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LATE QUATERNARY ENVIRONMENTAL CHANGES IN THE EASTERN SAHARA
(LIBYAN DESERT) DOCUMENTED BY AN OSTRACODE DIAGRAM

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Ostracodes and diatoms are the most abundant microfossils in sediments of Late Quaternary stagnant water bodies of the Eastern Sahara (Libyan Desert). After having investigated the ostracode faunas of several surface samples that I had taken in the Wadi Howar area during the first B.O.S. expedition (Kuper 1981) it turned out that it is necessary to study sections continuously as far as possible in order to achieve results on which good interpretations can be based on.

In the present paper the results and interpretations are given of the qualitative and quantitative ostracode studies of two fossiliferous horizons from Section C in Wadi Shaw (NW Sudan). The samples have been taken by Dr. Baldur Gabriel (Berlin) who also has conducted extensive field studies in that area (Gabriel & Kröpelin 1983, 1984; Gabriel, in press).

The location of Section C is at 20°26'N and 27°15'E; the surface is situated at about 500 m above mean sea level. Both the investigated horizons belong to the sedimentary succession called OLA (Obere Limnische Akkumulation = Overlieing Limnic Accumulation) by Gabriel. The sediments predominantly consist of silt with minor additions of fine sand and clay. Only the lowermost sample (135-140 cm below surface) is mainly formed by fine sand. A radiocarbon analysis of gastropod shells from a section 5 km away has delivered an age of some 6550 years B.P. for the OLA. If the correlation with Section C is correct, an age of some 7000 to 6000 radiocarbon years B.P. can be estimated for the horizons studied.

Results

The qualitative study (table 1) reveals that at least 6, but up to 12 ostracode species are represented in each of the samples. As the associations, however, show distinct differences in their spectra a total sum of 19 species results. It is very interesting to note that these species or genera form a mixture of representatives of the palaeartic faunal province (numbers 2, 3, 5, 6, 7, 8, 9, 12, 13) and the ethiopian faunal province (numbers 4, 10, 11, 14, 15, 16, 17, 18). Nowadays the region under discussion is regarded to belong zoogeographically to the southern part of the palaeartic faunal province. The qualitative investigations are not yet finished. As the living and fossil nonmarine ostracodes of Africa are not yet studied well enough, very detailed studies are urgently needed to answer all the questions connected with an unequivocal determination of several of the species.

The quantitative study (tables 1 and 2) shows that the total amount of ostracodes per sample varies very much, as does the number of specimens of each species, when all the investigated samples are compared. Altogether nearly 50.000 specimens have been counted. With more than 60 % as a mean value *Cyprideis torosa* (variety *littoralis*) is the most abundant species.

WADI SHAW Sedi- Section C ment Depth: cm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	Sum	
30 - 35	500	552	1139	820	2	1	77	41	0	1	0	3	1	0	3	1	0	0	0	1	2642
35 - 40	500	843	1651	112	38	29	612	113	12	0	3	44	5	0	8	0	0	0	0	0	3468
40 - 45	500	0	5147	1	5	0	390	48	4	19	0	8	0	0	17	1	0	0	0	0	5640
45 - 50	500	14	109	44	54	1	8	60	172	29	0	0	0	0	10	141	1	0	0	0	643
50 - 55	500	912	4	1257	531	0	0	0	776	0	0	0	0	1	23	2937	30	14	0	0	6487
55 - 60	500	1856	4	1830	148	0	2	0	1318	4	0	0	0	0	4	1437	33	37	0	0	6676
100 -105	500	22	16692	193	15	0	0	262	0	0	0	0	0	0	10	0	4	0	0	0	17198
105 -110	500	70	5063	749	7	0	0	936	5	0	0	0	0	14	0	7	0	0	0	0	6850
110 -115	500	339	14849	594	2	2	0	89	15	4	0	0	0	6	72	0	93	0	4	0	16071
115 -120	500	690	177	1110	54	0	0	10	109	0	0	0	0	16	454	0	291	0	14	0	2925
120 -125	500	305	0	1272	106	0	0	0	191	0	0	0	0	177	299	0	1224	0	163	0	3738
125 -130	500	129	339	475	0	0	0	3	0	3	0	0	0	0	0	0	225	0	3	0	1178
130 -135	500	38	1290	199	0	1	0	9	9	4	0	0	0	0	28	0	24	0	1	0	1602
135 -140	500	11	1084	50	0	0	0	14	4	8	0	0	0	0	0	0	0	0	0	0	1171
Total amount: 5781 47548 8706 962 34 1088 1586 2614 73 3 55 6 201 942 4518 1932 52 185 1 76287																					

Table 1: Qualitative and quantitative distribution of ostracodes in two fossiliferous horizons of section C in Wadi Shaw, NW Sudan.

The samples have been taken continuously, each sample comprising 5 cm of the section. Varying amounts of sediment have been analyzed. For better and easier comparison all counts of ostracodes have been recalculated later on to an equal weight base of 500 g of sediment per sample. Before doing that the original weight has been corrected, as differing portions had to be deducted for minerals (gypsum, etc.) that have formed after sedimentation and for non-disintegrated parts of the samples. The number of ostracodes comprises adult specimens and to a certain degree last instars. Two single valves have been counted as one specimen. The ostracode taxa that have been met with are represented by the following numbers: *1* Heterocypris sp. (one highly variable or two less variable species) plus some specimens of a reverse Hemicypris; *2* Cyprideis torosa (without nodes = variety littoralis); *3* Plesiocypridopsis newtoni; *4* Cyprretta sp.; *5* Candonopsis sp.; *6* Darwinula stevensoni; *7* Limnocythere cf. inopinata; *8* Cypridopsis cf. vidua; *9* Ilyocypris sp.; *10* Stenocypris sp.; *11* Hemicypris cf. pyxidata; *12* Limnocythere stationis; *13* Cypricerus obliquus; *14* Darwinula sp. B; *15* Paracyprretta (?) amati; *16* Cyprinotus cf. scholiosus; *17* Cypris bispinosa; *18* Cypris sp. B; *19* Eucypris (?) sp.

WADI SHAW Section C Depth: cm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*		
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
30 - 35	20.90	43.10	31.05	.08	.04	2.90	1.56	.00	.04	.00	.11	.04	.00	.11	.04	.00	.00	.00	.00	.04	
35 - 40	24.29	47.59	3.23	1.10	.83	17.64	3.26	.33	.00	.10	1.26	.13	.00	.23	.00	.00	.00	.00	.00	.00	
40 - 45	.00	91.26	.02	.09	.00	6.91	.84	.07	.34	.00	.14	.00	.00	.30	.02	.00	.00	.00	.00	.00	
45 - 50	2.19	16.93	6.77	8.37	.20	1.20	9.36	26.69	4.58	.00	.00	.00	.00	1.59	21.91	.20	.00	.00	.00	.00	
50 - 55	14.06	.07	19.38	8.19	.00	.00	.00	11.96	.00	.00	.00	.00	.02	.35	45.28	.47	.22	.00	.00	.00	
55 - 60	27.81	.07	27.41	2.21	.00	.03	.00	19.75	.07	.00	.00	.00	.00	.07	21.53	.50	.56	.00	.00	.00	
100 -105	.13	97.06	1.12	.09	.00	.00	1.52	.00	.00	.00	.00	.00	.00	.06	.00	.02	.00	.00	.00	.00	
105 -110	1.02	73.92	10.94	.10	.00	.00	13.67	.07	.00	.00	.00	.00	.00	.20	.00	.10	.00	.00	.00	.00	
110 -115	2.11	92.40	3.70	.01	.01	.00	.55	.09	.03	.00	.00	.00	.04	.45	.00	.58	.00	.03	.00	.00	
115 -120	23.59	6.05	37.94	1.84	.00	.00	.36	3.73	.00	.00	.00	.00	.53	15.53	.00	9.96	.00	.47	.00	.00	
120 -125	8.17	.00	34.04	2.83	.00	.00	.00	5.12	.00	.00	.00	.00	4.74	8.01	.00	32.73	.00	4.36	.00	.00	
125 -130	10.93	28.82	40.37	.00	.00	.00	.25	.00	.25	.00	.00	.00	.00	.00	.00	19.13	.00	.25	.00	.00	
130 -135	2.36	80.51	12.42	.00	.06	.00	.58	.58	.23	.00	.00	.00	.00	1.73	.00	1.50	.00	.06	.00	.00	
135 -140	.90	92.57	4.25	.00	.00	.00	1.20	.36	.72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
Total per-																					
centage:	7.58	62.33	11.41	1.26	.04	1.43	2.08	3.43	.10	.00	.07	.01	.26	1.24	5.92	2.53	.07	.24	.00	.00	.00

Table 2: Qualitative and quantitative distribution of ostracodes in two fossiliferous horizons of section C in Wadi Shaw, NW Sudan. This table shows the percentage of the different ostracode taxa for each sample and on the whole based on the calculated values of table 1.

This is an euryhaline and eurythermal form that predominantly lives in brackish waters. Some of the other species are also known to be able to tolerate brackish water conditions to a certain degree. But there are also samples with a dominance of freshwater species. The ostracode diagram clearly shows that a decrease of brackish water species is directly connected with an increase of freshwater species.

Interpretations

As far as palaeolimnology is concerned best interpretations can be given with regard to the palaeosalinities (table 3). For most of the samples the ostracode associations reveal that brackish water conditions of different degrees existed. But there is also clear evidence for two phases of freshwater conditions of a duration of some 100 to 150 years.

The freshwater phases are dominated by species of the Ethiopian faunal province, the brackish water phases on the contrary are dominated by species of the palae-arctic faunal province. It has to be taken for sure that the investigated site has always been situated within the range of that passage of the migration of birds that follows the direction of river Nile. Living ostracodes or their eggs are distributed geographically by waterfowl. Single occurrences of an ostracode species within the diagram can be interpreted by this but also the quite sudden appearance of a certain species which corresponds to the colonization of a new area.

WADI SHAW Section C Depth: cm	Palaeosalinity (estimated)	‰
30 - 35	oligohaline	0.5- 3.0
35 - 40	oligohaline	0.5- 3.0
40 - 45	pliohaline	9.0-16.5
45 - 50	freshwater	0.0- 0.5
50 - 55	freshwater	0.0- 0.5
55 - 60	freshwater	0.0- 0.5
100 -105	pliohaline	9.0-16.5
105 -110	mio-mesohaline	3.0- 9.0
110 -115	pliohaline	9.0-16.5
115 -120	freshwater	0.0- 0.5
120 -125	freshwater	0.0- 0.5
125 -130	oligohaline	0.5- 3.0
130 -135	mio-mesohaline	3.0- 9.0
135 -140	pliohaline	9.0-16.5

Table 3: Estimated palaeosalinities on the base of the different ostracode taxa present and on their percentage within the whole association of each sample.

From the dominance of brackish water conditions it can be concluded that the climate has mainly been arid during the deposition of the sediments. There is, however, no actual proof of desiccations within Section C, neither in the sediments nor in the ostracode diagram. During the two freshwater phases of the Overlying Limnic Accumulation the climate must have been less arid with more rainfall and a rise of the groundwater level.

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