouse@psu.edu

Professional Preparation

- 1999 Ph.D. in Geology, University of California, Los Angeles
“Carbon Isotopic Fractionation by Diverse Extant and Fossil Prokaryotes”
Graduate advisor – J. William Schopf, Ph.D.
- 1995 B.S. in Biochemistry & Cell Biology, University of California, San Diego
Undergraduate advisor – Stanley L. Miller, Ph.D.

Appointments

- 2012-present Professor of Geosciences, The Pennsylvania State University
2020-present Center for Planetary System Science Center, Director
2008-present Pennsylvania Space Grant Consortium, Director
2000-present Huck Institute for the Life Sciences faculty appointment, Penn State
2008-2020 Penn State Astrobiology Research Center, Director
2000-2012 Assistant / Associate Professor of Geosciences, Penn State
1998-1999 Research Assistant, IGPP Center for Astrobiology, UCLA
1997-1997 Visiting Researcher, Lehrstuhl für Mikrobiologie, Regensburg, Germany
1996-1998 Teaching/Research Assistant, ESS, UCLA
1993-1994 Summer Fellow, NSCORT in Exobiology

Honors and Awards

- 2019 Member of the NASA Planetary Protection Independent Review Board (PPIRB)
2017-2019 Member of the European Science Foundation’s ESSC ExoOceans Study Group
2016 Fellow of the Geological Society of America (GSA)
2016-2022 Co-chair of NAS Committee for Astrobiology and Planetary Sciences (CAPS)
2016-2021 Participating Scientist for the Mars Science Laboratory (MSL) Mission
2012-2016 Member of NASA Advisory Council, Planetary Sciences Subcommittee
2010 Selected for an organic geochemistry position for IODP Expedition 331
2008 Paper selected as an ACS Publications Most-Accessed Article
2006-2007 Ocean Drilling Program Distinguished Lecturer
2005-2008 Scientific Ocean Drilling Vessel (SODV) Program Advisory Committee Member
2002 Selected for a microbiology position of Leg 201 of the Ocean Drilling Program
1994-1995 Adjunct Fellow, NSCORT in Exobiology

Graduate Students Advised

Karianne L. C. Smith (M.Ed., completed), Aubrey Zerkle (Ph.D., completed), Jennifer Biddle (Ph.D., co-advised, completed), Jim Moran (Ph.D., completed), Vyllinniskii Cameron (Ph.D., completed), Beth A. Bauman (M.S., completed), Burt Thomas (Ph.D., co-advised, completed), Emily J. Beal (Ph.D., completed), Moshe Rhodes (Ph.D., completed), Amanda Martino (Ph.D., completed), Karen Smith (Ph.D., completed), Peter Ilhardt (M.S., completed), Leah Brandt (Ph.D., completed), Regina Wilpiseski (Ph.D., completed), Laura Rodriguez (Ph.D., completed), Greg Wong (Ph.D., completed), Julia LaFond (M.S., completed), Hillary Smith (M.S., completed), Andrew Hyde (Ph.D., current), Esther Muñoz (Ph.D., current).

Postdoctoral Students Advised

Jennifer Biddle, Ph.D., Lisa Steinberg, Ph.D., Rachel Wagner, Ph.D., and Jeff Havig, Ph.D., Erica V. Barlow, PhD, Georgia G. Soares, Ph.D.

Peer-reviewed Journal Publications

- Webster, C.R., Hofmann, A.E., Mahaffy, P.R., Atreya, S.K., House, C.H., Simon, A.A., Garvin, J.B., (2023). Tunable Laser Spectrometers for Planetary Science. *Space Science Reviews*.
- Barlow, E.V., House, C.H., Liu, M., Wetherington, M.T., Van Kranendonk, M.J., (2023). Distinctive microfossil supports early Paleoproterozoic rise in complex cellular organization. *Geobiology*.
- Treiman, A. H., Lanza, N. L., VanBommel, S., Berger, J., Wiens, R., Bristow, T., ... & Anderson, R., (2023). Manganese-Iron Phosphate Nodules at the Groken Site, Gale Crater, Mars. *Minerals*, 13, 1122.
- Sturtz, M., and House, C.H., (2023). Metal Catalysis Acting on Nitriles in Early Earth Hydrothermal Systems. *Life*. 13: 1524.
- McAdam, A. C., Sutter, B., Archer, P. D., Franz, H. B., Wong, G. M., Lewis, J. M. T. and +23 others. (2022). Evolved gas analyses of sedimentary rocks from the Glen Torridon Clay-Bearing Unit, Gale crater, Mars: Results from the Mars Science Laboratory Sample Analysis at Mars Instrument Suite. *Journal of Geophysical Research: Planets*, e2022JE007179.
- Stack, K. M., Dietrich, W. E., Lamb, M. P., Sullivan, R. J., Christian, J. R., Newman, C. E., ... & Van Beek, J. K. (2022). Orbital and In-Situ Investigation of Periodic Bedrock Ridges in Glen Torridon, Gale Crater, Mars. *Journal of Geophysical Research: Planets*, e2021JE007096.
- Stern, J. C., Malespin, C. A., Eigenbrode, J. L., Webster, C. R., Flesch, G., Franz, H. B. + 10 others. (2022). Organic carbon concentrations in 3.5-billion-year-old lacustrine mudstones of Mars. *Proceedings of the National Academy of Sciences*, 119(27), e2201139119.
- House, C. H., Franz, H. B., Wong, G. M., Mahaffy, P. R., Pavlov, A., Steele, A., ... & Malespin, C. A. (2022). Reply to Schoell: Implications of a temperature trend in methane evolved from Cumberland during Mars evolved gas analyses experiments. *Proceedings of the National Academy of Sciences*, 119(30), e2207901119.
- Millan, M., Williams, A. J., Mcadam, A. C., Eigenbrode, J. L., Steele, A., Freissinet, C., ... & Mahaffy, P. R. (2022). Sedimentary organics in Glen Torridon, Gale Crater, Mars: Results from the SAM instrument suite and supporting laboratory analyses. *Journal of Geophysical Research: Planets*, 127(11), e2021JE007107.
- Wong, G. M., H. B. Franz, J. V. Clark, A. C. McAdam, J. M. T. Lewis, M. Millan, D. W. Ming, F. Gomez, B. Clark, J. L. Eigenbrode, R. Navarro-González, and C. H. House (2022). Oxidized and reduced sulfur observed by the Sample Analysis at Mars (SAM) instrument suite during the Glen Torridon campaign at Gale crater, Mars. *Journal of Geophysical Research: Planets*.
- House, C. H., Wong, G. M., Webster, C. R., Flesch, G. J., Franz, H. B., Stern, J. C, Pavlov, A., Atreya, S. K., Eigenbrode, J. L., Gilbert, A., Hofmann, A. E., Millan, M., Steele, A., Malespin, C.A., Mahaffy, P. R (2022), Depleted carbon isotope compositions observed at Gale crater, Mars. *Proceedings of the National Academy of Sciences*.
- Steinberg, L. M., Martino, A. J., House, C. H. (2021). Convergent microbial community formation in replicate anaerobic reactors inoculated from different sources and treating ersatz crew waste. *Life*, 11(12), 1374.
- Kempes, C. P., Follows, M. J., Smith, H., Graham, H., House, C. H., & Levin, S. A. (2021). Generalized Stoichiometry and Biogeochemistry for Astrobiological Applications. *Bulletin of Mathematical Biology*, 83(7), 1-22.
- Clark, B. C., Kolb, V. M., Steele, A., House, C. H., Lanza, N. L., Gasda, P. J., ... & Martínez-Frías, J. (2021). Origin of Life on Mars: Suitability and Opportunities. *Life*, 11(6), 539.
- Smith, H. H., Hyde, A. S., Simkus, D. N., Libby, E., Maurer, S. E., Graham, H. V., ... & Johnson, S. S. (2021). The Grayness of the Origin of Life. *Life*, 11(6), 498.

- Castillo-Rogez, J. C., Neveu, M., Scully, J. E., House, C. H., Quick, L. C., Bouquet, A., ... & Young, E. (2020). Ceres: astrobiological target and possible ocean world. *Astrobiology*, 20(2), 269-291.
- Edgar, L. A., Fedo, C. M., Gupta, S., Banham, S. G., Fraeman, A. A., Grotzinger, J. P., ... & Van Beek, J. (2020). A lacustrine paleoenvironment recorded at Vera Rubin Ridge, Gale crater: Overview of the sedimentology and stratigraphy observed by the Mars Science Laboratory Curiosity Rover. *Journal of Geophysical Research: Planets*, 125(3), e2019JE006307.
- Franz, H. B., Mahaffy, P. R., Webster, C. R., Flesch, G. J., Raaen, E., Freissinet, C., ... & Summons, R. E. (2020). Indigenous and exogenous organics and surface-atmosphere cycling inferred from carbon and oxygen isotopes at Gale crater. *Nature Astronomy*, 4(5), 526-532.
- Farag, I. F., Biddle, J. F., Zhao, R., Martino, A. J., House, C. H., & León-Zayas, R. I. (2020). Metabolic potentials of archaeal lineages resolved from metagenomes of deep Costa Rica sediments. *The ISME journal*, 14(6), 1345-1358.
- De Sanctis, M. C., Mitri, G., Castillo-Rogez, J., House, C. H., Marchi, S., Raymond, C. A., & Sekine, Y. (2020). Relict Ocean Worlds: Ceres. *Space Science Reviews*, 216, 1-33.
- Neveu, M., House, C. H., & Wieman, S. T. (2020). Phoebe's carbon isotope composition as evidence for self-shielding in the solar nebula. *Icarus*, 345, 113714.
- Wong, G. M., Lewis, J. M., Knudson, C. A., Millan, M., McAdam, A. C., Eigenbrode, J. L., ... & House, C. H. (2020). Detection of reduced sulfur on Vera Rubin ridge by quadratic discriminant analysis of volatiles observed during evolved gas analysis. *Journal of Geophysical Research: Planets*, 125(8), e2019JE006304.
- Frydenvang, J., Mangold, N., Wiens, R. C., Fraeman, A. A., Edgar, L. A., Fedo, C. M., ... & House, C. H. (2020). The chemostratigraphy of the Murray formation and role of diagenesis at Vera Rubin ridge in Gale crater, Mars, as observed by the ChemCam instrument. *Journal of Geophysical Research: Planets*, 125(9), e2019JE006320.
- Bralower, T. J., Cosmidis, J., Heaney, P. J., Kump, L. R., Morgan, J. V., Harper, D. T., ... & Vajda, V. (2020). Origin of a global carbonate layer deposited in the aftermath of the Cretaceous-Paleogene boundary impact. *Earth and Planetary Science Letters*, 548, 116476.
- McAdam, A. C., Sutter, B., Archer, P. D., Franz, H. B., Wong, G. M., Lewis, J. M., ... & Johnson, S. S. (2020). Constraints on the Mineralogy and Geochemistry of Vera Rubin Ridge, Gale Crater, Mars, From Mars Science Laboratory Sample Analysis at Mars Evolved Gas Analyses. *Journal of Geophysical Research: Planets*, 125(11), e2019JE006309.
- l'Haridon, J., Mangold, N., Fraeman, A. A., Johnson, J. R., Cousin, A., Rapin, W., ... & Wiens, R. C. (2020). Iron mobility during diagenesis at Vera Rubin ridge, Gale crater, Mars. *Journal of Geophysical Research: Planets*, 125(11), e2019JE006299.
- Fraeman, A. A., Edgar, L. A., Rampe, E. B., Thompson, L. M., Frydenvang, J., Fedo, C. M., ... & Wong, G. M. (2020). Evidence for a diagenetic origin of Vera Rubin ridge, Gale crater, Mars: Summary and synthesis of Curiosity's exploration campaign. *Journal of Geophysical Research: Planets*, 125(12), e2020JE006527.
- Edgett, K. S., Banham, S. G., Bennett, K. A., Edgar, L. A., Edwards, C. S., Fairén, A. G., ... & Yingst, R. A. (2020). Extraformational sediment recycling on Mars. *Geosphere*, 16(6), 1508-1537.
- Wilpsheski, R. L., Sherwood Lollar, B., Warr, O., & House, C. H. (2020). In Situ Growth of Halophilic Bacteria in Saline Fracture Fluids from 2.4 km below Surface in the Deep Canadian Shield. *Life*, 10(12), 307.
- Rodriguez, L. E., House, C. H., Smith, K. E., Roberts, M. R., & Callahan, M. P., 2019. Nitrogen heterocycles form peptide nucleic acid precursors in complex prebiotic mixtures. *Scientific Reports*, 9, 9281.
- Smith, K. E., House, C. H., Arevalo, R. D., Dworkin, J. P., & Callahan, M. P., 2019. Organometallic compounds as carriers of extraterrestrial cyanide in primitive meteorites. *Nature Com.*, 10, 2777.
- Martino, A., Rhodes, M. E., León-Zayas, R., Valente, I. E., Biddle, J. F., & House, C. H., 2019. Microbial Diversity in Sub-Seafloor Sediments from the Costa Rica Margin. *Geosciences*, 9, 218.
- Sun, V. Z., Stack, K. M., Kah, L. C., 2019. Late-stage diagenetic concretions in the Murray formation, Gale crater, Mars. *Icarus*, 321, 866-890.

- Wilpiseski, R. L., Zhang, Z., & House, C. H. (2019). Biogeography of thermophiles and predominance of *Thermus scotoductus* in domestic water heaters. *Extremophiles*, 23(1), 119-132.
- Webster, C.R., et al., 2018. Background levels of methane in Mars' atmosphere show strong seasonal variations. *Science*, 360, 1093-1096.
- Stein, N., et al., 2018. Desiccation cracks provide evidence of lake drying on Mars, Sutton Island member, Murray formation, Gale Crater. *Geology*, 46, pp.515-518.
- Franz, H. B., Fischer, W. W., Grotzinger, J. P., & Farley, K. A., 2017. Large sulfur isotope fractionations in Martian sediments at Gale crater. *Nature Geoscience*, 10, 658-662.
- Steinberg, L. M., Kronyak, R. E., & House, C. H., 2017. Coupling of Anaerobic Waste Treatment to Produce Protein-and Lipid-Rich Bacterial Biomass. *Life Sciences in Space Research*.
- Sutter, B., et al., (2017). Evolved gas analyses of sedimentary rocks and eolian sediment in gale crater, mars: results of the curiosity Rover's Sample Analysis at Mars (SAM) instrument from Yellowknife Bay to the Namib Dune. *Journal of Geophysical Research: Planets*.
- Smith, K. E., House, C. H., Dworkin, J. P., & Callahan, M. P., 2017. Spontaneous Oligomerization of Nucleotide Alternatives in Aqueous Solutions. *Origins of Life and Evolution of Biospheres*, 47, 3-11.
- Oehler, D. Z., Walsh, M. M., Sugitani, K., Liu, M. C., & House, C. H., 2017. Large and robust lenticular microorganisms on the young Earth. *Precambrian Research*, 296, 112-119.
- Sugitani, K., Van Kranendonk, M. J., Oehler, D. Z., House, C. H., & Walter, M. R., 2017. Comment: Archean coastal-plain paleosols and life on land. *Gondwana Research*, (44), 265-269.
- Sugitani, K., Van Kranendonk, M. J., Oehler, D. Z., House, C. H., & Walter, M. R., 2017. Comment: Archean coastal-plain paleosols and life on land. *Gondwana Research*, (44), 265-269.
- Brandt, L.D. and House, C.H., 2016. Marine Subsurface Microbial Community Shifts Across a Hydrothermal Gradient in Okinawa Trough Sediments. *Archaea*.
- Peng, X., Guo, Z., House, C.H., Chen, S., Ta, K., 2016. SIMS and NanoSIMS analyses of well-preserved microfossils imply oxygen-producing photosynthesis in the Mesoproterozoic anoxic ocean. *Chemical Geology* 441, 24-34.
- House, C. H., 2015. A synthetic standard for the analysis of carbon isotopes of carbon in silicates, and the observation of a significant water-associated matrix effect. *Geochemical transactions*, 16, 1-8.
- House, C. H., Pellegrini, M., & Fitz-Gibbon, S. T., 2015. Genome-wide gene order distances support clustering the gram-positive bacteria. *Frontiers in Microbiology*, 5, 785.
- Todd, Z. R., & House, C. H., 2014. Vesicles Protect Activated Acetic Acid. *Astrobiology*, 14, 859-865.
- Smith, K. E., Callahan, M. P., Gerakines, P. A., Dworkin, J. P., and House, C. H., 2014. Investigation of pyridine carboxylic acids in CM2 carbonaceous chondrites: Potential precursor molecules for ancient coenzymes. *Geochimica et Cosmochimica Acta*, 136, 1-12.
- Worth, R. J., Sigurdsson, S., and House, C. H. 2013. Seeding Life on the Moons of the Outer Planets via Lithopanspermia. *Astrobiology*, 13, 1155-1165.
- Yanagawa, K., Nunoura, T., McAllister, S. M., Hirai, M., Breuker, A., Brandt, L., ... and Takai, K., 2013. The first microbiological contamination assessment by deep-sea drilling and coring by the D/V Chikyū at the Iheya North hydrothermal field in the Mid-Okinawa Trough (IODP Expedition 331). *Frontiers in microbiology*, 4.
- House, C. H., Oehler, D. Z., Sugitani, K., and Mimura, K., 2013. Carbon isotopic analyses of ca. 3.0 Ga microstructures imply planktonic autotrophs inhabited Earth's early oceans. *Geology*, 41(6), 651-654.
- Cameron, V., House, C. H., and Brantley, S. L., 2012. A First Analysis of Metallome Biosignatures of Hyperthermophilic Archaea. *Archaea*.
- Rhodes, M.E., Oren, A., and House, C.H., 2012. Dynamics and persistence of Dead Sea microbial populations as shown by high-throughput sequencing of rRNA. *Applied and Environmental Microbiology*, 78: 2489-2492.
- Martino, A.J., Rhodes, M.E., Biddle, J.F., Brandt, L.D., Tomosho, L.P., and House, C.H., 2012. Novel degenerate PCR method for whole genome amplification applied to Peru Margin (ODP Leg 201) subsurface samples. *Frontiers in Extreme Microbiology*. 3: Article 17.
- Takai, K., Mottl, M.J., Nielsen, S.H., and IODP Expedition 331 Scientists (2012). IODP expedition 331: strong and expansive seafloor hydrothermal activities in the Okinawa Trough. *Scientific Drilling*,

13, 19-27.

- House, C.H., Beal, E.J., and Orphan, V.J., 2011. The Apparent Involvement of ANMEs in Mineral Dependent Methane Oxidation, as an Analog for Possible Martian Methanotrophy. *Life*. 1: 19-33.
- Rhodes, M.E., Spear, J.R., Oren, A. and House, C.H., 2011. Differences in lateral gene transfer in hypersaline versus thermal environments. *BMC Evolutionary Biology*, 11: 199doi:10.1186/1471-2148-11-199
- Callahan, M.P., Smith, K.E., Cleaves, H.J., II, Ruzicka, J., Stern, J.C., Glavin, D.P., House, C.H., and Dworkin, J.P., 2011. Carbonaceous meteorites contain a wide range of extraterrestrial nucleobases. *Proceedings of the National Academy of Sciences*, 1106493108v1-13998.
- Beal, E., Claire, M.W., House, C.H., 2011. The anaerobic oxidation of methane at low sulfate concentrations and the redox state of Earth's atmosphere through time. *Geobiology*, 9, 131-139.
- Biddle, J.A., White, J.R., Teske, A.P., House, C.H., 2011. Metagenomics of the subsurface Brazos-Trinity Basin (IODP Site 1320): comparison with other sediment and pyrosequenced metagenomes. *The ISME Journal* ,doi:10.1038/ismej.2010.199.
- Rhodes, M.E., Fitz-Gibbon, S.T., Oren, A., House, C.H., 2010. Amino Acid Signatures of Salinity on an Environmental Scale with a Focus on the Dead Sea. *Environmental Microbiology*, 12: 2613-2623.
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- Cameron, V., Vance, D. Archer, C. House, C.H., 2009. Nickel Stable Isotopes: A Novel Isotope Biomarker. *Proceeding of the National Academy of Sciences*, 106: 10944-10948.
- Orphan, V.J., Turk, K.A., Green, A.M., House, C.H., 2009. Patterns of ¹⁵N assimilation and growth of methanotrophic ANME-2 archaea and sulfate-reducing bacteria within structured syntrophic consortia revealed by FISH-SIMS. *Environ. Microb.*, 11: 1777 -1791.
- Orphan, V.J., and House, C.H., 2009. Geobiological investigations using secondary ion mass spectrometry (SIMS): microanalytical analysis of extant and ancient microbial processes. *Geobiology*, 7: 360 – 372.
- House, C.H. 2009. The Tree of Life viewed through the contents of genomes. *Methods in Molecular Biology*, 532: 141-161.
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- Zerkle, A.L., C.K. Junium, D.E. Canfield, House, C.H., 2008. Production of ¹⁵N-depleted biomass during cyanobacterial N₂-fixation at high Fe concentrations, *J. Geophys. Res. Biogeosci.*, 113: G03014.
- Biddle, J.F., Fitz-Gibbon, S.T., Schuster, S.C., Brenchley, J.E., House, C.H., 2008. Metagenomic signatures of the subseafloor biosphere. *Proceedings of the National Academy of Sciences* 105: 10583-10588.
- Moran, J.J., Beal, E.J., Vrentas, J.M., Orphan, V.J., Freeman, K.H., House, C.H., 2008. Methyl sulfides as intermediates in the anaerobic oxidation of methane. *Environmental Microbiology*. 10: 162.
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- Moran, J.J., House, C.H., Thomas, B., Freeman, K.H., 2007. Products of trace methane oxidation during nonmethyltrophic growth by Methanosarcina. *J. Geophys. Res. Biogeosci.*, 112: G02011.
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- Ferry, J.G. and House, C.H., 2006. The Stepwise Evolution of Early Life Driven by Energy Conservation. *Molecular Biology and Evolution*, 23: 1286-1292.
- Zerkle, A.L., House, C.H., Cox, R.P., Canfield, D.E., 2006. Metal limitation of cyanobacterial N₂ fixation and implications for the Precambrian nitrogen cycle. *Geobiology*, 4: 285-297.
- Biddle, J.F., House, C.H., Brenchley, J.E., 2005. Microbial stratification in deeply buried marine sediment reflects changes in sulfate/methane geochemistry. *Geobiology*, 3: 287-295.
- Biddle, J.F., House, C.H., Brenchley, J.E., 2005. Enrichment cultivation of microorganisms from sediment from the slope of the Peru Trench (ODP Site 1230). *Proceedings of the Ocean Drilling Program, Scientific Results*, 201.
- Moran, J. J., House, C. H., Freeman, K. H., Ferry, J. G., 2005. Trace methane oxidation studied in several Euryarchaeota under diverse conditions. *Archaea*, 1: 293-301.
- Zerkle, A.L., House, C.H., Brantley, S., 2005 Genomic Study of Biogeochemical Signatures for Microbial Metabolisms through Time. *American Journal of Science*, 305: 467-502.
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- Fitz-Gibbon, S.T., House, C.H., 1999. Whole Genome-based Phylogenetic Analysis of Free-Living Microorganisms. *Nucleic Acids Research*, 27: 4218-4222
- House, C.H. and Miller, S.L., 1996, Hydrolysis of dihydrouridine and related compounds. *Biochemistry*, 35: 315-320.

Other Published Journal Articles and Reports

- Committee on Astrobiology and Planetary Science, 2022. Report Series: Independent Review of the Community Report from the Biosignature Standards of Evidence Workshop/
- Castillo-Rogez, J., Scully, J., Neveu, M., Wyrick, D., Thangjam, G., Rivkin, A., ... & Schenk, P. (2021). Science Motivations for the Future Exploration of Ceres. *Bulletin of the AAS*, 53(4).
- Hand, K., Phillips, C. B., Chyba, C. F., Toner, B., Katija, K., Orphan, V., ... & Roussel, A. (2021). On the Past, Present, and Future Role of Biology in NASA's Exploration of our Solar System. *Bulletin of the American Astronomical Society*, 53(4), 229.
- Miller, K. E., Theiling, B., Hofmann, A. E., Castillo-Rogez, J., Neveu, M., Hosseini, S., ... & Drouin, B. J. (2021). The value of CHONS isotopic measurements of major compounds as probes of planetary origin, evolution, and habitability. *Bulletin of the American Astronomical Society*, 53(4), 243.
- Neveu, M., Aponte, J., Castillo-Rogez, J., Ehlmann, B., Franz, H., House, C., ... & Zacny, K. (2021). Exploring Solar System Organic Chemistry Evolution through the Surfaces of Ceres and Large Asteroids. *Bulletin of the AAS*, 53(4).
- Committee on Astrobiology and Planetary Science, 2020. Report Series: Options for the Fifth New Frontiers Announcement of Opportunity
- Committee on Astrobiology and Planetary Science, 2019. Report Series: Review of the Planetary Science Aspects of NASA SMD's Lunar Science and Exploration Initiative
- Committee on Astrobiology and Planetary Science, 2019. Report Series: Review of the Commercial Aspects of NASA SMD's Lunar Science and Exploration Initiative
- Committee on Astrobiology and Planetary Science, 2017. Report Series: Getting Ready for the Next Planetary Science Decadal Survey
- House, C.H., 2015. Penciling in details of the Hadean, *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1519765112
- Shipboard Scientific Party, 2011. Deep Hot Biosphere. *Proceedings of the Ocean Drilling Program, Expedition Report*, 331.
- Shipboard Scientific Party, 2003. Controls on Microbial Communities in Deeply Buried Sediments, Eastern Equatorial Pacific and Peru Margin. *Proceedings of the Ocean Drilling Program, Initial Reports*, 201: Ch. 1 & Ch. 5-12.
- House, C.H., 2007. Linking taxonomy with environmental geochemistry and why it matters to the field of geobiology. *Geobiology*, 5: 1-3.
- House, C.H., and Schuster, S.C., 2006. Box 1. IODP Microbiology Through Massively Parallel DNA Sequencing. *Oceanography*, 19: 68.
- House, C.H., 2003. To Build a Pre-RNA. *Astrobiology*, 3: 245-247.

Patents Filed

House, K.Z., House, C.H., Aziz, M. Carbon Dioxide Capture and Related Processes.

Grants Received

2022-2025

Advanced Organic Isotope Studies of Asteroid Bennu Samples from OSIRIS-REx

2022-2024 \$300,000 (NASA), House as PI

Pennsylvania Space Grant Consortium Augmentation

2018-2023 \$~8M (NASA) with House lab portion at ~\$467,409

Agnostic Biosignatures

2018-2023 \$6.8M (NASA) with House lab portion at ~\$263,283

The origins of molecules in diverse space and planetary environments and their intramolecular

isotope signatures

2017-2019 \$720,000 (NASA), House as PI
 Pennsylvania Space Grant Consortium Augmentation

2017-2020 \$484,560 (NSF), PSU portion
 Collaborative Research: Biochemical, Genetic, Metabolic, and Isotopic Constraints on an Ancient
 Thiobiosphere

2016-2020 \$379,700 (NASA), House as PI
 Enhanced Evaluation of the Possible Habitability of Ancient Mars through Possible Earth
 Analogs

2016-2019 \$720,000 (NASA), House as PI
 Pennsylvania Space Grant Consortium Augmentation

2015-2019 \$1,375,000 (NASA), House as PI
 Pennsylvania Space Grant Consortium

2015-2017 \$265,993 (NASA), House as PI
 Exploring the Fate of Heterocyclic Compounds in Complex Prebiotic Mixtures

2013-2014 \$50,000 (C-DEBI), mini-grant from NSF center
 Investigating the active microbial community members as a function of temperature in a
 hydrothermal subsurface

2013-2015 \$436,634 (NASA), House as PI
 STEM Academic Research Training engaging Underrepresented Pennsylvanians (START-UP)

2010-2014 \$15,000 (COL), House as PI
 Exploring for life at great depth and examining patterns of microbial diversity in the Costa
 Rica Margin subsurface

2011-2013 \$249,560 (NASA), House as PI
 Safety, Reliability, and Reproducibility of Microbial Systems for Space Colonization

2010-2013 \$17,908 (NAI DDF), House as PI
 Pilot Citizen Science Study of Distributed Domestic Water Heater Microbiology
 Diversity

2010-2014 \$15,000 (COL), House as PI
 Metagenomics of the Okinawa Back-arc Basin

2010-2014 \$15,000 (COL), House as PI
 Exploring Anaerobic Oxidation of Methane in the Deep, Hot Biosphere

2010-2013 \$148,472 – PSU portion (DOE)
 Characterizing the mechanisms and syntrophic interactions driving the anaerobic
 oxidation of methane: cell-specific analysis using stable isotope tracers, targeted proteomics
 and single-cell imaging of structured microbial consortia and their gene products

2010-2014 \$2,850,000 (NASA), House as PI
 Pennsylvania Space Grant Consortium

2009-2014 \$8,728,908 (NASA), House as PI
 Signatures of Life from Earth and Beyond

2009 \$70,000 (NASA), House as PI
 Space Colonization Life-support based on Electrochemical and Microbial
 Processes

2008-2009 \$44,883 (NSF), House as PI
 IODP Microbiology through Massively Parallel DNA Sequencing Supplement

2008-2010 \$1,575,000 (NASA), House as PI
 Pennsylvania Space Grant Consortium

2007-2008 \$153,609 (NAI DDF), House as PI
 Molecular Signatures of Life on the Edge

2006-2009 \$210,000 (NSF), House as PI

IODP Microbiology through Massively Parallel DNA Sequencing
 2005-2007 \$250,000 (Moore Foundation), House as PI
 Ion microprobe upgrade for marine microbiology applications: Improved spatial resolution of isotopic analysis and enhanced imaging capabilities
 2003-2008 \$6,430,646 – House laboratory portion is ~\$250,000 (NASA)
 Evolution of a Habitable Planet
 2005-2007 \$16,000 (JOI), House as PI
 Leg 308 Post-Cruise Science Proposal: Metagenomics of the Subsurface Biosphere
 2005-2007 \$218,240 (NASA), House as PI
 Mediation of Early Microbial Evolution and Ecology by Cyanide Inhibition?
 2005-2006 \$0 (DOE JGI)
 Hypothermophilic Archaeal Species
 2005 \$11,949 (NURP)
 Microscale molecular and isotopic investigations of carbon transfer and microbial trophic interactions in marine methane seeps
 2005 \$3,000 (PSU), House as PI
 Summer Research: Pore water Geochemistry of in Eel River Basin
 2005 \$6,000 (NSF), House as PI
 NSF REU Supplemental Request for: “Examination of diverse anaerobic methane oxidizing Archaea and associated syntrophic relationships using high resolution molecular and isotopic methods”
 2004-2007 \$254,318 (NSF), PSU portion.
 Examination of diverse anaerobic methane oxidizing Archaea and associated syntrophic relationships using high resolution molecular and isotopic methods
 2002-2005 \$5,000 (Ettinger Foundation), House as PI
 Geomicrobiological Studies
 2000-2004 \$40,000 (NSF), House as PI
 International Studies in Microbial Biogeochemistry: An IGERT Funding Supplement
 2002-2004 \$22,556 (JOI), House as PI
 Post-Cruise Science Proposal: Probing the Subsurface Biosphere
 2000-2003 \$314,309 (NASA)
 Exploring New Frontiers of the Connections Between the Biological and the Environmental Evolution of the Early Earth
 2001-2002 \$5,000 (Penn State), House as PI
 Carbon isotopic analysis of target ribosomal RNA
 2000-2001 \$8,000 (Penn State), House as PI
 AMO: a test of the syntrophic growth hypothesis for reverse methanogenesis

Invited Lectures

Penn State Astronomy Colloquium. Fall 2023. Enabling the Penn State planetary community
 MSL Team Meeting. Fall 2023. An update on the carbon isotopic composition of methane evolved from Gale crater samples
 Nittany Mineralogical Society, Winter 2022. Title: Organic Carbon on Mars.
 SETI institute and Georgetown University. Fall 2021. Panel title: Earth at the Crossroads: Can the Study of Other Worlds Help Us Save This One?
 NAS Committee on Planetary Protection. Fall 2020. My Opinion / Recollections Regarding the Perspective of the Planetary Protection Independent Review Board (PPIRB)
 Earth and Environment Systems Institute. Title: Positive Societal Impacts of Origin of Life and Space Sciences Research

The Village at Penn State. Fall 2019. Title: Exploring the Potential for an Extended Period of Habitability on Mars.

Astrobiology Science Conference, Seattle, Washington. Spring 2019. Title: The NAI @ Penn State: Training a Generation and Evolving with the Field.

Earth and Environment Systems Institute, Penn State. Spring 2019. Title: Exploring the Potential for an Extended Period of Habitability on Mars.

Millennium Cafe, Penn State. Spring 2018. Title: Exploring the Potential for an Extended Period of Habitability on Mars.

MSL Science Team Meeting, Montreal, Canada, Summer 2017. Title: Odds and Ends Relating to the Longevity of Gale Crater Habitability.

Nittany Mineralogical Society, Summer 2017. Title: The Curiosity Rover at Gale Crater, insights from a New Member of the Mars Science Laboratory Mission.

SAM Instrument Team Meeting, Caltech, Spring 2017. Title: Carbon isotopic fractionation during pyrolysis to methane.

Research Unplugged, Fall 2016. Title: Red Rover: Exploring NASA's Robotic Mission on Mars

Delaware Valley Amateur Astronomers, Fall 2016. Title: The Curiosity Rover at Gale Crater, insights from a New Member of the Mars Science Laboratory Mission

MSL Science Team Meeting, Caltech, Spring 2016, Title: Enhanced Evaluation of the Possible Habitability of Ancient Mars through Possible Earth Analogs.

Penn State Astronomy Department, Spring 2014. Title: Icy-World Ceres Explorer (ICE): A low-cost astrobiology mission to the icy planet that we can reach and explore!.

Penn State Astronomy Department, Fall 2013. Title: Astrobiology right here on Earth: Direct isotopic analysis of modern and ancient microbial cells.

Penn State Microbiology Symposium, Fall 2013. Title: Direct isotopic analysis of microbial cells.

Penn State Public Talk, Fall 2012. Title: Controlled Ecological Life Support Systems: A Key to Space Colonization.

Penn State Plant Pathology and Environmental Microbiology Department, Spring 2012: Title: Direct isotopic analysis of environmental microbial cells.

Penn State Earth and Environmental Systems Institute, Fall 2011. Title: The Pennsylvania Space Grant Consortium and Penn State Astrobiology Research Centers.

Penn State Geosciences Club, Spring 2011. Title: Studying extreme environments in preparation for the search for microbial life beyond the Earth.

Hershey Medical Center, Fall 2010. Title: Coupling microscopy with isotopic analysis to study marine sediment microbiota.

Tokyo University, Spring 2010. Title: Various views on early life.

JAMSTEC (Yokohama, Japan), Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

JPGU (Toyko, Japan), Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

Yale University, Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

Rensselaer Polytechnic Institute. New York Center for Studies on the Origin of Life. Spring 2009. Title: Moving beyond sulfate-dependent methane oxidation in cold seeps.

National Space Grant Conference (Portland, OR), Fall 2009. Title: Penn State Astrobiology Research Center (PSARC): Probing "Unusual" Microorganisms of the Earth.

Gordon Research Conference on Organic Geochemistry, Summer 2008. Title: "Methylogenesis" by Methanosarcina: a Possible Model for the Anaerobic Oxidation of Methane.

Penn State University, Fall 2008. Title: Linking taxonomy with Environmental Chemistry in Marine Sediments.

Central State University, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Eastern Kentucky, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Arkansas, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Texas, Arlington, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

Penn State University, Spring 2007. Title: Methane munching microbes meandering on margins. La Salle University, Fall 2006. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Idaho, Fall 2006. First title: Linking Taxonomy with Environmental Geochemistry: The Anaerobic Oxidation of Methane in Cold Seeps. Second title: Probing the Microbiology of Deeply Buried Marine Sediments

Caltech, Fall 2006. Title: Gene Sequences, Gene Content, and Gene Order: Trying to find a “Genomic” Record for Geobiology.

University of California, Riverside. Fall 2006. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of California, Los Angeles. Fall 2006. Title: Margins, Methane, and Microbes.

Goddard Space Flight Center, Spring 2005. Title: Terrestrial analogs 3 biogenic methane.

NAI General Meeting (Boulder, CO), Spring 2005. Title: Geologic Primer, part 2.

Goldschmidt Conference (Copenhagen, Denmark), Summer 2004. Title: Using genomes to speculate on early microbial evolution & environments.

ASM Meeting (Salt Lake City, Utah), Spring 2002. Title: Single cell isotope techniques and biogeochemistry.

American Geophysical Union (San Francisco, CA), Fall 2005. Title: Linking Taxonomy with Environmental Geochemistry: the Anaerobic Oxidation of Methane in Cold Seeps & deeply Buried Marine Sediments.

Harvard University. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

NASA Astrobiology Institute Director’s Seminar. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

Rutgers University. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

NAI Meeting (Tempe, AZ), Spring 2003. Title: Genomic-based tree building applied to 55 ecological Bacteria, Archaea, and Eukarya.

University of Maryland, Center for Environmental Science / Chesapeake Biological Laboratory. Fall 2003. Title: The carbon isotopic analysis of microbial cells: Investigations into the anaerobic oxidation of methane.

Gordon Research Conference on the Origin of Life, Summer 2003. Title: What do gene sequences say about the antiquity of life?

ASM Meeting (Washington, D.C.), Spring 2003. Title: Gene content based phylogenetic methods. *American Society of Microbiology Annual Meeting*. Washington, D.C. Rensselaer Polytechnic Institute. New York Center for Studies on the Origin of Life. Fall 2003. Title: Tracing the Microbial Tree of Life: Novel Approaches Using Geochemistry and Genomics.

ISSOL Meeting (Oaxaca, Mexico), Summer 2002. Title: Exploration of subsurface Pacific microbial ecosystems.

University of California, Santa Cruz. Department of Molecular Biology. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Penn State University. Department of Geosciences. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

AGU Meeting (San Francisco, CA), Fall 2002. Title: Microbial tungsten extraction from basalt under hydrothermal conditions (100°C).

University of North Carolina at Chapel Hill. Department of Marine Sciences. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Ohio State University. Department of Geological Sciences Lunch Brownbag. Spring 2002. Title: Of microbes and men (people): Whole genome-based phylogenetics applied to Bacteria, Archaea, and Eukarya.

Ohio State University. Department of Geological Sciences Colloquium Series. Spring 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Goldschmidt Meeting (Hot Springs, VA), Summer 2001. Title: Using homolog groups to create a whole-genome tree of free-living organisms: an update.

Woods Hole Oceanographic Institute. Fall 2001. Title: Of microbes and men (people): Whole genome-based phylogenetics applied to Bacteria, Archaea, and Eukarya. Monterey Bay Aquarium Research Institute Colloquium Series. Fall 2001. Title: Novel approaches for microbial geochemistry and for microbial phylogenetics.

University of Massachusetts, Lowell. Department of Biology Colloquium Series. Spring 2001. Title: Novel approaches for microbial phylogenetics and for microbial geochemistry. State University of New York at Stony Brook Department of Geosciences Colloquium. Spring 2001. Title: Culture-independent study of carbon metabolism in microorganisms from the environment and from the fossil record.

Gordon Research Conference (Plymouth State College, NH), Summer 2000. Title: From Genomes to Microfossils: The search for ancient biochemical diversity.

University of Rochester, Department of Earth and Environmental Science Colloquium Series. Fall 2000. Title: Examining Microbial Diversity in the Precambrian.

University of Maryland, Department of Geology Colloquium Series. Fall 2000. Title: Examining Microbial Diversity in the Precambrian.

EUG Meeting (Strasbourg, France), Spring 1999. Title: Carbon isotopic analyses of Precambrian microfossils: a tool for constraining molecular evolution.

Arizona State University, Geology Colloquium Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Carnegie Institute of Washington Seminar Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

University of Chicago, Department of Geophysical Sciences Colloquium Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

University of California, Los Angeles, Institute of Geophysics and Planetary Physics Astrobiology Seminar Series. Spring 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Washington University in St. Louis, Department of Earth and Planetary Sciences Colloquium Series. Spring 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Caltech, Geology Club Seminar. Spring, 1997. Title: Pseudofossils and microfossils - important differences.