Landscape versus climate changes at lake Volvi (Macedonia, Greece) during the Holocene

This research aims to highlight human responses and resilience to climate changes detected through pollen analyses. Understanding the effects of abrupt climate change on past societies is crucial to undertake present mitigation and adaptation actions.

The research focuses on the vegetation reconstruction of Lake Volvi, Chalkidiki peninsula, central Macedonia (Greece). The area, inhabited since the Palaeolithic, shows a continuous human occupation in the last millennia. The main focus is on the impact of a changing climate on past societies.

The project is linked to a larger study lead by the “Palaeo-Science and History” Independent Max Planck Research Group whose purpose is the development of an interdisciplinary method, involving scientific and humanistic disciplines, to better investigate human history and its relation to environmental changes. The research issue concerns the comprehension of the environmental dynamics occurred during the Holocene or, according to the denomination of its most recent part, to Anthropocene.

Balkan Peninsula has been recognized as a preeminent area in the paleoenvironmental reconstruction due to its faunal and floristic richness (Willis 1994 Quat Sci Rev 13:769-788, Krystufek 2004 in: Griffiths H.I., Kryštufek B., Reed J.M. Balkan Biodiversity pp.79-108, Sadori et al. 2016 Biogeosciences 13:1423-1437) and is considered one of the main hot-spots of the Mediterranean basin. In addition to the biodiversity, Balkans are the cradle of some of the most important societies in the Mediterranean. Despite its historical importance, investigations of Holocene records are quite rare in Macedonia and limited to Lake Dojran (Masi et al. 2018 Clim Past 14:351-367), Tristinika marsh (Panajiotidis et al. 2016 Journ Archaeol Sci Rep 7:138-145) and to a marine core from Mount Athos Basin (Kotthoff et al. 2008 Holocene 18:1019-1032).

The 37 years old palynological study of a core from Lake Volvi (Bottema 1982 Palaeohistoria 24: 258–289) provided at that time a first attempt to assess the human-vegetation relationship using pollen of anthropogenic plants.

The research intends to investigate this important environmental and cultural area in order to build a complete paleoenvironmental archive to relate to archaeology and history. My contribution will concern palynology and will contribute to a multi-proxy analysis of the Lake Volvi sediment record, allowing to compare vegetation data with isotope and geochemical ones. This modern multi-proxy approach will provide essential elements to distinguish between environmental changes and human agency.

Lake Volvi is the second largest lake of Greece and is protected by the Ramsar convention for its importance as wetland habitat. It formed, with the nearby Lake Koroneia, a single huge lake in the past inside the alluvial plain of Mygdonia. The geological bedrock of the area is mainly constituted by sedimentary (limestone, clay, marl), igneous (granite), and metamorphic (gneiss) rocks (Nimfopoulos et al. 2002 Proc 6th Pan-Hellenic Geographical Conf Hellenic Geographical Society Vol.II 436-444).

The lake has been classified as meso-to-eutrophic and its status is mainly influenced by agricultural runoff and farming activities. It is fed by rainfall, surface, ground water and thermal springs. The main outlet, Richeios, flows through the Macedonian Tempi valley, characterized by dense riparian vegetation.

The obtained sequence will be soon AMS radiocarbon dated. Palynology is a fundamental method in paleoenvironmental studies: pollen data provide information on past flora and estimate the vegetation biomass and its changes due to both human impact and climate changes. Disentangling between the two causes is a never-ending story. Pollen concentration data and clues from other sedimentological proxies are crucial to distinguish between climate and human agency. NPPs, microcharcoals.

During the research I will subsampling the cores according to a step (2-4 cm) decided using mean sedimentation rates obtained by radiocarbon dates and carry on the follow activities:

* Chemical treatment of pollen samples: Chemical treatment is a fundamental step in the research for the further analysis. Sporopollenin is the major component of spores and pollen grains’ wall. It’s one of the most resistant organic compounds known in nature, showing an exceptional stability to chemical and biological attacks. In order to allow the identification of pollen and spores, chemical processing involving strong acids and bases (HCl 37%, HF 40%, and boiling NaOH 10%) is required. The treatment is rather dangerous and attention/time demanding, so I plan to process 16 samples/month and ca. 150 samples in total.
* Pollen and NPPs microscope analysis: Identification of pollen taxa and of the other microfossils found in pollen samples. Slides of pollen samples are examined under optical microscope (400-1000X) and the identification of pollen and NPPs is achieved through the use of atlases and reference collections.
* Microcharcoal analysis: Identification and measure of microcharcoals using optical microscope (400X).
* Selection of plant macroremains for AMS radiocarbon analyses. The sediment cores will be examined in order to find plant remains. They will then be identified in order to find terrestrial plant remains not affected by hard water effect suitable for 14C measures.
* Construction of a chronology in collaboration with the geochemists working on the record.
* Interpretation of results: pollen and microcharcoal data allows to explore the linkages among vegetation, climate, fire and human activities in the Balkans, offering a new insight into human-environment relationship.
* Integrating pollen data with other available sediment proxies produced by other specialists.
* Comparison of the reconstructed environmental archive with historical and archaeological sources.