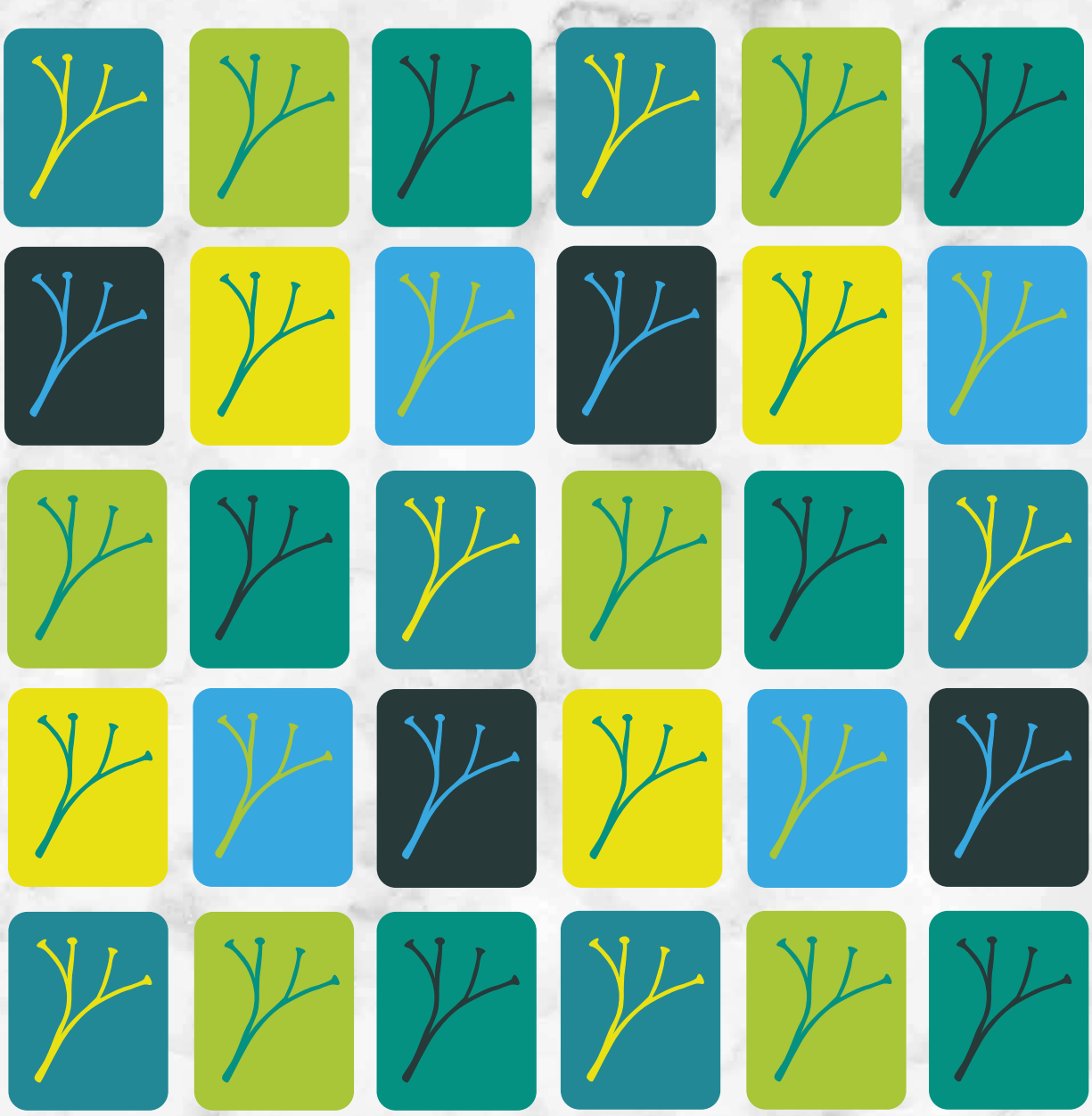
10TH EUROPEAN PALAEOBOTANY & PALYNOLOGY CONFERENCE

University College Dublin, Ireland
12-17 August 2018



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PROGRAM & ABSTRACTS

EPPC2018
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O029

PALYNOLOGY OF PENNSYLVANIAN TO PERMIAN SUCCESSIONS IN SAUDI ARABIA (JUWAYL, NUAYYIM AND KHUFF FORMATIONS)

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Palynology has provided important chronostratigraphic, paleoenvironmental and paleoclimatic controls in the development of the current understanding of depositional architecture, sedimentary facies and regional stratigraphic relationships within the highly variable and complex reservoir units of the Pennsylvanian to Permian succession on the Arabian Peninsula.

The Unayzah Group, comprising the Juwayl and Nuayyim formations, ranges in age from Early Pennsylvanian (Bashkirian) to Early Permian (Artinskian/?Kungurian), and is bound by significant tectonically driven surfaces, the Hercynian Unconformity at the base and Pre-Khuff Unconformity at the top. The Juwayl Formation encompasses a range of depositional facies associated with fluvio-glacial and glacio-lacustrine processes, in response to glacial advance and retreat. The Nuayyim Formation also encompasses a range of depositional facies associated with a post-glacial succession.

The Khuff Formation (Middle Permian-Early Triassic) reflects an overall marine transgression, following the initial phase of rifting associated with opening of Neotethys. Basal Khuff Clastics Member comprising coarse clastic fluvial sediments and overbank paleosols, occur from the base of the Middle Permian (Roadian-Wordian) and followed by thin transgressive tidally influenced shallow marine sandstones, shales and limestones. The latter are deposited progressively later (Wordian-Capitanian) from southeast to northwest and signify the diachronous nature of Basal Khuff Clastics and the transition to dominant limestone deposition throughout the remainder of the Khuff Formation.

Late Paleozoic palynostratigraphy of the Arabian Peninsula was developing in Oman from the mid 1980's with several zonations published. Pioneering palynological studies of the succession in Saudi Arabia were from the early 1990's, but no zonation was published. In early 2000's the first correlations between Saudi Arabia and Oman defined a series of semi-regional palynozones and palynosubzones for the late Moscovian-Capitanian. In parallel, and based on subsurface samples from exploration wells, an operational palynozonation was developed specifically for Saudi Arabia comprising seven palynozones and eight palynosubzones, and spanning the Bashkirian to Changhsingian.

These assemblage zones and subzones reflect a complex interplay of paleoclimate and paleogeography, resulting from the impact of both latitudinal and altitudinal controls on megafloral communities. Recognition of occasional chronostratigraphically significant palynomorphs enable broad correlation with global standards, but precise age assignments are still debated, particularly around the Carboniferous-Permian transition. Clear evidence of phytopaleogeographic provincialism adds to the challenge of fully understanding the palynostratigraphy of the Arabian Peninsula. Nevertheless, the palynozonation developed provides a robust stratigraphic framework, and demonstrates apparent diachroneity of transition from glacial to deglacial and deglacial to post-glacial successions.

O030

POLLEN EDNA METABARCODING FROM ICE CORES AS A TOOL FOR RECONSTRUCTING PLANT BIODIVERSITY DYNAMICS. A CASE STUDY FROM THE LARGEST AND DEEPEST SOUTHERN ALPS GLACIER: ADAMELLO, ITALY.

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DNA obtained from environmental samples (eDNA) is an important source of biological information and eDNA metabarcoding is an emerging approach for reconstructing biodiversity changes through space and time. Past eDNA can be retrieved from many different sources such as ice cores, permafrost, terrestrial and lake sediments, caves, speleothems, etc.

To this end, Alpine glaciers can be viewed as precious climate and biological archives, located in the proximity of areas that are facing dramatic land use and climatic changes since the last decades. Due to the good preservation of pollen DNA in the ice and the detailed stratigraphy, they offer a unique opportunity to test the potential of eDNA metabarcoding approach, specifically aimed at investigating plant biodiversity dynamics in adjacent and surrounding areas.

Despite the obvious power of this emerging molecular approach, several caveats associated with the eDNA metabarcoding workflow need to be considered: false positives due to contaminations, false negatives resulting from primer biases, errors due to cross-contamination and chimaera sequences. Moreover primer choice, that affects taxonomic coverage and resolution, the need of complete reference databases, as well as difficult interpretation of results relative to the nature and spatial scale of eDNA represent other critical issues.

We first present and discuss different eDNA metabarcoding approaches (e.g. PCR-based sequencing vs PCR-free sequence-capture enrichment), together with their main advantages, limitations and challenges.

Second, we show the preliminary results from CALICE (CALibrating Biodiversity from Glacier ICE), a three-years research project aimed at estimating plant biodiversity changes through the last decades in the Adamello glacier catchment area. Adamello is the largest, 16.4 km^2, and deepest, 270 m, Italian glacier whose catchment area, mainly lying in the Po valley in Northern Italy, is characterized by strong anthropogenic pressure.

Our results, referring to a 10 m section extracted from the glacier at a depth of 45-35 m, demonstrate that ice cores provide a valuable source of pollen eDNA, allowing taxonomic identification at the species level. We couple eDNA data with classical high resolution morphology-based palynological analyses to provide complementary taxonomical information on the original vegetation as well an annual/seasonal timescale for the core. Our contribution will highlight the potential of integrating a molecular and morphology-based approach to encourage further studies.

O031

USING STABLE ISOTOPE ECOLOGY OF HISTORICAL *THUJA* (CUPRESSACEAE) SPECIMENS AS A TOOL TO IDENTIFY CARBON SOURCES IN DEEP TIME

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The isotopic composition of atmospheric carbon dioxide ($\delta^{13}C_{atm}$) has not been constant over geologic time due to changes in atmospheric CO_2 sources, but past fluctuations are poorly constrained. $\delta^{13}C_{atm}$ has changed rapidly since the start of the Industrial Revolution as a result of fossil fuel combustion, providing a natural experiment to test potential proxies for $\delta^{13}C_{atm}$. Here we use stable isotope biogeochemistry to track this change with herbarium and modern leaf specimens (1806 – present) of two evergreen gymnosperms in family Cupressaceae, Northern white cedar (*Thuja occidentalis*) and Pacific red cedar (*Thuja plicata*). *Thuja* has little intraspecific isotopic variation, spans a range of precipitation and temperature conditions in North America, and has a fossil record dating back into the Late Cretaceous. Thus, the results from historical herbarium samples of *Thuja* can be applied to *Thuja* fossils up to ~71 million years old to reconstruct $\delta^{13}C_{atm}$ at the time. Stable carbon isotope ($\delta^{13}C_{leaf}$) compositions were measured for historical leaf samples of North American *Thuja* (n=137) using a Picarro Cavity Ring-Down Spectroscope at the University of Michigan. A second parameter (Δ_{leaf}) was calculated by the subtracting $\delta^{13}C_{leaf}$ from $\delta^{13}C_{atm}$ values at the time the plant was growing that were derived from direct and interpolated measurements. Δ_{leaf} reflects the deviation of a tree's ^{13}C fractionation from the moving (as a result of the burning of fossil fuels, i.e. the Suess Effect) atmospheric baseline. $\delta^{13}C_{leaf}$ values ranged from -21.9 to -28.8‰ and were more negative with decreased $\delta^{13}C_{atm}$, demonstrating that *Thuja* is a potentially useful recorder of the paleo-atmosphere composition on both historic and potentially longer time scales. Δ_{leaf} values were nearly constant (mean: 18.11‰ ± 1.14‰) indicating that carbon isotope fractionation of these evergreen gymnosperms has not been affected by climate variables over the period of Industrialization. The consistency within this genus supports its potential use as a paleoclimate indicator across a broad range of (paleo-)environments. The linear relationship between *Thuja* $\delta^{13}C_{leaf}$ and $\delta^{13}C_{atm}$ was applied to compressed leaf fossils from the Cretaceous, Eocene, and Oligocene to estimate $\delta^{13}C_{atm}$; results showed the same relative differences from each other as values found by Tipple et al. (2010) using foraminifera. Thus, *Thuja* $\delta^{13}C_{leaf}$ values provide a reasonable additional proxy for paleo-$\delta^{13}C_{atm}$ and can help us to consider potential geologic sources of pCO_2.

Tipple, B. J., et al. (2010). *Paleoceanography*, *25*(3): PA3202.

O032

CHEMICAL CLASSIFICATION OF GRASS POLLEN: A NEW TOOL FOR PALYNOLOGISTS AND ARCHAEOLOGISTS TO STUDY CROP DOMESTICATION

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The grass family (Poaceae) is one of the most economically important plant groups in the world today. In particular many major food crops, including rice, wheat, maize, rye, barley, oats and millet, are grasses that were domesticated from wild progenitors over the course of the Holocene. Archaeological evidence has provided key information on domestication pathways of different grass lineages through time and space. However the most abundant empirical archive of floral change – the pollen record – has so far been underused for reconstructing grass domestication patterns, because of the challenges of classifying grass pollen grains based on their morphology alone. Here we test the potential of a novel approach for pollen classification based on the chemical signature of the pollen grains, measured using Fourier Transform infrared (FTIR) microspectroscopy. Using a dataset of eight domesticated and wild grass species, we demonstrate a 95% classification success rate on training data, and an 80% classification success rate on validation data. This result shows that FTIR spectroscopy can provide enhanced taxonomic resolution for palynological studies, and further information on the spread of crop domestication and agriculture over the last 10000 years.