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PALAEOECOLOGICAL AND GEOMORPHOLOGICAL STUDIES OF A PEAT BOG (2240 m a.s.l.) IN THE NORTHWESTERN PIRIN MOUNTAIN (PRELIMINARY RESULTS)

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Juliana Atanassova, Dimitar Krenchev, Petko Bozhkov. PALAEOECOLOGICAL AND GEOMORPHOLOGICAL STUDIES OF A PEAT BOG (2240 m a.s.l.) IN THE NORTHWESTERN PIRIN MOUNTAIN (PRELIMINARY RESULTS)

The aim of the investigations was to improve the knowledge on the vegetation, climate and geomorphological processes' dynamics during the postglacial period in the high mountain area of the Pirin mountains. For this purpose, pollen analysis, detailed sedimentological and geomorphological studies of a peat bog (2240 m. a.s.l.) in Begovitsa river valley were performed. In order to characterize peat bog sediments and sequences, samples from core with depth 210 cm were taken. The differentiation of sediment layers was based on matrix differences and changes in color. The results of the pollen analyses were presented in percentage pollen diagram. Three local assemblage pollen zones were identified when the most characteristic changes in pollen composition (PAZ: PB-1,

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PB-2 and PB-3) were taken into account. The age of the peat layers is determined by comparison with pollen diagrams with 14 C dates from the highest part of the mountain. Detailed geomorphological description and mapping of the study area were performed.

Key words: Northern Pirin Mountain, pollen analysis, non-pollen palynomorphs, sedimentological investigation, geomorphological mapping

INTRODUCTION

Lake and peat bog deposits provide a good opportunity for reconstruction of past climate and environmental changes of a given territory. They are frequently used as archives and supply good information on morphological dynamics, slope process activity, climatic fluctuations and vegetation development back in time.

The Pirin Mountain is characterized by a typical alpine landscape, especially the northern part, dominated by large cirques, trough valleys and moraines which have been preserved since the last Pleistocene glaciation. Most of the cirques are situated at a height of between 2100 and 2500 m a.s.l. and are occupied by glacial lakes and peat bogs. There are available data on physical, chemical and biological parameters for most of the lakes in Pirin Mountain (Ivanov et al., 1964) and also the region is well researched in regard to the vegetation and climate variability. Over 20 cores of various lakes and peat bogs in the mountains have been analyzed for pollen content, supported by radiocarbon dating (Tonkov 2003; Tonkov et al. 2002; Stefanova, Bozilova 1995; Stefanova, Ammann 2003; Atanassova, Stefanova 2003, 2005; Stefanova et al. 2006, etc.). Several research on mountain lacustrine deposits and their sedimentological characteristics so far are exceptional in Bulgaria (Kenderova 1992; Kenderova et al. 2018).

The main aim of the investigations was to improve the knowledge about the vegetation, climate and geomorphological processes' dynamics during the postglacial period in the high mountain area of the Pirin Mountain. For this purpose, pollen analysis, detailed sedimentological and geomorphological studies of a peat bog (2240 m. a.s.l.) in Begovitsa river valley were performed.

STUDY AREA

The Begovitsa river valley is located on the southwestern slope of the northern Pirin Mountain and has an east-west direction (Fig. 1). The river basin covers an area of 16,0 km^2 and occupies the higher part of the mountain between 1250 m and 2750 m a.s.l. The length of the river from its source (2300 m a.s.l.) to its confluence with Sandanska Bistritsa (1250 m a.s.l) is 8,21 km. The high relative altitude, slope gradient (average 23°) and preserved Pleistocene landforms (cirques, U-shaped valleys, moraines, etc.) characterize the catchment as a typical alpine landscape. The peat bogs in the valley are formed mostly in the periphery of the lakes and on flat areas near the river with high groundwater level and poor drainage regime.

They are located mainly in the highest part of the river basin, above the tree line (1900–2000 m a.s.l), and occupy an area of about 0,07 km². The investigated peat bog is at an altitude of 2246 m and has an area of 7 989 m² (Fig. 1).

The climate in this part of the mountain is a mountainous modification of temperate, continental with Mediterranean influence. At a hight of about 2000 m the average annual temperature is 3,7 ºC, the average temperature in January is –4,2 ºC and the average temperature in August is 12,8 ºC. Average annual precipitation is between 1500 and 1600 mm/m². In the lower parts (about 1500–1800 m a.s.l) the precipitation is about 700 mm/m². Snow cover lasts for 8 months above 2000 m.

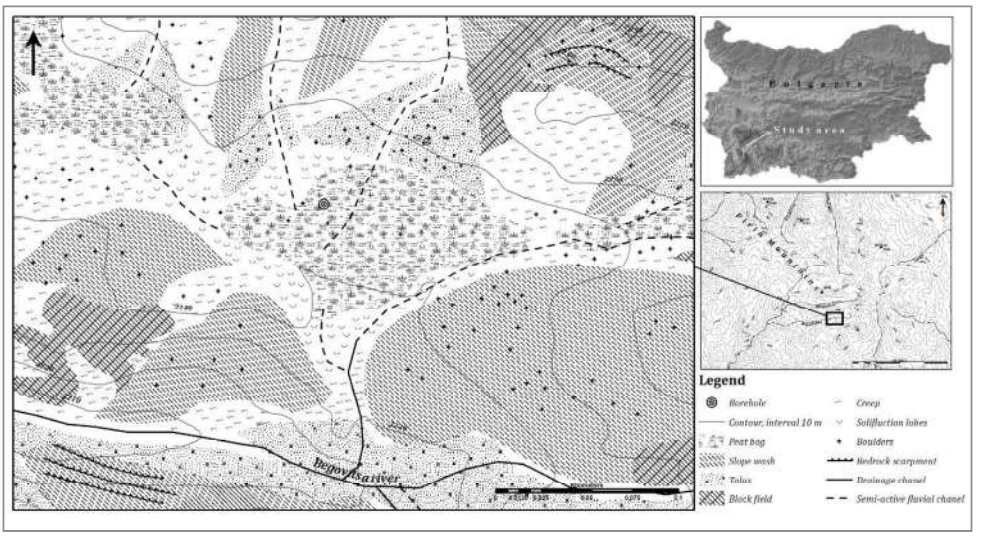

Fig. 1. Location of the peat bog and geomorphological scheme of the study area

The present vegetation of the study area (above tree line) is represented by subalpine species. The dominant plant species in this belt are *Juniperus sibirica* Burgsd. and *Pinus mugo* Turra. The vegetation surrounding the sites is formed by *Nardus stricta* L., *Phleum alpinum* L., *Anthoxanthum odoratum, Gentianella bulgarica* (Velen.) Holub., *Gentiana verna* L., *Bruckenthalia spiculifolia* (Salisb.) Rchb., *Sibbaldia procumbens* L., *Geum montanum* L., *Dianthus microlepis* Boiss., *Plantago gentianoides* Sibth. et Sm., *Rumex acetosella* L., *Thymus* spp., *Chamaecytisus absinthioides* (Janka) Kuzm.etc.

The bog vegetation is composed of *Sphagnum* spp., *Calliergon stramineum* (Brid.) Kindb., *Carex acuta* L., *Carex ovalis* Good., *Carex echinata* Murr., *Eriophorum angustifolium* Roth, *E. vaginatum* L., *Juncus filiformis* L., *Deschampsia caespitosa.*

Fig. 2. Location of the peat bog, core place and sampling

MATERIAL AND METHODS

In order to characterize peat bog sediments and sequences, samples from core with depth 210 cm were taken. The distinction of sediment layers was based on matrix differences and changes in color (Munsell Color Firm, 2010). To identify and localize the peat bogs, orthophoto image analysis was carried out. For geomorphological mapping of the area digital elevation model (DEM) analysis in GIS environment and field observations and measurements were done. Detailed geomorphological description and mapping of the study area were performed.

For the palynological study the sediment samples were taken at 5–10 cm intervals.They were processed using a standard method (Faegri and Iversen, 1989). The pollen sum used for percentage calculations consists of arboreal (AP, trees and shrubs) and non arboreal pollen (NAP, herbs) and excludes Cyperaceae and fern spores. Non-pollen palynomorphs (NPP) were also counted. As mentioned by Van Geel (2001), Van Geel et al. (2003), Cugny et al. (2010), Feeser, O'Connell (2010) among the NPP several types still have no taxonomic identification, but they can also be used for palaeoecological reconstruction. Their frequency is presented as a percentage of the pollen sum. The palynological results were presented in a percentage pollen diagram. For calculations and drawing of the pollen diagram the programs TILIA and TILIA GRAPH were used (Grimm 1992). Three local assemblage pollen zones were identified when the most characteristic changes in pollen composition (PAZ: PB-1, PB-2 and PB-3) were taken into account (Fig. 3).

The age of the peat layers is determined by comparison with pollen diagrams with C-14 dates from the highest part of the mountain (Bozilova 1977; Stefanova, Bozilova 1995; Tonkov et al. 2002; Bozilova et al. 2004; Atanassova, Stefanova 2005).

RESULTS

The palynological data show three stages in the vegetation development (corresponding to tree pollen assemblage zones) in the area of research, over the last ca. 3000 cal. years BP. The boundaries of the zones are well correlated with the boundaries of the sediments layers (Fig. 3).

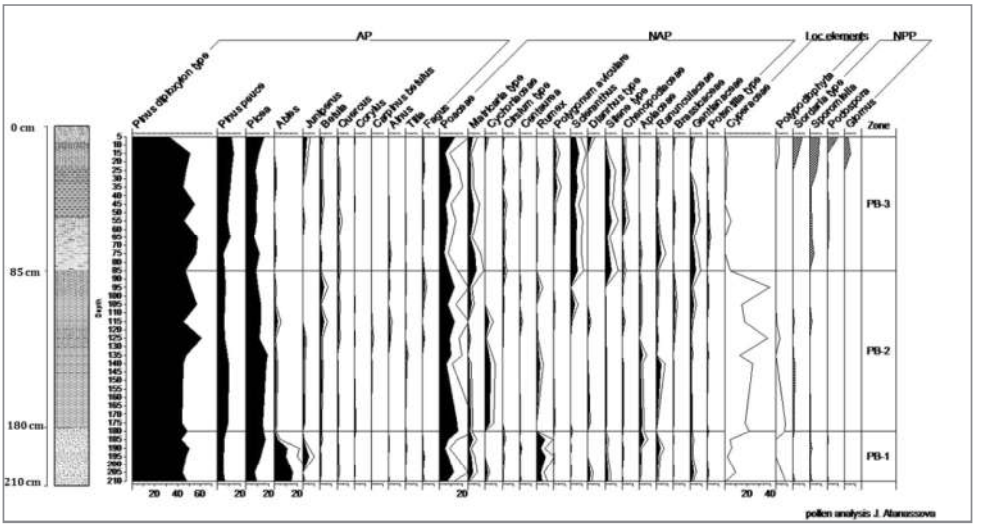

Fig. 3. Pollen diagram and sediment sequences from a peat bog in Begovitsa valley, northwestern Pirin Mountain

PAZ PB-1 ***Abies – P. diploxylon type – P. peuce.*** This zone clearly coincides with the sediment layer 210–180 cm. Within it the presence of sands and high content of gravel is observed (Fig. 4). The palynological analysis shows that the pollen of *P. diploxylon* type (including *Pinus sylvestris, P. mugo*, and *P. heldreichii*) dominates with 45–50%, followed by *Abies* 10–17%, *P. peuce* 5–7% and *Juniperus* 2–4%. Single pollen grains of *Fagus*, *Betula, Corylus* and *Tilia* were found. The herbs (NAP) are represented by Poaceae with 5–10%, *Matricaria*-type and *Rumex* 3–6%, Cichoriaceae, *Cirsium*-type, *Silene, Dianthus,* Ranunculaceae, Gentianaceae have low importance.

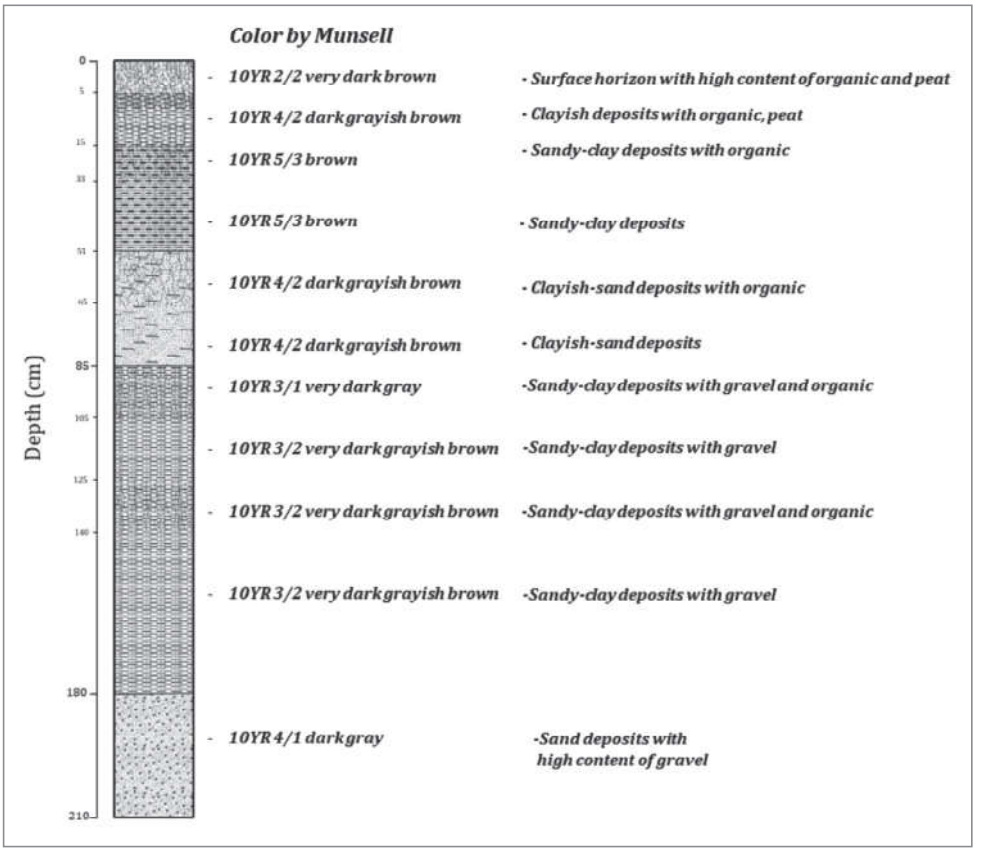

Fig. 4. Descriptions and matrix differences of the sediment layers in the core

PAZ PB-2 ***P. diploxylon – type – Picea – P.peuce.*** The boundaries of this zone coincide with the boundaries of the sediment layer 180 – 85 cm. Here, within the whole layer the sediment matrix is with high content of clay minerals, sands and sporadic gravel particles. High organic content was found within the layers 140 – 125 cm and 105 – 85 cm.

The pollen content is characterized by a decrease of *Abies* and consistently high percentage values of *P. diploxylon-type* 45–60%, *Picea* 10–15% and *P.peuce* 5–10%. The participation of *Abies* does not exceed 2–3%. *Betula* and *Fagus* have low importance and single pollen grains of *Quercus, Corylus, Carpinus betulus* and *Alnus* are also recorded. The herbs are represented by Poaceae with 10–15%, Cichoriaceae, *Matricaria*-type, *Rumex*, Ranunculaceae, Apiaceae are also important. This zone is distinguished by characteristic maxima for Cyperaceae up to 40%.

PAZ PB-3 ***P. diploxylon-type – Picea – P.peuce – anthropogenic indicators***. This zone corresponds with the layer 85 – 0 cm. Here, several changes in the type

of sedimentation were noted – at 51 cm, at 15 cm and one at the top of the core (Fig. 4). Pollens of *P. diploxylon*-type dominate with 40 – 55%. A slight decrease of *Picea* is observed and *P.peuce* has about 10%. Pollen grains of deciduous trees – *Betula, Quercus, Alnus, Tilia, Fagus* are rare. Poaceae dominate among the NAP pollen taxa, the pollen curves of *Scleranthus, Polygonum aviculare, Cirsium* type, Chenopodiaceae and Gentianaceae rise. There is a parallel increase in the percentage values of the NPP – *Sordaria*-type, *Sporomiella* and *Podospora.*

DISCUSSION

The pollen diagram for the investigated peat bog shows that the vegetation changes in the surroundings for the last ca. 3000 cal. years BP are similar to those in other parts at high altitudes on the northern Pirin Mountain (Atanassova, Stefanova 2003; Bozilova et al. 2004; Stefanova, Bozilova 1995; Stefanova et al. 2006; Tonkov 2003). PAZ PB-1 reflects the last stage of high distribution of *Abies* together with *P. peuce, P. sylvestris* and *P. heldreichii* in the coniferous belt. The pollen-stratigraphical boundary PB-1/PB-2 coincides with the Subboreal/Subatlantic transition, related to the increase of *Picea abies*. Spruce have become a dominant tree in the upper part of the coniferous belt along with *P. peuce, P. sylvestris* and *P. heldreichii.* The high percentages of *Pinus diploxylon*-type are probably also related to the presence of *P. mugo* around the peat bog. Many authors point out the lower temperatures and the higher precipitation as main reason for these changes in the coniferous belt (Bozilova et al. 2004; Stefanova et al. 2006; Tonkov et al. 2002). In PAZ PB-2 the pollen maxima of Cyperaceae together with the increase of fern spores is probably due to an increase in humidity in the area of research. The high percentage values of such anthropogenic indicators as *Scleranthus, Polygonum aviculare, Cirsium* type, Chenopodiaceae (PAZ PB – 3) and the increase of non-pollen palynomorphs indicators for grazing and livestock breeding (*Sporomiella*, *Podospora, Sordaria*-type) correspond to the results of Bozilova (1977) and Bozilova et al. (2002) who have identified increased human activity at high altitudes in the Begovitsa river valley, dated around 16-th century A.D.

CONCLUSION

The beginning of *Picea* expansion in northern Pirin Mountain is estimated at ca. 3000 cal. BP possibly as a result of climate change – lowering temperatures and increasing humidity. Additional evidence for this are the change in the type of sedimentation, as well as the appearance of zones with high organic content within the layer 180 – 85 cm. This, and the high presence of clay minerals show that during this period, mostly a chemical weathering and changes in the peat took place. The conditions of sedimentation during this period were relatively steady

and uniform, without any sudden changes. The spruce replaced the fir and has become a dominant tree in the upper part of the coniferous belt along with *P.peuce*. Anthropogenic activity and, in particular, livestock breading in historical times has led to changes in natural vegetation in the area of investigation.

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