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Voukaria 1966: the earliest palynological study of sediment from Lake Voukaria, Northwestern Greece

Lake Voukaria is situated in northwestern Greece in the Prefecture of Etoloakarnania, 6 km SW of the city of Vonitsa and 10 km east of the northern tip of the island of Levkás (Leukás, Lefkada). The lake is separated from the Ionian Sea on the West by a narrow limestone ridge ca 10 m high and has a size of 940 ha. An almost continuous fringe of *Phragmites* surrounds the open water. This reed bank is up to 500 m wide along the southern shore of the lake. Water depth is low, predominantly less than 2 m. In the south-eastern part of the lake a maximum depth of 3.1 m was measured in September 1997.

South of the lake, on the peninsula Plaghia, the ruins of the important ancient city of Palairos are found at an elevation of 200 m. Palairos had to be abandoned after the battle of Actium (31 BC) and was never resettled again.

The lake, which was called Myrtountion in antiquity, is connected with the Ionian Sea by a canal, almost 1.5 km long, a canal cut through the low limestone ridge in ancient times, probably to provide an harbour for Palairos.

In the 1960's a scientific project aimed at reconstructing the Bronze Age environment of Messenia, the "Minnesota Messenia Expedition", was carried out at the University of Minnesota, U.S.A. In the context of this project two piston cores were collected by the first author in order to undertake a palynological study of Lake Voukaria. The cores were taken from a floating *Phragmites* island off the west shore of Lake Voukaria in July 1966, and a second one, which was not studied, in 1967. The stratigraphy and the radiocarbon ages of core Voukaria 1966 are presented in tables 1 and 2.

The pollen content of core Voukaria 1966 was investigated by Johanna Gröger in 1968 at the Limnological Research Center (LRC) of the University of Minnesota at Minneapolis under the guidance of H.E. Wright. The preparation of sediment samples for pollen analysis included treatment with concentrated HCl, 48% HF and acetolysis. Pollen preservation was satisfactory in the younger part of the profile only, but poor in samples from the brown layer (3.7 - 4.05 m) and the gray clay below. Sample 3.8 m, within the brown marl, and all samples below 7.5 m, black clay, rich in Pyrite, were devoid of pollen. Pollen determination was facilitated by a publication of Beug (1961), one of the earliest articles on Mediterranean pollen types. As an excellent pollen reference collection was available at the LRC more than 120 pollen types could be distinguished.

Corresponding to the change from clay (below 4.05 m) to marl above (its lowermost portion forming a brown layer) major changes can be observed at this point in the pollen diagram so that the diagram can be divided into two parts. Oak pollen (*Quercus pubescens-robur* type as well as *Quercus ilex-coccifera* type) dominates in all samples, but the proportions of evergreen pollen grains are greater in the upper part of the profile than in the lower. This suits well with the increased importance of *Phillyrea* and *Pistacia* in the upper samples, where the proportions of Poaceae and of some other non-arboreal pollen types are distinctly lower than below.

The high proportions of the "Olea type" in the lower marl samples are conspicuous. This pollen type comprises the pollen grains of *Olea* and the larger grains of *Phillyrea* which resemble one another very much. Their distinction relies mainly on the thickness of the exines and the maximal width of the brochi (the meshes of the reticulum) (Beug 1961, 2004). As - due to too many transitional forms - it appeared impossible to distinguish *Olea* pollen grains reliably from *Phillyrea* these pollen grains were counted together as "Olea type" pollen, leaving the interpretation for a later discussion. Only pollen grains with relatively thin exines lacking wide brochi were counted as *Phillyrea*. Thus the *Phillyrea* curve of the core Voukaria 1966 shows minimum values only for this taxon. The pollen diagram of another core from Lake Voukaria (see below) studied much later (Jahns 2004) shows high *Phillyrea* values in the correspondent levels.

Two sediment samples were radiocarbon dated in July 1967 (Table 2). The Calendric Age of the lower one (8.34 – 8.40 m), taken almost one meter below the oldest pollen-bearing sample, is $10,815 \pm 357$ calBC. The other sample comes from the lower part of the brown marl (3.89 – 3.99 m). Its Calendric Age is $1,261 \pm 152$ calBC.

An additional core, named VOUL1, was taken from Lake Voukaria at the end of September 1997, about 2 km ESE the site of Voukaria 1966 (38°51'05" N 20°50'35" E). Comparing the pollen diagram of this core (Jahns 2005) with that of core Voukaria 1966 it must be noted that the depths of the new profile were measured from the surface of a platform 0.65 – 0.7 m above the lake level. The two diagrams are in good accordance with one another.

A few years later Vött et al. (2009) did comprehensive sedimentological, micromorphological and other studies on several vibro cores from the Voukaria area including the above mentioned "brown layer". The authors concluded (page 3): "... a so called "Brown layer" with marine fossils, fine sand, and abundant organic material that was encountered in core VOUL1 from the profundal zone of the Lake Voukaria was found to represent a tsunamigenic suspension deposit dating to 1000 cal". If so, at least this part of both pollen diagrams cannot be used for a reconstruction of the former vegetation and a hiatus cannot be excluded. Vött's publication is a rich source of information on additional studies on Lake Voukaria and its surroundings.

Literature

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