

CV — Mohit Melwani Daswani, Ph.D.

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Research Scientist specializing in coupled evolution modeling for ocean world habitability and sample return science. My computational-experimental approach integrates thermodynamic modeling with laboratory analysis to predict planetary habitability evolution. Recent JWST validation of my Europa outgassing predictions demonstrates the predictive power of coupled interior-atmosphere frameworks applicable to exoplanets and planetary bodies in our solar system.

Research expertise

Coupled evolution modeling: Thermodynamic-geological coupling, interior-atmosphere evolution, habitability prediction over geological timescales.

Computational frameworks: PHREEQC, PFLTRAN, Perple_X, custom thermodynamic databases, reactive transport modeling. Lead developer of NASA software DEWPython and AccretR.

Sample return science: Apollo sample mineralogy, meteorite classification, planetary surface mineralogy characterization.

Experimental capabilities: High-pressure thermodynamics, water-rock interactions, mineral-fluid equilibria, differential scanning calorimetry.

Cross-cutting applications: Planetary defense, exoplanet characterization, Mars paleoclimate, small body physical and geochemical properties.

Employment

2020–Present: Research Scientist, Jet Propulsion Laboratory, California Institute of Technology

Development of coupled evolution models for ocean world habitability assessment.

Sample return mission formulation and landing site characterization.

International collaboration leadership: JAXA, ELSI/Science Tokyo, Nantes University, The Open University (UK), Australian National Science and Technology Organisation.

2018–2020: Postdoctoral Scholar & Europa Clipper Project Science Affiliate, JPL - Ocean world geochemistry and mission science with Dr. Steven Vance

2015–2017: Postdoctoral Scholar, University of Chicago - Mars geochemistry and paleoclimate modeling with Prof. Edwin Kite

Education

2011–2015: Ph.D. Planetary Science/Geochemistry, The Open University.

2009–2011: M.Sc. Geo-information Science & Earth Observation (Erasmus Mundus), Southampton/Lund/Warsaw/Twente.

2003–2009: Geology, Autonomous University of Barcelona + Erasmus year at University of Bern.

Validated predictions and international recognition

Europa outgassing and ocean composition predictions validated by 2023 JWST CO₂ observations, confirming coupled interior-surface evolution models published in Geophysical Research Letters (2021).

Media coverage: Research featured in The Atlantic, Smithsonian Magazine, Forbes, and international outlets.

NASA Planetary Science Early Career Award (2020) for computational thermodynamics and planetary structure modeling.

Training and international collaboration

Mentoring track record: 17 students and postdocs supervised with documented success including first-author publications and placements at top institutions.

International partnerships: Active research collaborations with JAXA/University of Tokyo (Mars mineralogy and geochemistry), Earth-Life Science Institute Tokyo (coupled geochemistry-climate modeling), University of Nantes (planetary dynamics), Australian Nuclear Science and Technology Organisation (advanced analytical techniques for extraterrestrial samples).

Teaching experience: Guest lectures at UCLA, Louisiana State University, University of Washington. Instructor for USC's "Bridge to the Geosciences" program for underrepresented students.

Community leadership: Network for Ocean Worlds (NOW) Steering Committee member, conference session organizer, reviewer for 10+ journals including Nature Astronomy and Science Advances.

Service and Leadership

Editorial service: Regular reviewer for Nature Astronomy, Geophysical Research Letters, Science Advances. Editor for Frontiers in Astronomy and Space Science special issue on planetary habitability.

NASA proposal review: Panelist 10+ times for planetary science and astrobiology programs.

Community contributions: Co-author on Planetary Science Decadal Survey white papers, open-source software development, public engagement through international media.

List of Achievements

Dr. Mohit Melwani Daswani

1 A. Peer-reviewed original papers

Legend: 🌊 Ocean world studies 🌍 Paleoclimate and environmental chemistry 🪨 Meteorite geochemistry
🔬 Analytical methods 📊 Computational tools 🔥 Thermodynamics 🎓 Student mentored by me.

1. 📊 🔥 Wang, C.-C. 🎓, Usui, T. & **Melwani Daswani, M.** (In revision.) “A Thermochemical Modeling Perspective of Why Ca/Fe Carbonates Broadly Associate with Felsic Terrains on Mars.” *Preprint available if requested.*
2. 🌍 📊 🔥 Kadoya, S. & **Melwani Daswani, M.** (In revision.) “Continued continental weathering during snowball Earth mitigated greenhouse gas buildup and prolonged global glaciation.” *Preprint available if requested.*
3. 🌍 📊 🔥 Weber, J.M. et al. incl. **Melwani Daswani, M.** (In revision.) “Architectures and Instruments for Enceladus Exploration.” *Preprint available if requested.*
4. 🌊 📊 Bagheri, A. et al. incl. **Melwani Daswani, M.** (Accepted.) “Exploring the Interior Structure and Mode of Tidal Heating in Enceladus.” *Planetary Science Journal* doi:10.3847/PSJ/ae0cab. *Preprint:* arXiv:2505.14743.
5. 🌊 📊 🔥 🌍 Courville, S.W. 🎓, Castillo-Rogez, J.C., **Melwani Daswani, M.** et al. (2025) “Core metamorphism controls dynamical habitability of mid-sized ocean worlds: The case of Ceres.” *Science Advances* 11, eadt3283. doi:10.1126/sciadv.adt3283.
6. 🌊 📊 Scully, J. E. et al. incl. **Melwani Daswani, M.** et al. (2025) “Small in Number but Mighty in Significance: Impact Craters as Windows into Europa’s Subsurface.” *Journal of Geophysical Research: Planets*, 130:7, e2024JE008670. doi:10.1029/2024JE008670.
7. 🌊 🌍 📊 🔥 Işık, S. 🎓, **Melwani Daswani, M.** et al. (2025). “Thermodynamic constraints on the citric acid cycle and related reactions in ocean world interiors.” *ACS Earth and Space Chemistry*. doi:10.1021/acsearthspacechem.4c00371.
8. 🌊 🔬 Martinez, E. et al. incl. **Melwani Daswani, M.** (2025). “Organic Adsorption onto Iron Hydroxide and Sulfide Minerals: Implications for Ceres Sample Return Analysis.” *ACS Earth and Space Chemistry*. doi:10.1021/acsearthspacechem.4c00372.
9. 🌊 📊 Petricca, F. 🎓 et al. incl. **Melwani Daswani, M.** (2025). “Gravity and Radio Science Investigation at the Moons of Uranus to Reveal Subsurface Oceans and Characterize Interior Structures.” *Journal of Geophysical Research: Planets*, 140, e2024JE008715. doi:10.1029/2024JE008715.
10. 🌊 🌍 🔥 Affholder, A. et al. incl. **Melwani Daswani, M.** (2025). “The viability of glycine fermentation in Titan’s subsurface ocean.” *Planetary Science Journal*, 6, 86. doi:10.3847/PSJ/adbc66.
11. 🌊 📊 🔥 Lesage, E. et al. incl. **Melwani Daswani, M.** (2025). “Signatures of past and present cryovolcanism on Europa: Composition, geology, interior.” *Nature Communications*, 16, 1886. doi:10.1038/s41467-025-57070-8.
12. 🌊 📊 🔥 Petricca, F. 🎓 et al., incl. **Melwani Daswani, M.** (2025). “Partial differentiation of Europa inferred from Galileo gravity data.” *Nature Astronomy*. doi:10.1038/s41550-024-02469-4.
13. 🌊 📊 🔥 Pou, L. et al. incl. **Melwani Daswani, M.** (2024). “Tidal seismicity in the Moon and implications for the rocky interior of Europa.” *Planetary Science Journal*, 5, 142. doi:10.3847/PSJ/ad47bc.

14.   Chua, B.H. et al. incl. **Melwani Daswani, M.** (2023). “Low-temperature specific heat capacity of water–ammonia mixtures down to the eutectic.” *ACS Earth and Space Chemistry*, 7, 1971-1979. doi:10.1021/acsearthspacechem.3c00091.
15.   Courville, S.W. et al. incl. **Melwani Daswani, M.** (2023). “Timing and abundance of clathrate formation control ocean evolution in outer solar system bodies: Challenges of maintaining a thick ocean within Pluto.” *Planetary Science Journal*, 4, 179. doi:10.3847/PSJ/acf377.
16.   Styczinski, M.J., Vance, S.D., & **Melwani Daswani, M.** (2023). “PlanetProfile: Self-consistent interior structure modeling for ocean worlds and rocky dwarf planets in Python.” *Earth and Space Science*, 10, e2022EA002748. doi:10.1029/2022EA002748.
17.   Naseem, M. et al. incl. **Melwani Daswani, M.** (2023). “Salt distribution from freezing intrusions in ice shells on ocean worlds: Application to Europa.” *Planetary Science Journal*, 4, 181. doi:10.3847/PSJ/ace5a2.
18.   Castillo-Rogez, J.C. et al. incl. **Melwani Daswani, M.** (2023). “Compositions and interior structures of the large moons of Uranus and implications for future spacecraft observations.” *Journal of Geophysical Research: Planets*, 128, e2022JE007432. doi:10.1029/2022JE007432.
19.   Diab, J., , **Melwani Daswani, M.** & Castillo-Rogez, J. (2023). “Bulk composition and thermal evolution constrain the formation of organics in Ceres’ subsurface ocean via geochemical modeling.” *Icarus*, 391, 115339. doi:10.1016/j.icarus.2022.115339.
20.   Castillo-Rogez, J.C., **Melwani Daswani, M.** et al. (2022). “Contribution of non-water ices to salinity and electrical conductivity in ocean worlds.” *Geophysical Research Letters*, 49, e2021GL097256. doi:10.1029/2021GL097256.
21.    **Melwani Daswani, M.**, & Castillo-Rogez, J.C. (2022). “Porosity-filling metamorphic brines explain Ceres’ low mantle density.” *Planetary Science Journal*, 3, 21. doi:10.3847/PSJ/ac4509.
22.    Castillo-Rogez, J.C. et al. incl. **Melwani Daswani, M.** (2022). “Science drivers for the future exploration of Ceres: From solar system evolution to ocean world science.” *Planetary Science Journal*, 3, 64. doi:10.3847/PSJ/ac502b.
23.   Marusiak, A.G. et al. incl. **Melwani Daswani, M.** (2021). “Exploration of icy ocean worlds using geophysical approaches.” *Planetary Science Journal*, 2, 150. doi:10.3847/psj/ac1272.
24.    **Melwani Daswani, M.** et al. (2021). “A metamorphic origin for Europa’s ocean.” *Geophysical Research Letters*, 48, e2021GL094143. doi:10.1029/2021GL094143.
25.    Běhouňková, M. et al. incl. **Melwani Daswani, M.** (2021). “Tidally-induced magmatic pulses on the oceanic floor of Jupiter’s moon Europa.” *Geophysical Research Letters*, 48, e2020GL090077. doi:10.1029/2020GL090077.
26.  Perl, S.M. et al., incl. **Melwani Daswani, M.** (2021). “A proposed geobiology-driven nomenclature for astrobiological in situ observations and sample analyses.” *Astrobiology*, 21, 954-967. doi:10.1089/ast.2020.2318.
27.    Morlok, A., et al. incl. **Melwani Daswani, M.** (2020). “Mid-infrared reflectance spectroscopy of carbonaceous chondrites and calcium–aluminum-rich inclusions.” *Planetary and Space Science*, 193, 105078. doi:10.1016/j.pss.2020.105078.
28.    Vance, S.D. & **Melwani Daswani, M.** (2020). “Serpentinite and the search for life beyond Earth.” *Philosophical Transactions of the Royal Society A*, 378, 20180421. doi:10.1098/rsta.2018.0421.
29.    Kite, E.S., & **Melwani Daswani, M.** (2019). “Geochemistry constrains global hydrology on Early Mars.” *Earth and Planetary Science Letters*, 524, 115718. doi:10.1016/j.epsl.2019.115718.
30.   **Melwani Daswani, M.** & Kite, E.S. (2017). “Paleohydrology constrained by mass balance and mineralogy of pre-Amazonian sodium chloride lakes on Mars.” *Journal of Geophysical Research: Planets*, 122, 1802-1823. doi:10.1002/2017JE005319.

31. 🌍📊🔥🪨 Melwani Daswani, M. et al. (2016). “Alteration minerals, fluids, and gases on early Mars: Predictions from 1-D flow geochemical modeling of mineral assemblages in meteorite ALH 84001.” *Meteoritics & Planetary Science*, 51, 2154-2174. doi:10.1111/maps.12713.
32. 🪨🔬 Gross, J. et al. incl. Melwani Daswani, M. (2013). “Petrography, mineral chemistry, and crystallization history of olivine-phyric shergottite NWA 6234: A new melt composition.” *Meteoritics & Planetary Science*, 48, 854-871. doi:10.1111/maps.12092.

2 B. Non-peer-reviewed original papers

1. 📊🔥 Chan, A. 🎓, Melwani Daswani, M. & Vance, S. (2021). “DEWPython: A Python implementation of the Deep Earth Water model and application to ocean worlds.” *arXiv preprint*, arXiv:2105.14096.

3 C. Books and other publications

1. 🌊📊🔥🌍 Vance, S.D., Crósta, A.P., Melwani Daswani, M., et al. (2025). “Chapter 13: Exchange processes between surface, atmosphere, and interior.” In *Titan After Cassini-Huygens* (R.M.C. Lopes, Ed.), Elsevier, pp. 399-422 doi:10.1016/B978-0-323-99161-2.00009-7.
2. **Co-author on four Community Papers** for the National Academies of Sciences, Engineering, and Medicine’s Planetary Science and Astrobiology Decadal Survey 2023-2032. (Co-signee on three additional papers.)

4 D. Other (awards, teaching, academic activities, contributions to society, international collaborations)

4.1 Awards and recognition

1. **NASA Planetary Science Early Career Award** (2020) - for “Experimental and Computational Thermodynamics, Organics, and Planetary Structure Modeling (ECTOPlaSM)”.
2. **Lunar and Planetary Institute Career Development Award** (2014) - Travel stipend for outstanding research contributions.
3. **Mineralogical Society of Great Britain and Ireland Bursary** (2014) - Research presentation support.
4. **European Commission Erasmus Mundus Fellowship** (2009–2011) - Competitive international program for environmental science education.

4.2 Speaking Engagements

5. **Keynote speaker** - International Symposium on Origin of Life, Keihanna, Kyoto, Japan (September 2025).
6. **Invited speaker** - ISAS/JAXA Planetary Exploration Workshop, Tokyo, Japan (August 2023) - “The Metamorphic Brine—Ocean—Surface Deposit Connection at Ceres”.
7. **Invited speaker** - Earth-Life Science Institute (ELSI) Seminar, Tokyo Institute of Technology (August 2023) - “Irreversible dehydration of rocky interiors leads to oceans on planetary bodies: Europa and Ceres as case studies, and implications for habitability”.

4.3 Teaching and mentoring

8. **Graduate student and postdoc mentoring** - 17 students mentored to successful career advancement (2018–present)

9. **Bridge to Geosciences program instructor** - USC Wrigley Marine Science Center - Applied environmental geochemistry for underrepresented STEM students.
10. **Science career advisor** (2025) - La Merced Academy Grade 6–8 students, Montebello, California.
11. **Guest lecturer** - UCLA Department of Earth, Planetary, and Space Sciences (2024); Louisiana State University, Geology & Geophysics (2023); University of Washington, Astrobiology Colloquium (2021)
12. **Workshop development and leadership** - NASA Research Coordination Network Network for Ocean Worlds seminars and interdisciplinary training programs.

4.4 Professional service and leadership

13. **Editorial and review service** - Reviewer for 10+ journals including *Nature Astronomy*, *Science Advances*, *Geophysical Research Letters*.
14. **NASA proposal review panels** - Service on 10+ review panels for competitive research programs.
15. **Conference organization** - Session convener for Astrobiology Science Conference, Goldschmidt, American Geophysical Union Fall Meeting, Water-Rock Interaction Meeting.
16. **Science committee member** - Network for Ocean Worlds Steering Committee, Lunar and Planetary Institute Brines Across the Solar System conference organizing committee.
17. **Community leadership** - Co-author on planetary science decadal survey white papers, public engagement through media interviews.

4.5 Technical and Computational Expertise

18. **Open-source software development** - Contributor to PlanetProfile framework for planetary interior modeling, Lead author of AccretR planetary accretion model, and DEWPython (Python implementation of the Deep Earth Water Model).
19. **Database development** - Advanced thermodynamic databases for extreme environmental conditions.
20. **Analytical method development** - High-pressure experimental techniques, neutron imaging protocols, spectroscopic characterization methods.

4.6 Public engagement and science communication

21. **Media coverage** - Research featured in *The Atlantic*, *Forbes*, *Smithsonian Magazine*, *CBC News*, *Reuters*, *The Times* and others.
22. **International science communication** - Interviews and articles reaching global audiences about planetary habitability and environmental research.