



AASP-TPS
53RD ANNUAL
MEETING

AASP – TPS 53RD ANNUAL MEETING

ABSTRACT BOOKLET

HOSTED ONLINE BY THE NATURAL HISTORY MUSEUM, LONDON

9 – 13TH AUGUST 2021

 @AASPTPS

#AASPTPS2021



Palynology.org

Contents

WELCOME TO THE AASP – TPS 53 RD ANNUAL MEETING	2
LOGO COMPETITION WINNER 2021.....	4
KEY EVENTS.....	6
AASP – TPS BUSINESS “LUNCHEON”	6
Tuesday 10 th , 18:55 BST	6
STUDENT EVENTS	6
STUDENT AWARDS	6
INSTRUCTIONS FOR PRESENTERS	13
ABSTRACTS	14
DAY 1, AUGUST 9 th General palynology, session 1	14
DAY 1 LIGHTNING TALKS, SESSION 1	21
DAY 1 ORAL PRESENTATIONS, SESSION 2	26
DAY 1 LIGHTNING TALKS, SESSION 2	33
DAY 2, AUGUST 10 th <i>in situ</i> spores and pollen & general palynology	38
DAY 2 LIGHTNING TALKS, <i>in situ</i> spores	47
DAY 2 LIGHTNING TALKS general palynology	50
DAY 2 ORAL PRESENTATIONS, SESSION 2	54
DAY 3, AUGUST 11 th Vaughn M. Bryant & general palynology	58
DAY 3 LIGHTNING TALKS, VAUGHN M BRYANT	69
DAY 3 LIGHTNING TALKS	70
DAY 3, ORAL PRESENTATIONS, SESSION 2	76
DAY 4, AUGUST 12 th Precambrian palynology & general palynology	78
DAY 4 LIGHTNING TALKS, SESSION 1	85
DAY 4 ORAL PRESENTATIONS, SESSION 2	92
DAY 5, AUGUST 13 th General palynology	98
ABSTRACTS for POSTER PRESENTATIONS	111

CODE OF CONDUCT AND DIVERSITY STATEMENT

AASP is an associated society of the Geological Society of America (GSA) and as such a full Code of Ethics and Professional Conduct can be found on their **website**; we expect all attendees to abide by this code.

AASP – TPS is against racism and discrimination of any kind. We as a society take great pride in being home to a diverse group of early career and professional members internationally. We therefore aim to promote and embody an inclusive and equitable culture that is free from discrimination.



WELCOME TO THE AASP – TPS 53RD ANNUAL MEETING

Dedicated to Vaughn M. Bryant

Welcome to the 53rd Annual Meeting, the society's 1st online meeting.

The 53rd Annual Meeting of the AASP-The Palynological Society, will take place virtually for the first time this year and is hopefully only a temporary measure until we can all meet up in person once again.

The meeting will be hosted by the NHM on GOTO Webinar which is a platform designed to host meetings such as this and will create a simple, safe and secure way for everyone to attend the conference.

We have thought long and hard about the event format and have decided to host relatively short days to avoid online 'fatigue'. The schedule will be designed to accommodate the majority of delegates but we will record all or parts of the meeting for delegates to view at a more convenient time.

This year we have accepted abstracts for live oral and poster presentations. For the live oral presentations both standard talks (i.e., 12-minute talk with 3 minutes for questions) and lightning talks associated with posters (2-minute talk) will be accepted.

 @AASPTPS (Follow the discussion on twitter using #AASPTPS2021)

 [Palynology.org](https://www.palynology.org)

 aaspmeetings@gmail.com

MEET THE COMMITTEE



ALEXANDER BALL: Third-year PhD student at The University of Sheffield and Natural History Museum (London), studying the adaptive radiation of vascular land plants across the Siluro-Devonian boundary. CIMP student rep. and AASP book review editor. Cheese board enthusiast.



KIMBERLEY BELL: Palynologist/ Canadian Business Developer at Petrostrat Ltd., with expertise in Mesozoic and Paleogene palynology and stratigraphy of Northern and Western Canada. Especially interested in angiosperm pollen evolution.



DAMIÁN CÁRDENAS LOBOGUERRERO: Current AASP-TPS Student Director-at-Large (2020-2022). BSc in Geology from the Universidad Nacional de Colombia (2012) and PhD in Geology and Geophysics from the Missouri University of Science and Technology (2021) interested on studying the palynology of the tropical Americas.



VERA KORASIDIS: Postdoctoral Fellow at the National Museum of Natural History, Smithsonian Institution, studying Paleocene-Eocene Thermal Maximum palynofloras.



STEPHEN STUKINS: Senior Curator of Micropalaeontology at the Natural History Museum, London. Dabbled in many fields of palynology from Ediacaran acritarchs through to innovative techniques to analyse modern pollen but most often stuck in the Mesozoic. Secretary of the AASP-TPS since 2014. Lover of Yorkshire Tea and beer.



JIM RIDING: a biostratigrapher and a Team Leader in the Climate and Landscape Change Science Area at the British Geological Survey. He is also an honorary Lecturer in the School of Geography, University of Nottingham where he teaches palaeontology on the Environmental Geosciences BSc course. Jim's main research focus is on Mesozoic-Cenozoic palynology, including aspects such as Jurassic dinoflagellate cyst palaeobiology and global Late Miocene and Pliocene vegetation and climate change.

Contact the committee

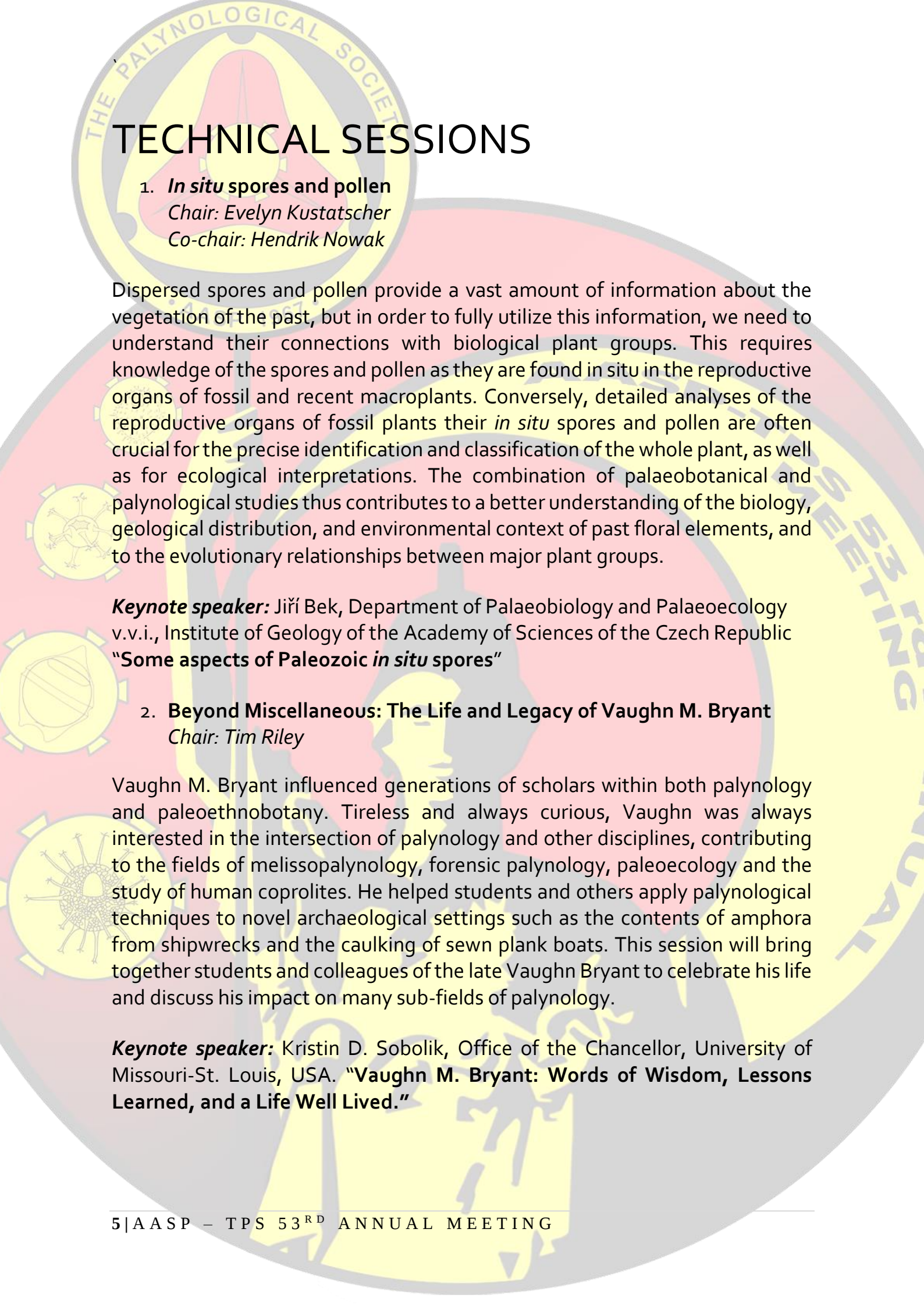
If you need to contact the committee at any point, please email us at aaspm meetings@gmail.com, or tweet us at @AASPTPS.

LOGO COMPETITION WINNER 2021

This year's competition winner was Alessandro Cesare Bruno, Ensenada Center for Scientific Research and Higher Education (CICESE), Mexico.

"When I decided to create the logo for the AASP – TPS 53rd Annual Meeting, I immediately thought to capture the goddess Athena, who was considered the goddess of wisdom, knowledge and science. Athena also represents the creativity and strategy that is required in the scientific field. For me it's an honor that my logo was chosen for this edition. Thank you!"





TECHNICAL SESSIONS

1. *In situ* spores and pollen

Chair: Evelyn Kustatscher

Co-chair: Hendrik Nowak

Dispersed spores and pollen provide a vast amount of information about the vegetation of the past, but in order to fully utilize this information, we need to understand their connections with biological plant groups. This requires knowledge of the spores and pollen as they are found *in situ* in the reproductive organs of fossil and recent macroplants. Conversely, detailed analyses of the reproductive organs of fossil plants their *in situ* spores and pollen are often crucial for the precise identification and classification of the whole plant, as well as for ecological interpretations. The combination of palaeobotanical and palynological studies thus contributes to a better understanding of the biology, geological distribution, and environmental context of past floral elements, and to the evolutionary relationships between major plant groups.

Keynote speaker: Jiří Bek, Department of Palaeobiology and Palaeoecology v.v.i., Institute of Geology of the Academy of Sciences of the Czech Republic
"Some aspects of Paleozoic *in situ* spores"

2. **Beyond Miscellaneous: The Life and Legacy of Vaughn M. Bryant**

Chair: Tim Riley

Vaughn M. Bryant influenced generations of scholars within both palynology and paleoethnobotany. Tireless and always curious, Vaughn was always interested in the intersection of palynology and other disciplines, contributing to the fields of melissopalynology, forensic palynology, paleoecology and the study of human coprolites. He helped students and others apply palynological techniques to novel archaeological settings such as the contents of amphora from shipwrecks and the caulking of sewn plank boats. This session will bring together students and colleagues of the late Vaughn Bryant to celebrate his life and discuss his impact on many sub-fields of palynology.

Keynote speaker: Kristin D. Sobolik, Office of the Chancellor, University of Missouri-St. Louis, USA. **"Vaughn M. Bryant: Words of Wisdom, Lessons Learned, and a Life Well Lived."**

3. Precambrian Palynology

Chair: Evelyn A. M. Sanchez

Co-chair: Thomas Rich Fairchild

Discussion of key-events in the evolutionary history of Precambrian plankton: the Archean record – morphology, biogenicity, biological affinities. Eukaryogenesis: timing, morphodisparity, palaeoecological background and/or consequences during the Proterozoic. Refinement of palynomorph-based proposals for Proterozoic biostratigraphy: useful corroboration or useful contradiction?

Keynote speaker: Dr. Kathleen Grey, Geological Survey of Western Australia
“Review of Australian Precambrian palynology”

KEY EVENTS

AASP – TPS BUSINESS “LUNCHEON”

Tuesday 10th, 18:55 BST

Get yourself a drink and nibbles of your choice and join us as we bring you the brief annual society business and exciting news of our future events.

STUDENT EVENTS

This event is designed for students and early careers (< 5 years after graduation) and consists of two half-hour sessions.

#1 Tuesday 10th, 14:00 BST. Participants will get to know each other.

#2 Friday 13th, 19:30 BST. Discussion and networking among the future leaders in palynology.

STUDENT AWARDS

L.R. WILSON BEST STUDENT PAPER AWARD

Named for Leonard R. Wilson, University of Oklahoma, a pioneer in the field of palynology who published over 200 scientific papers effectively demonstrating

the relationships of plants to sediments and rocks through time. He actively advanced the idea that plant microfossils could become a powerful biostratigraphic tool. Wilson was the first scientist to perceive the common uses of palynology in oil exploration. He served as a consultant to 17 major and independent oil companies during his career.

This award is given to student presenters at the AASP annual meeting. Evaluation criteria include audibility, clarity, audience engagement, and pacing of the speaker, with emphasis placed on a clear statement of the problem, methods, and conclusions of the research. *The award recipient will be selected by the Award committee, and the prize includes a certificate, \$250 cash prize, and two years membership in AASP.*

VAUGHN M. BRYANT BEST POSTER AWARD

Named for Vaughn Bryant (Texas A&M University), a world-renowned palynologist, prolific author, respected teacher, and long-time leader and member of AASP. His career spanned longer than 50 years, and he is widely recognized as the leading expert in forensic palynology and melissopalynology in the United States. Dr. Bryant published over 130 articles and book chapters, as well as co-authored two AASP Contribution Series and an AASP book. He received the Medal for Scientific Excellence (2016), Medal for Excellence in Education (2013), Honorary Membership (2005), and the Distinguished Service Award (1999) from AASP throughout the course of his career.

This award is given at the annual meeting. The judging criteria, established by the Awards Committee, include neatness and attractiveness of the poster including its graphics; scientific merit of the research problem; clarity and innovativeness of the research methods; clarity and simplicity of the results, and the poster presenter must have delivered a lightning talk with their poster. Awardee must be first author, should be a student, or if the awardee has formally completed a graduate degree, cannot have been employed more than 6 months before the award is made. *The award recipient will be selected by the Award committee, and the prize includes a certificate, \$250 cash prize, and two years membership in AASP.*

53rd ANNUAL MEETING PROGRAMME

Monday 9th August, General palynology

London (BST)	Central Europe (CEST)	(CDT)	(MST)	Australia (AEST)				
12:30	13:30	6:30	5:00	21:30				
13:00	14:00	7:00	6:00	22:00	Outgoing board meeting			
14:00				23: 00				
15:00	16:00	9:00	8:00	0:00				
					Welcome			
					housekeeping'			
15:10	16:10	9:10	8:10	0:10	Horn et al.	Pollen and Stable Carbon Isotope Analysis at Guayabo de Turrialba and Laguna Azul, Costa Rica	Chairs: Stephen Stukins and Vera Korasidis	
15:25	16:25	9:25	8:25	0:25	Castilla-Beltrán et al.	Domesticating Fire Island: linking vegetation change, volcanism and land-use in Fogo (Cabo Verde) through the study of a scoria-cone sediment sequence		
15:40	16:40	9:40	8:40	0:40	Jean et al.	A comparative study of honey bee pollen loads to understand the foraging preferences of Apis cerana indica Fabricius in and around Puducherry, southern India		
15:55	16:55	9:55	8:55	0:55	Katsi et al.	Chemotaxonomy: an alternative method for classification of grass species?		
16:10	17:10	10:10	9:10	1:10	Pilkington et al.	The Rise of the Green Algae: Using underutilized freshwater microfossils as proxies of anthropogenic activities		
16:25	17:25	10:25	9:25	1:25	Ando et al.	Aquatic palynomorphs in Nakaumi Lagoon, Japan.	Chairs: TBC	
16:40	17:40	10:40	9:40	1:40	McCarthy et al.	Effects of taphonomy on cysts of the dinoflagellates Parvodinium umbonatum and Peridinium limbatum – implications for paleolimnological studies		
16:55	17:55	10:55	9:55	1:55	LTs:	LTs (5): Riddick et al., Ershova and Bakumenko, Maia and Eliso, Martkoplshvili and Kvavadze, Alumbaugh and Horn		
17:10	18:10	11:10	10:10	2:10	BREAK			
17:25	18:25	11:25	10:25	2:25	Rachid et al.	Upper Pleistocene to Holocene Palaeoenvironmental Reconstruction of Marine sediments of Carbonate Mounds in the North Atlantic and Western Mediterranean Sea		
17:40	18:40	11:40	10:40	2:40	Radmacher et al.	Paleoceanography of the subpolar North Atlantic ODP Site 984 for the Last Interglacial (Late Pleistocene): preliminary results based on dinoflagellate cysts.		
17:55	18:55	11:55	10:55	2:55	Balota et al.	Dinoflagellate cyst stratigraphy and paleoceanography across the Lower–Middle Pleistocene Subseries (Calabrian–Chibanian Stage) boundary at the Chiba composite section, Japan.		
18:10	19:10	12:10	11:10	3:10	Al-Silwadi and Head	Paleoceanography and Dinoflagellate Cysts of The Pliocene–Pleistocene transition at IODP Site U1424, Sea of Japan – Preliminary Results		
18:25	19:25	12:25	11:25	3:25	Farmani and Head	Palynological record of northwestern North Pacific ODP Site 882 during the Pliocene–Pleistocene transition – preliminary results		
18:40	19:40	12:40	11:40	3:40	Okafor and Head	Paleoceanography and dinoflagellate cyst record through the Pliocene–Pleistocene transition, southern South China Sea: preliminary results		
					O'Keefe et al.	Fungi in a Warmer World: fungal biodiversity across the Middle Miocene Climate Optimum		
18:55	19:55	12:55	11:55	3:55	LTs:	LTs (5): Rachid et al., Blentlinger et al., Lavrenov and Ershova, Andriambelomanana et al., Misumi et al.		
19:10	20:10	13:10	12:10	4:10	Closing remarks			
19:25	20:25	13:25	12:25	4:25				

Tuesday 10th August, *in situ* spores and pollen & General palynology

London (BST)	Central Europe (CEST)	(CDT)	(MST)	Australia (AEST)		
				21:30		
12:30	13:30	6:30	5:00	22:00		
13:00	14:00	7:00	6:00			
14:00					Student and Early Career Mixer #1	
15:00	16:00	9:00	8:00	0:00	Welcome	
15:10	16:10	9:10	8:10	0:10	Jiří Bek	Some aspects of Paleozoic <i>in situ</i> spores
15:25	16:25	9:25	8:25	0:25		
15:40	16:40	9:40	8:40	0:40	Kent et al.	Consistency without confidence? Thoughts on deploying classification algorithms on real-world palynological data
15:55	16:55	9:55	8:55	0:55	Lomax et al.	Chemopalynology as a tool to link dispersed and <i>in situ</i> sporomorphs
16:10	17:10	10:10	9:10	1:10	Cabrera Saenz and Torreggiani	The Pollen Atlas of Nicaragua: A tool to understand the past and present anthropic and climatic impacts on the Dry Tropical Forest
16:25	17:25	10:25	9:25	1:25	Ball and Taylor	Reconstructing the Lower Devonian (Lochkovian) vegetation from the Anglo-Welsh Basin: two spore masses containing <i>Emphanisporites</i> McGregor spores
16:40	17:40	10:40	9:40	1:40	Kustatscher et al.	Botanical affinities of spores and pollen from the Triassic of the Southern Alps
16:55	17:55	10:55	9:55	1:55	Nowak and Kustatscher	<i>In situ</i> fern spores from the Triassic in Europe
17:10	18:10	11:10	10:10	2:10	BREAK	
17:25	18:25	11:25	10:25	2:25	Zavialova and Nosova	Peculiar pollen grains found in <i>Schidolepium</i> Heer cones from the Middle Jurassic of East Siberia
17:40	18:40	11:40	10:40	2:40	Tekleva et al.	Pollen from a <i>Hedyosmum</i> -like staminate structure (<i>Chloranthaceae</i>) from the Early Cretaceous of the western Portuguese Basin: morphology, ultrastructure, and evolution
17:55	18:55	11:55	10:55	2:55	LTs: Mendelin et al., Tekleva et al., Ball et al	LTs: Ramírez-Arriaga et al., Pinzón et al., Ochoa and Montenegro, Hamed and Hassan
18:10	19:10	12:10	11:10	3:10	Romero et al.	<i>Fungi in a Warmer World: A preliminary view of the fungal diversity of Thailand and Slovakia in the Middle Miocene.</i>
18:25	19:25	12:25	11:25	3:25	Gibson et al.	The development of UK Neogene Climate: a comparison of the co-existence approach, Bayesian and probability reconstruction techniques
18:40	19:40	12:40	11:40	3:40	Mariani et al.	Oceanographic and vegetation changes across the Paleocene–Eocene Thermal Maximum in NW Europe and the Arctic
18:55	19:55	12:55	11:55	3:55	Li et al.	Taxa and distribution of dinoflagellate cysts in surface sediments from nearshores of the China Seas
19:10	20:10	13:10	12:10	4:10	BUSINESS HAPPY HOUR!!	
19:25	20:25	13:25	12:25	4:25		

Chairs: Evelyn Kustatscher and Hendrick Nowak

Chairs TBC

Wednesday 11th August, V
palynology

London	Central Europe			Australia
--------	----------------	--	--	-----------

Wednesday 11th August, Vaughn M. Bryant & General palynology

London (BST)	Central Europe (CEST)	(CDT)	(MST)	Australia (AEST)				
12:30	13:30	6:30	5:00	21:30				
13:00	14:00	7:00	6:00	22:00				
14:00								
15:00	16:00	9:00	8:00	0:00				
					Welcome			
15:10	16:10	9:10	8:10	0:10	Adovasio	Pollen from Meadowcroft Rockshelter (36WH297), Washington County, Pennsylvania	Chair: Tim Riley	
15:25	16:25	9:25	8:25	0:25	Reinhard	Coprolites and the Ancient Gut Microbiome		
15:40	16:40	9:40	8:40	0:40	Blong et al	Early to middle Holocene subsistence in the Great Basin: coprolite evidence from the Paisley Caves, Oregon.		
15:55	16:55	9:55	8:55	0:55	Perrotti et al.	Diversity in vegetation and fire responses after Pleistocene megaherbivore extinction across the Eastern US		
16:10	17:10	10:10	9:10	1:10	Paredes	Vaughn Bryant's influence on Peruvian palynology		
16:25	17:25	10:25	9:25	1:25	MacFawn and O'Keefe	Melissopalynology of honey produced adjacent to a South Carolina biodiversity hotspot		
16:40	17:40	10:40	9:40	1:40	Kristin Sobolik	Vaughn M. Bryant: Words of Wisdom, Lessons Learned, and a Life Well Lived.		
16:55	17:55	10:55	9:55	1:55	4			
17:10	18:10	11:10	10:10	2:10	BREAK			
17:25	18:25	11:25	10:25	2:25	Lau et al.	Everything's sweeter in Texas? A chemical and palynological analysis of honey in Texas		
17:40	18:40	11:40	10:40	2:40	Briles	Vaughn Bryant: the versatility of pollen		
17:55	18:55	11:55	10:55	2:55	Warny et al.	Using museum pelt collections to generate pollen prints from high-risk regions: A new palynological forensic strategy for geolocation		
18:10	19:10	12:10	11:10	3:10	Laurence	From Vision to Reality: Vaughn M. Bryant's Legacy of Forensic Palynology in the United States		
18:25	19:25	12:25	11:25	3:25	LT: Spencer	LTs (5): Liao-Kang and Borges, Soares et al., Nour et al., Kablova and Schneebeil-Hermann, Mamontov, Ayyanar et al.	Chairs TBC	
18:40	19:40	12:40	11:40	3:40	Demchuk et al.	Marine deposition in the up-dip Wilcox of eastern Texas: age control and paleoenvironmental implications.		
18:55	19:55	12:55	11:55	3:55	Korasidis et al.	Terrestrial pollen carbon isotope record across the Paleocene-Eocene Thermal Maximum		
19:10	20:10	13:10	12:10	4:10	Closing remarks			
19:25	20:25	13:25	12:25	4:25				

10 | AUGUST 9TH – 13TH 2021

Thursday 12th August, Precambrian palynology & General palynology

London (BST)	Central Europe (CEST)	(CDT)	(MST)	Australia (AEST)			
12:30	13:30	6:30	5:00	21:30	Incoming board meeting		
13:00	14:00	7:00	6:00	22:00			
14:00							
15:00	16:00	9:00	8:00	0:00			
					Welcome		
15:10	16:10	9:10	8:10	0:10	Kathleen Grey	Review of Australian Precambrian palynology	
15:25	16:25	9:25	8:25	0:25			
15:40	16:40	9:40	8:40	0:40	Acosta & Gaucher	Organic-walled microfossils from the Paso Severino Formation, Paleoproterozoic of Uruguay	
15:55	16:55	9:55	8:55	0:55	Strother & Wellman	Possible Holozoan Palynomorphs from the 1,074 Ma Nonesuch Shale	
16:10	17:10	10:10	9:10	1:10	Shukla & Sharma	Microfossils and age controversy on the rocks of Kurnool Group of south India: A debate	
16:25	17:25	10:25	9:25	1:25	Gaucher et al.	Eutrophic conditions prior to the end-Cryogenian glaciation in the Otavi Group (Namibia): a causal relationship?	
16:40	17:40	10:40	9:40	1:40	Ouyang et al.	Ediacaran acanthomorphic acritarchs in the lower Doushantuo Formation of the Yangtze Gorges area, South China: distribution and stratigraphic implications	
16:55	17:55	10:55	9:55	1:55	Jäger et al	Palynological Insights into Neoproterozoic glaciations. The Marinoan Glaciation in Namibia.	
17:10	18:10	11:10	10:10	2:10	BREAK		
17:25	18:25	11:25	10:25	2:25	LTs:	LTs (7): Sirenko and Shevchuk, Hssaida et al, Correia et al., Camina and Rubinstein, García Muro et al., Akyüz et al., Oktay and Akyüz	
17:40	18:40	11:40	10:40	2:40	Gotz and Uhl	Triassic charcoal from the Germanic Basin: Puzzle piece in climate reconstruction	
17:55	18:55	11:55	10:55	2:55	Mantle et al.	Late Triassic dinoflagellate cysts from the Northern Carnarvon Basin, Western Australia	
18:10	19:10	12:10	11:10	3:10	Vilas-Boas et al.	Palynostratigraphy of the Triassic-Jurassic of the Silves Group, Lusitanian Basin, Portugal	
18:25	19:25	12:25	11:25	3:25	Khaffou et al.	Preliminary geochemical palynological study of Toarcian (Jurassic) in the Central High Atlas, Morocco	
18:40	19:40	12:40	11:40	3:40	Chakir et al.	Bajocian palynology of the Boulmane marls (Middle Atlas, Morocco): Palynostratigraphy & Paleoenvironment.	
18:55	19:55	12:55	11:55	3:55	Jaydawi et al.	Palynology of the Tarhrat Ifesfassen section of the Agadir Basin (Morocco): Palynobiostratigraphy and Paleoenvironment	
19:10	20:10	13:10	12:10	4:10	Closing remarks		
19:25	20:25	13:25	12:25	4:25			

Chairs: Evelyn Sanchez and Thomas Rich Fairchild

Chairs: TBC

Chairs: Evelyn Sanchez and Thomas Rich Fairchild

Chairs: TBC

Friday 13th August, General palynology

London (BST)	Central Europe (CEST)	(CDT)	(MST)	Australia (AEST)				
12:30	13:30	6:30	5:00	21:30				
13:00	14:00	7:00	6:00	22:00				
14:00	15:00	8:00	7:00	23:00				
15:00	16:00	9:00	8:00	0:00	Welcome			
15:10	16:10	9:10	8:10	0:10	Santos et al.	First palynological data from the Jurassic-Cretaceous boundary in the Galicia Bank (NW Spain; ODP Leg 103; Site 639)	Chairs: TBC	
15:25	16:25	9:25	8:25	0:25	Wheeler et al.	Palynological analysis of an Early Cretaceous peat-forming flora: Insights into the floral composition, environment, and climatic conditions of the Yimin Formation (Hailar Basin, Inner Mongolia, China)		
15:40	16:40	9:40	8:40	0:40	Fredborg et al.	Dinocyst stratigraphy of the Carolinefjellet Formation at Schönrockfjellet– age constraints for the youngest part of the Lower Cretaceous succession in Svalbard		
15:55	16:55	9:55	8:55	0:55	Goetz et al.	Palynofacies of the Lower Cretaceous Pietraroja Lagerstätte (Campanian Apennines, southern Italy): Tool to unravel the depositional environment		
16:10	17:10	10:10	9:10	1:10	Rodriguez-Barreiro et al.	Palynology from the Late Albian-Cenomanian deposits of the Vigo Seamount, Eastern North Atlantic (LEG 47B, site 398D).		
16:25	17:25	10:25	9:25	1:25	Walker-Trivett et al.	Oceanographic and biotic changes in Australia during Oceanic Anoxic Events		
16:40	17:40	10:40	9:40	1:40	Chafai et al.	New palynostratigraphic data on the Tarfaya basin		
16:55	17:55	10:55	9:55	1:55	McLachlan et al.	Bursting the bubble on vesiculation: A case study of ecophenotypy in the dinoflagellate cyst <i>Cannosphaeropsis franciscana</i> Damassa, 1979 across the K/Pg boundary with consideration for the genus <i>Hafniasphaera</i>	Chairs: Stephen Stukins and Kimberley Bell	
17:10	18:10	11:10	10:10	2:10	Gibson and Bodman	Evaporite palynology: a case study of the Permian (Lopingian) Zechstein Sea		
17:25	18:25	11:25	10:25	2:25	BREAK			
17:40	18:40	11:40	10:40	2:40	Marshall	Spore malformation, the Devonian-Carboniferous boundary and the tener Event		
17:55	18:55	11:55	10:55	2:55	Mclean et al.	Early Carboniferous (Asbian-Brigantian, Mississippian) miospore stratigraphy from the coast of Northumberland, UK.		
18:10	19:10	12:10	11:10	3:10	Jha and Sinha	Occurrence of acritarchs and their palaeoenvironmental significance in the Lower Gondwana of West Bokaro Coalfield, Hazaribagh, Jharkhand, India		
18:25	19:25	12:25	11:25	3:25	Lopes et al.	The Late Permian in the Muaradzhi Sub-basin, Moatize-Minjova Basin, Mozambique – multidisciplinary palaeoenvironmental characterization		
18:40	19:40	12:40	11:40	3:40	AWARDS AND CLOSE			
18:55	19:55	12:55	11:55	3:55	Student and Early Career Mixer #2			
19:10	20:10	13:10	12:10	4:10				

INSTRUCTIONS FOR PRESENTERS

The event will take place using GoTo Webinar software which should involve no downloads. Please follow this link to register for the software link to attend: <https://attendee.gotowebinar.com/register/732475272046425359>

Chat and Questions – Like other meeting platforms, there will be a chat function and there is also a questions function, similar to the chat. Please use the Questions function to ask a speaker a question about their talk. These will be collected at the end of a talk and asked by the session chair, if time permits.

Instructions for Standard/Lightning/Keynote speakers

Please be logged into the conference before the start of the session you are speaking in, or at least the break if you speak after one. One of the organisers will add you as a panellist for the session until you have done your presentation. Until you start your presentation, please be muted while you have panellist status.

Once an organiser gives you presenter control for your talk you will need to share your screen. Here are some short instructions:

Share your screen

When an organizer gives you presenter controls, you will be able to share your screen, pass keyboard/mouse controls, and switch Presenters. You will also see an "Audience View" pane that provides a thumbnail view of what the audience is currently seeing.

To share your screen, click the Screen icon in the Grab Tab or the Show icon in the Sharing pane of the Control Panel. When sharing your screen, you can choose to share a specific application, a clean screen with no icons or taskbar, etc. Read through the Control Panel article for more details on tools and features.

You should not need to do anything more than share/ unshare screen as the organisers/session chair will pass the presenter controls over.

More information is available here <https://support.goto.com/webinar/help/panelists-g2wo10018>

Lightning Talks – we have compiled all of your slides for the short sessions you are involved in.

ABSTRACTS *in order of presentation*

DAY 1, AUGUST 9th General palynology, session 1

Pollen and Stable Carbon Isotope Analysis at Guayabo de Turrialba and Laguna Azul, Costa Rica

Horn, S.P.^{1*}, Kerr, M.T.¹, Rodgers III, J.C.², Boehm, M.S.¹, Alarcón-Zamora³, and Lane, C.S.⁴

¹Department of Geography, University of Tennessee, Knoxville, TN, USA

²Department of Geosciences, Mississippi State University, Mississippi State, MS, USA

³Escuela de Antropología, Universidad de Costa Rica, San Pedro de Montes de Oca, Costa Rica

⁴Department of Earth and Ocean Sciences, University of North Carolina, Wilmington, NC, USA

*Corresponding author: shorn@utk.edu

Guayabo de Turrialba is an extensive and important archaeological site in Costa Rica, characterized by architectural features that include mounds, plazas, stone house foundations, cobblestone causeways, and aqueducts. The site is centered at 1100 m elevation on the southeastern slope of Turrialba Volcano, surrounded by remnant premontane rain forests and agricultural fields. Radiocarbon dates indicate that features of monumental architecture were mainly constructed between 900 and 1100 CE, though there is evidence of human occupation over a wider time span. Some interpretations of site chronologies and artefact assemblages indicate the site was abandoned a century or two before the Spanish Conquest.

To develop a record of vegetation change at and near the Guayabo site, we examined pollen assemblages and stable isotope signatures in soil from an archaeological excavation, and in the sediments of a small lake, Laguna Azul, located 4.5 km downslope. The lake sediments are from a test core we recovered in 1992, for which we have near-surface sediments and a single piston core section that spans from ca. 1300 to 1500 CE. Despite the value of a full record from this site, we cannot obtain one as the lake was converted to a cement-lined reservoir for a small hydroelectric plant before we could return to collect a full core.

The excavated soil contained only sparse and poorly preserved pollen, with concentrations too low for useful analysis (less than 1200 to 2500 pollen grains/cm³). Scans revealed Poaceae, Urticales, Asteraceae, and Amaranthaceae pollen, along with fern spores, but whether these palynomorphs are contemporaneous with archaeological materials or washed downward more recently is unknown. Microscopic charcoal particles were abundant in some samples. Stable carbon isotope ($\delta^{13}\text{C}$) values at the top of the profile suggest C₃ input from tropical forest, while values in deeper soil suggest mixed isotopic composition with some contribution from C₄ plants, such as maize or other C₄ grasses.

In contrast, the lake sediments contained abundant, well-preserved pollen with taxa characteristic of premontane, lower montane, and tropical wet forest along with disturbance pollen types. Pollen of maize (*Zea mays* subsp. *mays*) was identified in both the near-surface and deeper sediments, confirming historic and prehistoric maize agriculture in the watershed. Microscopic charcoal fragments were comparatively rare, suggesting minor fire use. Some differences in pollen percentages and stable carbon isotope signatures exist between the near-surface and deeper sediments, and across the time span of the deeper sediments. These differences provide fragmentary hints about the prehistory of the Guayabo area, possibly including evidence of site decline around 1400 CE. They also underscore the loss to science of the destruction of Laguna Azul. As scientists interested in stratigraphic records of environmental change, we should be working to save natural lakes from destruction, or to sample them first if destruction cannot be avoided. We should redouble our efforts when it comes to lakes near archaeological sites, given the value of the pollen record from lake sediments in complementing and extending the archaeological record.

Domesticating Fire Island: linking vegetation change, volcanism and land-use in Fogo (Cabo Verde) through the study of a scoria-cone sediment sequence

Castilla-Beltrán, A.^{1*}, de Nascimento, L.¹, Fernández-Palacios, J. M.¹, Monteath, A.^{2,3}, Jensen, B.², Strandberg, N.³, Edwards, M.³, Nogué, S.³

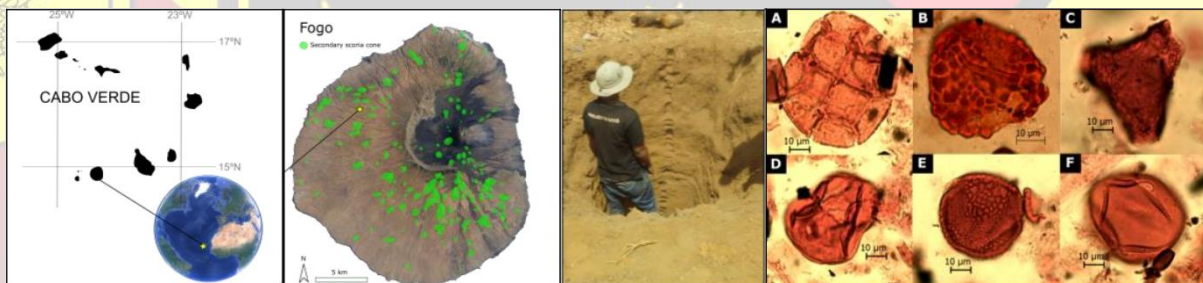
¹Island Ecology and Biogeography Group, University of La Laguna, Spain

²Department of Atmospheric Sciences, University of Alberta, Edmonton, Canada

³School of Geography and Environmental Science, University of Southampton

*Corresponding author: acastilla@fg.ull.es

Cabo Verde was the first tropical archipelago settled by Europeans (1462 CE), but due to the scarcity of historical information the degree to which island ecosystems have been transformed by human action remains uncertain. Applying palynological methods to sediment sequences in volcanic calderas offers a unique opportunity to determine the effects of land-use and volcanism on vegetation and fungal communities. In this paper, we apply palynological (pollen, non-pollen palynomorphs, phytoliths), and sedimentological analyses (Granulometry, X-Ray Diffraction, Loss on Ignition, tephra quantification and microprobe analysis) to a 2-m scoria-cone sediment sequence dated back to 4000 cal yr BP. Our results shed light to the transition from pre-human to human-dominated landscapes in the highland slopes (1010m asl) of Fogo island. The basal stratigraphic zones reveal the pre-human dynamics of an open landscape that was subjected to natural fires and erosion pulses. High abundance of organic matter, fungal spore *Brachidesmiella* and fern spores could correspond to a woody landscape not represented in the pollen record due to poor pollen preservation. Increase in tephra depositions between 1700-500 cal yr BP shows the Late-Holocene increase in Fogo's volcanic eruptions, which led to increases in natural fires. First documented land-use evidence is in the form of pollen of *Zea mays*, with increasing abundances of coprophilous fungal spores. Contemporary change in land-use practices towards pea cultivation (*Cajanus cajan*) is recorded, as well as the introduction of exotic trees and invasive herbs. The increase of sandy titanium-rich, organic-poor sediments in the last century reflects land degradation effects of intensive land-use in this fertile yet hazardous volcanic island.



A comparative study of honey bee pollen loads to understand the foraging preferences of *Apis cerana indica* Fabricius in and around Puducherry, southern India

Jean., L.,^{1, 2*} Vadivelu, K.,² Ayyanar, I.,¹ Srinivasan, P.,¹ Das, L.³ and Anupama Krishnamurthy¹

¹Laboratory of Palynology & Paleoecology, Department of Ecology, French Institute of Pondicherry, No.11, Saint Louis street, Puducherry, India

²Department of Botany, Kanchi Mamunivar Government Institute for Postgraduate Studies and Research, Lawspet, Puducherry, India

³ Project Eco-lake, Sri Aurobindo International Centre of Education, Pondicherry, India

*Corresponding author: lazar.j@ifpindia.org

Honey bees are globally recognized as valuable pollinators of both natural and agro-ecosystems. In India, four species of honey bees have been reported: 1. *Apis cerana indica* Fabricius, 2. *Apis dorsata* Fabricius, 3. *Apis florea* Fabricius and 4. *Tetragonula iridipennis* Smith. (Stingless bee). Scientific beekeeping with boxes seems to have been introduced in India at least at the beginning of the 20th century in the erstwhile Madras Presidency. Analysing the native Indian honey bee (*Apis cerana indica* Fabricius) pollen loads from different landscapes provides reliable information regarding the pollen sources of this crucial pollinator as well as the availability and seasonality of the source plants around the study site. In the framework of an ongoing PhD dissertation (of LJ) and as part of a project focusing on the role of honey bees in sustaining agriculture and biodiversity in the heavily human impacted region in and around Puducherry, Southern India, this study aims to determine the diversity and seasonal variations of bee foraged and preferred plants in two different landscapes (Urban and Rural). Wooden bee hive boxes with frames and a narrow entrance were installed, in which the Indian honeybee *A. cerana indica* Fabricius was introduced. A queen gate was placed at the entrance and pollen loads from the hindlegs of the honey bees returning back to their hives were collected with a brush. Collections were made twice or thrice in a week from June 2020 to June 2021. We present here the results from two of the study sites, namely 1. IFP garden (urban) and 2. Poothurai (rural). Pollen load samples were collected between 08:00 and 09:00 hrs. Each sample has been acetolysed and observed under a light microscope at x400 magnification. A total of 76 pollen taxa were identified from 233 pollen load samples from both the study sites. The predominant pollen taxa were Cocos, Peltophorum, Calophyllum, Leucaena, Fabaceae, Bignoniaceae, Sapotaceae, Borassus, Syzygium, Borreria, Phoenix, Mollugo, Turnera, Asteraceae, Phyllanthus and Securinega. The taxa belonging to the family Euphorbiaceae were most dominant followed by Arecaceae, Malvaceae, Fabaceae, Sapotaceae and Mimosaceae. The pollen grains identified from the bee loads from the two sites revealed the influence of seasonal changes and also the vegetation patterns in these distinct landscapes providing clarity on the plants used by honey bees in different settings. These results, in conjunction with results from twelve more sites in this landscape that are being monitored along the same lines during this year (2021), will be used to provide inputs on bee preferred plants that can provide conservation strategies for creating pollinator-friendly habitats.

Chemotaxonomy: an alternative method for classification of grass species?

Katsi, F.^{1,2}, Jones M.^{2,3}, Kent M.⁴, Fraser W.⁵, Jardine P.⁶, Eastwood W.⁷ and Lomax B.⁴

¹School of Bioscience, University of Nottingham, Sutton Bonington Campus, Loughborough, LE12 5RD, UK.

²Future Food Beacon of Excellence, University of Nottingham, University Park, Nottingham, NG7 2RD, UK

³School of Geography, University of Nottingham, University Park, Nottingham, NG7 2RD, UK

⁴School of Bioscience, University of Nottingham, Sutton Bonington Campus, Loughborough, LE12 5RD, UK

⁵Geography, Department of Social Sciences, Oxford Brookes University, Headington Campus, OX3 0BP, UK

⁶Institute of Geology and Palaeontology, University of Münster, 48149 Münster, Germany

⁷School of Geography, Earth and Environmental Science, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

*Corresponding author: faidra.katsi@nottingham.ac.uk

The Poaceae (grass) family, and especially the cereal crops, have been of particular economic interest to most civilisations since the beginning of the Holocene. Accurate identifications to species level are crucial for reconstructing the history of cereal exploitation through time and to investigate environmental/cultural relationships. Nevertheless, Poaceae pollen is not generally classified below family level and the discrimination between domestic and wild species is frequently not possible, since the morphology of pollen grains from different grass species is very similar.

The chemical spectra acquired by Fourier transform infrared (FTIR) spectroscopy obtain a good taxonomic signal offering an alternative approach to grass pollen classification. My research project aims to assess the validity of using FTIR as a tool to extract the chemical fingerprint of Poaceae pollen (wild and domesticated plants) and from these data to create a model that can discriminate between wild and domesticated grass species from extant and extinct samples. We collected the chemical fingerprint of 450 samples belonging to twenty three wild and domesticated grass species from modern grass plants, which were used to train and test the accuracy of our classification models. In this talk, I will present the methodology we followed as well as the preliminary results from the classification models of both clusters of pollen and individual pollen grains from modern grass plants.

The Rise of the Green Algae: Using underutilized freshwater microfossils as proxies of anthropogenic activities

Pilkington, P.M.¹, McCarthy, F.M.G.¹, Riddick, N.L.¹, Volik, O.², Head, M.J.¹

¹Department of Earth Science, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON, L2S 3A1, Canada

²Department of Geography and Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada

*Corresponding author: ppilkington@brocku.ca

Green algae and cyanobacteria have comprised a large portion of the freshwater ecosystem biomass since the eukaryotic “green lineage” evolved from cyanobacterial ancestors during the Paleoproterozoic. Algal palynomorphs in sediments from multiple lakes in eastern North America also provide insights into the recent impacts of humans on our planet. Colonization by European settlers, beginning in the 17th century in New England and by the mid-19th century in the Great Lakes region, is clearly recorded, with land clearing resulting in accelerated erosion and siltation/ turbidity, and eutrophication caused by the increased nutrient influx in runoff, particularly from agricultural lands and fixed settlements. Despite differences in land-use and size, each site displayed a marked increase in green algal palynomorphs in the mid-20th century – the ‘rise of the greens’. This major shift in phytoplankton community, previously reported in several studies of lake sediments world-wide, is probably attributable to increased atmospheric CO₂ associated with the ‘Great Acceleration’, since green algae are less efficient at carbon capture than cyanobacteria and other freshwater algae. The recent increase in green algal palynomorphs may be useful in identifying the Anthropocene Epoch (with a base in the mid- 20th century as proposed by the Anthropocene Working Group) but very different groups of green algae appear to thrive in different eastern North American lakes, for reasons that are not yet understood. A sharp increase in abundance of desmid half-cells characterises the ‘Anthropocene’ in sediments from small lakes in non-urbanized settings (e.g., Walden Pond, MA and Crawford Lake, ON) as well as large lakes with large cities on their shores, including Lake Simcoe (Ontario). In contrast, planktonic colonial and coenobial chlorophytes such as *Botryococcus* spp. and *Coelastrum* spp. are abundant in palynological preparations of ‘Anthropocene’ sediments from the large Lake George, much of which is in the Adirondack State Park of New York and from the small Sluice Pond in the industrial city of Lynn, MA. The increased frequency of cyanobacterial harmful algal blooms (cHABs) in recent decades, even in the “EPA water quality standard” Lake George, may also prove a useful signal for subsequent decades of the proposed Anthropocene Epoch. More attention should be paid to the underutilized remains of green algae and cyanobacteria in palynological preparations, requiring sediment processing that avoids the use of strong oxidants which can destroy entire groups of palynomorphs, notably desmids.

Aquatic palynomorphs in Nakaumi Lagoon, Japan.

Ando, T.^{1*}, Matsuoka, K.^{2,3}, Seto, K.¹ and Saito, Y.¹

¹Estuary Research Center, Shimane University, Matsue, Shimane, Japan

²Institute for East China Sea Research, Nagasaki University, Nagasaki, Japan.

³Osaka Museum of Natural History, Osaka, Japan

*Corresponding author: tact@soc.shimane-u.ac.jp

Palynologists mainly focus on pollen, fern spore, and dinocyst to apply for biostratigraphy and/or reconstruction of the paleoenvironment. However, other organic-walled remains formed by several taxa such as cyanobacteria, green algae, prasinophyte ciliate, crustacean, and other metazoa are preserved as palynomorphs especially in Quaternary sediments although they have been mostly ignored. Aquatic palynomorphs including other than dinocysts are useful to reveal ecosystems in the past because these are inhabiting various environments. The ecosystem in the brackish environment is quite sensitive to rapid climate changes like floods, heavy rain, and global warming. Nakaumi Lagoon is the 2nd largest brackish lake in Japan and connects to the Japan Sea and the other brackish lake (Lake Shinji). Especially after 1960s, red tide of dinoflagellate *Prorocentrum minimum* has frequently occurred in Nakaumi Lagoon due to eutrophication caused by human activities. In this study, as a modern analogue approach to developing the paleo-ecosystem proxies, we investigated aquatic palynomorphs including dinocysts, ciliate cysts/ loricae, prasinophycean phycoma, raphidophycean cysts, benthic foraminiferal linings, turbellarian egg capsules, (resting) eggs of zooplankton, remains of green algae/cyanobacteria and acritarchs in the surface sediments collected from Nakaumi Lagoon. We got the following results from the present study.; 1) Total aquatic palynomorphs (/dry sediment-g) in surface sediments is positively correlated with (N=10, R²= 0.63) total organic carbon (TOC) contents rather than mean grain size (R² = 0.06). These data suggest that the deposition of palynomorphs in this area is controlled by organic matter burial rather than transportation processes.; 2) The proportions of heterotrophic species among dinocysts are higher in the samples deposited near the Ohashi-gawa River connected to Lake Shinji where is characterized by relatively high influence by freshwater compared with Nakaumi Lagoon. In addition, acritarchs including *Micrhystridium ariakense* are similarly higher in the samples deposited near the Ohashi-gawa River. These gradients of dinocysts and acritarchs are strengthened in summer samples deposited in anoxic conditions.; 3) Benthic foraminiferal linings are higher in the samples deposited near Miho Bay connected to the Japan Sea. The abundance of foraminiferal linings, as well as the autotrophic-heterotrophic dinocysts ratio, have the potential to reconstruct paleo-salinity, although interestingly dinoflagellate and benthic foraminifera are different ecological habitats as plankton and benthos, respectively.; 4) Ciliate loricae are lower but cysts of raphidophyte *Chattonella* are higher in the summer samples characterized by low C/S deposited in anoxic conditions. It is possibly related to differences in the timing of individual palynomorph formations, although further studies are needed.; 5) Remains of green algae are mainly composed of *Pediastrum* and *Staurostrum* which cannot live in Nakaumi Lagoon due to their higher salinity. This result suggests these algal palynomorphs are allochthonous and possibly useful for the proxies as freshwater input.; In order to reconstruct the paleoenvironment of a certain aquatic region.

Effects of taphonomy on cysts of the dinoflagellates *Parvodinium umbonatum* and *Peridinium limbatum* – implications for paleolimnological studies

McCarthy, F.M.G.,^{1,2*} Danesh, D.C.,³ Krueger, A.M.,² Michels, K.K.,⁴ Cumming, B.F.³ and Head, M.J.¹

¹Department of Earth Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1

² Department of Biological Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1

³Paleoecological Environmental Assessment and Research Laboratory (PEARL), Queen's University, Kingston, Ontario, K7L 3J9

⁴Department of Botany, University of Wisconsin-Madison, Madison WI, 53706

*Corresponding author: fmccarthy@brocku.ca

Cysts of *Parvodinium umbonatum* and *Peridinium limbatum* have been reported from palynological preparations of lake sediments from North America, Europe and Asia. Both species of thecate dinoflagellate are common in oligotrophic to mesotrophic lakes with circum-neutral to acidic waters, such as those found on the Canadian Shield – neither is common in lakes from regions with calcareous bedrock and soils. Their cysts can be present together in non-acetolysed preparations, where the small (approx. 20 µm) brown-walled cysts of *P. umbonatum* often outnumber pollen grains in the same slide. In contrast, the large distinctive cysts of *P. limbatum*, with prominent apical and antapical horns, are typically rare, although they occasionally outnumber cysts of *P. umbonatum* – e.g., in Mule Lake, Upper Michigan (USA) and in Lakes 257, 627, and 661 in the Experimental Lakes Area (ELA) of NW Ontario (Canada). The environmental variable most strongly associated with the distribution of cysts of *P. umbonatum* in the 32-lake calibration set in the ELA is maximum lake depth, and their abundance in cores tends to correlate with increased rates of sedimentation associated with land clearing. These observations are consistent with laboratory experiments demonstrating the sensitivity to oxidation of these cysts, whose brown walls resemble those of oxidation-susceptible 'round brown cysts' produced by marine protoperidiniacean dinoflagellates. Cysts of *P. limbatum*, in contrast, are resistant to oxidation, consistent with reports from acetolysed preparations. Water column-to-lakebed analysis of phycological and palynological assemblages of lakes in the Dorset region of central Ontario (Canada) suggest that ecological factors, including predation, appear to impact the abundance of these large distinctive cysts, with prominent apical and antapical horns, in lakebed sediments. Although these dinoflagellate cysts in lakebed sediments have complex relationships with motile cell distributions and are largely controlled by taphonomic factors, they can be useful paleolimnological proxies.

DAY 1 LIGHTNING TALKS, SESSION 1

Spatial and temporal changes in the palynological record of Crawford Lake: historical connections

Riddick, N.L.¹, Heyde, A.¹, Pilkington, P.M.¹, Boyce, J.I.², Krueger, A.M.¹, Llew-Williams, B.M.¹, McCarthy, F.M.G.¹ and Patterson, R.T.³

¹Department of Earth Science, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON, L2S 3A1, Canada

²School of Earth, Environment & Society, McMaster University, 1280 Main St W, Hamilton, ON, L8S 4L8, Canada

³Department of Earth Science, Carleton University, 1125 Colonel By Drive, Ottawa, ON, K1S 5B6, Canada

*Corresponding author: riddick.nicholas@gmail.com

Crawford Lake, a potential GSSP for the Anthropocene, is a small meromictic lake located near Milton, Ontario. Most paleolimnological research has been carried out with sediment cores from the deep basin where annual laminations preserve an excellent microfossil record (Lagerstätte) that can be related to the settlement history. The shallower parts of the lake above the chemocline have received little attention, and no one has investigated the spatial variability of the palynological record between the distinct depositional environments in the deep karstic basin and shallower parts of the lake. This ongoing study of cores near the inlet and outlet and in the deep basin (Figure 1), as well as lakebed sediments taken along a N-S transect, examines how documented human impact and climate change are recorded by algal and consumer palynomorphs as well as pollen outside the deep basin. Only limited geochemical data has been available until now, when we present high resolution micro-XRF geochemical data that allow for correlation across the lake. In the deep basin, geochemical differences between marl and gyttja-dominated intervals record substantial hydrologic changes in this karstic sinkhole through the Holocene, in addition to the increase in terrigenous elements associated with anthropogenic land use in the small watershed beginning in the late 13th century AD. Pollen analysis confirms that the similar geochemical record of accelerated erosion in shallower parts of Crawford Lake was the result of agricultural land use, and it is the anthropogenic impact on the lake that is the focus of this study.

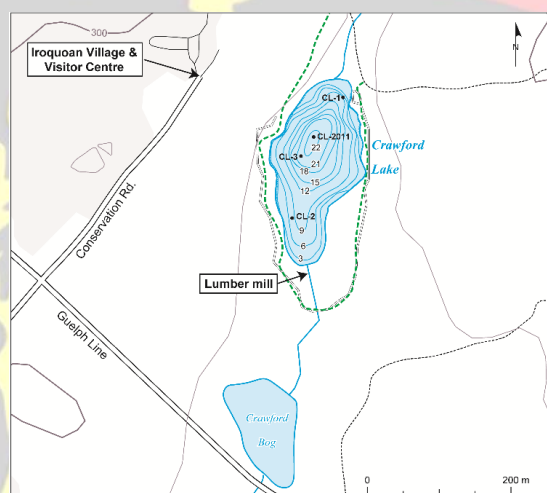


Figure 1: Crawford Lake points of interest and core locations

Soil pollen indicators of historical arable horizons

Ershova, E. G.^{1,*}, Bakumenko, V. O.¹

¹Ecology and Geography of Plants, Moscow State University, Moscow, Russia

*Corresponding author: ekaterinagershova@mail.ru

In this work we present the results of spore and pollen analysis of forest soils from the Zvenigorodbiological station of Moscow State University (Moscow Region, Russia). 25 sites are modern forests growing on sites that were fields in the 19th and 18th centuries, 12 are located in territories designated on historical maps as forests or shrubs/woodlands. The analysis showed that forest soils, which in the past underwent plowing, retain pollen of plants characteristic of former fields at a depth of 20-25 cm. This includes pollen of cultivated cereals, *Centaurea cyanus*, *Fagopyrum esculentum*, etc. However, the most reliable indicators of the former fields are the spores of mosses *Riccia glauca* and *Anthoceros* spp., as well as the spores of *Lycopodium clavatum*. Spores of these plants are found in abundance in old plow horizons but are completely absent in modern vegetation and surface spectra. The pollen indicators of old plow horizons identified as a result of this study can be used to determine the boundaries of ancient fields under modern forests. They can also be used to interpret the data of spore-pollen analysis of gully-ravine sediments, which accumulate soil material washed away from fields. This is especially important for forest-steppe regions that have passed through multiple cycles of agricultural use.

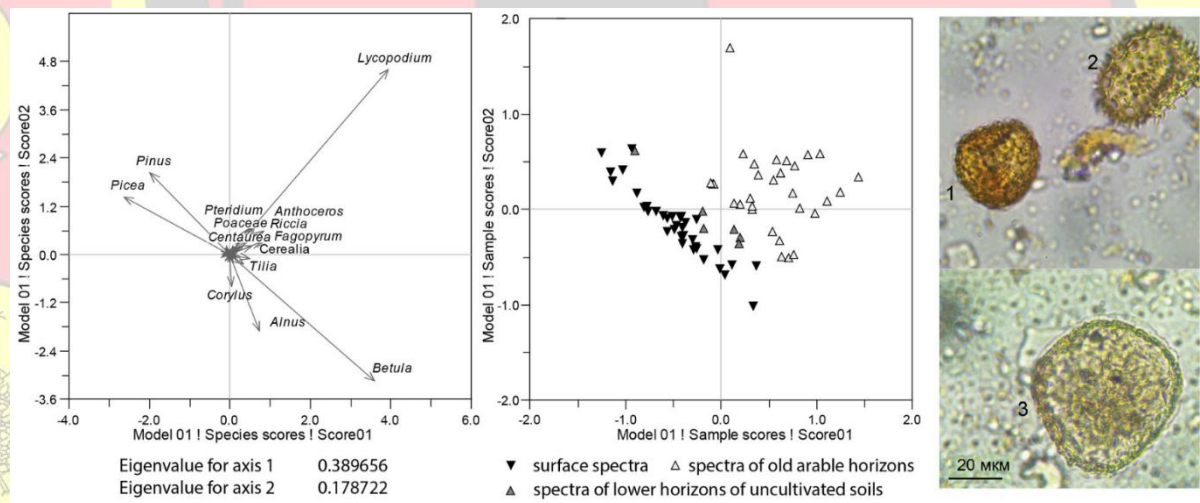


Figure 1. PCA showing species and sample scores of the soil pollen spectra. Spores of *Lycopodium clavatum* (1), *Anthoceros* spp. (2) and *Riccia glauca* (3) from old arable horizons.

The significance of the investigation of pollen and non pollen palynomorphs (NPP) in archaeological materials of the Classical Period in Georgia

Maia, C.^{1*} and Eliso, K.²

¹Georgian National Museum, The Paleoanthropology and Paleobiology Research Institute, 3 Rustaveli Av., Tbilisi 5, Georgia 0105

²Georgian National Museum, The Paleoanthropology and Paleobiology Research Institute, 3 Rustaveli Av., Tbilisi 5, Georgia 0105

*Corresponding author: e-mail: maizdroo1@gmail.com

Investigation of non-pollen palynomorphs, along with pollen grains, is of great significance in the course of study of organic remains discovered in archaeological materials unearthed in habitation layers and burials.

The organic remains obtained from the artefacts found at the sites dated from the Classical Period and located in Western Georgia, namely, at the Vani site and the Pichvnari necropolis, were studied from the palynological point of view.

Skeletons of deceased and visible remains of organic origin (bone, wood, fabric, etc.) are scarcely encountered at archaeological sites due to damp climate and high acidity characteristic of the soil in the Colchian Lowland. Microscopic bone crystals revealed by means of the palynological studies proved the existence of bone in the archaeological material. Parenchymal cells of disintegrated wood attest to the existence of wood. Parenchymal cells of pine wood discovered in the bronze covers of the kline legs found in the Vani hoard (1st c. BC) represented best proofs in favor of an assumption that the kline legs were made of pine. Salt crystals defined in the same sample attested to the usage of wood glue for the kline. It is well known that broth of bones and cartilages served as glue in the ancient times. The fabric fiber helped to identify the type of the textile used for the deceased's garment. Mainly linen cloth was used in the Classical Period. Remains of cotton and silk fabrics were presented in small quantities. Our researches also revealed that wooden constructions were arranged in the Vani and Pichvnari burials.

The existence of honey products and honey proper was stated both in burial N24 and the bronze hoard of the Vani site. It was implied by identification of bee hair, claws and epidermis, along with pollen of melliferous plants. Honey of the highest quality was revealed in the bronze pitcher (oinochoe) placed in burial N24. The trace of honey was nearby defined in the multilayered linen fabric stuck to the iron bracelet. This fact gives grounds for the assumption that the deceased could be embalmed in honey. In addition, eggs, belonging to several types of parasitic worms (*Trichuira*, *Ascaris lubricoides*, *Capillaria*, *Enterobius vermicularis*, *Yokogawa fluke*) were found in the habitation layers, indicating at the existence of helminthiasis in the period under discussion

This work was supported by Shota Rustaveli National Science Foundation (SRNSF) (Grant № YS-19-819).

Definition of ancient human food on the basis of non - pollen palynomorphs

Martkoplshvili, I.¹ and Kvavadze, E.¹

¹ Palaeoanthropology and Paleobiology research institute of Georgian National Museum, 3. Purtseladze str. Georgia.

*Corresponding author: imartkoplshvili@yahoo.com

In Georgia, detailed palynological researches were carried out at the early bronze age sites. The organic remains of non-pollen palynomorphs (NPP) obtained from artefacts excavated at 21 sites. They mainly represented the contents of vessels, household pits, storerooms, and hand-mills. In household pits and pots used for keeping cereals pollen grains sometimes were found in small amounts. As for NPP, they were well-presented. Among them were phytoliths of cereals, remains of insects, and spores of fungus glomus. Burnt tracheal cells of wood, occurring into the porridge from fire, defined in kitchenware used for cooking porridge. Cereal phytoliths and starch were identified in the spectrum, however, no insect remains were found. Starch dominated in a vessel used for the keeping of flour, which sometimes was turned into 'sponges'. Scales of butterfly wings of moths or hairs of moth worms were also defined there. Different kinds of NPP were defined in the vessel used for cooking meat. Their fat had well-preserved both pollens and other kinds of palynomorphs, especially microscopic crystals of bone salt. If fish had been kept in a vessel, along with bone salt crystals, a parasitic worm diphyllbothrium eggs, characteristic for fish, could be evidenced there. Great amounts of coprophilous fungi spores were always evidenced in the contents of vessels, containing milk or milk products. Presumably, in the process of milking, they occurred there from animals' udders or their hair. Plenty of burnt parenchymal cells of timber were found in boiled milk, which occurred via fire or smoke. The existence of honey and its products in vessels was well-evidenced by means of hairs, claws and epidermis of bees. As for wine, along with pollen grains, other markers of its existence were grapevine starch, its epidermis, and epidermis, hair, and other microscopic remains of fruit fly (*drosophila*).

A Preliminary Pollen Record from the Ecuadorian Andes

Alumbaugh, J.L.^{1*} and Horn, S. H.²

¹ Department of Geography, University of Tennessee, 1000 Phillip Fulmer Way, Knoxville, TN, 37996, United States

² Department of Geography, University of Tennessee, 1000 Phillip Fulmer Way, Knoxville, TN, 37996, United States

*Corresponding author: jalumbau@tennessee.edu

Andean ecosystems are under pressure due to anthropogenic climate change and local disturbances such as fire, deforestation, and the introduction of livestock. However, human activity in high-elevation sites characterizes much of the Holocene, and disentangling natural and anthropogenic pressures is challenging. Changes in floral composition at high-elevation sites through time can offer insight into how these ecosystems have changed. We present a preliminary pollen record spanning the last 12,900 years from Laguna Culebrillas, a high-altitude (3,900 m a.s.l.) páramo lake in the Cañar province of Ecuador, that complements prior work on microscopic charcoal. We compare the concentrations of a major palynomorph taxa in the Culebrillas sediments to previous work on microscopic pollen and to results from pollen analyses of other glacial lakes in the Andes and in the Cordillera de Talamanca of southern Costa Rica, with an emphasis on Poaceae, *Alnus* and *Isoëtes*. Changes in these taxa along with others have been used at other páramo lakes to infer local impacts of drought and human activity. Palynomorph assemblages in the Laguna Culebrillas core are dominated by *Isoëtes* spores. Changes through the profile in concentrations of this spore may indicate relative fluctuations in lake level through time, with higher concentrations indicating more intervals of lower water levels. In the context of the lake's charcoal record, changes in the concentration of grass and *Alnus* pollen contribute to discussions on human activity in the southern Ecuadorian highlands.

DAY 1 ORAL PRESENTATIONS, SESSION 2

Upper Pleistocene to Holocene Palaeoenvironmental Reconstruction of Marine sediments of Carbonate Mounds in the North Atlantic and Western Mediterranean Sea

Rachid, J.^{1*}, Hssaida, T.¹, Hamoumi, N.², Spezzaferri, S.³, Daghor.⁴, Khaffou, H.¹ and Chafai, K.¹

¹Laboratory of dynamics of sedimentary basins and geological correlations, department of Geology, Faculty of Sciences Ben M'Sick, Hassan II University, B.P 7955, Sidi Othmane, Casablanca, Morocco

²ODYSSEE Research Group, Department of Geology, Faculty of Sciences Rabat, Mohammed V University, Morocco

³Department Geosciences, University of Fribourg B.1700 Fribourg, Switzerland

⁴Laboratory of Ecology and Environment, Department of Biology, Faculty of Sciences Ben M'sik, Hassan II University, Casablanca, Morocco

*Corresponding author: jihadrachid237@gmail.com

The palynology of carbonate mound sediments recovered during the MD 194/Eurofleet - GATEWAY oceanographic cruise in 2013 is the first research of its kind on the Moroccan Atlantic and Mediterranean margins.

The organic microfossils displayed a diverse array of palynomorph associations (pollen spores, dinoflagellate cysts, and basal chitinous Foraminifera), with dinoflagellate cysts clearly dominating. Despite its low representativeness, the continental fraction appears to be a significant tool for palaeoclimate interpretation. Variations in the relative frequencies of the selected marker taxa allowed for the reconstruction of paleoenvironments during the study interval: Upper Pleistocene-Middle Holocene.

The quantitative and qualitative palynological study revealed the development of the palaeoenvironment and climatic change of the carbonate mounds. The transition from the upper Pleistocene to the Lower Holocene underlined by the preponderance of cold dinoflagellate cyst species with a dominance of tree and shrub pollen associated with the presence of altitudinal conifers, confirming a cold environment. The variations in the relative frequencies of dinoflagellate cyst associations indicate the change of the palaeoenvironment from inner neritic to oceanic during the Lower-Middle Holocene.

During the Lower Holocene, the microflora cycled from arid to semi-arid (the abundance of herbaceous and steppe), then back to arid due to the constantly high rate of herbaceous and steppe elements. The palaeoclimate of the mid-Holocene is semi-humid (high rate of trees and shrubs) to hot dry, as evidenced by the abundance of herbaceous and steppe pollen.

Paleoceanography of the subpolar North Atlantic ODP Site 984 for the Last Interglacial (Late Pleistocene): preliminary results based on dinoflagellate cysts.

Radmacher, W.^{1*}, Head, M. J.² and Singh, V.³

¹ING PAN – Institute of Geological Sciences, Polish Academy of Sciences, Senacka 1, 31-002, Kraków, Poland

²Department of Earth Sciences, Brock University, St. Catharines, Ontario, L2S 3A1, Canada

³Birbal Sahni Institute of Palaeosciences, 53 University Rd, Babuganj, Hasanganj, Lucknow, Uttar Pradesh 226007, India

*Corresponding author: ndkrol@cyf-kr.edu.pl

The Last Interglacial (~129 ka) is societally and scientifically relevant for understanding future climate, but in spite of its accessibility the ocean and climate dynamics of this warm episode are not well understood. Ocean Drilling Program (ODP) Site 984, drilled in the subpolar North Atlantic just south of Iceland, is ideally located to detect past shifts in the Arctic front, the subpolar front, and the North Atlantic Current (NAC) including its offshoot the Irminger Current. Here, sediments representing the Last Interglacial and its bounding glacials have high sedimentation rates and excellent temporal control based primarily on benthic foraminiferal isotopes. Of interest regarding the Last Interglacial is whether conditions were stable or not, and when full interglacial conditions began. Multiproxy evidence for Site 984 during this interval is already available (Mokeddem & McManus, 2016, Paleoceanography) but lacks information on the dinoflagellate cysts. A dinoflagellate cyst study based on 123 samples for the interval 132.45–108.9 ka (average sample spacing of 183 years) is in progress. The last interglacial is characterised by a rich association including the autotrophs *Ataxiodinium choane*, *Bitectatodinium tepikiense*, *Dalella chathamensis*, *Impagidinium* species including *I. sphaericum*, *I. paradoxum*, and *I. plicatum*, *Nematosphaeropsis labyrinthus*, *Operculodinium centrocarpum* sensu Wall and Dale, and *Spiniferites* species including *S. elongatus*, *S. mirabilis*, and *S. ramosus*; and heterotrophs including *Brigantedinium* species, *Lejeunecysta* species, *Polykrikos* sp., and *Selenopemphix quanta*. Some assemblages indicate conditions warmer than today at this subpolar site. In particular, the first signs of climatic amelioration with dominant *O. centrocarpum* sensu Wall and Dale at 131.7 ka, and sustained warming from 131.0 ka, indicate the active influence of the North Atlantic Current at Site 984 well before the onset of full interglacial conditions in the North Atlantic at 128–129 ka.

Dinoflagellate cyst stratigraphy and paleoceanography across the Lower–Middle Pleistocene Subseries (Calabrian–Chibanian Stage) boundary at the Chiba composite section, Japan.

Balota, E. J.¹, Head, M. J.^{1*}, Okada, M.², Suganuma, Y.^{3,4} and Haneda, Y.⁵

¹Department of Earth Sciences, Brock University, St. Catharines, Ontario L2S 3A1, Canada

²Department of Environmental Sciences, Ibaraki University, 2-2-1 Bunkyo, Mito, Ibaraki 310-8512, Japan

³National Institute of Polar Research, 10-3 Midori-cho, Tachikawa, Tokyo 190-8518, Japan

⁴Department of Polar Science, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies (SOKENDAI), Japan

⁵Geological Survey of Japan, AIST, Higashi 1-1-1 Central 7, Tsukuba, Ibaraki, 305-8567, Japan

A dinoflagellate cyst record from the highly resolved Chiba composite section in Japan has been used to reconstruct sea-surface paleoceanographic changes across the Lower–Middle Pleistocene Subseries (Calabrian–Chibanian Stage) boundary at the global stratotype, constituting the first detailed study of this microfossil group from the Pleistocene of the Japanese Pacific margin (Balota et al., 2021). In total, 107 samples from late MIS 20 to mid-MIS 19a were processed for marine palynology from the Chiba and Yoro-Tabuchi sections of the Chiba composite section. Cold, subarctic water masses from 794.2 ka gave way to warming and rapid retreat of the Subpolar Front at 789.3 ka, ~2000 years before the end of Marine Isotope Stage (MIS) 20. Throughout the fully interglacial conditions of MIS 19c, assemblages are consistent with warm sea surface temperatures but also reveal instability and latitudinal shifts in the Kuroshio Extension system. The abrupt (within ~300 years) shift to dominance of *Protoceratium reticulatum* cysts between 772.9 and 770.4 ka (MIS 19b) registers the influence of cooler, mixed, nutrient-rich waters of the Kuroshio-Oyashio Interfrontal Zone resulting from a southward shift of the Kuroshio Extension. Its onset at 772.9 ka serves as a local ecostratigraphic marker for the Chibanian Stage Global Boundary Stratotype Section and Point (GSSP) which occurs just 1.15 m (= 1300 years) below it (Suganuma et al., 2020). An interval from 770.1 ka to the top of the examined succession at 765.8 ka (MIS 19a) represents warm, presumably stratified but still nutrient-elevated surface waters, indicating a northward shift of the Kuroshio Extension ~5 kyrs after the termination of full interglacial conditions on land.

References:

Balota, E.J., Head, M.J., Okada, M., Suganuma, Y., Haneda, Y., 2021. Paleoceanography and dinoflagellate cyst stratigraphy across the Lower–Middle Pleistocene Subseries (Calabrian–Chibanian Stage) boundary at the Chiba composite section, Japan. *Progress in Earth and Planetary Science*.

Suganuma, Y., Okada, M., Head, M.J., Kameo, K., Haneda, Y., Hayashi, H., Irizuki, T., Itaki, T., Izumi, K., Kubota, Y., Nakazato, H., Nishida, N., Okuda, M., Satoguchi, Y., Simon, Q., Takeshita, Y. 2021. Formal ratification of the Global Boundary Stratotype Section and Point (GSSP) for the Chibanian Stage and Middle Pleistocene Subseries of the Quaternary System: the Chiba Section, Japan. *Episodes* <https://doi.org/10.18814/epiugs/2020/020080>.

Paleoceanography and Dinoflagellate Cysts of The Pliocene–Pleistocene transition at IODP Site U1424, Sea of Japan – Preliminary Results

Al-Silwadi, S.^{1*} and Head, M. J.^{1,2}

¹ Department of Earth Sciences, University of Toronto, 22 Ursula Franklin St., Canada

² Department of Earth Sciences, Brock University, 1812 Sir Isaac Brock Way, Canada

[*saif.silwadi@mail.utoronto.ca](mailto:saif.silwadi@mail.utoronto.ca)

The Pliocene–Pleistocene transition marks a significant intensification of Northern Hemisphere glaciation and the beginning of high-amplitude glacial–interglacial cyclicity that characterises the Quaternary. While many mechanisms have been proposed for this change in climate state, including the closure of the Isthmus of Panama and the onset of ocean stratification in the Pacific at ~2.7 Ma, the role of the Pacific Ocean remains poorly understood.

The largely enclosed Sea of Japan has been a sensitive recorder of climate change since its formation, owing to its: shallow connections to the Pacific and adjacent basins which prevent bottom water exchange; reliance on the Tsushima Warm Current as its major source of nutrients, salt and heat; proximity to the Westerly Jet; and position relative to the East Asian Summer and Winter Monsoon systems. This makes it ideally suited for understanding the role and response of East Asia and the Pacific Ocean across this interval of crucial change in climate. Dinoflagellate cysts, acritarchs, and other palynomorphs are here used to elucidate hydrographic changes during the Pliocene–Pleistocene transition at Integrated Ocean Drilling Project (IODP) Site U1424, east-central Sea of Japan. The study covers 2.85 Ma to 2.41 Ma with an average sample spacing of ~2 kyr, allowing paleoenvironmental reconstructions at suborbital resolution. This is the first high-resolution study using dinoflagellate cysts for the Sea of Japan.

Preliminary results reveal more than 60 marine palynomorph taxa and moderate to excellent preservation. Changes in assemblages correspond to shifts in marine isotope stages (MIS). In particular, strong responses coincide with glacial MIS 100 (2.52 Ma) and 102 (2.57 Ma), these being characterized by higher numbers of *Corrudinium harlandii*, *Habibacysta tectata*, the cyst of *Protoceratium reticulatum* and *Spiniferites elongatus*. The high- to mid-latitude acritarch *C. invaginata* also occurs in very high numbers in some intervals, seemingly tied to specific glaciation events.

Assemblages will be compared with independently derived sea-surface temperature reconstructions to be obtained from alkenone and Tex₈₆ analyses. Results from IODP Site U1424 will also be compared with a dinoflagellate cyst analysis of Ocean Drilling Project Site 1148 in the northern South China Sea to obtain a more complete picture of paleoceanographic changes in the western Pacific across the Pliocene–Pleistocene transition.

Palynological record of northwestern North Pacific ODP Site 882 during the Pliocene–Pleistocene transition – preliminary results

Farmani, T.^{1*} and Head, M. J.¹

¹Department of Earth Science, Brock University, Niagara Region, 1812 Sir Isaac Brock Way, St. Catharines, ON, L2S 3A1, Canada

*Corresponding author: tfarmani@brocku.ca

The Pliocene–Pleistocene (Neogene–Quaternary) transition marks important changes in the planktonic record of the northwestern North Pacific Ocean. Ocean Drilling Program Site 882 is located on the Detroit Seamount at the northern end of the Hawaiian–Emperor seamount chain. This site lies just south of the Aleutian trench and was the focus of an important study by G.H. Haug et al. 2005 (*Nature*, 433: 821–825) that examined the Pliocene–Pleistocene transition using a range of chemical and biotic proxies. These authors surmised that an abrupt drop in biogenic opal around 2.7 Ma (latest Pliocene), and which coincides with the onset of ice-rafted debris, represents the establishment of a stratified upper water column. This would have caused surface waters to remain warm further into the summer/fall, allowing westerly winds to deliver moisture over the colder land to the east, which would then precipitate as snow. This in turn would have accelerated the growth of ice sheets over northern North America, so providing a mechanism (the snow gun hypothesis) for the intensification of Northern Hemisphere glaciation at ~2.7 Ma. The present study is the first to investigate dinoflagellate cysts and acritarchs across the Pliocene–Pleistocene transition from Site 882 at suborbital resolution. Its purpose is to examine the marine palynomorph response across the critical interval of stratification at ~2.7 Ma, and also to assess evidence of cooling at 2.6 Ma as recorded in the North Atlantic and in northern Asia. Preliminary results show a predominance of round brown (heterotrophic) dinoflagellate cysts that would have thrived on an abundant food supply prior to stratification. Other taxa include *Impagidinium aculeatum*, *I. detroitense*, *I. paradoxum*, *I. patulum*, and *Pyxidopsis reticulata*. *Cymatiosphaera? invaginata*, a common constituent of late Cenozoic assemblages in high northern latitudes, is abundant in the upper part of the examined interval and appears to support cooling and perhaps a lowering of surface water salinity at this time. Pyritized diatom fragments are present in all samples but a notable decrease across the transition from Pliocene to Pleistocene suggests lowered productivity, supporting the contention that the water column became stratified at this time.

Paleoceanography and dinoflagellate cyst record through the Pliocene–Pleistocene transition, southern South China Sea: preliminary results

Okafor O.S¹* and Head, M.J¹

¹Department of Earth Sciences, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, Ontario, L2S 3A1, Canada.

*Corresponding author: so18ts@brocku.ca

Dinoflagellate cysts and other palynomorphs are being analyzed from Ocean Drilling Program Site 1143, southern South China Sea, to reconstruct paleoceanographic and paleoclimatologic changes across the Pliocene–Pleistocene (Neogene–Quaternary) transition between 2.9 and 2.4 Ma. This location is within the influence of the Indo-Pacific Warm Pool, an area of the central western Pacific in which sea-surface temperatures have remained high at least since the Miocene, maintaining warmth during glacial as well as interglacial climate cycles. Accordingly, the Indo-Pacific Warm Pool has served as a refugium for species that have disappeared from other areas of the world. The South China Sea has also captured a multimillion-year record of the East Asian monsoon which has a dominant influence on climatic development in this region. The East Asian monsoon has itself been influenced by the development of Northern Hemisphere glaciation throughout the Late Pliocene and Quaternary. Specific aims of the present study are to assess the effects of intensified Northern Hemisphere glaciation around 2.74, 2.6 and 2.54 Ma in the southern South China Sea, to add detail to sea-surface hydrographic evolution of South China Sea within the study interval, to explore the development of the East Asian monsoon system during both glacial and interglacial intervals, and to establish the extent to which this area has served as a refugium for dinoflagellates during the Late Pliocene–Early Pleistocene interval. Seventy-two samples are under analysis and abundant and diverse assemblages are being recovered. Increase in dinoflagellate cyst abundance and diversity during interglacials may reflect localized strengthening of the Asian summer monsoon intensity. However, this pattern is not repeated in all glacial–interglacial oscillations, portraying complexity in the climate system over time. This study is the first to document dinoflagellate cysts from the South China Sea at this level of stratigraphic detail across the Pliocene–Pleistocene transition. This is also the first study to document the thermophilic *Operculodinium bahamense* from the Pacific. Other notable species recorded are *Atlanticodinium* sp. of Head and Mantilla-Duran (2020), *Dapsilidinium pastielsii*, *Desotodinium wrenii*, *Edwardsiella sexispinosa*, *Impagidinium plicatum*, *Invertocysta tabulata*, and the acritarch *Nannobarbophora walldalei*. The palynomorph record from this site confirms that the intensification of Northern Hemisphere glaciation had an effect on climatic and oceanographic conditions in the southern South China Sea.

Fungi in a Warmer World: fungal biodiversity across the Middle Miocene Climate Optimum

O'Keefe, J.M.K.^{1*}, Pound, M.J.², Nuñez Otaño, N.B.³, Warny, S.⁴, Romero, I.C.¹, Gibson, M.E.², Pilié, M.R.⁴, Spears, T.M.¹, McCoy, J.L.², Fairchild, C.J.¹, Jones, S.B.⁵, Lennex-Stone, J.E.¹, Tarlton, L.⁶

¹Department of Physics, Earth Science, and Space Systems Engineering, Morehead State University, Morehead, KY, USA.

²Department of Geography and Environmental Sciences, Northumbria University, Newcastle upon Tyne, UK.

³Laboratorio de Geología de Llanuras. Facultad de Ciencia y Tecnología, Universidad Autónoma de Entre Ríos, Sede Diamante. CONICET (National Scientific and Technical Research Council) Argentina.

⁴Center for Excellence in Palynology, Department of Geology & Geophysics, and Museum of Natural Science, Louisiana State University, Baton Rouge, LA, USA.

⁵Craft Academy for Excellence in Science and Mathematics, Morehead State University, Morehead, KY, USA.

⁶Department of Biology and Chemistry, Morehead State University, Morehead, KY, USA.

*Corresponding author: j.okeefe@moreheadstate.edu

Fungi are key components of ecosystems, although often overlooked in deep-time palynological preparations. Elucidating their distribution and diversity in ancient ecosystems has become a vital endeavor to predict the future behavior of agriculturally and silviculturally important fungi, which requires large-scale, long-term datasets unavailable from modern records. These datasets can only be derived from the deep-time rock record, but ecological and climatological interpretations are difficult when using datasets that rely only on fossil names because few are correlated with their nearest living relatives. The Fungi in a Warmer World (FiaWW) project is addressing both problems by developing a global dataset of fungal diversity and distributions from sites representative of early-middle Miocene climatic conditions worldwide. Sites were chosen to take advantage of existing palaeobotanical, palynological, and/or geochemical studies that permit traditional methods for palaeoecological and palaeoclimatic reconstructions. Fossil fungi are identified using modern taxonomic assignments to family, and frequently, genus, when possible. The fossil assemblages are then directly compared to modern guilds, yielding snapshots of community ecosystem dynamics through time. Unlike pollen, fungal remains in the terrestrial environment are generally deposited very close to their origin, providing a more detailed record of local conditions. While many are cosmopolitan, others have very narrow substrate preference such as sedges, bamboos, and palms (the pollen of which may be under- or not at all represented in palynological preparations), temperature, and rainfall tolerances, while many others have symbiotic associations (as mutualists, such as with mycorrhizae, and/or as biotrophs) with specific plant taxa. Thus, identification of individual fossil fungal palynomorphs and the correlation of these fossil assemblages with modern fungal guilds' ecological traits provide a framework to refine existing palaeoecologic and palaeoclimatic records, and to trace fungal assemblage responses to climate change. This project, the first of its kind, is facilitated by intensive cross-training of and collaboration among an international team of palynologists, mycologists, and palaeoclimatologists, which has been called for since at least the 1970's.

DAY 1 LIGHTNING TALKS, SESSION 2

Climate variability and environment changes in the western Mediterranean area (Alboran Sea) over the last 14 000 years

Rachid, J.^{1*}, Hssaida, T.¹, Hamoumi, N.² and Rooij, D.V.³

¹Laboratory of dynamics of sedimentary basins and geological correlations, department of Geology, Faculty of Sciences Ben M'Sick, Hassan II University, B.P 7955, Sidi Othmane, Casablanca, Morocco

²ODYSSEE Research Group, Department of Geology, Faculty of Sciences Rabat, Mohammed V University, Morocco

³Department of Geology, Ghent University

*Corresponding author: jihadrachid237@gmail.com

Palynology based on dinoflagellate cysts has been widely applied to the Upper Pleistocene-Holocene Mediterranean sediments. However, no palynological studies on the sediments associated with the cold-water coral carbonate mounds observed in the western Mediterranean have been undertaken. The analysis of dinoflagellate cysts in the MD13-3451G gravity core, taken from the Moroccan margin of the Alboran Sea during the MD194 "Gateway" Eurofleets oceanographic expedition in 2013, is the topic of this paper.

The dinoflagellate cyst assemblages provide a credible record of paleoenvironmental and paleoclimatic development over the interval: Bölling/Alleröd - Late Holocene (14.02ka-3.47ka).

The depositional environment during the Bölling/Alleröd is an inner neritic to an inner-outer neritic with a warm microflora reflecting a warm and humid climate and cold dry climate during the Young Dryas and an outer neritic to oceanic environment. The Holocene marked by the remarkable development of taxa, which indicate:

- From an inner to an outer neritic environment to an inner to an oceanic neritic environment.
- A climatic cyclicity throughout the Lower Holocene between a warm dry, a warm arid climate, and a warm semi-arid climate, with a noteworthy optimum of warm microfauna such as the two species *Spiniferites mirabilis* and *Impagidinium acculeatum*.

The environment is usually inner neritic to oceanic, with a warm humid climate throughout the transition period and an excessive warming during the upper Holocene, indicating a warm dry climate with a significant extension of the warm microfauna and microflora.

Organic Microfossils and Stable Carbon Isotope Signatures in a Savanna Wetland

Blentlinger, L. B.^{1*}, Artavia-Rodriguez, L. G.², Horn, S. P.¹ and Lane, C. S.³

¹Department of Geography, University of Tennessee, 1000 Phillip Fulmer Way, Knoxville, TN, 37916, United States

²Escuela de Geografía, Universidad de Costa Rica, Facultad de Ciencia Sociales, San Pedro de Montes de Oca, San José, Costa Rica

³Department of Earth and Ocean Sciences, University of North Carolina Wilmington, 601 South College Road, Wilmington, NC, 28403-5944, United States

*Corresponding author: lblentli@vols.utk.edu

The factors that determine boundaries between savanna and forest vegetation in Central America have generated debate. In some areas, savannas are not regarded as the “natural” vegetation but instead as a type of disturbance vegetation created by the activities of European settlers or Indigenous occupants. In June 2019, we raised sediment cores from two wetlands in the town of Buenos Aires, in the El General Valley of southern Pacific Costa Rica, to develop stratigraphic records of fire and vegetation history in a neotropical savanna from analyses of charcoal, pollen, and stable carbon isotopes. Both wetlands are remnants of formerly larger lakes and both were historically surrounded by savanna vegetation. Here we describe our analyses of core samples from Laguna Redonda. Radiocarbon dates indicate that the record extends to the early Holocene. Macroscopic pieces of charcoal occur in low abundance through the profile, with higher concentrations in recent sediments. Microscopic charcoal is common on pollen slides, however, indicating a long history of regional if not local fires. Pollen is unexpectedly rare in comparison to non-pollen palynomorphs in our samples. In this presentation, we focus on stratigraphic changes in microscopic charcoal assemblages and stable carbon isotope signatures in the sediments, what these proxies reveal about savanna history, and how results from Laguna Redonda relate to what we have found at other lakes in southern Pacific Costa Rica.

Late Holocene vegetation dynamics in Western Russia (Smolensk Region)

Lavrenov, N. G.^{1,2} and Ershova E. G.^{1,2}

¹Faculty of Biology, Lomonosov Moscow State University, 119234, Leninskie gory 1s12, office 508, Moscow, Russia

²Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

*Corresponding author: lavren.ng@gmail.com

The poster presents the results of the palaeoecological study based on pollen analysis of the peat sediments from 4 sites located in different districts of the Smolensk Region (Western Russia) and distanced from each other at least for 100 km. All the samples were dated using AMS-radiocarbon dating or mathematical modelling. Dated climate reconstructions in modern analogue technique were also obtained.

The study reveals 4 population waves in the Late Bronze Age, Iron Age, Migration Period and Early Medieval Period, ecological impact all of them were approximately estimated. Human impact on ancient landscapes was detected even at the sites which are located far from known archaeological sites and predict their presence in neighborhood. Sufficient cooling of the Little Ice Age correlates with decline of the agricultural activity and that trend is more noticeable at the western sites.

Comparison of pollen spectra of southern and northern sites allowed us to establish an ancient border of natural zones. The first pick of *Picea* curve dated 3200 y. BP at northern sites, while at southern sites that pick appears 2000 y. BP. The distance between the sites is about 100 km and now both of them are located in sub-taiga zone. The observed effect allows to suggest that the border sub-taiga border moved from the north to the south for about 10 km per century in Late Subboreal and Early Subatlantic.

According to results of the presented study human activities is the main factor of the landscape dynamics in Western Russia. It does not correlate with the results of other studies made in Pskov Region (to the North from Smolensk Region), Bryansk Region (to the South from Smolensk Region) and in Moscow Region (to the East from Smolensk Region) while studies in Belarus demonstrate similar effects. Therefore, our study raises the question where exactly the border of this impact is and which factors determinate it.

The study was funded by Russian Foundation for Basic Research (RFBR), project numbers 19-34-90172 and 20-59-04002.

Palynological records from the Quaternary Subfossil Site Ambodifiakarana, Madagascar

Andriambelomanana, M.C.^{1*}, T. Rakotondrazafy¹, K. Samonds² and J. Schwartz³

¹Mention Bassins sédimentaires Evolution - Conservation, Domaine Sciences et Technologies, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar;

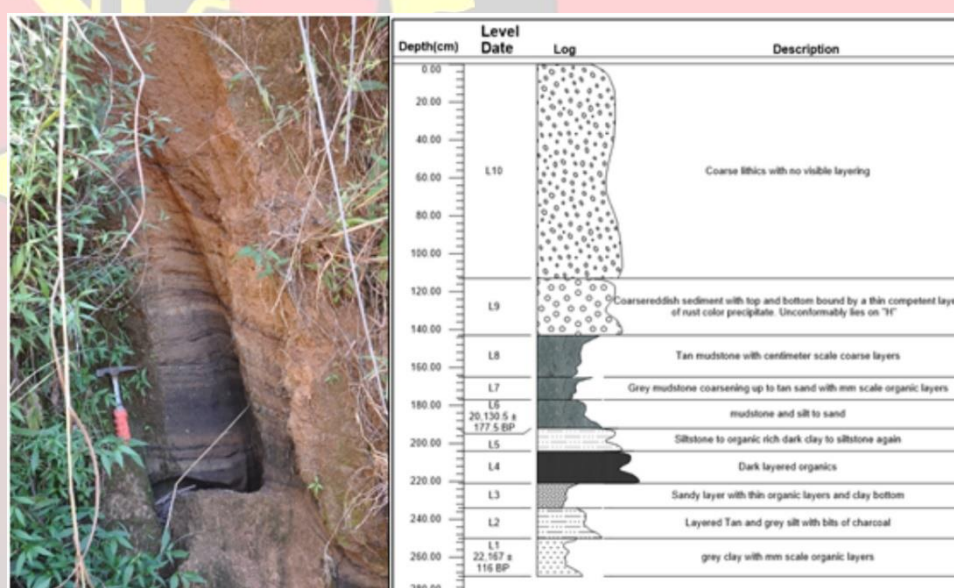
²Department of Biological Sciences, Northern Illinois University, DeKalb, IL 60115 USA ;

³Geology and Environmental Geosciences, Northern Illinois University

*Corresponding author: miorachrisandria@gmail.com

Madagascar's sedimentary deposits are primarily distributed in the western part of the island, but there are also lacustrine deposits in the Central Highlands. Palaeoenvironmental research was carried out at the subfossil site of Ambodifiakarana, Commune Analavory, Itasy (Central Highlands). The section was measured and sampled for laboratory analysis. Sediment samples consist of varying amounts of clay, silt, sand and organic layers with a general trend of coarsening upwards. The Calibrated age for the boundary levels are $22,167 \pm 116$ BP (L1) and $20,130.5 \pm 177.5$ BP (L6). Palynological techniques were utilized to reconstruct the vegetation and the climate over this time periode. The pollen of both terrestrial and aquatic taxa from the site characterize the mountain zones of Madagascar. Pollen spectra suggest that terrestrial vegetation in this region during the Pleistocene consisted of montain shrub grassland (Moraceae, Ericaceae, Gramineae). From the lower horizons to the upper ones, the dominant taxa testify the vegetation degradation. Cyperaceae characterizes the aquatic plants present and it suggest a wet environment. Palynological analysis can provide important data about paleoclimatic and paleovegetation changes in the studied area during the Quaternary.

Figure 1 : Picture of the outcrop (left) ; strat column (right).



Palynological and sedimentological evidences of coastal (restinga) vegetation and paleosea-level during the Late Pleistocene in northern Rio de Janeiro State, Brazil

Misumi, S. Y.^{1*}, Barros, M. A.¹, Vasconcellos, F. M.¹ and Barth, O. M.^{1,2}

¹ Departamento de Geologia, Universidade Federal do Rio de Janeiro, Av. Athos da Silveira Ramos 274, Ilha do Fundão, 21941-916, Rio de Janeiro, RJ, Brazil

² Instituto Oswaldo Cruz, Av. Brasil 4365, 21040-900, Rio de Janeiro, RJ, Brazil

*Corresponding author: smisumi@yahoo.com.br

Considered as centers of endemism, restingas are peculiar Atlantic Forest biome ecosystems with remarkable flora and vegetation structure, established on coastal sand plains. The presented study was carried out in the Restinga de Jurubatiba National Park, northern Rio de Janeiro State. The park features the longest quaternary sand plain of the State, with terraces and paleo-beach ridges formed by Pleistocene and Holocene marine sand. Between the beach ridges, there are floodable areas fed by coastal lagoons transversal to the coastline and continental drainage. This national park exhibits a mosaic of terrestrial and aquatic environments, ranging from creeping herbaceous to forest communities, interspersed by freshwater and brackish lagoons, representing the best-preserved restinga area of the State. In this scenario, organic sediments surfaced at the foreshore near the Comprida lagoon during storm events. A block of sandy to tarsand sediments was collected for palynological and sedimentological analyses and AMS ¹⁴C dating, aiming to evaluate the landscape evolution and the past environmental conditions. Samples for palynological analyses were successively treated with HF, HCl, KOH, and acetolysis with posterior sonication. ¹⁴C dates were obtained at Beta Analytic Lab, USA. Sedimentological results showed that the deposit was composed of well-selected, mildly rounded coarse sand and high content of tar-like organic matter with plant remains that bound the sand together. AMS ¹⁴C dating pointed to Late Pleistocene ages ranging from 43,500 to 23,420 yrs BP. Palynological analyses revealed the presence of pollen grains and ferns and lycopphytes spores, indicating open vegetation, probably associated with the restinga ecosystem. Marine elements were not observed. Around 43,500 yrs BP a predominance of Poaceae was verified, as well as taxa related to humid environments and forest pioneer species, like Trema (Urticaceae) and Melastomataceae. Such vegetation remained until around 23,420 yrs BP when Myrtaceae and Aquifoliaceae (Ilex) species increased. These cited botanical families are currently found in the national park. The palynological, sedimentological, and ¹⁴C data suggest the presence of a freshwater body, established between two beach ridges and directly connected to continental drainage without marine influence during the Late Pleistocene. The local accumulation of sand and organic matter generated the tarsand deposit, probably under low oxygen concentration conditions. Surrounding the water body, humid and open vegetation was present, with scattered trees and pioneer plants. Back then, the sea level was farther from the current one. Later on, after 23,420 yrs BP, the outer beach ridge was eroded due to sea-level elevation and the tarsand deposits were buried. Holocene tars and deposits are present along the Brazilian coast. However, the Restinga de Jurubatiba National Park tars and deposits are the oldest ones ever found in restinga environments, which makes them unique and quite meaningful for micropaleontological, paleoenvironmental, and paleoecological studies

DAY 2, AUGUST 10th *in situ* spores and pollen & general palynology

Keynote speaker: Jiří Bek¹

Some aspects of Paleozoic *in situ* spores

¹Department of Palaeobiology and Palaeoecology v.v.i., Institute of Geology of the Academy of Sciences of the Czech Republic

The research of *in situ* spores and pollen, i.e. fossil spores and pollen isolated directly from reproductive organs of their parent plants has a long history. First reported *in situ* spores are megaspores of arborescent lycopids that were described in the first half of 19th Century. This type of the research combines palynological and palaeobotanical methods and is perfect opportunity for collaboration of palynologists and paleobotanists. *In situ* spores can help with definition of dispersed taxa including emendation of diagnoses. Sometimes identical *in situ* spores can help with synonymization of their parent plants. *In situ* spores isolated from holotypes of plants complete their diagnoses.

It is possible to recognize six major aspects of this inter-disciplinary research.

- 1) Certainty about *in situ* origin of spores and pollen. The best way is careful preparation and maceration of the spores resulted findings of whole sporangia or their fragments. Important is precise maceration avoids the contamination by dispersed spores.
- 2) LM versus SEM. Diagnoses and descriptions of fossil spore and pollen taxa are based on LM observation and this method has priority over SEM. We cannot be quite sure using SEM about inner morphology of the spores and pollen and classification of *in situ* spores based only on SEM may be questionable.
- 3) Relationships of spores and their parent plants. This is major role of this type of the research i.e. which plants produced certain spores and pollen.
- 4) Determination of plants. Sometimes palaeobotanists have no idea about affinity of plant specimens and palynologists can help them with right classification based on previously described *in situ* spores and pollen.
- 5) Variations of spores. Important is recognise natural and ontogenetic variations. It is not exceptional if *in situ* spores are assigned to more than one dispersed species or even more than species of more spore/pollen genera. Sometimes ontogenetic stages are the reason, sometimes man-made system of classification of dispersed spore/pollen taxa.
- 6) Man-made versus natural taxa. This is very important aspect for grouping of fertile plant specimens. Palaeobotanists almost ignored palynological results and often grouped taxa producing monolete, trilete, operculate, laevigate, sculptured into one genus. Only the combination of palaeobotanical and palynological methods can lead to the classification of fertile plants that will be more close to natural fossil plant taxa.

Simply close collaboration of palynologists and palaeobotanists is needed.

Consistency without confidence? Thoughts on deploying classification algorithms on real-world palynological data

Kent, M.S.^{1*}, Jardine, P.E.², Katsi, F.¹, Fraser, W.T.³, Walker, C.⁴ and Lomax, B.H.¹

¹The School of Biosciences, Division of Agricultural and Environmental Sciences, The University of Nottingham, Sutton Bonington Campus, Sutton Bonington, Leicestershire, LE12 5RD, UK

²Institute of Geology and Palaeontology, University of Münster, 48149, Germany

³Geography, School of Social Sciences, Oxford Brookes University, OX3 0BP, UK

⁴School of Environment, Earth and Ecosystem Sciences, Open University, Walton Hall, Milton Keynes, MK7 6AA, UK

*Corresponding author: matthew.kent@nottingham.ac.uk

Palynologists are increasingly deploying machine learning algorithms in supervised classification exercises, where 'supervision' equates to providing an algorithm with a labelled training dataset with which it tries to characterise and distinguish between certain groups within that data. Such classification studies tend to be constrained to classifying specific taxa, often because they are cryptic (e.g. grasses) and because classifying them manually is challenging. It is unclear, however, how efficacious specific methods are when applied to real-world environmental samples that may be broader taxonomically, exhibit natural intra-taxon diversity and also contain 'unknowns'; types or taxa not present in a training dataset.

We present chemometric data and models that we have used whilst developing a high-throughput automated pollen classification system based on Fourier-transform infrared (FTIR) imaging spectroscopy and random forest algorithms which uses pollen chemistry as the basis for classification. One drawback of using FTIR is that individual spheroidal objects of a certain size range typical of some pollen can cause the infrared beam to scatter, resulting in distorted spectra. Such aberrant spectra can pose a challenge to identification. Whilst solutions to beam scatter are being explored it is also important to devise methods of vetting spectral (test) datasets so that distorted spectra are not misclassified.

We introduced artificial observations with the characteristics typical of scattered spectra to the training data to attract 'unclassifiable' test observations and further devised methods of assessing the model output in terms of the reasonableness of the classifications. We argue that classification exercises would benefit from pursuing measures of confidence, rather than relying solely on model accuracy (and related metrics) which can obscure actual performance and subsequent usefulness of a model; a higher degree of consistency does not necessarily equate to improved correctness.

Chemopalynology as a tool to link dispersed and *in situ* sporomorphs

Lomax, B.H.^{*}, Kent, M.S.¹, Nowak, H.² and Kustatscher, E.^{2,3,4}

¹The School of Biosciences, Division of Agricultural and Environmental Sciences, The University of Nottingham, Sutton Bonington Campus, Sutton Bonington, Leicestershire, LE12 5RD, UK

²Museum of Nature South Tyrol, Bindergasse/Via Bottai 1, 39100 Bozen/Bolzano, Italy

³Department of Earth and Environmental Sciences, Paleontology & Geobiology, Ludwig-Maximilians Universität München, 80333 München, Germany

⁴SNSB-Bayerische Staatssammlung für Paläontologie und Geologie, 80333 München, Germany

*Corresponding author: Barry.Lomax@nottingham.ac.uk

The pollen and spore (sporomorph) fossil record is one of the most complete archives available to palaeontologists in terms of the temporal and spatial ranges of plants in the past. This record is a function of both their production and their preservation potential due to the chemistry of the spore and pollen wall. Whilst the palynological record provides a rich treasure trove of data, it is often difficult to link specific sporomorphs to their parent plants which limits the amount of information that can be recovered. The linkage of palynomorphs to parent plants has traditionally been achieved via the analysis of the morphology and/or ultrastructure of *in situ* grains and their comparison with equivalent characteristics of dispersed sporomorphs. However, even when descriptions of *in situ* sporomorphs are cosmopolitan the challenge of relating them to their dispersed counterparts remains. In the presentation, we will discuss how the application of chemical analysis of sporomorphs via Fourier-transform infrared (FTIR) spectroscopy along with machine learning such as random forest algorithms could be used to derive new data from *in situ* sporomorphs for the chemical classification and separation of morphologically cosmopolitan taxa.

The Pollen Atlas of Nicaragua: A tool to understand the past and present anthropic and climatic impacts on the Dry Tropical Forest

Cabrera Sáenz, L.^{1*} and Torreggiani, I.²

¹Department of Biology, Universidad Nacional Autónoma de Nicaragua, Managua, Nicaragua

²School of Archaeology, University of Oxford

Corresponding author: lina.cabrerasaenz@gmail.com

The Pollen Atlas Project (PAP) started in 2018 in the Mayales River Valley, Juigalpa-Chontales (Nicaragua). The Project aims to understand the effects of climate change and anthropogenic activity on the vegetation of the Nicaraguan Dry Tropical Forest, through the study of modern pollen. Additionally, the project is creating the first comparative Pollen Atlas for Nicaragua. The Atlas provides information on the ecology, pollen morphology and visual resources of different botanical families characteristic of the most endangered forest formation of Nicaragua. The Atlas is an essential open-source tool to understand human and climatic impacts on vegetation, and plant adaptations to environmental changes, which can be used as a reference in palaeoenvironmental and paleoclimatic reconstructions, since it facilitates the taxonomic identification of fossil pollen records. More than 200 floral samples have already been identified, collected, and analyzed along the Mayales River Valley, through fresh pollen samples collections and the positioning of pollen traps. In 2021, the PAP expanded the fresh pollen collection in Laguna del Tigre (Asososca-León, Nicaragua) and planned future collections in El Gancho (Granada, Nicaragua). The collection along these areas will allow the comparison of modern flora to the palaeoenvironmental data retrieved by lake core analysis, providing a unique understanding of vegetational and climatic changes in Nicaragua during the last 1000 years. Keywords: Pollen, Dry Tropical Forest, Climate Change, Palaeoenvironment.

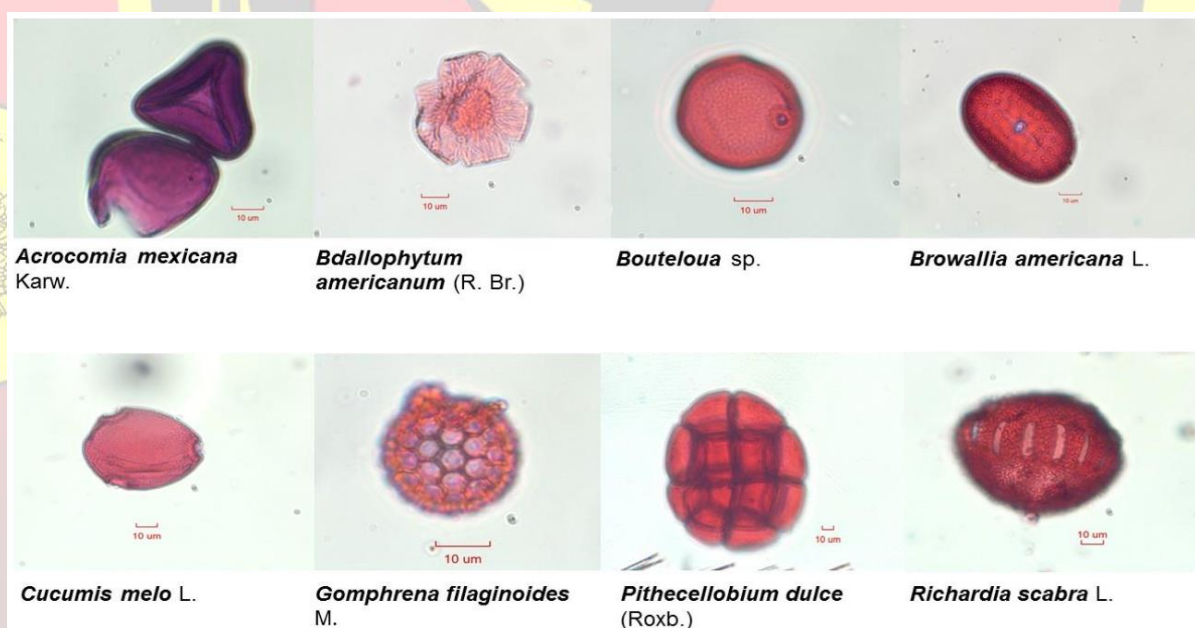


Figure: LM micrographs of some pollen species analyzed by the PAP (40X)

Reconstructing the Lower Devonian (Lochkovian) vegetation from the Anglo-Welsh Basin: two spore masses containing *Emphanisporites* McGregor spores

Ball, A. C.^{1,2*} and Taylor, W. A.³

¹Dept. of Animal & Plant Sciences, University of Sheffield, Alfred Denny Building, Western Bank, Sheffield. S10 2TN, UK

²Dept. of Earth Sciences, Natural History Museum, Cromwell Road, London. SW7 5BD, UK

³Dept. of Biology, University of Wisconsin-Eau Claire, Eau Claire, WI, 53706, USA

*Corresponding author: acball1@sheffield.ac.uk

In situ spores have gone some way towards harmonising the prominent disparity between the Early Devonian dispersed spore and megafossil records, greatly advancing, and often challenging, our understanding of early vegetation. Here, we investigate an elongate and discoidal spore mass yielding *E. epicautus* Richardson and Lister and *Emphanisporites* sp. respectively from the early (not: earliest) Lochkovian (Lower *micronatus-newportensis* spore assemblage biozone) fluvial deposits of the M50 motorway section, Anglo-Welsh Basin, UK. We explore the morphology and spore wall ultrastructure of the specimens using SEM and TEM. A paucity of useful phylogenetic characters precludes formal identification or description and a dearth of vascular tissues necessitates their placement amongst the rhyniophytoids. Both the sporangial morphology and spore wall ultrastructure differs between the specimens, distancing them from each other and from other *Emphanisporites* species. While similarities exist, no unequivocal relationships with contemporaneous or extant taxa/ lineages can be made using sporangial morphology or spore wall architecture. The variation between specimens lends further support to deliberations that the emphanoid condition was a consequence of convergent evolution. Using the dispersed spore record we explore the paleoecology of the plants, which points towards them being minor components of the vegetation, perhaps bound to restricted ecological niches; an interpretation redolent of the middle Lochkovian cf. *Horneophyton* (*E. cf. micronatus* parent) from North Brown Clee Hill. What characterised the restricted niches is uncertain, but they may have been ephemerally water stressed, perhaps hinting at a moisture sensing function for the 'emphanoid' condition.

Botanical affinities of spores and pollen from the Triassic of the Southern Alps

Kustatscher, E.^{1,2,3*}, Nowak, H.¹ and Roghi, G.⁴

¹Museum of Nature South Tyrol, Bindergasse/Via Bottai 1, 39100 Bozen/Bolzano, Italy

²Department für Geo- und Umweltwissenschaften, Paläontologie und Geobiologie, Ludwig-Maximilians-Universität, 80333 München, Germany

³Bayerische Staatssammlung für Paläontologie und Geobiologie, 80333 München, Germany

⁴Istituto di Geoscienze e Georisorse - CNR, Padova, Italy

*Corresponding author: evelyn.kustatscher@naturmuseum.it

Spores and pollen are produced in large numbers by plants and distributed by wind, water or animals up to thousands of kilometers away from the source area. Due to their high number (thousands in each sporangium), small size (20–200 µm) and high preservation potential (chemically resistant wall), they are particularly suitable to reconstruct past environments and climate. This works very well in relatively young sediments containing spores/pollen of still living plants or pollen of angiosperms. However, the older the rocks, the higher the percentage of spores and pollen originating from extinct plants, and therefore with unknown biological affinity. In order to reconstruct the botanical affinity, it is necessary to identify the original plant, and in particular the corresponding reproductive organs, whether gymnosperm cones, lycopphyte or equisetophyte strobili, fertile leaves of various groups of ferns, flowers of angiosperms, etc. Finally, not all organs were mature at the time of burial, and therefore do not always contain fully developed microspores.

In the Dolomites and the Southern Alps in general, there are a number of fossiliferous localities (Kühwiesenkopf/Monte Prá della Vacca, Piz da Peres, Rifugio Dibona, Dogna, Recorao) with fossil plants from the Middle and Late Triassic in an exceptionally well-preserved state of conservation. Dozens of different species of horsetails, lycopphytes, ferns, seed ferns, cycads and conifers were found, always containing vegetative organs (stems, branches, leaves) but often also with the presence of male and female reproductive organs. Micro- and megaspores have been found in situ in sporangia of the equisetophyte *Equisetites mougeotii*, as well as the lycopphytes *Selaginellites* and *Isoetites*. Several fertile fronds of possibly osmundaceous ferns (*Gordonopteris lorigae*, *Scolopendrites grauvogelii*, *S. scolopendrioides* and *Anomopteris mougeotii*) have yielded isospores. Cones attached to a well-preserved conifer shoot assignable to *Voltzia recubariensis* yielded bisaccate pollen. The detailed study of these reproductive organs permits to identify the palaeobotanical affinity of a considerable number of spores and pollen types previously known only dispersed in the sediment. These findings also make it possible to identify intraspecific variability within individual sporangia, as well as common traits of related taxa.

In situ fern spores from the Triassic in Europe

Nowak, H.^{1*} and Kustatscher, E.^{1,2,3}

¹Museum of Nature South Tyrol, Bozen/Bolzano, Italy

²Department für Geo- und Umweltwissenschaften, Paläontologie und Geobiologie, Ludwig-Maximilians-Universität, München, Germany

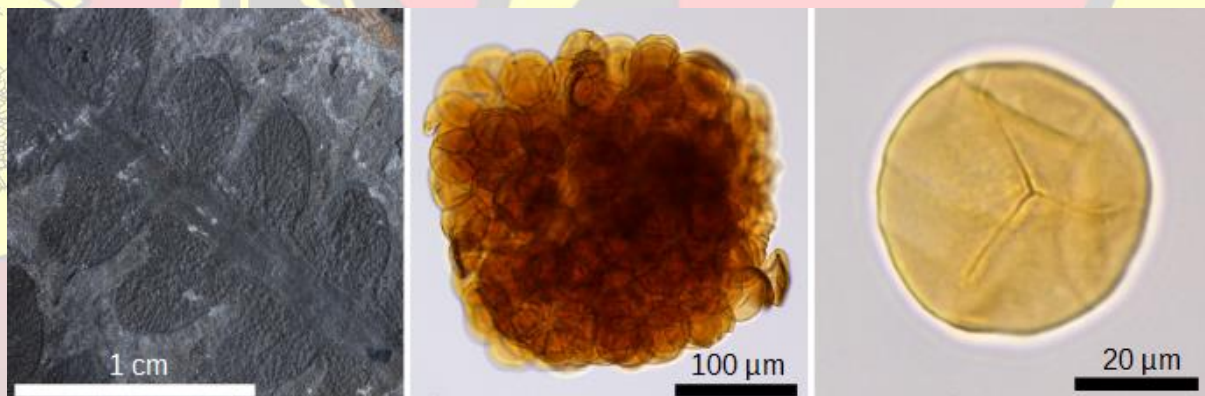
³Bayerische Staatssammlung für Paläontologie und Geobiologie, München, Germany

*Corresponding author: hendrik.nowak@naturmuseum.it

We studied the *in situ* spores of ferns from exceptionally well-preserved palaeofloras of the Triassic in Europe with a focus on intraspecific and interspecific morphological variability. The material mainly comes from the Kühwiesenkopf/Monte Prà della Vacca flora (Dont Formation, Anisian) of Italy, the Lettenkeuper (Erfurt Formation, Ladinian) of Germany, and the Lunz flora (Lunz Formation, Carnian) of Austria. The studied specimens belong to the Marattiales (*Asterotheca merianii*), Osmundales (*Todites* spp.), possible Osmundales (*Anomopteris mougeotii*, *Gordonopteris lorigae*, *Scolopendrites scolopendrioides*, *S. grauvogelii*), and Gleicheniales (*Dictyophyllum serratum*, *Clathropteris* cf. *reticulata*). Our analysis was aimed at distinguishing characters that can serve to identify specific taxa from those that fall into the normal range of variability, differentiating developmental stages, and determining the frequency of malformed or abortive grains, which may provide evidence for environmental disturbances affecting plant reproduction.

We found considerable variability in spore size and surface ornamentation both between individual plant specimens of a particular species and within single sporangia. Both can be attributed in part to different stages in the sporogenesis, as the spores are not equally mature. Even spores from different parts of a frond show significant differences in their average and maximum sizes, which suggests diachronous maturation. Differences in the size of spores between individuals may also be related to ploidy levels (genome size), which can vary even within populations. Variations in the surface ornamentation are mostly based on the presence or absence of certain sculpture elements. Spore grains with or without these elements correspond to different dispersed taxa.

Abortive grains are generally rare but appear with increased frequency in some specimens. The cause may be environmental stress or disease, as well as natural hybridization.



Peculiar pollen grains found in *Schidolepium* Heer cones from the Middle Jurassic of East Siberia

Zavialova, N.^{1*} and Nosova, N.²

¹Laboratory of Paleobotany, A.A.Borissiak Paleontological Institute, Russian Academy of Sciences, ul. Profsoyuznaya 123, Moscow 117647, Russia

²Laboratory of Paleobotany, Komarov Botanical Institute, Russian Academy of Sciences, ul. Professora Popova 2, St. Petersburg 197376, Russia

*Corresponding author: zavial@mail.ru

We have studied pollen grains from cones of *Schidolepium gracile* Heer from the Irkutsk Basin in East Siberia of Russia with application of light microscopy as well as scanning and transmission electron microscopy, in aim to understand their morphology and exine ultrastructure and clarify the botanical affinity of the parent conifer (Zavialova and Nosova, 2021). The pollen grains show an unusual combination of morphological and ultrastructural traits, so that we did not find a suitable taxon among pollen dispersae or similar enough pollen grains known from reproductive organs. In pollen masses, they appear circular, asaccate, and flattened in a polar position. Detached monads show a polar and equatorial position equally often; the outlines are rounded, oval, and irregular. An indistinct equatorial-distal saccus was revealed. A small trilete scar is occasionally present. The surface is fossulate. The ectexine is formed by structural elements that fused with each other by their lateral surfaces partially or completely. The element is a solid elongated cylinder with a rounded external end and narrowing internal end/ends. The elements are arranged along their length, perpendicular to the pollen surface. The endexine is more electron dense than the ectexine, and it is prominent and appears homogeneous. We revealed variations in the pollen morphology that we consider preservational, although the existence of two species of *Schidolepium* is not excluded. The exine ultrastructure excludes an araucariaceous affinity, with its characteristically granulate ectexine, in spite of a relatively close general morphology. Certain similarities to *Cerebropollenites* were found in the exine ultrastructure, but this pollen type is characterized by a distal aperture and proximal saccus-like extensions by contrast to the occasional proximal scar and equatorial-distal saccus of the pollen grains under study. Although the pollen cones have something in common with the Taxodiaceae and Voltziales, the palynological data do not support this relationship. The pollen grains under study show a combination of characters that forces us to seek for the relatives of their parent plant in several groups of conifers, and we cannot choose only one of them. The plant apparently represents an early member of an evolutionary line within conifers; this is why it does not show a complete assemblage of features that we can use to consider as characteristics of one of the groups but a mixture of them. One of the cones was contaminated by *Cycadopites* pollen grains, which showed the ginkgoalean exine ultrastructure and might have been brought by a nonspecialized animal pollinator. The results contribute to our ongoing study of Middle Jurassic localities of Siberia, which are rich sources of sufficiently well-preserved reproductive remains of gymnosperms with in situ pollen as well as other types of plant fossils. The study was supported by the Russian Foundation for Basic Research, no. 20-04-99355A.

Zavialova, N. and Nosova, N., 2021. Pollen grains found in pollen cones of *Schidolepium* Heer (Pinopsida) from the Middle Jurassic of East Siberia, Russia. *International Journal of Plant Sciences*, 182(6), doi:10.1086/714286.

Pollen from a *Hedyosmum*-like staminate structure (Chloranthaceae) from the Early Cretaceous of the western Portuguese Basin: morphology, ultrastructure, and evolution

Tekleva, M.¹, Mendes, M. M.^{2,3}, Endress, P. K.⁴, Kvaček, J.⁵, Doyle, J. A.^{6*}

¹Paleontological Institute of the Russian Academy of Sciences, Profsoyuznaya 123, Moscow 117647, Russia

²University of Coimbra, MARE - Marine and Environmental Sciences Centre, Largo Marquês de Pombal, 3030-790 Coimbra, Portugal

³Fernando Pessoa University, Praça 9 de Abril, 4249-004 Porto, Portugal

⁴Department of Systematic and Evolutionary Botany, University of Zurich, Zollikerstrasse 107, 8008 Zurich, Switzerland

⁵National Museum Prague, Václavské nám. 68, 115 79 Praha, Czechia

⁶Department of Evolution and Ecology, University of California, Davis, California 95616, USA

*Corresponding author: jadoble@ucdavis.edu

Since Couper compared the Barremian reticulate-columellate monosulcate dispersed pollen genus *Clavatipollenites* with extant *Ascarina* in the Chloranthaceae, this near-basal family has emerged as one of the most important groups of Early Cretaceous angiosperms. The chloranthaceous affinities of several dispersed pollen types have been confirmed by studies of *in situ* pollen. One is *Asteropollis*, first described by Hedlund and Norris from the middle Albian of Oklahoma, which is like *Clavatipollenites* in exine structure but differs in having a four- to six-armed sulcus, as in the extant genus *Hedyosmum*. Similar grains with a three-armed sulcus (trichotomosulcate) have been variously assigned to *Clavatipollenites*, *Asteropollis*, or *Jusinghipollis*. Both *Asteropollis* and similar trichotomosulcate pollen have been associated with *Hedyosmum*-like female flowers (*Hedyflora*) from the Early Cretaceous of Portugal. However, corresponding male structures are known only as isolated stamens with *in situ* pollen, or immature inflorescences containing no pollen.

Here we describe pollen from a well-preserved spike of flowers that consist of a single stamen with no subtending bract, as in *Hedyosmum*, from the Catefica mesofossil flora (late Aptian–early Albian) in the Estremadura region, western Portugal. This pollen is only half the size of living *Hedyosmum* pollen and middle Albian *Asteropollis*. The aperture is often poorly delimited under SEM (cryptoaperturate) but most often a sulcus with three arms. The exine is reticulate-columellate, with nanoverrucate supracteal sculpture. The non-apertural nexine consists of a thick foot layer and a thin but continuous endexine, which is thicker and lamellated under the aperture; total nexine thickness is less than in most extant Chloranthaceae. Phylogenetic relationships of the fossil were examined using a morphological data set for extant basal angiosperms and fossils, with extant taxa arranged as found in molecular analyses. Despite some uncertainty due to similarities between the Catefica fossil and the staminate structures of *Ceratophyllum*, these analyses are most consistent with a position of the fossil on the stem lineage of *Hedyosmum*.

These results show that extinct relatives of *Hedyosmum* were more diverse in pollen size and aperture condition than the extant genus and suggest an evolutionary sequence from an ancestral simple sulcus (as in *Clavatipollenites*), through a three-armed sulcus, to the four- to six-armed sulcus of *Hedyosmum*. Dispersed trichotomosulcate pollen has been compared with *Ascarina*, which produces occasional trichotomosulcate grains, but much of it may have been produced by relatives of *Hedyosmum*. A sulcus with more than three arms may have originated as variation within a trichotomosulcate species, but its appearance may be stratigraphically useful as an Indicator of Albian age.

DAY 2 LIGHTNING TALKS, *in situ* spores

Early Triassic *Pleuromeia* sp. strobilus from Nevada, USA, and its *in situ* spores

Mendelin, M.^{1,2*}, Schneebeli-Hermann, E.¹, Kustatscher, E.³, Nowak, H.³ and Bucher, H.¹

¹ Paleontological Institute and Museum, University of Zurich, Karl Schmid-Strasse 4, 8006 Zurich, Switzerland

² Department of Biology, ETH Zurich, Zurich, Switzerland ³Department, Institute, Address, Country

³Museum of Nature South Tyrol, Bindergasse/Via Bottai 1, Bozen, Bolzano 39100, Italy.

*Corresponding author: mmorris@student.ethz.ch

A lycopsid plant fossil from Lower Triassic rocks of the southern Humboldt Range, Nevada, is presented. The specimen consists of a 12.7 cm long and 1.3–2.0 cm wide strobilus preserved primarily as an imprint with only a small amount of organic material preserved. Macromorphologically, the strobilus strongly resembles those of the genus *Pleuromeia*, which has, to our knowledge, not been found in North America so far. This finding thereby corroborates the global distribution of *Pleuromeia* during Early Triassic times. The specimen most closely resembles strobili of the type species *Pleuromeia sternbergii*, which is otherwise known from Germany, Russia, Kazakhstan, China, and Argentina. The fossil is preserved in sediments deposited in the shallow marine environment of the Sonoma Basin. Organic material was sampled from the strobilus and treated with the Schultze reagent in order to extract *in situ* spores.

Only few microspores were recovered, partially as tetragonal tetrads. The spores are monolet and cavate, with the form of a sphere section and an oval outline in polar view. They correspond to the dispersed form genus *Aratrisporites*. *Pleuromeia* is more commonly associated with trilete spores corresponding to *Densoisporites* and *Endosporites*, but *Aratrisporites* is known, e.g., from *P. longicaulis* from Australia. Microspores of *P. sternbergii* have been described both as trilete and monolet at times. *Aratrisporites*-type spores have otherwise been reported from various Triassic Isoetales. Notably, *Lepacyclotes* has yielded spores corresponding to both *Aratrisporites* and the trilete form *Lundbladispora*. The co-occurrence of monolet and trilete spores is thus a shared trait between the genera *Pleuromeia* and *Lepacyclotes* and underlines their close botanical affinity.

Fine structure of *in situ* *Pteruchus* pollen from the Upper Permian of the Dead Sea region, Jordan

Tekleva, M.^{1*}, Blumenkemper, P.², Kerp, H.², Abu Hamad, A.³, Bomfleur, B.²

¹ Laboratory of Paleobotany, Paleontological Institute of the Russian Academy of Sciences, 117647 Moscow, Russia

² Forschungsstelle für Paläobotanik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

³ Department of Applied and Environmental Geology, University of Jordan, 11942 Amman, Jordan

*Corresponding author: tekleva@mail.ru

The pollen organ *Pteruchus* is a member of Umkomasiales (Corytospermales), an extinct group of seed ferns. Other taxa of this group include those established for leaves (e.g., *Dicroidium*), wood (e.g., *Rhexoxylon*, *Kykloxylon*), and ovuliferous organs (e.g., *Umkomasia*, *Fanerotheca*). We present a detailed study of *in situ* pollen from *P. lepidus*, one of the oldest records of *Pteruchus* worldwide and also part of one of the most completely reassembled Umkomasiaceae plants, with *Dicroidium robustum* leaves and *Umkomasia aequatorialis* ovuliferous organs (Blumenkemper et al. 2020). The material comes from the upper part of the late Permian (Lopingian) Umm Irna Formation exposed at the Dyke Plateau locality, Dead Sea region, Jordan; it was treated following standard protocols for transmitted light (LM), scanning electron (SEM), and transmission electron (TEM) microscopy.

Pollen grains are monosulcate and bisaccate with crescent-shaped, laterally attached sacchi, and measure on average 61 (52.4–70) μm from saccus to saccus. Sacchi are eusaccate and have distinct endoreticulations. The proximal and saccus surface is psilate to scabrate, the aperture membrane is rugulate. The ectexine in the cappus region consists of a relatively thick tectum, an infratectum with one row of ‘alveoli’ and a thin foot layer. The endexine is more electron-dense, lamellate, and of uniform thickness throughout the pollen except for the saccus region where it is considerably thickened and multi-lamellated. The aperture region is represented by an endexine and a very thin ectexine layer.

Dispersed pollen grains compared to those from *Pteruchus* pollen organs are *Pteruchipollenites* and *Alisporites*. Electron microscopy studies on these dispersed genera are scarce and the few pollen types studied thus far do not show much similarity to *P. lepidus* pollen in the exine ultrastructure. *In situ* pollen of several *Pteruchus* species was previously studied with SEM and TEM from the Triassic of Argentina, South Africa, and Antarctica; namely *P. dubius*, *P. africanus*, *P. papillatus*, and *P. fremouwensis*. The pollen size is similar or somewhat larger in the studied *Pteruchus* pollen except for *P. dubius* from Argentina which is characterized by significantly larger pollen. Further differences can be observed in the aperture membrane ornamentation and in the structure of the cappus region. The aperture membrane is rugulate in *P. lepidus*, but smooth (or unknown) in other *Pteruchus* species. The cappus region is described as homogeneous or nearly so in earlier studied *Pteruchus* pollen, whereas in *P. lepidus* the exine shows a one-row ‘alveolate’ or “honeycomb” layer. Small lacunae along the outer saccus wall together with long pending ectexine elements create a characteristic saccus ultrastructure in the studied pollen. Another unusual feature is the multi-lamellated and significantly thickened endexine under the saccus regions observed for pollen of *P. lepidus*. The same multi-lamellated endexine thickened under the sacchi was reported for *Caytonanthus arberi*. The ultrastructure of the saccus and cappus regions in *Caytonanthus arberi* also resemble those of *P. lepidus*, but *Caytonanthus* pollen is considerably smaller. Based on the still limited evidence available to date, the studied material appears most similar to *Caytonanthus* pollen grains. Such similarity, however, might reflect functional aspects rather than close phylogenetic relationship.

A new wildfire derived plant mesofossil assemblage from the Lower Devonian (Lochkovian) of the Anglo-Welsh Basin, UK.

Ball, A. C.^{1, 2*}, Wellman, C. H.,¹ Richardson, J. B.,² Kenrick, P.² and Stukins, S.²

¹Dept. of Animal & Plant Sciences, University of Sheffield, Alfred Denny Building, Western Bank, Sheffield. S10 2TN, UK

²Dept. of Earth Sciences, Natural History Museum (London), South Kensington, London. SW7 5BD, UK

*Corresponding author: ACBall1@sheffield.ac.uk

The near continuous fluvial sequence of the Anglo-Welsh Basin is rich with plant macrofossils, mesofossils and spores. The record is far from perfect, however, with a prominent disparity between the diversity and number of taxa identified in the near-ubiquitous dispersed spore record and the less complete macrofossil record, which is affected by preservational bias. Wildfires began to appear in the late Silurian and burning can 'bypass' some of these biases, allowing delicate tissues and in situ spores to be preserved in exceptional, albeit fragmentary, detail. Such mesofossil assemblages offer their own challenges but go some way towards harmonising the spore and macrofossil records. They allow us to (1) identify dispersed spore source plants, (2) provide additional morphological characters for phylogenetic investigation, and (3) allow deliberations of palaeoecology. Two charcoalified Konservat-Lagerstätte are already well documented from the Anglo-Welsh Basin and here we present abundant, fragmentary charcoalified spore masses from the little documented early Lochkovian M50 motorway section in western England. This horizon has consigned a kaleidoscope of plant mesofossils with in situ spores directly comparable to dispersed trilete and cryptospore species. Whilst spore masses are abundant, no complete sporangia have yet been recovered, setting the level of preservation a little below other charcoal assemblages in the basin. However, the M50 assemblage has excellent potential for elucidating the parent plants of many contemporary dispersed spore species, unpicking phylogenetic affinities through morphological (e.g., axial anatomy) and TEM (spore wall architecture) analysis, and exploring the palaeoecologies of some of these plants. Finally, this assemblage lends support to the idea that wildfire derived plant mesofossil assemblages occur reasonably often in this basin and hints that a wealth of information waits to be recovered.

DAY 2 LIGHTNING TALKS general palynology

Miocene palynoflora from the Tomellín Formation (Oaxaca, Mexico), its comparison with modern pollen rains and its sedimentary analysis.

Ramírez-Arriaga E.^{1*}, Prámparo M.B.², Martini M.³ and Martínez-Hernández E.¹

¹Departamento de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México, Av. Universidad 3000, Ciudad Universitaria, Coyoacán, C.P.04510., Ciudad de México, México.

²IANIGLA-CCT CONICET, Av. A. Ruiz Leal s/n, Parque Gral. San Martín, Mendoza, 5500 Argentina.

³Departamento de Procesos Litoféricos, Instituto de Geología, Universidad Nacional Autónoma de México, Av. Universidad 3000, Ciudad Universitaria, Coyoacán, C.P.04510., Ciudad de México, México.

*Corresponding author: elia@unam.mx

The aims of this research are to document the Miocene palynoflora, suggest the plant communities using actualism by mean of comparison with modern pollen rains and contribute to the knowledge of the Tomellín Formation's depositional environment (UNAM, DGAPA-PAPIIT project IN-109920). A total of 18 samples from the Tomellín Formation (lower to middle Miocene) located between Zongolica and Juárez mountain ranges, that belongs to the Sierra Madre del Sur physiographic province, Mexico, were processed by standard paleopalynological methods. Moreover, a preliminary sedimentological study was carried out at the type locality of the Tomellín Formation named "El Gallo" hill. Furthermore, paleopalynological results were compared with modern pollen rains recovered from Bromeliaceae samples: 20 samples from two transects of xerophytic shrubland at Villa Alegría and 20 samples from tropical deciduous forest at Tilapa hill, Puebla. The palynological assemblage recovered from the Tomellín Formation suggests the existence of cloud forest at mountain ranges, represented by Cyathaceae, *Laevigatosporites* and *Polypodiisporites*, as well as pollen grains of *Alnus*, Betulaceae, *Liquidambarpollenites* and *Momipites*. The palynoflora also proves the presence of *Pinus* – *Quercus* forests. Additionally, representatives of *Bursera*, Fabaceae and Asteraceae are indicative of tropical deciduous forest. According to the modern pollen rain assemblages obtained, *Bursera*, Asteraceae and *Ceiba* are considered excellent pollinic indicator of tropical deciduous forest, whereas Euphorbiaceae and Asteraceae are characteristic in modern xerophytic shrubland pollen rain. Concerning the preliminary sedimentary analysis, the type locality "El Gallo" hill of the Tomellín Formation represents a fluvial unit dominantly composed of cobble-pebble conglomerate and coarse- to medium-grained sandstone, which are arranged in decimeter- to meter-thick, lense-shaped bodies that cut into each other both laterally and vertically. Conglomerate deposits are clast-supported, moderately to well sorted, display cross-bedding and imbrication and transitionally grade upward into a cross-bedded sandstone. Locally, conglomerate and sandstone are interbedded with decimeter- to meter-thick tabular bodies composed of rhythmically alternating fine-grained sandstone with ripple-cross-lamination and mudstone with a lower plane lamination developed by suspension settling. This kind of deposits are typical of high-energy and relatively high-gradient fluvial settings like braided rivers and alluvial fans, which are dominantly composed of in-channel conglomerate to sandstone bars that progressively grow downstream during high-water stages and fine-grained deposits accumulated during low-water stages.

Neogene marine palynology in deep water deposits of the Colombian Caribbean Basin

Pinzón, D.^{1*}, Prámparo M.,¹ Rodríguez, G.,² Guerstein, G. R.,³ Vargas, M.C.,² De la Parra, F.,² and Martínez, J.⁴

¹IANIGLA, CCT-CONICET Mendoza, Mendoza, Argentina

²Instituto Colombiano del Petróleo – ECOPETROL, Santander, Colombia

³INGEOSUR–CONICET, Departamento de Geología – Universidad Nacional del Sur, Bahía Blanca, Argentina

⁴Smithsonian Tropical Research Institute, Ancón, Panamá. Instituto de Investigaciones en Estratigrafía – Universidad de Caldas, Manizales, Colombia.

*Corresponding author: dpinzon@mendoza-conicet.gob.ar

The palynology of marine stratigraphic sequences in the Neogene at tropical latitudes is still scarcely studied. The palynological content of 112 samples from ODP Hole 999A and DSDP Hole 502A from the Colombian Caribbean basin was analyzed to improve the knowledge about the spatio-temporal distribution of marine palynomorphs. The age model based on calcareous nannofossils, planktonic foraminifera, and magnetostratigraphic data indicated a continuous record from the Aquitanian to the Gelasian and the Tortonian to the Gelasian in Holes 999A and 502A, respectively. A low palynological recovery from the Early Miocene to the Middle Miocene, and intervals of moderate to good palynological recovery from the Middle Miocene to the Late Pliocene were recorded. The palynological association contains a higher proportion of coastal and neritic dinoflagellate cysts (dinocysts), compared with the oceanic species, together with abundant terrigenous material, in which pteridophyte spores are predominant. The comparison of our fossil records with those found in mid and high latitudes, allow to detect dinocysts with a biostratigraphic potential such as *Quadrina? condita*, *Selenopemphix armagedonnensis*, *Operculodinium janduchenei*, *Minisphaeridium latirictum*, *Trinovantedinium ferugnomatum*, and *Selenopemphix dionaeacysta*. Moreover, *Lejeunecysta interrupta*, *Barssidinium taxandrianum*, *Selenopemphix conspicua*, and *Lejeunecysta hatterasensis* were recorded for the first time in the Neotropical region. The continental palynological assemblages reveal synchronous events with a biostratigraphic potential for regional correlations, and several diachronic events compared to the records from Panama and the zonations of northern South America. These events include *Palaeosantalaceapites cingulatus*, *Psilastephanoporites herngreenii*, *Ladakhipollenites? caribbiensis* and *Echitricolporites mcneillyi*, among others. Our preliminary results highlight the potential of the continental palynomorphs, deposited in deep marine environments, to establish more accurate time correlations with coetaneous continental deposits. Calibration of dinocyst events in future works and their integration with information of continental palynomorphs will increase the temporal resolution of palynostratigraphic schemes in the region and will contribute to reduce the gap for a better understanding of the latitudinal control of dinocyst species.

Plant communities of the Peruvian Desert (14°S) during the late Miocene

Ochoa, D.^{1*} and Montenegro, J-F.¹

¹ Centro de Investigación para el Desarrollo Integral y Sostenibles, Universidad Peruana Cayetano Heredia, Lima, Peru

*Corresponding author: diana.ochoa@upch.pe

The Peruvian-Chilean coastal desert is one of the driest places on Earth. The existence of this hyperarid ecosystem is associated with the establishment of the northeasterly trade winds and the northward-flowing Humboldt Current, which in conjunction bring cold and nutrient-rich deep waters to the surface and prevent rain-bearing air masses from forming. During the late Miocene-early Pliocene, however, climatic conditions in the southeastern Pacific resembled those of the present-day El-Niño with permanent warm sea surface temperatures and a possible weaker Humboldt Current. The paleontological record further indicates that organisms with tropical to sub-tropical affinities (*e.g.*, crocodiles, sirenians, chondrichthyans, gastropods, bivalves, and corallites) inhabited the Peruvian-Chilean coastal-marine ecosystems. It is yet unknown how the terrestrial ecosystems and landscapes looked like during the Mio-Pliocene. The lack of continental records prevents understanding the response of the coastal hyperarid ecosystems to the warm-climate conditions of the Mio-Pliocene.

During our last field trip (April 2021), our research group discovered several levels with abundant and well-preserved vegetal remains associated with the costal-marine Pisco Formation (East Pisco Basin, Peru; 14°S). The unearthed fossil material includes palynomorphs, leaves rest and wood fragments. To this date, we have been able to identify a plant community without modern analog, which is dominated by angiosperm elements related to the Rosaceae (*Sanguisorbeae*, *Acaena*-type), Malvaceae, and Asteraceae families, coexisting with herbs (*Amaranthaceae*, *Polygonaceae*), palms (*Arecaceae*), grasses (*Poaceae*), gymnosperms (*Podocarpaceae*, *Araucariaceae*), and ferns (*Polypodiaceae*, *Pteridaceae*). These findings constitute the first evidence of a plant community living on the Peruvian coasts and will be key to reconstruct the paleovegetation and estimate regional paleoprecipitation conditions during the late Miocene.

Integration of palynological & lithofacies analyses of the Sudanese Red Sea Littoral sediments, NE Sudan

Hamed, S.E.E. and Hassan, A.

¹petroleum geology, Al-Neelain University, Khartoum, Sudan

² Petroleum labs, research & Studies (PLRS), Khartoum, Sudan

[*salma.hamed019@gmail.com](mailto:salma.hamed019@gmail.com)

This study focuses on the lithofacies and palynological analyses of Neogene to Quaternary sequence along the Sundance Red Sea basin.

Sedimentological part of the study: ten sedimentary logs were investigated, eleven facies has been analyzed identified namely massive matrix-supported gravel (Gms), massive gravel (Gm), pebbly sandstone (Sp), massive sand (Sm), horizontally stratified sandstone (Sh), fine laminated mud (Fl), limestone fossiliferous (coquina or lumachelle), white limestone (Wlm), Oolitic limestone and coralline limestone evaporite.

Palynostratigraphy: Forty-eight samples selected from Tokar-1 and Suakin-1 wells, based on the three slides per sample the recovered palynomorphs are generally well preserved and moderately diversified, the recovered palynomorphs are overwhelming of terrestrial origin (spores dominated), a few of brackish water dinoflagellates, secolodonts and freshwater phytoplankton (e.g. pediaturn).

Based on the distribution of 57 species from both Tokar-1 and Suakin, three Palynozones of Neogene age have been designated in ascending order as follow, assemblage Zone 1 (Oligocene –Miocene), assemblage Zone 2 (Miocene), and assemblage Zone 3 (Miocene-Pliocene), the age are based on stratigraphic position and first downhole occurrence (FDO) of key (marker) species such as bombacacidites noremii (Zone 1), polypodiaceoisporites simplex (Zone 2), Chenopodipollis chenopodiaceoids (Zone 3).

Palynofacies Analysis: Four palynofacies unit has been identified based on the visual estimation of kerogen type.

The integration of lithofacies (from outcrops) and palynological (from subsurface) analyses revealed the depositional environment, paleogeography, paleoclimate, and hydrocarbon potentiality for each lithological unit.

DAY 2 ORAL PRESENTATIONS, SESSION 2

Fungi in a Warmer World: A preliminary view of the fungal diversity of Thailand and Slovakia in the Middle Miocene.

Romero, I.C.¹, Nuñez Otaño, N.B.², Spears, T.¹, Fairchild, C.J.¹, Jones, S.³, Tarlton, L.⁴, Belkin, H.E.⁵, Warny, S.⁶, Pound, M.J.⁷, O'Keefe, J.M.K.^{1*}

¹Department of Physics, Earth Science, and Space Systems Engineering, Morehead State University, Morehead, KY 40351, USA.

²Laboratorio de Geología Neógeno-Cuaternario (CICyTTP-Prov.ER-UADER-CONICET) Facultad de Ciencia y Tecnología, Universidad Autónoma de Entre Ríos, Sede Diamante, Argentina.

³Craft Academy for Excellence in Science and Mathematics, Morehead State University, Morehead, KY 40351, USA.

⁴Department of Biology and Chemistry, Morehead State University, Morehead, KY 40351, USA.

⁵U.S. Geological Survey retired, 11142 Forest Edge Dr., Reston, VA 20190, USA.

⁶Center for Excellence in Palynology, Department of Geology & Geophysics, and Museum of Natural Science, Louisiana State University, Baton Rouge, LA 70803, USA.

⁷Department of Geography and Environmental Sciences, Northumbria University, Newcastle upon Tyne NE1 8ST, UK.

*Corresponding author: j.okeefe@moreheadstate.edu

The Middle Miocene Climate Optimum (MMCO) is considered the warmest interval of the last 23 million years and the best analogue for near future climate change scenarios. Fungi play a key role in the terrestrial carbon cycle as dominant decomposers of plant debris. Thus, their study in the fossil record, especially during the MMCO, is essential to better understand biodiversity changes and terrestrial carbon cycle dynamics in past analogous environments, as well as, to model future ecological and climatic scenarios. The fossil record also offers a unique long-term large-scale dataset to evaluate fungal assemblage dynamics across long temporal and spatial scales, providing a better understanding of how ecological factors influenced assemblage development through time. Here, we assess the fungal diversity and community composition recorded in two geological sections from the early Middle Miocene from the coal mines of Thailand and Slovakia. We used presence-absence data to quantify the fungal diversity of each locality. Spores and fungal remains are identified using modern taxonomical names whenever possible, but fossil names are used when this correlation is not possible. This study represents the first of its kind for southeast Asia, and it expands existing work from Slovakia. Our preliminary results indicate the presence of over 180 morphotypes in Thailand, while fewer than half that number of morphotypes in Slovakia. Although impacted by taphonomy, fungal assemblage biodiversity appears to be following predicted latitudinal patterns, as it is higher in the tropics and lower in warm-temperate regions. This work will allow us to use modern ecological data to make inferences about ecosystem characteristics and community dynamics for the studied regions and opens new horizons for the study of past fungal diversity based on modern fungal ecological analyses. It also sheds light on how global variations in fungal species richness and community composition were affected by different climatic conditions and under rapid increases of temperature in the past to make inferences for the near climatic future.

The development of UK Neogene Climate: a comparison of the co-existence approach, Bayesian and probability reconstruction techniques

Gibson, M. E.^{1*}, McCoy, J.¹, O'Keefe, J. M. K.², Nuñez Otaño, N. B.³, Warny, S.⁴ and Pound, M. J.¹

¹Department of Geography and Environmental Sciences, Northumbria University Newcastle, Newcastle upon Tyne NE1 8ST, UK.

²Department of Physics, Earth Science, and Space Systems Engineering, Morehead State University, Morehead, KY 40351 USA.

³Laboratorio de Geología de Llanuras. Facultad de Ciencia y Tecnología, Universidad Autónoma de Entre Ríos, Sede Diamante. CONICET (National Scientific and Technical Research Council), Argentina.

⁴Center for Excellence in Palynology, Department of Geology & Geophysics, and Museum of Natural Science, Louisiana State University, Baton Rouge, LA 70803 USA.

*Corresponding author: Martha E. Gibson (martha.gibson@northumbria.ac.uk)

Little is known about the development of the modern oceanic climate regime of northwest Europe in deep time. During the Neogene (23.03-2.588 Ma), the British Isles had a unique location on the northwest edge of the Eurasian continent forming a peninsula separating the Atlantic Ocean from the North Sea making the Neogene sediments of the UK ideal for understanding the early development of hydrological dynamics and atmospheric circulation. The British geological record is not replete with onshore deposits of Neogene fossiliferous strata. Onshore deposits are limited to the solution pipe fills at Trwyn y Parc in Anglesey (Middle Miocene), the Brassington Formation of Derbyshire (Serravallian-Tortonian), and the Coralline Crag Formation (latest Zanclean-earliest Piacenzian) and Red Crag Formation (Piacenzian-Gelasian) in southeast England. These palynoflora from these localities can be used to provide snapshots into the climate at the time of deposition.

Palaeobotanical-based reconstructions are typically lacking in their poor estimation of statistical error. Therefore, we present the first pre-Quaternary application of two terrestrial climate reconstruction models: CREST (Climate Reconstruction SoftWare) and CRACLE (Climate Reconstruction Analysis using Coexistence Likelihood Estimation), that use Bayesian and likelihood estimation probability respectively to generate 2 σ confidence intervals, generating a new palaeoclimate reconstruction. These two models are compared to reconstructions generated by the widely applied Co-existence Approach to compare the development of oceanic climates to European continental climates.

Our study shows that the UK followed a similar pattern of development to that of continental Europe during the Neogene. Mean Annual Temperature (MAT) declines by 3-6 °C, Mean Annual Precipitation (MAP) declines by 480-600 mm and Precipitation Seasonality approximately halves. The decline in MAT, MAP and Precipitation Seasonality is interrupted by a brief increase throughout the Zanclean and Piacenzian, before resuming into the Gelasian. All three models reconstruct the same general pattern but the Co-existence Approach reconstructs the most exaggerated changes. While the 2 σ confidence intervals for CREST are wide, especially for precipitation, the results of CREST and CRACLE overlap with the Co-existence Approach.

The UK appears to have had a milder, wetter, and less seasonal climate than continental Europe records suggest. This is likely due to the buffering effects of the Atlantic Ocean and North Sea which ameliorated the UK Neogene climate despite regional and global changes in atmospheric and oceanic circulation.

Oceanographic and vegetation changes across the Paleocene–Eocene Thermal Maximum in NW Europe and the Arctic

Mariani, E.¹, Kender, S.^{1,2}, Riding, J.B.², Dybkjær, K.³, Pedersen, G.K.³, Littler, K.¹, Hesselbo, S.P.¹ and Leng, M.J.²

¹ Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn, Cornwall TR10 9FE, United Kingdom

² British Geological Survey, Keyworth, Nottingham NG12 5GG, United Kingdom

³ Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, DK-1350, Copenhagen, Denmark

The Paleocene-Eocene Thermal Maximum (PETM, ~56 Ma) was a global warming event associated with rapid carbon release and consequent atmospheric and oceanic warming. Marine and continental ecosystems were equally affected by the climatic event and underwent substantial changes including migrations, extinctions, radiations and diversification. To investigate environmental changes that occurred before and after the onset of the PETM, we present high-resolution geochemical, isotopic and palynological investigations from two exceptionally well-resolved marine sediment cores located in the central North Sea. Palynological studies (pollen, spore and dinoflagellate cyst assemblages) are used to provide vegetation and oceanographic reconstructions on a regional scale, as well as to establish correlation within sites. We present evidence of rapid and profound environmental changes at the PETM onset in both marine and continental settings. Particularly, we document a shift from gymnosperm-dominated to angiosperm-dominated vegetation and the occurrence of low salinity-high nutrients dinoflagellate cysts. Pre-PETM conditions were never fully re-established during the recovery phase, suggesting that the hyperthermal event had long-term palaeoenvironmental consequences.

Taxa and distribution of dinoflagellate cysts in surface sediments from nearshores of the China Seas

Li, Z.^{1,2,*}, Pospelova, V.^{2,3}, Mertense, K.N.⁴, Liu, L.⁵, Wu, Y.⁶, Jiang, W.^{7,2}

¹ Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, 329 West Mall, Vancouver, British Columbia V6T 1Z4, Canada

² School of Earth and Ocean Sciences, University of Victoria, PO Box 1700 STN CSC, Victoria, British Columbia V8W 2Y2, Canada

³ Department of Earth and Environmental Sciences, University of Minnesota, 116 Church St SE, Minneapolis, MN 55455, USA

⁴ Ifremer, LER BO, Station de Biologie Marine, Place de la Croix, BP40537, F-29185 Concarneau Cedex, France

⁵ First Institute of Oceanography, Ministration of Natural Resources, 6 Xianxialing Road, Qingdao 266061, China

⁶ Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, NS B2Y 4A2, Canada

⁷ School of geographical Sciences, Guangzhou University, Guangzhou 510006, China

*Corresponding author

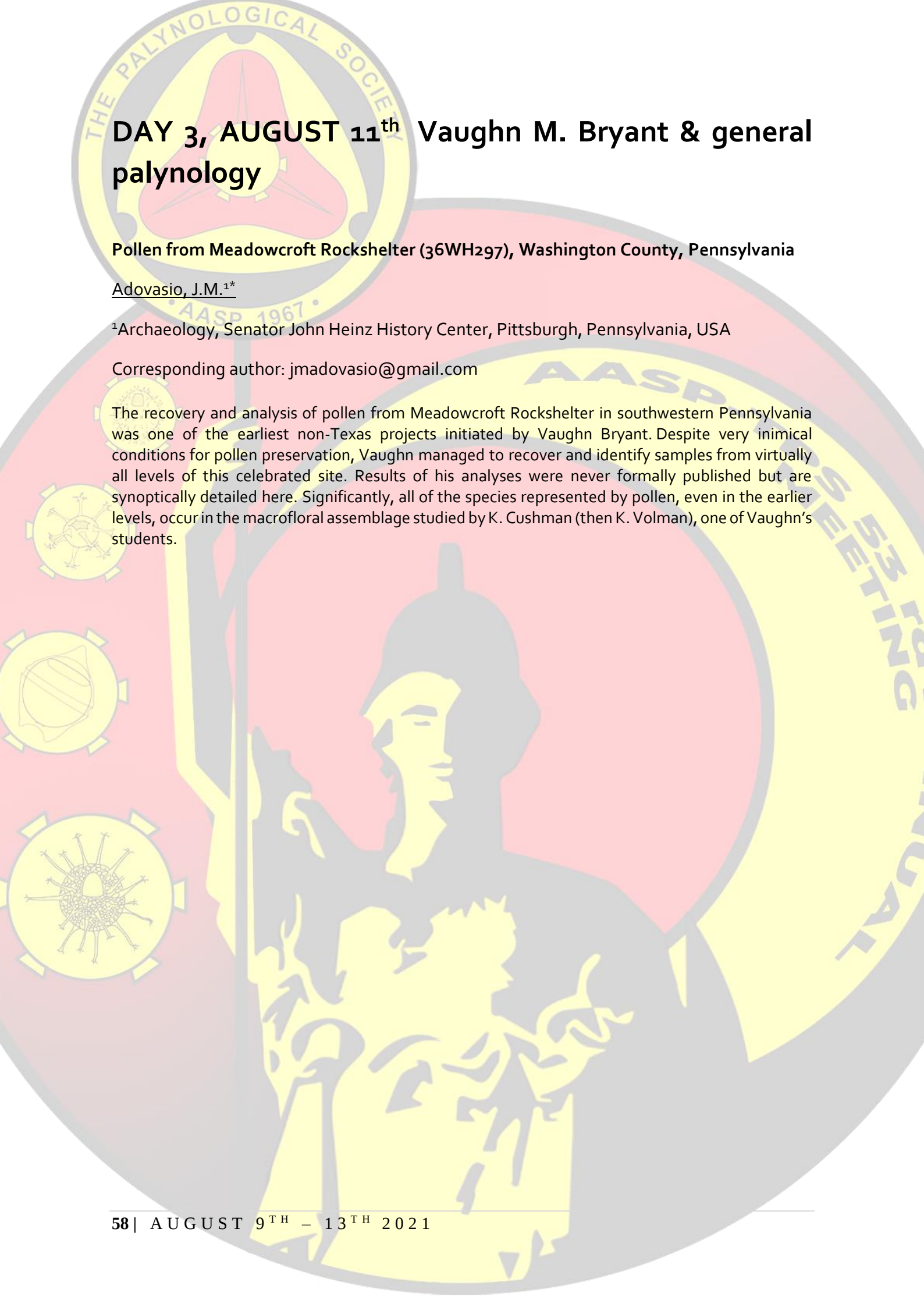
Zhen Li: imlizhen@hotmail.com

or

zhenli@eoas.ubc.ca

This study conducted palynological analysis on 18 surface sediment samples from the Bohai Sea, the Yellow Sea (YS), the East China Sea and the South China Sea (SCS) to know the common taxa of dinoflagellate cysts and their distributions in nearshores of the China Seas. A total of 58 taxa were identified. The highest diversity occurred in the SCS. Concentrations in the YS were the highest with a maximum of 19,332 cysts g⁻¹. Autotrophic taxa *Spiniferites ramosus*, *Spiniferites* spp. or cyst of *Pentapharsodinium* sp. were predominant in the assemblages. Concentrations in other seas were generally less than one-tenth of those in the YS. The assemblages were dominated by heterotrophic taxa *Brigantedinium* spp., cyst of *Protoperdinium* spp., or *Selenopemphix quanta*. Redundancy Analysis results showed that sea surface temperature (SST) was the most significant factor on dinoflagellate assemblages. SST in August positively correlated with the relative abundances of *Brigantedinium* spp., cysts of *Protoperdinium* spp., *Selenopemphix quanta*, *Echinidinium transparantum* and *Selenopemphix neohroides*. Distance to coast was the second significant factor and positively correlated with relative abundances *Spiniferites ramosus*, *Spiniferites elongates* and cyst of *Pentapharsodinium* sp. Dinoflagellate cyst distributions were also influenced by the concentrations of iron ions that positively correlated with *Cryodinium?* spp. and *Votadinium* spp., whereas negatively correlated with most *Spiniferites* species and *Lingulodinium* spp.

Business happy hour 18: 55 BST



DAY 3, AUGUST 11th Vaughn M. Bryant & general palynology

Pollen from Meadowcroft Rockshelter (36WH297), Washington County, Pennsylvania

Adovasio, J.M.^{1*}

¹Archaeology, Senator John Heinz History Center, Pittsburgh, Pennsylvania, USA

Corresponding author: jmadovasio@gmail.com

The recovery and analysis of pollen from Meadowcroft Rockshelter in southwestern Pennsylvania was one of the earliest non-Texas projects initiated by Vaughn Bryant. Despite very inimical conditions for pollen preservation, Vaughn managed to recover and identify samples from virtually all levels of this celebrated site. Results of his analyses were never formally published but are synoptically detailed here. Significantly, all of the species represented by pollen, even in the earlier levels, occur in the macrofloral assemblage studied by K. Cushman (then K. Volman), one of Vaughn's students.

Coprolites and the Ancient Gut Microbiome

Reinhhard, K. J.^{1*}

¹School of Natural Resources, University of Nebraska – Lincoln, Lincoln Nebraska 68583-0987, USA

*kreinhard1@mac.com

Bacteria living in and on our bodies, the microbiome, are more numerous than our own cells. Recent research has traced the changes in the gut microbiome from ancient to modern times. The changes defined modern health problems. These include Crones disease, diabetes, obesity and possibly autism. Recent research combined standard coprolite analysis as defined by Vaughn Bryant with the reconstruction of gut microbiome by molecular biology (*Nature*, 2021, 594:234–239 DOI 10.1038/s41586-021-03532-0).

My part of this study was the analysis of coprolites from Durango, Mexico and two cave samples from southeast Utah. The Durango site dates to 665-770 AD. Dietary analysis showed that the main foods were maize and *Agave*. Squash blossoms were also part of their food source determined by the presence of pollen grains. Other remains included, rodent bones, plant seeds, huitlacoche “mushrooms” and a diversity of beans and collector foods. Some of these foods are retained in current Tarahumara communities.

Boomerang Shelter, Utah dates to 21 BC-127 AD. It contrasts with data from other studies from the Colorado Plateau. Of the nine samples, four stand out in their unique or rare components: greasewood pollen and ricegrass. Only three contained milled maize. The Boomerang Shelter coprolites are consistent with famine foods or diet in areas where maize agriculture is less dependable.

The unnamed Utah site dates to 568-652 AD and provides a representation of typical Pueblo diet. Six of nine samples were maize-based. In some samples, maize was milled to less than 0.5mm. Maize pollen was intentionally collected and eaten. Maize Starch grains were abundant in seven of the samples. In one sample, over a million altered starch grains were evident with 215,000 huitlacoche “mushroom” spores. *Cleome* (beeweed) pollen grains were ubiquitous in the samples. Crush bone, rabbit hair, orthopteran chitin, *Lycium* (wolfberry) seeds, cactus cladode elements, *Sarcobatus* (greasewood) pollen, *Amaranthus* (pigweed) seeds, *Descurainia* (tansy mustard) trichomes and grass caryopses were less common food components.

The microbiome molecular show a significant loss of diversity of species and genes from ancient to modern gut microbiomes. The ancient feces had over 400,000 different bacterial genes compared to 200,000 for modern feces. When bacteria species were identified, ancient samples had more species, some of which were unique to prehistory.

Some of the bacteria finds correlate with microscopic finds. There are unique enzyme/genus connections with specific foods. The chitin CAZymes correlate with the occurrences of insect exoskeleton and *Ustilago maydis* spores. The bifidobacteria relate to reliance on *Agave* inulin and prickly pear pectin oligosaccharides. Therefore, this pioneering paper shows that microscopic methods of food identification are relevant to understanding the transitions from ancient to modern microbiomes, thereby explaining emergent diseases of modernization.

References:

Wibowo, M. C., Yang, Z., Borry, M., Hübner, A.,... Kostic, A. D. 2021. Reconstruction of ancient microbial genomes from the human gut. *Nature* 594(7862), 234–239, DOI 10.1038/s41586-021-03532-0).

Early to middle Holocene subsistence in the Great Basin: coprolite evidence from the Paisley Caves, Oregon.

Blong, J. C.^{1*}, Whelton, H. L.², Jenkins, D. J.³, Bull, I. D.², Shillito, L-M.⁴

¹ Department of Anthropology, Washington State University, PO Box 644910, Pullman, WA, 99164, USA.

² Organic Geochemistry Unit, School of Chemistry, University of Bristol, Cantock's Close, Bristol BS8 1TS, UK.

³ Museum of Natural and Cultural History, University of Oregon, 1680 East 15th Avenue, Eugene, OR 97403, USA.

⁴ School of History, Classics and Archaeology, Armstrong Building, Newcastle University, Newcastle upon Tyne NE1 7RU, UK

[*john.blong@wsu.edu](mailto:john.blong@wsu.edu)

The early and middle Holocene periods in the Great Basin are marked by increasingly warmer and drier conditions, resulting in a reduction of wetlands and significant changes in plant and animal communities. This period also marks a cultural transition from the Western Stemmed Tradition to the Archaic period. Archaeologically, there is evidence for population decline in the middle Holocene, increased reliance on small seeds for subsistence, and associated proliferation of heavy grinding and milling equipment. This transition is typically explained as the emergence of a broad-based subsistence strategy in response to desiccation of wetland resource patches and is sometimes described as a significant departure from previous subsistence and land-use strategies. However, there is evidence that the same plant foods consumed in the Archaic period were also consumed during the Western Stemmed Tradition, suggesting that the apparent difference in subsistence may be one of scale, and not a radical transformation of lifeways. There are also questions about the timing of the shift to a seed-based subsistence strategy and how it maps on evidence for Holocene climate stress. The Paisley Caves, Oregon provide a unique opportunity to investigate existing questions about early to middle Holocene subsistence strategies. Excavations at the caves have produced an assemblage of human coprolites spanning this time period. These coprolites provide an important resource for diachronic study of human occupation and subsistence in the region. This paper presents the results of gas chromatography mass spectrometry fecal biomarker analysis demonstrating human origin for coprolites from the Paisley Caves, as well as plant macrofossil and microfossil analysis of coprolite contents to assess human diet across the early to middle Holocene. This study finds evidence for continuity in consumption of some plant foods from the early to middle Holocene, but also finds evidence for a more diverse range of plant foods consumed in the middle Holocene. The results suggest that there were key plant food species that were relied upon as a secure food source across climate periods and cultural traditions. These results have implications for understanding how small-scale societies maintain food security in periods of climate change.

Diversity in vegetation and fire responses after Pleistocene megaherbivore extinction across the Eastern US

Perrotti, A.G.,^{1,2*} Kiahtipes, C.,³ Russell, J.,¹ Gill, J.,^{4,5} Robinson, G.,⁶ Williams, J.W.²

¹Department of Earth, Environment, and Planetary Sciences, Brown University, USA

² Department of Geography, University of Wisconsin-Madison, USA

³Institute for the Advanced Study of Culture and the Environment, University of South Florida, USA

⁴School of Biology and Ecology, University of Maine, USA

⁵ Climate Change Institute, University of Maine, USA

⁶Department of Biology, Fordham University, USA

*Corresponding author: aperrotti@wisc.edu

Megaherbivores are keystone species in many modern environments, and their removal can cause a cascade of ecosystem changes. Previous research indicates that the terminal Pleistocene extinction of large herbivores such as mammoths and mastodons caused such changes including the formation of plant associations with no modern analog, woody vegetation overgrowth, and an increase in fire activity. Using dung fungal spores as a proxy for large herbivore abundance alongside other environmental proxies such as pollen and charcoal, I investigate the consequences of terminal Pleistocene megaherbivore extinctions across six eastern North American sites. In general, herbivory release in the north-central US co-occurs with or precedes no-analog plant associations, woody vegetation encroachment, and an increase in fire activity. Sites in the southeastern US exhibit mixed signals, indicating that the effects of megaherbivore extinction are diverse across different regions of North America. Ultimately, this data can be used to inform modern ecosystem management through the maintenance or reintroduction of megaherbivory. This research also interprets palynological data within a framework of archaeological, faunal, ecological, and paleoclimatic data, embodying the interdisciplinary nature of Vaughn Bryant's career.

Vaughn Bryant's influence on Peruvian palynology

Paredes, R.^{1*}

¹Departamento de Ciencias Biológicas y Fisiológicas, Universidad Peruana Cayetano Heredia, Ave Honorio Delgado 430, Lima, Peru

*Corresponding author: rossana.paredes@upch.pe

Vaughn Bryant's research contributed to the development of palynology in many countries. His early publications on pollen processing and identification marked a before and after in Peruvian palynology. He influenced Peruvian scholars within melissopalynology and archaeological palynology mostly. He trained the first Peruvian palynologist, helped to build the first palynology and paleoethnobotany laboratory in Peru, published the first honey research from Peruvian samples in an international journal and took peculiar flights from Puno to Texas with a suitcase full of coprolites. Vaughn left a clear path to continue to investigate on coastal, Andean and Amazonian palynology.

Melissopalynology of honey produced adjacent to a South Carolina biodiversity hotspot

MacFawn, D.E.¹, and O'Keefe, J.M.K.^{2*}

¹South Carolina Beekeepers Association, 205 Ridgecreek Dr., Lexington, South Carolina, USA

²Department of Physics, Earth Science, and Space Systems Engineering, 404-A Lappin Hall, Morehead State University, Morehead, KY, USA

*Corresponding author: j.okeefe@moreheadstate.edu

Melissopalynology is widely used globally for determining the floral origin of honey, honeybee foraging behaviors, and monitoring actual bloom times. Despite decades of research by isolated laboratories, it remains an under-utilized tool in the United States, especially for examining changes in bloom time and monitoring honeybee foraging behaviors. This study presents a year-long snapshot of bloom times of bee plants and bee nectar foraging behaviors in and near the Congaree National Park, a major biodiversity hotspot in South Carolina. Nectar flow began in February and the first surplus honey above the brood box was observed the third week of March, 2020. Sufficient was present that the first 5-cm square of honey-bearing comb was collected for analyses in late March. The last square of comb for the year was collected at the end of October, 2020. Nectar flow was low and no surplus honey was produced between the end of June and the middle of October. Of the 72 documented bee plants in the region, pollen from 24 occurred in honey samples collected during the spring-early summer and fall nectar flows. An additional 38 pollen types previously undocumented in South Carolina honeys were found. Early spring honey was rich in *Nyssa* sp., *Salix* sp., and *Cephalanthus* sp. pollen. *Ilex* sp. pollen was present from mid-April through early May; *Liriodendron* sp. and *Ligustrum* sp. pollen were both common in honey from the first half of May. Brassicaceae pollen were present primarily in the first part of June. While the autumn nectar flow did contain some pollen considered typical for the season, including *Artemisia* sp., *Urtica* sp., and *Ribes* sp., it was dominated by taxa more typical for June and entirely lacked the typical autumn-blooming Asteraceae frequented by bees in this region (*Ambrosia* sp., *Eutrochium* sp., and *Solidago* sp.). *Acer* sp., Brassicaceae, *Trifolium* sp., *Liriodendron* sp., *Ilex* sp., *Lonicera* sp., pollen first appeared in samples at or after the published initial bloom times and continued beyond the published last bloom times. *Rhus* sp., *Mimosa* sp., and *Solidago* sp. first appeared before the published bloom times, and in the case of *Mimosa* and *Solidago*, had ceased to occur in the samples prior to their published bloom times. It is clear from this study that published bloom date ranges are inaccurate and need to be revised, as does the published list of bee plants for South Carolina.

Key Note: Kristin D. Sobolik¹

Vaughn M. Bryant: Words of Wisdom, Lessons Learned, and a Life Well Lived.

¹Office of the Chancellor, University of Missouri-St. Louis, USA.

Vaughn M. Bryant was a true interdisciplinary scholar, someone who welcomed and sought information, ideas, and processes from across scientific disciplines to obtain different ways of viewing the world and the past. These diverse viewpoints and ideas are apparent in the hundreds of publications he has authored and in the directions he has taken throughout his scientific career, from botany, geology, palynology, archaeology, and forensic honey research, to teaching, advising, and mentoring, and even into administration where he served a short stint as department chair for 24 years. Vaughn was a major contributor and scientific game changer for more than 50 years, helping pioneer and develop the fields of paleoethnobotany, coprolite analysis, and forensic palynology, with publications disseminated broadly throughout the top scientific venues including *Science*, *Ecology*, *Proceedings of the National Academy of Sciences*, *Quaternary Research*, *Forensic Science International*, and *Palynology*, as well as more popular venues such as *Dig Magazine*, *Odyssey*, and media including CBS News, FOX News, BBC, 3-2-1 Contact, and the Today Show.

Vaughn's greatest accomplishments, however, are in the thousands of undergraduate students he has taught and the graduate students he has mentored and who carry on the torch of his knowledge, teaching, productivity, professionalism, humanism, and overall life philosophies. Vaughn chaired or co-chaired dissertations of more than 40 doctoral students. Many went on in archaeology, and others focused their research on the use of botanical skills and pollen analyses in geology, geography, entomology, agriculture, and forensics. Still others took the life skills that Vaughn helped instill and are making productive lives in a number of diverse careers.

Vaughn is the epitome of a life well lived. He is lauded as a pioneer, game-changer, and leader in his profession. He has received numerous awards from Texas A&M University where he taught for 50 years, as well as the Fryxell Award for Outstanding Botanical Research in Archaeology presented by the Society for American Archaeology, and the Distinguished Service Award, the Honorary Membership Award, and the Medal for Scientific Excellence from his beloved American Association of Stratigraphic Palynologists, for whom he served as President from 1994-95. Vaughn's 60-year marriage to Carol, their three children, numerous grandchildren, and precious dogs were the love of Vaughn's life. This keynote will encompass Vaughn's life and impact, with Vaughn's words of wisdom, life's lessons, and numerous photos along the way. He is surely missed, and his impact is immense.

Everything's sweeter in Texas? A chemical and palynological analysis of honey in Texas

Lau, P. L.^{1*}, Bryant, V.M.², Dübbecke A.³, and Rangel, J.¹

¹Entomology, Texas A&M University, 2475 TAMU, United States of America

² Texas A&M University, 340 Spence Street, United States of America

³Quality Services International GmbH, 28199 Bremen, Germany

*Corresponding author: plau0168@tamu.edu

Honey bees (*Apis mellifera*) use nectar as their main source of energy to fuel colony growth and development. Nectar is converted to honey, which is increasing in demand for their health benefits in humans. Understanding the floral resources collected by colonies in different regions will aid in the promotion of plant species to enhance honey bee colony health and honey production. The significance of this research is two-fold. First, this study will help us identify and promote important plant species that honey bees forage on. This study will also help local beekeepers by establishing a baseline for detecting adulterated honey, as honey is commonly mixed with foreign products to improve economic yield. We conducted a palynological analysis of 119 honey samples provided by participating beekeepers whose colonies were located throughout Texas. The pollen in each honey sample was extracted, acetolyzed, identified, and classified in frequency categories depending on each taxon's relative abundance. The water content, pH, and sugar spectrum were also analyzed with Nuclear Magnetic Resonance (NMR) spectroscopy. We have found at least 121 unique pollen types in honey including *Triadaca*, *Mimosa*, *Ulmus*, *Prosopis*, and *Rhus* (Figure 1). The water content in honey ranged from 14% to 20.6%, the pH ranged from 3.6 to 5.4, and the combined fructose and glucose content ranged from 50.7% to 77%. This information will help us better understand honey bee nectar foraging preferences in their environment. This will also serve as a foundation for future studies on promoting pure, unadulterated honey.

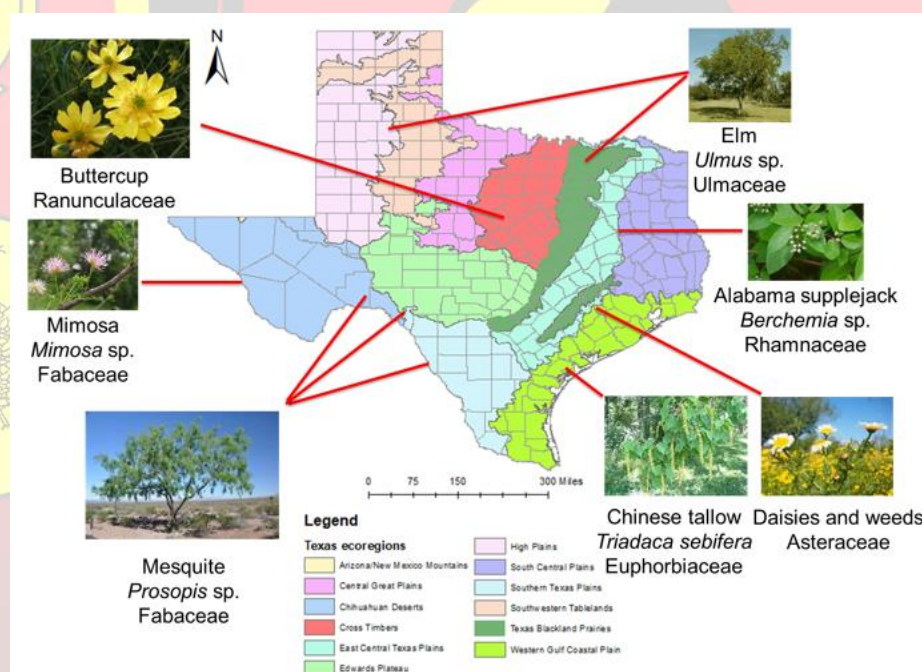


Figure 1: Notable taxa detected in honey from different ecoregions in Texas within Texas.

Vaughn Bryant: the versatility of pollen

Briles, C. E.^{1*}

¹Geography and Environmental Sciences, University of Colorado Denver, 1200 Larimer St. Denver CO 80217, USA

*Corresponding author: christy.briles@ucdenver.edu

Vaughn Bryant taught me the versatility of pollen. When I began my 2-year postdoctoral position (2009-2010) with Vaughn, I only knew western US anemophilous pollen types as my training had been in paleoecology. The postdoc with Vaughn was funded by three of the top federal crime agencies and involved refining pollen identification techniques used to track criminals in the Middle East. One significant aspect of the project involved sampling and analyzing pollen from comparable environments to the Middle East in the US. The second project involved the agencies testing our ability to identify the location of where several articles of clothing had traveled. We were tested against another group using DNA to get species level identifications. While I did not get to work on any of the authentication studies of honey, the forensic palynology work I conducted allowed me to transfer and apply skill sets in that arena. Once I started my academic positions at Monash University in Australia and the University of Colorado at Denver, I used the experiences I gained from working with Vaughn to develop a diverse research program where pollen was one of the main tools. In this talk, I will discuss the projects I worked on with Vaughn and how they shaped my current research agenda. Vaughn taught me to be resourceful and to not shy away from what others might see as impossible or unimportant. He also had more energy than most that I knew, which stemmed from his passion for palynological research and training others in the arena.



Figure 1. Vaughn Bryant and Christy Briles--Thanksgiving 2009 in College Station, Texas.

Using museum pelt collections to generate pollen prints from high-risk regions: A new palynological forensic strategy for geolocation

Warny, S.¹, Ferguson, S.^{1,2}, Hafner, M.S.³ and Escarguel, G.³

¹Department of Geology and Geophysics, E235 Howe-Russell, Louisiana State University, Baton Rouge, LA, 70803, USA; Museum of Natural Science, 109 Foster Hall, Louisiana State University, Baton Rouge, LA, 70803, USA.

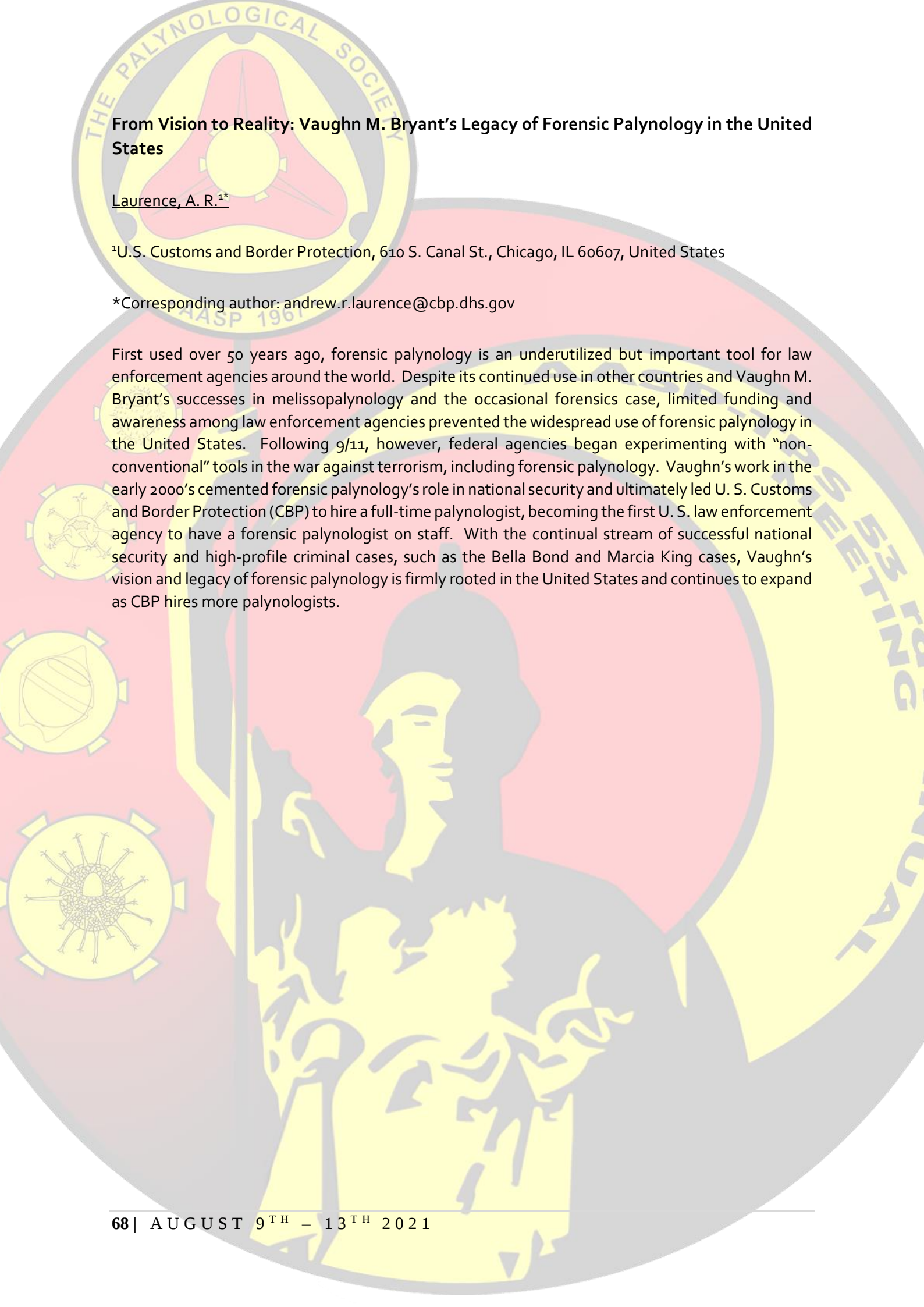
²Department of Homeland Security, Chicago, USA.

³Museum of Natural Science, 109 Foster Hall, Louisiana State University, Baton Rouge, LA, 70803, USA.

⁴Laboratoire d'écologie des hydrosystèmes naturels et anthropisés, UMR CNRS 5023, Université Claude Bernard Lyon 1, Boulevard du 11 novembre 1918, F69622, Villeurbanne Cedex, France.

*Corresponding author: swarny@lsu.edu

The use of pollen as a forensic tool for geolocation is a well-established practice worldwide in cases ranging from the provenance of drugs and other illicit materials to tracking the travel of individuals in criminal investigations. It was mainly developed in the United States thanks to the tireless work of Ddr. Vaughn Bryant. Here we propose a novel approach to generation of pollen databases that uses pollen vacuumed from mammal pelts collected historically from international areas that are now deemed too high risk to visit. We present the results of a study we conducted using mammal pelts collected from Mexico. This new investigative technique is important because, although it would seem that the ubiquitous and geo-specific nature of pollen would make pollen analysis among the most promising forensic tools for law enforcement and intelligence agencies, it is not the case. The process is notoriously slow because pollen identification is a tedious task requiring trained specialists (palynologists) who are few in number worldwide, and the reference materials necessary for geolocation usually are rare or absent, especially from regions of the world that are no longer safe to visit because of war or threat of terrorism. Current forensic palynological work is carried out by a few highly trained palynologists who require accurate databases of pollen distribution, especially from sensitive areas, to do their jobs accurately and efficiently. Our project shows the suitability of using the untapped museum pelt resources to support homeland security programs. This first palynological study using museum pelts yielded 133 different pollen and spore types, including 8 moss or fern families, 12 gymnosperm genera and 112 angiosperm species. We show that the palynological print from each region is statistically different with some important clustering, demonstrating the potential to use this technique for geolocation.



From Vision to Reality: Vaughn M. Bryant's Legacy of Forensic Palynology in the United States

Laurence, A. R.^{1*}

¹U.S. Customs and Border Protection, 610 S. Canal St., Chicago, IL 60607, United States

*Corresponding author: andrew.r.laurence@cbp.dhs.gov

First used over 50 years ago, forensic palynology is an underutilized but important tool for law enforcement agencies around the world. Despite its continued use in other countries and Vaughn M. Bryant's successes in melissopalynology and the occasional forensics case, limited funding and awareness among law enforcement agencies prevented the widespread use of forensic palynology in the United States. Following 9/11, however, federal agencies began experimenting with "non-conventional" tools in the war against terrorism, including forensic palynology. Vaughn's work in the early 2000's cemented forensic palynology's role in national security and ultimately led U. S. Customs and Border Protection (CBP) to hire a full-time palynologist, becoming the first U. S. law enforcement agency to have a forensic palynologist on staff. With the continual stream of successful national security and high-profile criminal cases, such as the Bella Bond and Marcia King cases, Vaughn's vision and legacy of forensic palynology is firmly rooted in the United States and continues to expand as CBP hires more palynologists.

DAY 3 LIGHTNING TALKS, VAUGHN M BRYANT

“Goldilock Palynomorphs” and the Three Geologic Structures: A Tale of Meteorite Impact

Spencer, M.K.^{1*}, Oboh-Ikuenobe, F.E.¹ and Warny, S.²

¹Department of Geosciences and Geological & Petroleum Engineering, Missouri University of Science and Technology, Rolla, Missouri, USA

²Department of Geology & Geophysics and Museum of Natural Science, Louisiana State University, Baton Rouge, Louisiana, USA

*Corresponding author: mksb7d@mst.edu

Impact-damaged acritarchs at correlatable horizons in three aligned geologic structures (Crooked Creek, Decaturville, and Weaubleau) in southern Missouri (USA), and coincident to $40\text{Ar}-39\text{Ar}$ ages from Crooked Creek impact spherules (485.4 ± 9.1 Ma), provide support for a suspected coeval timing of impact. The sudden and intensely damaging processes during and following meteorite impact disrupt and complicate stratigraphy. These processes may also cause alteration or destruction of biota. Damage to palynomorphs such as breakage, abrasion, and loss of ornamentation can result from oxidation and other processes, but extreme conditions during impact events produce unique damage such as surface melting and alteration, in addition to fusing of processes. This distinctive damage may be used to infer temporal and areal proximity of the palynomorphs to the impact, but may also render identification of palynomorphs difficult. To enable their utility for inferring the timing of impact, the palynomorphs must be uniquely damaged enough to be linked to the event, but not too damaged to be identifiable; thus, they are herein termed “Goldilock palynomorphs.” Although palynomorphs representing various ages (Cambrian to Holocene) occur in each of the three structures, the youngest of these characteristically damaged acritarchs may attest to their presence at impact and be used to infer the timing of the latest meteorite event.

DAY 3 LIGHTNING TALKS

Pollen morphology of 18 species of *Mimosa* (Leguminosae)

Liau-Kang, S.^{1,2*} and Borges, eL.²

¹Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, University of São Paulo, 3900 Bandeirantes Avenue-Ribeirão Preto, Brazil

²Departamento de Botânica, Federal University of São Carlos, Washington Luiz Road km 235 São Carlos, Brazil

*Corresponding author: stefanyliaukang@gmail.com

The pollen diversity of *Mimosa*, one of the most diverse genera of Leguminosae, is known only to one-fifth of its more than 500 species. The species already studied present variability as for the dispersion units, grain disposition, ornamentation, and size, mainly. For example, the dispersion unit in *Mimosa* can be tetrads (4 cells), in smaller amounts of 8 cells and rarely the polyads of 12 to 16 cells. But also, the dispersion units have general variation in the arrangement of the cells. In this work, we studied for the first time the pollen morphology of 18 species of *Mimosa*, treated with acetolysis with modifications to avoid deformation or disaggregate the polyads, for later optical microscopy. We observed small-sized ellipsoidal tetrahedral tetrads in *M. paludosa*, *M. monidea*, *M. laticifera*, *M. oedoclada*, *M. dryandoides*, *M. adenocarpa*, *M. adenotricha* and *M. cruenta*. Ellipsoidal and small-sized strains in *Mimosa strobiliflora*, *M. myrioglandulosa*, *M. invisa* var. *macrostachya* and *M. acantholoba*. In the case of *Mimosa diplotricha* var. *diplotricha* observed rhomboidal tetrads, ellipsoidal shape, and median size, being those of larger size within the studied species (30 -40µm). On the other hand, we observe *M. aurivillus* var. *aurivillus*, has tetragonal and rarely tetrahedral tetrads, with spheroidal shape and small size (11 -15µm). Distribution with 8 cells has been observed in *M. Ceratonia* var. *pseudo-obovata*, but it has polymorphism as it also has 4-cell arrangements. In *M. foliolosa* subsp. *brevibractea* var. *paranani*, we observe rhomboidal and rarely tetrahedral tetrads of ellipsoidal shape and small size. Finally, in *M. foliolosa* var. *pachycarpa*, we observed rhomboid tetrads varying in being smaller (15 -22µm). The ornamentation of the exine may be areolate, reticulated, and rarely psilate. Our results agree with that previously studied by other authors: the genus *Mimosa* presents tetrads as main dispersion unit, with a few exceptions (8, 12 or 16 cells), varying in the disposition of cells and size of polyads. Finally, our work will add knowledge about the morphology of polyads genus *Mimosa*, and we hope that it can fill the existing gaps to better understand the evolution of characters in the group.

Unveiling the diversity of pollen morphology of Fabaceae species from Cerrado forest fragments, Brazil

Soares, E. L.^{1*}, Landi, L. A. D. C.¹, Souza, C. N.¹ and Gasparino, E. C.²

¹Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

²Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*Corresponding author: eduardolsoares@usp.br

Fabaceae are considered the third largest family of Angiosperms, with 751 genera and 19,500 species, belong to the order Fabales together with Quillajaceae, Polygalaceae and Surianaceae families. The present study aimed to describe the pollen morphology of 40 species of 21 genera, belonging to the subfamilies Caesalpinioideae (including Mimosoid clade), Cercidoideae, Detarioideae and Dialioideae native in Cerrado forest fragments of the northwest of São Paulo state, Brazil. The pollen materials were obtained from exsiccatae deposited in Brazilian herbaria. The pollen grains were acetolysed, measured ($n=25$) and photographed in light microscopy and in scanning electron microscopy. The pollen data were described qualitatively and the quantitative data were subjected to statistical analysis. The analyzed species of Fabaceae present pollen grains in monads, tetrads or polyads. The monads are isopolar; small to very large; circular to subtriangular amb; very small to large polar area; oblate to prolate; 3- or 5-colpate, 3-colporate, angulaperturate, fossaperturate, planaperturate or subplanaperturate, colpi very short to very long and narrow to wide; circular, lalongate or lolongate endoaperture, costate or not; exine tectate, psilate or scabrate; or semitectate, microreticulate (hetero or homobrochate) or reticulate (hetero or homobrochate); exine thick or thin; sometimes with clavae, gemmae and verrucae; the sexine is thicker than nexine or nexine thicker than sexine. The tetrads are tetrahedral and acalymmate with pollen isopolar; medium size; circular amb; small polar area; suboblate; 3-colporate, angulaperturate, coaperturate; endoaperture not evident; exine semitectate, reticulate heterobrochate, exine thin; sexine almost three times thicker than nexine. The polyads of the mimosoid clade are circular, semicircular or elliptical in front view, circular or elliptical in side view; acalymmate or calymmate; with 8 to 30 pollen grains; with pollen 3-, 4-, 5- or 10-porate; exine tectate with psilate, psilate-foveolate or rugulate ornamentation; or semitectate with areolate or areolate-fossulate ornamentation; sexine two to three times thicker than nexine. The descriptions along with the quantitative data performed here confirm the eurypalynous character of Fabaceae, demonstrating the diversity of pollen morphology of this family in relation to the pollen unit, amb, shape, type, number and details of apertures, and type of ornamentation.

Palynological study on *Allium* L. (Amaryllidaceae) in the Flora of Egypt

Nour, I. H.^{1*}, Hamdy, R. S.², Osman, A. K.³ and Badry, M. O.³

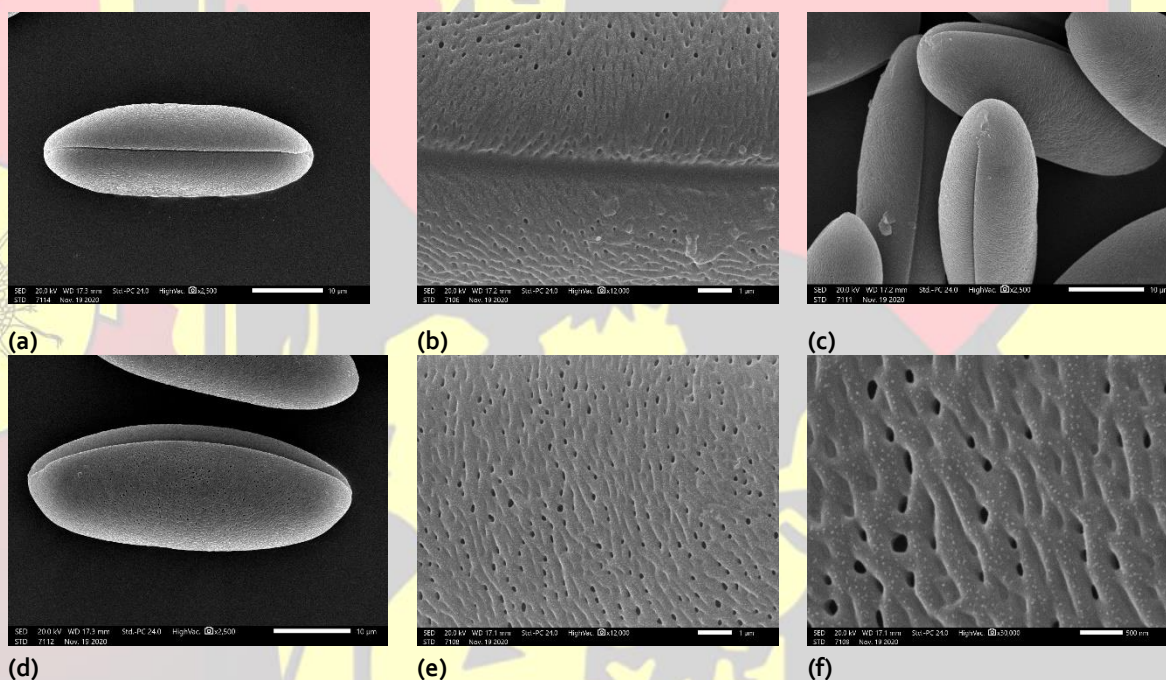
¹Botany and Microbiology Department, Faculty of Science, Alexandria University, Alexandria 21511, Egypt.

²Department of Botany and Microbiology, Faculty of Science, Cairo University, Giza 12613, Egypt.

³Department of Botany and Microbiology, Faculty of Science, South Valley University, Qena 83523, Egypt.

*Corresponding author: Iman-Hassan@hotmail.com

Pollen morphology of 22 taxa of *Allium* (Amaryllidaceae, Alliioideae, Allieae) from Egypt was studied comprehensively by scanning electron microscopy. Twenty Two quantitative and qualitative traits were recorded for the studied taxa. *Allium* pollen grains are monads, heteropolar, with bilateral symmetry, monosulcate, small to medium-sized ($P=10.44-29.76\ \mu\text{m}$, $E=18.97-59.24\ \mu\text{m}$). The pollen shape is oblate to peroblate ($P/E=0.29-0.73$). The sulcus may be anasulcate, meridionosulcate, or subzonasulcate. The sulcus ends are rounded, blunt, undulated, or sometimes pointed. The exine ornamentation differs between poles and equator, as well the density of perforations in a unit area ($5 \times 5\ \mu\text{m}^2$). The exine ornamentation is regulate, regulate-granulate, regulate-striate, regulate-striate-granulate, or striate-granulate. The performed multivariate analyses emphasize that the pollen morphology is not taxonomically significant at the sectional levels, but it is useful for understanding the morphological diversity at the species level. Dichotomous keys based on pollen morphological data are also given.



Exine morphology and ultrastructure of selected *Aratrisporites* species

Koblova, S. D.^{1*} and Schneebeil-Hermann E.²

¹Department of Higher plants, Lomonosov Moscow State University, Moscow, Russian Federation

²Paläontologisches Institut und Museum, Zurich, Switzerland

*Corresponding author: koblovasofya521@gmail.com

Spores of *Aratrisporites* have been reported from isoetalean strobili. We have studied the exine morphology and ultrastructure of dispersed spores of *Aratrisporites*. Spores of the genus were widespread throughout the Triassic. Particularly, they are abundant in Triassic sediments of the northwestern part of the Salt Range of Pakistan, the Nammal gorge. Stratigraphically, the specimens come from the Spathian. The spores were sequentially studied under LM, SEM and TEM. The examined species include *A. paenulatus*, *A. strigosus*, *A. major*, and *A. fischeri*. SEM study elucidated the following traits of the species. The surface of *A. paenulatus* spores is microreticulate, granulate, proximally gemmate and distally echinate; echini are larger at the equatorial margin; the mean distance between the elements is 2.5 µm. The surface of spores of *A. strigosus* is also microreticulate and granulate; sculptural elements include gemmules and occasional microechini (equatorially), and the mean distance between them is 1.5 µm. Spores of *A. major* possess a microreticulate and granulate surface, small gemmules (1 µm) are present and the echini are absent. Spores of *A. fischeri* and *A. paenulatus* were inspected under TEM. The exosporium of all featured spores is subdivided into three distinct layers: a seemingly homogenous external layer, 100 nm thick, a spongy middle layer, formed by numerous intersecting lamellae, each 50 nm thick, and a homogenous inner layer, 200 nm thick. A cavum is formed within the middle layer. All elevations of the surface, including echini and labrum, are formed by the external and middle layers simultaneously. We have detected a laminated zone in the proximity of the laesura in a specimen of *A. fischeri*. The inner layer becomes about three times as thick and is split into numerous lamellae, similarly to laminated zones described in spores of several extant and fossil heterosporous lycophytes.

The study was supported by the Russian Foundation for Basic Research, project #19-04-00498, and by the Paleontological society International Research Program, The Sepkoski Grant.

Wall ultrastructure of miospore *Maiaspora* from the Late Visean of European Russia

Mamontov, D.A.^{1*}

¹Lomonosov Moscow State University, Faculty of Geology, Department of Palaeontology, 119234, Leninskie gory 1, Moscow, Russian Federation

*Corresponding author: palynologist.dm@mail.ru

Dispersed monotype genus *Maiaspora* Mamontov, McLean, Orlova, Gavrilo, 2021 from Late Visean of European Russia comprises rare trilete miospores with triangular-concave or triangular outline and delicate metareticuloid sculpture. This complex ornament incorporates both the polygonal muri and the circular scrobiculae at the base of the lumina. Such sculptural surface has been detected only on the few in situ spores from the Moscovian of the Czech Republic and North France. On the one hand, suggestions of miospores affinities based on morphological comparison with in situ spores. On the other hand, morphological similarities between miospores and microspores often reflect some sort of convergence rather than a natural link to parent plants. However, reliable evidence of relations between micro- and miospores is inferred only from the comparison at the ultrastructural level. Unfortunately, the ultrastructure of the metareticuloid dispersed spores remains uncertain. Therefore, the main purpose of this contribution is to study the ultrastructural details for the sporoderm organization of *Maiaspora* to elucidate its natural relationships. Studied miospore specimens of *Maiaspora panopta* were collected from the sample MS-7 of upper Visean (middle Mississippian) from Kaluga Region (Moscow syncline). All material was prepared and analyzed using LM (Light Microscopy), SEM (Scanning Electron Microscopy) in the Department of Palaeontology (Lomonosov Moscow State University (MSU)), and Borissiak Paleontological Institute of Russian Academy of Science. Individually picked miospore specimens were cut on a diamond knife. Ultrathin sections were stained with uranyl acetate followed by lead citrate solution, then examined using TEM (Transmission Electron Microscopy) in the Electron Microscopy Laboratory of the Biological Faculty (EMLBF) of MSU. TEM analysis of ultrathin sections through the *Maiaspora* revealed a 'specialized' level of exospore organization. It is characterized by a well-developed proximal flange (= kyrtome-like bands) with a distinct foliated substructure of the middle exospore layer. The exospore is three-layered (inner, middle, and outer layers) between the aperture and flange in contrast with the two-layered (inner and outer layers) structure that continues outside of the flange up to the distal pole. This remarkable spore ultrastructure is shared exclusively by modern primitive families of leptosporangiate ferns: *Gleicheniaceae*, *Matoniaceae*, and *Dipteridaceae*. However, none of them produce a metareticuloid exospore surface. In the *in situ* record, only microspores of fructifications *Radiiithea dobranyana* from the Moscovian (Brousmiche-Delcambre *et al.* 1997) display a close correlation with *Maiaspora* in the ultrastructure and sculpture features. Thus, the discovery of 'specialized' three-layered exospore in *Maiaspora* allows us to introduce the earliest record (Late Visean) of *Gleicheniaceae* based on the ultrastructure evidence. The study was supported by the Russian Foundation for Basic Research No 19-04-00498. The author thanks Svetlana V. Polevova and Julia V. Kupriyanova from EMLBF for their invaluable assistance with the preparations miospore material for TEM. Reference: Brousmiche-Delcambre, C., Lugardon, B., Coquel, R., Goubet, P. 1997. Decouverte dans le bassin Houiller Sarro-Lorrain du genre *Radiiithea* (organs reproducteurs de Filicophytes) et ultrastructure du genre *Microreticulatisporites*. *Geobios* 30, 3–14 [In French]

Co-existence of communities of *Apis cerana indica* Fabricius and *Xylocopa* sp in the same vicinity- A pollen based test study in plant-pollinator interactions

Ayyanar, I.,¹ Jean, L.,² Anand, G.,³ Srinivasan. S.,¹ Das, L.² and Krishnamurthy, A.¹

¹Laboratory of Palynology & Paleoecology, Department of Ecology, French Institute of Pondicherry, No.11, Saint Louis street, Puducherry, India

²Project Eco-lake, Sri Aurobindo International Centre of Education, Puducherry, India

³Department of Agricultural Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India.

*Corresponding author: indhuayyanar@ifpindia.org

Species compete for resources that are limited in their landscapes. Some key nutritional resources for pollinators are nectar and pollen from flowers in exchange for pollination services. Species coexist because they use different resources or use them in a different way. This combination of resources is called as "ecological niche" of a species. There are two categories of pollinators, the specialist (oligolectic) with a narrow niche or the generalist (polylectic) with wider range of resources. Honey bees are generalists, and by analysing the pollen carried by them one may understand the source vegetation that produced the flowers that yielded the pollen as well as their seasonalities. In other words, the flowers visited by the pollinators around a year may yield crucial information on their responses to seasonal and landscape dynamics. With this basic Understanding and as part of a pilot project focusing on "Protection of pollinators and Agro ecological Transition in the Pondicherry Region" ([POLLIN](#)) in Southern India, this study seeks to explore the co-existence of two bee species- Carpenter bees (*Xylocopa* sp.) and the Indian Honey bee (*Apis cerana indica* Fabricius) in a favourable niche. The study was carried out in a small urban garden in the French Institute of Pondicherry (11°56'13.80"N, 79°50'9.50"E), in Puducherry, South India with diverse (heterogeneous) plant species where wooden bee hive boxes with removable frames having a slit (entrance) were installed, in which the Indian honey bee (*A. cerana indica* Fabricius) had been introduced in February 2020. Using a queen gate and a paint brush with soft bristles the pollen loads from the hind legs of the honey bees were collected and studied at regular intervals on a weekly basis. In April 2021, carpenter bees (*Xylocopa* sp.) were found in close proximity to the previously (*A. cerana indica* Fabricius) hives, inside holes on bamboo plants that occurred barely a metre away from the box hive. To know the relative foraging behaviour of these two bee species, pollen samples were collected from outside the holes where the carpenter bees resided using a clean brush, usually in the mornings as both the bee species were morning foragers. The collected samples were acetolysed and observed under a light microscope at x400 magnification and studied. We present here the results from our preliminary exploratory study. Among the pollen spectrum analysed so far, the predominant and similar pollen taxa found in both the bee species were, in descending order of relative proportions *Peltophorum*, *Calophyllum*, *Leucaena* and Bignoniaceae. The same analysis is to be continued further for the remaining months to understand the foraging patterns and especially the overlap in the resources they utilize. It is of interest that generally these two pollinators exhibit different foraging behaviours, in the sense that buzz pollination is exhibited only by *Xylocopa* sp. However, here they are apparently coexisting in a niche and possibly sharing floral resources. Subsequently we saw another bee (*Ceratina* sp) within the same vicinity. At a time when pollinators are facing a threat globally due to many reasons, we hypothesize that introduction of the native honeybee by creating a favourable niche for them could bring back other pollinators too, but this requires further observations and data collection.

DAY 3, ORAL PRESENTATIONS, SESSION 2

Marine deposition in the up-dip Wilcox of eastern Texas: age control and paleoenvironmental implications.

Demchuk, T. D.^{1*}, Denison, C. N.², Flaig, P. P.³, Ambrose, W. A.⁴ and Campion, N.⁵

¹Petrostrat, 1544 Sawdust Road, Suite 506, The Woodlands, Texas 77380, USA

²Astra Stratigraphics, 501 Lone Star Road, Bastrop, Texas 78602

^{3, 4}Bureau of Economic Geology, University of Texas at Austin, University Station, Box X, Austin, Texas 78713, USA

⁵PetroStrat Ltd, Tan-y-Graig, Parc Caer Seion, LL32 8FA, Conwy, Wales, United Kingdom

[*chris.denison@earthlink.net](mailto:chris.denison@earthlink.net)

In Texas, recognition of tidally-dominated deposits at outcrop and in the subsurface in the Wilcox (Paleocene) interval, is displacing long-held views that fluvial depositional processes were pervasive. New palynological and sedimentological data from 1730 ft (~530 m) of slabbed core from Leon County, eastern Texas, provide further evidence for tidal influences. In this core, repetitive coarsening-upward parasequences that resemble shoreface profiles, but have tidal sedimentary structures throughout, are the products of progradation along a linear, tidally-dominated coastline. When combined with previous accounts of tidal sedimentary structures and marine palynomorphs in outcrops and core from the Sabine Uplift in East Texas and northwestern Louisiana, it is clear that marine deposition was prevalent throughout much of the Wilcox succession in this area.

In the deepest part of the core, siltstone-dominated lithologies from 2350-2140 ft (205 ft), attributable to the Midway Group, have produced rare specimens of *Apectodinium*, suggesting a Selandian age at the oldest, rather than the Danian age typically assigned to the Midway. The lower part of the Wilcox Group, 2145-1883.3 ft (261.7 ft) consists of shelf shales and coarsening upwards tidally-dominated parasequences. Rather sparse dinocyst assemblages include rare *Apectodinium*, again indicating a Selandian age.

Interval 1883.3-1490.7 ft (392.6 ft) is dominated by a series of thick paleosols, including lignites, with intervening tidally-dominated units. This is postulated to be equivalent to the lignite-bearing Naborton-Dolet Hills-Cow Bayou formations which are open-pit mined in the Sabine Uplift and northwestern Louisiana. A tidally-dominated interval, 1490.7-954.1 ft (536.6 ft), is a complex succession of shelf siltstones, tidal point-bars, tidal parasequences, and thin paleosols. *Apectodinium* continues to be sparse and sporadic. A thick, multi-story channel sandstone, 954.1-840.5 ft (113.6 ft), interpreted as a tidal channel complex, transitions upwards into shelf siltstone. A further tidal channel complex, 807.6-740.6 ft (67 ft) transitions upwards to a succession of tidal flats and tidal point bars with rare thin paleosols that continues to the top of continuous core at 628 ft.

Pollen assemblages, particularly taxa of the *Momipites-Caryapollenites* lineage illustrate that there are paleolatitudinal differences in species presence and ranges in comparison to the original biozonation defined in Wyoming. Along with species appearances and extinctions, quantitative events associated with certain species, likely related to paleoclimatic changes along the Gulf Coast, have significant chronostratigraphic value. This core represents a dynamic paleoenvironmental setting that fluctuated from shallow shelf to a tidally-dominated coastline to lower coastal plain, in a predominantly marine rather than fluvial paleoenvironmental setting. With a coastline either in the vicinity of the core location or mostly to the north or northeast, paleogeographic concepts of extensive coastal plains far to the south during Wilcox deposition need to be revised.

Terrestrial pollen carbon isotope record across the Paleocene-Eocene Thermal Maximum

Korasidis, V.A.¹, Wing, S.L.,¹ Nelson, D.M.,² Baczynski, A.A. and ³Harrington, G.J.⁴

¹ Department of Paleobiology, Smithsonian Institution, Washington, DC 20560, USA

² Appalachian Laboratory, University of Maryland Center for Environmental Science, Frostburg, MD 21532, USA

³ Department of Geosciences, The Pennsylvania State University, University Park, PA, USA

⁴ Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK

*Corresponding author: korasidisv@si.edu

Paleobotanical research on Paleocene-Eocene Thermal Maximum (PETM) megafloras in the Bighorn Basin, USA, has emphasized that their composition is radically different from those immediately before and after the PETM. Palynofloral change in the same studied sections was, in contrast, remarkably subtle, with only rare occurrences of pollen types generally more common in the southerly Gulf Coastal plain recorded during the PETM interval. To investigate this discrepancy, we employed traditional palynological analysis and novel species-specific pollen stable carbon isotope analysis on numerous Bighorn Basin successions. We found that pollen taxa of temperate affinity (i.e., Cupressaceae, Juglandaceae) are poorly preserved during the PETM, whereas pollen taxa of tropical affinity (i.e., Arecaceae) are well preserved. We also found that the $\delta^{13}\text{C}$ of PETM pollen taxa with a temperate affinity are similar to pre-PETM grains of the same taxon. However, the carbon isotopic composition of pollen grains of tropical affinity from the PETM is significantly lighter (i.e., by 4 per mil) than the same taxon before the PETM. We propose that the poorly preserved temperate taxa, that do not show a shift in carbon isotopic composition during the PETM are likely reworked. The increased abundance of Cretaceous spores, pollen and dinoflagellates in samples derived from the PETM body is consistent with this interpretation. We conclude that the enhanced reworking of palynotaxa, due to the sudden onset of more seasonal precipitation, could explain the reduced turnover in palynofloras previously reported for the Bighorn Basin PETM successions. These findings also make it probable that temperate plant lineages were extirpated throughout the Bighorn Basin during the body of the PETM. Caution is therefore required in high-resolution palynological studies of intervals with major climate change documented.

DAY 4, AUGUST 12th Precambrian palynology & general palynology

Keynote speaker: Dr. Kathleen Grey¹

Review of Australian Precambrian palynology

¹Geological Survey of Western Australia

Near-continuous records of Precambrian organic-walled microfossils (OWMs) are present in Australia's largely undeformed sedimentary basins. Records of OWMs are mainly in chert, morphologically simple and facies controlled, so are generally unsuitable for biostratigraphy, causing doubt that Phanerozoic palynological methods can be applied to the Precambrian. However, selected examples indicate that palynology can be a potential tool for correlating some ancient successions. Complex OWMs, including films, filaments, hollow spheres and lenticular microfossils with a flange, are present in the Paleoarchean Strelley Pool Fm (3426–3350 Ma) and Mesoarchean Farrel Quartzite (3066–3022 Ma), Pilbara, WA. Palynological extraction and taphonomic analysis support their biogenicity. Neoarchean and late Paleoproterozoic assemblages are rare. Diverse morphotypes are present in chert in the Turee Creek Gp (2420–2208 Ma) of WA. Some resemble OWMs in the Gunflint Chert (c. 1878 Ma) of North America and Duck Creek Dolomite (2008–1799 Ma) and Frere Fm (1891–1876 Ma) of WA, but systematic studies are needed. Several mid to late Paleoproterozoic chert units (2.0–1.6 Ma) contain OWMs, typically simple or septate filaments and spheres. Few OWMs have complex characteristics useful for biostratigraphy. This contrasts with the Mesoproterozoic, especially the McArthur Basin, NT, where exploration has provided continuous cores through palynologically suitable successions. Preliminary palynology indicates considerable scope for additional work, particularly in the Roper Gp (1493–1324 Ma), Beetaloo Sub-basin, which hosts proven hydrocarbon source rocks. *Tappania plana*, filaments and spheres occur in the lower Roper Gp and suggest facies control. However, the overlying Velkerri, Kyalla and Chambers River Fms show promise for biostratigraphic zonation based on diverse assemblages. Species descriptions and analysis of their distributions are needed. The late Mesoproterozoic and early Neoproterozoic (Tonian) are poorly studied. Limited records indicate the usual filaments and small spheres, but large spheres and clusters of spheres (*Synsphaeridium* and *Symplassosphaeridium*) become predominant. The late Tonian is best characterized by chert and siltstone assemblages in the Johnnys Creek Fm, Amadeus Basin (Bitter Springs Gp and correlatives in other Neoproterozoic basins). The overlying Wallara Fm (and correlatives) contain *Cerebrosphaera buickii*, a potential stratigraphic marker. Reworked fragments occur in tillite in the Sturt glacial deposits. The Aralka Fm (Amadeus Basin) and correlatives are mostly barren despite lithologies appearing ideal for palynology. A new species of *Vandalosphaeridium* is present in the middle of the formation. The overlying Elatina glacials and equivalents have a few reworked organic fragments. The Ediacaran, above the glacial, is perhaps palynologically the most comprehensively studied Precambrian succession. Twenty mostly continuous cores, from four tectonic units, contain morphologically complex, taxonomically diverse acritarchs. Proposed correlations and zones correspond to lithostratigraphy, isotope chemostratigraphy, stromatolite biostratigraphy and seismic and sequence stratigraphy, but additional studies of unexamined drillholes and cored intervals are needed. Nevertheless, the Australian Ediacaran provides a classic example of how palynology and biostratigraphy can be applied to Precambrian successions.

Organic-walled microfossils from the Paso Severino Formation, Paleoproterozoic of Uruguay

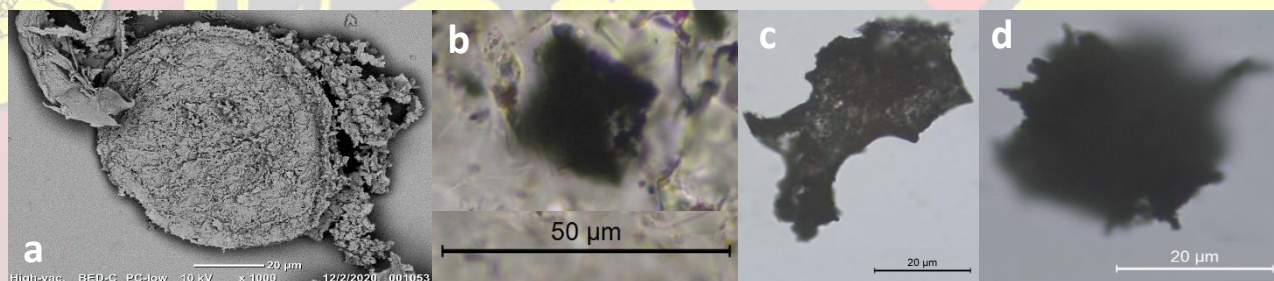
Acosta, I.¹ and Gaucher, C.¹

¹Departamento de Paleontología, Facultad de Ciencias, Universidad de la República, Iguá 4225, 11400 Montevideo, Uruguay. ismacosta96@gmail.com

As we move further back in the geological record, the characterization of life and the distinction between fossils and non-fossils becomes increasingly difficult. There are few records in the world of body fossils dating back to the Archaean or early Paleoproterozoic, compared to the vast amount of fossils in the Phanerozoic. The Paso Severino Formation is one of the oldest geological units in Uruguay with appreciable organic matter remains. Interbedded acid volcanic rocks yielded a U-Pb SHRIMP zircon age of 2146 ± 7 Ma (Santos *et al.*, 2003), accepted as the depositional age of the unit. We studied thin sections and palynological macerations of carbonates and shales of the Paso Severino Formation using combined trans- and epi-illumination microscopy, as well as scanning electron microscopy. The organic remains suffered advanced carbonization due to greenschist-facies metamorphism. A relatively diverse paleomicroflora is described here, consisting of sphaeromorphic acritarchs (*Leiosphaeridia* sp., Fig. 1a, SEM image), polygonomorphic acritarchs (*Octoedryxium truncatum*, Fig. 1b, thin section), microfossils of probable bacterial affinity (*Kakabekia* sp., Fig. 1c), colonial sphaeroids and possibly acanthomorphic acritarchs (Fig. 1d). The microfossils represent the oldest body fossils so far described in South America. This study confirms not only the presence of these organisms in the geological past of Uruguay, but also has implications in what concerns the evolution and diversification of the first eukaryotic organisms on Earth. Furthermore, carbonates of the Paso Severino Formation yielded strongly positive $\delta^{13}\text{C}$ values of up to +11.6‰ VPDB (Maheshwari *et al.*, 2010), showing that they were deposited at the climax of the Lomagundi anomaly. The microfossil assemblage can potentially contribute toward the understanding of the causes and biotic impact of such a large environmental perturbation.

Maheshwari, A. Sial, A.N., Gaucher, C., Bossi, J., Bekker, A., Ferreira, V.P., Romano, A.W. 2010. Global nature of the Paleoproterozoic Lomagundi carbon isotope excursion: A review of occurrences in Brazil, India, and Uruguay. *Precambrian Research* 182, 274-299.

Santos, J.O.S., Hartmann, L.A., Bossi, J., Campal, N., Schipilov, A., Piñeyro, D., McNaughton, N.J., 2003. Duration of the Transamazonian and its correlation within South America based on U-Pb SHRIMP geochronology of the la Plata Craton, Uruguay. *International Geology Review* 45, 27-48.



Possible Holozoan Palynomorphs from the 1,074 Ma Nonesuch Shale

Strother, P. K.^{1*} and Wellman, C. H.²

¹Weston Observatory, Department of Earth & Environmental Sciences, Boston College, Weston MA, US

²Department of Animal & Plant Sciences, Alfred Denny Bldg., University of Sheffield, Sheffield, England

*Corresponding author: strother@bc.edu

Precambrian palynology is plagued with an overwhelming dominance of sphaeromorph acritarchs whose position in the eukaryotic phylogeny is completely unknown, claims of Neoproterozoic prasinophyte and chlorophyte phytoplankton notwithstanding. The Nonesuch Shale is no exception – all palyniferous samples examined to date are dominated by simple sphaeromorph acritarchs such as *Leiosphaera* and *Stictosphaeridium*. However, the Nonesuch palynoflora also includes a considerable variety of cell clusters, which, by their very nature of demonstrating cell to cell attachment, provide a modicum of morphological characters with which to compare to multicellularity in living protists. The recognition of probable holozoan protists in the contemporary Diabaig Formation (Torridonian) (Strother et al., 2021) opens an opportunity to explore multicellular form in the Nonesuch assemblage with an eye to comparison with Recent holozoan protists that possess multicellular stages in their life cycles. One such example includes multicellular clusters composed of loosely-packed ovoidal cells, that are partially covered in a diaphanous, single-layered membrane. Morphological comparison with the multicellular phase of the Recent Ichthyosporean, *Creolimax fragrantissima* helps explain the incomplete nature of the membranous covering of these morula-like clusters. These form a distinct member of the Nonesuch palynological assemblage and are consistent with the projected osmotrophic lifestyle of a free-living, basal holozoan, expanding the fossil record of the non-metazoan holozoan clade.

References:

Strother, P. K., Brasier, M. D., Wacey, D., Timpe, L., Saunders, M., Wellman, C. H. 2021. A possible billion-year-old holozoan with differentiated multicellularity. *Current Biology* 31 (12), P2658–P2665.E2, doi:<https://doi.org/10.1016/j.cub.2021.03.051>.

Microfossils and age controversy on the rocks of Kurnool Group of south India: A debate

Shukla, Y.¹ and Sharma, M.¹

¹Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow-226007, India

*Corresponding author: yogmayashukla@bsip.res.in

Recorded occurrence of vertical burrows in the Narji Limestone, and distinct carbonaceous microfossils *Obruchevella* in the Owk Shales of the Kurnool Group of India indicate Ediacaran age of the fossils bearing successions, which were otherwise correlated and considered Palaeo/Mesoproterozoic succession. Till recently, no direct radiometric dates were available on any of the litho-units of the Kurnool Group. However, recent discovery of tuff beds in the Owk Shales with uncertain correlation with the Palaeo-Mesoproterozoic Singhora and Chopan Porcellanite have initiated a debate on the age of the basin. In such a situation, Proterozoic microfossils and characteristic acritarchs assemblages emerge as a powerful tool of Precambrian biostratigraphy in determining age of encompassing rocks and correlation of the distant sedimentary successions.

A well preserved and diversified microfossil assemblage reported from the Ediacaran Owk Shale of Kurnool Basin, South India consisted of 21 taxa belonging to 9 genera. The assemblage comprise of species of prokaryotes or and possible eukaryotes. This assemblage includes diverse and abundant sphaeromorphs, colonial aggregates and filamentous forms, acanthomorphic acritarchs and spiral cylindrical filaments. The assemblage demonstrates the biostratigraphic usefulness of the Owk Shale microbiota. Present study discusses the occurrence of *Obruchevella* Reitlinger from the Owk Shale of the Kurnool Group of the peninsular India. Among the various helically coiled microfossils, *Obruchevella* is reported mostly from close to Precambrian–Cambrian boundary successions on the global scale. Based on coiling shapes various species of *Obruchevella* were established. In the Owk Shale assemblage, four species of *Obruchevella* viz., *O. delicate*, *O. parva*, *O. minor* and *O. valdaica* were recorded as an organic walled microfossil. Among them, *O. valdaica* is the largest in terms of size range. All four species are known from the Ediacaran to Early Cambrian age successions. Presence of pyrite crystals in sheaths of some the specimens and benthic mode of occurrence compare with modern cyanobacterium genus *Spirulina*. These microfossils are considered as remains of oscillatoriacean cyanobacteria. The assemblage further includes cyanobacteria: *Siphonophycus kestron*, *S. robustum*, *S. typicum*, *S. solidum*, *Polytrichoides lineatus*; Netromorphic acritarch: *Arctacellularia tetragonala*, *Navifusa majensis*, *Jacutianema solubila*; Sphaeromorphic acritarch: *Ostiana microcystis*, *Synsphaeridium* spp., *Leiosphaeridia minutissima*, *L. tenuissima*, *L. crassa*, *L. jacutica*, *L. ternata* and acanthomorphic acritarch: *Cavaspina* aff. *C. acuminata* and *Variomargosphaeridium* aff. *V. litoschum*. Many taxa of the assemblage indicate Owk Shales Ediacaran age, such as, *Obruchevella*, *Variomargosphaeridium*, and *Cavaspina*. In spite of evolutionary conservatism of cyanobacteria, spiral cylindrical filaments of *Obruchevella* are mostly recorded from Ediacaran and younger deposits. These taxa are reported mostly from close to the Precambrian-Cambrian boundary successions thereby implying the younger age of the Kurnool basin. The present study discounts the possibility of Mesoproterozoic age of the basin and supports the Neoproterozoic age for the Kurnool basin.

Eutrophic conditions prior to the end-Cryogenian glaciation in the Otavi Group (Namibia): a causal relationship?

Gaucher, C.^{1*}, Germs, G.J.B..² and Frei, R.³

¹Departamento de Paleontología, Facultad de Ciencias, Universidad de la República, Iguá 4225, 11400 Montevideo, Uruguay. *gaucher@startmail.com

²University of the Free State, Bloemfontein, South Africa

³Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark

The most severe Neoproterozoic glaciation is represented in the Otavi Group by the Ghaub Formation, of terminal Cryogenian age (635 Ma, "Marinoan"). The unit overlies a thick (550 m) carbonate shelf succession comprising the Berg Aukas, Gauss and Auros/Ombaatjie formations. Palynological macerations and thin sections revealed the occurrence of a low-diversity microbiota in the pre-glacial carbonates, which is essentially composed of *Bavlinella faveolata* (Schepeleva) Vidal. The organic-walled microfossils are fairly well preserved despite anchimetamorphic thermal overprint. We carried out quantitative measurements of microfossil concentrations per volume unit and measured maximum (Dmax) and mean (Dmean) diameter of *Bavlinella*.

A consistent trend of decreasing microfossil abundance is observed: from 21 million vesicles/cm³ at the base of the Gauss Formation to 9 million/cm³ in the upper Auros/Ombaatjie Formation. Concomitant to the decrease in *Bavlinella* concentration, a trend to larger vesicles is evident: from Dmean=7.8 μ m and Dmax=16 μ m at the base of the Gauss Formation to Dmean=12.6 μ m and Dmax=36 μ m in the middle-upper Auros Formation. The carbonate matrix of the diamictites of the Ghaub Formation hosts a more diverse microflora, with small acanthomorphs assigned to *Asteridium*. *Bavlinella* reaches there low concentrations of 1 million/cm³ and diameters Dmean=10.8 μ m and Dmax=20 μ m. Postglacial carbonates (Maieberg Formation) only locally contain poorly-preserved *Bavlinella*, with Dmean=10 μ m and Dmax=16 μ m some 250 m above the diamictites.

The depauperate *Bavlinella* microflora of pre-glacial carbonates bears all the hallmarks of eutrophic assemblages. *Bavlinella* has affinities with the Cyanobacteria, and is a close morphological and ecological analogue of *Microcystis*, an opportunistic cyanobacterium known for its large and toxic blooms. Coeval units elsewhere, such as the Datangpo Formation in China, show the same microfossil assemblage hinting at a global perturbation likely caused by enhanced nutrient influx in the wake of Rodinia breakup. Enhanced bioproductivity during this period is also shown by high $\delta^{13}\text{C}$ of carbonates and high organic matter contents. The mechanism may help explain the cause of the low-latitude terminal Cryogenian glaciation by CO₂ drawdown and enhanced dimethyl sulfide (DMS) production.

Ediacaran acanthomorphic acritarchs in the lower Doushantuo Formation of the Yangtze Gorges area, South China: distribution and stratigraphic implications

Ouyang, Q.^{1*}, Zhou, C.¹, Xiao, S.² and Guan, C.¹

¹ State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China

² Department of Geosciences, Virginia Tech, Blacksburg, VA 24061, USA

*Corresponding author: qouyang@nigpas.ac.cn

Ediacaran acanthomorphic acritarchs are critical to the subdivision and correlation of Ediacaran strata due to their high diversity and worldwide distribution. Since the establishment of four acanthomorphic biozones in Australia, to recognize similar biozonal sequence has become one of the most attractive aims of Ediacaran biostratigraphic studies elsewhere. The Ediacaran Doushantuo Formation in South China yields diverse acanthomorphic acritarchs, and for them different biozonation schemes have been proposed. However, whether these previously proposed biozones can be consistently recognized at a regional scale have not been demonstrated. Based on 1547 newly recovered specimens from three sections and together with published data, we investigated the spatial and stratigraphic distribution of acanthomorphs in Member II of the Doushantuo Formation from the Yangtze Gorges area, South China. Two conclusions have been tentatively reached.

Firstly, we found strong spatial heterogeneity in both composition and abundance of acanthomorphic taxa among the three studied sections. Fifty-nine percent of the acanthomorphic species in our investigation (41 out of 69) were found at only one section. As the sampled strata have been well correlated using litho- and chemostratigraphy, the taxonomic difference may reflect true spatial variations. The spatial heterogeneity of acanthomorphic acritarchs in the Doushantuo Formation shows that they can be applied to biostratigraphic correlation only if their occurrences are traceable and stratigraphic ranges are consistent at least at the regional scale.

Secondly, despite the spatial heterogeneity, there are taxa that consistently occur at multiple sections, supporting their biostratigraphic significance. Twelve species occur at the three studied sections, and among them nine have also been reported from other sections in South China. Four species (*Appendisphaera grandis*, *Cavaspina acuminata*, *Eotylotopalla dactylos*, and *Knollisphaeridium maximum*) out of these nine have been reported outside South China, indicating their potential in global stratigraphic correlation. However, five species (*Dicrospinasphaera improcera*, *Distosphaera speciosa*, *Ericasphaera fibrilla*, *Mengeosphaera chadianensis*, and *Tianzhushania spinosa*) out of the nine are endemic to South China. Whether the absence of these five species outside South China is due to taphonomic bias, stratigraphic inequality (i.e., Member II of the Doushantuo Formation may be stratigraphically older than other acanthomorph-bearing strata outside China), or their limited biogeographic distribution is still unresolved, and requires further investigation.

Palynological Insights into Neoproterozoic glaciations. The Marinoan Glaciation in Namibia.

Jaeger, H*, Reutner, T. and Bechstaedt, T.

GeoResources Science Transfer Centre, Konrad-Adenauer-Strasse 58, 64625 Bensheim, Germany

*Corresponding author: jaeger@georesources.de

The Neoproterozoic is seen as a time of extreme climatic changes. At least two ?global glaciations, known as 'Snowball Earth', are proposed within the Neoproterozoic. This is based on widespread palaeogeographic distribution of diamictites reaching out to low palaeolatitudes, overlain by Cap Carbonates showing negative $\delta^{13}\text{C}$ excursions. The negative $\delta^{13}\text{C}$ excursion is seen as a result of the collapse in organic productivity in the ocean, due to the decoupling of global oceans from the atmosphere by a global ice cover. Cap Carbonates are interpreted as anorganic precipitates produced by the switch from 'Snowball Earth' into a super-hot green-house – the Neoproterozoic climatic paradox. In contrast, sedimentological studies show the waxing and waning of glaciers and the coexistence of open oceans with low latitude sea-ice, contradicting essential requirements of the 'Snowball Earth' theory. The controversial debate on 'Snowball Earth' is focused mainly on geochemical data and sedimentological analyses. The input from paleontology is very low, because macro- and microfossils are very sparsely recorded from these intervals until now.

Palynological studies of the late Neoproterozoic Ghaub glaciation (Marinoan) in the Otavi Mts. (NE-Namibia) show a continuous microfossil record throughout the entire glacial interval – from pre- to post-glacial – for the first time. Therefore palynology presents essential new data for the analysis of paleoenvironments during Neoproterozoic glaciations. In the Otavi Mts. a continuous record of life is observed from pre-glacial carbonate platform deposits throughout the glacial diamictites into post-glacial Cap Carbonates and the overlying highstand platform deposits. Changes in the composition of the palynological assemblages are related to facies changes, approved by sedimentology. Similar facies shows similar palynology regardless of the position within the glacial cycle (pre- to post-glacial). Pre- and post-glacial strata show rarely benthic filamentous microbiota, but mainly organic debris (partially highly carbonized) and acritarchs. Cap Carbonates are dominated by filamentous cyanobacteria and algae accompanied by coccoidal bacteria/algae. The decrease of the total organic matter in the Cap Carbonates is most probably related to the facies change towards very shallow, marginal marine (?brackish) conditions of a very proximal carbonate platform and not to less organic productivity in the ocean. Palynology also proves, that Cap Carbonates are mainly biogenic, mostly with microbial assemblages typical for very shallow marine microbial mat deposits. These microbiota give evidence, that the Cap Carbonates are at least partially biomediated and not abiogenic precipitates.

Palynofacies analysis of Cap Carbonates shows rhythmical changes in the proportions of benthic organisms (filamentous cyanobacteria/algae, coccoidal bacteria/algae) and planktonic organisms like acritarchs. This gives evidence for changes in water depth most probably related to sea-level variations within the generally shallow, marginal marine environment of the Cap Carbonates. Therefore palynofacies shows continued climatic variability during Cap Carbonate deposition and no rapid change from a 'Snowball Earth' to an extremely hot green-house during the Cap Carbonate deposition, as proposed by the 'Snowball Earth' theory.

The continuous record of fluctuations in relative sea-level supports a model of long-term waxing and waning of glaciers at the end of the Ghaub glaciation, similar to most glaciations in Earth history. The continuous palynological record gives evidence for areas of open oceans and ice-free shelves during the entire glacial interval. The similarity of the pre- to post-glacial microbial assemblages strongly questions a rapid change to extremely high temperatures. Based on the palynological results it is proposed, that Neoproterozoic glaciations are widespread to low latitudes, but merged with open oceans in between, similar to the results of sedimentological studies.

DAY 4 LIGHTNING TALKS, SESSION 1

The role of *Pinus* L. in the composition of Meso-Cenozoic flora of Ukraine. Stratigraphic aspect

Sirenko, O.A.¹ and Shevchuk O.A.²

¹Department of Stratigraphy and Paleontology of the Cenozoic sediments at the Institute of Geological Sciences of the National Academy of Sciences of Ukraine, 55b Olesia Gonchara St. 01054 Kyiv, Ukraine

²Department of Stratigraphy and Paleontology of the Mesozoic sediments at the Institute of Geological Sciences of the National Academy of Sciences of Ukraine, 55b Olesia Gonchara St. 01054 Kyiv, Ukraine

*Corresponding author: hshevchuk@ukr.net

Pinus (Pinaceae) is a diverse conifer genus that dominates Northern Hemisphere forests today. Analysis of the results of palynological studies of Mesozoic and Cenozoic sediments of Ukraine allowed us to trace changes in the participation and species composition of *Pinus* L. in Mesozoic and Cenozoic flora. The genus *Pinus* has a large stratigraphic range, but its species diversity and quantitative changes in the composition of different ages of Mesozoic and Cenozoic flora differ markedly. The analysis of these changes provides an opportunity to trace the emergence and main boundaries at which there was a renewal of the species composition and an increase in its role in the flora during the Mesozoic and Cenozoic.

Representatives of *Pinuspollenites* originated in the Middle Jurassic period and are clearly recorded in the flora of Ukraine (Carpathians, Dnieper-Donetsk basin, Ukrainian shield – Bajocian, Mountain Crimea – Aalenian). From Aalenian to Barremian, a large number of ancestral forms of *Pseudopinus* spp. and *Protopinus* spp. are noted. *Pinuspollenites* spp., *Pinuspollenites verrucosus*, *Pinus divulgata*, *P. pernobilis* played a significant role among the Late Jurassic flora of Ukraine. At the turn of the Jurassic and Cretaceous periods, there was a decrease in pine. During the Cretaceous, the role of *Pinus* in the flora grew from Valanginian to Albian. By the middle of the Cretaceous period, they had diverged into two lineages, the *Strobus* (Haploxylon) and *Pinus* (Diploxylon) subgenera (Millar 1998). The timing of pine diversification coincides with the evolution of angiosperms, and it is likely that competition between flowering plants and gymnosperms played a role in adaptation, which has reduced species diversity and pine participation. The flora of the Late Cretaceous period is characterized by a significant participation of *Pinus* cf. *minor*, *P. vulgaris*, *P. subconcinua*, *P. concessa* and other. At the boundary of the Cretaceous and Paleogene, there is again a decrease in pine, both in quantitative and species composition.

The role of *Pinus* in the flora grew from the Early Paleogene to the Late (Stotland, 1974). The beginning of the dominance of this genus corresponds to the Eocene-Oligocene boundary. But the greatest number and variety of *Pinus* is characteristic of the second half of the Late Oligocene. The flora of this period is characterized by a significant participation of *Pinus* spp. subg. *Haploxylon* and among them - *Pinus* sect. *Mirabilis*. At the beginning of the Early Miocene, the number of *Pinus* spp. subg. *Haploxylon* in the flora of Northern Ukraine (Early Novopetrovskiy time) decreased significantly. Instead, representatives of the subgenus *Diploxylon* dominated. Among the Middle Miocene flora of Southern Ukraine, a significant role also belonged to the *Pinus* representatives, but the largest representation is characteristic of the Konkian and, especially, Early Sarmatian times. *Pinus baileyana*, *P. veronica*, *P. gigantea* appear in the Konkian period. The flora of the Early Sarmatian period has the greatest species diversity and number of pines: *Pinus mirabilis*, *P. baileyana*, *P. ruthenica*, *P. veronica*, *P. minutus*, but *Pinus* subg. *Diploxylon* prevailed (Syabryay, Shchekina, 1983; Shchekina, 1979). The next frontier of increasing the role of *Pinus* in the flora was the Early Pontian, Early Kimmerian, Early Kuialnykian, Martonosha time of Early Pleistocene. The flora of these stages was dominated by representatives of the subgenus *Diploxylon*. The flora of the Early Pontian differed in the greatest representation and species diversity of *Pinus* - *Pinus* sp. sect. *Eupitys* (dominate) *P. sp. sect. Sula*, *P. sp. sect. Taeda*, *P. sp. sect. Pseudostrobus*, *P. sp. sect. Banksia*, *P. longifoliaformis*; *Pinus* spp. subg. *Haploxylon*: *P. pusillus*, *P. sp. sect. Cembrae*, *P. sp. sect. Strobus*. From the Late Miocene to the Early Pleistocene, the presence of *Pinus* sp. sect. *Eupitys* in the flora increases and the role of *Pinus* spp. subg. *Haploxylon* decreases. The traced boundaries can be used as benchmarks for stratigraphic divided of Mesozoic and Cenozoic sediments of Ukraine and their correlation with the same rocks of other regions.

The contribution of dinoflagellate cysts to the dating of Moroccan Mesozoic terrains and the reconstruction of paleoenvironments.

Hssaida, T.¹, Ben-bouziane, A.¹, Essamoud, R.¹, Jaydawi, S.², Chakir, S.¹, Rachid, J.¹, Chafai, K.¹ and khaffou, H.¹,

¹ Laboratory of Dynamics of Sedimentary Basins and Geological Correlations, Department of Geology, Faculty of Sciences Ben M'Sik, Hassan II University of Casablanca, Avenue Cdt Driss El Harti, BP 7.955, Ben M'Sik 20,800, Casablanca, Morocco (touria.hssaida@gmail.com)

²University Mohammed V, Faculty of Science, Rabat, 4 Avenue Ibn Batouta, B.P. 1014

This study is a palynostratigraphic synthesis work, based on Dinoflagellate cysts, carried out on several polls and Moroccan Mesozoic land cuts (Jurassic - Cretaceous). Currently, thanks to dinoflagellates, it has been possible to establish scales stratigraphic, unequalled finesse, especially for the field Boreal and sub-Boreal. For the Tethysian domain (eastern North Morocco: Guercif basin, the Atlantic margin: The Essaouira basin, the Rifain domain (external Rif, internal Rif, Mesorif) and the South Rifian wrinkles and the Atlas domain: Middle Atlas), and precision dating were done in several polls and cuts of land.

In addition to their stratigraphic role by fossilized cysts in sediments, Dinoflagellates have a distribution according to the nature of the sediments, the physico-chemical parameters and a latitudinal distribution: from the coast to the open sea, this gives them the title of excellent ecological marker.

Thus the variations in the composition of their assemblages in sediments, allowed us to reconstruct the palaeoenvironments (deposit environment, bathymetry ...) in all studied regions.

The Middle Jurassic dinoflagellate cyst biostratigraphy of the Lusitanian Basin, Portugal

Correia, V.F.^{1,2*}, Riding, J.B.³, Henriques, M.H.⁴, Fernandes, P.¹, Pereira, Z.² and Wiggan, N.J.⁵

¹ Corresponding author: CIMA – Centro de Investigação Marinha e Ambiental, Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal

² LNEG, Rua da Amieira, 4465-965 S. Mamede de Infesta, Portugal

³ British Geological Survey, Environmental Science Centre, Keyworth, Nottingham NG12 5GG, UK

⁴ University of Coimbra, Faculty of Science and Technology, Department of Earth Sciences and Geosciences Centre, Rua Sílvio Lima, 3030-790 Coimbra, Portugal

⁵ CGG Robertson, Tyn y Coed, Llanrhos, Llandudno LL30 1SA, UK

*Corresponding author: vfraguito@hotmail.com

A mainly Middle Jurassic composite succession with 129 samples was examined palynologically. This spans the Toarcian–Aalenian transition to the lowermost Bathonian, exposed at Cabo Mondego (includes the GSSP and the ASSP for the Bajocian and Bathonian stages respectively) and São Gião in the northern Lusitanian Basin, western Portugal. The main goal was to establish a biostratigraphical scheme based on dinoflagellate cysts bioevents. The major results are represented in the Figure 1.

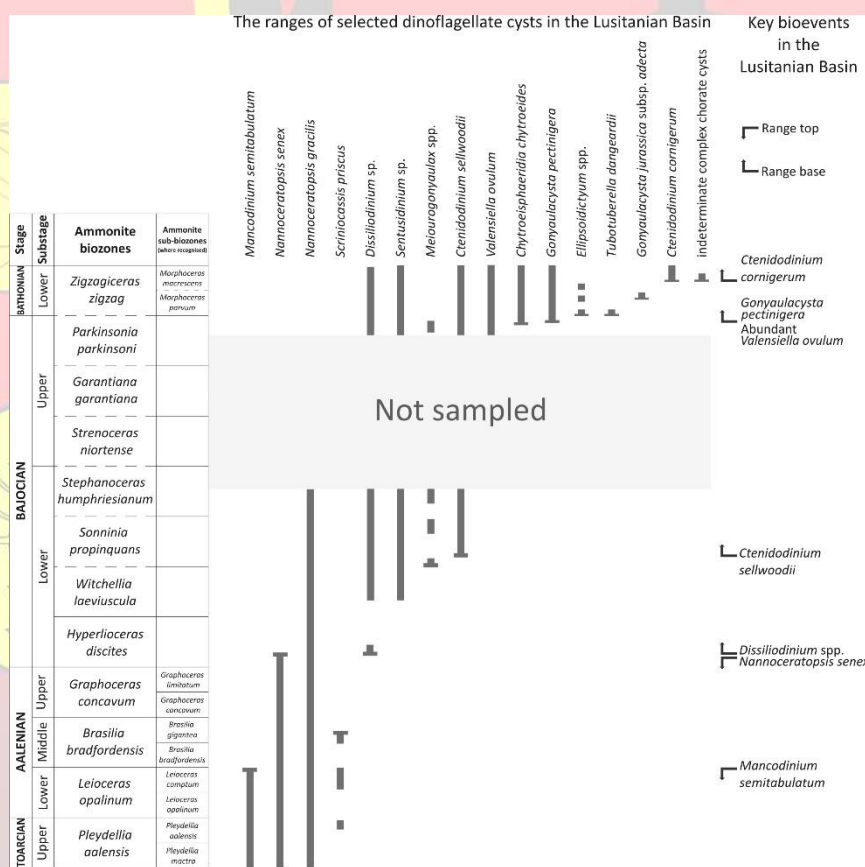


Fig. 1. The ranges of 15 stratigraphically significant dinoflagellate cysts and selected bioevents plotted against the ammonite biozones (AB) from the uppermost Toarcian to lowermost Bathonian of Cabo Mondego, Lusitanian Basin. The dotted ranges indicate the scarcity of the respective form. The Middle Jurassic dinoflagellate cyst of the Lusitanian Basin are markedly less diverse than coeval basins further north and east in the northern hemisphere. Nevertheless, at *Witchellia laeviuscula* AB is recorded an influx of species, which is the manifestation of the evolutionary early Bajocian radiation. Dinoflagellate cyst richness continued to increase at the Bajocian–Bathonian transition.

Diversity of the genus *Ancyrochitina* in the Middle Devonian of Bolivia

Camina, S. C.^{1*} and Rubinstein, C. V.¹

¹Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA), Av. Dr. Adrian Ruiz Leal, Argentine.

*Corresponding author: scamina@mendoza-conicet.gob.ar

Ancyrochitina, one of the best represented and most diversified chitinozoan genus in the Middle Devonian basins of Western Gondwana, has been recorded in large numbers in the Los Monos Formation of the Tacobo X-1001 borehole, located in the southern foothills of Bolivia. The sedimentary succession is characterized by shallow marine deposits, recently dated as late Eifelian? to middle Givetian, based on spores and organic-walled phytoplankton. A moderately well-preserved chitinozoan assemblage was analyzed under SEM. The chitinozoans are completely flattened; nevertheless, systematic was carried out without applying a correction factor for flattening in the measurements and morphology relations were calculated. All the specimens show the general vesicle outline of *Ancyrochitina*, with a conical body chamber, a conspicuous neck, and a crown of basal processes. The morphology (simple or branched), the complexity (order of branching), and the number and size of the basal processes of well-preserved specimens allowed the positive identification of 12 species. Moderately damaged specimens were assigned as cf. to three species, and poorly preserved individuals were left in open nomenclature at the species level. The genus *Ancyrochitina* in the Tacobo X-1001, is represented by more species than in other Middle Devonian assemblages from all over the world. Additionally, it shares more *Ancyrochitina* species with Western Gondwana basins than with other coeval basins, in particular with the Brazilian Paraná basin. This demonstrates a well-known connection between Bolivian and Brazilian basins at the Middle Devonian, with some species restricted to Western Gondwana, such as *Ancyrochitina arirambaensis* and *Ancyrochitina biconstricta*, and *Ancyrochitina monosi* only known from Bolivia. Species such as *Ancyrochitina aculeata* and *Ancyrochitina tomentosa* were recorded for the first time in Western Gondwana, in this study.

	WESTERN GONDWANA						Northern Gonwana	Euramerica
	South-central Bolivia		Paraguay	Brazil				
	Los Monos Formation		Paraná Basin	Amazonas Basin	Solimoes Basin	Parnaíba Basin		
	Tacobo X1001	Other papers						
<i>Ancyrochitina aculeata</i>	●						●	
<i>Ancyrochitina tomentosa</i>	●						●	
<i>Ancyrochitina kutasii</i>	●							●
<i>Ancyrochitina arirambaensis</i>	●	●	●	●	●	●	●	
<i>Ancyrochitina langei</i>	●	●		●	●	●		●
<i>Ancyrochitina biconstricta</i>	●	●		●				
<i>Ancyrochitina flexuosa</i>	●	●		●				●
<i>Ancyrochitina morzadeci</i>	●	●		●		●	●	
<i>Ancyrochitina ancyrea</i>	●			●			●	
<i>Ancyrochitina cornigera</i>	●			●			●	
<i>Ancyrochitina frankeli</i>	●			●				●
<i>Ancyrochitina multibrachiata</i>	●			●	●		●	
<i>Ancyrochitina simplex</i>	●			●	●		●	
<i>Ancyrochitina taouratinensis</i>	●			●	●		●	
<i>Ancyrochitina monosi</i>	●	●						
<i>Ancyrochitina</i> sp. A	★							
<i>Ancyrochitina</i> sp. B	★							
<i>Ancyrochitina</i> sp. C	★							

Figure 1: Global distribution of the Middle Devonian *Ancyrochitina* genus. Black circles indicate positively identified species; grey circles indicate cf. species and the stars indicate species left in open nomenclature.

Palynomorphs abundance of the Jaciara section (Ponta Grossa Formation, Paraná Basin, Brazil), what does it tell us about the paleoenvironment?

García Muro, V. J.^{1*}, Rubinstein, C. V.¹, Pereira, E.², Steemans, P.³

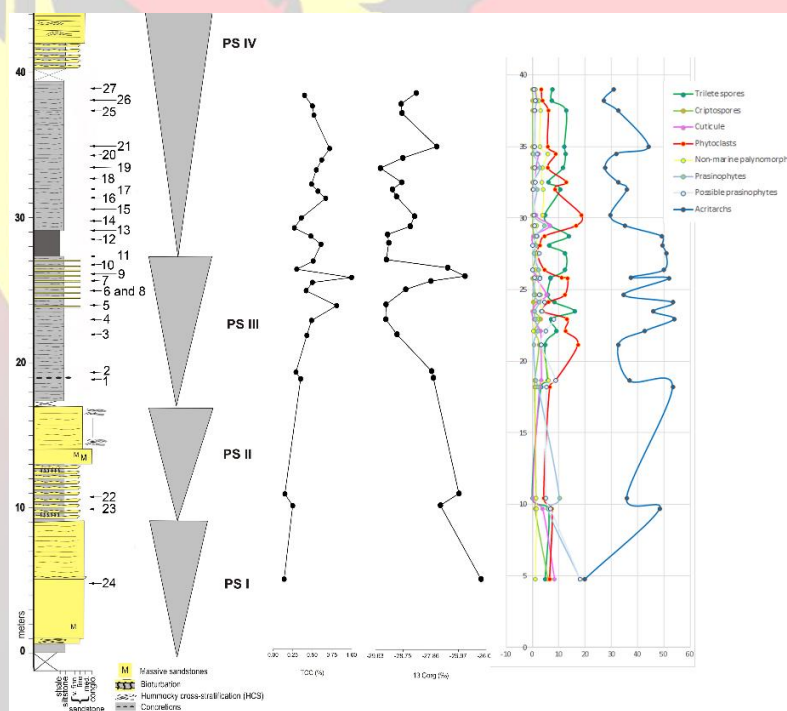
¹ Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA), CCT CONICET Mendoza, A. Ruiz Leal s/n, Parque General San Martín, M5502IRA Mendoza, Argentina

² Departamento de Estratigrafia e Paleontologia, FGEL, Universidade do Estado do Rio de Janeiro (UERJ), Rua São Francisco Xavier 524, Bloco A, 20559-900 Rio de Janeiro, RJ, Brazil

³ EDDY Lab/Palynology, 14 Allée du 6 Août, Bât. B-18, University of Liège, B-4000 Liège 1, Belgium

*Corresponding author: vgarcia@mendoza-conicet.gov.ar

Four coarsening upward depositional cycles (PS I-IV) can be observed in the Jaciara section, limited by flooding surfaces, corresponding to a ramp basin type. Palynomorphs from this section were preliminary studied and subsequently, in a later contribution focused on terrestrial palynomorphs, the diversity of the spores in the section notably increased. A late Pragian – possibly middle Emsian age was previously suggested for the Ponta Grossa Formation, based on the spore assemblages. The marine components of the assemblage were recently broadly examined. A detailed counting of all palynomorphs reveals that the marine fraction represents, in most of the samples, more than 50% of the assemblage, mainly coinciding with the flooding surfaces at the beginning of each cycle. PS I, PS II and the lower part of PS III, present major abundance of acritarchs, followed by prasinophytes and phytoclasts. This portion also corresponds to the high values of $\delta^{13}\text{C}_{\text{org}}$, related to greater contribution from land plants. Besides, the sandier deposits of PS I and II are strongly related to the forced regression episodes during the Early Devonian transgression. Samples corresponding to the rest of the cycle PS III and PS IV, including the black shales flooding surface, contained higher abundance of acritarchs, followed by fluctuating abundance of trilete spores and phytoclasts. This matches with high values of TOC and negative $\delta^{13}\text{C}_{\text{org}}$ values, associated with the flooding surfaces. Since the middle part of the PS III, the increase of phytoclasts and trilete spores, might indicate a general shallowing trend towards the top of the Jaciara section. Although, the presence of terrestrial organic material in relatively distal marine facies could also be related to climatic conditions, such as humid periods that increased nutrient input to the sea.



Palynostratigraphic Investigation of the Ordovician Units in the Tufanbeyli Region, Eastern Taurides, Turkey: Preliminary Results

Akyüz, I.^{1,2*}, Altiner, D.¹ and Altiner, S.¹

¹Department of Geological Engineering, Middle East Technical University, 06800 Ankara, Turkey

²Turkish Petroleum Corporation, Research and Development Center, 06530 Ankara, Turkey

*Corresponding author: akyuz.isil@metu.edu.tr

Acritarchs and chitinozoans from the Seydisehir and the Halevikdere formations of the Tufanbeyli region, the Eastern Taurides were studied to construct biostratigraphic framework and to determine the age of the formations more precisely. A total of 221 palynological samples taken from five measured sections have been investigated. Even though the maturation of the organic matter is high, the samples provide workable acritarch and chitinozoan assemblages. The samples taken from the Halevikdere Formation, which corresponds to Hirnantian glacially related sediments, include poorly preserved and dark colored palynomorphs. Many of the samples collected from this formation are devoid of palynomorphs. According to preliminary results of the palynological analysis, the diversity and abundance of the palynomorphs are very low. A few taxa have been observed from the Halevikdere Formation such as *Villosacapsula setosapellicula*, *Armoricochitina nigerica*, and cryptospores. Conversely, many samples taken from the Seydisehir Formation, which is composed of alternating quartzites, siltstones and shales, are highly rich in palynomorphs. Many important Arenig acritarch taxa have been recorded from the Seydisehir Formation such as *Stelliferidium trifidum*, *Stelliferum*, *Stelliferidium stelligerum*, *Coryphidium bohemicum*, *Cymatiogalea messaoudensis*, *Peteinosphaeridium angulstilaminae*, *Rhopaliophora palmata*, *Barakella felix*, *Dactylofusa velifera*, *Arbusculidium filamentosum*, *Caldariolaglabra*, *Cristallinium dentatum*, *Cymatiogalea deunffi*. In addition to important acritarch assemblages recorded, a few poorly preserved chitinozoans have been also recovered in the samples. This typical *messaoudensis-trifidum* acritarch assemblage has been recorded for the first time in the Eastern Taurides. The identification of the diagnostic species of the cold-water *messaoudensis-trifidum* acritarch assemblage indicates that the study area in the Eastern Taurides was located in high latitudes (>60°) in the southern hemisphere during the Early Ordovician.

A New Research on the Late Ordovician Bedinan Formation and Seeking for Palynostratigraphic Evidence of Hirnantian Age, Southeastern Turkey

Oktay, B.^{1*} and Akyüz, I.¹

¹Turkish Petroleum Corp., Research and Development Centre, 06510 Ankara, Turkey

*Corresponding author: berkino@tpao.gov.tr

Early Palaeozoic rocks of the North Gondwana have recently attracted the attention of petroleum companies. Early Silurian organic-rich dark shales form hydrocarbon source rock whereas glacial related rock sequences of Late Ordovician indicate reservoir rock characteristics. Dadaş Formation initiated to deposit as a result of sudden marine flooding has been proved to be moderate to excellent source rock in the southeastern Turkey. Underlying Bedinan Formation deposited in shallow marine and tidal flat environments is of main reservoir targets in the area. Studies in recent years suggest that upper part of the Bedinan Formation, highly porous and permeable, is directly linked to the Hirnantian glacial events. In addition to the current discussions, inconsistent age constraints in the Upper Ordovician strata of southeastern Turkey are remarkable and no detailed age data is present to confirm the Hirnantian age.

In order to establish fully implemented chronostratigraphy and to make palaeoenvironmental approach in the Late Ordovician of southeastern Turkey, a detailed palynological study is required. For this purpose cryptospore, acritarch and chitinozoan assemblages together with organic matter are analysed both in cutting and core samples from wells. Studied core samples yield abundant, moderate to well-preserved acritarchs and cryptospores but chitinozoans are rare. Preliminary palynofacies results may suggest that middle part of the Diyarbakır Basin is shallower than the surroundings and this could have been affected the deposition of overlying Silurian Dadaş Formation.

DAY 4 ORAL PRESENTATIONS, SESSION 2

Triassic charcoal from the Germanic Basin: Puzzle piece in climate reconstruction

Götz, Annette E.^{1*} and Uhl, Dieter²

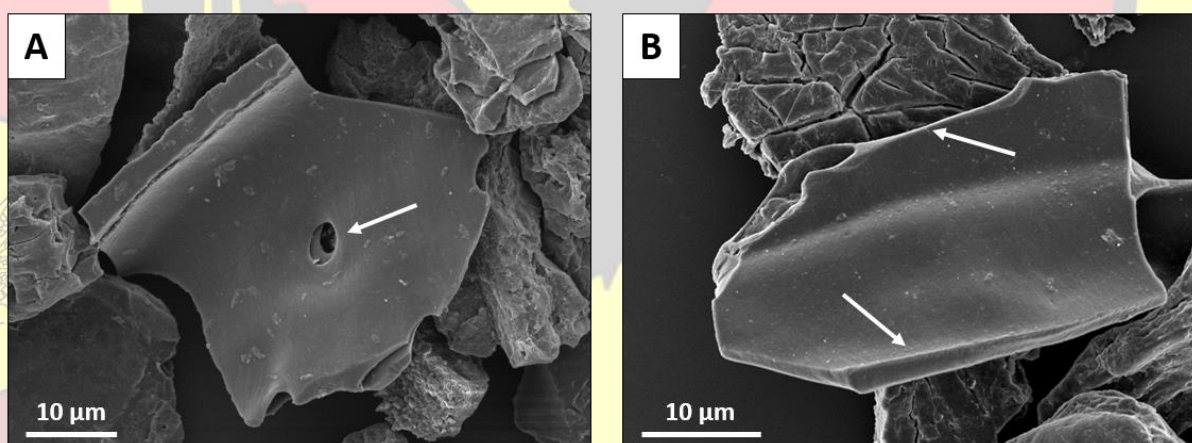
¹State Authority for Mining, Energy and Geology, Hannover, Germany

²Senckenberg Forschungsinstitut und Naturmuseum Frankfurt, Frankfurt am Main, Germany

*Corresponding author: annette.goetz@lbeg.niedersachsen.de

Fossil charcoal provides indirect evidence of palaeo-wildfires and gains increasing interest as a proxy in the reconstruction of past climates. Today, increasing temperatures and decreasing precipitation/humidity appear to correlate with increases in the frequency and intensity of wildfires in many regions worldwide. Apart from appropriate climatic conditions, sufficient atmospheric oxygen (>15%) is a necessary condition to sustain combustion in wildfires. The Triassic has long been regarded as a period lacking evidence of wildfires; however, recent studies have provided data suggesting their occurrence throughout almost the entire Triassic. Still, the macro-palaeobotanical record is scarce and the study of charcoal and inertinite as a group of pyrogenic coal macerals from palynological residue is seen very promising to fill the gap in our current knowledge on the fossil record of Triassic wildfires, both on a regional and global scale.

Here, we present new records of micro-fossil charcoal from the Triassic of the Germanic Basin, demonstrating the occurrence of wildfires during Buntsandstein, Muschelkalk and Keuper (Anisian–Ladinian). The particles analyzed by means of scanning electron microscopy show anatomical features typical of gymnosperms, a major element of the early Mesozoic post-extinction vegetation. From the continuously increasing dataset of Triassic charcoal it becomes apparent that the identification of wildfires will play a crucial role in future studies deciphering Triassic climate dynamics.



Scanning electron microscope images of Triassic micro-fossil charcoal. A) Fragment of a tracheid with a bordered pit; B) Fragment of a tracheid with homogenised cell wall.

Late Triassic dinoflagellate cysts from the Northern Carnarvon Basin, Western Australia

Mantle, D. J.^{1*}, Riding, J. B.² and Hannaford, C.¹

¹MGPalaeo, 1/5 Arvida Street, Malaga, WA 6090, Australia

²British Geological Survey, Keyworth, Nottingham NG12 5GG, United Kingdom

*Corresponding author: e-mail: dan.mantle@mgpalaeo.com.au

The Late Triassic radiation of cyst-forming dinoflagellates in the Southern Hemisphere is investigated in the Northern Carnarvon Basin, Western Australia. This major depocentre, situated on the southern margin of the Tethys Ocean, accumulated extensive deltaic and shallow marine successions at this time, that frequently host early dinoflagellate cyst assemblages. Numerous petroleum exploration wells in the basin have penetrated the fluvially dominated Mungaroo Formation and shallow marine Brigadier Formation, of Anisian–Norian and Rhaetian ages, respectively. Consequently, huge numbers of cuttings and sidewall core samples from these northwest prograding deltaic systems are available for study. Many of the dinoflagellate cysts from the Mungaroo and Brigadier formations have not been taxonomically formalised, including many forms that are used in open nomenclature within the oil and gas industry. This study formally documents these occasionally abundant and diverse dinoflagellate cyst assemblages with the aim of providing a consistent taxonomic framework for future work on the Upper Triassic successions of the Northern Carnarvon Basin. This will aid the recognition of individual flooding events via their characteristic palynomorph signatures and help to build on significant recent advances in regional sequence stratigraphy. One new genus, 14 new dinoflagellate cyst species and one new subspecies are described from the most diverse Late Triassic dinoflagellate assemblage yet published. A further nine genera and 15 dinoflagellate species are also recorded from the Carnian–Rhaetian *R. wigginsii*, *W. listeri*, *H. balmei*, *R. rhaetica* and *D. priscum* dinoflagellate zones. The documented assemblages are not only significant biostratigraphically, but it is also postulated that high diversity Triassic dinoflagellate cyst associations were paleoclimatically controlled, and were likely confined to the temperate and cool temperate paleolatitudes.

Palynostratigraphy of the Triassic-Jurassic of the Silves Group, Lusitanian Basin, Portugal

Vilas-Boas, M.^{1*}, Pereira, Z.², Cirilli, S.³, Duarte, L. V.⁴ and Fernandes, P.¹

¹CIMA - Centro de Investigação Marinha e Ambiental, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal

²LNEG, Laboratório Nacional de Energia e Geologia, Rua da Amieira, 4465-965 S. Mamede de Infesta, Porto, Portugal

³Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, 06123 Perugia, Italy

⁴University of Coimbra, MARE - Marine and Environmental Sciences Centre, Rua Sílvio Lima, 3030-790 Coimbra, Portugal

*Corresponding author: margarida.vboas@gmail.com

We studied the miospore assemblage from an Upper Triassic to Lower Jurassic succession of the Silves Group near Coimbra, Portugal. The latter consists of, from base to top, the Conraria, Penela, Castelo Viegas, and the Pereiros formations. The palynological assemblages allowed establishing an informal palynozonation and providing new biostratigraphic that helped constrain the age attribution to the Silves Group formations.

Accordingly, the main results of this study are the presence of a palynological assemblage referable to the *Classopollis meyerianus* - *Granuloperculatipollis rudis* (CG) palynozone that allowed to date the Norian, to possibly earliest Rhaetian, for the Conraria Formation at the base of the Silves Group. The palynological content of the Pereiros Formation, at the top of the Silves Group, allowed us to distinguish two informal palynozones: *Ischyosporites variegatus* - *Kraeuselisporites reissingeri* (IK), and *Pinuspollenites minimus* (Pm). The palynozones date the latter formation as upper Rhaetian to early Hettangian. Therefore, the Triassic-Jurassic Boundary should lie in the lower Pereiros Formation, within the *Ischyosporites variegatus* - *Kraeuselisporites reissingeri* (IK) palynozone. Lastly, the lack of palynological data from the Penela and Castelo Viegas formations, due to unsuitable lithologies, did not allow a palynostratigraphic revision for the entire Silves Group. However, their stratigraphic position is sandwiched between the underlying Conraria Formation (Norian-earliest Rhaetian?) and the overlying Pereiros Formation (uppermost Rhaetian to Hettangian age); thus, a Rhaetian age is the most likely. The presence of an hiatus between the underlying Castelo Viegas and the overlying Pereiros formations did not allow the identification of the lower boundary of the IK palynozone.

The microflora assemblages from the Lusitanian Basin recorded along the Late Triassic to Early Jurassic times might shed new light on future palaeogeographic and palaeoclimatic reconstructions of this sector of the Tethys realm. The close affinity of these assemblages with those of Western Europe and Tethys basins should suggest general homogenous climate conditions (warm and humid) caused both by intense monsoonal activity.

Preliminary geochemical palynological study of Toarcian (Jurassic) in the Central High Atlas, Morocco

Khaffou, H.¹, Hssaida, T.¹, Ben-Bouziane, A.¹, Essamoud, R.¹, Essafroui, B.², El Ouali, M.², Jaydawi, S.³, Chakir, S.¹, Rachid, J.¹ and Chafai, K.¹.

¹ Laboratory of Sedimentary Basin Dynamics and Geological Correlations, Department of Earth Sciences, Ben M'sik Faculty of Sciences, Hassan II University Avenue Cdt Driss El Harti, BP7.955, Ben M'sik 20.800, Casablanca, Morocco (hananekhaffou02@gmail.com)

² Department of Geology Faculty of Sciences and Techniques Errachidia, Moulay Ismail University, BP 509 Boutalamine-Errachidia, 52000, Morocco

³ University Mohammed V, Faculty of Science, Rabat, 4 Avenue Ibn Batouta, BP 1014

The High Atlas, where the studied section is located, is an intracontinental chain, connected to the Alpine cycle and the Africa / Europe convergence (Frizon de Lamotte et al., 2008; Mattauer et al., 1977). The Atlas results from the Cenozoic inversion of a Triassic-Jurassic rift open during the rifting phases of the Tethys and the Central Atlantic Ocean.

The Central High Atlas mainly corresponds to a Lower and Middle Jurassic marine sedimentation basin that has been inverted and folded in the anticlinal axis in a WSW-ENE direction. . The Toarcian is a significant stage in the evolution of the Atlas domain.

The Toarcien, the subject of this research, was surveyed at the level of a part in the town of Rich's center southwestern high atlas (410m thick). A qualitative and quantitative palynological research was conducted on around thirty field samples. Thirty field samples were subjected to a qualitative and quantitative palynological research. The first results are promising by their composition in Palynomorphs (dinoflagellate cysts, spores, pollens, Acritarchs, chitinous foraminifera and Tasmanaceae). The association of dinoflagellate cysts composed of *Walloedinium* spp, *Mancodinium semitabulatum* and *Phalocysta* spp which dominates in all the samples.

The lack of the genus *Nannoceratopsis* spp. and the presence of the marker taxon *Luehndea spinosa*, which identifies the Toarcien, are notable. The evolution of paleoenvironments throughout the Toarcian and the quality of organic matter are determined from the palynofacies study using Tyson's technique, 1993, combined with geochemical data (Rock Eval), which indicates immature organic matter of type III. The quantitative and qualitative data from the palynofacies reveal five intervals that correspond to the evolution of the paleoenvironment during the Toarcian, oscillating between the proximal continental plateau (PC) (the section's base) and an anoxic-dysoxic paleoenvironment towards a Continental Oxic – heterolithic plateau.

References :

-Frizon de Lamotte, D., Zizi, M., Missenard, Y., Hafid, M., El Azzouzi, M., Charriere, A., Maury, RC, Taki, Z., Benammi, M., Michard, A., 2008. The Atlas system. In: Michard, A., Saddiqi, O., Chalouan, A., Frizon de Lamotte, D. (Eds.), *Continental Evolution: The Geology of Morocco*. Springer-Verlag, Heidelberg. pp. 133–202.

-Mattauer, M., Tapponnier, P., Proust, F., 1977. On the mechanisms of formation of intracontinental chains: the example of the Atlas chains of Morocco. *Soc. Geol. Fr.*, 7, XIX, 3, 521-526.

-Tyson RV (1993) -Palynofacies analysis. In: Jenkins DG (ed) *Applied micropaleontology*. Kluwer Academic Publishers, Dordrecht, the Netherlands, pp 153–191.

Bajocian palynology of the Boulmane marls (Middle Atlas, Morocco): Palynostratigraphy & Paleoenvironment.

Chakir, S.¹, Hssaida, T.¹ Slimani, H.² Riding, J.B.³ Benzaggagh, M.⁴, Ben-bouziane, A.¹, Essamoud, R.¹, Jaydawi, S.², Afenzar, A.³, Rachid, J.¹, Khaffou, H.¹ et Chafai, K.¹

Sara CHAKIR¹, Touria Hssaida¹, Hamid SLIMANI², James B. RIDING⁴, Mohamed BENZAGGAGH³, Abdelmajid BENBOUZIANE¹, Rachid ESSAMOUD¹, Soukaina JAYDAWI⁵, & Hanane KHAFFOU¹

¹ Laboratory of Dynamics of Sedimentary Basins and Geological Correlations, Department of Geology, Faculty of Sciences Ben M'Sik, Hassan II University of Casablanca, Avenue Cdt Driss El Harti, BP 7.955, Ben M'Sik 20,800, Casablanca, Morocco (sarachakiro20@gmail.com).

² Geo-Biodiversity and Natural Patrimony Laboratory (GEOBIO), "Geophysics, Natural Patrimony and Green Chemistry" Research Center (GEOPAC), Scientific Institute, Mohammed V University in Rabat, Avenue Ibn Batouta, P.B. 703, 10106 Rabat-Agdal, Morocco

³ British Geological Survey, Environmental Science Centre, Keyworth, Nottingham NG12 5GG, Royaume-Uni.

⁴ Moulay Ismail University, Faculty of Science, BP 11201, Jbabra, Zitoune, Meknes, Morocco.

⁵ University Mohammed V, Faculty of Science, Rabat, 4 Avenue Ibn Batouta, B.P. 1014

After their appearance at the Middle Triassic and a low occurrence during the lower Jurassic, the dinoflagellates underwent a great abundance of the Gonyaulacoides family in the Bajocian with an important generic and specific diversity, through more than 100 species. While the abundance work on the Jurassic dinoflagellate, the dinoflagellates studies on the Bajocian are still rare on the series from the north-Tethyan domain, and almost absent on those of South-Tethyan domain. In order to better contribute in the characterization of the Bajocian association from this paleontological group, we studied a lithological section in the thick marl formation of Boulmane. This formation was dated as middle Bajocian by ammonites and foraminifera. (Middle Bajocian corresponding to the Ammonite zones: *Sauze* Zone – *S. Humphriesanum* Zone. Du Drenay, 1971-1974). The studied section (70m) is located near the center of Boulmane and belongs to the folded Middle Atlas domain. As a result, 28 species of dinoflagellate cysts have been counted there, including five species of: *Wallodinium cylindricum*, *Batiacasphaera* sp., *Dissilodinium giganteum*, *Phallocysta* sp. *Cribroperidinium crispum*, *Endoscrinium asymetricum*, *Scriniocassis priscus* and *Durotrigia Davey*. This association characterized the "middle" Bajocian and allow us to confirm this age, previously attributed to this formation. The paleoenvironmental evolution of the Boulemane Marl Formation was also enlightened by the palynofacies and lithofacies analysis.

Palynology of the Tarhrat Ifesfassen section of the Agadir Basin (Morocco): Palynobiostratigraphy and Paleoenvironment

Jaydawi, S.^{1*}, Hssaida, T.², Benbouzaine, A.², Chakir, S.², Khaffou, H.²

¹Mohamed V University in Rabat, Faculty of Sciences Rabat

²Hassan II University in Casablanca, Faculty of Sciences Ben M'Sik

³Department, Institute, Address, Country

*s.jaydawi@um5r.ac.ma

Palynological studies of about twenty samples carried out in more favorable sediments of the Tarhrat Ifesfassen section (north of the city of Agadir: at the level of the Ida Outanane mountain range): revealed the presence of rich and diversified dinoflagellate cyst associations. Thanks to the markers contained in these associations, ages ranging from Upper Bathonian-Lower Oxfordian were proposed and five biozones established.

Two biozones for the Callovian (Biozone with *Ctenidodinium sellwoodii*, *Ctenidodinium combazii*, *Ctenidodinium continuum*, and *Lithodinia caytonensis*), one biozone for the Callovo-Oxfordian Passage (Biozone With: *Wanaea thysanota* and *Gonyaulacysta centriconnata*) and two biozones for the Oxfordian (Biozone of association with *Gonyaulacysta jurassica adecta*, *Liesbergia liesbergensis*; *Scriniodinium cristallinum* and *Endoscrinium galeritum*). These biozones have been correlated with biozones of the South-Thysian margin of northern Morocco (Guercif basin and external Rif) and with synchronous biozones defined in other paleogeographic domains of the globe (sub-boreal, boreal and southern domains).

The evolution of the paleoenvironment can be summarised in two phases: a transgression during the Lower Callovian-Oxfordian with fine fluctuations in sea level. A regressive regime, during the Middle-Upper Oxfordian, manifested by the very high rate of the terrigenous fraction.

DAY 5, AUGUST 13th General palynology

First palynological data from the Jurassic-Cretaceous boundary in the Galicia Bank (NW Spain; ODP Leg 103; Site 639)

Santos A.A.^{1,2*}, Rodríguez-Barreiro, I.^{1,2}, Villanueva-Amadoz, U.³, and Diez, J.B.^{1,2}

¹ Department of Marine Geosciences, University of Vigo, Campus As Lagoas-Marcosende, Vigo, Spain

² Centro de Investigación Mariña, Universidade de Vigo (CIM-UVIGO), Vigo, Spain.

³ Estación Regional del Noroeste (ERNO), Instituto de Geología, UNAM, 83000, Hermosillo, Mexico

*Corresponding author: artaisantos@gmail.com

The Jurassic-Cretaceous boundary (J/K) has been debated for years, its delimitation is not clear and currently it is the last remaining system boundary without GSSP. In this preliminary study, we have analyzed a total of 96 samples of marls and mudstones from 4 different holes in the Leg 103 site 639 (drilled in the Galicia Bank, NW Spain), requested to the Bremen Core Repository. It consists of a continuous succession from the Tithonian to the Valanginian strata. The palynological extraction carried out following standard methods in palynology (HCl-HF-HCl). All holes presented productive levels in palynomorphs. In the studied samples 3 palynological assemblages could be distinguished: The Assemblage 1 from the Tithonian samples (Site 639; Core D; 5R to 11R Sections) is dominated by *Leptolepidites*, *Pilosporites*, *Concavissimisporites* and *Classopollis*. The Assemblage 2 is Upper Tithonian-Lower Berriasian (Site 639; Core B, C, and upper sections of D) with abundance of *Classopollis*, bisacate pollen and *Cicatricosisporites*. The Assemblage 3 is Valanginian in age (Site 639; Hole A; Core 1R to 5R) is dominated by *Cicatricosisporites*, *Cibotiumspora* and *Patellasporites* with presence of angiosperm-like pollen. Other Non-Pollen Palynomorphs (NPPs) were found in the different levels of the sequence, including dinoflagellate cysts, foraminiferal test lining, Lepidopteran scales, scolecodonts, algae, fungi, and cuticle remains. The relatively abundant presence of marine palynomorphs as dinoflagellate cysts and foraminiferal test linings from the Tithonian-Berriasian limit to the Valanginian levels suggests a transitional environment with a clear marine influence during the Early Cretaceous and the Jurassic-Cretaceous boundary in the Galicia Bank area. In the Tithonian levels no marine palynomorphs were found. These data represent the first palynological study from the Jurassic-Cretaceous boundary in the Galicia area and in the northwest of the Iberian Plate.

Palynological analysis of an Early Cretaceous peat-forming flora: Insights into the floral composition, environment, and climatic conditions of the Yimin Formation (Hailar Basin, Inner Mongolia, China)

Wheeler, A.^{1*}, Shen, J.², Moore, T.A.^{2,3,4}, Moroeng, O.M.⁵ and Liu, J.^{2,6}

¹Independent Contractor, Bloemfontein, South Africa.

²School of Resources and Geosciences, China University of Mining and Technology, Xuzhou, 221116, China

³School of Earth and Atmospheric Sciences, Queensland University of Technology, Brisbane, QLD, Australia

⁴Cipher Consulting Pty Ltd, Kenmore, QLD, Australia

⁵Department of Geology, University of Johannesburg, Auckland Park, South Africa

⁶State Key Laboratory of Coal Resources and Safe Mining, China University of Mining and Technology, China

Corresponding author: alex.thomas.wheeler@gmail.com

The Yimin Formation in the Hailar Basin contains a significant accumulation of lignite that formed contemporaneously with the diversification and expansion of angiosperms across Eurasia in the late Early Cretaceous. The main aims of this study were to use palynological data from samples extracted from the #16 seam (which features an average VR of 0.24%) to reconstruct the flora of a peat mire during the Early Cretaceous, and to gain insights into the local environmental and regional climatic conditions of the Hailar Basin. Eighteen palynological samples from the lignite as well as from the claystone/mudstone intraseam partings, and from the immediate roof of the seam were collected, processed and counted. The lignite samples yielded fewer palynomorphs and less diverse assemblages than in the inorganic sediments, but the dominant taxa were broadly the same. The palynological assemblage is dominated by spores mainly belonging to ferns (*Deltoidospora*, *Cyathidites*, *Osmundacidites*), and pollen, which were predominantly conifers (*Pinuspollenites*, *Discciatrileti*, *Protoconiferus*). Other notable taxa could be associated with bryophytes (*Sphagnumsporites*), lycopsids (*Lycopodiumsporites*) and ginkgoes/cycads (*Cycadopites*, *Eucommidiites*). Araucarian conifer pollen (*Araucariacites* and *Chasmatosporites*), and cheirolepidacean conifer pollen (*Classopollis*) were also observed throughout the studied section. The absence of angiosperm taxa is notable as these pollen grains have been found in other non-peat-forming localities in the Yimin Formation and are used to define the major biostratigraphic zones of the region. The lack of angiosperms in the mire may be due to environmental conditions (i.e., acidity) or competition with a relatively stable peat-forming flora. Most of the conifer pollen can be attributed to Pinaceae, which contrasts with historical palaeobotanical data suggesting that the lowland conifers were made up of mainly Taxodiaceae/Cupressaceae and Taxaceae. This likely indicates significant pollen input into the mire from upland or extrabasinal forests. The input of pollen from outside of the mire also causes the true abundance of ginkgoes and cycads to be underestimated in the dataset as they are far more common and diverse in the macrofloral record. The basinal flora itself is consistent with a warm and humid climate, though high abundances of fusinite (fossil charcoal) in the lignites suggest that wild and/or peat fires were frequent. The rare but consistent appearance of *Classopollis* may suggest drier periods (seasonally or over a longer timescale).

Further work is necessary to better connect the palynological assemblages to macrofossil and geochemical data as well as to establish if the absence of angiosperms in the mire is an isolated local phenomenon or a regional occurrence. This may have implications for our understanding of the environmental tolerances of early angiosperms, their spread across Eurasia and how they became a significant part of Late Cretaceous floras.

Dinocyst stratigraphy of the Carolinefjellet Formation at Schönrockfjellet– age constraints for the youngest part of the Lower Cretaceous succession in Svalbard

Fredborg, J.M.^{1*}, Grundvåg², S. and Śliwińska, K.K.³

¹Department of Geoscience and Natural Resources Management (IGN), University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K, Denmark (vzl153@alumni.ku.dk)

²Department of Geosciences, UiT The Arctic University of Norway, 9037 Tromsø, Norway

³Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, 1350 Copenhagen K, Denmark

The Carolinefjellet Formation is an Aptian–Albian marine succession on Spitsbergen (Svalbard, Arctic Norway). The formation comprises five intercalated sandstone and mudstone-dominated members, whereby the upper two have informal member status: the Zillerberget and the Schönrockfjellet members. Their informal member status is partly due to uncertainties in regards to their age, as well as their stratigraphic and lateral relationship to the underlying units. Previous palynological studies of these two units, which were based on relatively few samples and was limited to the presence/absence of key species, suggests a middle Albian age for the succession. The aim of this study is thus to more precisely constrain the age of these two members, based on biostratigraphy of palynomorphs (dinoflagellate cysts (dinocysts) and acritarchs).

Eleven sedimentary rock samples were collected from a c. 160 m thick vertical section at Schönrockfjellet in SE Spitsbergen, thus spanning the upper part of the Zillerberget member and the entire Schönrockfjellet member. The samples vary in palynomorph preservation state as well as in dinocyst diversity. The palynomorph assemblage in the uppermost sample exhibited an excellent preservation and a high diversity. The two lowermost samples yielded poorly preserved palynomorphs and were of a lower dinocyst diversity. In the remaining samples the preservation was moderate to good, and the diversity varied from low to moderate.

We found that both members belong to the *Rhombodella paucispina* Zone, thus confirming a middle Albian age for the investigated succession. The Zillerberget member and the lower part of the overlying Schönrockfjellet member belongs to the *Litosphaeridium arundum* Subzone, and the two uppermost samples from the Schönrockfjellet member belongs to the *Chichaouadinium vestitum* Subzone. Furthermore, our study provides a more precise position of the lower boundary for the *Chichaouadinium vestitum* Subzone, which is now positioned at least 20 meters higher in the succession than previously indicated. Our study provides the first quantitative palynological analysis of the youngest part of the Lower Cretaceous succession in Svalbard and may thus shed new light on the regional palaeo-geographic development of the area.

Palynofacies of the Lower Cretaceous Pietraroja Lagerstätte (Campanian Apennines, southern Italy): Tool to unravel the depositional environment

Goetz, A. E.^{1*}, Graziano, R.², Bartiromo, A.², Raspini, A.³ and Jones, R.⁴

¹State Authority for Mining, Energy and Geology, Hannover, Germany

²Department of Earth Sciences, University of Naples Federico II, Naples, Italy

³Institute of Geosciences and Earth Resources (IGG-CNR), Florence, Italy

⁴Paly Parlour, Caerphilly, UK

*Corresponding author: annette.goetz@lbeg.niedersachsen.de

The early Albian Pietraroja Lagerstätte, famous for its exceptional fossil preservation and the finding of the theropod dinosaur *Scipionyx samniticus* (Dal Sasso and Signore, 1998), revealed well-preserved plant remains in the so-called Plattenkalk shedding light on the plant diversity of the Apenninic Carbonate Platform during the Early Cretaceous. The described macrofloral assemblage, its preservation and plant taphonomy support a low-energy, shallow-water environment with parautochthonous and allochthonous elements being preserved (Bartiromo, 2013). However, the depositional setting of these laminated, bituminous limestones is still controversial. Previous interpretations reach from a shallow intra-platform basin, high-energy marginal marine platform, restricted lagoon, to submarine channels. Here, we present palynofacies data from the Pietraroja Plattenkalk aiming to unravel the depositional setting of these early Albian deposits: The high percentage of amorphous organic matter (AOM) and well-preserved cuticles, as well as large phytoclasts and prasinophytes support a lagoonal environment. Stratigraphic variations in the sedimentary organic matter content may point to changes in fluvial sources, salinity, and high-frequency sea-level fluctuations. Ongoing studies target an integrated sedimentological and palynological-palaeobotanical approach to unravel the depositional history of the Albian Plattenkalk of the Pietraroja Lagerstätte.

References:

- Bartiromo, A. 2013. Plant remains from the Lower Cretaceous Fossil-Lagerstätte of Pietraroja, Benevento, southern Italy. *Cretaceous Research* 46, 1–15.
- Dal Sasso, C., Signore, M. 1998. Exceptional soft-tissue preservation in a theropod dinosaur from Italy. *Nature* 392, 383–387.

Palynology from the Late Albian-Cenomanian deposits of the Vigo Seamount, Eastern North Atlantic (LEG 47B, site 398D).

Rodríguez-Barreiro, I.^{1,2*}, Santos, A. A.^{1,2}, Villanueva-Amadoz, U.³ and Diez, J. B.^{1,2}

¹Departamento de Xeociencias Mariñas e Ordenación do Territorio, Universidade de Vigo, 36310 Vigo, Spain.

²Centro de Investigación Mariña, Universidade de Vigo (CIM-UVIGO), Vigo, Spain. ³Estación Regional del Noroeste (ERNO), Instituto de Geología, UNAM, 83000, Hermosillo, Mexico

*Corresponding author: ivanrodbar@gmail.com

The site 398D drilled during Leg 47B from the Deep Sea Drilling Project is located in the southern part of the Vigo Seamount, less than 150 km off the Iberian coast. The samples were requested to the Bremen Core Repository. A total of 35 samples between cores 58-2 (84 cm) and 40-2 (1 cm), were analyzed under the palynological standard treatment of HCl-HF-HCl. Eleven samples yielded palynomorphs. Palynological content shown two distinctive palynological assemblages. The assemblage A, located between cores 58-2 (84 cm) and 56-4 (7 cm), is dominated by spores of *Appendicisporites*, *Camarozonosporites*, *Cicatricosisporites*, *Crybelosporites* and *Patellasporites* as well as marine palynomorphs like foraminiferal test linings and dinoflagellates cysts in all the positive levels. The age of this assemblage seems to be Late Albian-Cenomanian. The assemblage B, located between cores 56-2 (132 cm) and 56-2 (123 cm), is dominated by *Normapolles* pollen as *Atlantopollis* and *Complexiopollis*, whereas the marine influence is absent in most of the levels. The age of this assemblage seems to be Middle Cenomanian. The samples above core 56-2 (123 cm) are barren in palynomorphs. This work provides a more complete study from the palynology content of the mid-Cretaceous deposits of the site 398D. The assemblage B has a special interest as it is the first report of a *Normapolles*-dominated assemblage documented in this area. This assemblage is corresponding to the Cenomanian-Turonian Boundary Event (CTBE) and, comparing to nearby palynological assemblages as those from site 641A from the Leg 103, composition and relative abundances of the palynomorphs are very close.

Oceanographic and biotic changes in Australia during Oceanic Anoxic Events

Walker-Trivett, C. A.^{1,2*}, Kender, S.¹, Littler, K.¹, Bogus, K.¹, Hesselbo, S.¹, Riding, J.², Leng, M.².

¹Camborne School of Mines, The University of Exeter, Tremough Campus, Penryn, TR10 9EZ, UK

²The British Geological Survey, Nicker Hill, Keyworth, Nottingham, NG12 5GG, UK

*Corresponding author: cw725@exeter.ac.uk

During the Mesozoic, Earth experienced a rare series of abrupt and short-lived episodes of widespread oceanic anoxia known as "Ocean Anoxic Events" (OAEs). OAEs are characterised by severe global warming, often considered to be triggered by volcanic degassing of CO₂. Despite their importance for understanding the deep-Earth/ocean/atmosphere system, the environmental impacts and causal mechanisms of OAEs have yet to be fully resolved, and are particularly poorly understood in the Southern Hemisphere where records are extremely limited. One of the largest such events, OAE 2 at the Cenomanian–Turonian boundary (~94 Ma), has been associated with volcanism, abrupt warming, an enhanced hydrological cycle, increased nutrient supply to the oceans, high productivity, and mass extinctions in marine biota. This project aims to reconstruct the climate, palaeoceanography and vegetation of SW Australia before, during, and after OAE 2 for the first time, through analysis of new core material collected during International Ocean Discovery Program (IODP) Expedition 369.

To date, OAE 2, and one regional 'precursor' event called OAE 1-d, have been identified using stable bulk C and O isotopes. These data demonstrate the global extent of low oxygen oceans and indicate short-term relative sea surface temperature changes over OAEs. Changing Nd and Sr isotope values over OAE 2 indicate shifts in sediment provenance – highlighting a change in weathering or sediment source/transport in terrestrial environments at the Cenomanian-Turonian boundary. Ongoing work examines the biotic response to changes in climate and ocean chemistry, using dinoflagellate cyst, pollen, and spore assemblages to track oceanic productivity and terrestrial vegetation change, respectively. Observations so far indicate a reduction in both abundance and diversity of dinoflagellate cysts prior to OAE 2, which will be confirmed with ongoing quantitative counts. Future work will reconstruct sea surface temperatures through the Albian – Cenomanian using the TEX₈₆ proxy – providing climatic context for the abrupt shifts in ocean chemistry seen over OAEs, and linking possible long term shifts in dinoflagellate and vegetation communities with temperature variations across 20 million years.

Combined, these proxies will determine the extent and extremity of climate change in the mid-Cretaceous over OAE 2, and provide insights into marine and terrestrial biotic responses to high global temperatures of the past. This information is critical in understanding the possible responses of modern organisms to our ever-warming planet, and to oceans at increased risk of experiencing dysoxic or anoxic conditions in the near future.

New palynostratigraphic data on the Tarfaya basin

Chafai, K.¹, Hssaida, T.¹, Essamoud, R.¹, Rjimati, CH.², Houssa, R.³, Afenzar, A.⁴, Louaya, A.⁴, Rachid, J.¹ and Khaffou, H.¹

¹Laboratory of Dynamics of Sedimentary Basins and Geological Correlations, Department of Geology, Faculty of Sciences Ben M'Sik, Hassan II University of Casablanca, Avenue Cdt Driss El Harti, BP 7.955, Ben M'Sik 20.800, Casablanca, Morocco.

²Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement, Rabat, Maroc

³National Institute of fisheries Research, Bd Sidi Abderrahmane, Casablanca, Morocco

⁴Laboratory of Geosciences, Environment and Associated Resources (LGERA), Department of Geology, Sidi Mohamed Ben Abdellah University, Faculty of Sciences Dhar El Mahraz, Fes, Morocco

*Corresponding author: chafai.khaoula@gmail.com

An approach integrating sedimentological and palynological data was conducted on samples from sections located in limestone and marl outcrops rich in organic matter, and which are exposed near the coast and around the sebkhs.

These outcrops are of Cretaceous-Cenozoic age belonging to the Tarfaya-Laayoune-Boujdour-Dakhla-Lagouira basin (TLBDL). This basin being along the west coast of Africa in a direction NNE-SSW, it is limited to the south by the parallel 27 ° 40' North and to the east by the meridian 8 ° 40' West Greenwich. It is for the most part located in the southwest of the Moroccan Sahara. It is limited to the North by the Anti Atlas, to the South by the Oulad Dlim Domain, to the East by the Réguibate Dorsal and to the West by the Atlantic Ocean.

The evolution of TLBDL basin is tightly connected with the geological history of the African craton and the opening of the Atlantic.

The objective of this study is to:

- Is to contribute in the precision of the stratigraphy of this basin thanks to the rich and diverse associations of the dinoflagellate cysts listed in the samples studied
- To trace the evolution of paleoenvironments during the Upper Cretaceous by ecological marker taxa
- Characterize the organic matter by pyrolysis Rock-Eval.

Bursting the bubble on vesiculation: A case study of ecophenotypy in the dinoflagellate cyst *Cannosphaeropsis franciscana* Damassa, 1979 across the K/Pg boundary with consideration for the genus *Hafniasphaera*

McLachlan, S. M.S.^{1*}, Pospelova, V.^{2,1} and Humphrey, E. C.¹

¹School of Earth and Ocean Sciences, University of Victoria, Victoria, BC, Canada

²Department of Earth and Environmental Sciences, University of Minnesota, Minneapolis, MN, USA

*Corresponding author: sandymcl@uvic.ca

Recent discovery of an Upper Cretaceous–lower Paleogene (upper Maastrichtian–lower Selandian) succession within the Oyster Bay Formation on eastern Vancouver Island, British Columbia, Canada, has been made possible based on dinoflagellate cyst biostratigraphic controls (McLachlan and Pospelova 2021). The exquisite preservation of material in these strata has presented the opportunity to analyze an unprecedented range of variation within an enigmatic spiniferate gonyaulacacean genus and species represented by *Cannosphaeropsis franciscana* (McLachlan et al. 2021). Using both light-transmitted and scanning electron microscopy, we observe forms across a broad morphological plexus defined by differences in process type, autophragm geometry and most significantly, vesiculation. The presence and extent of cyst vesiculation is designated as a higher-order diagnostic character resulting in the erection of three subspecies: *Cannosphaeropsis franciscana* subsp. *franciscana* (autonym), *Cannosphaeropsis franciscana* subsp. *Vacuoseptata* subsp. nov. and *Cannosphaeropsis franciscana* subsp. *vesiculate* subsp. nov. The onset and decline of vesiculate forms within the lowest Danian interval constitutes the basis for the interpretation that the subspecies reflect an ecophenotypic response to changing paleoenvironmental factors above the K/Pg boundary, specifically those of unstable, stratified marine conditions associated with the post-Cretaceous transgressive phase. Assemblage data throughout the formation also reveal members of the vesiculate genus *Hafniasphaera* increase their abundances in nutrient-rich and likely stratified coastal waters when *Spiniferites* species are also abundant. The development of vesicles is suggested as an adaptation prolonging cyst buoyancy and slowing their descent in the water column. An extensive literature review encompassing all illustrated reports of formally recognized species belonging to *Cannosphaeropsis* and *Hafniasphaera* is also presented alongside taxa chronostratigraphic ranges.

References: McLachlan, S.M.S., Pospelova, V. 2021. Dinoflagellate cyst-based paleoenvironmental reconstructions and phytoplankton paleoecology across the Cretaceous–Paleogene (K/Pg) boundary interval, Vancouver Island, British Columbia, Canada. *Cretaceous Research* 126, 104878, doi: 10.1016/j.cretres.2021.104878.

McLachlan, S.M.S., Pospelova, V., Humphrey, E.H. 2021. Vesiculation in the dinoflagellate cyst *Cannosphaeropsis franciscana* Damassa, 1979 across the K/Pg boundary (Vancouver Island, Canada) with implications for spiniferate gonyaulacacean taxonomy and ecophenotypy. *Review of Palaeobotany and Palynology* 292, 104452, doi: 10.1016/j.revpalbo.2021.104452.

Evaporite palynology: a case study of the Permian (Lopingian) Zechstein Sea

Gibson, M. E.^{1,2*} and Bodman, D. J.^{2,3}

¹Department of Geography and Environmental Science, Northumbria University, Ellison Building, Ellison Place, Newcastle Upon Tyne NE1 8ST, UK

²Department of Animal and Plant Sciences, The University of Sheffield, Alfred Denny Building, Western Bank, Sheffield S10 2TN, UK

³MB Stratigraphy Limited, Unit 11 Clement Street, Sheffield S9 5EA, UK

*Corresponding author: martha.gibson@northumbria.ac.uk

Ancient salt bodies were deposited under extreme environmental conditions, representing periods of climate and environmental change. Organic matter is trapped and protected from decomposition by evaporite minerals as they grow rapidly from shallow saline surface water. Evaporites are therefore the ideal trap for microscopic wind-borne organic matter, including sporomorphs, but have historically presented obstacles for palynological study as standard processing techniques are ineffective. Sequences of evaporites can therefore present technical challenges for palynological and biostratigraphic studies. Nevertheless, with appropriate processing techniques, they represent a valuable opportunity for high-resolution studies.

Thick evaporites characterize the Lopingian of Europe therefore we present a case study for processing the Lopingian Zechstein Group (c. 258–251 Ma) evaporites of central-western Europe for the recovery of palynomorph assemblages. The Zechstein Sea of western and central Europe is a classic example of a giant evaporite basin. The basin is filled with thick evaporites originating from marine-derived brines, supplemented by intermittent meteoric contributions forming a total thickness of c. 2000 m. These have presented ample opportunity for developing a method for extracting palynomorphs from a variety of evaporative lithologies including rock salt, potassium-magnesium salt and sulfates.

We demonstrate that full recovery is easily achieved, with two main modes of palynomorph preservation observed: palynomorphs are either exceptionally well-preserved and orange-brown in colour, or poorly preserved, brown–black, opaque and fragmented. The latter are reminiscent of palynomorphs of high thermal maturity. We propose that the intact nature of preservation is a result of the rapid growth of near-surface halite crystals, with their darkening a consequence of locally enhanced heat flux due to the relatively high thermal conductivity of salt. The additional recovery of many large pollen grains and exceptionally three-dimensionally preserved fragments of cuticle is also a testament to the rapid precipitation and growth of salt crystals and their mechanical stability.

This case study highlights the exceptional preservation potential of evaporites and how they enable novel insights into an otherwise undescribed environment, demonstrating the utility and possibility of extracting palynomorphs from a variety of rock salt types with efficient processing times. This method should be applicable to a wide range of ancient, particularly other Permian evaporite systems which are used as terrestrial analogues for parts of the Martian surface and subsurface.

Spore malformation, the Devonian-Carboniferous boundary and the *tener* Event

Marshall, J. E. A.^{1*}

¹School of Ocean & Earth Science, University of Southampton, European Way, Southampton, UK

*Corresponding author: jeam@soton.ac.uk

Malformation in pollen and spores is being increasingly recognized in palynological assemblages. Many of these instances come from mass extinction event levels, and are generally interpreted as implying UV-B damage as a consequence of a reduced ozone layer. Examples from the Mesozoic have the advantage that experiments on wall development in living plant relatives has confirmed the link between UV-B radiation and malformation. For Palaeozoic spores there is, as yet, no experimental database that links UV-B irradiation to its likely expression through malformation and particularly how it might be expressed in the range of rather different types of sculpture present. This means that the recognition of malformation becomes a judgement based around expected variation within the sculptural elements of a particular spore species. In fact, several of the cited examples of spore malformation are probably within the normal range of morphological variation in these taxa.

The recent discovery that there is a short interval of intense spore malformation coincident with the Devonian-Carboniferous (D-C) boundary in East Greenland has focused attention on the slightly earlier latest Devonian records of hypothesized malformed spores. Particularly significant is *Retispora lepidophyta*, a key marker for the latest Famennian that despite its abundance and near global occurrence became extinct at the Devonian-Carboniferous boundary. Morphological variation has been recognized within *R. lepidophyta* with the separation of a smaller variety *R. lepidophyta tener* which also differs in details of its sculpture, again inferred as malformation (Streel, 2020). It is used to define the *tener* event with an inception in marginal sections in Belgium within a few meters of the D-C boundary.

In East Greenland the sediments were deposited within an active extensional basin with very high sedimentation rates. This provides a much higher resolution latest Devonian palaeoclimatic record with intervals of cool aridity separated by warmer and wetter episodes. *Retispora lepidophyta tener* is found within these sections with an inception in the basal LE spore zone coincident with a thermal maximum. However, it doesn't simply replace *R. lepidophyta* as larger forms reappear. Data for *tener* are presented including at Backlund Ridge which has the best record of latest Devonian spores within the basin.

Despite the evident success of its parent plant in spreading across the Devonian world it swiftly becomes extinct at the D-C boundary. It is speculated that it would have been an annual plant with little sporangial protection such that a few decades of elevated UV-B levels would rapidly exterminate the population. If this is the case it will always have been susceptible to UV-B damage. There is a lower magnitude warming event coincident with the LE spore zone boundary in East Greenland that may reflect an earlier episode of ozone layer thinning and UV-B damage which would result in malformation within *R. lepidophyta*. The DNA damage would increase the pool of 'natural' diversity and hence the inception of new variants. In fact, the *R. lepidophyta* plant may always have been susceptible to UV-B damage with its ruderal strategy making it at high risk of extinction within the Late Devonian terrestrial ecosystem. It lived fast, spread far, became a super-producer but was forever on the environmental edge.

References:

Streel, M. 2020. The Devonian/Carboniferous transition based on miospores in Europe. *SDS Newsletter* 35, 29-45.

Early Carboniferous (Asbian-Brigantian, Mississippian) miospore stratigraphy from the coast of Northumberland, UK.

McLean, D.,^{1*} Ingrams, S.,² Bodman, D.J.¹ and Booth, M.³

¹MB Stratigraphy Limited, 11 Clement Street, Sheffield, S9 5EA, UK

²School of Geosciences, University of Aberdeen, Kings College, Aberdeen, AB24 3FX.

³CGG-Robertson, Tyn-y-Coed, Llanrhos, Llandudno, LL30 1SA, UK

*Corresponding author: mbstratigraphy@gmail.com

The Scremerston section provides a continuous sequence of late Asbian to late Brigantian sedimentary rocks on the northumbrian coast South of Berwick-upon-Tweed between Spittal (NU 010 509) and Cocklawburn Beach (NU 026 489). The exposed strata belong to the upper part of the Tyne Limestone Formation and the lower and middle parts of the Alston Formation. The strata represent deposition in a mixed carbonate and siliciclastic fluvio-deltaic environment, and are arranged into coarsening- and cleaning-upward parasequences bounded by flooding surfaces. An idealised parasequence, consists of marine limestones and mudstones overlain by a coarsening-upwards clastic succession, topped by a palaeosol and coal. Fourteen limestones and twenty coal seams have been recorded in the section. Most coals are thin and laterally impersistent and their recording is dependent upon fortuitous location of good foreshore exposures which vary from time-to-time under different conditions of boulder, sand and seaweed cover.

Miospores from seventy-seven samples of mudstones, siltstones and coals associated with limestone units in the Scremerston section indicate a mid Asbian to late Brigantian age. The highest record of Asbian miospores (*Murospora margodentata* – *Rotaspora ergonulii* Subzone) is from mudstones above the *Spirifer* Bed while the lowest record of Brigantian miospores (*Tripartites vetustus* – *Rotaspora fracta* Biozone) is from mudstones and thin coals (close to the horizon of the Muckle Howgate Coal) above the Maiden Kirk Brae Sandstone. The intervening section is largely occupied by sandstones and reddened finer clastics considered unsuitable for miospore analysis. The horizon of the Watchlaw Limestone (locally taken as representing the base of the Brigantian) lies within this interval, but this unit is either lost to erosion beneath the Maiden Kirk Brae Sandstone, or is heavily dolomitised. An unnamed coal lying above the Watchlaw Limestone provided a fairly diverse miospore assemblage but which, despite extensive searching, could not be determined as either Asbian or Brigantian.

The base of the late Brigantian *Cingulizonates* cf. *capistratus* Subzone is identified between the Redhouse Burn Limestone and the Acre Coal. The age of this part of the section is controlled by conodonts. The underlying Eelwell Limestone provided conodont assemblages assigned to the *Gnathodus girtyi* - *Gnathodus bilineatus* Subzone, while the overlying Acre Limestone provided assemblages assigned to the *Lochreia nodosa* Subzone. The *L. nodosa* Subzone is correlated with the late Brigantian *Neoglyphioceras subcircularis* P_{2b} ammonoid Subzone.

Occurrence of acritarchs and their palaeoenvironmental significance in the Lower Gondwana of West Bokaro Coalfield, Hazaribagh, Jharkhand, India

Jha, Y.N.^{1*} and Sinha, H.N.¹

¹Department of Geology, Vinoba Bhave University, Hazaribagh-825301, India

*Corresponding author: ynjha1993@gmail.com

The palynological study of the Lower Gondwana Supergroup was carried out from the West Bokaro Coalfield comprising Talchir, Barakar, Barren Measures and Raniganj formations which yielded well preserved palynomorphs of spores, pollen and acritarchs. Spore and pollen dominates the assemblage and acritarchs are found in a subsidiary quantity. The yield of acritarchs is not uniform throughout the stratigraphic column. The Talchir Formation is characterised by only sphaeromorphs in sufficient numbers. The overlying Barakar Formation yielded rare occurrence of polygonomorphs and acanthomorphs whereas the Barren Measures has a good yield of acanthomorphs, sphaeromorphs and diacromorphs in sufficient quantity. The younger formation of the Lower Gondwana, the Raniganj Formation, has a poor yield of acritarchs.

The palynological findings of acritarchs with spores and pollens attributes to a marine influence in the terrestrial settings. The identified taxa from these formations are *Leiosphaereida* sp., *Michrhystridium* sp., *Baltisphaeridium* sp., *Acanthodiacrodium* sp., *Veryhachium* sp. in which the Barren Measures has yielded a well preserved abundant and diversified forms of acritarchs suggesting a sudden flood of unusual microphytoplankton in marine realm during middle Permian. The acritarch assemblage also suggests a definite shallow marine incursion and a transgression in the Lower Gondwana formations of the West Bokaro Coalfield. The yield of spore and pollen along with acritarchs from Lower Gondwana Supergroup represents the global temporary explosive spread of stress-tolerant acritarchs and the most survived ones possibly from the Tethyan marine transgression. This transgression justify the global transgression of Permian and the possible marine incursion in the basin may have occurred from the eastern continental margin along western Australia through a passage between the Indian southern margin and the western margin of Antarctica.

The Late Permian in the Muarádzi Sub-basin, Moatize-Minjova Basin, Mozambique – multidisciplinary palaeoenvironmental characterization

Lopes, G.^{1*}, Pereira, Z.², Fernandes, P.¹, Mendes, M.³, Marques, J.⁴ and Jorge, R.C.G.S.⁵

¹CIMA - Center for Marine and Environmental Research, Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal

²Laboratório Nacional de Energia e Geologia (LNEG), Rua da Amieira, Apartado 1089, 4466-901 S. Mamede de Infesta, Portugal

³Laboratório Nacional de Energia e Geologia (LNEG), Bairro da Val D'Oca, Apartado P. 14, 7601-909, Aljustrel, Portugal

⁴Gondwana Empreendimentos e Consultorias, Limitada, Rua B, No. 233, Bairro da COOP, Caixa Postal 832, Maputo, Mozambique

⁵Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa, Campo Grande, Edifício C6, Piso 4, 1749-016, Lisboa, Portugal

*Corresponding author: gmlopes@ualg.pt

A study involving lithofacies, palynofacies, and palynological analysis is presented for the Muarádzi Sub-basin. This sub-basin is part of the Moatize-Minjova Basin (MMB), a crucial Karoo aged coalfield in Mozambique previously situated in the southern-central part of Gondwana.

The study of Lopes et al. (2021) presents the data of 3 coal exploration boreholes. This study enabled the characterization of the depositional environments and existing palaeofloras in the Muarádzi Sub-basin. The palynological data indicates that all the successions have a Lopingian age and the vegetation recorded is typical of the Glossopteris Province. The flora is dominated by glossopterids (*Protohaploxypinus* and *Striatopodocarpites*) and gymnosperm pollen (*Alisporites*). Other palynomorphs revealed the presence of ferns (e.g., *Osmundidacites senectus*, *Thymospora pseudothiessenii*), sphenopsids (e.g., *Calamospora*), and lycopsids (e.g., *Lundbladispora*, *Kraeuselisporites*) in the area. The palynological data, together with the palynofacies and lithofacies analysis, indicates a typical lowland setting. It was an area where floodplains, wetlands, and small lakes dominated, controlled by tectonic movements associated with a continental rifting pulse. Correlation between the three sections enabled the recognition of an initial meandering fluvial system affected by repeated flooding events that changed to a braided river. Additionally, humid and warm climates promoted widespread vegetation growth, leading to the accumulation of numerous thin barcode coal beds in anoxic-dysoxic depositional environments.

Acknowledgments

This research was fully supported by the project PALEOCLIMOZ (PTDC/CTA-GEO/30082/2017), funded by Fundação para a Ciência e Tecnologia, Portugal. The authors would also like to acknowledge the financial support of the Portuguese Foundation of Science and Technology (FCT) to CIMA through UIDP/00350/2020.

AWARDS AND CLOSE

ABSTRACTS *for* POSTER PRESENTATIONS

All posters are available throughout the conference [here](#)

Palynological Study on Byttnerioideae (Sterculiaceae s.l.) Species in Malaysia.

Amirul-Aiman, A.J.^{1*}, Noraini, T.², Nurul-Aini, C.A.C.³, Ruzi, A.R.², Chung, R.C.K.⁴, Idris,⁵ and Suhaniza, R.⁵

¹Department of Environment, Faculty of Forestry and Environment, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Department of Biology and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

³Department of Plant Science, Kuliyyah of Science, International Islamic University Malaysia, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

⁴Forest Biodiversity Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia

⁵ Scanning Electron Microscopy Unit, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

*Corresponding author: amirulaimanahmad@upm.edu.my

A palynology study was conducted on 15 species from seven genera of subfamily Byttnerioideae (Sterculiaceae s.l.) in Malaysia. The objective of this study is to understand the variation in micromorphology and characteristics of pollen in Byttnerioideae species in Malaysia. Dried pollen samples of one species of *Abroma*, seven *Byttneria*, one *Commersonia* and *Kleinhovia*, two *Leptonychia* and *Melochia* and one *Waltheria* were selected in this study, namely *A. augusta* (L.) Willd., *B. scabrida* Ridl., *B. pilosa* Roxb., *B. elliptica* Pohl, *B. curtisii* Oliv., *B. reinwardtii* Korth., *B. maingayi* Mast., *B. jackiana* Wall., *C. batramia* (L.) Merr., *K. hospita* L., *L. caudata* Burret, *L. parviflora* (Ridl.) Veldkamp & Flippin, *M. corchorifolia* Wall., *M. umbellata* (Houtt.) Stapf and *W. indica* L. Methods involved were acetolysis techniques, single-grain technique, observation under light and scanning electron microscope. Findings have shown that there are no common characters shared by all genera studied except common characters occur between species under the same genus. There are variations in pollen characteristics in pollen size and class, aperture, outline, ratio of exine thickness, pore width and height, amb, shape and measurements. These characters are valuable in assisting identification of a group of taxa that can be used to differentiate between species and genus in the subfamily. This study proved that pollen morphological characteristics have taxonomic value in identification and differentiation of species and genus in subfamily Byttnerioideae (Sterculiaceae s.l.) in Malaysia.

***Pontiadinium* – an endemic brackish-water dinoflagellate cyst genus from Lake Pannon and the Paratethys realm (Central Europe, late Miocene -early Pliocene)**

Baranyi, V.^{1*}, Mudie, P.J.², Magyar, I.³, Kovács, Á.⁴ and Bakrač, K.¹

¹Department of Geology, Croatian Geological Survey, Sachsova 2, 10000 Zagreb, Croatia

²Geological Survey of Canada Atlantic, Box 1002, Dartmouth NS B2Y 4A2, Canada

³MOL Hungarian Oil and Gas Plc., Október huszonharmadika utca 18, 1117 Budapest, Hungary

⁴ Department of Geology, Eötvös Loránd University, Pázmány Péter sétány 1/C, 1117 Budapest, Hungary

*Corresponding author: vbaranyi@hgi-cgs.hr

The biota of the brackish-water Lake Pannon in the Pannonian Basin (Central Europe) is characterized by remarkable endemism due to its isolated evolution in the Central Paratethys realm for 8 myr. Lake Pannon was a large endorheic brackish-water lake during the late Miocene–early Pliocene that evolved isolated from the world ocean and the Mediterranean Sea after the last Miocene marine connection ceased ca. 11.6 Ma. A conspicuous feature of the endemism is the large, probably ecophenotypic morphological variability of dinoflagellate cysts as a response to brackish-water that challenges taxonomy and complicates biostratigraphy and ecological interpretations. Comparable dinoflagellate cyst taxa with morphological similarity to Lake Pannon cysts (including *Pontiadinium*) have been recorded from Pliocene-Pleistocene deposits of the Ponto-Caspian realm, but their classification and ecology remains largely unclear due to large intrageneric and intraspecific morphological plasticity and lack of laboratory experiments on living brackish-water Ponto-Caspian cysts.

The Lake Pannon *Pontiadinium* is a proximate cyst with biconical outline and prominent apical and antapical horn-like protuberances. This cyst type was first - although invalidly - described from Romanian Lake Pannon deposits as *Diconodinium inequicornutum* Baltes, 1971. The genus *Pontiadinium* Stover & Evitt, 1978 was erected later. The taxonomic relations of these Lake Pannon horned cysts are highly debated starting with the questionable assignment of its species, *Pontiadinium inequicornutum* to the Mesozoic nontabulate genus *Komewuia*. *Pontiadinium obesum* and *Pontiadinium pecsvaradensis* have been questionably assigned to *Impagidinium*. These taxonomical issues are rooted mainly in the lack of widely accessible, high quality illustrations. Our new material from northern Croatia and Hungary provides the basis for the taxonomical re-evaluation of *Pontiadinium*. The new Lake Pannon material clearly shows that a gonyaulacacean paratabulation is indicated by sutural features on large populations of cysts. Atrophied expression of sutures can be explained by low salinity conditions. A new species of *Pontiadinium* is described as *Pontiadinium szentaiae* n. sp. that is characterized by unique sutural septa formed from a beaded tegillum supported by columellae or rod-like luxuriae.

While the morphological features of *Pontiadinium* such as the characteristic antapical horn might have developed as response to subnormal salinities or to help flotation and anti-predation, simple ecophenotypic variability cannot resolve the morphology of the *Pontiadinium* species and other Lake Pannon dinoflagellate cysts. The various *Pontiadinium* species can co-occur in the same samples thus indicating that their morphological variability is inherent. The Lake Pannon assemblages including *Pontiadinium* cysts show-case how morphological adaption can lead to the evolutionary development of new dinoflagellate cyst species and genera due to long-term isolation over an extended amount of time.

This research was funded by the Hungarian National Research, Development and Innovation Office (NKFIH-116618 project), Hungarian-Croatian bilateral project (TÉT_16-1-2016-0004) and supported by the Croatian Geological Survey through funding provided by the Croatian Ministry of Science and Education.

Hypothesis of evolution in apertures and pollen ornamentation of Brazilian *Besleria Plum ex L. species* (Gesneriaceae)

Bellonzi, T. K.^{1*} and Gasparino, E. C.²

¹Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil

²Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil

*Corresponding author: talitakb@usp.br

The morphological diversity of pollen grains is usually of great diagnostic value in taxonomic studies. Using the morphology of pollen grains in phylogenetic studies has been advantageous for the taxonomy of groups, as their morphological characters are genetically established and not subject to environmental changes, allowing the elaboration of evolutionary hypotheses for genera and family. *Besleria Plum. Ex L.* is the most representative genus of *Beslerieae*, and one of the largest and least explored of *Gesneriaceae*. It has a neotropical distribution, and in Brazil, 24 species are known and located in the Amazon and Atlantic rainforests. Pollen grains of 14 Brazilian *Besleria* species were acetolyzed and the qualitative and quantitative pollen data were analyzed. Variations in aperture (very short to long ectoaperture and lolongate or circular endoaperture) and exine ornamentation (microreticulate, microreticulate-rugulate, rugulate, rugulate-perforate, microreticulate-fosulate) were the main qualitative distinguishing characteristics of the studied species. These qualitative data were optimized in the phylogeny based on molecular analysis of *Besleria*, and it was found that these characteristics do not support the clades obtained in the phylogeny. Thus, the variation of morphological characteristics observed in *Besleria* pollen grains probably followed different paths of modification. In view of this, hypotheses were formulated about the evolution of ectoaperture length, type of endoaperture and exine ornamentation. Long ectoaperture with circular endoaperture is probably a plesiomorphic character, which diversified by reducing the size of the ectoaperture (short ectoaperture) and the shape of the endoaperture (lolongate). This ancestral pattern of aperture possibly gave rise to the types: short ectoaperture and circular ectoaperture and long ectoaperture without endoaperture. In addition, loss of endoaperture may be seen in pollen grains with a short ectoaperture. Therefore, a tendency to decrease the size of the ectoaperture and loss of the endoaperture in *Besleria* is suggested. The microreticulate-fosulate type is a plesiomorphic character that possibly originated the microreticulate pollen ornamentation (present in most species), and diversified into rugulate, rugulate-perforate and microreticulate-rugulate. Thus, the possible evolution paths of the pollen morphological characters can contribute to the understanding of the relationships among *Besleria* species.

The size and thickness exine influence on Rutaceae Juss. palynology: preliminary data

Dutra, F. V.^{1*} and Gasparino, E. C.²

¹ Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

² Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (UNESP), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*Corresponding author:fernandad@usp.br

Rutaceae Juss. belong to the Sapindales and their species are mainly characterized by the presence of glandular cavities producing aromatic essential oils, and they are native to tropical and temperate regions of the Southern Hemisphere, especially South Africa and Australia. Galipeinae have about 130 species and 25 genera, some of which are monospecific. *Conchocarpus* J.C. Mikan have the largest number of species in the subtribe with very restricted geographic distribution, especially in coastal forests. Although molecular data strongly support the positioning of Rutaceae in Sapindales, the relationships among the genera of the family have not yet been fully clarified, such as in *Conchocarpus*. Furthermore, in morphological studies, synapomorphies are not evident for the genus, making it difficult to delimit it. From a palynological point of view, the family is very interesting, it is a eurypalynous group—their pollen grains present a great variability of characteristics, especially in type and number of apertures and exine ornamentation, characters of great value to palynology, but they are still little explored in the taxonomy and phylogeny of the group. The aim of the present study was to analyze quantitative data of pollen grain diameter and thickness exine in order to attest whether through these results it is possible to separate genera and assist in the taxonomy of the group. Twenty-nine species belonging to 7 genera were selected, most of which are from *Conchocarpus*. Pollen grains were collected from herborized material (SPF and SPFR herbaria) acetolyzed, measured and photographed under a light microscope. The quantitative data were analyzed using descriptive and multivariate statistics (principal components analysis and cluster analysis). The pollen grains studied are small to medium (*Conchocarpus bellus*, *C. diadematus*, *C. minutiflorus* and *C. modestus*), medium, medium to large (*C. longiflorus*, *Dryadescyrtantha* and *D. insignis*) large (*C. silvestris* and *C. ruber*) or very large (*S. trifolius*) and the thickness of the exine ranged from very thin (*C. cuneifolius*, *C. ruber*, *C. hamadryacus*, *C. obovatus*, *C. odoratissimus* and *C. silvestris*), thin and thick (*Hortia brasiliensis* and *H. oreadica*). The principal component analysis showed *Galipea*, *Hortia* and *Sigmatanthus* separated from the other genera, which form a group with similarities in the quantitative pollen data. We can observe, in some cases, the similarity between species of *Conchocarpus* and *Dryades*. Size and thickness exine are useful to separate some *Rutaceae* genera, but the best tool for species distinction is to incorporate qualitative and quantitative pollen data for a more accurate result.

The morphological diversity of the pollen grains in Gesneriaceae species from Brazil

Gasparino, E. C.^{1*}, Dutra, F. V.^{1,2}, Lopes, A. C. V.^{1,2}, Landi, L. A. D. C.^{1,2}, Bellonzi, T. K.^{1,2} and Souza, C. N.^{1,2}

¹Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

² Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

*Corresponding author: eduardo.gasparino@unesp.br

Palynology is a morphological tool widely used to define pollen types, which can help to better delimit genera, subgenus or related groups of species, contributing to clarify the phylogenetic relationships among them. In recent years, Gesneriaceae have had their systematic and phylogeny revised based mainly on molecular data, combined with previously morphological research; and especially in Brazil, the pollen morphology of species of the family has been widely analyzed by detailed studies with their pollen grains. Gesneriaceae with approximately 150 genera and 3500 species have wide distribution in tropical regions, in Brazil, 228 species of 30 genera are native, all inserted within Gesnerioideae, represented here by three tribes and six subtribes. The pollen studies carried out on Brazilian species of Gesneriaceae account so far, the analysis of 153 taxa in Napeantheae, Beslerieae (Besleriinae) and Gesnerieae (Gloxiniinae, Columneinae, Sphaerorrhizinae and Ligeriinae). For the analysis we used material collected from exsiccatae in herbaria of Brazil and also material kept in cultivation. The pollen grains were acetolyzed, measured and photographed under light microscopy, scanning and transmission electron microscopy. Qualitative data were described and quantitative data subjected to multivariate analysis. Our results showed that the pollen grains in monads and isopolar are common characteristics for all native species of Gesneriaceae. Variations in size, amb, shape, type and number of apertures, ecto and endoaperture details, exine layer stratification and pollen grain ornamentation allowed the grouping of genera and species with similarities in these characteristics of pollen morphology. In general, 3-colporate and micro or reticulate pollen grains can characterize the Brazilian species of Gesneriaceae, however divergences in this pattern were observed, which helps in the identification of groups, especially of genera. Quantitative data complement the qualitative analysis which confirms that the family is a eurypalynous group. Future pollen morphology studies in Gesneriaceae groups not yet studied, especially the Columneinae clade and groups outside the Neotropical region, will provide a better understanding of how palynology can clarify the phylogenetic relationships in the group. Studies with this scope, which analyze the pollen morphology of a large number of species in a botanical family, can significantly contribute to consolidate the importance of the use of palynology in the taxonomic study of Angiosperms.

Bronze Age Climate Change on the Akrotiri Peninsula, Island of Cyprus

Hazell, C.J.^{1*}, Hocking, E. P.¹ and Pound, M. J.¹

¹ Department of Geography & Environmental Sciences, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK

*Corresponding author: calian.j.hazell@northumbria.ac.uk

Climate change has been proposed as a major driver of societal collapse during the Bronze Age of the eastern Mediterranean. Here we present two multiproxy records covering the last 5000 years from the Akrotiri Marsh in southern Cyprus. Pollen and diatom analysis of radiocarbon dated marsh sediments reveal expansion and contraction of the marsh in response in mid-late Holocene climate events. The record provides important contextual climate data to the debate surrounding the so called Early and Late Bronze Age Societal Collapse Events present in numerous archaeological archives throughout the Mediterranean and Near Eastern Region. Uniquely, this research examines a previously unstudied region of the island, and is the first multiproxy study to display both the 4.2K Event and the 3.2K Event. The 3.2K Event in the Akrotiri Marsh record displays the characteristic two-phases of aridity with an interim period of relative humidity. We propose it was the first of these two arid phases that caused the destruction of monumental structures and abandonment of the thriving nearby Bronze Age settlement of Alassa *Paleotaverna*.

Palynological study (dinoflagellate cysts) of middle Jurassic deposits in the Skoura Syncline (middle Atlas fold, Morocco): Biostratigraphy and palaeoenvironment.

Khaffou, H.¹, Hssaida, T.¹, Ben-bouziane, A.¹, Essamoud, R.¹, Jaydawi, S.², Afenzar, A.³, Chakir, S.¹, Rachid, J.¹ and Chafai, K.¹

¹ Laboratory of Sedimentary Basin Dynamics and Geological Correlations, Department of Earth Sciences, Ben M'sik Faculty of Sciences, Hassan II University Avenue Cdt Driss El Harti, BP7.955, Ben M'sik 20.800, Casablanca, Morocco

² University Mohammed V, Faculty of Science, Rabat, 4 Avenue Ibn Batouta, BP 1014

³ Laboratory of Geosciences, Environment and Associated Resources (LGERA), Department of Geology, Sidi Mohamed Ben Abdellah University, Faculty of Sciences Dhar El Mahraz, Fes, Morocco

*Corresponding author: hananekhaffou02@gmail.com

The Middle Atlas, where the investigated section is located, is an intracontinental chain that is part of the Atlas system and is one of Morocco's most important relics of the Alpine orogeny (Frizon de Lamotte et al., 2008). It is the consequence of the Upper Cretaceous convergence of Europe and Africa. The Middle Atlas split into two structural units: the folded Middle Atlas to the southeast and the tabular Middle Atlas to the northwest (Piquet, 2007). These two units are divided by the North Middle Atlas Accident (ANMA), a large NE-SW fault (Choubert 1956, Martin 1973).

The research section was erected at the level of the carbonate series of the Middle Jurassic platform of the Middle Atlas, in the Skoura synclinal. The palynomorph associations in the samples (20 samples) were rich and diversified, with Dinoflagellate cysts predominating. The latter are composed of: *Meiourogoniaulax valensii*, *Ctenidodinium sellwoodii*, *Gonyaulacysta jurassica*, *Meiourogoniaulax spp.*, *Valensiella ovolum*, *Pareodinia ceratophora*, *Wanaea acollaris* and *Dissiliodinium ssp.*

The stratigraphic markers in this association confer a higher Bajocian age on the treated materials. The continental fraction is dominated by *Classopolis spp.*, indicating aridity during the Upper Bajocian.

References:

Frizon de Lamotte, D., Zizi, M., Missenard, Y., Hafid, M., El Azzouzi, M., Charriere, A., Maury, R.C., Taki, Z., Benammi, M., Michard, A., 2008. The Atlas system. In: Michard, A., Saddiqi, O., Chalouan, A., Frizon de Lamotte, D. (Eds.), Continental Evolution: The Geology of Morocco. Springer-Verlag, Heidelberg. pp. 133–202.

Choubert, G., 1956. Geological map of Morocco, sheet of Rabat at 1: 500,000. Notes and Memoirs of the Geological Service of Morocco 70.

-Martin, J., 1973. Geomorphological map of the central Middle Atlas at 1: 100,000. Notes and Memoirs of the Geological Service of Morocco 258, 5 sheets.

Dispersion and composition of pollen rain by the litterfall collection method in a cerradoarea under densified trees.

Landi, L. A. D. C.^{1*} and Gasparino, E. C.²

¹ Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

² Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*Corresponding author: lorrayne_landi@hotmail.com

The number of vascular plants found in the Cerrado biome is higher than that found in most regions of the world, there are more than 7,000 species, presenting itself as the most diversified tropical savanna in the world, with 44% of endemic flora, including forest formations, savanna and open forms. With the intense replacement of the Cerrado by monocultures and pastures, a large part of this biodiversity is being lost, practically all conservation units that are intended for the protection of cerrado ecosystems are currently, to a greater or lesser degree, invaded by species exotic. Studies on pollen flora carried out in fragmented regions help in the identification of remaining species, providing a breakdown of biodiversity for degraded regions and information about the ecological effects of exotic species and their possible interference in native environments. Thus, this study aims to carry out pollen analysis through the collection of litter fall in a conservation unit of the Cerrado Biome in the interior of the state of São Paulo (Estação Ecológica de Assis –EEcA) testing the hypothesis of using litterfall for the knowledge of pollen dispersion and deposition, effect of exotic species on pollen rain in the area, in addition to contributing to a description and analysis of pollen characteristics of Cerrado species. For this, the area of the ecological station was sampled, totalling 56 sampling (15g litter fall per point). In the laboratory, the litter fall substrate was submerged in distilled water (3 hours), and the larger debris removed with a sterile forceps, in order to “wash” the possible palynomorphs from the sample. Inside the washing containers, 10 drops of ethyl alcohol were added in order to break the surface tension of the water for the sedimentation of possible palynomorphs. From this, 8ml of solution was collected for each sample, and divided into four portions (2ml each) different from the solution (bottom of container, middle of container, surface of container, mixing solution: middle of container). Subsequently, the solution was centrifuged at 2000 rpm for 10 minutes and its supernatant discarded; the tubes were filled with acetic acid for 24 hours, and then the samples were treated by the acetolysis technique (water bath (80°C) in 1:30min). After making the palynological slides (4 slides per point), a total scan was performed, with all palynomorphs found photographed, counted, described qualitatively and separated into different pollen types. As a result, 97 pollen types (n= 966) were sampled, with 88 pollen types of pollen grains (n= 839) and 8 pollen types of spores (n= 35), distributed in 33 botanical families, described among five life forms, presenting four undescribed species for the area (two of them invasive). This is the first study to describe the litterfall pollen composition for areas of the Brazilian Cerrado.

Palynological study of the Permian/Triassic boundary of East Greenland (Kap Stosch): stratigraphic, palaeoenvironmental, palaeoecological implications

Louboutin, C.^{1,2*}, Stukins, S.² and Twitchet, R. J.²

¹UMR CNRS 6118 - Géosciences Rennes, Université de Rennes 1, France

²Department of Earth Sciences, Natural History Museum, London, Cromwell Road, UK

*Corresponding author: claralouboutin@gmail.com

The Permo–Triassic boundary (PTB) interval documents the largest biodiversity crisis in the history of life. It is generally accepted that this crisis had a significant impact on marine ecosystems and terrestrial vertebrates, but the consequences for land plants are still debated. High-resolution palynological analyses of shallow marine rocks containing marine invertebrates and zone fossils enable changes in the terrestrial flora to be compared directly to changes in the marine realm using the same samples. Using this approach, we undertook a detailed palynological analysis of a PTB section from Kap Stosch, East Greenland.

A rich palynoflora from Kap Stosch was recovered and the raw data analysed using multivariate statistics to help elucidate any flux within the floral ecology of the hinterland in the lead up to, and during, the crisis. The results show that a relatively dry, gymnosperm-dominated forest was replaced by a wet, most likely disturbed environment that consisted mainly of lycopsids and ferns.

Pollen types of Amazonian species: preliminar data on palynology of Columneinae (Gesneriaceae)

Lopes, A. C. V.^{1*} and Gasparino, E. C.²

¹ Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

² Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultura and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*anacvlopes@usp.br

Columneinae (Gesneriaceae), the monophyletic subtribe what comprises 26 genera and more than 700 species, formed by morphologically diverse taxa. Palynology is the area of science dedicated to the morphological analysis of pollen grains, which has been widely used in taxonomy for its diagnostic value in identifying species and genera. This study aimed to provide preliminary data from the characterization of pollen grains of Amazonian species Columneinae and establish possible pollen types for the subtribe, so investigating the morphological diversity of the group is also found in the analysis of pollen grains. We analyzed 27 species belonging, distributed in genera *Alloplectus* Mart., *Chrysothemis* Decne., *Columnea* L., *Drymonia* Mart., *Lesia* J.L. Clark & J.F. Sm. and *Nautilocalyx* Linden. The species studied have pollen grains in monads, isopolar, medium, with hexagonal, subcircular, circular, subtriangular ou triangular amb, area polar very small, small, large or very large, suboblate, spheroidal oblate, spheroidal prolate, subprolate or prolate form, 6-heteroaperturate, 3-colpate or 3-colporate, narrow, wide or very wide colpi, brevicolpate, short, long or very long. In some species the presence of bridges, constriction or margo in ectoaperture. The endoaberture are circular, lolongate or difficult to visualize, tectate or semitectate exine, rugulate, perforate, microreticulate or reticulate ornamentation, thin or very thin exine. The species were grouped into three pollen types based on variations in the apertures, in some cases subtypes were defined by the ornamentations of the pollen grains: types I - 6-heteroaperturate, perforate (*Drymonia teuscheri* (Raymond) J.L. Clark.); types II - subtype A - 3-colpate, microreticulate (*Chrysothemis dichroa* Leeuwenb., *Chrysothemis melittifolia* (L.) M.M. Mora and J.L. Clark, *Chrysothemis pulchella* (Donn ex Sims) Decne., *Drymonia serrulata* (Jacq.) Mart. and *Nautilocalyx porphyrotrichus* (Leeuwenb.) Wiehler.); subtype B - 3-colpate, reticulate (*Glossoloma tetragonoides* (Mansf.) J.L. Clark. and *Nautilocalyx cordatus* (Gleason) L.E. Skog.); subtypes C - 3-colpate, rugulate (*Drymonia coccinea* (Aubl.) Wiehler, *Drymonia conchocalyx* Hanst., *Drymonia doratostyla* (Leeuwenb.) Wiehler, *Drymonia pendula* (Poepp.) Wiehler and *Drymonia semicordata* (Poepp.) Wiehler.); types III - subtype A - 3-colporate, microreticulate (*Alloplectus* sp1, *Columnea rubra* C.V. Morton., *Columnea ulei* Mansf., *Lesia savannarum* (C.V.Morton) J.L. Clark & J.F.Sm., *Nautilocalyx fasciculatus* L.E.Skong & Steyerem., *Nautilocalyx pallidus* (Sprague) Sprague, *Nautilocalyx pictus* (Hook.) Sprague, *Nautilocalyx* sp1 and *Nautilocalyx* sp3.); subtype B - 3-colporate, reticulate (*Columnea sanguinea* (Pers.) Hanst., *Glossoloma bolivianum* (Britton ex Rusby) J.L. Clark and *Nautilocalyx forgetti* (Sprague) Sprague.); subtype C - 3-colporate, rugulate (*Drymonia strigosa* (Oerst) Wiehler and *Nautilocalyx* sp2.). The palynological results for the Amazonian species of Columneinae suggest that subtribe is a eurypalynour group, highlighting the need for further studies including other species of the genera.

The oldest Neogene sediments in Wales: palaeoenvironment and palaeoclimate of the Trwyn y Parc solution pipe complex

McCoy, J.L.^{1*}, Gibson, M.E.¹, O'Keefe, J.M.K.², Nuñez Otaño, N.B.³, Warny, S.,⁴ and Pound, M.J.¹

¹Department of Geography and Environmental Sciences, Northumbria University, Newcastle upon Tyne, UK.

²Department of Physics, Earth Science and Space Systems Engineering, Morehead State University, Morehead, KY, USA.

³Laboratorio de Geología de Llanuras. Facultad de Ciencia y Tecnología, Universidad Autónoma de Entre Ríos, Sede Diamante. CONICET (National Scientific and Technical Research Council) Argentina.

⁴Center for Excellence in Palynology, Department of Geology & Geophysics, and Museum of Natural Science, Louisiana State University, Baton Rouge, LA, USA.

*Corresponding author: jessica.mccoy@northumbria.ac.uk

Trwyn y Parc, Anglesey, Wales is one of three onshore UK sites to contain a Miocene-age fossil flora, it is both a Regionally Important Geological Site and part of the GeoMôn UNESCO Global Geopark, making its geoheritage of national importance. While Trwyn y Parc was assigned to the Miocene, when in the Miocene was never established. A reanalysis of the original palynology has enabled the fossiliferous sediments in solution pipes 11/12 to be assigned to the Middle Miocene, possible Langhian in age. The palaeoclimate of the UK during the Middle Miocene has been reconstructed. The reconstruction is comparable to those of both the Middle Miocene and the Langhian post-Middle Miocene Climatic Optimum in Germany. Reconstructed mean annual temperature and precipitation were 17.2-18.1°C and 1217-1356mm, both warmer and wetter than present (10.0°C and 836mm). Reconstructed coldest (4.3-5.8°C) and warmest (26.5-27.8°C) mean month temperatures, were also higher than those of the present day (2.9°C and 18.8°C, respectively). These results confirm a stronger summer cooling in the UK from the Middle Miocene to today. Dissemination of results highlights the site's geoheritage value, and suggests the site should be upgraded to Geological Conservation Review and protected as a Site of Special Scientific Interest. Results contribute to the understanding of long-term interactions between Neogene climate and biota in the western-most peninsula of Neogene Eurasia.

The palynology of the Nemegt Formation (Upper Cretaceous) of southwest Mongolia

Odgerel, N.^{1*}, Ichinnorov, N.,² Ganbayar, G.³ and Tumurchudur, C.³

¹Department of Geology and Geophysics, School of Earth and Sciences, National University of Mongolia, Ikh surguuliin gudamj 1, p.o. box 46A/26, Ulaanbaatar, Mongolia, 14201

²Mongolian Academy of Sciences, Danzan street 3/1, p.o. 46/650, Institute of Paleontology, Ulaanbaatar, Mongolia, 15160

³Gurvantaist LLC, Tokyo street 8, p.o. box 49/309, Ulaanbaatar, Mongolia, 13380

*Corresponding author: n.odgerel@num.edu.mn

This study presents on first findings and analysis of palynomorph (using LM and SEM analysis) from the Upper Cretaceous Nemegt Formation of Mongolia. Nemegt formation is the youngest formation of the Cretaceous of Mongolia, abundant in dinosaur fossils and molluscs, ostracods, conchostracans, turtles, lizards, and widely distributed in Nemegt Basin, Bugiin Tsav (Khaichin Uul area) in southwestern Mongolia (Fig.1). Nemegt Formation is dated before based on a variety of dinosaurs, vertebrate, invertebrate fossils and underlying Baruungoyot formations absolute age 75-80 myr confirm that it is the Maastrichtian age. The palynological composition, the botanical affinities of spore- pollen species identified in this study are taken into confirmation of age data of Nemegt Formation of the Khaichin Uul area.

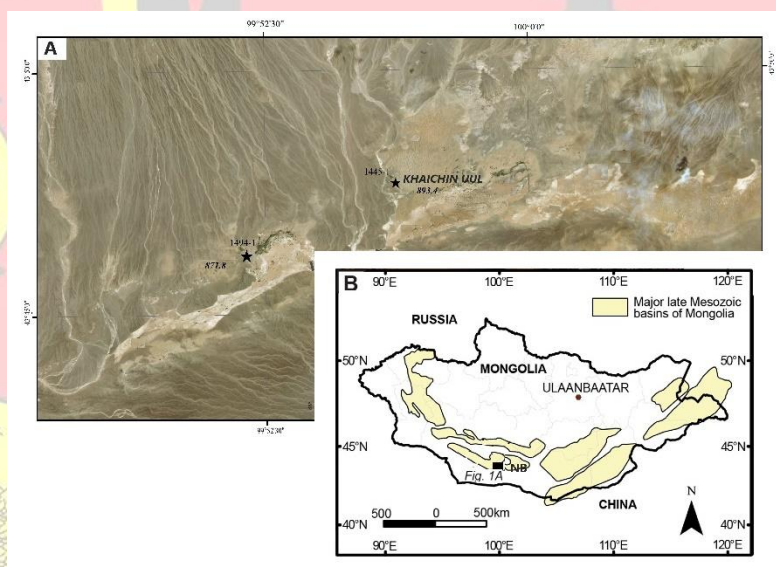


Fig. 1. Bugiin Tsav (Khaichin Uul) location and late Mesozoic sedimentary basins Mongolia. (A) Bugiin Tsav (Khaichin Uul) location map overlain on the regional digital elevation model. (B) Late Mesozoic sedimentary basins of Mongolia. NB-Nemegt Basin

The stratigraphic range of Nemegt Formation (near Khaichin-Uul, Bugiin Tsav), has been determined by the presence of spores *Concavissporites* sp., *Cicatricosisporites punctatus* (*Lygodiumsporites asper*), *Foraminisporis asymmetricus*, *Foraminisporis* sp., *Osmundacidites wellmanii*, *Osmunda* sp., *Laevigatosporites haardtii*, cf. *Taurucosporites* sp., monolete fernspore without perispor (*Laevigatosporites* sp.), as well as by pollen *Ginkgocycadophytus* sp., *Sciadopitipollenites megaorbiculus*, *Disaccites* sp., *Ephedripites* sp., *Inaperturapollenites* sp., freshwater algae *Pediastrum boryanum*, *Zygnemataceae* sp. This palynological assemblages is dominated by spores of bryophytes and ferns. These spores and pollen results confirmed that Nemegt formation's age is Maastrichtian.

New assemblage of Organic-Walled Microfossils (OWM) from the Mesoproterozoic Chandarpur Group, Chhattisgarh Supergroup, Peninsular India

Veeru Kant Singh¹, Mukund Sharma¹, A. H. Ansari¹ and Zhongwu Lan²

¹Birbal Sahni Institute of Palaeoscience, 53 University Road, Lucknow – 226007, India

²Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029, China

Corresponding author email – veerukantsingh@bsip.res.in

In the Peninsular region of the Indian subcontinent, ~ 2300 meters thick sedimentary succession of siliciclastic and carbonate rocks of the Chhattisgarh Supergroup are considered to have deposited during Mesoproterozoic age. Poor geochronological constraints and absence of any age diagnostic fossil pose a considerable uncertainty in the understanding of the time frame of the evolution of the Chhattisgarh basin. To address this issue, Organic-Walled Microfossils (OWMs) recovered from the Chaporadih Formation of the Chandarpur Group, exposed in part of the Baradwar Sub-basin, are used as an essential biostratigraphic tool. New assemblage of microfossils, namely Cheilofilum, Germinosphaera, Jacutianema, Ourasphaera, Pterospermopsisimorpha and Trachyhystriosphera are reported in this paper. OWMs are spheroidal, unornamented vesicles, in range of 25 – 250 µm with varied wall thickness. Morphological feature viz. reticulate pattern of the cell wall, striation on vesicle surface, complex morphologies, such as processes on internal body together with large vesicle sizes suggest ambiguous eukaryotic affinity for the Chandarpur OWMs. Additionally, detrital zircon SIMS U–Pb ages from the porcellanite samples of the Lohardih Formation (stratigraphic unit just below the Chaporadih Formation) yield a maximum depositional age of ~1.2 Ga. Correlation with globally known distinct microfossils assemblages from the well-dated sedimentary succession and zircon dates of the Lohardih Formation (~1.2 Ga) suggest Chaporadih OWMs ranges between Stenian to Tonian (1200 Ma – 720 Ma) age. The new information of morphologically distinct microfossils from the Chandarpur Group adds to the growing diversity of unicellular eukaryotes with complex morphologies during the boring billions.

Importance of quantitative data on pollen grains of Gesneriaceae species

Souza, C. N.^{1,3*}, Araujo, A. O.² and Gasparino, E. C.³

¹Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

² Department of Biology, Center for Human and Biological Sciences, Federal University of São Carlos (UFSCar), ZIP 13506-900, Sorocaba, State of São Paulo, Brazil. ³ Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*Corresponding author: cintiasouza011@gmail.com

Gesneriaceae have approximately 150 genera and 3500 species, with wide distribution in tropical regions and with few representatives in temperate regions, with the main centers of diversity located in north western South America and in south eastern Brazil. The species of the family have a great floral diversity and also a wide diversity of pollen morphology. Numerous studies indicate that external morphology characteristics of pollen grains can be used to distinguish groups of species, being useful subsidies for taxonomic studies. The aim of this study was to analyze the quantitative data from pollen grains of Titanotricheae (1 species), Beslerieae (Besleriinae, 3 species), Coronanthereae (Coronantherinae, 3 species; Mitrariinae, 2 species) and Gesnerieae (Gesneriinae, 7 species; Gloxiniinae, 19 species; Columneinae, 8 species; Sphaerorrhizinae, 4 species; Ligeriinae, 6 species) inserted into Gesnerioideae; and Trichosporeae (Ramondinae, 2 species; Streptocarpinae, 2 species; Didymocarpinae, 5 species), tribe representing Didymocarpoideae. It was also analyzed *Peltanthera floribunda* as an outside group from Gesneriaceae. The pollen material was collected from exsiccatae of the herbarium of Geneva (G), Zurich (Z), Paris (P) and from cultivation material of Sítio Primavera, Brazil. The pollen grains were submitted to the acetolysis technique, measured (n= 25 for the diameters; n= 10 for the apertures and exine layers) and photographed under light microscopy. The quantitative data were analyzed using descriptive and multivariate statistics. We observed that the size of the pollen grains is an important pollen character for the distinction of the studied species groups and, consequently, it is related to the length and width of the colpi. The close relationship among Titanotricheae, Beslerieae, *Coronanthera* and *Peltanthera floribunda*, most of the species of Gloxiniinae, Sphaerorrhizinae, *Sinningia reitzii* (Ligeriinae) and Trichosporeae is clear, as they have small pollen grains compared to the other studied clades; while *Rhabdothamnus solandri*, Mitrariinae (Coronantherinae), Gesneriinae, some species of Gloxiniinae, Ligeriinae (except *Sinningia reitzii*) they have small to medium or medium size pollen grains. Therefore, quantitative data, mainly related to the sizes of pollen grains, as well as colpi measurements, allow the distinction of the Gesneriaceae clades analyzed in this study, reinforcing that both quantitative and qualitative characters are good tools for taxonomic delimitation this family.

Palynology of Archean microfossils - a new window into the ancient life

Sugitani, K.^{1*} and Grey, K.²

¹Graduate School of Environmental Studies, Nagoya University, Nagoya, Japan

²Department of Mines, Industry Regulation and Safety, Geological Survey of Western Australia, Mineral House, 100 Plain Street, East Perth, Western Australia 6004

*Corresponding author: sugi@info.human.nagoya-u.ac.jp

Palynological approaches have rarely been applied to Archean paleontology, mainly because of concerns about contamination and general lack of expectation for successful extraction of microfossils. This is not surprising because most Archean rocks have been subjected to higher-level metamorphic events than those for the Proterozoic and younger rocks, lowering the preservation potential of organic-walled microfossils. However, by applying a modified palynological preparation method, designed to reduce fragmentation by lessening vigorous physical or chemical treatments, to black cherts from the ca. 3.0 Ga Farrel Quartzite and the 3.4 Ga Strelley Pool Formation in the Pilbara Craton, Western Australia, in which abundant microfossil-like structures of various morphologies were previously recognized in petrographic thin sections, we successfully extracted palynomorphs of the same morphological types. They included films, filaments, flexible spheres, solid spheres, and lenticular structures comprising a central spheroid body surrounded by a discoid flange. Palynological extraction demonstrated that these microstructures are organic-walled and therefore of biogenic origin, as had been preliminarily suggested by thin-section examination. Extraction also indicated that they are not, as suggested by some researchers, an aggregation of carbonaceous particles but are composed of continuous organic walls. Furthermore, they display types of taphonomic degradation commonly observed in younger palynomorphs. Additionally, extracted specimens can be subjected to various analyses, including precisely targeted FIB-TEM analyses, elemental mapping, and isotopic analyses, and morphometry, providing further evidence for their biogenicity which will provide a basis for systematic description. Here we present results from the morphometric analyses of lenticular microfossils from the 3.4 Ga Strelley Pool Formation (SPF) and recent results of palynological studies of the 3.0 Ga Farrel Quartzite (FQ). Morphometric analyses of the SPF lenticular bodies imply that the SPF bodies had already morphologically diversified into several species characterized by distinct parameters, oblateness and relative flange width. FQ palynomorphs include not only solitary specimens but also composite structures, including linearly connected triplets of lenticular bodies, two-dimensionally connected lenticular bodies sharing a flange, connected and branched lenticular bodies and three-dimensionally connected solid spheres. Such arrangements appear to be far more complex than expected for Archean microbes. They could be artifacts formed during processes of palynology. However, some of them, such as the linearly connected lenticular triplets, two-dimensionally connected lenticular bodies sharing a flange, are present in petrographic thin sections. Identification of palynologically obtained microfossils provides us with a new window to ancient life and clues to elucidate their significance in the early evolution of life.

Geographic distribution and transport mechanisms of modern pollen in southern Morocco

Sokaina Tadoumant¹, Ilham Bouimetarhan^{1,2,3}, Martin Kolling², Asmae Baqloul¹, Mohammed Hssaisoune^{1,3} and Lhoussaine Bouchaou^{1,4}

¹ Laboratory of Applied Geology and Geo-Environment, Ibn Zohr University, Agadir 80000, Morocco; ² MARUM—Center for Marine Environmental Sciences, University of Bremen, D-28359 Bremen, Germany;

³ Faculty of Applied Sciences, Ibn Zohr University, Ait Melloul 86153, Morocco;

⁴ International Water Research Institute, Mohammed VI Polytechnic University, Ben Guerir 43150, Morocco.

*Sokaina Tadoumant: tadoumant.sokaina@gmail.com

During the last decades, the vegetation is affected by recurrent severe drought, desertification, pastoralism and increasing land degradation in southern Morocco. The objective of this study is to evaluate the geographical distribution of pollen and spores in southern Morocco. Besides, transport mechanisms, using a palynological, and geochemical approach. The results of spatial distribution show that pollen of Asteroideae, Cichorioideae, Poaceae, and Cyperaceae are the most dominant in the area. The pollens of Poaceae and Cyperaceae are present in all climates and altitudes with the percentages ranging around 45%. Those of *Olea/Phillyrea* are present mainly in the semi-arid climate. Moreover, *Argania spinosa* with modest distribution are endemic to southern Morocco and present a high value only in Souss basin with 67%. *Quercus*, *Artemisia*, and *Pinus* were found in the high latitude of the High Atlas and Anti Atlas Mountains between 500 to 1200m. At the coastal level the pollens of Cichorioideae and Chenopodiaceae-Caryophyllaceae-Amaranthaceae (CCA) are the most dominant. Towards the Saharan zones with hyper arid and desert climate, the pollen of *Tamarix*, *Asphodelus* type, *Acacia* and *Ziziphus* type seem to be the most adapted to this type of climate. The distribution of pollen in southern Morocco and its transport is controlled by surface runoff draining the different basins and by NE trade winds. It is noted that the latter is the most dominant because of the arid climate in southern Morocco where rivers have a temporary regime and only reach the Atlantic Ocean during exceptional rainy periods.

Palynomorphological research of Azerbaijan flora representing the genus of *Nonea* (Boraginaceae-Boragineae)

Taghiyeva, E.,¹ and Shafag, B.²

¹ Department of Paleogeography, Institute of Geography of Azerbaijan National Academy of Scientists, Baku, AZ1143, H.Javid av., 115, Azerbaijan

² Department of Paleofloristics, Institute of Geology of Azerbaijan National Academy of Scientists, Baku, AZ1143, H.Javid av., 119B, Azerbaijan

Corresponding author: shafagbayram@rambler.ru

The *Nonea* genus is the most heterogeneous in the tribe of Boragineae and has five types of the pollen grain (p.g.) structure, which do not correspond to sectional division of the genus (Bigazzi, Selvi, 1998; Selvi et al., 2002). Three sections of *Nonea* Medik. genus growing in Azerbaijan: *Nonea* (= *Cryptanthera* A. DC.), *Orthocaryum* A. DC, *Cystocaryum* DC.

Nonea bakuensis species for its morphological features appears to be a separate specie (Karimov, Illarionova, 2018). SEM analysis did not identify clear palynomorphological distinctions. *Nonea bakuensis* p.g. take intermediate position between *N. caspica* on one hand and *N. diffusa* and *N. melanocarpa* on the other. For the shapes of its pollen grain, colpates, pores, equatorial reticulum and partially for the structure of exine *N. bakuensis* is similar to *N. caspica*. P.g. of *N. bakuensis* differs from *N. diffusa* and *N. melanocarpa* in stridulate exine structure; more clearly manifested equatorial reticulum and broad colpates. Identified pollen features of *N. cyanocalix* p.g. and their similarity with p.g. of other species of the Pullae line cannot be used to determine it as a new specie. The p.g. of *N. cyanocalix* manifested highest similarity with *N. armeniaca* and *N. lenkoranika* in the size of p.g., shape and size of the colpates and equatorial reticulum. For the external shape and out line of the p.g. *N. cyanocalix* coincide with those of *N. persica*. P.g. of *N. cyanocalix* differ from other species of Pullae line only in lack of thickening of the equatorial reticulum along the groove as well as in poorly manifested grainy outgrowths on the reticule diaphragms.

The results of SEM analysis confirmed the palynomorphological similarity in p.g. of *N. persica*, *N. armeniaca*, *N. lenkoranika* and *N. cyanocalix*, which are also very close for the external features of the plants. Following the conclusions of M. Popov (1953) and Illarionova (2018) we acknowledge that these 4 species are the variations of the classical type *N. pulla*.

Pollen features of the *N. flavescens* species in comparative analysis with the close species of this line affirmed the separate type of taxon. The main difference in p.g. of *N. flavescens* and *N. lutea* is lack the equatorial reticule, even reticulation over the whole surface of the pollen grain and unclear outgrowths on the equatorial cells of the ectexine. It should be noted that p.g. of *N. flavescens* from Azerbaijan differ from p.g. of *N. flavescens* from Iran (Falatoury et al., 2011). Perhaps that is why Falatoury et al. (2011) as well as Pakravan et al. (2009), consider *N. lutea* and *N. flavescens* as the variations of exactly the same species, confirming this through significant similarity of their p.g. However we support Khatamsaz (2002) and Riedl (1967), who acknowledged these as separate species.

Pollen features of *N. setosa* p.g. differ from all species of this line in scrobiculate surface of the tectum, (*N. lutea*, *N. flavescens* have reticulate tectum), thickening of equatorial reticulum along the endoaperture (it is not observed for other species). For pollen features of *N. setosa* from the line of Flavescentes manifest evident similarity in p.g. with the line of Pullae. It is necessary to examine this attribution for other features too.

Karimov, V. Systematic structure and controversial issues in the taxonomy of the *Nonea* Medik genus in Azerbaijan Flora. World Science, 2018, v.2, No2 (30), p. 275-287.

Falatoury A., Pakravan, M., Sharifnia, F. Palynological study of *Nonea* (Boraginaceae-Boragineae) in Iran. Progress in Biological Sciences, 2011, Vol. 1, No.2, 36-43.

Selvi F., Papini A., Bigazzi M. (2002) Systematics of *Nonea* (Boraginaceae-Boragineae): new insights from phenetic and cladistic analyses. Taxon 51, 719-730.

Palynology of Celastraceae from Brazilian forest fragments: a focus on exine ornamentation

Torrati-Guioti, P. G.^{1*}, Bellonzi, T. K.¹ and Gasparino, E. C.²

¹Department of Biology, Faculty of Philosophy, Sciences and Letters, Graduate Program on Comparative Biology, University of São Paulo (USP), ZIP 14040-901, Ribeirão Preto, State of São Paulo, Brazil.

²Department of Applied Biology for Agriculture, Laboratory of Plant Morphology and Palynology, School of Agricultural and Veterinarian Sciences, São Paulo State University (Unesp), ZIP 14884-900, Jaboticabal, State of São Paulo, Brazil.

*Corresponding author pgtorrati@usp.br

Observations of external morphological characteristics of pollen grains, such as the number and type of apertures, exine ornamentation and pollen unit, assists in the identification and differentiation of plant species, besides contributing to ecological and conservation studies of different plant formations. Celastraceae R.Br. have approximately 100 genera and 1200 species, being represented by trees, shrubs and sub-shrubs, present in tropical and subtropical regions, with few species in the temperate regions. The family is currently positioned in Celastrales, within the Fabids in the clade of Rosids. In Brazil, Celastraceae is represented by 20 genera, of which 17 genera are native, with more than 100 species, and two endemic genera with 57 species, occurring in all biomes of the country. The objective of the present study was to characterize the pollen morphology of ten native Celastraceae species from forest fragments and to separate pollen types based on differences in exine ornamentation. Pollen materials were removed from exsicatae deposited in the SJRP Herbarium. The pollen grains were prepared according to the traditional method of acetolysis, and measured from 25 grains of pollen taken at random on four slides, photo digitalised and described qualitatively. The pollen grains of the studied species are monads, isopolar, small to medium in size, suboblates, oblate-spheroidal, prolate-spheroidal and subprolates with subcircular to subtriangular amb, 3-colporates, long and narrow colpi, without margo, circular or longitudinal apertures. Furthermore, differences in ornamentation (microreticulate, reticulate or bireticulate and homo or heterobrochate) delimit species within the established pollen types. The results obtained here allow separating the genera analyzed and confirms Celastraceae as aneurypalynous Family.



Bombacacidites baculatus
MALVACEAE

54th Annual Meeting AASP-The Palynological Society

Manizales, Colombia
August 7 – 11, 2022

Organized jointly with
The Latin America Association of Paleobotany and Palynology (ALPP)
The Online Pollen Catalogs Network (RCPoL)

The annual Palynological Society AASP-TPS meetings have as main goal to show the last advances in palynology at a scientific, technical, and academic level. For years, the AASP-TPS has focused on palynology as a biostratigraphic tool. In 2022, the annual meeting of the AASP-TSP will be held in Colombia for the first time and for the second time in Latin America. For this reason, we want to celebrate the palynological diversity of the Neotropics and make this event an opportunity to include the diversity of the palynological community.

This meeting will include the participation of the Latin American Society of Paleobotany and Palynology (ALPP), and the Online Pollen Catalogs Network (RCPoL). The meeting will take place in Manizales, a traditional coffee city. Manizales and the Institute of Investigations in Stratigraphy (IIES) at Universidad de Caldas will welcome the global palynological community.

