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Malacostratigraphical Investigation of the Late Quaternary Subsided Zones of Hungary

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ABSTRACT: The author briefly performs the ecelogical, biostratigraphical and malakostratigraphical elaboration of the Mollusc faunae of the most complete sequences and with the knowledge of the results gives the general concludes.

During the investigation of the Hungarian Holocene Mollusc-fauna more and more and important flat-land fauna became known, beside the faunae of the medium high mountain-ranges. The increase of these data enabled to attempt - with full knowledge of the facts until now - giving outline history of the succession of the juvenile subsided zones with the help of malacostratigraphy. Because the ecological conditions of the species of our fresh-water fauna is less explored than the ecological conditions of the terrestrial ones,so such detailed analysis cannot be expected than have been made from the medium high mountain territories (FŰKÖH, L. 1987). The faunal evolution of these territories (Fig. 1.) is approximately the same, it is why we made attempt to publish the fundamental informations about courses of development and stratigraphical examinations.

In the next part of this paper I introduce to biostratigraphical-malacostratigraphical elaboration of the most complete sequences and with the knowledge of the results I give the general concludes.

MALACOSTRATIGRAPHICAL INVESTIGATION OF THE TRANSDANUBIA

Sárrét, Fejér county

The finding place can be found at the Transdanubian part of Hungary at the so called Mezőföld (ÁDÁM, L. - MAROSI, S. - SZILÁRD, J. 1955). The first collection, with the consideration of stratigraphical data was done by E. KROLOPP in 1964, during the geological mapping of this territory (RÓNAI, A. - SZENTES, F. 1972). The examinations suited to the fine-stratigraphical - malacostratigraphical requirements were begun in 1972 (FŰKÖH, L. - SZABÓ, I. 1975, FŰKÖH, L. 1976). Meanwhile the peat and bog-lime production accomplished here made possible the soil research investigation of the utilizable deposits (DÖMSÖDI, J. 1977).

The results of the investigations, done until now is contained by great number of papers. The most significants were written by FŰKÖH, L. and KROLOPP, E. in 1986 and by FŰKÖH, L. in 1988. According these works are determinable the next about this subsided zone and its fauna:

The territory of the Sárrét (Fejér county) was sunk during the Upper Pleistocene and was filled up with fluvial deposits. It is shown by the series of sediments consisting of strongly abraded, well-classified gravels, covered by fine-grained sand locally. It is explored at several point of the basin. These sediments occur in different depths. Its supposable reason is a significant settlement on the Pleistocene - Holocene boundary (ÁDÁM, L. - MAROSI, S. - SZILÁRD, J. 1955). The samples contain good deal of Litoghlyphus naticoides which, according to our ecological knowledge prefers fresh-water enviroment primarily. As a result of a new subsidence the basin were filled with fluvial deposits, becaming without an outlet during the Holocene. The subsidence might dissect this former homogenous basin into small ones (FŰKÖH, L. 1988). After it we can point out three periods of the lake's slow siltation (fig. 2). The dominant species of the first period is the Valvata piscinalis. The characteristic gastropod species of the second period are the Gyarulus albus and the Bithynia tentaculata. This is the main period of the lime mud formation.

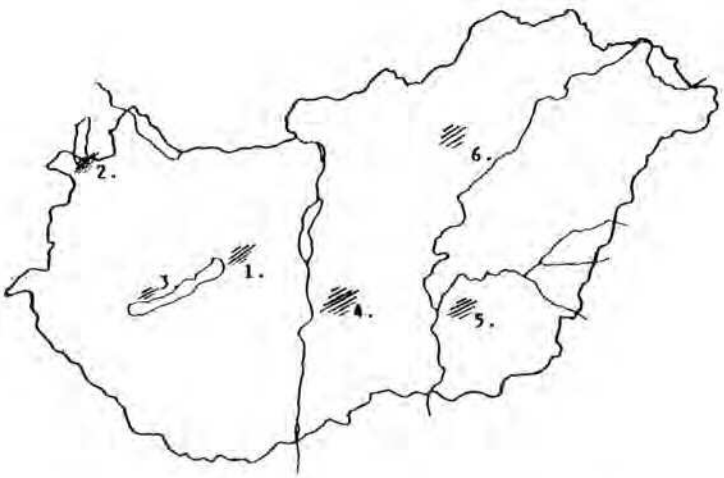


Fig. 1. Holocene lacustrine deposits in Hungary. -- I. Area of Transdanubia: 1. Sárrét, Fejér county, 2. Fertő-lake (Fertőrákos, Fertőboz, Fertőújlak, Balf), 3. Balaton-lake (Balatonederics, Lesence: Nádas-lake) - II. Hungarian Great Plain: 4. Danube-Tisza interfluvial region (Petőfi-lake, Kolon-lake, Kerek-lake, Vörös-swamp, Bócsa-Bugac area, Feketeszék-lake, Gáspárszék-lake,Háromszék-lake), 5. Békés county (Fehér-lake, Körösladány), 6. Area of Jászság

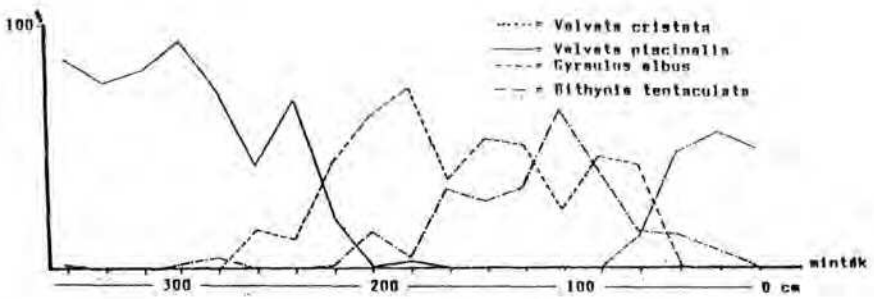


Fig. 2. Three phases of lake succession based on Mollusc fauna

The age of the sediment is 8200 150 B.P. according to the radiocarbon analysis (FÜKÖH, L. 1991) of the samples taken from the lime mud. In the third period of the siltation appeared the typical palaudal species (Lymnaeidae, Planorbidae) and those species which occurrence refer to periodical dessication (Vallonia costata and Pupilla muscorum). The faunistical attraction of the sediment is the presence of Gyraulus riparius.

Fertő-tó (Neusiedler See)

The formation of the Fertő-tó basin is not cleared up totally until now. There are some authors who bring it into connection with the Late-Pleistocene crustal movements (SOMOGY, S. 1969). The others emphasize the erosional role of the river Danube (MIKE, K. 1988). Investigations have been performed partly to clear up this problem, partly to explorate the past of the recent very poor Mollusc fauna.. (RICHNOVSZKY, A. 1981, FÜKÖH, L. 1986, FÜKÖH, L. 1988). The exploration of the Holocene sediments were taken place in the area of Fertőrákos, Fertőboz and Balf. The oldest deposits were found in 270 - 170 cm depth. It can be supposed that after the beginning of the sedimentation crustal movements might distrub this territory. It corroborates the fact that the quality and the fauna of deposits from different depths is similar. These Early-Holocene sediments are characterized by the presence of Lithoglyphus naticoides and Theodoxus sp.. The occurence of Theodoxus reinforces Mike's theory, because we can conclude from it that there was connection between the basin and the Danube. There could be a shallow-water lake here at that time, as it is shown by the frequent occurrence of the fresh-water gastropod species. (Fig. 3.) The next period has brought a significant, rapid change in the lake's evolution. The relative frequency is 60 - 70 % of the terrestrial species in the sediment. The typical species are Vallonia costata and Vallonia pulchella. In the third period of the succession we can observe the frequency of the fresh-water species again. This changement presumably can be attributed to climatical causes. While the rapid water level deminution of the second period can be brought into connection with the warming up of the climate, the presence of Gyraulus riparius in the third period's sediments sings fall in temperature. The fourth period, the further siltation goes on until now, too. The process, delienated here naturally could have been accomplished differently in case of other territories, the good example for it the peat, formed in the area of Fertőrákos (FÜKÖH, L. 1986).

Balatonederics, Lesence: Nádas-tó

To invstigate the Holocene alongshore sediments we have choosen the territory of Lesence, Nádas-tó, which is situated north from the Lake Balaton, in the Tapolca-basin. We aimed to dig up with help of borings the sediments of the former lake-basin. The sampling was performed between 1986 and 1988 (FÜKÖH, L. 1988). According 18 samples we could study the different character of the sedimentation here. This fact, presumably is the result of the diverse geomorphology, formed by the Lesence-stream. The next conclusions can be drawn from the simultaneous examination of the deposits and the Mollusc-fauna. The basin's sediments were characterized by quartz and limestone gravels which were deposited by the streaming water, in the initial period (18th sample). The supportional depth of water was 500 cm approximately. The vegetation could be highly insignificant (lime mud formation). The characteristic species are the Lithoglyphus naticoides occurring among the gravels, and the Valvata piscinalis which can be found in the initial phase of the lime mud deposits. This type of sediment contains the Marstoniopsis soltzi, a rare gastropod species of the Hungarian Holocene fauna. The occurence of this species was described by E. KROLOPP from Mezőlakháza, in 1982 (KROLOPP, E. - VÖRÖS, I 1982). This occurrence is older, presumably.

According the succession of the fauna (Fig. 4) this part of the basin may have been filled up rapidly and uniformly. Initially the rate of the terrestrial species is insignificant (1-6 period). Then it accelerates, and the siltation in the 9th period increases to such an extent, that the of the aquatic species decreases only 3,6%. After those samples which contain gravel and lime mud, appears in the swampy boggy deposits of this territory the Gyraulus riparius, which does not occur in the juvenile sediments.

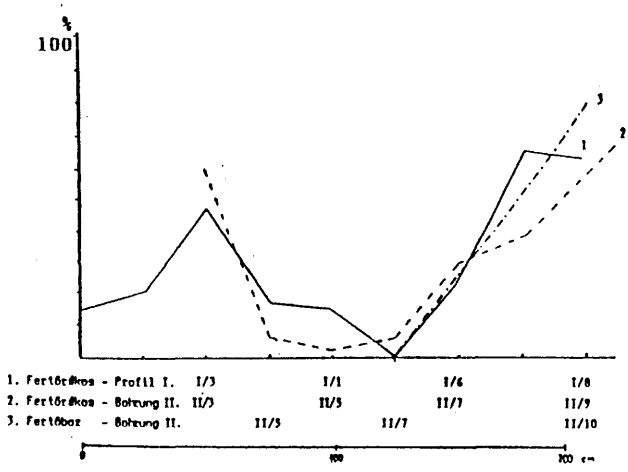
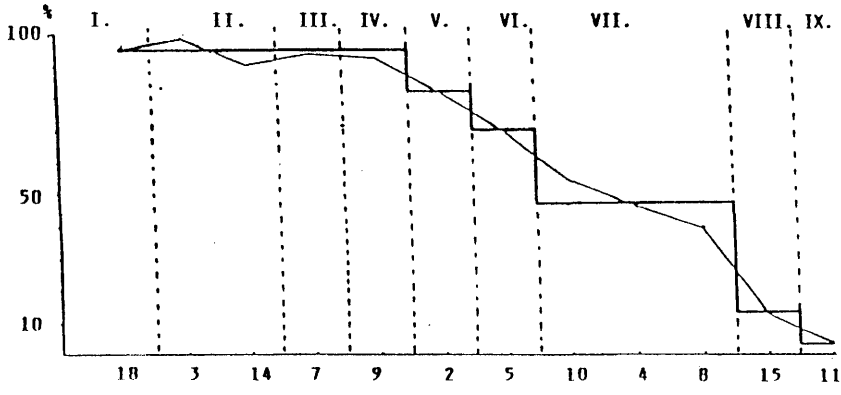


Fig. 3. Frequency of the water species in deposits (Fertő-lake)



2-18 = number of samples
I-IX = ecological groups (Fűköh,L.1988b)

Fig. 4. Frequency of the water species in deposits (Balaton-lake)

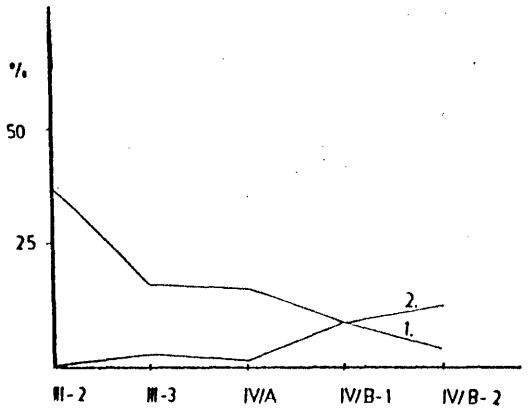


Fig. 5. Change of the frequency of the species Bithynia tentaculata (1.) and Bithynia leachi (2.) (Sárrét, Fejér county)

Chronostratigraphy Járai-Komlodi,M. 1969.	Boreal	Atlantic	Sub-Boreal	Sub-Atlantic
Succession of Holocene Mollusc fauna of the Subsided Zones FGköh,L. 1991.	Fluvial phase	Lacustrian period	Fen and Peat formation	Antropogenic transformation of the environment
Malacostratigraphy (Biostratigraphy) FGköh,L. 1991.	Lithoglyphus naticoides - Valavata piscinalis	Gyraulus albus - Bithynia tentaculata	Bithynia leachi - Gyraulus crista	anonim
Radiocarbon year B.P. (1950)	8.200-6.500	6.500-4.500	4.500 - 2.500	2.500 - 0.

Synoptic table of chronostratigraphy, ecostratigraphy and biostratigraphy

MALACOSTRATIGRAPHICAL INVESTIGATION OF THE GREAT PLAIN

Danube - Tisza Interfluve

The juvenile subsided zones of the Great Plain has been examined at the Danube-Tisza Interfluve the best. The results of these investigations were published by the research workers of the Geological Department of the József Attila University of Arts and Sciences at Szeed. The papers contain the palaeecological examinations of the Holocene faunae. Hereinafter I summarize the results of the faunistical examinations of the best known subsided zones.

The sequences begin mostly with loessy-sandy sdiments (MUCSI, L. 1963, 1965, 1966) which sign cold climate. The following calcareous deposits and their fresh-water species prove the permanent humid relief and the rainy climate. The sequence is completed by peat formation and humic depostis. The characteristic species of the fauna are the Planorbis planorbis the Gyraulus crista, the Valvata cristata, etc.

The best investigated lake of the territory is the Kolon-tó (MOLNÁR, B. - IVÁNYOSI-SZABÓ, A. - FÉNYES, J. 1979). It was emerged in one of the filled up branches of the river Danube. The bottom of the sequence is consist of fractions of different grain size sand and silt, on which settles lime mud. The siltation is finished with peat sediments here, too. The most interesting and most significant species of the Holocene layers is the Gyraulus riparius. Beside this species the other faunistical interest is meant by the Pisidium moitesserianum which rare occurrance is already noteworthy in the fauna of the Fertő-tó (Lake-Fertő) (FŰKÖH, L. 1986).

The paper, written by FÉNYES (1983) contains the results of the further examinations. Beside the Kolon-tó he publishes the malacostratigraphical and palaeocological examination of the Kerek-tó (Bugac) and the Vörös-mocsár (Danube-valley). In case of Kerek-tó the sequence is similar to the above mentioned series: sandy loess is on the bottom, the next is the lime mud and the overlying bed is the peat. According the ecological distribution of Fényes the calcareous mud contains the so called "species requiring permanent water-cover" here,too.

The sequence of Vörös-mocsár is almost homogeneus peat. There are clay deposits under the peat. Its deposits are highly similar to the formation of those sediments which were explored at the vicinity of Nádasladány (Sárrét, Fejér county), (FŰKÖH, L. 1988), and also similar to the sequence Fertőrákos 2 (Fertő-tó), (FŰKÖH, L. 1986).

The author (FÉNYES, J. 1983) with the full knowledge of the three lakes' faunal-succession, attempts to analyse the connection between the sedimentation and the climate. It is based on the relative frequency of the polythermic and oligothermic species of the fauna. Relying upon these findings he writes the next: the absolute rate of the polythermic species grow remarkably during the formation of the calcareous mud. This conclusion is in well-accordance with the result of those investigations which were performed at Sárszentmihály profile number I. (Sárrét, Fejér County FŰKÖH, L. 1977). The growth of the relative abudance of the polythermic species during the period of peat formation, stops short in its lower level-we could observe 20 per cent decrease in case of Kolon-tó - and then it grows rapidly again.

The paper of TÓTH, Á. - MOLNÁR, B. (1987) marks the third period in the malacological investigation of the Danube-Tisza Interfluve. The paper dissects the fauna of the holocene sediments of Bugac-Bócsa from the point of view of palaeoecology. The teritory belongs to the Kiskunság National Park. The above mentioned dissertation is published in that volume which issued for the Canadian Congress of the INQA. Apart from the detailed analyses I refer to that the deposits of the three finding places are similar to the formers,: calcareous mud settles onto the sandy-loess sediments, and the sequence is finished by peat. In both sequence (Bugac-Bócsa, Feketeszéki-tó, Gáspárszéki-tó,) can be found the Gyraulus riparius!

Among the lakes of the Kiskunság National Park we have some informations from the fossil fauna of the Háromszéki-tó. SZABÓ, S. (1990) remarks in his paper, in the course of representation of the recent fauna of the lake, that he had collected Lithogliphus naticoides, Valvata piscinalis, Bithynia tentaculata, from the deposits of the outcrop which is situated at the SE part of the lake. These species are not living here, nowdays.

South - east Hungary (Békés county)

The till now published south-east Hungarian data are reviewed reffering to literary details. Detailed analysis is given by Tamás Domokos (1984) about the Holocene Mollusc-fauna of Fehér-tó (Kardoskút). According the author the deposits are Holocene resedimented, marsh-loesses in one of the remained branches of the Ancient-Maros river. Because of the unified sediment biostratigraphical evaluation were not performed, only the ecological analyses of the malacological material were completed. The chronological ranking of the fauna was accomplished on the basis of the results of parallel examinations (malacological, archeological, vertebrate paleontological). According the author the fauna lived in the period following the Atlanticum, in the Late Holocene.

The other exposed Holocene sediments of this teritory is the profile of the Körösladány Brickworks (KROLOPP, E. - SZÓNOKY, M. 1982). The profile represents the sequence of the Ancient-Körös river. The type of the sediment mainly clay and silt. Because of the rapid sedimentation unambiguous stratification was failed to reveal. So the Mollusc-fauna were published jointly by the authors. It is why malacostratigraphical evaluation couldn't be done. But here we have to stress the presence of Gyraulus riparius, which can be found in three sampling horizons. And we have to mention about the presence of Lithoglyphus naticoides and about the frequency of Bithynia leachi in contradiction to Bithynia tentaculata.

The Jászság (Northern border of the Great Plain)

The third examined teritory of the Great Plain is the Jászság. Fine-stratigraphical collections were performed between Jászberény and Jásztelek in the fossil meanders of the Ancient-Zagyva river, in connection with archeological examinations. Detailed analysis is not performed yet. This is the first publication of the preliminary examination of the fauna. The sediments exposed by boring can be taken to two parts. The upper is highly humic loam with fluvial sand separated by clay deposits under it. Its fauna bears marks of fluvial mixed character, but in spite of this, its elements can be separeted well from each other. The borings were deepened in the fossil river-bed and on the margin of the river-bed.

The number of the mollusc species in the loam is very little. With the exception of one or two terrestrial species (Pupilla muscorum, Vallonia pulchella) these are palaudal species. The most frequent are: Anisus spirorbis, Planorbis planorbis, Bithynia tentaculata operculum and Pisidium species. The problem of turning up the species and the operculum was mentioned by KROLOPP (KROLOPP, E. - SZÓNOKY, M. 1982).

In the lower, sandy sediments appears the Lithoglyphus naticoides, the Valvata piscinalis and the Valvata pulchella . The value of the fauna is the occurrence of the Gyraulus riparius. The dissimilar character of the sediments and their fauna points to the fact that the sediments deposited by the Ancient-Zagyva formed rapidly in consequence of the repeated channel-changing of the river. This may be the cause of the poor fauna, and even we can suppose that the river gave place to a shallow, in a phase dry marsh territory. This is the cause, that those terrestrial species are absent characterise, like in case of Fertő-tó, the intermittent humid, intermittent arid territories.

The above mentioned faunae, by all means do not contain the all exposed in the foregoing Holocene fluvial sediments. Beside the territories examined by me, I was anxious to introduce those which are the most significant in the view of the examination of the Hungarian subsided zones.

There were left out deliberately mountain of medium height stream-side sequences at which the lacustrical character is not expressed.

STRATIGRAPHICAL AND CHRONOLOGICAL RESULTS

On the basis of the faunal-succession of the territories described in this paper it can be laid down as a fact that the juvenile subsided zones in Hungary can bring into connection with the crustal movements of the end of the Pleistocene and the beginning of the Holocene. The basis formed after the subsidence were filled by fluvial sediments in the beginning. It is documented by partly the gravel containing deposits, like the Early-Holocene sediments of the Fertő-tó, Lesence: Nádas-tó, Sárrét, Fejér county; or the presence of the fluvial sand in Békés county, in the Danube-Tisza Interfluve or in the Jászság. These juvenile Holocene sediments are characterised by the occurrence of Lithoglyphus naticoides as reophyl species, and Valvata piscinalis, Valvata pulchella in view of malacology. Here have to be noted that after the fluvial period in the initial deposits of the lacustrical phase the Valvata piscinalis appears as "guide fossil", since there is no vegetation, or only the lower plant vegetation can be found here in this period of the lake's evolution.

The second period of the succesion of the lakes in case of our subsided zones can be characterised with forming calcareous deposits. It can be observed both in the case of the Great Plain and Transdanubia, but we can find this sediment in the Nyirség, too. (SZÖÖS, Gy. - SÜMEGI, P. - HERTELENDI, E. 1991.)

The third period is characterised by developing of bogs, sometimes peat-bogs. While the polythermic species are typical mostly in the second period like Bithynia tentaculata, Gyraulus albus. In the third period, in which we can find the terrestrial species reffering to intermittent dry phases, characteristic is the presence of Gyraulus riparius generally. It is interesting because this species does not occur in Hungary nowdays. It was the member of the Pleistocene mollusc-fauna (KROLOPP, E. 1982-83) but as the climate became warmer disappeared. And this species appeared again at the end of the Holocene (Sárrét, Fejér county; Lesence: Nádas-tó; Kolon-tó; Körösladány; Jászság). This fact is refer to fall in temperature. The occurrence of Valvata pulchella refers to fall in temperature, too. (Körösladány, Jászság, Danube-Tisza Interfluve). The third evidence of cooling down is the presence of Bithynia leachi in the sediments. This species is the vicarious species of the Bithynia tentaculata and was forced back by the warming up in our fauna. The vicariaty of these two species can be observed in the deposits of the Sárrét (Fejér county) the most expressively (FÜKÜH, L. 1977). According the above mentioned indicator species it can be laid down as a fact that the third period of the succession of our lakes may be put to the second cool-phase of the Holocene.

Finally the fourth period, which is not natural process solely, but it has anthropogen aspects, is the course of becoming boggy or sometimes the total filling up.

These successional processes beside the relative character of malacostratigraphy can be bring into connection with the absolute chronology. The radio-carbon analysis of the calcareous sediment presents basis for it. According the survey data, performed from the lower part of the calcareous deposits of Sárrét (Fejér county) the age of the sediments is 8200$\pm$150 BP. While this value in case of the lakes of the Great Plain is 8000-8500 BP. (FÜKÜH, L. 1991). In accordance with these we can state that these sediments developed at the end of the Boreal period and during the Atlanticum period. This is keeping with the dominancy of the polythermic species and the presumably extensive precipitation. This was the real "lake-age" of our subsided zones.

Compared to the age of the calcareous mud we can lay down as a fact that the beginning of the siltation of the subsided zones can be ascribed to the Preboreal - Boreal period, while the bog-formation and peat-formation is identiable with the fall in temperature following the Atlanticum, with the Subboreal period.

If we concende this logical reasoning, it can be established that the Gyraulus riparius can be used as subboreal indicator species in the territory of Hungary, nowdays (FÜKÜH, L. 1989).

This paper contains the malacostratigraphical data of those most significant subsided zones which were examined untill 1990. This enumeration is not complete naturally. There were left out short, yet completed works, or the proceeding investigations. This paper does not cover the parallel performed sedimentological examinations, the palynological analysises, the vertebrate-palaeontological data. The publication of them, together with further malacological data the task of an other dissertation (FÜKÖH, L. 1991).

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