Late Miocene environmental changes in an embayment of Lake Pannon on a decadal-scale

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Lake Pannon is a well documented lake system, which covered south-eastern Europe for approximately six million years. Although the basic processes of lake evolution, its faunistic inventory and its surrounding vegetation zones are understood, the pace of environmental changes is still poorly constrained. Especially, the linkage between climate change and shifts in lake environments is still a matter of ongoing research.

The clay pit Mataschen (SE Austria) exposes lowermost Tortonian (= lower Pannonian) deposits of Lake Pannon along its north-eastern margin. Due to its laminated sediments and the aspect, that former studies already reported a relatively warm regional climate, Mataschen offers ideal conditions for high-resolution analyses based on palynomorphs. Furthermore, geophysical data (magnetic susceptibility and gamma ray) reveal several highly significant cyclicities and point to astronomical forcing throughout the 30-m-thick section. Within this study, two consecutive 50-cm-long cores were studied with a sample distance of 10 mm and analysed for pollen and dinoflagellate assemblages. Based on preliminary estimates of sedimentation rates, the studied cores encompass environmental changes within only few hundreds of years during the earliest Late Miocene. Despite rather stable lake level conditions, as indicated by constant amounts of *Pinus* and *Impagidinium*, shifting patterns within both palynomorph groups are evident. Dinoflagellate cysts show re-occurring short-time events with blooms of heterotrophic taxa. These events may point to significant increases of nutrients in the surface water due to variations in the mean annual precipitation as indicated by the pollen data. Within the pollen record, the lake shore vegetation is most sensitive to alternations in climate. Lake Pannon was surrounded by Taxodiaceae swamps and wetlands of *Sparganium*, *Typha* and species of Poaceae and Cyperaceae, whose expansion is significantly varying within few decades whilst the hinterland vegetation displays a delay as it needs more time to react.

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“Green Walls”: Microbiology of algae growing on sandstone walls and implications for the impacts of climate change on cultural heritage

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Recent observations have shown that many sandstone buildings, including important components of the UK’s cultural heritage, are becoming covered with green algal growths. This is likely to result from recent changes in air quality and the impacts of a changing climate. The precise influences of these growths on the stone surface and sub-surface are under considerable debate. The underlying question is whether they are benign and indeed bioprotective, or conversely if they are detrimental and biodeteriorative. To approach this question, there is a need for interdisciplinary studies linking geomorphological expertise with that of molecular microbiology and climatology.

The ‘Green Walls’ project contributes to this question by drawing together state of the art methods from each of these disciplines, as part of a larger project on sandstone heritage and climate change. The overall aim is to form a multi-faceted analysis of the current and future nature of algal greening on sandstone heritage in north-west Britain.

In order to better understand the interplay between climate change and the growth and impacts of green algae (chlorophyta), three phases of study have been adopted within an integrated overall methodology. Linked field and laboratory experiments, microbial species identification as well as impact and bioreceptivity analyses of sandstone contribute towards achievement of the project aim.

Northern Ireland has an abundance of sandstone heritage and given the likelihood of warmer, wetter winters; algal growth on vulnerable monuments is likely to become a primary conservation concern in the next 50 years. It thus makes an ideal major field location for the project. As a point of comparison, a satellite study is being conducted at Sheffield Cathedral. This will form an interesting comparison given the difference in climatic conditions and pollution history. Key foci for study are the impacts of stone aspect and angle of inclination on degree of algal colonisation.

Phase One of the study involves sampling from purpose-built test walls in Derrygonnelly, Northern Ireland as well as sandstone buildings in central Belfast and Sheffield. Novel, non-destructive biological sampling is conducted twice yearly, alongside measurements of moisture movements within stone facades. The rate, extent and composition of biological coverage is and will be closely monitored over the 3-year assessment period.

Phase Two encompasses laboratory analysis of these samples; standard gene profiling and sequencing techniques are used to establish community composition and abundance.

In order to contextualise this information, Phase Three involves laboratory simulations of algal growth on sandstones under likely, future climatic conditions. Composition and growth rates of algal biofilms and their impacts on sandstone will be compared to results from field studies. In effect, this allows for a comparative simulation-based study between present and future climatic conditions.

Investigation of the nature and impacts of algal soiling, as provided by this project, will supply invaluable information for those managing our sandstone cultural heritage. This will enable more informed decisions to be made over appropriate management and conservation strategies for the future.

Architecture of kinematics and deformation history of the Tertiary supradetachment Thrace basin (NE Greece)

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Detailed tectonic analysis on the Tertiary molassic and volcanosedimentary rocks of the Thrace basin allowed us to reconstruct the architecture and structural evolution of the basin, as well as the orientation of the regional paleostress field. The Tertiary molassic sedimentation of the Thrace basin was linked by a calc-alkaline magmatism associated with the Tertiary syn-orogenic extension in the Rhodope province. The Thrace basin was initially developed on the hanging wall of a low angle extensional detachment fault system of Mid-Late Eocene age simultaneously with uplift and exhumation of the Rhodope metamorphic rocks in the footwall. We interpret the molassic Tertiary Thrace basin as a supra-detachment basin associated with intense magmatism. Five (5) deformational events (T1 to T5) have been distinguished related to the basin evolution from Eocene to Quaternary time. T1 is related to low angle normal detachment faults with a mainly toward SW to SSW sense of movement of the tectonic top and subsidence of the initial Thrace basin during Mid-Late Eocene time. T2 is evolved during Oligocene-Miocene time. It is characterized by transpressional tectonic and formation of big strike slip faults and extensional fractures, as well as conjugate thrust faults