PHILLIP E. JARDINE Ph.D.

1. PERSONAL INFORMATION

Address: Institute of Geology and Palaeontology, University of Münster, 48149 Münster, Germany.
Email: jardine@uni-muenster.de
Website: https://philjardine.weebly.com
Languages: English (native), German (B1 level attained, currently studying for B2).

2. RESEARCH INTERESTS AND ETHOS

I combine botany, data science and the fossil record to study plant macroecology and macroevolution, and specifically how and why plant diversity varies through time and space. I also work on developing plant-based climate proxies for understanding past climatic and environmental change, and how this in turn drives biodiversity change through time. More generally, and with reference to the UN Sustainable Development Goals (SDGs), I aspire to use my research to answer pressing societal questions concerning the causes and consequences of biodiversity change, to carry out my research in a way that prioritises sustainability and minimises negative environmental impacts, and to make research outputs publicly available to ensure a fair and open distribution of knowledge and resources.

My research is currently funded via the DFG-funded project "Sporomorph chemistry, size and morphological disparity: towards a better understanding of the plant fossil record". This project focuses on integrating extant and fossil palynological records using a range of different parameters, with the aim of developing new tools for understanding floral macroecological and macroevolutionary dynamics.

3. EMPLOYMENT

05/2020 – present: **Research Associate**, *University of Münster, Germany.* PI on DFG funded 'Sporomorph chemistry, size and morphological disparity: towards a better understanding of the plant fossil record' (grant funds own position).
05/2017 – 04/2020: **Lecturer in Palaeobotany**, *University of Münster, Germany*. Three-year fixed term teaching and research position.
12/2016 – 04/2017: **Postdoctoral Researcher**, *University of Potsdam, Germany.* ERC funded 'Monsoons of Asia caused Greenhouse to Icehouse Cooling'.
06/2013 – 09/2016: **Postdoctoral Research Associate**, *Open University, UK.* NERC funded '500,000 years of solar irradiance, climate and vegetation changes'.
11/2011 – 05/2013: **Postdoctoral Research Associate**, *University of Birmingham, UK.* NSF funded 'Bighorn Basin Coring Project'.
10/2006 – 07/2011: **Teaching support assistant** (25% part-time), *University of Birmingham, UK.*

4. EDUCATION

10/2006 – 10/2011: **Ph.D.** (75% part-time), *University of Birmingham, UK.* 'Spatial and temporal diversity trends in an extra-tropical, megathermal vegetation type: the early Palaeogene pollen and spore record from the US Gulf Coast' (available at https://etheses.bham.ac.uk/id/eprint/2953/).
09/2005 – 09/2006: **M.Sc. Palaeobiology**, *University of Bristol, UK.* Independent research project: 'The alpha diversity of ancient mammalian grassland communities'.
10/2000 – 06/2003: **B.Sc. Geology/Geography (2.1 Hons.)**, *University of Birmingham, UK.* Dissertation: 'The fabric of extinctions across the Cretaceous/Tertiary boundary'.

5. RESEARCH

5.1 Funding

To date I have generated ~€1.4M in external research income, with ~€360K as principal investigator/lead applicant, and collaborations on successful grant proposals worth over €1.1M. I am currently PI on a DFG

Research Grant, as well as being a collaborator (Associate Investigator/Project Partner) on two ongoing international grants funded by the Royal Society of New Zealand and NERC, respectively.

11/2020: **Royal Society of New Zealand Marsden Fund Grant (20-MAU-005):** 'Unlocking centuries' worth of surface UV-B radiation hidden in pollen'. Associate investigator (PI: Dr. Kat Holt, Massey University, funded value NZ$944,000).
02/2020: **DFG Research Grant (443701866):** 'Sporomorph chemistry, size and morphological disparity: towards a better understanding of the plant fossil record'. PI: €346,021.
06/2019: **NERC Standard Grant (NE/T000392/1):** 'Solar irradiance and vegetation dynamics at the K/Pg boundary'. Project partner (PI: Dr. Barry Lomax, University of Nottingham, funded value £463,789).
05/2018: **Palaeontological Association Research Grant (PA-RG201802):** 'A chemical clue to an abominable mystery? Chemotaxonomy of basal angiosperm pollen and cuticles'. PI: £5,886
12/2012: **Palaeontological Association Sylvester-Bradley award:** 'Geochemistry and palynology: a proof of concept study'. PI: £1,480
05/2010: **IFPS travel grant** to present research at IPC3, London, UK. £350
04/2009: **TMS Grant-in-aid** to support attendance at the Advanced Course in Jurassic, Cretaceous and Cenozoic Organic-Walled Dinoflagellate Cysts, in Urbino, Italy. £200
02/2008: **Geological Society of London Timothy Jefferson Fund research grant:** 'The biogeography and biodiversity of Palaeocene paratropical plant communities'. PI: £1,040
12/2007: **Palaeontological Association Sylvester-Bradley award:** 'Palaeocene vegetation and climate change from the U.S. Gulf Coast'. PI: £993
09/2007: **AASP travel grant** to present research at the AASP 40th annual meeting, Panama City, Panama. $1,200
09/2006: **University of Bristol Alumni Foundation travel grant** to present research at the SVPCA 54th annual meeting, Paris, France. £302

5.2 Awards and prizes

11/2013: **TMS Charles Downie award**, awarded annually for the most significant publication from post-graduate research. Awarded for: **Jardine, P.E.**, Harrington, G.J. and Stidham, T.A. 2012. Spatial heterogeneity in Late Paleocene paratropical forests on the U.S. Gulf Coast. *Paleobiology*, **38**(1), 15-39.
06/2008: **Progressive Palaeontology 2008 best poster award**, for: **Jardine, P.E.** and Harrington, G.J. 2007. The Red Hills Mine flora: a diverse palynological assemblage from the Late Palaeocene of Mississippi.

5.3 Research fieldwork/sample collection

07/2019: **Herbarium Hamburgense, Hamburg**, to sample pollen/anthers from herbarium specimens for chemical analysis. Organised trip and worked independently. Carried out as part of the Palaeontological Association funded 'A chemical clue to an abominable mystery? Chemotaxonomy of basal angiosperm pollen and cuticles'.
07/2014: **LacCore repository, Minneapolis**, to sample the Lake Bosumtwi sediment cores. Organised trip and worked independently. Carried out as part of the NERC funded '500,000 years of solar irradiance, climate and vegetation changes'.
10/2013: **Ghana**, to recover and deploy pollen traps from vegetation study plots. Organised and led fieldwork, and provided mentoring to OU PhD student Adele Julier. Work carried out in collaboration with Dr Stephen Abu-Bredu, Forestry Research Institute of Ghana, as part of the NERC funded '500,000 years of solar irradiance, climate and vegetation changes' project.
05/2013: **USGS, Virginia**, to sample Palaeogene cores from the US Gulf and Atlantic Coastal Plains. Organised trip and carried out sampling in collaboration with Lucy Edwards, USGS. Funded by a Palaeontological Association Sylvester-Bradley award to PEJ.
01/2011: **MARUM, University of Bremen**, part of science team describing, sampling and archiving cores as part of the NSF-funded 'Bighorn Basin Coring Project'.
08/2010: **Bighorn Basin, Wyoming**, part of science team drilling sediment cores through the PETM as part of the NSF-funded 'Bighorn Basin Coring Project'.

02/2008: **US Gulf Coast**, for field and core sampling of Palaeogene sediments in Texas, Mississippi and Alabama. Organised trip and carried out sampling in collaboration with Guy Harrington (PhD supervisor). Funded by a Palaeontological Association Sylvester-Bradley award and Geological Society of London Timothy Jefferson Fund award to PEJ.

01/2007: **Rutgers University, New Jersey**, to sample early Palaeogene sediment cores. Organised trip and carried out sampling in collaboration with Guy Harrington (PhD supervisor).

5.4 Research skills

I.T.: Experience of Microsoft Word, Excel, PowerPoint and Access; Adobe Photoshop, Illustrator and InDesign; Affinity Photo, Designer and Publisher; Endnote; PAST; and R, on both Mac and PC platforms (where available).

Data acquisition: Experience of palaeontological/sedimentological sample collection in core repositories and in the field, botanical sample collection from herbaria and botanical gardens, laboratory processing of palynological samples, light and electron microscopy, manipulation of microfossils using micromanipulator and microinjector, micro-FTIR analysis of palynomorphs.

Data analysis: Familiarity with univariate and multivariate data exploration and statistics, model fitting including linear models, generalised linear models, additive models and mixed models, frequentist and Bayesian (using JAGS) approaches to model fitting, data simulation.

6. TEACHING AND EXAMINATION

6.1 University of Münster (2017 to 2020)

2017 – 2020: Data Analysis in the Geosciences (MSc module, covering data generation and analysis, including statistical tests, model fitting, multivariate analyses, and palaeobiodiversity measurement, using the R statistical package and programming environment. Assessed via written coursework. Set up and led course independently)

2017 – 2020: Progress in Palaeobotany (MSc block course, covering generation and analysis of chemical palaeobotanical and palynological data, principally using FTIR, as well as integrating phylogenies into palaeobotanical research and measuring morphological disparity, with information shared via student presentations on key papers. Set up and led course independently)

2017 – 2020: Introduction to Palynology (3rd/4th year module, covering introduction to major palynological groups and their applications, as well as data generation and analysis. Assessed via end of year exam)

2017 – 2019: Piemonte, Italy (3rd/4th year residential field excursion)

2018 – 2019: Ardennes, Belgium/France (3rd/4th year residential field excursion)

6.2 University of Birmingham (2006 to 2013)

2012: Micropalaeontology (co-taught 3rd/4th year module, acting module lead in 2012. Course covered introduction to main micropalaeontological groups, delivered via lectures and practicals. Assessed via written coursework and end of year exam)

2012: Topics in Geology (1st year small group tutorials, providing an introduction to academic writing practices and information transfer. Assessed via written coursework)

2006 – 2013: Dorset, U.K. (2nd/3rd year residential field trip)

2007 – 2012: Betics Cordillera, Spain (2nd/3rd year residential field trip)

From 2006 to 2011 I was a PhD demonstrator in practical classes for Mineralogy and Petrology, Evolutionary and Environmental Palaeobiology, Practical and Applied Geology, and Earth Surface Processes

6.3 Guest teaching

2013 - 2018: Statistical analysis of Micropalaeontological Data (workshop for Applied and Petroleum Micropalaeontology MSc students, University of Birmingham. Covered data generation, biodiversity measurement, multivariate analyses, and tutorial on PAST software)

2014: Atmosphere and Climate (3rd year module, lectures delivered on the PETM and early Paleogene climates, Oxford Brookes University)

6.4 Postgraduate examination

2021: External opponent in PhD viva for Florian Muthreich, University of Bergen, Norway.

Thesis title: New methods in palaeopalynology: classification of pollen through pollen chemistry
Supervisors: Dr A. Seddon (University of Bergen), Prof. H.J.B. Birks (University of Bergen), Prof. V. Vandvik (University of Bergen).

7. SUPERVISION AND MENTORING

7.1 Postdoctoral researchers

10/2022 – present: Co-host of Dr Francesca Galasso (main host Dr William Foster, Universität Hamburg)
Project: Malformation in fossil sporomorphs as proxies for atmospheric perturbations during mass extinction events
Funding: Humboldt Research Fellowship

7.2 Doctoral students

11/2021 – present: Co-supervisor of Timothy Anane
Title: Holocene UV-B variations recorded in pollen from Nar Gölü, Turkey. Linked to Marsden funded project 'Unlocking centuries' worth of surface UV-B radiation hidden in pollen'
Based: Massey University, NZ
Other supervisors: Dr Katherine Holt (primary supervisor), Prof. Barry Lomax, Prof. Mark Waterland

11/2021 – present: Co-supervisor of Bert Verleijsdonk
Title: Reconstructing Holocene relative changes in UV-B flux based on sporopollenin in pollen from a Lake Ohau, New Zealand, sediment core. Linked to Marsden funded project 'Unlocking centuries' worth of surface UV-B radiation hidden in pollen'
Based: Massey University, NZ
Other supervisors: Dr Katherine Holt (primary supervisor), Prof. Barry Lomax, Prof. Mark Waterland

02/2021 – present: Co-supervisor of Amber Woutersen
Title: The evolution of Central Asian vegetation from greenhouse to icehouse climate
Based: University of Amsterdam, NL
Other supervisors: Dr Carina Hoorn (principal supervisor and promotor), Prof. William Gosling, Dr Guillaume Dupont-Nivet

09/2019 – present: Co-supervisor of Caixia Wei
Title: Poaceae from Andes to Amazon: pollen morphometrics, phylogeny and Neogene origins
Based: University of Amsterdam, NL
Other supervisors: Dr Carina Hoorn (principal supervisor), Prof. William Gosling (promotor)

09/2019 – present: Co-supervisor of Faidra Katsi
Title: Reconstructing 11,500 years of cereal diversity in Central Anatolia, Turkey
Based: University of Nottingham, UK
Other supervisors: Prof. Barry Lomax (primary supervisor), Dr Matthew Jones, Dr Wesley Fraser, Dr Warren Eastwood

7.4 MSc students

02/2023 – present: Primary supervisor of Hannah Morck
Title: Testing the impact of phylogeny on palaeo-pCO_2 reconstructions.
Other supervisors: Prof. Benjamin Bomfleur

7.3 BSc students

02/2021 – 08/2021: Primary supervisor of Ina Kraus
Title: Palynofacies analysis of Paleocene to Miocene sediments, Atlantic Coastal Plain, USA.
Other supervisors: Prof. Benjamin Bomfleur

7.4 Student assistants

02/2022 – present: Hannah Morck, employed from DFG grant 'Sporomorph chemistry, size and morphological disparity: towards a better understanding of the plant fossil record'

8. OTHER ACADEMIC ACTIVITIES

8.1 Science communication

I enjoy the challenge of communicating research to a non-specialist audience. My recent research into ozone collapse across the end-Permian mass extinction, published in *Science Advances*, was featured in news reports, radio features and popular science articles from around the world (280 media mentions recorded), and I was interviewed for the Swiss SRF Wissenschaftsmagazin and Dutch BNR Wetenschap Vandaag radio shows, as well as for articles in New Scientist, Popular Science and Eos. Via my earlier research into the Paleocene-Eocene Thermal Maximum, I was interviewed for a report for the Mongabay website, and contributed an article to Palaeontology [online].

8.2 Participation in University/School activities

10/2017: Ran training workshop on FTIR data generation and analysis for students and staff in the Department of Ecosystem and Landscape Dynamics, University of Amsterdam.
02/2016: 'Model fitting with R' presentations delivered to Open University Environment, Earth and Ecosystems R user group, covering data simulation, linear models, mixed models and additive models.
09/2009 - 06/2010: Organiser of Geosystems Research Group seminar series, University of Birmingham.

8.3 Learned societies

11/2020 – 11/2022: Chair of the Palynology Group of The Micropalaeontological Society (associated position: TMS Councillor for the International Federation of Palynological Societies).
11/2014 – 11/2020: Secretary of The Micropalaeontological Society
03/2009 – 11/2012: Secretary of the Palynology Group of The Micropalaeontological Society

8.4 Contributions to academic conferences

11/2022: Delivered 'Data analysis with R' pre-conference workshop at the 2022 TMS Annual Conference, Bremen, Germany.
07/2022: Co-organiser of the TMS Silicofossil-Palynology 6th joint meeting, held online and at Northumbria University, UK.
08/2018: Co-organiser of session 'Geochemical and molecular proxies from fossil plants and palynomorphs: new techniques, new challenges' for EPPC 2018, Dublin, Ireland.
07/2015: Co-organiser of session 'Organisms and environments: Frontiers in palaeoecological technique development' for the XIX INQUA congress 2015, Nagoya, Japan.
04/2014: Co-organiser of 'Challenges in Macroecology: Scaling the Time Barrier' conference, held at the Natural History Museum, London, UK.
06/2012: Co-organiser of the TMS Palynology Group Annual Meeting, held at the University of Sheffield, UK.
03/2010: Co-organiser of the TMS Silicofossil-Palynology 3rd joint meeting, held at the University of Tromso, Norway.
05/2009: Chair of organising committee for Progressive Palaeontology 2009, held at the University of Birmingham, UK.
05/2009: Co-organiser of the TMS Palynology Group Annual Meeting, held at the Natural History Museum, London, UK.

8.5 Peer review

I review grant proposals for the British Ecology Society (member of the BES Review College since 2020); I have also acted as a reviewer for the Chile National Research and Development Agency. I am a member of the Editorial Board for *Palynology*, and I regularly peer review manuscripts for journals across a range of subject areas:

Palaeobiology and (palaeo)environmental change: *Cretaceous Research*; *Earth System Science Data*; *Journal of the Geological Society of London; Journal of South American Earth Sciences*; *Global and Planetary Change*; *New Zealand Journal of Geology and Geophysics*; *Palaeogeography, Palaeoclimatology, Palaeoecology*; *Palaeontology*; *Papers in Palaeontology*.

Evolution and ecology: *Communications Biology*; *Ecology and Evolution*; *Evolution*; *Journal of Biogeography*; *Methods in Ecology and Evolution*; *Molecular Phylogenetics and Evolution*; *The Biologist*.
Plant sciences, palaeobotany and palynology: *International Journal of Plant Sciences*; *Journal of Vegetation Science*; *New Phytologist*; *Palynology*; *Physiologia Plantarum*; *Review of Palaeobotany and Palynology*.
Chemistry and microscopy: *Chemical Papers*; *Micron*; *Phytochemical Analysis*; *Phytochemistry*; *Rapid Communications in Mass Spectrometry*.
Multidisciplinary: *PLoS ONE; Science Advances*.

8.6 Invited talks

11/2019: **Jardine, P.E.**, Hoorn, C., Beer, A.M., Barbolini, N., Woutersen, A., Bogota-Angel, G., Gosling, W.D., Fraser, W.T., Lomax, B.H., Huang, H., Sciumbata, M., He, H., and Dupont-Nivet, G. Sporopollenin chemistry and its durability in the geological record. Invited keynote speaker for the 28th International Plant Taphonomy Meeting, University of Münster.
02/2019: **Jardine, P.E.** Chemical analysis of pollen and spores: a new tool for reconstructing past vegetation and environmental change. Invited speaker for the Integrated Microscopy Approaches in Archaeobotany 2019 workshop, University of Reading.
05/2018: **Jardine, P.E.** New uses for old pollen: pollen chemistry as a taxonomic and palaeoclimatic tool. Invited international speaker for Palynologische Kring meeting, University of Amsterdam.
03/2017: **Jardine, P.E.** Analysing pollen and spore chemistry with Fourier Transform infrared (FTIR) spectroscopy. Palaeoecology and Landscape Ecology Research Group seminar, University of Amsterdam.
12/2014: **Jardine, P.E.** Low latitude diversification in the early Palaeogene greenhouse. Department of Animal and Plant Sciences seminar series, University of Sheffield.
06/2013: **Jardine, P.E.** Low latitude floral diversification in the early Palaeogene greenhouse. Palaeobiology Discussion Group, University of Bristol.
05/2013: **Jardine, P.E.** Plant diversification and dispersal in the early Palaeogene greenhouse. School of Ocean and Earth Sciences seminar series, University of Cardiff.
12/2012: **Jardine, P.E.** The Paleocene-Eocene Thermal Maximum: rapid global warming and its impact on the biosphere. Geologists' Association evening lecture.
02/2012: **Jardine, P.E.** Palaeogene global warming and the latitudinal diversity gradient. SoGEES seminar series, Plymouth University.

8.7 Training courses attended

09/2014: International Summer School on Bayesian Modelling: An Introduction for Ecologists and Environmental Scientists, taught by Joe Chipperfield, Florian Hartig and Jörn Pagel. Selected by application.
04/2013: Data exploration, regression, GLM and GAM with introduction to R, taught by Alain Zuur and Elena Ieno (Highland Statistics).
08/2009: Advanced Course in Jurassic, Cretaceous and Cenozoic Organic-Walled Dinoflagellate Cysts: Morphology, Paleoecology and Stratigraphy, taught by Henk Brinkhuis, Martin Head, Jörg Pross, James Riding, Paul Schiøler and Appy Sluijs.
06/2007: The Paleobiology Database Summer Course in Analytical Paleobiology, covering diversity curves, quantitative biochronology (taught by John Alroy), geometric morphometrics (taught by David Polly), community palaeoecology (taught by Tom Olszewski), phylogenetics (taught by Pete Wagner), and speciation and extinction (taught by Michael Foote). Selected by application.
07/2006: "Cracking Statistics", an intensive postgraduate statistics course taught by Ian Jolliffe, covering linear regression, ANOVA, general linear models, PCA, cluster analysis, and discriminant analysis.

8.8 Professional affiliations

AASP – The Palynological Society
GfÖ: The Ecological Society of Germany, Austria and Switzerland (member of the Macroecology Specialist Group)
Nordic Society Oikos and the Danish Oikos Society
The British Ecological Society (member of the Macroecology Special Interest Group)
The Micropalaeontological Society (member of the Palynology Specialist Group)
The Palaeontological Association

9. RESEARCH OUTPUTS

I disseminate my research findings via publications in high-quality, high-ranking journals (e.g. *Science Advances*, *New Phytologist*, *Geology*), and regular presentations at conferences and workshops. I am committed to open research, and deposit my data and code in open access repositories such as figshare and Dryad. I also contribute data to the Paleobiology Database.

9.1 Articles in peer reviewed journals

Number of publications 38, Google Scholar h-index 17, publications with ≥10 citations 21, total citations 886.
* = student that I am/have supervised

[38] Tellería, M.C., and Barreda, V.D., **Jardine, P.E.**, and Palazzesi, L. *In press*. The use of pollen morphology to disentangle the origin, early evolution, and diversification of the Asteraceae. *International Journal of Plant Sciences*.

[37] *Woutersen, A., **Jardine, P.E.**, Silvestro, D., Bogotá-Angel, G., Zhang, H.-X., Meijer, N., Bouchal, J., Barbolini, N., Dupont-Nivet, G., Koustodendris, A., Antonelli, A., and Hoorn, C. 2023. The evolutionary history of the Central Asian steppe-desert taxon *Nitraria* L. (Nitrariaceae) as revealed by integration of fossil pollen morphology and molecular data. *Botanical Journal of the Linnean Society*, boac050. doi: 10.1093/botlinnean/boac050

[36] Liu, F., Peng, H., Marshall, J.E.A, Lomax, B.H., Bomfleur, B., Kent, M.S., Fraser, W.T. and **Jardine, P.E.** 2023. Dying in the Sun: direct evidence for elevated UV-B radiation at the end-Permian mass extinction. *Science Advances*, **9**(1), eabo6102. doi: 10.1126/sciadv.abo6102

[35] *Wei, C., **Jardine, P.E.**, Gosling, W.D. and Hoorn, C. 2023. Is Poaceae pollen size a useful proxy in palaeoecological studies? New insights from a Poaceae pollen morphological study in the Amazon. *Review of Palaeobotany and Palynology*, **308**, 104790. doi: 10.1016/j.revpalbo.2022.104790

[34] Korasidis, V., Wing, S., Harrington, G.J., Demchuk, D., Gravendyck, J., **Jardine, P.E.** and Willard, D. 2023. Biostratigraphically significant palynofloras from the Paleocene–Eocene boundary of the USA. *Palynology*, **47**(1), 2115159. doi: 10.1080/01916122.2022.2115159

[33] Seyfullah, L.J., Roberts, E.A., **Jardine, P.E.**, Rikkinen, J., and Schmidt, A.R. 2022. Uncovering the natural variability of araucariacean exudates from *ex situ* and *in situ* tree populations in New Caledonia using FTIR spectroscopy. *PeerJ Analytical Chemistry*, **4**, e17. doi: 10.7717/peerj-achem.17

[32] Steinthorsdottir, M., **Jardine, P.E.**, Lomax, B.H. and Sallstedt, T. 2022. Key traits of living fossil *Ginkgo biloba* are highly variable but not influenced by climate – implications for palaeo-pCO_2 reconstructions and climate sensitivity. *Global and Planetary Change*, **211**, 103786. doi: 10.1016/j.gloplacha.2022.103786

[31] **Jardine, P.E.**, Palazzesi, L., Tellería, M.C., and Barreda, V.D. 2022. Why does pollen morphology vary? Evolutionary dynamics and morphospace occupation in the largest angiosperm order (Asterales). *New Phytologist*. **234**(3), 1075–1087. doi: 10.1111/nph.18024

[30] Seyfullah, L.J., Roberts, E.A**., Jardine, P.E.**, and Schmidt, A.R. 2021. Experimental induction of resins as a tool to understand variability in ambers. *Fossil Record*, **24**, 321–337. doi: 10.5194/fr-24-321-2021

[29] Huang, H., Pérez-Pinedo, D., Morley, R.J., Dupont-Nivet, G., Philip, A., Win, Z., Aung, D.W., Licht, A., **Jardine, P.E.**, and Hoorn, C. 2021. At a crossroads: The late Eocene flora of central Myanmar owes its composition to plate collision and tropical climate. *Review of Palaeobotany and Palynology*, **291**, 104441. doi: 10.1016/j.revpalbo.2021.104441

[28] Denis, E.H., Maibauer, B.J., Bowen, G.J., **Jardine, P.E.**, Harrington, G.J., Baczynski, A.A., McInerney, F.A., Collinson, M.E., Belcher, C.M., Wing, S.L., and Freeman, K.H. 2021. Decreased soil carbon in a warming world: Degraded pyrogenic carbon during the Paleocene-Eocene Thermal Maximum, Bighorn Basin, Wyoming. *Earth and Planetary Science Letters*, **566**, 116970. doi: 10.1016/j.epsl.2021.116970

[27] **Jardine, P.E.** and Lomax, B.H. 2021. Comment on "A 23 m.y. record of low atmospheric CO_2". *Geology*, **49**(4), e523. doi: 10.1130/G48596C.1

[26] Bogotá-Ángel, G., Huang, H., **Jardine, P.E.**, Chazot, N., Salamanca, S., Banks, H., Pardo-Trujillo, A., Plata, A., Dueñas, H., Star, W., Langelaan, R., Eisawi, A., Umeji, O.P., Enuenwemba, L.O., Parmar, S., Rocha da Silveira, R., Lim, J.Y., Prasad, V., Morley, R.J., Bacon C.D., and Hoorn, C. 2021. Climate and

geological change as drivers of Mauritiinae palm biogeography. *Journal of Biogeography*, **48**, 1001–1022. doi: 10.1111/jbi.14098

[25] **Jardine, P.E.**, Hoorn, C., Beer, M.A.M., Barbolini, N., *Woutersen, A., Bogotá-Angel, G., Gosling, W.D., Fraser, W.T., Lomax, B.H., Huang, H., Sciumbata, M., He, H., and Dupont-Nivet, G. 2021. Sporopollenin chemistry and its durability in the geological record: an integration of extant and fossil chemical data across the seed plants. *Palaeontology*. **64**(2), 285-305. doi: 10.1111/pala.12523

[24] Steinthorsdottir, M., **Jardine, P.E.**, and Rember, W.C. 2021. Near-Future pCO_2 during the hot Mid Miocene Climatic Optimum. *Paleoceanography and Paleoclimatology*, **36**, e2020PA003900. doi: 10.1029/2020PA003900

[23] **Jardine, P.E.**, Fraser, W.T., Gosling, W.D., Roberts, C.N., Eastwood, W., and Lomax, B.H. 2020. Reconstruction of ultraviolet-B irradiance at the Earth's surface, and its relationship with solar activity and ozone thickness. *The Holocene*, **30**(1), 155-161. doi: 10.1177/0959683619875798

[22] **Jardine, P.E.**, Kent, M., Fraser, W.T., and Lomax, B.H. 2019. Ginkgo leaf cuticle chemistry across changing pCO_2 regimes. *Paläontologische Zeitschrift*, **93**(3), 549-558. doi: 10.1007/s12542-019-00486-7.

[21] **Jardine, P.E.**, Gosling, W.D., Lomax, B.H., Julier, A.C.M., and Fraser, W.T. 2019. Chemotaxonomy of domesticated grasses: a pathway to understanding the origins of agriculture. *Journal of Micropalaeontology*, **38**, 83-95. doi: 10.5194/jm-38-83-2019.

[20] Lomax, B.H., Lake, J.A., Leng, M.J., and **Jardine, P.E.** 2019. An experimental evaluation of the use of $\Delta^{13}C$ as a proxy for palaeoatmospheric CO_2. *Geochimica et Cosmochimica Acta*, **247**, 162-174. doi: 10.1016/j.gca.2018.12.026

[19] Julier, A.C.M., **Jardine, P.E.**, Adu-Bredu, S., Coe, A.L., Fraser, W.T., Lomax, B.H., Malhi, Y., Moore, S., and Gosling, W.D. 2019. Variability in modern pollen rain from moist and wet tropical forest plots in Ghana, West Africa. *Grana*, **58**(1), 45-62. doi: 10.1080/00173134.2018.1510027

[18] Woutersen, A., **Jardine, P.E.**, Bogotá-Angel, G., Zhang, H.-X., Silvestro, D., Antonelli, A., Gogna, E., Erkens, R.H.J., Gosling, W.D., Dupont-Nivet, G., and Hoorn, C. 2018. A novel approach to study the morphology and chemistry of pollen in a phylogenetic context, applied to the steppe-desert taxon *Nitraria* L. (Nitrariaceae). *PeerJ*, 6, e5055. doi: 10.7717/peerj.5055.

[17] **Jardine, P.E.**, Harrington, G.J., Sessa, J.A. and Dašková, J. 2018. Drivers and constraints on latitudinal floral diversification gradients. *Journal of Biogeography*, **45**(6), 1408-1419. doi: 10.1111/jbi.13216.

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[3] **Jardine, P.E.**, Harrington, G.J. and Stidham, T.A. 2012. Spatial heterogeneity in Late Paleocene paratropical forests on the U.S. Gulf Coast. *Paleobiology*, **38**(1), 15-39.

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9.2 Other publications/outputs

[2] Devine K., Julier, A., **Jardine, P.E.**, Gosling, W.D., Fraser, W.T., Lomax, B.H. and Miller, C. 2014. Predicting the future by understanding the past. British Ecological Society Educational Wallchart: http://www.britishecologicalsociety.org/education/teaching-resources/wallcharts/

[1] **Jardine, P.E.** 2011. The Paleocene-Eocene Thermal Maximum. Article for Palaeontology [Online]: http://www.palaeontologyonline.com/articles/2011/the-paleocene-eocene-thermal-maximum/

9.3 Datasets and code

[7] **Jardine, P.E.**, Palazzesi, L., Tellería, M.C., and Barreda, V.D. 2022. Data and code for "Why does pollen morphology vary? Evolutionary dynamics and morphospace occupation in the largest angiosperm order (Asterales)". figshare, https://dx.doi.org/10.6084/m9.figshare.17104463

[6] **Jardine, P.E.** and Lomax, B.H. 2021. Data and code for "A 23 m.y. record of low atmospheric CO_2" comment in *Geology*. figshare, https://doi.org/10.608 4/m9.figshare.13194554

[5] **Jardine, P.E.**, Hoorn, C., Beer, M.A.M., Barbolini, N., Woutersen, A., Bogotá-Angel, G., Gosling, W.D., Fraser, W.T., Lomax, B.H., Huang, H., Sciumbata, M., He, H., and Dupont-Nivet, G. 2020. Data and code for "Sporopollenin chemistry and its durability in the geological record: an integration of extant and fossil chemical data across the seed plants". figshare, https://doi.org/10.6084/m9.figshare.11382102

[4] Steinthorsdottir, M., **Jardine, P.E.**, and Rember, W.C. 2020. CO_2 reconstruction for the Miocene Climatic Optimum based on fossil plants. Dataset version 1.0. Bolin Centre Database, https://doi.org/10.17043/steinthorsdottir-2020

[3] **Jardine, P.E.**, Fraser, W.T., Gosling, W.D., Roberts, C.N., Eastwood, W., and Lomax, B.H. 2019. Data for "Proxy reconstruction of ultraviolet-B irradiance at the Earth's surface, and its relationship with solar activity and ozone thickness". figshare, https://doi.org/10.6084/m9.figshare.8075519.v2

[2] **Jardine, P.E.**, Gosling, W.D., Lomax, B.H., Julier, A.C.M., and Fraser, W.T. 2019. Data and code for "Chemotaxonomy of domesticated grasses: a pathway to understanding the origins of agriculture". figshare, https://doi.org/10.6084/m9.figshare.8046395

[1] **Jardine, P.E.**, Harrington, G.J. and Stidham, T.A. 2012. Data from "Regional-scale spatial heterogeneity in the Late Paleocene paratropical forests of the U.S. Gulf Coast". Dryad Digital Repository, https://doi.org/10.5061/dryad.0d7t0

9.4 Conference presentations (non-refereed)

* = student that I am/have supervised

[91] Steinthorsdottir, M., **Jardine, P.E.**, Lomax, B. and Sallstedt, T. 2022. Global analysis of *Ginkgo biloba* stomatal frequencies and other key traits shows no influence by climate, indicating that the stomatal paleo-pCO_2 proxy is robust. *AGU 2022 Fall Meeting*.

[90] **Jardine, P.E.** and Lomax, B.H. 2022. Can we use morphological traits to estimate genome size in fossil plants? *SFE²-GFÖ-EEF International Conference on Ecological Sciences*.

[89] **Jardine, P.E.** and Lomax, B.H. 2022. Can we use morphological traits to estimate genome size in fossil plants? *TMS 2022 Annual Conference*.

[88] Korasidis, V., Wing, S., Harrington, G.J., Demchuk, D., Gravendyck, J., **Jardine, P.E.** and Willard, D. 2022. Biostratigraphically significant palynofloras from the Paleocene–Eocene boundary of the USA. *GSA Connects 2022*, https://doi.org/10.1130/abs/2022AM-379828.

[87] *Woutersen, A., **Jardine, P.E.**, Silvestro, D., Bogotá-Angel, G., Zhang, H.-X., Meijer, N., Bouchal, J., Barbolini, N., Dupont-Nivet, G., Koustodendris, A., Antonelli, A., and Hoorn, C.. 2022. The Eocene-Oligocene Transition in Central Asia: an evolutionary bottleneck for the steppe-desert taxon *Nitraria* L. (Nitrariaceae). *Asian climate, tectonics and biodiversity conference*.

[86] *Wei, C., **Jardine, P.E.**, Gosling, W.D. and Hoorn, C. 2022. The potential of Poaceae pollen size for past vegetation and climate reconstruction on a global level. *Asian climate, tectonics and biodiversity conference*.

[85] **Jardine, P.E.** and Lomax, B.H. 2022. Testing pollen size as a proxy for palaeo-genome size. *BES MacroFest 2022*.

[84] **Jardine, P.E.** and Lomax, B.H. 2022. Can pollen size be used as a proxy for palaeo-genome size? *6th Joint Meeting of the TMS Silicofossil and Palynology groups*.

[83] **Jardine, P.E.** and Lomax, B.H. 2022. Can pollen and spore size be used to predict genome size? *11th European Palaeobotany and Palynology Conference (EPPC)*.

[82] *Woutersen, A., **Jardine, P.E.**, Silvestro, D., Bogotá-Angel, R.G., Zhang, H.-X., Meijer, N., Bouchal, J., Barbolini, N., Dupont-Nivet, G., Koutsodendris, A., Antonelli, A. and Hoorn, C. 2022. The evolutionary bottleneck of the steppe-desert taxon *Nitraria* L. (Nitrariaceae) at the Eocene-Oligocene Transition in Central Asia, revealed by the integration of fossil pollen morphology and molecular data. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[81] *Katsi, F., Jones, M., Kent, M., Fraser, W., **Jardine, P.E.**, Eastwood, W. and Lomax, B.H. 2022. Using the chemical fingerprint of Poaceae pollen grains for classification purposes. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[80] Steinthorsdottir, M., **Jardine, P.E.**, Lomax, B. and Sallstedt, T. 2022. Global analysis of *Ginkgo biloba* key traits suggests that these are not influenced by climate, that the ginkgo paleo-pCO2 proxy is robust, and that elevated climate sensitivity may explain past pCO2-temperature mismatches. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[79] Roberts, E.A., Seyfullah, L.J., **Jardine, P.E.**, Rikkinen, J. and Schmidt, A.R. 2022. Uncovering the natural variability of araucariacean exudates from ex situ and in situ tree populations in New Caledonia using FTIR spectroscopy. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[78] *Wei, C., **Jardine, P.E.** and Hoorn, C. 2022. Is pollen size a useful proxy in paleobiogeographic studies? A comprehensive assessment from Poaceae pollen size study in the Amazon drainage basin. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[77] Seyfullah, L.J., Roberts, E.A**., Jardine, P.E.**, and Schmidt, A.R. 2022. Experimental induction of resins as a tool to understand variability in ambers. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[76] **Jardine, P.E.**, Palazzesi, L., Tellería, M.C., and Barreda, V.D. 2022. Why does pollen morphology vary? Morphospace occupation, disparity and evolutionary rates as tools to understand the evolution of pollen form. *11th European Palaeobotany and Palynology Conference (EPPC)*.

[75] *Katsi, F., Jones M., Fraser W.T., **Jardine P.E.**, Eastwood W. and Lomax B.H. 2022. Chemical fingerprinting of grass pollen: a tool for wild and domesticated species. *PAGES OSM 2022*.

[74] *Katsi, F., Mariani, M., Connor, S., Stevenson, J., Jones M., Kent, M., **Jardine P.E.**, Fraser W.T. and Lomax B.H. 2022. Chemotaxonomy case study on Australian Asteraceae. *Geochemistry Group's Research in Progress (GGRiP) meeting*.

[73] Seyfullah, L.J., Roberts, E.A**., Jardine, P.E.**, and Schmidt, A.R. 2021. Experimental induction of resins as a tool to understand variability in ambers. *92nd Annual Meeting of the Paläontologische Gesellschaft*.

[72] Kent, M.S., **Jardine P.E.**, Katsi, F., Jones M., Fraser W.T., Walker, C. and Lomax B.H. 2021. Consistency without confidence? Thoughts on deploying machine learning classification algorithms on real-world palynological data. *AASP-TPS 53rd Annual Meeting.*

[71] *Katsi, F., Jones M., Kent, M., Fraser W.T., **Jardine P.E.**, Eastwood W. and Lomax B.H. 2021. Chemotaxonomy: an alternative method for classification of grass species? *AASP-TPS 53rd Annual Meeting.*

[70] *Katsi, F., Jones M., Fraser W.T., **Jardine P.E.**, Eastwood W. and Lomax B.H. 2021. Using the chemical fingerprint of pollen as an alternative method for classification of grass species. *Geochemistry Group's Research in Progress (GGRiP) meeting*. Talk won the Zeiss prize for best ECR presentation on micro-analytical research.

[69] Bogotá-Ángel, G., Huang, H., **Jardine, P.E.**, and Hoorn, C. 2021. Delimitación palinológica de Mauritiinae, su historia biogeográfica influida por cambios geológicos y climático. *XVIII Colombian Congress of Geology*.

[68] Huang, H., Pérez-Pinedo, D., Morley, R.J., Dupont-Nivet, G., Philip, A., Win, Z., Aung, D.W., Licht, A., **Jardine, P.E.**, and Hoorn, C. 2021. The Burma Terrane in the late Eocene: A crossroads for plant dispersals between Gondwana and Laurasia. *1st Paleobotany Seminar of the Botanical Society of Yunnan*.

[67] Holt, K., Lomax, B.H., Jardine, P.E., Vandergoes, M., Liley, B. 2020. Unlocking centuries' worth of surface UV-B radiation hidden in pollen. *Geoscience Society of New Zealand Annual Conference*.

[66] **Jardine, P.E.**, Fraser, W.T., Gosling, W.D., Roberts, C.N., Eastwood, W., and Lomax, B.H. 2020. A pollen chemistry-based reconstruction of ultraviolet-B irradiance at the Earth's surface. *UV4Plants Network Meeting 2020*.

[65] Hoorn, C., Kirschner, J., Beer, A.M., Wei, C., Kukla, T., and **Jardine, P.E.** 2020. Grass development in the Amazon drainage basin, evidence from the fossil and phytochemical record**.** *European Geosciences Union General Assembly 2020*.

[64] *Katsi, F., Lomax, B.H., Jones, M., Fraser, W.T., **Jardine, P.E.**, and Eastwood, W. 2020. Reconstructing 11,500 years of cereal diversity in Central Anatolia, Turkey. *Integrated Microscopy Approaches in Archaeobotany 2020 workshop*.

[63] Kent, M.S., **Jardine, P.E.**, Fraser, W.T., and Lomax, B.H. 2019. Automated pollen identification with FPA-FTIR. *TMS 2019 Annual Conference*.

[62] Kent, M.S., **Jardine, P.E.**, Fraser, W.T., and Lomax, B.H. 2019. Automatic determination of pollen and spore taxonomies and chemotaxonomies using FPA-FTIR and machine learning. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2019.*

[61] **Jardine, P.E.**, Hoorn, C., Beer, A.M., Barbolini, N., Woutersen, A., Bogota-Angel, G., Gosling, W.D., Fraser, W.T., Lomax, B.H., Huang, H., Sciumbata, M., He, H., and Dupont-Nivet, G. Sporopollenin chemistry and its durability in the geological record. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2019.*

[60] Kent, M., Fraser W.T. **Jardine, P.E.**, Benca, J., Looy, C., Duijnstee, I., and Lomax, B.H. 2018. Studies of fossil and modern spore wall sporopollenins using FTIR. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2018.*

[59] *Woutersen, A., **Jardine, P.E.**, Bogotá-Angel, G., Silvestro, D., Antonelli, A., Zhang, H.-X., Gogna, E., Erkens, R.H.J., Hoorn, C., Dupont-Nivet, G. and Gosling, W.D. 2018. A chemical and morphological study of *Nitraria* (Nitrariaceae) pollen, with implications for historical biogeography. *10th European Palaeobotany and Palynology Conference (EPPC).*

[58] Lomax, B.H., Lake, J.A., Leng, M.J. and **Jardine, P.E.** 2018. An experimental evaluation of the use of $\Delta^{13}C$ as a proxy for palaeoatmospheric CO_2. *10th European Palaeobotany and Palynology Conference (EPPC).*

[57] Lomax, B.H., **Jardine, P.E.**, and Fraser W.T. 2018. Studies of fossil and modern spore wall sporopollenins using FTIR. *10th European Palaeobotany and Palynology Conference (EPPC).*

[56] **Jardine, P.E.**, Gosling, W.D., Lomax, B.H. and Fraser, W.T. 2018. Chemical classification of grass pollen: a new tool for palynologists and archaeologists to study crop domestication. *10th European Palaeobotany and Palynology Conference (EPPC).*

[55] **Jardine, P.E.**, Fraser, W.T., Gosling, W.D., Roberts, C.N., Eastwood, W. and Lomax, B.H. 2018. Reconstruction of solar irradiance: implications for future climate. *10th European Palaeobotany and Palynology Conference (EPPC).*

[54] Huang, H., Licht, A., Morley, R., Dupont-Nivet, G., Win, Z., Westerweel, J., Littell, V., Swe, H.H., Kaythi, M., Aung, D.W., Roperch, P., Poblete, F., Sein, K., **Jardine, P.E.**, Philip, A. and Hoorn, C.

2018. Palynology of the Central Myanmar Basin corroborates Eocene–Oligocene monsoonal conditions in south-east Asia. *10th European Palaeobotany and Palynology Conference (EPPC).*

[53] **Jardine, P.E.**, Gosling, W.D., Lomax, B.H. and Fraser, W.T. 2017. Chemical classification of grass pollen: a new tool for palynologists and archaeologists to study crop domestication. *The Micropalaeontological Society Annual Meeting 2017*.

[52] Wing, S.L., Clyde, W.C., Gingerich, P.D., Baczynski, A.A., Bowen, G.J., Denis, E.H., Harrington, G.J., **Jardine, P.E.** and the BBCP Science Team. PETM stratigraphy of the Basin Substation core. *Climatic and Biotic Events of the Paleogene (CBEP) 2017*.

[51] Lomax, B.H., **Jardine, P.E.** and Fraser, W.T. 2017. Sporopollenin chemistry: a treasure-trove to plunder. *50th AASP – The Palynological Society Annual Meeting.*

[50] Fraser, W.T., **Jardine, P.E.**, Lomax, B.H. and Gosling, W.D. 2017. Reconstructing past ultraviolet irradiance using pollen and spore chemistry. *Goldschmidt 2017.*

[49] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., Sephton, M.A., Shanahan, T.M., Miller, C.S. and Gosling, W.D. 2017. Pollen and spores as biological recorders of past ultraviolet irradiance. *PAGES Open Science Meeting 2017.* Presented by W.D. Gosling.

[48] Fraser, W.T., **Jardine, P.E.**, Lomax, B.H., Sephton, M.A., Shanahan, T.M., Miller, C.S. and Gosling, W.D. 2017. Pollen and spores as biological recorders of past ultraviolet irradiance. *European Geosciences Union General Assembly 2017.*

[47] Wheeley, J.R., **Jardine, P.E.**, Raine, R.J., Boomer, I. and Smith, M.P. 2016. Reconstructing Ordovician (Floian) conodont ecology and Laurentian seawater temperatures using oxygen isotopes. *Palaeontological Association Annual Meeting 2016.*

[46] Julier, A.C.M., **Jardine, P.E.**, Coe, A.L., Fraser, W.T., Lomax, B.H., Malhi, Y., Adu-Bredu, S. and Gosling, W.D. 2016. Characterization of the modern pollen-vegetation relationship across the savannah-forest transition in tropical West Africa. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2016.*

[45] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H. and Gosling, W.D. 2015. Chemical palynology as a proxy for past ultraviolet irradiance: validation and further development**.** *Linnean Society of London Palynology Specialist Group Autumn Meeting 2016.*

[44] Julier, A.C.M., **Jardine, P.E.**, Coe, A.L., Fraser, W.T., Lomax, B.H., Malhi, Y., Adu-Bredu, S. and Gosling, W.D. 2016. Characterization of the modern pollen-vegetation relationship across the savannah-forest transition in tropical West Africa. *XIV International Palynological Congress/X International Organisation of Palaeobotany Conference.*

[43] Julier, A.C.M., **Jardine, P.E.**, Coe, A.L., Gosling, W.D., Lomax, B.H. and Fraser, W.T. 2016. Chemotaxonomy as a tool for interpreting the cryptic diversity of Poaceae pollen. *XIV International Palynological Congress/X International Organisation of Palaeobotany Conference.*

[42] Lomax, B.H., **Jardine, P.E.**, Gosling, W.D. and Fraser, W.T. 2016. Sporopollenin chemistry and environmental signals: new uses for old sporomorphs. *XIV International Palynological Congress/X International Organisation of Palaeobotany Conference.*

[41] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., Miller, C.S., Shanahan, T.M. and Gosling, W.D. 2016. Long-term solar and ultraviolet-B irradiance detected using sporopollenin chemistry. *Palynologische Kring (Dutch Palynological Society) meeting 2016*. Presented by W.D. Gosling.

[40] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2016. Pollen chemistry as a tool for reconstructing past solar and ultraviolet irradiance. *European Geosciences Union General Assembly 2016.*

[39] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2016. The impact of oxidation on spore and pollen chemistry: an experimental study. *European Geosciences Union General Assembly 2016.*

[38] Fraser, W.T., Lomax, B.H., and **Jardine, P.E.** 2016. Experimental and geological approaches to elucidate chemical change in sporopollenin over geological time. *European Geosciences Union General Assembly 2016.*

[37] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2015. A new use for old pollen: reconstructing past solar irradiance using pollen chemistry. *Palaeontological Association Annual Meeting 2015.*

[36] Julier, A.C.M., **Jardine, P.E.**, Coe, A.L., Gosling, W.D., Lomax, B.H., and Fraser, W.T. 2015. Can FTIR spectroscopy be used to identify grass pollen. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2015.*

[35] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2015. A new use for old pollen: reconstructing past solar irradiance using pollen chemistry. *Linnean Society of London Palynology Specialist Group Autumn Meeting 2015.*

[34] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2015. Sporopollenin chemistry as a tool for reconstructing solar irradiance through time. *The Micropalaeontological Society Annual Meeting 2015*.

[33] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2015. Pollen chemistry as a proxy for past solar irradiance. *Past Earth Network 1st Meeting*.

[32] Fraser, W.T., **Jardine, P.E.**, Julier, A.C.M., Lomax, B.H., and Gosling, W.D. 2015. A biogeochemical proxy for solar irradiance: proxy development and application to Lake Bosumtwi, Ghana. *Goldschmidt 2015.*

[31] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2015. A proxy for past ultraviolet-B and solar irradiance based on pollen and spore chemistry. *XIX INQUA congress 2015*.

[30] Miller. C, Fraser, W.T., **Jardine, P.E.**, and Kürschner, W. 2015. Quantifying UV-B flux over the Late Triassic Carnian Pluvial Extinction Event (c. 233-229 Ma). *EGU General Assembly 2015.*

[29] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2014. A proxy for fossil sunshine based on pollen wall chemistry. *Palaeontological Association Annual Meeting 2014.*

[28] **Jardine, P.E.**, Fraser, W.T., Lomax, B.H., and Gosling, W.D. 2014. Recovering sporopollenin chemical information from processed palynological samples. *Linnean Society of London Palynology Specialist Group Meeting 2014.*

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