Kentucky Geological Survey University of Kentucky Lexington, KY Geology Program; Department of PHES Morehead State University Morehead, KY

Lexington 2023:

A Joint Meeting of the 55th Annual Meeting of AASP - The Palynological Society and Meeting of the CIMP - Commission Internationale de la Microflore du Paléozoïque Subcommissions

8-9 June 2023

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Program and Abstracts







45th Annual Meeting of AASP - The Palynological Society and Meeting of the CIMP - Commission Internationale de la Microflore du Paléozoïque Subcommissions

At the William T. Young Library, Lucille Caudill Little Arts Library, and Kentucky Geological Survey University of Kentucky Lexington, KY USA

Organizing Committee: Cortland Eble Jen O'Keefe

Special Thanks to our Volunteers and Sesson Chairs:

Onema Christopher Adojoh Margaret Alden Martha Gibson Shaan Heydenrych Md Kibria Duncan McLean Jessica McCoy Erdoo Mongol Matthew Pound Laikin Tarlton

Meeting Spaces and Posterboards Provided by:

University of Kentucky/Kentucky Geological Survey

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Program

Monday, 5 June –

5:15 pm – 5:45 pm

6:00 pm – 9:00 pm

4:00 pm – 5:00 pm	Registration, Kentucky Geological Survey (KGS) atrium.
Tuesday, 6 June –	Pre-Meeting Workshops
8:30 am – 9:00 am	Registration, KGS atrium
9:00 am – 12:00 pm	Cenozoic Fungal Palynology in honor of Bill Elsik, Jan Jansonius,
	and Ramakant Kalkutkar. KGS Conference Room 222
	room 102
12:00 pm – 1:00 pm	Lunch Break
1:00 pm – 4:00 pm	Cenozoic Fungal Palynology in honor of Bill Elsik, Jan Jansonius,
	and Ramajant Kalkutkar. KGS Conference Room 222
	room 102
4:00 pm – 5:00 pm	Registration, Kentucky Geological Survey.
Wednesday, 7 June –	
7.00	Desistantian, KCC Atrium and Field Trip Destision at Assembly
7:00 am = 7:30 am 7:30 am = 5:00 nm	Registration, RGS Athum and Field Trip Participant Assembly.
7.50 am – 5.00 pm	Jackson, KY area, Transportation departs from and returns to the

KGS.

Registration, KGS Atrium

Meeting Icebreaker: Kentucky Native Café, Transportation

sponsored by Hess and the Paleontological Society

departs from the KGS at 5:45. Transportation departs KNC at 9:00 pm and drops off at campus housing and conference hotel. *Co*-

* denotes student presenter

Thursday, 8 June – CIMP-sponsored session on Paleozoic Palynology and Mesozoic Palynology

8:00 am – 8:30 am	Registration, William T. Young Library
8:30 am – 8:45 am	Opening Remarks by the organizers and Bill Haneberg, Kentucky State Geologist
8:45 – 8:50 am	in Memoriam
CIMP-sponsored session on Pal	eozoic Palynology, moderated by Duncan McLean and Erdoo Mongol
8:50 – 9:00 am	CIMP Opening Remarks
9:00 – 9:20 am	Organic-walled microfossils from the restricted marine environment of the Paskey Shale (Barrandian area, Czech Republic). <i>*Vojtěch Kovář</i>
9:20 – 9:40 am	Assessing the thermal maturity of early Silurian rocks from Saudi Arabia using Palynomorph Darkness Index ('PDI'): progress and challenges. <i>Geoff Clayton</i>
9:40 – 10:00 am	Devonian chitinozoans from the Los Monos Formation in the Ramos borehole, northwestern Argentina. <i>*Sonia Clara Camina</i>
10:00 – 10:20 am	Coffee/Tea Break and Poster Viewing
10:20 – 10:40 am	Palynology of the Horton Bluff Formation, Nova Scotia, Canada. Duncan McLean
10:40 – 11:00 am	New Insights into the Age of the Strawn Group, Texas. <i>Maria</i> Antonieta Lorente
11:00 – 11:20 am	It's a trap!: the preservation potential of ancient salt minerals. Martha Gibson
11:20 – 11:40 am	Lopingian (Late Permian) palynomorphs from the Cadeby Formation, Cadeby Quarry, Yorkshire, UK. <i>Duncan McLean</i>
11:40 am – 1:40pm	Lunch Break; Student/ECR ONLY Luncheon, PieTana, sponsored by the Paleontological Society AASP Outgoing Board Meeting, KGS Conference Room 222

Mesozoic Palynology, moderated by Martha Gibson

1:40 – 2:00 pm	Palaeoenvironmental analysis of Triassic sediments in the Norwegian North Sea. <i>*Shaan Heydenrych</i>
2:00 – 2:20 pm	Palynology of Select Samples from the Campanian Neslen Formation, Book Cliffs, UT: Findings from an Integrated Chronostratigraphic and Sedimentological Study. <i>Thomas</i> <i>Demchuk</i>
2:20 – 2:40 pm	Mantell's Spiniferites. Stephen Stukins
2:40 pm – 3:00 pm	Coffee/Tea Break and Poster Viewing
3:00 pm – 4:00 pm	Posters Session I
4:00 pm	Group Photo – In front of the William T. Young Library
6:00 pm - 9:00 pm	Conference Dinner – Ethereal Brewing Public House

Friday, 9 June – Cenozoic Palynology

8:00 – 8:20 am	Registration – Niles Gallery, Little Fine Arts Library

Cenozoic Palynology I – Moderated by Onema Christopher Adojoh and Shaan Heydenrych

8:30 – 8:40 am	Opening Remarks
8:40 – 9:00 am	A 9500-year record of climatic and floristic dynamics in the Lake Izabal Basin, eastern lowland Guatemala. * <i>Erdoo Mongol</i>
9:00 – 9:20 am	Holocene environments from Cyprus: Bronze Age boom and bust to nutty Romans. <i>Matthew Pound</i>
9:20 – 9:40 am	Atlantic Ocean offshore Mexico: palaeoceanographic and palaeoecological inferences from hydrocarbon exploratory wells of Miocene - Pliocene age. <i>Elena Menchetti</i>
9:40 – 10:00 am	Paleoecology and climatic cyclicity in the Kerio Valley Basin, Kenya. * <i>Opeyemi Taiwo</i>
10:00 – 10:20 am	Coffee/Tea Break and Poster viewing
10:20 – 10:40	Oligocene-Early Miocene (33.9-15.97 Ma) palaeoclimate reconstruction of the British Isles using a Bayesian climate reconstruction on palynological data. <i>*Jessica McCoy</i>
10:40 – 11:00 am	Ypresian dinocysts from the Carrizo and Reklaw formations (Claiborne Group), Anderson County, Texas: stratigraphic and paleoenvironmental implications. <i>Chris Denison</i>
11:00 – 11:20 am	Palynofloral change through the Paleocene-Eocene Thermal Maximum in the Bighorn Basin, Wyoming. <i>Vera Korasidis</i>
11:30 am – 1:30 pm	AASP Business Luncheon and Meeting Awards Ceremony, KGS room 102. Fully sponsored for all students by the Paleontological Society

Cenozoic Palynology II – moderated by Jen O'Keefe

1:40 – 2:00 pmConfirmation of the Paleocene-Eocene Thermal Maximum (PETM)
at Bastrop, Texas: Integrated Palynology, Isotope Geochemistry,
and Sedimentology. Thomas Demchuk

2:00 – 2:20 pm	Terrestrial pollen and spores from the Paleocene Cedar Keys Formation of peninsular Florida. <i>Curt Klug</i>
2:20 – 2:40 pm	Hooper 'Formation' (Wicox Group), Bastrop County, Texas: chronostratigraphy, lithostratigraphy, and palynology. <i>Chris</i> <i>Denison</i>
2:40 – 2:50 pm	Closing Remarks from AASP-TPS Incoming President Sophie Warny
2:50 – 3:50 pm	Poster Session II with Coffee/Tea
4:00 – 5:00 pm	Student/ECR Networking, sponsored by the Paleontological Society KGS Conference Room OR Starbucks at the William T. Young Library (People's Choice)
5:00 – 6:00 pm	AASP Incoming Board Meeting, KGS Conference Room 222

Saturday, 10 June 2023 –

7:00 am – 7:30 am	Field Trip check-in, KGS atrium
7:30 am – 7:00 pm	Post-meeting trip: <i>Natural Bridge & Red River Gorge.</i> Transportation departs from and returns to the Kentucky Geological Survey.

Posters

1	Non-pollen palynomorphs compared to other proxies in the sediments of Lago Morrenas 1, Costa Rica. * <i>Jamie Alumbaugh</i>
2	High-latitude fungal palynology of coals and interseam rocks leading to the Miocene Climate Optimum warming event, Victoria, Australia. * <i>Laikin Tarlton</i>
3	Fungal palynology of early-middle Miocene sediments from Northwestern Peru. *Jeremyah Cabrera and Jen O'Keefe
4	Fungi in a warmer world: Middle Miocene fungi and global palaeoclimates. <i>Matthew Pound</i>
5	Pollen Morphology and Systematics of East African Palms. *Opeyemi Taiwo
6	Palynology across the K-Pg Boundary in the Jackson Purchase Region of Kentucky. *Maeve McCarty
7	Comparison of organic and fossil materials trapped within ancient and modern bedded halite. *Sarah Titta
8	A palynological analysis of core samples from Eyasi-Wembere sub-basins, north eastern Tanzania. Johanes Kakoki

ONLINE POSTERS

1	"Paradrymonia alliance": data pollen of "Chrysothemis clade" (Gesneriaceae). *T.K. Bellonzi
2	Contribution of morphometric pollen grains data of native Rosales species from Southeastern Brazil. * <i>I.P. Cerdan</i>
3	Qualitative and quantitative data of some speices of Ligeriinae (Gesneriaceae). * <i>R. Magalhães</i>
4	Pollen morphology of ornamental crops associated with stingless bees. *G.A. Pio
5	Local Vegetation of the Kamchatka River Valley During the Holocene: Reconstruction based on Palynological and Tephrochronological Data. * <i>Valerii</i> <i>Pimenov</i>

- 6 Paleoclimate and hydrological reconstructions of the Lake Erie during the Holocene: New evidence from pollen and palynodebris. **Yunlang Zhang*
- 7 Exploring fungal diversity through the recent past: new laboratory and educational approaches. *Susy Franco-Velasquez*
- 8 Palynofloral and carbon isotope records of the Wolfang Basin, Australia: insights into the onset of the Permian P3 glaciation. *Alex Wheeler*



*denotes presenter

Non-pollen palynomorphs compared to other proxies in the sediments of Lago Morrenas 1, Costa Rica

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Non-pollen palynomorphs (NPPs) are acid-resistant organic microfossils in lake sediments that are not pollen grains, including fungal spores, testate amoebae, and algal cysts. NPPs on pollen slides prepared from lake-sediment cores can provide information about past environments, climates, and even the presence of megaherbivores near the lake. This research presents the NPP assemblage from Lago Morrenas 1 (9.4925N, 83.4848W; 3480 m) and compares the environmental signals suggested by NPP data to existing paleoenvironmental proxies from Lago Morrenas 1 and nearby lakes. Lago Morrenas 1 is a 5.2 ha glacial lake on the north slope of Cerro Chirripó, the highest peak in Costa Rica. This lake in the Cordillera de Talamanca is surrounded by páramo vegetation, with montane forests below 3200 m elevation. Diatom assemblages indicate little change in water chemistry since deglaciation. But pollen, charcoal, and stable isotope records indicate shifts in terrestrial vegetation, fire, and hydroclimate, with wetter conditions and few fires in the highland during the middle Holocene, and drier conditions and more fires during the Early and Late Holocene. We identified over 80 types of NPPs, mainly fungal spores that travel short distances from their point of release and thus offer localized evidence of past conditions. Here we present data on 15 of these NPPs, and compare them to existing paleoenvironmental data, including reconstructed precipitation based on hydrogen isotope analysis of leaf waxes in the lake sediments.

Keywords: non-pollen palynomorphs; Costa Rica; Holocene; lake sediments.

"Paradrymonia alliance": data pollen of "Chrysothemis clade" (Gesneriaceae)

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"*Chrysothemys* clade" is a recent natural group formed by species of the Chrysothemis (Gesneriaceae) genus. This taxon, *Paradrymonia*, and *Nautilocalyx* historically had problems in their generic relationships and delimitations and was taxonomically problematic for many years.

Recently, from field expeditions and increased sampling, these genera underwent a new circumscription based on molecular data establishing the "Paradrymonia alliance", composed of five genera (Paradrymonia Hanst. s.s., Centrosolenia Benth., Chrysothemis Decne., Trichodrymonia Oerst. and Nautilocalyx Linden ex Hanst.) and seven clades, one of which is "Chrysothemis clade". This clade includes Chrysothemis pulchella Donn ex Sims (the generic type species of Chrysothemis Decne.), C. friedrichsthaliana (Hanst.) H. E. Moore, Nautilocalyx melittifolius (=Chrysothemis melittifolia (L.) M. M. Mora and J. L. Clark), and N. panamensis (=Chrysothemis panamensis (Seem.) M. Mora and J. L. Clark). The aim of the present study is to characterize and described the morphology of the pollen grains, to search for pollen data that characterize the "Chrysothemis clade" and provide information from the comparison with the other six clades, including one species from each clade that form their sister clades. "Amazonian Nautilocalyx clade' (Nautilocalyx pemphidius L.E. Skog); "Nautilocalyx clade" (Nautilocalyx erytranthus J.L. Clark & M.M. Mora) and "Trichodrymonia clade" (Trichodrymonia metamorphophylla (Donn. Sm.) M. M. Mora & J. L. Clark). Pollen grains were acetolyzed, measured and photographed under light microscopy. The preliminary results of the seven species analyzed demonstrate the pollen grains are monads, ispolar, medium, with small variation of amb, being circular, subcircular, subtriangular or triangular, very small, small, large to very large polar area, with shape variation, even within the same sample, being able to be suboblate, oblate-spheroidal, prolate-spheroidal, subprolate or prolate. They exhibit a tricolporate or tricolpate circulaperturate aperture, wide to narrow, short to long ectoaperture, sometimes the ectoaperture are so long that they are found to form structures similar to syncolpores, the ends are rounded, and may have a margo or ectoaperture membrane ornamented, endoapertures circular or lolongate, exine semitected with ornamentation varying between microreticulate or microreticulate-reticulate with differentiation of apocolpus and mesocolpus in some cases, exine thin ou very thin, sexine is thicker than nexine. The results demonstrate that there are important differences between the type of aperture and ornamentation. The most ancestral species of the "Chrysothemis" clade, have a 3-colporate aperture, and the ornamentation varies in the apocolpium. and mesocolpium of the grains. In Chrysothemis melittiolia the exine is microreticulate in the apocolpium and reticulate-heterobrochate in the mesocolpium, in *Chrysothemis panamensis* the ornamentation is reticulate heterobrochate in the apocolpium and microreticulate in the mesocolpium. This same variation of ornamentation in the same pollen grain is present in the more derived species Chryshothemis pulchella (reticulate apocolpium and microreticulate mesocolpium), however, the reticulate ornamentation in the apocolp is homobrochate and the microreticulum in the mesocolpium present sinuous curves. However, in the species, Chrysothemis friedrichsthaliana, which shares a common ancestor with Chryshothemis pulchella, the exine ornamentation is only microreticulate with also sinuous curves. For these two derived species of *Chrysothemis*, we observe the 3-colpate evolutionary novelty for the apertures. Regarding the species representing the three sister clades, we observed mainly the presence of a margo in the most ancestral species of *Chrysothemis*, also in Nautilocalyx pemphidius; Nautilocalyx erytranthus and Trichodrymonia metamorphophylla and the absence of margo in the most ancestral species (Chryshothemis pulchella and Chrysothemis friedrichsthaliana), we also verified the presence of very thin exine only in Nautilocalyx erythranthus, being thin in all other species. Finally, there are also significant differences in the width of the ectoapertures. The partial results demonstrate a diversity of pollen grains, which

certainly helps in the search for morphological characters that support the new taxonomic changes in the clade. The results also confirm the eurypolynic character of the Columneinae and Gesneriaceae tribes.

Keywords: Columneinae; Gesnerieae; new combinations; ornamentation; palynotaxonomy

Fungal palynology of early-middle Miocene sediments from Northwestern Peru

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Fungal communities provide vital terrestrial ecosystem functions. Understanding how they respond to climate change is necessary for predicting future assemblage dynamics and ecosystem function. Sediments deposited during the Miocene Climate Optimum (MCO), 18-13 million years ago, provide an opportunity to examine fungal responses to a warming event with CO_2 values both similar to those today and in line with forecast climate change. Few fungal datasets exist for tropical regions during the MCO, and only one uses modern methods to identify fossil fungi and complete paleoecological inferences. To date, none have completed paleoclimatological reconstructions using the nearest living relative method. Two past studies examined fungal diversity in northwestern Peru. However, these did not utilize stratigraphically controlled samples, without which it is impossible to explain how fungal communities changed prior to, during, or following the MCO. For this study, new samples with stratigraphic control were collected in Summer 2022 for both biostratigraphy and fungal palynology. Here we present fungal diversity results from the lowermost part of the section to the uppermost. Samples from the lower part of the section contain a sparse, low-diversity assemblage, while the uppermost part of the section contains an abundant, diverse assemblage. The diversity and abundance changes track changes in the depositional environment, with greater diversity and abundance occurring in terrestrial sediments. Using the nearest living relative method, we demonstrate that the fungal assemblages track previously documented changes in moisture availability and indicate deposition under increasing warm conditions.

Keywords: Paleoclimate, Diversity, Nearest-Living Relative, Fungi, Miocene

Devonian chitinozoans from the Los Monos Formation in the Ramos borehole, northwestern Argentina

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The Ramos R1011 borehole, located in the north-eastern Salta province of Argentina, was palynologically analysed. It comprises rocks from the Tarija basin in northwestern Argentina which is considered to be connected with the Silurian-Devonian sub-Andean basin from South Bolivia. Preliminary palynological results of Middle Devonian samples from this borehole suggest a marine platform paleoenvironment for the upper samples with some fluctuations to shallower deposits in the deepest samples. The organic-walled marine phytoplankton and miospores would also indicate a possible Emsian - Givetian age for this section.

Nineteen cutting samples were processed and a moderately well-preserved chitinozoan assemblage was recognized from the Los Monos Formation in the upper and middle parts of the studied section. Five genera and twenty-one chitinozoan species were recognised from the 323 chitinozoan specimens analysed with SEM.

Three new chitinozoan species were recognised. Two of them (*Ramochitina candelariaensis* and *Ramochitina durandi*) were previously recorded as a *nomen nudum* for Pérez-Leytón (2007). Furthermore, another two species that were previously recorded from the Tacobo borehole (*Ancyrochitina* aff. *morzadeci* and *Lagenochitina* cf. *pirum*) are well represented herein, which suggest that they could also be new species themselves. The assemblage yielded species that are restricted to Western Gondwana such as *Ancyrochitina biconstricta, Ancyrochitina parisi* and *Ramochitina boliviensis*. However, well-known species with worldwide distribution such as *Ancyrochitina pilosa*, were also recognised.

The Ramos and Tacobo borehole chitinozoan assemblages share 50% of the species and both resemble strongly to the typical middle Devonian chitinozoan fauna from Western Gondwana and Bolivia.

The topmost part of the Ramos assemblage can be assigned to the early Givetian *postdesmeayeserae* biozone from South Bolivia (Pérez-Leytón, 2007) and the *Fungochitina microespinosa-Ancyrochitina taouratinensis* biozone from Western Gondwana (Grahn, 2005). Furthermore, the samples from the middle part of the section can be assigned to the late Eifelian – early Givetian *candelariaensis* informal biozone from South Bolivia, which correlates with the *Ramochitina stiphrospinata* biozone from Western Gondwana. The Middle Devonian *Ancyrochitina cornigera* global biozone (Paris et al., 2000) can be assigned to the entire assemblage.

Summarizing, the samples studied from the Ramos borehole yielded a typical Middle Devonian Western Gondwana assemblage that can be assigned to the late Eifelian – early Givetian.

Keywords: Devonian; Chitinozoan; Taxonomy; Argentina; Tarija basin.

Contribution of morphometric pollen grains data of native Rosales species from Southeastern Brazil

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Rosales has nine families with about 6300 species, with Cannabaceae, Moraceae, Rhamnaceae and Rosaceae families belonging to the order. In Rosaceae there are trees, shrubs, lianas, or herbs with flowers pollinated by bees, butterflies and coleoptera. Rhamnaceae has a wide geographic distribution in the world and includes about 58 genera and 900 species with flowers pollinated by flies, bees, wasps and coleoptera. Cannabaceae has about 11 genera and 180 species. Besides, in Brazil there are only two genera, Celtis L. and Trema Lour, and seven species. The Moraceae family is distributed mainly in tropical and temperate areas, with 50 genera and about 1000 species around the world. The present study aimed to analyze the qualitative and quantitative data of the pollen grains of 15 species from Cannabaceae, Moraceae, Rhamnaceae and Rosaceae (Rosales) from forest fragments in Southeastern Brazil: Celtis boliviensis, C. diffusa, C. gardneri, C. iguanaea, C. lancifolia, C. orthacanthos, Trema micrantha; Brosimum quianense, Maclura tinctoria, Sorocea bonplandii; Colubrina alandulosa, Gouania ulmifolia, G. virgata, Rhamnidium elaeocarpum; and Prunus myrtifolia. The pollen material was obtained from specimens deposited in herbarium SP ("Maria Eneyda P. Kaufmann Fidalgo"). The pollen grains were acetolyzed, measured, photographed, and described. The quantitative data were submitted to Multivariate Principal Component Analysis (PCA) and qualitative data were organized for pollen description and qualitative Cluster analysis. In the multivariate analysis, Axis 1 comprised 79.21% and Axis 2, 17.34% of the pollen grains metric variability. The metric variables that determined the separation of two large groups were: ectoaperture length and ectoaperture width for Axis 1, and equatorial diameter in polar view and polar diameter in equatorial view for Axis 2. In addition, the results of qualitative Cluster analysis showed that exine ornamentation, amb in polar view, format in equatorial view and ectoaperture are important characters to determine the genera and families. Therefore, the measures of pollen grains allow the distinction of the families and genera, being important to solve systematic and taxonomic problems of the group.

Keywords: pollen grains; Rosales; Brazilian species.

Assessing the thermal maturity of early Silurian rocks from Saudi Arabia using Palynomorph Darkness Index ('PDI'): progress and challenges

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Early Silurian (Llandovery to Aeronian) organic-rich shales ("hot shales") are widespread across large areas over the entire northern Gondwanan margin and particularly in North Africa and the Middle East, where they constitute the primary source rocks for Palaeozoic petroleum systems. In Saudi Arabia, these "hot shales" deposits occur within the Qusaiba Member of the Qalibah Formation. Accurately assessing the thermal maturity of these rocks is therefore important, but also challenging. Vitrinite Reflectance (VR) is the parameter most widely used for the assessment of thermal maturity and definition of boundaries of the various hydrocarbon generation 'windows', however, this method cannot be applied to pre-Mid Devonian rocks such as the Qusaiba Member due to the absence of vitrinite. In its place, several proxies for VR known as Vitrinite Reflectance Equivalents (VREs) are used. These include two VREs calculated from pyrolysis-based Tmax determination and one VRE calculated from measured graptolite reflectance but these methods often produce somewhat different results from the same sections.

Acritarch PDI (Palynomorph Darkness Index) is proving to be a useful method for estimating the relative maturity of Qusaiba Member sections and has the advantage of being rapid, inexpensive and easily deployed during routine palynostratigraphic investigations. The *Veryhachium* – *Neoveryhachium* morphological complex is the preferred group for PDI determination (PDI_V), as it has a very long stratigraphic range and consistent structure and vesicle wall thickness. PDI can also be obtained from all acritarch taxa in an assemblage (PDI_A) in samples containing too few specimens of the *Veryhachium* – *Neoveryhachium* Group for PDI_V to be measured. PDI_A is closely comparable to PDI_V at lower levels of maturity but the correlation is poorer in more mature rocks.

At present, calibration of PDI_V and PDI_A against standard VR-based maturity scale can only be achieved indirectly via other VREs. To overcome this problem, PDI_A and VR (Av. VR_o) have been determined from a small number of latest Devonian and earliest Carboniferous samples from the eastern and Midwest USA that contain both vitrinite and acritarchs. The results from these samples tightly constrain the relationship between PDI_A and VR around the base of the Oil Window but many more samples will need to be investigated to accurately establish the calibration of PDI_V/PDI_A against VR through the whole maturity range and thereby erect a robust, standalone, acritarch PDI-based maturity assessment.

Keywords: PDI; Silurian; acritarchs; Qalibah Formation; Saudi Arabia

CONFIRMATION OF THE PALEOCENE-EOCENE THERMAL MAXIMUM (PETM) AT BASTROP, TEXAS: INTEGRATED PALYNOLOGY, ISOTOPE GEOCHEMISTRY AND SEDIMENTOLOGY

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Years of reconnaissance investigations into the Wilcox outcrops around Bastrop (TX) have pointed to the presence of the Paleocene-Eocene Thermal Maximum (PETM) within the associated strata. Sedimentological findings indicated that strata of the uppermost Wilcox to Carrizo in this region were deposited in coastal, shallow-marine environments which contradicts earlier interpretations that these strata were strictly fluvial in origin. This is confirmed by the identification of tidally modified sedimentary structures, stratal architectures consistent with those of shelfal deltas and tidal flats, including tidal deltas, a highly diverse and abundant marine trace fossil assemblage, and marine dinocysts. Initial palynological findings established an *Apectodinium* spike within the Dark Band, above the Sabinetown Formation (uppermost Wilcox Group). The associated palynofloral assemblage pointed to a latest Paleocene age, and the *Apectodinium* spike suggested proximity to the PETM.

More recent and high-resolution investigations of upper Paleocene/lower Eocene outcrop and onshore core strata have built upon these earlier determinations and have confirmed the Dark Band as the local expression of the PETM interval, making the base of the Dark Band coeval with base Eocene. This is based on additional palynological findings which have clearly identified a significant *Apectodinium* spike, now associated with a negative carbon isotope excursion (NCIE). Additional palynoflora characteristics of latest Paleocene strata include *Caryapollenites veripites* (dominant), *Pistillipollenites mcgregorii* and *Thomsonipollis ma*gnificus. A regional unconformity is present between the Sabinetown and Carrizo formations, and the exact duration of missing time varies along the Gulf Coast, perhaps as many as 4Ma years, but much less in most areas. Recognition of the first early Eocene (Ypresian) palynofloral assemblage is also variable but usually includes abundant *Thomsonipollis magnificus, Annona foveoreticulata* and *Spinaepollis spinosus*, with a diminished *Caryapollenites* presence. *Platycaryapollenites platycaryoides* is locally present but never common and its first appearance datum along the Gulf Coast may not directly coincide with the Paleocene-Eocene boundary.

Keywords: PETM, Apectodinium, Gulf Coast, Texas, Wilcox

PALYNOLOGY OF SELECT SAMPLES FROM THE CAMPANIAN NESLEN FORMATION, BOOK CLIFFS, UT: FINDINGS FROM AN INTEGRATED CHRONOSTRATIGRAPHIC AND SEDIMENTOLOGICAL STUDY

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Palynofloral assemblages from the Neslen Formation (Fm) (Harley Dome, Book Cliffs, UT) illustrate a diverse and relatively abundant assemblage of Triprojectate lineage palynoflora, additional characteristic, and unique Late Cretaceous pollen, as well as sparse assemblages of low-diversity dinoflagellates. Pollen of the Triprojectates include species of Aquilapollenites, Triprojectus, Mancicorpus, and Parviprojectus. Along with other palynoflora, a predominant terrestrially influenced paleoenvironment with fluvial-system-delivered delta plain or coastal plain pollen is envisaged, which corroborates general sedimentological findings. Overall. assemblages are dominated by Aquilapollenites quadriolobus and Mancicorpus anchoriformis, both typical Campanian forms: however, the presence of such age-restricted species as (tentatively identified) Mancicorpus erosus would indicate a more exact age of approximately 78 Ma within the 'middle' Campanian. This is in agreement with ages for the Neslen Fm from other regional bio- and stratigraphic findings. Additionally, sparse dinoflagellate assemblages indicate intermittent intervals of marine-influence and shallow-marine sedimentation on these strata; assemblages are rather sparse and monospecific, dominated by Senegalinium-Subtilispharea species, as well as (mostly) nondescript marine algae. This corroborates interpretations based on intervals with marine trace fossils and evident marine flooding events from the stratigraphyichnology. The age of the dinoflagellate assemblages support the ages from the terrestrial palynoflora.

Sedimentology, ichnology, and stratal architecture analysis reveal deposits of proximal fluvialtidal channels, subaqueous delta-front splays, sandy and muddy tidal flats, as well as fluvial channels and associated floodplains modified by paleosols. A total of 28 trace-fossil morphotypes were identified in the Neslen Fm and underlying uppermost Sego Fm including 14 fully marine traces, 11 facies-breaking traces, (those traces that can exist in fresh, brackish, or marine salinities), 1 freshwater trace, and 2 continental traces. The *Teredolites* ichnofacies was used as an indicator of marine flooding events. Ichnology was critical for refining paleoenvironmental interpretations and separating intervals containing shallow-marine deposits from those of the subaerial delta plain. Deposition likely occurred within a distal, yet protected estuarine environment or on tidally affected deltas along an embayed coastline.

Keywords: Neslen Formation, Book Cliffs, Campanian, Utah, Aquilapollenites

Hooper 'Formation' (Wilcox Group), Bastrop County, Texas: chronostratigraphy, lithostratigraphy and palynology

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A previously unknown tonstein in the uppermost Hooper 'Formation' (Wilcox Group) at McKinney Roughs Nature Park, Bastrop County, Texas, has provided the first radiometric age date for the Gulf Coast onshore Wilcox and the first chronostratigraphic tie-point within the lower part of the Wilcox. The weighted mean age of sanidine crystals is 62.08±0.19 Ma, a reliable age for tephra ejection. This radiometric age, one of only three chronostratigraphic tie-points for correlation in Central Texas, has major implications for regional stratigraphy.

By dating the uppermost Hooper as latest Danian, this tonstein provides the first confirmation that all the Hooper and the subjacent Caldwell Knob and Solomon Creek formations are Danian (66.0 Ma to 61.6 Ma) in age, thereby limiting the superjacent Simsboro, Calvert Bluff and Sabinetown formations to a Selandian-Thanetian age. Based on this new evidence, the *O. duvali* biostrome at the top of the Caldwell Knob in Central Texas is on the order of 4 Myr older than the '*O. thirsae* beds' of Alabama, and the Midway/Wilcox boundary in Central Texas is on the order of 3.5 Myr older than that boundary in Alabama. The Midway/Wilcox boundary in Central Texas is below the Hooper, at the Solomon Creek/Caldwell Knob boundary, and therefore is older than 62 Ma, but otherwise unconstrained within the Danian. In Mississippi and Alabama the Midway/Wilcox boundary at the Naheola/Nanafalia formation boundary is co-incident with the NP6/NP7 nannofossil zones boundary at 59.6 Ma, within the upper part of the Selandian. Consequently, the Midway/Wilcox boundary in Central Texas is at least 2.4 million years older than that boundary in Central Texas is at least 2.4 million years older than that boundary in Alabama.

The thickness of this tonstein varies from 3 cm to 20 cm at different localities. Fossil leaves, bark and wood fragments incorporated in the tonstein indicate both deposition and contemporaneous modifications in slow-moving water. Pollen and spore assemblages from carbonaceous siltstones that enclose the tonstein at locations known as Nick's Pit, MoSU Ridge and Riverside Trail record a mosaic of nearby environments that range from standing water mires to fern and sedge wet meadows to bald cypress swamps, to wet subtropical lowland forests.

Freshwater algal cysts are still treated largely as curiosities despite having a Paleozoic to Recent record as rare to minor components of non-marine spore and pollen assemblages and as a transported component of marine acritarch and dinocyst assemblages. Cysts that can now be interpreted as the remains of freshwater algae with reasonable confidence have previously been identified as pollen, acritarchs, or simply as *incertae sedis*. Carbonaceous siltstones that represent standing water and wet meadow environments have produced unusually abundant

and diverse assemblages of freshwater algal cysts, providing a broader impression of Paleogene freshwater algal populations. Assemblages are typically dominated by *Ovoidites* species. At least six new algal cyst genera have been identified. Morphotypes previously attributed to *Tetraporina* have been re-evaluated in terms of 2-D and 3-D asymmetry, wall structure, and ornamentation. The virtual absence of *Botryococcus, Scenedesmus* and *Pediastrum* suggests they may prefer faster moving water. These freshwater carbonaceous siltstones represent the first terrestrial record of the Latest Danian Event (62.18 Ma to 61.99 Ma).

Keywords: Wilcox Group; Hooper; Danian; tonstein; chronostratigraphy; freshwater algae

Ypresian dinocysts from the Carrizo and Reklaw formations (Claiborne Group), Anderson County, Texas: stratigraphic and paleoenvironmental implications

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Endemism, regional morphological variations, and local environmental controls on dinocyst populations, combined with significant time gaps in an up-dip stratigraphic succession, introduce uncertainty when attempting to apply existing dinocyst zonations from distant areas to the Carrizo Formation and overlying Reklaw Formation (Claiborne Group) in northeast Texas. For example, *Axiodinium hyperacanthum*, a Paleocene/Eocene Thermal Maximum (PETM) marker species is absent, and *Wetzeliella astra*, a short-ranging earliest Ypresian species, is also absent, possibly due to the absence of earliest Ypresian deposits; alternatively both may be restricted to high-latitudes. Despite these caveats, dinocysts from the Carrizo and Reklaw in three cored wells in Anderson County, Texas, Burrow #1, Burrow #1A and Thompson Oran #1, indicate an Ypresian, probably early Ypresian age. This first account of Claiborne dinocyst assemblages in Texas provides a basis for robust, biostratigraphically constrained regional correlations in marine Claiborne successions of the larger Gulf Coast area.

In Bastrop County, the PETM interval, characterized by a pronounced acme of the dinocyst *Apectodinium homomorphum* and a well-developed Negative Carbon Isotope Excursion, is overlain by the Carrizo with a hiatus of previously undetermined duration. Above an erosional base with a *Glossifungites* surface, the Carrizo is mostly composed fine-grained cross-bedded sands, with tidally-modified sedimentary structures, and in places large *Ophiomorpha*, probably the deposits of a prograding tidal delta. Siltstones are a minor component of the Carrizo, either from hemipelagic settling between dunes, flocculation at the turbidity maximum in tidal channels, or clasts from bank collapse in tidal channels. Nearly all the siltstone samples selected for palynology produced marine dinocysts, although with highly variable numbers and diversity, demonstrating that Carrizo deposition occurred in shifting shallow marine conditions, in keeping with tidal depositional settings interpreted from sedimentary structures, and in marked contrast to prior fluvial channel interpretations. Dinocyst assemblages are quite similar to those from the

Reklaw, clearly Ypresian, although lacking definitive marker species. As a result, the age of the Carrizo from the dinocysts is likely equivalent to nannofossil zones NP10 or NP11, implying that duration of the PETM/Carrizo hiatus is a least one million years.

The Newby member of the Reklaw consists of glauconitic silty sandstones of variable thickness that lack primary sedimentary structures due to intense bioturbation. Dinocyst assemblages from the Newby are rich and diverse indicating open shallow marine conditions, possibly tidally-driven sand waves or dunes on a shallow shelf. Dracodinium sp. in the Newby is the first up-section appearance (i.e. the first evolutionary appearance, at least as recorded in this set of cores), indicating an early Ypresian age, no older than NP11. Several species of Apectodinium continue to be present. Siltstones of the Marguez member of the Reklaw are mostly featureless but diminutive (?juvenile) shelly faunas are sporadically present. Dracodinium sp. is present in the lower part of the Marguez and Apectodinium spp. continue throughout. The morphologically distinctive late Ypresian markers Charlesdowniea coleothrypta and Areosphaeridium dictyoplokum are known to be present in Texas, but have not been found in the Reklaw, giving a reliable constraint for the Reklaw being no younger than early Ypresian, possibly within the older part of NP12. A nearshore to offshore shallow marine progression can be interpreted from the Newby to Marquez lithological succession, but environmental stresses of as yet undetermined nature during Marquez deposition resulted in dinocyst assemblages being less abundant and less diverse than Newby assemblages.

Keywords: Carrizo; Reklaw; Claiborne Group; Ypresian; Texas; dinocysts

It's a trap!: the preservation potential of ancient salt minerals

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Chemical sediments, such as bedded halite (NaCl) and gypsum (CaSO₄), are strongly influenced by environmental conditions during deposition and, if unaltered, may preserve microfossils and microorganisms for hundreds of millions of years. Recent studies have shown that halite and gypsum can be an excellent repository for palynomorphs, biosignatures, and environmental data. However, the preservation potential of salt minerals remains relatively untested. Salt minerals are the perfect trap. As they grow "step-like" cleavage-controlled irregularities rapidly enclose the surface brine and other matter from the environment as fluid or solid inclusions. These inclusions function as "snapshot" repositories of surface water, air, crystals, and the remains of life.

Here, we present highlights of preservation in halite and gypsum of varying ages to showcase the diversity of life that has been documented within it. In addition, we use Permian bedded halite from western equatorial Pangaea and modern halite from acid saline lakes in Western Australia, as case studies. Halite from the Nippewalla Group of Kansas (Amoco Rebecca K. Bounds, Andarko Davis, and AEC 5 cores) and Opeche Shale of North Dakota (Gulf Romanysyn core) reveals chevron and cumulate crystals with primary fluid inclusions, many containing microbes and

accidental daughter crystals. Solid inclusions trapped along growth bands were also trapped as the halite precipitated. Biological material in our study includes representatives of Archaea, bacteria, fungi, and green algae, as well as pollen grains, spore, coniferous plant cuticle, charophyte algae, and organic fibers. Whole insects and insect segments, as well as halite ostracod molds, have also been recognized as solid inclusions. Pennate diatoms have been found as solid inclusions and inside fluid inclusions. Organic compounds, including beta-carotene and chlorophyll, are also present. We supplement our findings with examples of exceptional preservation from the literature. Our systematic review reveals how the remains of multiple Kingdoms of life have been reported from salt minerals: Archaea, Bacteria, Chromista, Plantae, Fungi, and Animalia.

Life and taphonomic processes in continental environments in dry climates are relatively poorly understood. Salt minerals forming in shallow saline surface waters may represent the most important sink of terrestrial organic matter in arid environments, as it traps both organisms living in parents surface waters as well as transported materials. Detailed study of organic and fossil materials in salt minerals has implications for the better understanding of life in extreme terrestrial environments, as well as aid in the search for life on Mars.

Keywords: palynology; paleoecology; taphonomy; evaporites

Palaeoenvironmental analysis of Triassic sediments in the Norwegian North Sea

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The Triassic of the Norwegian North Sea is represented by a sequence of continental sediments that were deposited in a large-scale distributive fluvial system. The Triassic Skagerrak Formation and Hegre Group, respectively, have significant potential as high pressure-high temperature hydrocarbon reservoirs. There is a range of issues within the region that makes correlation on a local and regional scale especially difficult. Limited/partial penetration of the Triassic, unconformities due to regional erosion, the inconsistent influence of salt tectonics, and disparate lithology all contribute to the correlation struggle. Biostratigraphic analysis has been historically complicated due to the poor preservation of fossils in the red-bed sandstone and mudstone facies which are a dominating feature in the Triassic. These red-beds are most often barren or have little in the way of diagnostic biostratigraphic material. Palynological studies are limited and there has been a dearth of biostratigraphically based projects in this region since the 1990's. This study aims to construct a biostratigraphic-based correlation framework within the Norwegian North Sea; as well as to reconstruct palaeoenvironmental conditions within the region. This involves extending and adapting an existing biostratigraphic correlation scheme developed for the Triassic Skagerrak of the Central North Sea (UK and Norwegian sectors) into the northern sectors of the Norwegian Sea. Targeted sampling of core and ditch cutting material from 20 wells across the Norwegian North Sea along with detailed palynological analysis form the basis for this project. The Triassic of the Norwegian North Sea represents an important opportunity to analyse floral community recovery post Permian-Triassic extinction; as well as floral changes leading up to the End-Triassic Extinction (ETE). The land plant response to both the P-T and ETE has been studied in other parts of the world, though the effects in this region have barely been determined. The scale of the project allows palaeoenvironmental interpretation both on a local and regional scale throughout the Triassic, as well as to bridge correlation across the North Sea.

Keywords: North Sea; Triassic; palaeoenvironment; Norway

High-latitude fungal palynology of coals and interseam rocks leading to the Miocene Climate Optimum warming event, Victoria, Australia

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Fungi are necessary elements in all ecosystems because of their critical role in terrestrial carbon cycling, soil formation, and plant ecology. Thus, it is critical to understand how fungal assemblages may change with global warming. Fungal assemblage shifts, associated with climate change have been documented in the northern high latitudes, but prior to this study, we did not know if this also occurred in southern high latitudes. The analysis of fungal assemblages from lower-middle Miocene sediments from Victoria, Australia is key to resolving this question. The sediments studied here, which include the M1B coal, Yallourn Interseam, and Yallourn coal, were deposited during the lead-up to and through the Miocene Climate Optimum (MCO; 18-13 Ma). Preliminary results indicate that the fungal assemblages of M1B and Yallourn coals are highly diverse. The Yallourn Interseam, between the two coals, is less diverse. While the assemblages differ, preliminary reconstructions of fungal assemblage-indicated Köppen-Geiger climate zones suggest that fungal communities are changing in relation to climate change.

Keywords: Paleoclimate, High Latitudes, Fungi, Miocene, Nearest Living Relative

A palynological analysis of core samples from Eyasi- Wembere sub-basins, north eastern Tanzania

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The aim of this study was to investigate palynoflora in rock samples in order to identify, date, and comment on the depositional environment and thermal maturation of the palynomorphs from three stratigraphic boreholes drilled in the Eyasi Wembere sub-basin in north-eastern Tanzania.

Forty-three core samples from three short boreholes, namely Kining'inila-1, Nyalanja-1, and Luono-1, were processed and analyzed for their palynological content. Some of the samples yielded fair-to-well-preserved terrestrial palynomorphs, while other samples were barren. Thirty-four terrestrial species were identified and systematically described, of which the most abundant were pollen grains. In addition, species from Chlorophycophyten algae (*Botryococcus* sp.) and various fungal fruitifications were observed.

The palynomorph assemblages were used in age assignment based on comparisons with previously developed biozones for Gondwana. The recognized palynomorphs suggest Miocene-Holocene age for Eyasi Wembere sub-basins.

Palynofacies analysis was used to reconstruct the palaeoenvironment, which revealed the lacustrine depositional environment.

A high abundance of amorphous organic matter in some of the studied samples suggests a lowenergy, dysoxic-anoxic environment. Maturation studies based on spore color index (SCI) indicated that the organic matter in the studied core samples was mature for hydrocarbon generation.

Keywords: Tanzania; Eyasi-Wembere; Kining'inila; Nyalanja; Luono; palynology.

Palynology of the Horton Bluff Formation, Nova Scotia, Canada

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^aSaint Mary's University, New Brunswick, Canada; ^bNew Brunswick Museum, St John, New Brunswick, Canada; ^cMB Stratigraphy Ltd., Sheffield, UK; ^dNew Mexico Museum of Natural History and Science, Albuquerque, New Mexico, USA The Late Devonian to Tournaisian Horton Bluff Formation is part of the widespread Horton Group in the Maritimes Basin of Atlantic Canada. It is exposed at several sites in the Blue Beach-Horton Bluff type area in Nova Scotia. These formations and locations have been known for their early, terrestrial tetrapod fauna since the pioneering work of Logan and Dawson. Ages of the Horton Bluff Formation are constrained by macrofloras and palynology (miospores). Questions about the existing palynological biostratigraphic zonation in this area arose when evaluating historical work. While a small number of samples have been analyed from high in the section, a systematic palynological study of the entire tetrapod-bearing interval has not been published. New samples were taken from Horton Bluff coastline in Nova Scotia, commonly referred to as Blue Beach. Sample coverage extends from the southernmost and stratigraphically deepest coastal exposure up to the axis of a syncline along the shore. It thus encompases all of the tetrapod-bearing strata in the section. These strata should preserve subdivisions within the Vallatisporites vallatus miospore Biozone: the *Claytonispora distincta* and *Spelaeotriletes cabotii* subzones (informally "spore zones 2 and 3"), but the exact position of the subzonal boundary cannot be identified from exisiting data. Preliminary results and taxonomy of these samples across the Claytonispora distincta and Speleaotriletes cabotii subzones will be discussed. This locality and stratigraphical interval are important because some of the oldest know tetrapod materials from within Romer's Gap come from this coastal section. Understanding the detailed biostratigraphy will allow correlation with tetrapod records from within Romer's Gap in the Horton Group in nearby New Brunswick. The study will also allow correlation with other euramerican tetrapod sites.

Keywords: Carboniferous; Tournaisian; Nova Scotia; miospores; tetrapods

Terrestrial pollen and spores from the Paleocene Cedar Keys Formation of peninsular Florida

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Well-preserved terrestrial pollen and spores were recovered from cuttings samples from two wells penetrating the upper part of the Cedar Keys Formation of Florida. The two wells included in this study are located in the southern half of peninsular Florida at Oldsmar, Pinellas County, and LaBelle, Hendry County. Both wells are "deep" injection wells intended primarily for the disposal of the brine concentrates that are produced during the reverse osmosis production of potable water.

The Cedar Keys Formation, in the study area, consists largely of dolomitic limestone to calcitic dolostone but anhydrite is also abundant and often comprises nearly the entire sample. The Cedar Keys Formation has not been extensively studied largely because it is restricted to the subsurface throughout Florida. Additionally, the low permeability due to the abundance of anhydrite, limits the interest in the unit as a potential aquifer or petroleum reservoir. Previous studies of the unit, however, have reported the presence of foraminifers, particularly the *Quasiborelis* fauna, that suggest a Paleocene age for the Cedar Keys Formation.

In this study, terrestrial pollen and spores tend to be sparse but have been recovered from nearly all samples. Although not abundant, the terrestrial palynomorphs recovered are fairly diverse including pteridophyte spores, pollen of the Normapolles group, bisaccates, monoporates, triporates, tricolporates, and *Classopollis*. Many samples also produced abundant dinoflagellate cysts, acritarchs and foraminiferal test-linings, suggesting a strong marine influence but, in others, they are nearly or entirely lacking. The Florida palynofloras appear to show significant differences when compared with other Paleocene palynofloras of the southeastern United States.

Based largely on the abundance and nature of the anhydrite, the Cedar Keys Formation has previously been interpreted to have been deposited in a back reef lagoon or sabkha-like environment. The latter, in particular, would imply periods of subaerial exposure. The recovered palynological floras provide some evidence for the existence of emergent land in Florida during the Paleocene. This appears to be the first report of terrestrial palynomorphs from the Paleocene of peninsular Florida.

Keywords: Paleocene, Florida, Cedar Keys Formation, pollen, spores, dinoflagellates, anhydrite

Palynofloral change through the Paleocene-Eocene Thermal Maximum in the Bighorn Basin, Wyoming

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Major changes to marine and terrestrial environments and biotas occurred globally in response to the rapid increase in climate associated with the Paleocene-Eocene Thermal Maximum (PETM). To better understand the effect on continental ecosystems, we studied forty new palynological samples recovered from the Paleocene Fort Union Formation and Paleocene–Eocene Willwood Formation of the Bighorn Basin (BHB), northwestern Wyoming, USA. This study spans ~ 1.5 m.y. and notably includes 22 samples from the negative carbon isotope excursion (CIE) associated with the PETM that were not available in previous palynofloral work on this area.

Palynofloral composition changed noticeably in the latest Paleocene and then dramatically with the onset of the CIE, with large increases in the abundance of palms (*Arecipites* spp.) and ferns (*Deltoidospora adriennis, Polypodiaceoisporites gracillimus granoverrucatus*). Many palynomorphs belonging to dominantly tropical plant groups (e.g., bombacoid Malvaceae) were present during the CIE but not before or after, and many palynomorphs of temperate plant groups such as walnuts (*Polyatriopollenites vermontensis, Caryapollenites* spp.) have gaps in their temporal ranges during the CIE body. During the CIE recovery pollen of plants with living relatives

that grow on wetter substrates such as Betulaceae/Myricaceae (*Triporopollenites infrequens, T. granilabratus*) and taxodioid conifers (*Cupressacites hiatipites*) became more common again even as taxa with tropical affinities remained part of the palynoflora. Post-CIE early Eocene palynofloras are generally similar to late Paleocene ones in having abundant taxodioid conifers (Cupressaceae), walnuts (Juglandaceae), birches/alders (Betulaceae), and sycamores (Platanaceae), though the genera may be different, and Eocene index taxa are also moderately common (e.g., *Platycarya* spp. (Juglandaceae), and *Intratriporopollenites instructus* (Malvaceae). Palynofloral diversity changed little across the PETM in spite of major changes in composition.

Palynofloral changes are consistent with paleoclimatic interpretations from megafloras and paleosol morphology/geochemistry in suggesting that floodplains dried rapidly at the beginning of the CIE body as the climate warmed. High abundances of palms and ferns in the lower part of the CIE body may indicate vegetation that was frequently disturbed by fire or flood events. The uncommon but consistent presence of palynomorphs with tropical affinities during the CIE body parallels the 5°C increase in mean annual temperature inferred from geochemical and leaf physiognomic proxies. The increase during the CIE recovery of palynomorphs of plants preferring wet substrates suggests that even as temperatures remained high, floodplain wetness, and possibly precipitation, increased. This is consistent with paleosol changes during the CIE recovery.

The pattern and floristic character of change in the palynoflora is consistent with that previously detected in the megaflora, indicating the extirpation of plants preferring cooler, wetter climate during the CIE body and the invasion of plants that grew in hotter, seasonally drier climates. The palynoflora also suggests that wetter climates returned to the BHB during the CIE recovery, which was not previously noted. Finding similar patterns of change in the palynoflora and megaflora implies that the floral response to climate change was a basin-wide phenomenon rather than restricted to streamside vegetation. The changes we observe in the palynofloras are more easily detected if reworked palynomorphs are removed from analyses. Both the amount and rapidity of floral turnover are underestimated if reworking, which became more extensive during the CIE body, is not accounted for.

Keywords: Paleocene-Eocene; PETM; USA; pollen; spores; paleoclimate

Organic-walled microfossils from the restricted marine environment of the Paseky Shale (Barrandian area, Czech Republic)

V. Kovář*^a, O. Fatka^a

^aInstitute of Geology and Paleontology, Faculty of Science, Charles University, Albertov 6 12800 Prague, Czech Republic The Cambrian Paseky Shale (Příbram–Jince Basin, Barrandian area, Czech Republic) is represented by an approximately 10 meters thick unit of shale and siltstone embedded within coarser sediments (mainly sandstone and conglomerates) of the Holšiny-Hořice Formation. Unlike the overlying and underlying unfossiliferous continental sediments, the Paseky Shale yielded a highly endemic skeletal fauna (Chlupáč 1995), atypical ichnofossil assemblage (Mikuláš 1995) and an unusual microfossil assemblage (Fatka & Konzalová 1995). Based on these characteristics and other lithological and geochemical data, a restricted marine depositional environment has been proposed for the Paseky Shale (Chlupáč et al. 1995).

A new analysis of the microfossil assemblage of the Paseky Shale, involving the application of the 'low-manipulation HF extraction' method of Butterfield & Harvey (2012) has been conducted. The obtained fossils include a variety of filamentous remains, acritarchs, small carbonaceous fossils as well as putative ciliates. These findings expand our understanding of the extraordinary restricted marine environment in Cambrian.

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Keywords: Paseky Shale, restricted marine environment, small carbonaceous fossils, acritarchs

New Insights into the Age of the Strawn Group, Texas

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^aEllington Geological Services, LLC, Houston, Texas; ^bSTARR-BEG, Austin, Texas; ^cUniversity of Kansa, Lawrence, Kansas; ^dUT Austin Non-Vertebrate Paleo Lab, Austin, Texas; ^eFormer UT MS Student The Strawn Group is a lithostratigraphic unit of Pennsylvanian age deposited primarily within the Fort Worth and Permian basins of Texas. The Strawn contains complex stratigraphy and regional stratigraphic relationships because 1) it was deposited during a time of high amplitude, high frequency sea-level fluctuations, 2) clastic sources such as deltas developed intermittently along a complex tidal coastline, 3) carbonates formed on a tidal shelf near-to but off axis of clastic sources, and 4) basins were tectonically active during deposition. Age control that allows for regional correlations of Strawn clastics and carbonates is lacking.

A new palynological study of samples from three subsurface cores of the Strawn Group in Stonewall and King Counties, and outcrops in the Greater Texas Stone Quarry in San Saba County, TX provide new insights into the age of the unit. The chronostratigraphy of the Strawn Group in the north-central Texas outcrop belt is often taken for granted, to the point that it is commonly misused as synonyms for some Pennsylvanian chronostratigraphic stages, such as the Desmoinesian and Missourian. Still, there is controversy about the age of the unit in the subsurface. To clarify the age, fifteen dark shale samples were analyzed, most of them with positive palynological results.

From the subsurface, core samples of the Continental Oil Osborn #7 well (King Co, TX) contained a palynological assemblage characterized by *Savitrisporites nux, Densosporites annulatus, Knoxisporites triradiatus Punctatisporites minutus, Punctatisporites glaber, Triquitrites bransonii, Laevigatosporites globosus,* and *Endosporites globiformis*. This sporomorphs assemblage can be correlated with the spore Zone *Radiizonates difformis* (Zone RD, Phillips and Peppers, 1984).

The samples from the Phillip CB Long C-16 well (Stonewall Co., TX) contained a varied and rich assemblage that included 34 different species. The Assemblage Zone *Radiizonates difformis* (RD) was identified on the lower part of the section based on key sporomorphs, e.g., *Torispora securis, Savitrisporites nux, Granaporites medius, Laevigatosporites globusus, Microreticulatisporites sulcatus* and an abundant and diverse *Lycospora* and *Densosporites* assemblage. The Zone OT was identified in the top studied sample based on well-diversified *Lycospora* and *Densosporites globusus*.

The Threshold Development Co #6A Fayette-Yates well (Jack Co., TX) assemblage was the richest analyzed, with 44 species that included, *Acanthotriletes echinatus, Cirratriradites annulatus, Cirratriradites annuliformis, Cirratriradites saturni, Crassispora kosankei, Deltoidospora levis, Deltoidospora subadnatoide, Densosporites irregularis, Endosporites zonalis, Granulatisporites granulatus, Knoxisporites stephanephorus, Laevigatosporites globusus, Laevigatosporites medius, Lophotriletes gibbosus, Lycospora granulate, Lycospora pellucida, Lycospora pusilla, Lycospora subtriquetra, Microreticulatisporites sulcatus, Punctatisporites glaber, Punctatisporites punctatus, Savitrisporites majus, Triquitrites exiguus,* and *Triquitrites tribullatus.* Based on the general assemblage in the section and the combined presence of *Microreticulatisporites sulcatus, Triquitrites scuptilis, Savitrisporites nux,* and *Laevigatosporites globusus,* it was possible to identify the palynological Zone SL (Clayton *et al.,* 1977), equivalent to the upper part of the Assemblage Zone *Radiizonates difformis* RD.

The Greater Texas Stone Quarry samples were mainly barren, with single occurrences of *Savitrisporites* cf. *nux*, *Ahrensisporites* cf. *guerickei*, *Leiotriletes* sp., *Vallatisporites vallatus*, and a few broken specimens comparable to *Punctatisporites minutus*. Based on this it was impossible to identify a palynological zone.

The age of the Strawn Group from these samples, based on the species ranges by Eble *et al.* 2022, belong to Zone SL/ RD hence of "upper" Atokan age, except the shallowest sample of the Phillips CB Long core with the presence of the Zone OT indicating a Desmoinesian age. These results indicate a mainly Atokan age for the Strawn Group in the subsurface of Texas, with some intervals of Desmoinesian age. This is a slightly older age than the generally accepted Desmoinesian age for the Strawn.

Keywords: Strawn; Atokan; Desmoinesian; Pennsylvanian; Paleozoic; Texas; palynology.

Qualitative and quantitative data of some species of Ligeriinae (Gesneriaceae)

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Palynology, as a subfield of botany, consists of studying and understanding the morphological characteristics of pollen grains and spores. To achieve this, appropriate tools are used to enable pollen description through qualitative data, such as pollen unit, polarity, shape, number and types of apertures and exine ornamentation, as well as the treatment of quantitative data using suitable statistical methods for species ordering. Therefore, quantitative data related to pollen grain measurements, such as diameter values (polar and equatorial views), length and width of ectoapertures and endoapertures, CWI (colpus width index), PAI (polar area index), and the P/E ratio (polar diameter/equatorial diameter), are important and support descriptive analyses. This study aimed to characterize and describe the pollen grains of 13 species belonging to the Ligeriinae subtribe (Gesneriaceae), including four species of *Paliavana* Vell. ex Vand. (*Paliavana gracilis* (Mart.) Chautems, *P. prasinata* (Ker Gawl.) Benth., *P. sericiflora* Benth., and *P. werdermannii* Mansf.), six species of *Sinningia* Nees (*Sinningia conspicua* (Seem.) G. Nicholson, *S. eumorpha* H.E. Moore, *S. gerdtiana* Chautems, *S. macropoda* (Sprague) H.E. Moore, *S. schiffneri* Fritsch, and *S. speciosa* Benth. & Hook.), and three species of *Vanhouttea* Lem. (*Vanhouttea bradeana* Hoehne, *V. calcarata* Lem., and *V. lanata* Fritsch), to understand the

characteristics that distinguish the species and genera of the subtribe through quantitative data. The pollen material was collected from herbariums and a cultivation site (Sítio Primavera, Mogi das Cruzes, São Paulo). Pollen grains were acetolyzed, measured, described, and photomicrographed, and scanning electron microscopy images were obtained using the technique for non-acetolyzed pollen grains to provide better ornamentation details. The results consist of pollen grains released in monads, isopolar, ranging from small to medium and medium-sized, circular to rarely subtriangular amb, with a small to very small polar area; oblate spheroidal, prolate spheroidal, subprolate, and prolate; 3-colporate, angulaperturate and fossaperturate, with long to very long and narrow colpi, tapered ends, margo and constriction present in most species; the endoaperture is lolongate and often difficult to visualize; semitectate exine with reticulate heterobrochate ornamentation, homobrochate or heterobrochate microreticulate ornamentation in the mesocolpium, and always microreticulate in the apocolpium; the exine is thin, with the sexine being thicker than the nexine. The quantitative data demonstrate the similarities between the studied genera, indicating little variation in pollen characteristics, particularly between the *Sinningia* and *Vanhouttea* genera.

Keywords: Pollen grains; Paliavana; Sinningia; Vanhouttea

Atlantic Ocean offshore Mexico: palaeoceanographic and palaeoecological inferences from hydrocarbon exploratory wells of Miocene - Pliocene age.

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An integrated biostratigraphic study was conducted on several hydrocarbon exploratory wells located in the Atlantic offshore of Mexico. The analyses of foraminifera, nannofossils and palynomorphs assemblages allow to build a reliable chronostratigraphic frame of Late Miocene and Early Pliocene successions. While the study followed a pragmatic industrial approach, observed oscillations in the abundance of some dinocysts taxa could bring to interesting consideration about the timing and modality of the closure of the Central America Seaway (CAS). This event is considered one of the most important driver of the establishment of modern circulation in the North Atlantic, and essential for the onset of Greenland glaciation. The debate is fed by only few studies available in the literature from tropical and sub-tropical areas, while more extensive records are available for higher latitude successions making the current dataset highly valuable. This study focused on three exploratory wells, studied trough the analysis of more than 150 cutting samples. Well A spans a succession of about 2600 m, Well B of 1100 m and Well C 1400 m. The chronostratigraphic interpretation was mainly based on foraminifera and nannofossils. Well A intercepted the older succession going from Zanclean and including Messinian and possible Tortonian interval. Well B reached down Messinian sediments, while Well

C was confined to Zanclean and possible Piacenzian. Environmental considerations were suggested based on the total abundances of fossil groups and on indices based on the ecological requirements of single taxa. A general shallowing upward trend was observed, going from upper bathyal to inner shelf conditions, coherently with the observations of Sanchez Rios et al. (2009) and with the cooling trend preceding the marine isotope stage (MIS) M2. An attempt to interpret the fossil records in terms of sequence stratigraphy was done with the aim of correlating the recognized surfaces with global events. The palynological record testifies persistent warm conditions with assemblages dominated by warm water affinity taxa such as S. mirabilis, P. zoharyi, M. choanophorum, O.? eirikianum and I. patulum. Abundance oscillations of marine palynomorphs (dinoflagellate cysts) were observed in the three wells, regarding mainly Operculodinium genus and Polysphaeridium zohary. The Messinian-Zanclean boundary is characterized in Well A by common to abundant P. zoharyi, and in a coeval time interval, the same trend is observed in Well B, while this chronostratigraphic interval is not recorded in Well C. A further peak of this taxon is recorded in the same two wells in a higher stratigraphic position just below the increase of Operculodinium genus. Such an increase is weak in Well A, possibly because of the interruption of the sampled succession. It is, on the contrary, well-expressed in wells B and C, recording a younger succession. In Well C, a local influx of brown peridinioid cysts is also observed. According to the conceptual model suggested by De Schepper et al. (2013), the succession of events could be expressed as follows: at the Messinian-Zanclean boundary, the closure of the CAS determines low productivity and high SST in the Caribbean Sea. The higher recorded peak of P. zoharyi could represent a salinity anomaly attested in the area between 4.2 and 4.5 Ma. The following increase of Operculodinium and the influx of brown cysts could correspond to an enhanced productivity related to the arrival of cooler water from the Pacific in a final pulse of opening of the CAS. The topmost interval is characterized by a weak increase in dinocysts and in particular in P. zoharyi and could represent the final closure of the corridor preceding the onset of Greenland glaciation. The available biostratigraphic record for the Caribbean Sea is not as rich as for high latitude areas; hence, the integration with studies conducted on hydrocarbon exploratory wells can provide an added value. Despite the analysed samples are mainly cuttings, significant information can be extrapolated. Understanding the mechanisms and relationships among single events is fundamental in a paleoceanographic perspective to evaluate possible future environmental changes and strategies of adaptation. From the exploration point of view, the CAS opening and closure needs to be considered as an important trigger in mass water circulation, having a critical role in sediment deposition. For all these reasons, a deep understanding of its evolution is crucial.

Oligocene-Early Miocene (33.9-15.97 Ma) palaeoclimate reconstruction of the British Isles using a Bayesian climate reconstruction on palynological data

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The Oligocene-Early Miocene (33.9-15.97 Ma) was an interval characterised by a warmer and wetter palaeoclimate than present, thus reconstruction of deep-time palaeoclimates allow for the better understanding of climate dynamics in the context of a developing Antarctic ice sheet with pCO2 levels like those in a warming world. Existing data suggests that in the North Atlantic, Late Oligocene sea-surface temperatures increased with corresponding declines in pCO2 (700-300 ppm), pointing to changes in oceanic circulation at that time. The Miocene was identified as an interval of interest in the recent IPCC AR6 report as a geological analogue for middle-late 21st century anthropogenic climate change. The Oligocene-Early Miocene-age palaeoenvironmental record from the British Isles has been reconstructed at selected sites, although no attempts to reconstruct the palaeoclimate have been made thus far. Here we present the results of the application of Bayesian probability-density-function-based reconstruction using Climate Reconstruction Software (CREST) to nearest-living relative records derived from palynological data. Results of the analysis are the first Oligocene-Early Miocene-age palaeoclimate record from the British Isles. We also present a new method of assigning Köppen-Geiger (K-G) signatures to reconstructions. Our results indicate that the Oligocene-Early Miocene palaeoclimates were just as warm, if not warmer, than present, as reconstructed K-G classifications ranged from a subtropical warm summer signal with no overall dry season (Cfb) to a tropical rainforest climate (Af), which was most prevalent in orbitally forced pulses during the Chattian. Our reconstructions show that the British Isles' precipitation regime became monsoon-driven, with a dry-winter season, during a short interval in the Chattian before the regime reverted to a no-dry-season signal. Early Miocene-age reconstructions reconstructed no overall dry season; thus, we suggest a westerly trade wind system was established earlier than the previously anticipated Middle Miocene.

Keywords: pollen, secondary data, Bayesian reconstruction, Oligocene, Miocene

A 9500-year record of climatic and floristic dynamics in the Lake Izabal Basin, eastern lowland Guatemala

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^oDepartment of Geosciences and Geological and Petroleum Engineering Missouri University of Science and Technology, Rolla MO, USA. ^bInstituto de Geología, Universidad Nacional Autónoma de México Mexico, D.F. **Aim:** The Holocene has been characterized by multiple changes in precipitation on different time scales from annual to millennial, modulating the composition and structure of vegetation. The palynological study of lacustrine sedimentary records offer an opportunity to study the temporal relationship between climate and vegetation. For this purpose, we analyzed a sedimentary sequence from Lake Izabal, lowland Guatemala, to reconstruct regional vegetation dynamics during the last 9500 years, aiming to identify patterns of climatic variability based on the pollen record.

Location: Lake Izabal, Eastern Guatemala, Central America.

Data: Pollen and charcoal

Methods: A sediment core was analyzed for pollen and charcoal concentrations to reconstruct vegetation variability and paleo-fire dynamics during the last 9500 years BP. Modern occurrences of the taxa found in the sedimentary record were used to model the environmental distribution of flora, which was in turn used to estimate temperature and precipitation seasonality changes of the past, while the charcoal distribution was associated with regional and local fires.

Results: Reconstructed regional vegetation trends coupled with Holocene insolation patterns of the Northern Hemisphere at millennial scale. Centennial scale variability observed was probably associated with more regional phenomena such as changes in the spatial configuration of the North Atlantic Subtropical High (NASH) and other regional and local factors. According to our findings, conditions were warm and wet during the early Holocene and characterized by high seasonality through mid and late Holocene. Quantitative estimations suggest that vegetation patterns may have been amplified and modulated by human disturbances and other local factors. Precipitation seasonality was substantially variable across early, mid, and late Holocene.

Main conclusions: The sedimentary record from Lake Izabal show a variable precipitation seasonality through the Holocene that follows the solar insolation pattern on millennial timescales. Fire regimes as defined by charcoal concentrations also appear to be driven by insolation rather than anthropic activities or randomness. However, other factors such as anthropic impacts, microclimate of the Lake Izabal Basin, etc., apparently defined the vegetation cover on centennial to lower timescales.

Keywords: Lake Izabal; pollen analysis; vegetation change; charcoal analysis; climatic variability.

LOCAL VEGETATION OF THE KAMCHATKA RIVER VALLEY DURING THE HOLOCENE: RECONSTRUCTION BASED ON PALYNOLOGICAL AND TEPHROCHRONOLOGICAL DATA

Valerii Pimenov

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The Kamchatka Peninsula provides the potential for conducting wide-ranging and interdisciplinary research endeavors. Despite a considerable number of studies focusing on regional reconstruction, there has been a deficiency in a comprehensive study of the ecological history of local plant communities in the area. This research aims to reconstruct the vegetation of the Kamchatka River valley during the Holocene and relate our findings with tephrochronological studies.

In order to achieve this, we carried out pollen analysis of soil samples collected from four archaeological sites located in the Kamchatka River valley, and utilized statistical processing techniques such as principal component analysis and cluster analysis. We employed AMS radiocarbon dating and tephrochronological dating to corroborate our findings.

Our outcomes contradict the prevalent belief that grass tundra-steppe communities propagated in the late Pleistocene (12730-11940 BP) and rather indicate the presence of arboreal taxa (AP). The principal component analysis of pollen spectra from soil samples identified volcanic activity and hydrological conditions as the primary factors influencing the formation of the local vegetation during the Holocene.

However, we do recognize that climate also played a part in shaping the regional vegetation. Nonetheless, since soil samples reflect only the local plant component and are impacted by high pollen-producing plants growing near the sampling point, it is essential to examine modern pollen spectra to acquire a more comprehensive understanding of the factors that determine local vegetation development in the valley.

Our study supplements previous research and provides a more distinct understanding of the relationship between past plant communities and environmental factors in Kamchatka. Thus, there is a need for further research into the relationship between climate and vegetation dynamics in Kamchatka to obtain a more comprehensive understanding of the ecological history of the peninsula.

Keywords: Kamchatka, vegetation reconstruction, river valley, pollen analysis, Holocene

Pollen morphology of ornamental crops associated with stingless bees

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^aDepartment of Biology, School of Agricultural and Veterinary Sciences, Jaboticabal, Brazil, Via de Acesso Prof. Paulo Donato Castellane, s/n Ornamental crops are produced with the purpose of decorating the environment, being distinguished by the presence of flowers and inflorescences, their shape and colors. Famous for their use in urban landscaping and gardening. These flower-rich habitats have proven to be valuable for urban pollinating insects, such as bees. Providing sources of nectar and pollen. In particular, the bee species from the subtribe Meliponini, the commonly known as stinglessbees, are the most recurrent native bees in the synanthropic environment. The objective of this study was to make an analysis of the morphology of ornamental plants pollen grains. For this study, we observed the pollinator visitation patterns in 6 botanical species to collect material manually, establishing two urban areas, in Fernandópolis-SP, Brazil and Jaboticabal-SP, Brazil cities. Flower buds and flowers were stored in parchment paper envelopes and identified with specialized bibliography. The species studied so far are from the families: Acanthaceae (Odontonema Nees.), Asteraceae (Tridax L.), Lamiaceae (Ocimum L.) e Talinaceae (Talinum Adans). The pollen grains were acetolyzed, measured and photomicrographed. The qualitative data were described. The species studied so far have pollen grains in monads, sizes ranging from medium to large, apolar or isopolar, 3-porate, 4-porate, 3-colporate and pantoporate. With exin microreticulate, reticulate or echinate. Based on the analyzed species, we verified a morphological diversity of pollen grains associated with stingless bees.

Keywords: pollen, palynology, ornamental crops, pollen morphology, stingless bees.

Fungi in a Warmer World: Middle Miocene fungi and global palaeoclimates

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A lack of long-term and large-scale information on how fungi will respond to climate change is a major barrier to understanding how this important kingdom will react to 21st century anthropogenic warming. Using the Middle Miocene (16-12 Ma) as a past warm interval, the Fungi in a Warmer World project has been expanding our lack of long-term and large-scale information on how fungi will respond to climate change is a major barrier to understanding how this important kingdom will react to 21st century anthropogenic warming. Using the Middle Miocene (16-12 Ma) as a past warm interval, the Fungi in a Warmer World project has been expanding our lack of long-term and large-scale information on how fungi will react to 21st century anthropogenic warming. Using the Middle Miocene (16-12 Ma) as a past warm interval, the Fungi in a Warmer World project has been expanding our taxonomical, ecological and climatological knowledge of fossil fungi. Here we present the first view of the FUNKI fungal database, how fossil fungi can reconstruct palaeoclimates and new palaeobotany and palynology-based reconstructions of global palaeoclimate.

Keywords: Miocene, palaeomycology, palaeoclimates, global

Holocene environments from Cyprus: Bronze Age boom and bust to nutty Romans

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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 wetland in response to mid-late Holocene climate events. New geochemical data tracks the local origins of copper production and

what did the Romans do for the Cypriot flora? Finally, we provide some initial results on the redated Agio Sozomenos Late Glacial section.

Keywords: Holocene, multi-proxy, climate change, societal collapse; anthropogenic indicators

Lopingian (Late Permian) palynomorphs from the Cadeby Formation, Cadeby Quarry, Yorkshire, UK

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Seventeen samples from the Cadeby Formation (Lopingian, Permian, EZ1) of Cadeby Quarry near Doncaster, South Yorkshire, UK, yielded organic residues including phytoclasts, cuticle, unstructured tissue and generally well-preserved palynomorphs. The palynomorph assemblages are dominated by taeniate and non-taeniate bisaccate pollen including *Klausipollenites schaubergeri, Limitisporites rectus, Lueckisporites virkkiae* and *Taeniaesporites noviaulensis*. The assemblages are generally similar to those from the English Midlands described from Kimberley Railway Cutting and the Haughton Hall Borehole, Nottinghamshire and those from the Marl Slate Formation (lower EZ1) of the Durham Sub-basin at Claxheugh Rock and Crime Rigg Quarry and to the mid EZ1 of the Salterford Farm Borehole and Woolsthorpe Bridge Borehole. The excellent preservation of the assemblages allows the recognition that *Dicappipollenites* Tiwari & Vijaya 1995 is a junior synonym of *Lueckisporites* Potonié & Klaus emend. Clarke 1965.

The presence of rare microphytoplankton and microforaminiferal test linings indicate a neashore marine environment. The clastic (and organic) content of the Cadeby Formation, part of a dominantly carbonate succession, may represent erosion and transport of material from the hinterland reflecting a wetter climatic period, though the alternation of clastic and carbonate sedimentation in the section at Cadeby suggests some wet/dry palaeoclimatic cyclicity.

Keywords: Permian; Lopingian; bisaccate pollen; Yorkshire; palaeoenvironments

Mantell's Spiniferites

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Gideon Mantell (1790 – 1852) is probably best known for naming Iguanadon in 1825 but his influence spanned much of palaeontology, including dinocyst palynology. Here I will present images and discussion about Mantell's Spiniferites (a slice of flint containing several specimens).

The nomenclature and type status of the different Spiniferites specimens and taxa is extremely complicated and so far, I have more questions than answers for which I aim to summarise in this presentation. Questions with or without answers include What is Spiniferites reginaldi? Why do some imaging techniques not work on these specimens? What is the type specimen for the genus Spiniferites if Ehrenberg's Xanthidium is invalid?

Keywords: Dinocysts; Spiniferites; Cretaceous.

Paleoecology and climatic cyclicity in the Kerio Valley Basin, Kenya

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The results of the palynological studies of Neogene lacustrine deposits penetrated by Cheptuket-1 well in the Kerio Valley Basin (KVB), Central Kenya, are presented. Palynomorphs were analysed with the aim of understanding climate cycling and modelling biofacies responses to changes in the depositional system in the rift basin. The subsurface successions penetrated by the 3083-mdeep Cheptuket-1 well were subdivided into three distinct units based on wireline signatures, and physical and microscope examinations. Unit 1 is composed of the Uasin Gishu Phonolites overlain by the fluvio-lacustrine Ngorora Formation of unit 2 and capped by the Ewalel phonolites of unit 3.

Palynomorph diversity in the studied well was low and poorly preserved. Based on the presence of *Acalypha sp.* (Euphorbiaceae), a late Miocene indicator in the Ngorora Formation, as well as an assemblage of Tortonian tropical grassland and tropical savannah biome, the Ngorora Formation was assigned an Upper Miocene age (Tortonian), denoting an older age for the underlying Uasin Gishu Formation and Muruyur bed, which was assigned a mid-Miocene age (Seravallian) based on the presence of Seravallian tropical evergreen forest and tropical semi-deciduous vegetation assemblage in the Muruyur beds.

From the detrended correspondence analysis (DCA), nine clustered groups (A-I) were established to define ecological distributions and affinities of the recovered palynoflora of Cheptuket-1 well. These ecological affinities were used to infer water variability and interpret climatic trends in the KVB. By fitting a sinusoidal model to the water variability groups, four climatic wet-to-dry cycles were established with each cycle having a wet phase capped by a dry phase. While cycle 1, showed no clearly defined climatically driven cyclicity due to the interference of volcanics and tectonism, the inverse relationship of the wet and dry phase indicators observed in cycles 2, 3 and 4, show distinctively defined climate-related cyclicities. The predominance of the grassland, savanna, and dry woodland megabiomes in cycles 2, 3 and 4, confirms the expansion of tropical savanna in the KVB by the Tortonian.

The biome pattern of the Tortonian Ngorora Lake regime reflects a cooler and drier environment than that of the Serravallian Muruyur lake regime, where the warm evergreen broadleaf and

mixed forest continued to be replaced by cooler and drier biomes. This research has advanced our understanding of using palynomorphs for tracking climatic changes through Miocene in the KVB, and its extension to other African rift basins is envisaged.

Keywords: paleoecology; climate cyclicity; ecological affinities; Kerio Valley Basin

Pollen Morphology and Systematics of East African Palms

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This study reports discoveries of palm pollen from the Northern parts of Central Kenya in East Africa from Oligocene to middle Miocene, including its taxonomy, morphological characteristics, and global historical significance. Forty-eight ditch cutting samples from Loperot-1 well in the Lokichar Basin (Central Kenya) were processed for palynomorphs using the standard acid method and viewed under light microscope (LM) and scanning electron microscope (SEM). Palm taxa were identified and described based on the morphology of the grains, including the amb, the aperture type and number, its symmetry, the presence and/or absence of the tectum and exine ornamentations. Using these morphological indices, twelve subtribes namely -Ptychospermatinae type, Arecinae type, Sclerospermatinae type, Roystoneae type, Linospadicinae type, Elaeidinae type, Bactridinae type, Wettiniinae type, Calamineae type, Plectocomiinae type, Rhapidinae type and Phoeniceae type, distributed within five tribes and three subfamilies of the palm pollen clade were recognised. These subtribes were compared to their fossil affinity using their shared morphological characteristics. This study contributes to understanding the chronological evolution of palms in Africa and the modern disparity in palm diversity between Africa and other tropical regions.

Keywords: Palm pollen; Morphology; East Africa; Oligocene-middle Miocene; Evolution

Palynology Across the K-Pg Boundary in the Jackson Purchase Region of Kentucky

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The recently re-located Cretaceous-Paleogene (K-Pg) boundary site in western Kentucky contains a relatively complete record of deposition in terrestrial environments from the upper McNairy Formation (Cretaceous) through the lower Clayton Formation (Paleocene), separated by an iridium-enriched zone located above the iron concretion bed previously thought to demarcate the boundary. While sedimentological, geochemical, and amber-based re-studies of the boundary interval have been completed, the palynology, originally used to determine the boundary position, has not been re-examined for over 40 years. Here we present a new palynological study that examines both paleoecological and paleoclimatological conditions, present at the time of deposition, using tandem studies of both plant and fungal remains. At this site, CREST-based climate reconstructions indicate humid subtropical climates that were increasingly summer-wet from the upper Maastrictian to lower Paleocene. This study improves the palaeoecological record of the Jackson Purchase region during the K-Pg Boundary interval and sheds light on the terrestrial ecology of a rarely studied region.

Keywords: Paleoecology, Paleoclimatology, CREST, Nearest Living Relative, K-Pg Boundary

Comparison of organic and fossil materials trapped within ancient and modern bedded halite

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The sedimentological record from western equatorial Pangea, now present-day Midcontinent U.S.A., contains evidence of a system of ephemeral acid saline lakes. These are the red-bedded evaporites of the Permian Nippewalla Group. High fidelity data about the sedimentology, water chemistry, atmospheric composition, and paleotemperature are known for the Nippewalla Group, but little is known about the vegetation associated with these saline systems. Preliminary study of bedded halite (NaCl) from the Nippewalla Group has shown that it hosts bacteria, Archaea, algae, pollen, fungi, and organic compounds, but the preservation of plant material has not been systematically assessed. This is an undergraduate senior thesis funded by the First2 Network at West Virginia University, exploring preservation of organic material in bedded halite.

The Rebecca K. Bounds (R.K.B.) #1 core, at 99% complete, is an exceptionally stratigraphically complete core from Kansas, U.S.A. The targeted section of core is 1500 ft of red siliciclastic and bedded and displacive halite and gypsum belonging to the Middle Permian Nippewalla Group (~267 Ma). Thin sections of bedded halite from the R.K.B. core from the Salt Plain and Blaine Formations, as well as thin sections of modern halite from Lake Brown and Twin Lake West in Western Australia, were examined using optical petrography techniques. The halite from Western Australia comes from ephemeral acid saline lake systems and is the best modern analog we have for the North American Permian halite. Plane transmitted microscopy with long working-distance

objectives (up to 200x) were used to image objects as small as 5 µm within individual halite crystals. Optical petrography techniques helped confirm that organic material is encased within individual halite crystals, dissuading concerns about possible contamination. UV-vis light microscopy (in the 330-380 nm wavelength range) was used to determine any fluorescent response of organic material. For example, prokaryotic cells (bacteria and Archaea) fluoresce pale green or blue-green.

Here we compare evidence of plant meso- and microfossils (cuticle, tracheids, pollen grains) and suspect organic material encased in ancient and modern bedded halite. We can select images the week after spring break. The variety of fossil and organic material observed in thin sections from the Permian Nippewalla Group, Lake Brown, and Twin Lake West suggest bedded halite is a good repository for evidence of past and present plant and microbial life, and worthy of continued study. Our findings allow us to interpret that ephemeral acid saline environments are capable of supporting a range of life forms. This study suggests bedded halite throughout geologic time should be targeted for palynologic study, suggests salt minerals other than halite may also contain signs of life, and helps inform the search for signs of life in extraterrestrial evaporites.

Keywords: paleoecology; taphonomy; evaporites; bedded halite; astrobiology

Palynofloral and carbon isotope records of the Wolfang Basin, Australia: insights into the onset of the Permian P3 glaciation

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The Permian P3 glaciation in Australia is interpreted to have occurred from the upper Roadian to the mid-Capitanian. This interval is thought to have been a less severe "alpine-style" glaciation with the glaciers themselves limited to mountainous regions. The aim of this study is to identify any changes in the palynological and carbon isotope record that would suggest climatic changes reflecting this interval using terrestrial coal measures as climate archives.

Biostratigraphy based on the zircon-calibrated palynostratigraphy of eastern Australia indicates deposition in the Wolfang Basin in Queensland, Australia would have been partially cotemporaneous with the P3 glaciation. This rift-controlled half-graben contains significant coal deposits. The Wolfang Main Seam can reach up to 50 metres in thickness and is laterally extensive representing a prolonged period of peat formation with little to no interruption. The overlying Prospect and Gowrie seams also reach high thicknesses (>10 m) in parts, but these thicker accumulations are more spatially constrained to the northern part of the basin, whereas in the

south they split into numerous plys and pinch out entirely. The age of the Main Seam is upper Kungurian to lower Roadian placing it below the onset of the P3 glaciation, while the Prospect and Gowrie seams would more likely have been deposited in the upper Roadian to Wordian.

Carbon isotope values show an overall trend of broad enrichment which may be suggestive of a cooling climate consistent with a glacial interval. Palynological assemblages in all seams have a relatively low diversity reflecting the low diversity of the floras themselves. Trilete spores form the main component of the palynofloras in nearly all samples with *Leiotriletes, Horriditriletes, Converrucosisporites, Acanthotriletes* as the most common taxa. Some few samples have a higher abundance in zonate trilete spores (*Indotriradites*) or monolete spores (*Laevigatosporites*). Pollen assemblages are dominated by a mix of striate bisaccate pollen grains (*Protohaploxypinus, Striatopodocarpites*), non-striate bisaccate pollen (*Alisporites, Scheuringipollenites*) and sulcate pollen grains (*Marsupipollenites*). Monosaccate pollen (*Plicatipollenites, Cannanoropollis*) are rare but consistent components, but often appearing as damaged grains or fragmented sacci potentially indicating transport into the mire. Floras in the Main Seam do not show a significant difference with those of the Prospect and Gowrie seams.

The mire flora would likely have been fern-dominated with subordinate glossopterids and potentially cordaitaleans. Horsetails and lycopsids likely also occurred in more local concentrations. Later Permian palynofloral assemblages are much more diverse particularly with the appearance of new spore taxa, particularly *Dulhuntyispora*, and more diverse forms of striate bisaccate pollen derived from *Glossopteris*. In this way the P3 may have had little effect on the floras that had been present before the glacial interval, but the subsequent interglacial may have triggered a wave of diversification that gave rise to the zenith of the *Glossopteris*-flora that would have been dominant until the end-Permian mass extinction.

Keywords: Permian Gondwana; Wolfang Basin; Australia; coal measures; P3 glaciation; palynology; carbon isotopes

Exploring fungal diversity through the recent past: new laboratory and educational approaches.

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To disentangle human disturbances recorded in non-consolidated sediments, this research uses coprophilous fungal remains as proxy of pastoralism and defaunation at the spatial scale of a watershed. A new protocol for examining coprophilous fungal conidiospores in lacustrine sediments was tested and calibrated using tropical lacustrine sediments and herbivore's dropping samples. Finally, we present an online activity that uses fungal remains to teach middle

schoolers ecosystem's matter and energy cycles with superficial soil samples from the Western US using this new lab procedure.

Traditional protocols to prepare Non-Pollen Palynomorphs (NPP's) in paleoecology and palynology can degrade fungal remains or even mask translucent remains. Improved methods for uncovering fungal remains are needed to allow fungi proxies to be used for detecting and understanding past disturbances. The new laboratory protocol allows for the recovery of fungal remains based on the physical separation of the sediment components, using fewer non-toxic reagents and reducing the overall lab expenses. This, in turn, makes the method more accessible in countries with limited equipment and reagents accessibility such as Colombia. The protocol prioritizes physical separation over chemical procedures to avoid adverse effects on fungal remains and toxic waste. The basic protocol entails: (1) Disaggregating soil components using sodium hexametaphosphate; (2) A hot water ultrasonic bath, vortexing, and letting the sample settle; (3) Sieving samples with double mesh (7 μ m and 250 μ m sizes) sieves to remove very large and very small particles; (4) Centrifuging to separate organic and mineral portions of the remaining sediment; (5) and lastly, staining the subsample using Lactophenol Cotton Blue (targets translucent fungal remains made out of Chitin). This new protocol is less corrosive than traditional methods since all separation steps emphasize physically splitting sediment components. Ongoing testing will establish the degree to which this new protocol reduces biases in studying fungal remains. The diversity of fungal conidiospores found in tropical lacustrine sediments (top 20 cm) of San Diego Lagoon (SDL core Fc2) is partial proof that this new method works properly to extract NPP's from lacustrine sediments where at least 77 types of conidiospores and other fungal remains were identified and at least 16 of them are ecologically informative.

Keywords: Non-pollen palynomorphs; fungi; palynology; education; ecological disturbances.

Paleoclimate and hydrological reconstructions of the Lake Erie during the Holocene: New evidence from pollen and palynodebris

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Lake Erie, the most populous of the Laurentian Great Lakes, is also the smallest and the most sensitive to changes in climate. In this study, we examine pollen and palynodebris (phytoclasts, amorphous organic matter, and non-pollen palynomorphs) in a dated, 10 m core from Lake Erie's central basin to establish a record of regional climate, vegetation, and water sources, and their relationship to lake levels. Pollen slides were prepared by analyzing about 3 grams of sediment sampled at every 31 to 75 cm along the core and examined at 20X magnification, counting

through a systematic grid search up to 300 individual pollen grains. Cluster analysis of pollen, spores, phytoclasts, and amorphous organic matter identified 4 zones. The zone boundaries correspond to changes in inorganic carbon (IC), organic carbon (OC), and C/N, and to time periods where geomorphologic evidence indicates changes in lake level. Zone I, between 800-1000 cm (~11,000 cal Yr. BP), features the highest abundances of Picea and trilete spores (mostly Sphagnaceae), as well as the highest C/N, indicative of cold temperatures and changing climate, and consistent with very low lake levels. These findings confirm the early Holocene age for the zone despite anomalously young radiocarbon ages (~5,000 cal Yr. BP) below the zone in the bottom 20 cm of the core. Zone II, from 800-550 cm (~8,000-5,000 cal Yr. BP) has higher abundances of Quercus, Acer, and Salix, and high IC, consistent with warmer middle Holocene climate and closed basin conditions with carbonate saturated water. Zone III from 550-250 cm (~5,000-2,000 cal Yr. BP) is similar to Zone II in tree and grass pollen and fern spores but has a higher proportion of small, equant opaque phytoclasts relative to larger, lath-shaped opaque phytoclasts. The Zone II-Zone III boundary corresponds to a stepwise drop in IC related to a rise in lake level that was driven by the influx of upper Great Lakes water; the change in phytoclast size and shape may reflect a longer transport distance associated with this influx. Zone IV (<250 cm and ~2000-<1000 cal Yr. BP) shows a rise in Ambrosia and other indicators of disturbance taxa and may record anthropogenic deforestation associated with early stages of development of pre-Columbian agriculture. After early Holocene warming (Zone I), the consistency in the vegetation dynamics over the last 8,000 years (Zones II-IV) shows little evidence for climate change, which favors a non-climate driver for the return of the upper Great Lake water ~5,000 cal Yr. BP.

Keywords: Lake Erie, Holocene, Pollen, Palynodebris



Parking for the Kentucky Native Café is available at 446 East High Street. Their entrance is at the back of the parking lot.

Ethereal Brewing's Public House is located at 102 W. Vine St. For-fee garage parking for Ethereal Brewing's Public House is either across Vine St. in the Marriott/City Center Garage (use the Jeff Ruby's Steakhouse elevator and exit to Vine St.) or a block past the venue on Vine (or High St. for high profile vehicles) in the Transit Center Parking Garage. Metered (free after 5 pm) parking is available along South Limestone NE of Vine St. and on South Upper, NE and SW of Vine Street. Note that South Limestone is one-way going NE and South Upper St. is one way going SW; Vine is one-way going SE.

Both venues are walk-able from the university and the conference hotel, although be aware it is approximately 1.5 mi/2.4 km from the conference hotel to each.







MINING AND MINERAL RESOURCES BUILDING Relevant portions of the Ground FLOOR

Relevant Portions of the MIDDLE Floor





- CELL PHONE USE RESTRICTED TO LOBBY AND SECOND FLOOR STUDY ROOMS
- FOOD AND DRINK RESTRICTED TO LOBBY

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