Acta Palaeobot. Suppl. 2: 545–548, 1999 — Proceedings 5th EPPC

PALAEOECOLOGICAL INVESTIGATIONS OF LATE QUATERNARY SEDIMENTS FROM THE WESTERN BLACK SEA

JULIANA ATANASSOVA

University of Sofia, Biological Faculty, Department of Botany, Bld. "Dragan Tzankov" 8, Sofia – 1421, Bulgaria;
e-mail: anely@biofac.uni-sofia.bg

ABSTRACT. The palynological data and lithological structure of the sediments from core A-96 situated on the northern Bulgarian continental slope (42° 47' 02''N and 28° 33' 0'' E; water depth 630 m) are presented. A transition from steppe vegetation to mixed oak forest is established, accompanied by an increase in the sea level, caused by climatic fluctuations during the Late Quaternary.

KEY WORDS: Pollen analysis, dinoflagellate cysts, Black Sea

INTRODUCTION

Late Glacial and Holocene sediments from the western Black Sea have been investigated palynologically and radiocarbon data to determine their age obtained by Filipova *et al*. (1989), Atanassova & Bozilova (1992), Shopov *et al*. (1992) and Atanassova (1995a). The palynological investigations make it possible to reconstruct the general trends in the vegetational history of the western Black Sea coast over the last 15000 years. They indicate significant changes in the vegetation cover: a transition from steppe vegetation to mixed oak forest caused by climatic fluctuations. Investigations of the surface sediments from the western Black Sea (Atanassova & Bozilova 1994) demonstrate that the main source of pollen input in them are the plant communities of a wide coastal area, not just the narrow strip of beach The prevailing wind direction, the surface currents and the differences in pollen production all have to be taken into consideration when interpreting the palynological results.

The aim of the present study is to correlate changes of vegetation and climate with sea level fluctuations using pollen analysis, analysis of dinoflagellate cysts and the lithological structure of the sediments of core A-96 (northern Bulgarian continental slope). The stratigraphic distribution of the fossil dinoflagellate cysts in the Late Quaternary Black Sea sediments and their palaeoecological relationships have been studied by Wall *et al.* (1973) and Wall & Dale (1974). Fossil dinoflagellate cysts as well as *Pediastrum* and *Botryococcus* have often been used for palaeoecological interpretations of marine sediments and sediments of lakes close to the shore to elucidate the transition from marine to freshwater conditions (Filipova *et al.* 1989, Ranheden 1989, Atanassova 1995b, Bozilova *et al*. 1998).

MATERIAL AND METHODS

The laboratory treatment of the material for pollen analysis followed the procedure described by Faegri & Iversen (1975) with a slight modification (Birks & Birks 1980).

Altogether 48 pollen taxa and spores of Polypodiaceae have been identified. Analysis of the dinoflagellate cysts were carried out in parallel with the pollen analysis and the presence of *Pediastrum* and *Botryococcus* in the sediments was also registered. The frequency of each pollen type in the pollen diagram is presented as a percentage of the total pollen sum, which includes all arboreal (AP) and non-arboreal (NAP) pollen types (excluding the dinoflagellate cysts, *Pediastrum* and *Botryococcus*).

The pollen diagram (Fig.1) is divided into two pollen assemblage zones (PAZ I and II) and the second into subzones (IIa, IIb and IIc).

As ^{14}C dates are not available for core A-96 the age of the sediments is confirmed by lithostratigraphical and palynostratigraphical correlation with radiocarbon dated cores from the western Black Sea (Fig. 2).

RESULTS

PAZ I (360–240 cm)

The sediments are terrigenous clay muds or carbonate muds (Fig. 2), poor in organic content. The pollen spectra are characterized by a dominance of NAP with Chenopodiaceae, *Artemisia* (up to 40%) and Poaceae prevailing (Fig. 1). The pollen of deciduous trees has very low representation. Arboreal pollen is mainly repre-

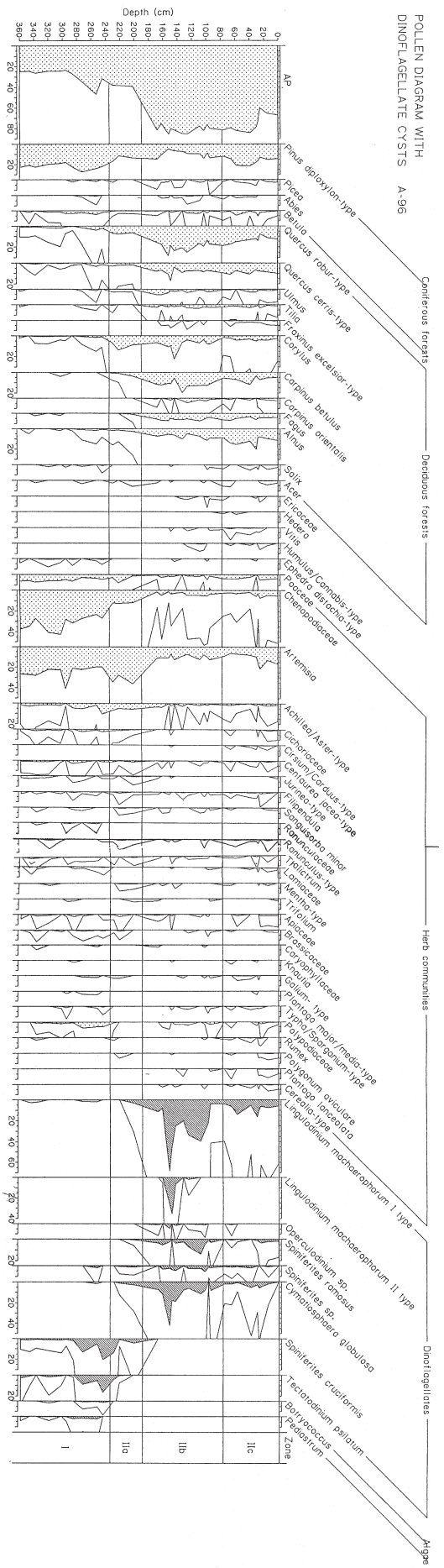

Fig. 1. Pollen diagram with dinoflagellate cysts A-96

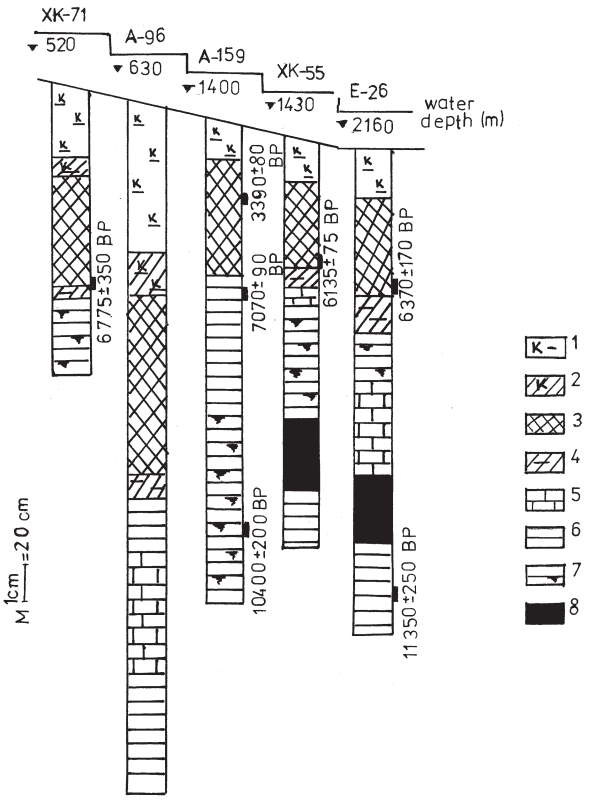

Fig. 2. Lithostratigraphical and palynological correlation of core A-96 with radiocarbon dated cores from the western part of the Black Sea. 1 – coccolith muds, 2 – coccolith muds with sapropel layers, 3 – sapropel muds, 4 – sapropel muds with low sapropel content, 5 – carbonate muds, 6 – clay muds, 7 – clay muds with bands of dark pigmentation, 8 – black muds

sented by *Pinus diploxylon*-type. The dinoflagellate cysts *Spiniferites cruciformis* and *Tectatodinium psilatum* predominate with *Pediastrum* and *Botryococcus* also well established.

PAZ II (240–0 cm)

PAZ II subzone a (240–195 cm). The sediments are transitional from clay muds to sapropel muds with low sapropel content. Characteristic is the increase of *Quercus* and *Corylus*. Among the NAP constituents *Artemisia* maintains the highest values (35–40%) followed by Chenopodiaceae, Poaceae and *Achillea*/*Aster*-type. Various species of dinoflagellate cyst are observed, *Spiniferites cruciformis*, *Tectatodinium psilatum* together with *Lingulodinium machaeropchorum*, *Spiniferites ramosus* and the acritarchs *Cymatiosphaera globulosa.*

PAZ II subzone b (195–80 cm). The sediments present in this subzone are sapropel muds rich in organic material and in the upper part sapropel muds with coccolith layers (Fig. 2). A predominance of pollen from deciduous trees (*Quercus robur*-type, *Q. cerris*-type, *Carpinus betulus*, *Corylus*, *Ulmus*, *Tilia*, *Fagus* and *Alnus*) is observed. These sediments are rich in dinoflagellate cysts, two

types of *Lingulodinium machaerophorum*, different species of *Spiniferites* and *Cymatiosphaera globulosa*.

PAZ II subzone c (80–0 cm). The sediments are coccolith muds (Fig. 2). AP pollen dominates with *Quercus*, *Alnus*, *Carpinus betulus* and *Pinus diploxylon*-type the most prominent. Some increase of NAP (primarily *Artemisia* – 25%) is also observed. The dinoflagellate cysts have a decreased distribution but their taxonomic composition remains unchanged.

DISCUSSION

The results of the analysis of pollen and dinoflagellate cysts indicate that the oldest sediments are those of PAZ I which were deposited under the conditions of a dry and cool climate, probably during the Late Glacial. There are two possible explanations for the peak abundance of Chenopodiaceae and *Artemisia* and very low representation of pollen from deciduous trees (Fig.1). There may have been a predominance of steppe vegetation along the northern Bulgarian coast, or it could have resulted of the spread of species growing on saline soils and sand dunes in the beach area (e.g. *Salicornia europaea*, *Salsola kali*, *Suaeda maritima*, *Elymus elongatus*, *Leymus racemosus* and *Artemisia maritima*) after the withdrawal of the sea and the drainage of some parts of the shelf. In view of the pollen analysis of the surface marine sediments (Atanassova & Bozilova 1994) the Poaceae were an important element in the herb communities in spite of their relatively low percentage values in the pollen spectra. A predominance of *Pinus* among the AP is established also for the Late Glacial in all pollen diagrams from the western Black Sea (Filipova *et al*. 1989, Shopov *et al*. 1992, Atanassova 1995a) as a result of long-distance pollen transport. The conclusion about the age of the PAZ I sediments is confirmed also by the high representation of the dinoflagellate cysts *Spiniferites cruciformis* and *Tectatodinium psilatum* which are stenohaline species restricted to low water salinity, as well as by the presence of *Pediastrum* and *Botryococcus*. The sediments containing these species of dinoflagellate cyst are dated to 15000–8000 BP (Wall *et al*. 1973, Atanassova 1995b). Non of the two has been observed outside of the Black Sea (Wall *et al*. 1973), which would indicate a phase when the Black Sea and the Mediterranean were not connected.

The increase in the percentage values of deciduous tree pollen, primarily *Quercus* and *Corylus* in PAZ II subzone a shows an extension of mixed oak forest along the northern coast, probably caused by increase of the temperature and humidity at the beginning of the Holocene. The relatively high percentage values of *Artemisia*, Chenopodiaceae, Poaceae and *Achillea*/*Aster*-type indicate that the steppe vegetation and halophilous herb communities maintained their distribution in the wide coastal area. The transitional structure of the sediments (Fig. 2) and the presence of the dinoflagellate cysts *Spiniferites cruciformis* and *Tectatodinium psilatum,* together with *Lingulodinium machaerophorum* and the acritarchs *Cymatiosphaera globulosa* which are euryhaline marine species (Wall *et al*. 1973) indicate a transition from low to higher water salinity as a result of the inflow of more saline water into the Black Sea. The connection between the Black Sea and the Mediterranean was restored after 9300 BP (Degens & Hecky 1973) and a reinvasion of the Black Sea by euryhaline marine organisms through the Bosphorus accompanied the rise in sea level.

The maximal spread of the pollen grains of deciduous trees *Quercus*, *Carpinus betulus*, *Corylus*, *Ulmus*, *Tilia*, *Fagus* in the sapropel muds (PAZ II subzone b) reflects the enlargement of the territories covered by mixed oak forest along the coast, probably during the climatic optimum of the Holocene. The sapropel muds are also rich in euryhaline species of dinoflagellate cyst. Among them *Lingulodinium machaerophorum* is the most abundant, but a number of *Spiniferites* species and *Cymatiosphaera globulosa* are also common. The data on the radiocarbon age of the sapropel muds in the western Black Sea show that they were deposited in the interval from 7000 to about 3000 BP (Shopov *et al.* 1992, Atanassova 1995a) (Fig. 2). The maximal spread of dinoflagellate cysts is probably associated with the maximum of the Holocene Black Sea transgression which occurred between 5700 and 4000 BP according to Chepalyga (1984).

The pollen spectra of PAZ II subzone c reveal the final step in the history of the vegetation when some enlargement of the herb communities dominated by *Artemisia* and Poaceae occurred. This could be the result of drier conditions in the northern coastal area, but may also reflect higher human activity indicated by the relative high percentage values of Cerealia-type. The increase of *Alnus* and *Salix* indicate the formation of local swamp forest in river valleys about 3000 years ago (Bozilova 1986). During the last 3000 years on the western continental slope of the Black Sea, coccolith muds have been deposited (Shopov 1989).

REFERENCES

ATANASSOVA J. 1995a. Palynological data of three deep – water cores from the western part of the Black Sea. In: Bozilova E. & Tonkov S. (eds.) Advances in Holocene palaeoecology in Bulgaria. Pensoft Publ., Sofia: 68–84.

ATANASSOVA J. 1995b. Dinoflagellate cysts of Late Quaternary and recent sediments from the western Black Sea. Ann. Univ. Sofia, 87(2): 17–29.

ATANASSOVA J. & BOZILOVA E. 1992. Palynological investigations of marine sediments from the western sector of the Black

Sea. Proceedings of the Institute of Oceanology, Varna, 1: 97–103.

ATANASSOVA J. & BOZILOVA E. 1994. Surface pollen samples from the western sector of the Black Sea. Ann. Univ. Sofia, 84(2): 53–69.

BIRKS J. & BIRKS H. 1980. Quaternary Palaeoecology. Edward Arnold Publishers, London.

BOZILOVA E. 1986. Palaeoecological conditions and changes in the vegetation of eastern and south-western Bulgaria during the last 15000 years. Abstract of Sci. Doc. Thesis, Sofia: 1–72.

CHEPALYGA A. 1984. Inland sea basins. In: Wright & Barnosky (eds.) Late Quaternary environments of the Soviet Union. Longman, London.

DEGENS E. & R. HECKY. 1973. Palaeoclimatic reconstruction of the Late Pleistocene and Holocene based on biogenetic sediments from the Black Sea and tropical African lakes. Colloque Internat. du CNRS "Methodes quantitatives d'etudes des variations du climate au cours du Pleistocene": 1–29.

FAEGRI K. & IVERSEN J. 1975. Textbook of pollen analysis. Blackwell, Oxford.

FILIPOVA M., BOZILOVA E. & DIMITROV P. 1989. Palynological investigation of the Late Quaternary deep-water sediments from the south-western part of the Black Sea. Bulletin Musée National Varna, 255(40): 177–186.

RANHEDEN H. 1989. Barknĺre and Lingnĺre human impact and vegetation development in an area of subrecent land uplift. Striae, 33: 3–80.

SHOPOV V. 1989. Holocene coccoliths from the depth- water carbonate sediments of the Black Sea. Bulgarian Geological Association, 50(1): 46–51.

SHOPOV V., BOZILOVA E. & ATANASSOVA J. 1992. Biostratigraphy and radiocarbon data of Upper Quaternary sediments from the western part of the Black Sea. Geologica Balcanica, 22(2): 59–69.

WALL D. & DALE B. 1974. Dinoflagellates in Late Quaternary deep-water sediments of the Black Sea. In: The Black Sea – Geology, Chemistry and Biology, 20.

WALL D., DALE B. & HARADA K. 1973. Description of new fossil dinoflagellates from the Late Quaternary of the Black Sea. Micropalaeontology, 19(1): 18–31.