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Climate and human–environment relationships on the edge of the Tenaghi-Philippon marsh (Northern Greece) during the Neolithization process

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ABSTRACT

Palynological and sedimentological investigations carried out around the tell of Dikili Tash (Eastern Macedonia, Greece), one of the oldest Neolithic sites in Europe, improve our understanding of the evolution of the paleoenvironment from the Late Pleistocene to the Neolithic period (6500–3200 cal BC in this region). While global climate reconstructions researches based on the study of the Tenaghi-Philippon pollen record, located 5–8 km from the tell, have focused on forces that drive the environment at regional or global scales, we attempt to use the sediment archives on the edge of the marsh to describe the context of the Neolithization process and related environmental changes. Our aim is to provide new data on environmental change during the Early Holocene by combining pollen, non-pollen palynomorphs (NPPs) and sedimentological analyses to be compared with archaeological information. The data give an overview of the original environment prior to the Neolithic and thereafter a comprehensive view of the first human impacts on the vegetation cover in local lowland areas. Two new pollen records located respectively 1.75 km (Dik4) and 150 m (Dik12) from the archaeological site provide the first evidence of human agropastoral activities on the landscape associated with the Early Neolithic communitiessince at least 6400 cal BC, largely earlier than observed in the reference pollen diagram in the Tenaghi-Philippon marsh which shows a first human impact from the second millennium cal BC. Admittedly, such impact on the local area around the site cannot be extrapolated to a regional scale, raising question of the spatial representativeness of the previous records. It also shows the need to develop multi-scalar investigations to assess the impact of climatic change and human activities on the landscape during the earliest phase of the Neolithic settlement in southeastern Balkans.

1. Introduction

Pollen studies have been carried out in Northern Greece since the 1960s, resulting in the publication of numerous pollen diagrams from eastern Macedonia and surrounding areas. These are the product of investigations undertaken within a radius of 100 km around the marsh of Philippi in very different environmental contexts: mountainous peat bogs (Bozilova and Tonkov, 2000; Gerasimidis, 2000; Filipovitch and Lazarova, 2003; Stefanova and Amman, 2003), marshes (Wijmstra, 1969; Greig and Turner, 1974; Turner and Greig, 1975; Tzedakis, 2000; Tzedakis et al., 2006), fluvio-deltaic deposits (Atherden and Hall, 1994; Atherden, 2000), ponds, mire lakes (Bottema, 1982) and even marine sediments (Kotthoff et al., 2008a, 2008b). Such analyses have largely contributed to produce information on vegetation cover changes in this Mediterranean region. The most recent work discusses the impact of Rapid Climatic Changes (RCC) (Mayewski et al., 2004; Weninger et al., 2009; Wanner et al., 2011) that occurred successively since the end of the last glacial period (Kotthoff et al., 2008a, 2008b, 2011; Pross et al., 2009; Bozilova and Tonkov, 2011; Muller et al., 2011; Peyron et al., 2011). The coinciding of the Neolithic transition and global climate changes that affected the end of the Lateglacial period and the onset of the Holocene has stimulated research and the proposal of explanatory models for the eastern

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Mediterranean areas even in the Balkan region (e.g., Weninger et al., 2006, 2009, 2014; Berger and Guilaine, 2009). However, until now very little research was specifically undertaken near a Neolithic site in order to examine the potential links between the environmental change at a regional scale driven by climate oscillations and local landscape transformation attributable to the earliest Neolithic population. The archaeological data obviously allow assessment of cattle breeding and plant cultivation, but they appear insufficient to evaluate the impact of human activities on vegetation cover in the surrounding landscape during the Neolithic transition (Willis and Bennett, 1994).

The paleoecological record raises the question as to what occurred after initial Neolithic settlement to make the impact of the farmers visible at the landscape scale. In Northern Greece, at Tenaghi-Philippon (Greig and Turner, 1974), as at Giannitsa (Bottema, 1974), several Neolithic sites are located well within the pollen catchment area, but there is no evidence of agricultural practices in the pollen diagrams. On the Philippi-Drama plain, Neolithic settlements first appear around 6500–6200 cal BC (Lespez et al., 2013) but it is not until the second millennium cal BC that evidence of agricultural activity in the paleoenvironmental record can be seen (Greig and Turner, 1974). The current interpretation is that human impact was strictly local and did not affect regional patterns of vegetation (Greig and Turner, 1986; Lespez, 2003), but the impact of the Neolithic transition on the landscape and environmental conditions near archaeological sites has never been accurately studied. On the other hand, the impact of RCC on the environment at Neolithic sites has not been thoroughly examined either; paleoenvironmental studies have mainly been used to discuss the regional effects of global climate changes (Kohttoff et al., 2008a; Pross et al., 2009; Peyron et al., 2011). So, through comparison of archaeological and paleoenvironmental data, the debate has centered on the role of the scale of observation used to understand the environmental transformations (Lespez, 2007). While the regional scale informs above all on landscape changes resulting from global climate forcings, at local scales pollen analyses reveal the complexity of the different contexts (Halstead, 2000). These preliminary conclusions led us to develop a multi-scalar approach to provide information at different scales to address Early Holocene vegetation changes in Northern Greece related to the Neolithization process.

This paper presents the results of palynological and sedimentological investigations conducted to identify and to understand the effects of climatic changes and the magnitude of the initial human impacts on the vegetation cover near the Neolithic site of Dikili Tash (Darcque, 2013) and the well-known pollen sequence of Tenaghi-Philippon (Wijmstra, 1969; Greig and Turner, 1974; Turner and Greig, 1975; Pross et al., 2009; Muller et al., 2011; Peyron et al., 2011). We complement pollen analyses with the identification of “non-pollen palynomorphs” (NPPs) that provide additional paleoecological information because these can be safely considered as local indicators as their dispersal is limited (van Geel, 2001). The results obtained, covering the beginning of the Neolithic period in the study area, offer the possibility of identifying and describing local environmental changes and analyzing the consequences of climate changes and the Neolithization process during the Early to Middle Holocene.

2. Regional setting and study area

The plain of Philippi-Drama, 40 m a.s.l., constitutes a basin area (55 km^2) located at 40°58′N, 24°15′E. It is filled by Neogene and Quaternary piedmont sediments (Lespez, 2008) with lignite and peat in a large former marsh area (Tenaghi Philippon) to the south (Fig. 1). The plain is bounded by massive Mesozoic limestones while older crystalline rocks form the mountain massifs of Pangaion (1956 m a.s.l.) to the south-southwest, the Lekani mountains (1298 m a.s.l.) to the east, the Falakro mountains (1911 m a.s.l.) to the north and to the south the less elevated Symbolon massif separating the plain from the Aegean Sea some 10 km distant. The Tenaghi-Philippon marsh has a sub-Mediterranean climate regime with colder winters and wetter summers than along the coastal area and in southern Greece. On the Aegean coast, the Kavala station recorded mean annual temperature of 10.8 °C and mean annual precipitation of 642 mm. The climate is affected by continental influences, particularly in winter with occasional incursions of cold polar air (Lespez, 2008). The maximum winter cold is a vegetation determinant, because few frost-sensitive xerothermophilous plants can grow on the surrounding mountains.

The present-day vegetation reflects the effects of both climate and humans with their livestock. The formerly extensive marshy area of Tenaghi-Philippon now consists almost completely of cultivated land, following a large drainage program of land improvement established during the 1930's. Nevertheless, every winter the groundwater table floods some of these fields. Agricultural practices such as farming and grazing have left little of the original vegetation. On the hills one finds shrub vegetation and other degraded maquis/phrygana including evergreen oaks (*Quercus ilex* and *Q. coccifera*), *Phillyrea angustifolia*, *Rhamnus alaternus*, *Juniperus oxycedrus* and *Paliurus spina-christi*. The surrounding mountains, where the slopes are difficult to reach, have maintained woodland composed of *Quercus pubescens*, *Ostrya carpinifolia*, *Acer monspessulanum*, *Fraxinus ornus*, *Corylus avellana* and some *Fagus sylvatica* (beech) and *Abies cephalonica* (fir) from the original forest (Strid and Tan, 1997).

The tell of Dikili Tash and its small wetland valley where our research was done is located in the south-eastern part of the Philippi-Drama plain, at the foot of the western slope of the Lekani mountains (Fig. 2). This study area lies some 2 km east of the ancient city of Philippi, near the modern town of Krinides (Kavala district). It is one of the many tells in the region (Koukouli et al., 2008) and one of the more extensive, extending over 4.5 ha (250 × 180 m at its base) and rising 17 m above the current ground surface (71 m a.s.l.). The chronology of the occupation is well-known from several archaeological excavations since the 1960's (Treuil, 1992; Koukouli-Chryssanthaki and Treuil, 2008; Darcque, 2013) and recently new discoveries indicate that the site was occupied since 6500 cal BC, making it one of the oldest Neolithic sites in Northern Greece (Lespez et al., 2013). The tell overlooks the Drama plain and the ancient Tenaghi-Philippon marsh. A perennial freshwater spring (monthly water flow between 2.4 m^3/s and 15 m^3/s, Knithakis, 1983) lies immediately north-east, forming a limited pond here which is drained by a small brook running into the small valley adjacent to the eastern side of the tell. Previous geomorphological studies assessed the potential of the Holocene sedimentary archive near the tell (Lespez and Dalongeville, 1998; Lespez et al., 2001; Lespez, 2008) and provided the opportunity to develop new paleoecological investigations.

3. Materials and methods

Reconstruction of environmental changes is based on 15 cores located in the small valley of Dikili Tash which run from the archaeological site to the edge of the Philippi marshes. The analyses have focused on two cores, Dik4 (3 m deep) and Dik12 (4 m), collected in September 2009 and May 2014 using a hand-driven percussion device (Cobra TT) and an hydraulic extractor, located at 1.75 km (Dik4) and 150 m (Dik12) respectively from the archaeological site. Sediment samples were collected in PVC tubes (diameter 60 mm, length 1 m), protected in plastic guttering and