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DIATOMS FROM UPPER SARMATIAN (HERSONIAN) SEDIMENTS OF THE NORTH-WEST PART OF EAST PARATETHYS

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Temniskova–Topalova, D., Passy, S. (1988): *Diatoms from upper sarmatian (hersonian) sediments of the north–west part of East Paratethys.* – Glasnik Instituta za botaniku i botaničke bašte Univerziteta u Beogradu, Tom XXII, 141–154.

The diatoms from Hersonian sediments of Balchik, North East Bulgaria, were investigated and 96 taxa diatoms were determined. A characteristic diatom complex was separated. The boundary between the Bessarabian, and Hersonian substages was determined by means of diatoms. By the ecological analysis of diatom flora, the paleogeographic conditions during the sedimentation were reconstructed. By cluster analysis the Balckik diatom flora was compared and correlated with the other Hersonian florae from East Paratethys.

Key words: Diatoms, Upper Sarmatian, Hersonian, stratigraphy, paleoecology
Ključne reči: Dijatomejske alge, gornjesarmatski sedimenti, herson, stratigrafija, paleoekologija

INTRODUCTION

Hersonian diatoms from East Parathethys are known from several deposits of Kerch peninsula: cape Karaagach (P a n t o c s e k, 1902), cape Ak–Burun (M i s s u n a, 1913), of Apsheron and Tamon peninsula (S h i s h o v a, 1955, S a v c h e n k o, 1911, M i l o v a n o v a, 1955, M a k a r o v a, 1960, 1962), the Tobechek lake and villages of Jurkino and Kurortnoe (K u l i c h e n k o, O l s t i n s k a j a, 1980); North East parts of Krim, the regions of Kirov and Nijnegor (K o z y r e n k o, 1958, 1959, 1961).

There are no data about Hersonian diatoms from the North West part of East Paratethys of North East Bulgaria and Romanian Dobrudzha.

MATERIAL AND METHODS

Investigated were Upper Sarmatian (Hersonian) sediments from the vicinity of the town of Balchik, situated 30 km to the North of Varna, North East Bulgaria. They belong to Balchik part of Varna–Balchik depression (K o j u d g i e v a, P o p o v, 1981). The sediments are taken from a drilling, which is a subject of stratigraphic correlative investigations under project 25 of the UNESCO International correlative programme. The stratigraphic sepation was made according to mollusca, ostracoda and foraminefera. The Sarmatian stage encompasses three substages: Lower (Volhynian), Middle (Bessarabian) and Upper (Hersonian). The thickness of the Hersonian sediments is 73,50 m (14,50–88,00 m). The diatoms from some of the Upper Bessarabian sediments (88,20–107,00 m) were studied for determining the boundary according to diatoms between the Hersonian and the Bessarabian substages. The lithological composition of the Hersonian sediments is cavernous, bedded, compact and detritic limestone and calcareous, bedded till banded clays with diatomic intercalations.

The sediments were treated by the method of G l e z e r et al. (1974). The quantity of diatoms was examined by means of the modied Vislouh scale (G l e z e r et al., 1974). The ecological spectra of diatoms with famíliar ecology were fixed. An ecological analysis was carried out applying the arithmetical weighted mean of quantity of every ecological group in relation to the halobic spectrum (marine, brakish–marine, brakish, freshwater–brakish and freshwater species). The arithmetical weighted mean A is equal to $= \frac{\Sigma a_i \cdot b_i}{\Sigma a_i}$ were a_i is the number of species of equal quantity and b_i – the number of species. The Hersonian diatom flora from East Paratethys were compared and correlated, using the characteristic complexes, guiding species and a cluster analysis.

RESULTS AND DISCUSSION

28 genera with 96 species, varieties and forms of diatoms were determined (Tab. 1). A lot of them are described and visualized in Temniskova–Topalova, Passy (1989). The diatoms mainly refer to class *Pennatophyceae* – 96%. Some of the typical genera for Sarmatian Sea, *Navicula* and *Amphora*, are represented in greatest species variety –21,6% and 15,5%, respectively followed by *Nitzschia* and *Achnanthes* – 7,2% and 5,2%. The quantity of the species *Nitzschia* and *Achnanthes* is significantly increased as compared to the Volhynian and the Bessarabian diatom flora (T e m n i s k o v a – T o p a l o v a, V a l e v a, 1983, T e m n i s k o v a – T o p a l o v a, 1983, 1984). *Achnanthes brevipes* A g. et with the varieties and *Licmophora hastata* M e r. are the basic dominants and in some levels, are rockforming diatoms. The dynamics of the variaton in the number of species within each genus, as well as of the variation in the number of genera and species, is illustrated in Fig. 2 (a, b, c). This variability is fairly modest during the Lower Hersonian. From the middle of Hersonian subcentury, significant change occurs – the species and the genera number sharply reduces till the total disappearance of diatoms.

The occurence of *Amphora*, *Nitzschia*, *Amphiprora gigantea* G r u n., *Pleurosigma elongatum* W. S m. in the Bulchik Hersonian diatom flora is assassed as „not rare" to „very often". There were found also diatoms with limited stratigraphic distribution – Hersonian and Hersonian–Maeotian – wich are described for Hersonian seidments of East

Tab. 1. – Taxonomic composition of Diatoms from Upper Sarmatian (Hersonian) sediments of the North–West part of East Paratethys, Balchik, Nort–East Bulgaria.

Diatoms	Stratigr. distribution	Ecology	Distribution in present day Seas: Black Sea	Sea of Azov	Caspian Sea	Other Sea
1	2	3	4	5	6	7
Achnanthes Bory 1822						
A. brevipes Ag. var. *brevipes*	Mi–R	BM,L	+	+	+	+
A. brevipes var. *clavata* (Pant.) Miss.	S	foss.	–	–	–	–
A. brevipes var. *intermedia* (Kütz.) Cl.	Mi–R	BM,L	+	+	+	+
A. brevipes var. *neogenica* Milov.	S_3	foss.	–	–	–	–
A. lanceolata (Breb.) Grun. var. *elliptica* Cl.	S_3–R	F	–	–	–	–
A. longipes Ag.	Mi–R	BM	+	+	+	+
Amphiprora Ehrenberg 1841						
A. alata (Ehr.) Kutz. var. *alata*	Mi–R	BM	+	–	–	+
A. gigantea Grun. var. *gigantea*	Mi–R	M,L	+	–	–	+
A. lata Grev.	S_3–R	M	–	–	–	+
Amphiprora sp.	–	–	–	–	–	–
Amphora Ehrenberg 1840						
A. angusta Greg. var. *angusta*	Mi–R	BM	+	–	+	+
A. arenaria Donk.	Mi–R	M	–	–	–	+
A. bigibba Grun.	S_3–R	M	+	–	–	+
A. eunotia Cl. var. *eunotia*	S_3–R	M	–	–	–	+
A. eunotia var. *holsatica* (Hust.) Tynni	S–R	B	–	–	–	+
A. exigua Greg.	S–R	BM	+	–	–	+
A. hyalina Kutz.	S_3–R	M	+	+	+	+
A. laevis Greg.	S_3–R	BM	+	–	+	+
A. lineolata Ehr.	S_3–R	B	+	–	+	+
A. macilenta Greg.	S_3–R	M	+	–	–	+
A. ovalis Kutz. var. *libyca* (Ehr.) Cl.	Mi–R	F	–	–	+	+
A. proteus Greg. var. *proteus*	Mi–R	BM,L	+	–	–	+
A. proteus var. *oculata* Perag.	Mi–R	M	+	–	–	+
A. variabilis Kozyr.	S_3	foss.	–	–	–	–
Caloneis Cleve in Cleve & Grive 1891						
C. liber (W. Sm.) Cl. var. *liber*	Mi–R	M,L	+	–	–	+
Cocconeis Ehrenberg 1838						
C. pediculus Ehr.	Mi–R	FB, L	+	+	+	+
C. placentula Ehr. var. *placentula*	Pg_3–R	FB,L	+	+	–	+
C. placentula var. *euglypta* (Ehr.) Cl.	Mi–R	FB,L	+	+	+	+
C. placentula var. *intermedia* (Herib. et Per.) Cl.	Mi–R	FB,L	+	–	–	+
C. quarnerensis Grun.	Mi–R	M,L	+	–	+	+
Cyclostephanus Round 1982						
C. cf. *dubius* (Fricke) Round	Mi–R	F	–	–	–	–
Cymbella Agardh 1830						

Nastavak tab. 1

C. leptoceros (E h r.) K u t z. var. *angusta* G r u n.	S_3–R	F	–	–	–	–
C. ventricosa K u t z.	Pg_3–R	F, i	–	–	–	+
Cymbela sp.	–	–	–	–	–	–
Diploneis E h r e n b e r g 1840						
D. smithiii (B r e b.) C l. var. *smithii*	Mi–R	BM,L	+	+	+	+
D. vacilans (A.S.) C l.	S–R	M	+	–	–	+
Epithemia B r e b i s s o n in B r e b i s s o n & G o d y 1838						
E. sorex K u t z. var. *sorex*	Mi–R	FB	+	–	–	–
Fragilaria L y n g f y e 1819						
F. virescens R a l f s. var. *virescens*	Pg_2–R	F,hal	–	–	–	+
F. virescens var. *maeotica* (P a n t.) P r. L a v r.	S_3–Me	foss.	–	–	–	–
F. virescens var. *subsalina* G r u n.	S_3–R	F,i	–	–	–	–
Frustulia A g a r d h 1824						
F. interposita (L e w.) D e T o n i	Mi–R	B	–	–	–	+
Frustulia sp.	–	–	–	–	–	–
Gomphonema A g a r d h 1824						
G. olivaceum (L y n g b.) K u t z.	Mi–R	FB	–	–	–	–
G. cf. *augur* E h r.	Mi–R	F,i	–	–	–	–
Grammatophora E h r e n b e r g, 1839						
G. oceanica E h r. var. *macilenta* (W. S m.) G r u n.	Mi–R	M,L	+	+	+	+
Gyrosigma H a s s a l l 1845						
G. spenceri (W. S m.) C l. var. *spenceri*	S_3–R	B	–	–	–	–
Licmophora A g a r d h 1827						
L. divergens P a n t.	S_3	foss.	–	–	–	–
L. ehrenbergii (K u t z.) var *ehrenbergii*	Mi–R	M	+	–	–	+
L. hastata M e r.	S_3–R	M	+	–	+	+
Licmophora sp.	–	–	–	–	–	–
Mastogloia T h w a i t e s in W. S m i t h 1856						
M. anadrussowii P a n t.	Mi	foss.	–	–	–	–
M. labuensis C l.	S_3–R	M	+	–	+	+
Melosira A g a r d h 1824						
M. ambigua (G r u n.) O. M u l l.	S_3–R	F,i	–	–	–	+
Navicula B o r y 1822						
N. andrussowii P a n t.	S_3	foss.	–	–	–	–
N. cancellata D o n k.	Mi–R	M	+	–	–	+
N. cf. *cricicula* (W. S m.) D o n k.	S–R	B	–	–	–	+
N. (G r e g.) A. S. var. *digitoradiata*	Mi–R	BM	+	+	+	+
N. forcipata (G r e g.) A. S. var. *densestriata* A.S.	S–R	BM	+	–	+	+
N. halophila (G r u n.) C l.	S–R	B	–	–	–	+
N. halophila var. *subcapitata* O s t r.	Mi–R	BM	–	–	–	+
N. palpebralis B r e b. var. *palpebralis*	Mi–R	M,L	+	–	–	+
N. palpebralis var. *semiplena* (G r e g.) C l.	S_3–R	M,L	+	+	–	+
N. pennata A. S. var. *pontica* M e r.	S_3–R	M	+	–	+	+
N. plicata D o n k.	S_3–R	M		–	–	+
N. scopulorum B r e b.	Mi–R	BM	+	–	+	+
N. subinflata G r u n.	S–R	M	–	-	–	+

Nastavak tab. 1

N. tumida Breb.	Mi–R	M	–	–	–	+
N. yarensis Grun.	Mi–R	BM	–	–	–	+
N. viridula (Kutz.) Ehr.	Mi–R	F,i	–	–	–	+
N. zichyi Pant.	S_3	foss.	–	–	–	–
N. zichyi var. *leonis* (Pant.) Kozyr.	S_3	foss.	–	–	–	–
N. zichyi var. *ursina* (Pant.) Kozyr.	S_3	foss.	–	–	–	–
Navicula sp.	–	–	–	–	–	–
Nitzschia Hassal 1845						
N. amphibia Grun var. *amphibia*	Mi–R	F	–	–	–	+
N. frustulum (Kutz.) Grun. var. *frustulum*	Mi–R	FB	+	–	–	–
N. navicularis (Breb et Kutz.) Grun.	S_3–R	B	+	–	–	+
N. compressa (J.W. Bail) Boyer	Mi–R	B	+	+	+	+
N. diluviana (Cleve in Cl et Jentz.) Cl.	S–R	B	+	–	–	–
N. romanoviana Pant.	Mi–S_3	foss.	–	–	–	–
N. vermicularis (Kutz.) Grun. var. *vermicularis*	S_3–R	F	–	–	–	–
N. vermicularis var. *maeotica* Pant.	S_3–Me	foss.	–	–	–	–
Nitzschia sp.	–	–	–	–	–	–
Opephora Petit 1888						
O. marina (Greg.) Petit	S–R	M,L	+–	–	–	+
Paralia Heiberg 1863						
P. sulcata (Ehr.) Cl. f. *radiata* Grun	Mi–R	M	+	–	–	+
Pinnularia Ehrenberg 1840 (1841)						
P. ambigua Cl.	S_3–R	M	–	–	–	+
Pleurosigma Wm. Smith 1852						
P. angulatum (Queck) W. Sm. var. *angulatum*	S_3–R	BM	+	+	+	+
P. elongatum W. Sm.	Mi–R	BM	+	+	+	+
Podosira Ehrenberg 1840 (1841)						
P. loczii Pant.	S	foss.	–	–	–	–
Rhopalodia Otto Müller 1895						
R. gibberula (Ehr.) O. Müll. var. *producta* (Grun.) O. Müll.	S–R	B	+	–	–	+
R. operculata (Ag.) Hakanson var. *operculata*	Mi–R	B,L	+	+	+	+
Semseyia Pantocsek 1902						
S. maeotica Pant.	S_3–Me	foss.	–	–	–	–
Synedra Ehrenberf 1830 (1931)						
S. tabulata (Ag.) Kutz var. *tabulata*	Mi_2–R	BM,L	+	+	+	+
S. tabulata var. *obtusa* (Pant.) Hust	S–R	BM,L	+	+	+	+
S. tabulata var. *parva* (Kutz.) Hust	Mi–R	BM,L	+	+	+	+
Surirella Agardh 1832						
S. striatula Turp. var. *striatula*	Mi–R	B	+	–	+	+

Legend: M – marine species, BM – brakish–marine, B – brakish, FB – freshwater–brakish, F – freshwater, i – indifferent, hal – halophyl, Pg_2 – Eocene, Pg_3 – Oligocene, Mi – Miocene, not devide, Mi_2 – Middle Miocene, S – Sarmatian, S_3 – Upper Sarmatian, Me – Maeotian, R – new (recent), foss. – fossil species, L – littoral sp.

Paratethys (K o z y r e n k o, 1958, 1959, P a n t o s c e k, 1902): *Semseyia maeotica* P a n t., *Navicula andrussowii* P a n t., *N. zichyi* P a n t. with var. *leonis* (P a n t.) K o z y r. and var. *ursina* (P a n t.) K o z y r., *Amphora variabilis* K o z y r., *Nitzschia romanowiana* P a n t. A characteristic diatom complex for the sediments from the Hersonian sustage of Balchik was separated. The vertical distribution and quantity of Diatoms representatives are depicted on Fig. 1(a).

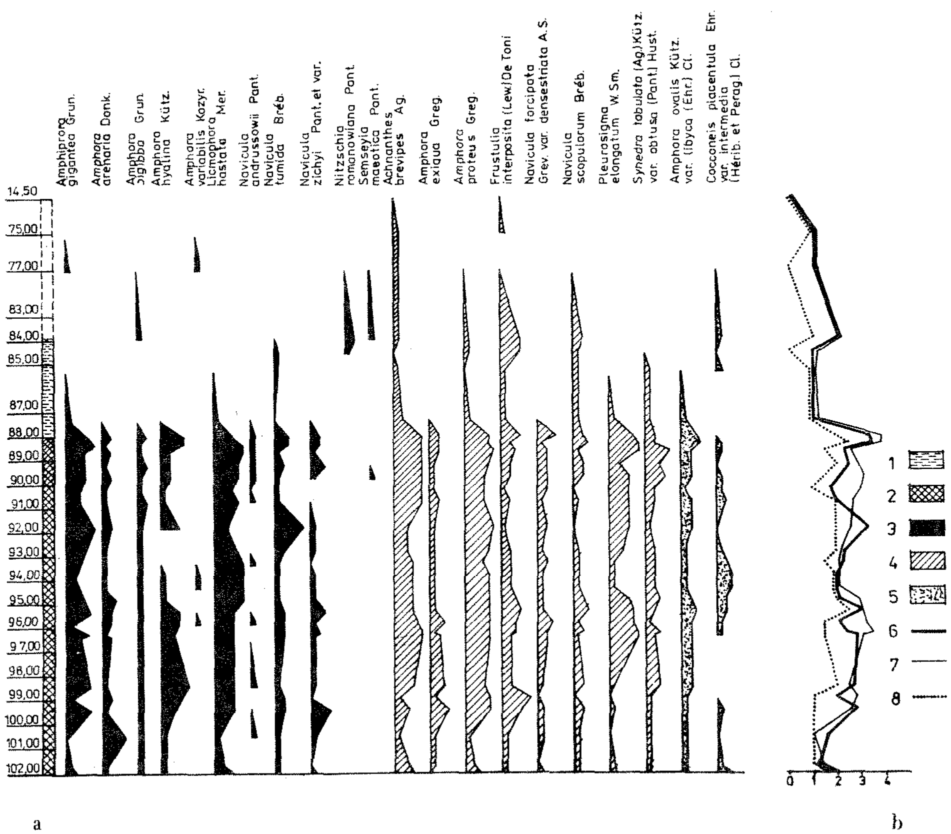

Fig. 1 – a) – Vertical and quantitative distribution of the dominanting and characteristic Diatoms from Upper Sarmatian (Hersonian) sediments, Balchik, North–East Bulgaria
1. Calcareous, bedded til banded clays with diatomitic intercalations and mollusca; 2. Calcareous, bedded clays and diatomit with mollusca; 3. Marine species; 4. Brakish–marine and brakish species; 5. Freshwater–brakish and freshwater species

b) – Arithemtical weighted mean of the ecological groups of Diatoms
6. Marine species; 7. Brakish–marine and brakish species; 8. Freshwater–braksih and freshwater species

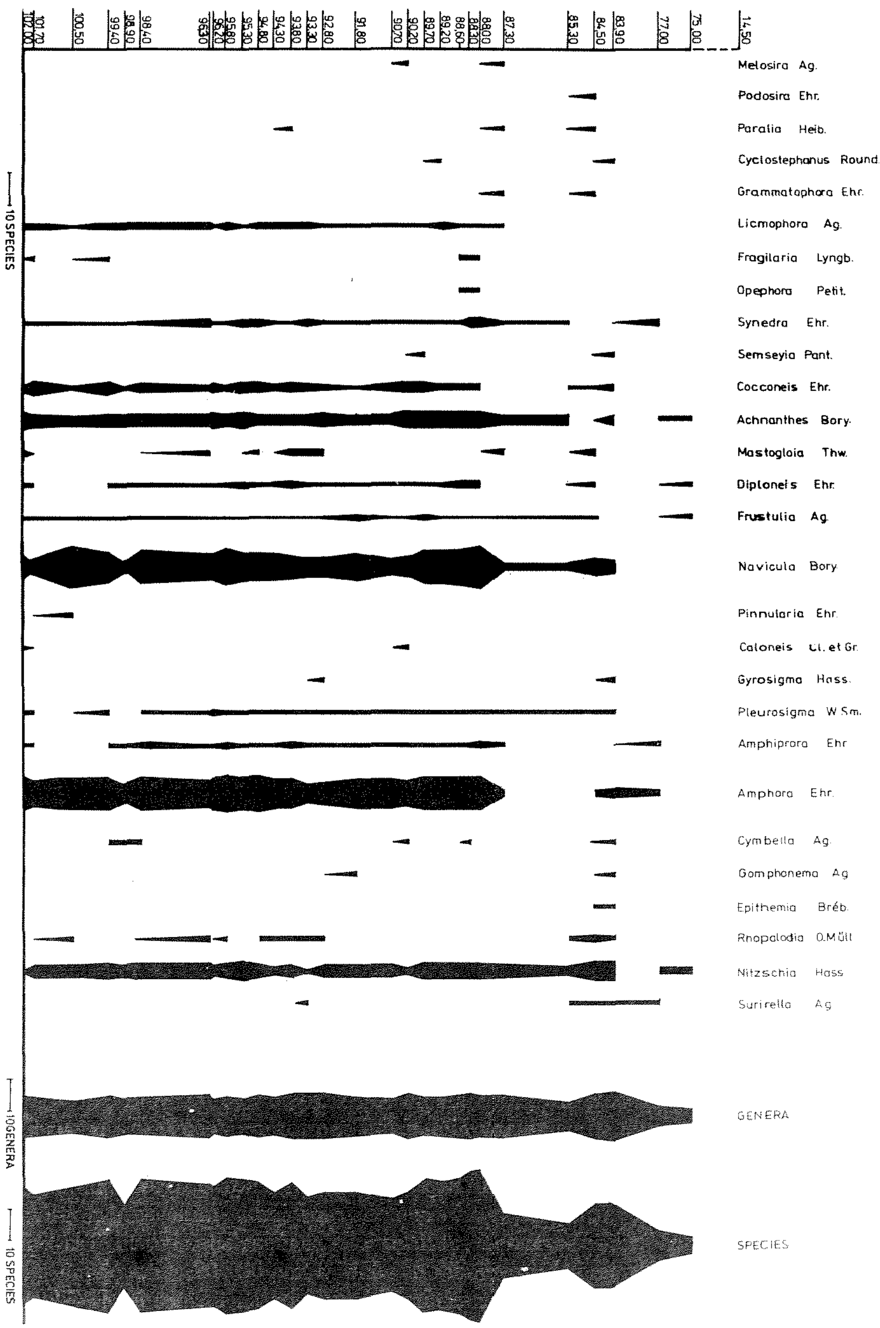

Fig. 2. Dynamic of the variation in the number of: species within each genus of Diatoms (a), genera (b) and species (c) of Upper Sarmatian (Hersonian) sediments, Balchik, North–East Bulgaria.

A Hersonian diatom flora was discovered in the range 14,50–102,00 m. Due to the presence of the Bessarabian ostracoda *Loxoconcha sucrassula* Suz. at 88,50 m the boundary between the Bessarabian and Hersonian sediments was drew at 88,00 m (Popov et al., 1986). No sharp boundary can be drawn according to diatoms. The Hersonian sediments continue gradually into Bessarabian ones. The upper Bessarabian sediments (107,00–102,20 m) have the typical abundance of species for the Bessarabian substage of *Grammatophora, Diploneis, Navicula, Rhopalodia, Surirella, Campylodiscus.* The guiding Bessarabian species *Achnanthes baldjikii* (Bright.) Grun. var. *podolica* Miss., *Campylodiscus fastuosus* Ehr. var. *baldjikianus* (Grun.) Van Lan. disapear at 105,20 m. The first Hersonian species: *Navicula andrussowii* Pant., *Amphiprora alata* Kutz., *A. gigantea* Grun., appear with a single representation in the range 105,10–102,00 m. The guiding species for the Hersonian substage: *Navicula zichyi* Pant. et var. *ursina* (Pant.) Kozyr. and *Amphora variabilis* Kozyr., were found at 102,00 m. From Bessarabian continue to exist: *Navicula scopulorum* Breb., *N. tumida* Breb., *Amphora ovalis* Kutz. var. *lybica* Ehr., *A. proteus* Greg. Between 102,00–88,00 m the diatom flora hasn't the typical Bessarabian species, it is generally close to the Bessarabian (Temniskova–Topalova, 1983, 1984), but it represents characteristic and guiding Hersonian diatoms. The greatest species variety was found at the levels 88,60, 88,30 and 88,00 m. The diatom flora is getting poorer between 88,00 and 83,90 m. There are no diatoms in the sediments between 83,90 and 14,50 m, except in two thin intercalations – at 77,00 and 75,00 m, where were established single representatives of: *Synedra tabulata* (Ag.) Kutz. et var. *parva* (Kutz.) Hust., *Achnanthes brevipes* Ag., *Frustulia interposita* (Lew.) De Tony, *Diploneis smithii* (Breb.) Cl., *Amphora variabilis* Kozyr., *Nitzschia amphibia* Grun., *N. romanowiana* Pant., *N. vermicularia* (Kutz.) Grun. et var. *maeotica, Suriella striatula* Turp.

Since the characteristic Bessarabian species disappear at 105,60 m and the guiding Hersonian diatoms *Navicula zichyi* Pant. et var. *ursina* (Pant.) Kozyr. and *Amphora variabilis* Kozyr., appear at 102,00 m the conclusion was made that the boundary between the Bessarabian and the Hersonian sediments is situated at 102,00 m. The gradual transition from Bessarabian to Hersonian diatom flora is due to the salinity difference between the Bessarabian and the Hersonian basins in North East Bulgaria, which is smaller than that in the other parts of Paratethys. The gradual transition between the two basins is confirmed by the lithological composition of sedimetns. Upper Bessarabian sediments – bedded and banded clays are the result of the increase of the calcium–magnesium carbonates content in the basin. In the beginning of the Hersonian subcentury, the paleogeographic situation is nearly the same and the sedimentation of banded clays continues (Popov, Kojumdgieva, 1987).

Balchik Hersonian diatom flora consists of 84,4% living and 15,6% fossil species. Most of the diatoms have a stratigraphic distribution from Miocene till now. From the Palaeogene only few diatoms were preserved till now: *Fragilaria virescens* Ralfs – from the Upper Eocene, *Cocconeis placentula* Ehr. and *Cymbella ventricosa* Kutz. – from the Oligocene. Some representatives of Balchik Hersonian flora are distributed today in the Black Sea–Caspian basin (40 in Black Sea, 20 – in Caspian Sea and 12 – in Azovian Sea) and in continental basins.

The diatom flora is quite desalted and brakish according to its character. In its composition, many marine species, typical for the early Sarmatian seas, are not present. It includes: 24 marine, brakish–marine and brakish – 30, freshwater–brakish and freshwater diatoms – 19. The arithemtical weighted mean of these ecological groups, for every level, is showed on Fig. 1(b). Marine diatoms slightly predominante in the sediments between 102,00 m 92,00 m, but at 92,00–83,90 m their quantity reduces and brakish–marine and brakish species prevail. The quantity of freshwater and freshwater–braksih species also increases. At 77,00 m and 75,00 m there are a few diatoms and none of them is a marine one. Brakish and freshwater species are equal in quantity at 75,00 m.

Diatom flora is littoral, it consists of epiphytic *(Achnanthes, Cocconeis)* and bentic *(Navicula, Amphora)* species. The ecological analysis of diatom flora, testifies that the Blachik Hersonian sediments are probably formed in shallow, covered with water plants and quite desalted bay of the Hersonian Sea. In the beginning of the Hersonian subcentury its salinity was close to that of the Upper Bessarabian Sea. After the decreasing of the Hersonain basin area, the salinity decreases and the marine and most of brakish–marine diatoms disappear. Many marine mollusca also disappear (N e v e s k a j a et al., 1984). In the middle of Hersonian subcentury a transgretion apperas in the North West part of the basin (hron Mactra bulgarica) and limestones are deposited (P o p o v, K o j u m d g i e v a, 1987). Diatoms are hardly preservable in such sediments, which explains the complete disappearance of the diatom flora. The basin regresses before the end of Hersonian subcentury and the teritory of North East Bulgaria becomes a dry land. This is the reason for the absence of sediments, corresponding to Mitridat horizon of Kerch and Taman peninsula.

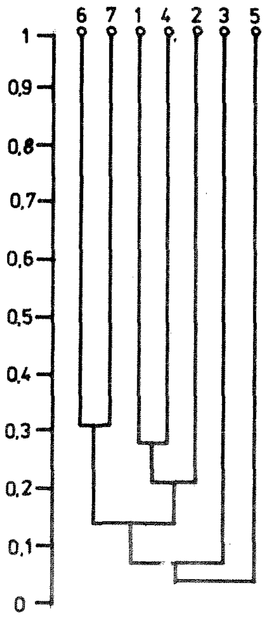

Fig. 3. Comparison of diatom flora from sediments of Uppersarmatian (Hersonian) substage in the Eastern Paratethys
1. Balchik, North–east Bulgaria; 2. The mountain Karaagach, Kerch peninsula; 3. Taman peninsula; 4. Steppe Krim; 5. Cape Ak–Burun, Kerch peninsula; 6. v. Jurkino and v. Kurortnoe, Kerch peninsula; 7. Lake Tobechek, Kerch peninsula

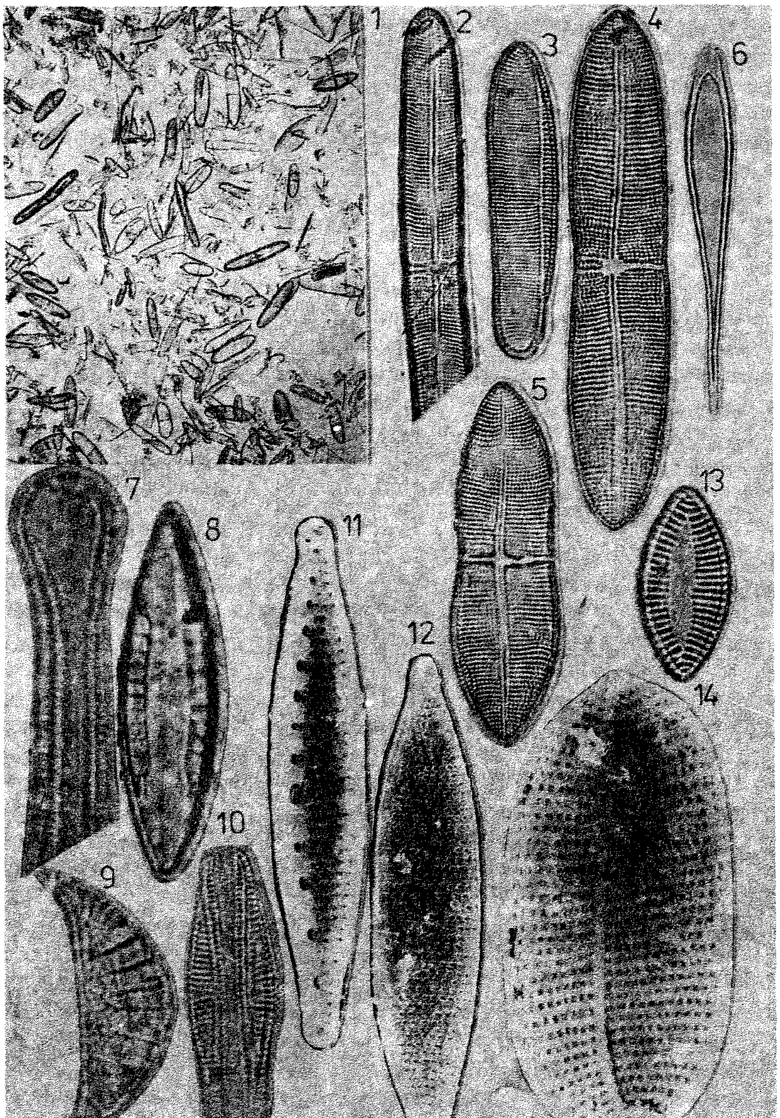

Fig. 4. – 1, 3, 4, 5. *Achnanthes brevipes* A g., 1 – x50, 3, 4, 5 – x330; 2. *Achnanthes brevipes* var. *intermedia* (K u t z.) C l., – x330; 6. *Licmophora hastata* M e r., – x330; 7. *Semseyia maeotica* P a n t., –x2000; 8. *Mastogloia labuensis* C l., –x1500; 9. *Rhopalodia operculata* H a k., – x1500; 10. *Amphora macilenta* G r e g., –x830; 11. *Nitzschia* cf. *frustulum* (K u t z.) G r u n., –x3600 SEM; 12. *Nitzschia* sp., –x2200 SEM; 13. *Nitzshia navicularis* (B r e b. et K u t z.) G r u n. –x830; 14. *Achnanthes brevipes* var. *neogenica* M i l o v, –x860 SEM

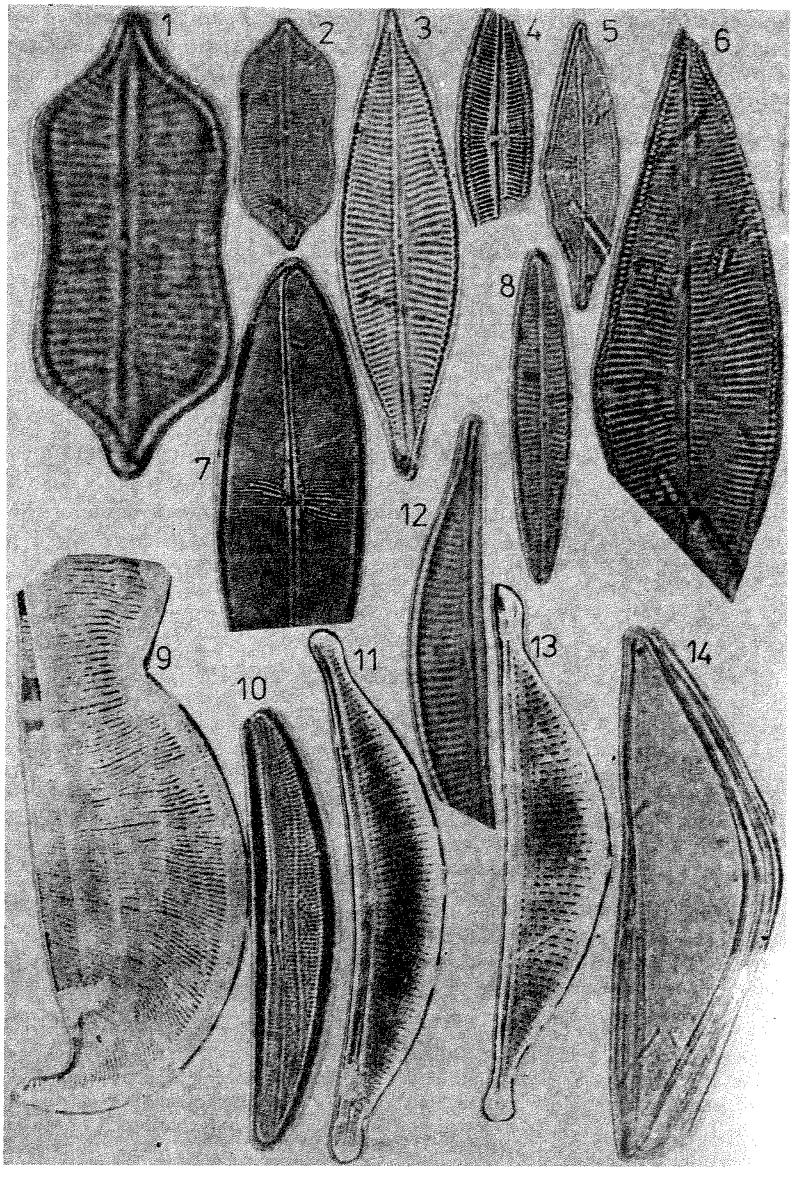

Fig. 5. – 1, 2 *Navicula andrussowii* Pant., 1– x1800, 2 – x800; 3. *Navicula zichyi* Pant var. *ursina* (Pant.) Kozyr., x800; 4. *Navicula jarnesis* Pant., –330; 5, 6 *Navicula zichyi* Pant., 5– x 330, 6 – x830; 7. *Navicula tumida* Breb., –x700; 8. *Navicula pennata* A.S. var. *pontica* Mer., – x880; 9. *Amphiprora gigantea* Grun., – x1600 SEM; 10. *Amphora proteus* Greg., – x830; 11, 12. *Amphora eunotia* Cl. var. *holsatica* (Hust.) Tynni, 11– x2200 SEM, 12– x 1800; 13. *Amphora einotia* Cl., – x2000 SEM; 14. *Amphora hyalina* Kutz., – x1000.

Hersonian diatom flora from Balchik correlates to this from Steppe Krim (Koyrenko, 1958, 1959) – Fig. 3. The characteristic Hersonian diatoms are common: *Navicula zichyi* Pant. et var., *N. andrussowii* Pant., *Amphiprora alata* Kutz., *A. gigantea* Grun., *Amphora hyalina* Kutz., *A. variabilis* Kozyr. The characteristic diatom complex from Balchik includes almost all species from Steppe Krim complex, but it is more varied than the latter and it represented by more brakish and freshwater forms. Many other diatoms are also common: *Navicula digitoradiata* (Greg.) A. S., *N. scopulorum* Breb., *N. subinflata* Grun., *N. tumida* Breb., *Pleurosigma elongatum* W. Sm., *Rhopalodia operculata* (Ag.) Hakanson, *Nitzschia amphibia* Grun. The Bachik and the Steppe Krim florae are connected with the Karaagach flora by smaller coefficient of similarity. The guiding Hersonian and some of the other species are common. These three florae show a more distant similarity with the florae from villages of Jurkino, Kurortnoe and from Tobechek lake, which have the highest coefficient of similarity. The florae of Taman peninsula and cape Ak–Burum remain isolated. These results prove that the decreasing of the area and depth of the basin during the Hersonian subcentury, provides conditions for the development of unique local florae in the different parts of the East Paratethys (Temniskova, Kozyrenko, 1987, 1988). The Balchik Hersonian diatom flora differs from the known florae of the same age from East Paratethys in quite desalted character and the presence of most freshwater representatives.

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Rezime

DOBRINA TEMNISKOVA–TOPALOVA I SOFIJA PASI

DIJATOMEJSKE ALGE SA GORNJESARMATSKIH (HERSONSKIH) SEDIMENATA IZ SEVEROZAPADNOG DELA ISTOČNOG PARATETISA

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Istraživani su gornjesarmatski (hersonski) sedimenti iz okoline grada Balčika, severoistočna Bugarska. Sedimenti iz sondaže korišćeni su za stratigrafska korelaciona istraživanja prema projektu 25 Međunarodnog korelacionog programa UNESCO–a.

Otkriveno je 96 vrsta, varijeteta i oblika dijatomejskih algi iz 28 rodova (Tab. 1). Determinisan je karakterističan dijatomejski kompleks u sedimentima iz hersonskog podetaža kod Balčika, vertikalna rasprostranjenost i količinska zastupljenost vrsta dijatomeja, koje izgrađuju kompleks (Fig. 1(a)). Određena je granica između besarabskog i hersonskog podetaža od 102.0 m.

Dijatomejska flora se sastoji od 84.4% recentnih i 15.6% fosilnih vrsta dijatomeja. Za vrste s poznatom ekologijom izrađen je ekološki spektar. Prosečna izmerena vrednost morskih, brakično–morskih i brakičnih, slatkovodno–brakičnih i slatkovodnih vrsta prikazana je na dijagramu 1. Ekološka analiza dijatomejske flore pokazuje da su hersonski sedimenti kod Balčika nastali verovatno u plitkom zalivu hersonskog mora, koji je obrastao vodenim rastinjem i čija je voda barovita.

Hersonska dijatomejska flora Balčika upoređena je i korelirana sa drugim hersonskim florama iz istočnog Paratetisa (Fig. 3). Rezultati pokazuju da su smanjivanjem površine i dubine bazena u hersonskom podveku stvoreni uslovi za razvijanje svojevrsnih lokalnih flora u pojedinim delovima istočnog Paratetisa. Flora Balčika se razlikuje od flora istog uzrasta istočnog Paratetisa svojim barskim karakterom.