CURRICULUM VITAE

Joseph D. McNeil Ph.D. MRes BSc

SUMMARY

I am a planetary scientist specialising in the geological evolution of Mars and planetary surface processes. I integrate my terrestrial geological background with orbital and in situ multi- and hyperspectral remote sensing to investigate the composition, stratigraphy, and habitability of planetary surfaces. My research has advanced our understanding of the evolution of Mars through stratigraphic and mineralogical analyses of Oxia Planum, the *ExoMars Rosalind Franklin Rover* landing site, regional-to-global-scale mapping of erosion along the hemispheric dichotomy, and compositional characterisation of the ancient martian crust exposed by giant impact events. I am an active member of the *Rosalind Franklin* science community, contributing to RSOWG, PanCam and Enfys activities, and serve as the theme lead for geologic contacts and stratigraphy on the CaSSIS instrument onboard *TGO*.

RESEARCH EXPERIENCE

STFC Postdoctoral Researcher; The Natural History Museum, London **April 2026 to Present**

- Project funded by STFC: "***Secondary Impact Craters as Absolute Stratigraphic Markers***", collaborating with Prof. Peter Grindrod (NHM) and Dr. Giulia Magnarini (Nantes University).
- Investigating secondary impact distributions on Europa using GPlates-based spatial analysis and visible imaging data, helping to understand tectonic movements of Europa's icy crust, providing new constraints on surface processes ahead of NASA's *Europa Clipper* and ESA's *JUICE* missions.
- Applying multispectral imaging and spectral clustering analysis to characterise secondary crater chain formation on Mercury and assess relative timing of volatile-driven processes through the observed relationships between secondary craters and hollows.

UKSA Postdoctoral Researcher; Natural History Museum, London **April 2023 to March 2026**

- Project funded by the UK Space Agency: "***Optimizing Multi- and Hyper-Spectral Orbital Data: Investigation of Water and Redox Evolution on Mars***", collaborating with Prof. Peter Grindrod (NHM), Dr. Livio Tornabene (University of Western Ontario) and Dr. Javier Cuadros (NHM).
- Detected and mapped hydrated silica (opal) deposits across southern Oxia Planum using integrated CRISM hyperspectral and CaSSIS multispectral analysis, identifying these as potential biosignature-preserving environments formed under Noachian habitable conditions, with direct relevance to the astrobiology goals of the *Rosalind Franklin* rover (***McNeil et al., 2025, JGR: Planets***).
- Demonstrated through geomorphological and spectroscopic analysis (CRISM, CTX, HRSC) that Mars' hemispheric dichotomy boundary has retreated by hundreds of kilometres in the Mawrth Vallis region, recording a multiphase aqueous alteration history with implications for Noachian habitability (***McNeil et al., 2025, Nature Geoscience***).
- Detected potential deposits of shock-metamorphosed plagioclase feldspar, mapping its extent across ancient impact basin ejecta to reveal an evolved pre-Noachian crust: a result with major implications for the geochemical evolution of early Mars (***McNeil et al., in prep, EPSL***).
- Independently conceived and generated the CaRDR dataset: a near-global (~99% coverage) 90 m/pixel multispectral map of Mars derived by resampling CRISM hyperspectral data to CaSSIS band passes. Enables improved imaging efficiency for CaSSIS, HiRISE, and future orbital imagers. Released publicly for community benefit (***McNeil & Stabbins, submitted, Earth & Space Sci.***).
- Developed novel multi- and hyperspectral data processing methods, including new CaSSIS band parameter combinations to detect and differentiate low-Fe mineral phases (e.g. opal and chloride

deposits) and to map hematite distribution for redox investigation, providing tools directly applicable to PanCam and Enfys data from the *ExoMars Rosalind Franklin Rover*.

- Associate member of the CaSSIS science team, serving as theme lead for geologic contacts and stratigraphy. Planned several rounds of image targeting, attended science team meetings, and produced peer-reviewed publications from multispectral data analysis.

EDUCATION

PhD, Planetary Science; The Open University **October 2019 to April 2023**

- Thesis: "***Mounds in Oxia Planum and Chryse Planitia, Mars: an unrecognised archive of Noachian geology***", supervised by Prof. Matthew Balme, Dr. Peter Fawdon, and Prof. Angela Coe.
- Used visible, compositional, and topographic orbital remote sensing data to investigate the geology of a population of kilometre-scale, isolated mounds which occur in Oxia Planum and across the circum-Chryse dichotomy region on Mars.
- Unravelled the connections between mound composition, morphology, and morphometry, improved our understanding of Noachian landscape evolution, and located astrobiologically important rover targets.
- Winner of competitive conference, university, national, and international prizes (see below).
- Successfully published two Q1 journal papers (***McNeil et al., 2021 and 2022, JGR: Planets***).
- Presented research at national and international conferences.

MSc by Research, Earth Sciences; Royal Holloway, University of London **2017 to 2018**

- Thesis: "***Sedimentary Provenance and Depositional Environment of the Oligocene Shwezetaw and Padaung Formations in the Salin Sub-basin, Onshore Myanmar***", supervisors: Prof. Robert Hall and Dr. Amy Gough.
- Planned and delivered a multi-institution analytical programme involving sediment disaggregation and light microscopy (Royal Holloway, University of London), Raman spectroscopy of heavy minerals (University of Göttingen, Germany), and LA-ICP-MS U-Pb zircon geochronology (UCL).
- Competitive 'Southeast Asia Research Group' scholarship recipient; project funded by *Eni S.p.A*.
- Successfully published one Q1 journal paper (***McNeil et al., 2021, J. Asian Earth Sci.***), presented at international and national conferences, and at internal *Eni* meetings.

BSc Geology; Royal Holloway, University of London; *First Class Honours (80%)* **2014 to 2017**

- Final Year Research Project: "***Volumetric Flow Rates of Lava Transport Mechanisms on the Surface of Olympus Mons, with Implications for Magma Supply Rate***" (95%).
- Final Year Mapping Project: "Geology of the Moine Thrust Zone West of Loch Eriboll" (78%).
- Selected honours courses: Advanced Topics in Sedimentology, Volcanology, Planetary Geology & Geophysics, Structural Analysis and Remote Sensing, Geochemistry, Advanced Techniques in Tectonic Interpretation.

KEY SKILLS AND COMPETENCIES

- Analysis and interpretation of visible, topographic, and multi/hyperspectral orbital remote sensing data for Mars (HiRISE, CaSSIS, CTX, HRSC, CRISM, OMEGA, THEMIS, TES) and other planetary bodies.
- Multispectral data analysis, Academic writing, geospatial data visualisation, surface interpolation, integration of diverse remote sensing data, large planetary database creation and management.
- Regular attendee/presenter at *Rosalind Franklin Rover* RSOWG, PanCam, and Enfys team meetings, CaSSIS science team meetings, and Oxia Planum Mapping Reconciliation Workshops.
- Software: ArcGIS Pro, ArcMap, QGIS, JMars, ENVI/IDL, CRISM Analysis Toolkit, Python, R, GPlates, Adobe Creative Suite, Affinity Designer, Microsoft Office, MacOS/Windows.
- Laboratory/field: Geologic field skills, SEM, LA-ICP-MS, Raman Spectroscopy, FTIR, sample disaggregation, sample separation (magnetic and density).

AWARDS, PRIZES, AND HONORARY POSITIONS

Keith Runcorn Thesis Prize 2024 (runner-up), Royal Astronomical Society, UK	**Aug. 2024**
Visiting Researcher, School of Physical Sciences, Open University	**Jun. 2023 -**
British Planetary Science Conference – departmental award for organisers	**Dec. 2022**
Open University Research Excellence Award – Overall Winner (out of 138 total nominees)	**Sept. 2022**
Pierazzo International Student Award (2022), Planetary Science Institute, USA	**Dec. 2021**
Best Student Talk: 'Mars – A New Geological Frontier', Geological Society of London, UK	**Nov. 2021**
Judge's Choice Poster, Open University Graduate School Poster Competition	**Jun. 2021**
Outstanding Contribution, Europlanet PlanMap Planetary Mapping Winter School	**Feb. 2021**
People's Choice – Open University Graduate School 'Bake Your Research'	**Nov. 2019**
Southeast Asia Research Group Scholarship (Fully funded MRes + stipend; Eni S.p.A.)	**Sept. 2017**
Departmental Volcanology Prize for Best Final Year Performance, Royal Holloway	**Jul. 2017**

JOURNAL PUBLICATIONS

(1) **McNeil, J.D.**, Grindrod, P.M., Tornabene, L.L., Fawdon, P., Rangarajan, V.G. "Hydrated Silica in Oxia Planum, Mars" (2025), *Journal of Geophysical Research: Planets*. *doi.org/10.1029/2025JE008989*

(2) **McNeil, J.D.**, Fawdon, P., Balme, M.R., Coe, A.L., Cuadros, J., Turner S.M.R. "Dichotomy retreat and aqueous alteration on Noachian Mars recorded in highland remnants" (2025*), Nature Geoscience. doi.org/10.1038/s41561-024-01634-8*.

(3) Charambolous, C., Pike, W.T, Fernando, B., Wójcicka, N., Doyeon, K.,... **McNeil, J.D.** et al. "New Impacts on Mars: Unraveling Seismic Propagation Paths through a Cerberus Fossae Impact Detection" (2025), *Geophysical Research Letters* Vol. 52, Issue 3, *doi.org/10.1029/2024GL110159*

(4) Fawdon, P., Orgel, C., Adeli, S., Balme, M.R., Calef, J.F.,... **McNeil, J.D.**,... "The high-resolution map of Oxia Planum, Mars; the landing site of the ExoMars Rosalind Franklin rover mission" (2024), *Journal of Maps Vol. 20 https://doi.org/10.1080/17445647.2024.2302361*

(5) Favaro, E.A., Balme, M.R., **McNeil, J.D.,** Fawdon, P., Davis, J.M., Grindrod, P.M., Lewis, S.R. "Periodic Bedrock Ridges at Oxia Planum and Chryse Planitia, Mars: Evidence for widespread aeolian erosion of an ancient surface by regional paleowinds" (2024), *Earth and Planetary Science Letters Vol. 626 doi.org/10.1016/j.epsl.2023.118522*

(6) **McNeil, J.D.**, Fawdon, P., Balme, M.R., Coe, A.L., Thomas, N. "Mounds in Oxia Planum: The Burial and Exhumation of the ExoMars Rover Landing Site" (2022), *Journal of Geophysical Research: Planets, Vol. 127 doi.org/10.1029/2022JE007246*

(7) **McNeil, J.D.**, Fawdon, P., Balme, M.R., & Coe, A. L. "Morphology, morphometry, and distribution of isolated landforms in southern Chryse Planitia, Mars" (2021), *Journal of Geophysical Research: Planets, Vol. 126 doi.org/10.1029/2020JE006775*

(8) **McNeil, J.D.**, Gough, A., Hall, R., Lünsdorf, N. K., Webb, M. & Feil, S. "A multi-proxy provenance study of Eocene to Oligocene sandstones in the Salin Sub-basin, Myanmar" (2021), *J. of Asian Earth Sciences Vol. 216 doi.org/10.1016/j.jseaes.2021.104825*

(9) Webb, M., Gough, A., Vannucchi, P., Lünsdorf, N. K., **McNeil, J.D.** "A switch from long distance Himalayan-derived to locally sourced provenance in the Plio-Pleistocene Nicobar Fan" (2021), *Marine and Petroleum Geology, Vol. 125. doi.org/10.1016/j.marpetgeo.2020.104874*

PENDING PUBLICATIONS

(1) **McNeil, J.D.** and Stabbins, R.B. CaRDRs: "A Global 90-m Visible/Infrared Spectral Map of Mars from CRISM-CaSSIS Resampling" (submitted), *Earth and Space Science. Data DOI: doi.org/10.5519/tbyp7pu2*

(2) **McNeil, J.D.**, Grindrod, P.M., Tornabene, L.L., Bickel, V.T., Stabbins, R.B., Cuadros, J., Sokołowska, A.J. Bill, C.A., Patel, M.R. "Early evolved crust on Mars revealed in ancient impact ejecta" (in prep), *Earth and Planetary Science Letters*.

(3) Fernando, B., Clennett, E., **McNeil., J.D.** "Searching for surviving antipodes of large terrestrial impacts" (submitted), *Tektonika*.

KEYNOTE AND INVITED CONFERENCE TALKS

(1) **McNeil, J. D.** (2025). "Technicolour Mars: Seeing the Red Planet in a New Light", British Planetary Science Conference (keynote, invited), St Andrews, Scotland, Oral Presentation, June 2026

(2) **McNeil, J. D.**, Fawdon, P., Balme, M. R., Coe, A. L., Cuadros, J., Turner, S.M.R. (2025). "Noachian landscape evolution at the dichotomy boundary: insights from Mawrth Vallis". EGU General Assembly – Planetary Geomorphology (invited), Vienna, Austria, Oral Presentation, May 2025

SELECTED FIRST-AUTHOR CONFERENCE ABSTRACTS

(1) **McNeil, J. D.**, Grindrod, P.M., Tornabene, L.L., Bickel, V.T., Cuadros, J., Stabbins, R.B., Sokołowska, A.J., Bill, C.A., Patel., M.R. (2025) Seeing Red: The Curious Case of the Crimson Crust. *The Impact of UK Planetary Geoscience, The Geological Society, London, UK, Oral Presentation, November 2025*.

(2) **McNeil, J. D.**, Grindrod, P.M., Tornabene, L.L., Bickel, V.T., Cuadros, J., Stabbins, R.B., Patel., M.R. (2025) Seeing Red: Shocked Plagioclase as Pre-Noachian Stratigraphic Tracers. *EPSC-DPS 2025, Helsinki, Finland, Oral Presentation, September 2025*.

(3) **McNeil, J. D.**, Grindrod, P.M., Tornabene, L.L., Fawdon, P., Rangarajan, V.G. (2025). Hydrated Silica in Oxia Planum, Mars. *EGU General Assembly 2025 – Planetary Geomorphology, Vienna, Austria, Oral Presentation, May 2025*

(4) **McNeil, J. D.**, Grindrod, P.M., Tornabene, L.L., Fawdon, P. (2025). A multi- and hyperspectral investigation of hydrated silica in Oxia Planum, Mars. *56th Lunar and Planetary Science Conference, The Woodlands, TX, USA. Poster Presentation, March 2025*.

(5) **McNeil, J. D.**, Fawdon, P., Balme, M. R., Coe, A. L., Turner, S.M.R. (2024). Landscape evolution along the martian dichotomy near Mawrth Vallis: an archive of Noachian aqueous processes. *Tenth International Conference on Mars, Caltech, Pasadena, CA, USA. Oral Presentation, July 2024*.

(6) **McNeil, J. D.**, Grindrod, P.M., Tornabene, L.L., Fawdon, P. (2024). Hydrated Silica in Oxia Planum, Mars. *4th British Planetary Science Conference, University of Leicester, UK. Poster Presentation, June 2024*.

(7) **McNeil, J. D.**, Fawdon, P., Balme, M. R., Coe, A. L., Turner, S.M.R. (2023). Noachian landscape evolution and aqueous alteration recorded by highland remnants in Chryse Planitia. *American Geophysical Union Fall Meeting, San Francisco, CA, USA. Poster Presentation, December 2023*.

(8) **McNeil, J. D.**, Fawdon, P., Balme, M. R., Coe, A. L., Turner, S.M.R. (2023). Noachian landscape evolution at the dichotomy boundary: insights from Mawrth Vallis. *54th Lunar and Planetary Science Conference, The Woodlands, TX, USA. Oral Presentation, March 2023*.

(9) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2022). The Former Extent of the Mawrth Vallis Phyllosilicates. 3rd *British Planetary Science Conference, The Open University, UK. Oral Presentation, June 2022*

(10) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L., Turner, S.M.R. (2022). Windows into Noachian Mars: Eroded landforms in Chryse Planitia and the ExoMars rover landing site. *53rd Lunar and Planetary Science Conference, The Woodlands, TX, USA (Virtual). Poster Presentation, March 2022*.

(11) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2021). Where There's a Hill, There's a Way: Mounds in the ExoMars Rover Landing Site. *Mars - a new geological frontier, Geological Society of London. Oral Presentation, November 2021*.

(12) **McNeil, J. D.** (2021) The Lost Landscape: A Story of Deposition and Erosion in the ExoMars 2022 Rover Landing Site. *Open University Graduate School Poster Competition. Poster Presentation, June 2021*.

(13) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2021). The geology of isolated landforms on the margin of Chryse Planitia, Mars. *52nd Lunar and Planetary Science Conference, The Woodlands, TX, USA (Virtual). Oral Presentation, March 2021*.

(14) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2021). Mounds in the ExoMars 2022 landing site. *52nd Lunar and Planetary Science Conference, The Woodlands, TX, USA (Virtual). Poster Presentation, March 2021*.

(15) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2020). Morphology, Morphometry, and Distribution of Isolated Landforms on the Margin of Chryse Planitia, Mars. *Europlanet Science Congress 2020, Virtual. Oral Presentation, September 2020*.

(16) **McNeil, J. D.**, Fawdon, P., Balme, M. R., & Coe, A. L. (2020). The nature of remnant rounded mounds north of the ExoMars landing site. *2nd British Planetary Science Conference, University of Oxford, UK. Poster Presentation, January 2020*.

(17) **McNeil, J. D.**, Gough, A., Hall, R. (2018) Provenance and Sedimentary Routing Pathways of the Salin Sub-Basin, Myanmar. *Southeast Asia Petroleum Exploration Society Conference, London. Poster Presentation, June 2018*.

TEACHING, SUPERVISION, AND LABORATORY EXPERIENCE

Supervision of Students **October 2023 to Present**

- Will begin supervision of first PhD student in Q3 2026, who will focus on secondary impact cratering in the Artemis III candidate landing sites, and the ExoMars Rover landing site, Oxia Planum.
- Supervised MSc Student Anya Champagne at Imperial College London for their final-year independent research project, teaching hyperspectral investigation of CRISM data using CAT-ENVI/IDL and integration of this data in ArcGIS.
- Taught GIS skills, introductory geology, and remote sensing techniques to 10+ students from across the world in PlanMap Winter Schools, resulting in each student producing a geological map of a crater on Mars.

Postgraduate Teaching Assistant, Royal Holloway, University of London **Sept 2017 to Sept 2018**

- Lectured first-year undergraduates in structural geology (two lectures), demonstrated in laboratory work throughout their first term, and marked stereonet and dip calculation coursework.
- Taught introductory structural and sedimentological field techniques to first year undergraduates in Charnwood Forest, Leicestershire, and advanced field mapping techniques to second year students in southern Spain (Carboneras Fault Zone, Tabernas/Sorbas Basins).

Sediment Laboratory Technician, Southeast Asia Research Group, Royal Holloway **Apr 2017 to Oct 2017**

- Supervised and conducted the preparation and initial analysis of sandstone samples, involving sample disaggregation, heavy mineral separation, and petrographic point-counting of heavy minerals.

CONFERENCE ORGANISATION AND PEER REVIEW

- Reviewer for Nature Scientific Communications (1), Journal of Geophysical Research: Planets (3), and Planetary and Space Science (2).
- Co-convener – Planetary Geomorphology session, EGU 2026, Vienna, Austria.
- Session chair – Mars Surface and Interior, EPSC-DPS 2025, Helsinki, Finland.
- Assisted organisation of the 3rd British Planetary Science Conference 2022, The Open University, UK.

OUTREACH AND COMMUNITY ACTIVITIES

- Interviewed by international and national news outlets for *McNeil et al., 2025 (Nature Geoscience),* both online and print: CNN, Ars Technica, The Sun.
- Regular interviewee on podcasts: 'A Watery History of Mars', The Supermassive Podcast, Royal Astronomical Society (1 Nov 2025); 'Tech and Science Daily', London Evening Standard (22 Jan 2025).
- Delivers regular public outreach events at the Natural History Museum, including at museum 'lates' (>500 people), 'meet the scientist' events (~100 people), 'Dinosnores' sleepovers (400–600 children KS1-KS5), and corporate events, delivering '*Landscapes of the Solar System*' and '*Seeing Through a Rover's Eyes*' stations.
- Regular outreach and departmental seminars (e.g. Imperial College London, MSSL (UCL), Geological Society of Hertfordshire, Natural History Museum Graduate Centre)
- Designed and delivered annual poster and figure design workshop for PhD students at the Open University and Natural History Museum, showcasing design tips and tools to create eye-catching scientific graphics.
- Webmaster and committee member for Ireland+UK Europlanet Regional Hub (April 2025-present).
- EDI Officer and Social Secretary, Robert Hooke Society (2020–21; Open University)
- Social Secretary, Lyell Society (2016–17, Royal Holloway, University of London)
- Volunteer at PlanMap Winter Mapping School (2021, 2023) and at the British Planetary Science Conference (2022)