A la recherche de l'Homme préhistorique, E.R.A.U.L. 95, Liège, 2000

PALAEOECOLOGICAL RECONSTRUCTION OF THE SÁGVÁR-LASCAUX INTERSTADIAL (UPPER WEICHSELIAN)

Pál SÜMEGI* & Endre KROLOPP**

* L. Kossuth University, 4010 Debrecen, P.O.B. 4., Hungary
** Hungarian Geological Institute, 1143 Budapest, Stefánia u. 14., Hungary

Introduction

Recently the malacological studies of the Hungarian Upper Weichselian loess deposits have had significant results. The quantitative studies of samples collected by standard fine stratigrafic methods have been completed and made more exact by the application of new methods. By the development of the "malacothermometer method" (SÜMEGI 1989, 1996) it is possible to reconstruct the palaeoclimatic July mean temperature. There are new findings on the interdependence of the malacofauna, climate and vegetation based on the repeated analysis of former quartermalacological data (SÜMEGI 1995). The time-stratigrafic correlations between these features have been justified by radiocarbon data determined by the method developed in the Nuclear Research Center, Debrecen (CSONGOR *et al.* 1982, HERTELENDI *et al.* 1989, 1992).

It has been realized that one could correlate local changes with each other on a regional level and also with global climatic changes.

Based on these considerations the palaeoecological reconstruction of the Hungarian Upper Weichselian, mainly loessy deposits has been prepared (KROLOPP & SÜMEGI 1995; SÜMEGI & KROLOPP 1995). As a result of this 9 shorter malacostratigrafic levels have been identified within the Upper Weichselian and Late Glacial, meaning different climatic and vegetation periods as well.

Out of these 9 periods there are 7 in the Upper Weichselian, which is in our opinion between 30,000-13,000 BP determined by radiocarbon data (KROLOPP & SÜMEGI 1995).

In case of deposits between 16,000-18,000 BP radiocarbon data a remarkable, palaeoecologically characteristic period was found. This period was characterized by the occurrence of *Vestia turgida* species (KROLOPP & SÜMEGI 1990) and the dominance of *Punctum pygmaeum* species (KROLOPP & SÜMEGI 1991) and it was separated as a Punctum pygmaeum - Vestia turgida zonula within the Semilimax kotulai subzone of the Bithynia leachi - Trichia hispida malacological biozone (SÜMEGI & KROLOPP 1995). This period of the Upper Weichselian having a relatively gentle climate and favorable rainfall distribution has been found to be identical with the Ságvár-Lascaux interstadial (GÁBORI 1965; GÁBORI & GÁBORI-CSÁNK 1957; GÁBORI-CSÁNK 1978).

Hungarian sediments of the Ságvár-Lascaux interstadial

In the Ságvár-Lascaux interstadial mainly loessy sediments were deposited in Hungary. The basis for their identification and classification was the presence of *Vestia turgida* and the significant (generally >10 %, but sometimes even 68 %) dominance value of *Punctum pygmaeum*

(Punctum pygmaeum - Vestia turgida zonula). Besides this

- the qualitative and quantitative characteristics of the malacofauna,
- archaeological findings,
- the Vertebrate fauna and
- radiocarbon data

have been taken into consideration. Based on the above factors sediments of the Ságvár-Lascaux interstadial have been described from 20 sites of Hungary (Fig. 1, Table 1). These sites could be clustered into 5 groups.

1. Surroundings of the Danube-bend

Sites belonging to this area are connected with archaeological excavations (GÁBORI-CSÁNK 1984; DOBOSI 1991, 1994; DOBOSI *et al.* 1983). There is a common malacological characteristic of the layers containing tools of the Gravettian culture, besides the significant dominance of *Punctum pygmaeum, Vestia turgida* was present in all of them (KROLOPP *In:* DOBOSI *et al.* 1983; KROLOPP 1991). The radiocarbon analysis gave similar, 16,000 BP data in all the three sites (Budapest-Csillaghegy, Pilismarót-Pálrét, Esztergom-Gyurgyalag). In the case of the Budapest-Csillaghegy site measurements have been made later, in 1994 (Table 1) using the Quaternary Mollusc (*Arianta arbustorum*) shells of the archaeological excavations.

Based on the archaeological evaluation of the excavations the stratigrafical position of the culture-layers was put into the Ságvár-Lascaux interstadial. The most characteristic site of the group is Pilismarót-Pálrét (DOBOSI *et al.* 1983), where 1.2-1.4 m under the surface a humic culture layer was found in the sandy loess. Within this layer almost 100 flint tools, sculptured stone pieces, Tertiary Mollusc shells used as trinkets (GÁBORI 1969) and bones of mammals were identified. Most of the latter turned out to be bones of the reindeer (*Rangifer tarandus*).

22 snail species have been found in the culture layer and in the sandy loessy one above it. Species having wide ecological tolerance spectrum or preferring open forest habitats were dominant in the fauna, the ratio of the cold-indicators was low. *Punctum pygmaeum* reaches its dominance-maximum above this culture-layer. The - fauna-based - reconstruction of July mean temperature gives a 16 °C value, the dominance of snail species living on the edge of open and closed vegetation areas indicate a gentle climate and a favorable distribution of precipitation, which corresponds to the development of the "embryonic" soil.

2. Northeast Hungary

Within the loessy layers deposited on the lava-ridge and foothills of the Kopasz Hill at Tokaj the species composition characteristic of the Punctum pygmaeum - Vestia turgida zonula has been demonstrated in 8 sites supported by radiocarbon data from 5 of them (Table 1). Because of the morphology of the hill remarkable microenvironmental and microclimatic influences could be shown out, effecting the occurrence of the characteristic species of the zonula, but its basic trends were recognizable (SÜMEGI 1996).

The most characteristic changes have been found in the profile I. of the brick-factory at Bodrogkeresztúr. Mollusc fauna found in the 1.5-2.75 m section of this 7 meter excavation was identified as the Punctum pygmaeum - Vestia turgida zonula. In this layer cold-indicators (*Vallonia tenuilabris, Columella columella*) are remarkably repressed, their ratio was decreased from 30-35 % to 9-13 %, while Holarctic and Central European fauna elements preferring a gentle climate and larger vegetation cover (*Clausilia dubia, Punctum pygmaeum, Vestia turgida, Discus ruderatus, Semilimax kotulai*) became predominant. Dominance of species preferring larger vegetation cover exceeds 50 %.

Based on the fauna composition it is probable that because of the gentle, cool, but not cold, at the same time wet and rainy climate natural forestation could start in the area. Development, composition and radiocarbon age of the fauna well coincides with that of the similarly aged loess profiles of the southern parts of the Great Hungarian Plain and Transdanubia, but because of the smaller number of species it is comparable with the profiles of the Danube-bend.

3. Central parts of the Great Hungarian Plain

Of the sites of this region the most characteristic is the layer series of the sand-pit at Tiszaalpár (SÜMEGI *et al.* 1992), revealing the sandy and loessy layers in a 6.5 m profile.

The Punctum pygmaeum - Vestia turgida zonula could be identified in the 3.5-4.0 m section of the profile. The ratio of the cold-resistant, hygrophilous, forest elements (*Clausilia dubia, Arianta arbustorum, Perforatella bidentata*) is remarkable (35 %) in this section, especially that of *Discus ruderatus* (10 %). Among the species living in the transitional zone between open and closed vegetation types, the dominance of *Punctum pygmaeum* is especially high: 39 %. This fauna composition marks a level of forestation, where the dominance of open forest species indicates the formation of a not too dense forest vegetation. The larger number of species (20) is comparable with that of the sites on the Great Hungarian Plain and Transdanubia. In this way besides the radiocarbon data the composition and development of the fauna indicate the belonging of this layer to the Punctum pygmaeum - Vestia turgida zonula.

4. Southern parts of Transdanubia

There are no archaeological findings uncovered from the profiles of this group of sites, and we have no radiocarbon data either. Malacological studies by the dominance of *Punctum pygmaeum* together with the character of the fauna have proved that some sections of the layers were deposited in the Ságvár-Lascaux interstadial. A common property of the malacofaunas studied that *Vestia turgida*, having recently a Carpathian distribution, is replaced by the forest species *Cochlodina laminata* and also *Orcula dolium* having a hilly distribution occurred everywhere. The dominance of *Punctum pygmaeum* gives a two-peak curve in several layer series, indicating probably a short period of unfavorable climatic conditions.

The most characteristic layer series has been found in the site at Bátaszék, where the dominance-curve of *Punctum pygmaeum* and that of the total number of species looks like a Gauss-curve, indicating that the series of deposits includes the introductory, main and final sections of the period as well. The presence of forest patches is indicated by *Macrogastra ventricosa* and *Aegopinella ressmanni*, besides which species preferring the edge zone between open and closed vegetation types are predominant.

5. Southern parts of the Great Hungarian Plain

In one of these sites the first palaeolithic finding of the Plain was found at Szeged-Öthalom (BANNER 1936), while V. T. Dobosi has excavated culture layers with Gravettian stone tools in Madaras brickyard (DOBOSI 1967, 1989).

Based on radiocarbon data the medium section of the Szeged-Öthalom profile - studied in detail (KROLOPP *et al.* 1995) also with shallow boreholes - was formulated between 16,000-18,000 BP. The composition of the fauna, but especially the high dominance of *Punctum pygmaeum*, exceeding 30 % in some layers, the occurrence of *Vestia turgida* and the malacother-

mometer data make it quite evident that this section is identical with the Punctum pygmaeum - Vestia turgida zonula. The relatively dense vegetation cover is proved by the high dominance value (>80 %) of hygrophilous and subhygrophilous species living in the edge of open and closed habitats. Some gallery forest species (e.g. *Perforatella bidentata*) also appear in the fauna. By the recent ^{14}C measurement of the mammoth bone (Table 1) found in the course of the 1935 excavations (BANNER 1936), it was possible to certify that it has identical age with the tools in the Gravettian culture.

Palaeoecological characterization of the Ságvár-Lascaux interstadial

Malacological data provide most of the information about the palaeoenvironmental conditions of loessy deposit formulation. Based on quartermalacological data between 16,000-18,000 BP in the Danube-bend, on the edge of the Northern Mountain Range and on the southern parts of Transdanubia and the Great Hungarian Plain, species preferring denser vegetation cover had been distributed (*Mastus venerabilis, Discus ruderatus, Punctum pygmaeum, Clausilia dubia, Vestia turgida, Macrogastra ventricosa, Aegopinella ressmanni, Semilimax semilimax, S. kotulai, Vitrina pellucida, Bradybaena fruticum, Arianta arbustorum*) and they became dominant in the profiles studied. Parallel with the dispersion and becoming domination process of the forest species, and those preferring denser vegetation cover, or living in the edge of open and closed habitats, the previously dominant fauna-elements of open areas (*Columella columella, Pupilla sterri, Vallonia tenuilabris*) had disappeared or their ratio had been seriously decreased.

Based on data gained by the malaco-thermometer method the July mean temperature increased from the previous 12-14° to 14-17 °C, while the average to 15.6 °C (Table 1). It is remarkable that in the case of the Danube-bend and Northern Hungary a 15.2 °C average has been calculated, whereas this value was 15.8 °C in Southern Transdanubia and 16.2 °C in the southern parts of the Great Hungarian Plain (Fig. 1). These variations on the whole are similar to the recent regional differences.

Based on the dispersion process and the increasing dominance of Mollusc species preferring forested, wet habitats one can state that in this 2,000-year long period the amount of precipitation had also raised together with the 2-3 °C increase in the July mean temperature compared with the previous climatic phase.

Based on recent analogies 16,000-18,000 years ago essentially taiga-like forests, covering large areas, had developed in the Carpathian Basin. At the same time malacological data indicate that there should be areas with more open vegetation, thus the vegetation cover showed a mosaic pattern.

The vegetation pattern reconstructed by the help of malacological data is supported by the analysis of the large number of charcoal samples from the same aged layer series. Studying these samples Stieber (STIEBER 1967) has reconstructed a broadleaved taiga environment in the Carpathian Basin between 16,000-18,000 BP. The new palaeobotanical data suggested that the areas covered by closed taiga forest spots and open coniferous forest within pathes of steppe and within the taiga there were also pockets of deciduous trees during the Ságvár-Lascaux interstadial period (WILLIS *et al.* 1995; SÜMEGI 1996; RUDNER *et al.* 1997).

As a consequence of the forestation process under the gentle, rainy climate a significant soil development process had started, as a result of which a thin, humic loessy layer, a weakly developed soil, the upper humic layer of the Dunaújváros-

Tápiósüly loess-complex was formulated (HAHN 1977; PÉCSI 1975, 1993). On the basis of the Tápiósüly profile the age of this weakly developed soil layer is around 16,000-17,000 years, thus it is identical with the development of the Punctum pygmaeum - Vestia turgida zonula.

The vertebrate fauna of the Ságvár-Lascaux interstadial is known - with a few exceptions - by findings from culture layers, thus it is highly selected. A relatively large number of reindeer remains were found from several colonies. There is probably a correlation between the migrating direction of reindeers and the sites of colonization (STURDY 1975; VÖRÖS 1982). The distribution of Gravettian sites of Ságvár stage (GÁBORI & GÁBORI-CSÁNK 1957; DOBOSI 1993, 1994; DOBOSI & VÖRÖS 1987a, 1987b; DOBOSI *et al.* 1988) indicate that a very important palaeoecological condition developed in the Carpathian Basin during the last period of Upper Weichselian, because human population of the analysed region hunted mainly the highly mobile reindeers and wild horses (STURDY 1975; VÖRÖS 1982). And during the Upper Pleistocene the peripheric southern boundaries of the reindeer distribution was in the southern part of the Carpathian Basin (VÖRÖS 1982). Based on macromammalian analyses of Upper Palaeolithic sites of the analysed region (VÖRÖS 1982) the reindeer herds spent the winter time in the Carpathian Basin, mainly its Transdanubian part. The palaeobotanical and malacological data of this region suggested that the areas were covered by taiga spots and open coniferous forest within pathes of steppe during the microinterstadial periods of Ságvár stage and within the coniferous forest there were also pockets of deciduous trees (STIEBER 1967; WILLIS et al 1995, 1997; SÜMEGI 1996; RUDNER *et al.* 1997). The nearest modern day analogue to this type of community can be seen at the southern edge of European boreal forest (SHUGART *et al.* 1992).

It is therefore suggested that a special open taiga environment, which was last aim of the reindeer herds migration, developed in the Carpathian Basin during the microinterstadial time of Ságvár stage. The similar modern analogue to this type of reindeer migration can be seen between taiga and tundra zones in North America and northern part of Euroasia where the reindeer herds live in tundra during the summer time and these herds start migrating to the taiga zone when the summer season closes. The reindeer herds spend the winter season in the taiga zone, and they start migrating back to the tundra zone when winter season closes.

Based on the distribution of the archaeological findspots and palaeozoological, palaeobotanical and quartermalacological data there seems to be a relationship among the Upper Palaeolithic sites and the reindeer migration paths and the palaeoecological-palaeovegetation condition of the Carpathian Basin and Central Europe during the last phase of Upper Weichselian. Probably, the Upper Palaeolithic hunters were following herds of reindeer as they moved from the winter (ancient taiga) grounds on the Carpathian Basin to summer (ancient tundra) ranges on the uplands of the Alps, the Carpathians and the Bohemian Basin and the German-Poland Plain during the Ságvár-Lascaux interstadial time and vica versa. Thus the Upper Palaeolithic hunters practiced a game animal herd following economy (VÖRÖS 1982) whose base was a cyclic herd migration between the Upper Weichselian tundra-taiga areas.

Based on malacological data one can state that prior to the 18,000 BP years there was a warmer, but drier climatic phase (KROLOPP *et al.* 1995), and after 16,000 BP a colder and drier period came (SÜMEGI *et al.* 1991). The clarification of their stratigrafical and palaeoecological aspects, and the quartermalacological study of the classic Ságvár site will be a task of future research projects.

Acknowledgements

We would like to thank E. Hertelendi for radiocarbon dating. This research was supported by OTKA (T. 025 043).

BIBLIOGRAPHY

BANNER J. 1936. Az első alföldi paleolit lelet. (Der erste Paläolithfund in der ungarischen Tiefebene.) *Dolgozatok a Magyar Királyi Ferenc József Tudományegyetem Archeológiai Intézetéből*, 12, p. 1-13.

DOBOSI V. 1967. Új felsőpaleolit telep az Alföldön. (A recent Upper Palaeolithic Settlement in the Great Hungarian Plain.) *Archeológiai Értesítő*, 94, p. 184-193.

DOBOSI V. 1989. Felső-paleolit telep Madaras-téglavetőben, régészeti feldolgozás. (Jungpaläolithische Siedlung in Madaras Téglavető.) *Cumania*, 11, p. 45-58.

DOBOSI, V. 1993. Jászfelsőszentgyörgy-Szúnyogos, Upper Palaeolithic locality. *Tisicum*, 8, p. 41-53.

DOBOSI, V. 1994. Contribution to the Upper Palaeolithic Topography. *Acta Archaeologica Hungarica*, 46, p. 3-20.

DOBOSI, V. & VÖRÖS, I. 1987a. Chronological revision of the Pilisszántó-Rock-shelter II. *Folia Archaeologica*, 37, p. 25-45.

DOBOSI, V. & VÖRÖS, I. 1987b. Chronological revision of the Pilisszántó-Rock-shelter I. *Folia Archaeologica*, 38, p. 7-64.

DOBOSI, V., JUNGBERT, B., RINGER, Á. & VÖRÖS, I. 1988. Palaeolithic Settlement in Nadap. *Folia Archaeologica*, 39, p. 13-39.

DOBOSI, V., VÖRÖS, I., KROLOPP, E., SZABÓ, J., RINGER, Á. & SCHWEITZER, F. 1983. Upper Palaeolithic Settlement in Pilismarót-Pálrét. *Acta Archaeologica Hungarica*, 35, p. 288-311.

GÁBORI, M. 1965. Der zweite paläolithische Hausgrundriss von Ságvár. *Acta Archaeologica Hungarica*, 17, p. 111-127.

GÁBORI, M. 1969. Paläolithische Schnekkendepots von Szob. *Acta Archaeologica Hungarica*, 29, p. 3-11.

GÁBORI, M. & GÁBORI-CSÁNK, V. 1957. Études archéologiques et stratigraphiques dans les stations de loess paléolithiques de Hongrie. *Acta Archaeologica Hungarica*, 8, p. 3-116.

GÁBORI-CSÁNK, V. 1978. Une oscillation climatique à la fin du Würm en Hongrie. *Acta Archaeologica Hungarica*, 30, p. 3-11.

GÁBORI-CSÁNK V. 1984. A felső paleolitikum nyoma Budapesten. (The prints of Upper Palaeolithic in Budapest.) *Budapest Régiségei*, 25, p. 7-14.

HAHN GY. 1977. A magyarországi löszök litológiája, genetikája, geomorfológiai és kronológiai tagolása. (Lithological, genetical, geomorphological and chronological subdivision of the Hungarian loesses.) *Földrajzi Értesítő*, 26, p. 1-28.

HERTELENDI, E., SÜMEGI, P. & SZÖŐR, GY. 1992. Geochronologic and palaeoclimatic characterization of Quaternary sediments in the Great Hungarian Plain. *Radiocarbon*, 34, p. 833-839.

HERTELENDI, E., CSONGOR, É., ZÁBORSZKY, L., MOLNÁR, I., GÁL, I., GYŐRFFY, M. & NAGY, S. 1989. Counting system for high precision C-14 dating. *Radiocarbon*, 32, p. 399-408.

KROLOPP, E. 1991. Malacological analysis of the loess from the archaeological site at Esztergom-Gyurgyalag. *Acta Archaeologica Hungarica*, 43, p. 257-259.

KROLOPP, E. & SÜMEGI, P. 1990. Vorkommen von *Vestia turgida* (Rossmässler, 1836) in den pleistozänen Sedimenten Ungarns. *Soosiana*, 18, p. 5-10.

KROLOPP, E. & SÜMEGI, P. 1991. Dominancia level of the species *Punctum*

pygmaeum (Draparnaud, 1801): a biostratigraphical and paleoecological key level for the Hungarian loess sediments of the Upper Würm. *Soosiana*, 19, p. 17-23.

KROLOPP, E. & SÜMEGI, P. 1995. Palaeoecological reconstruction of the Late Pleistocene, based on Loess Malacofauna in Hungary. *GeoJournal*, 36, p. 213-222.

KROLOPP, E., SÜMEGI, P., KUTI, L., HERTELENDI E. & KORDOS, L. 1995. Szeged környéki löszképződmények keletkezésének paleoökológiai rekonstrukciója. (Palaeoecological reconstruction of formation of the Szeged-Öthalom area loess formations.) *Földtani Közlöny*, 125, p. 309-361.

PÉCSI, M. 1975. Lithostratigraphical subdivision of the loess sequences in Hungary. *Földrajzi Közlemények*, 23, p. 228-239.

PÉCSI M. 1993. *Negyedkor és löszkutatás.* (Quaternary an Loess Research.) Akadémiai Kiadó, Budapest. p. 375.

RUDNER, E., BABOS, K. & SÜMEGI, P. 1997. Modelling of climatic change by wood anatomy and quartermalacology at Upper Pleniglacial/Interpleniglacial transition in Hungary. *Proceeding of 2nd European Paleontological Congress*, Vienna (in press)

SHUGART, H., LEEMANS, R. & BONAN, G.B. 1992. *A Systems Analysis of the Global Boreal Forest.* Cambridge University Press, Cambridge, p. 543.

SÜMEGI P. 1989. *A Hajdúság felsőpleisztocén fejlődéstörténete finomrétegtani (őslénytani, üledékföldtani, geokémiai) vizsgálatok alapján.* [Upper Pleistocene geohistory of Hajdúság based on fine-startigraphical (palaeontological, sedimentological, geochemical) investigation.] Dr. Univ. Thesis, Kossuth University, Debrecen, p. 96.

SÜMEGI, P. 1995. Quartermalacological analysis of Late Pleistocene Loess Sediments of the Great Hungarian Plain. *Malacological Newsletter*, Suppl. 1. p. 79-111.

SÜMEGI P. 1997. *Az ÉK-magyarországi löszterületek összehasonlító paleoökológiai és sztratigráfiai értékelése.* (Comparative Palaeoecological and Stratigraphical Valuation of NE Hungarian loess areas.) PhD Thesis, Kossuth University, Debrecen, p. 120.

SÜMEGI, P. & KROLOPP, E. 1995. A magyarországi würm korú löszök képződésének paleoökológiai rekonstrukciója Mollusca-fauna alapján. (Reconstruction of palaeoecological conditions during the deposition of Würm loess formations of Hungary, based on molluscs.) *Földtani Közlöny*, 124, p. 125-148.

SÜMEGI, P., SZÖŐR, GY. & HERTELENDI, E. 1991. Palaeoenvironmental reconstruction of the last period of the Upper Würm in Hungary, based on malacological and radiocarbon data. *Soosiana*, 19, p. 5-12.

SÜMEGI P., LÓKI J., HERTELENDI E. & SZÖŐR GY. 1992. A tiszaalpári magaspart rétegsorának szedimentológiai és sztratigráfiai elemzése. (The sedimentological and stratigraphical analyses of the high bluff sequence at Tiszaalpár.) *Alföldi Tanulmányok*, 14, p. 75-87.

STIEBER J. 1967. A magyarországi felsőpleisztocén vegetációtörténete az anthrakotómiai eredmények (1957-ig) tükrében. (Oberpleistozäne Vegetationsgeschichte Ungarns im Spiegel anthrakotomischer Ergebnisse (bis 1957). *Földtani Közlöny*, 97, p. 308-316.

STURDY, D.A. 1975. Some Reindeer economies in Prehistoric Europe. *In: Palaeoeconomy.* Cambridge University Press, Cambridge, p. 55-95.

VÖRÖS, I. 1982. Faunal remains from the Gravettian reindeer Hunters' campsite at Ságvár. *Folia Archaeologica*, 33, p. 43-69.

WILLIS, K.J., SÜMEGI, P., BRAUN, M. & TÓTH, A. 1995. The Late Quaternary Environmental History of Bátorliget,

NE Hungary. *Palaeoclimatology, Palaeoecology, Palaeogeography*, 118, p. 25-47.

WILLIS, K.J., SÜMEGI, P., BRAUN, M. & TÓTH, A. 1997. Does soil change cause vegetation change or vice versa ? A temporal perspective from N Hungary. *Ecology*, 78, p. 740-750.

Table 1. The chronological, palaeoclimatological, archaeological and palaeontological data from *Vestia turgida - Punctum pygmaeum* zonula.

Location	Deep (m)	Radiocarbon data (BP)	July palaeotemperature (°C)	Dominance of *Punctum pygmaeum* (%)	Vertebrata remains	Archeological data	*Vestia turgida*
Pilismarót-Pálrét	0.6 -1.2	16,000 ± 200	16.0	16,4	+	+	+
Esztergom-Gyurgyalag	1.2-1.5	16,160 ± 300	14.0	17.9	+	+	+
Budapest-Csillaghegy	1.7-2.0	15,935 ± 142	15.6	+	+	+	+
Györköny-brickyard	1.2-3.2	-	16.0	10.7	-	-	-
Kölesd-brickyard	2.0-3.0	-	16.4	22.6	-	-	-
Bátaszék-brickyard	1.0-2.5	-	15.7	25.6	-	-	-
Mohács-birckyard	0.5-2.5	-	15.3	9.5	-	-	-
Dunaszekcső-brickyard	0.5-5.0	-	15.5	20.4	-	-	-
Kecel-birckyard	2.75-4.0	-	15.8	22.0	-	-	-
Mindszent-brickyard	0.5-1.25	-	14.2	11.6	+	-	-
Szentes-brickyard	2.0-2.75	-	15.7	13.4	-	-	-
Nemesnádudvar-brickyard	0.5-1.5	-	15.9	51.5	-	-	-
Lakitelek-brickyard	2.2-2.4	16,820 ± 200	16.2	9.6	-	-	-
Tiszaalpár-sandpit	3.75-4.0	17,860 ± 350	16.5	25.2	-	-	-
Madaras-brickyard	4.0-6.0	18,080 ± 405*	15.7	47.3	+	+	-
Szeged-Öthalom 1935	4.3-4.6	15,956 ± 168**	-	+	+	+	+
Szeged-Öthalom I 1995	1.0-2.75	16,000 ± 200 16,080 ± 150 16,323 ± 145	16.8	24.2	+	-	+
Szeged-Öthalom II 1995	1.5-4.0	15,890 ± 100 16,530 ± 200 18,080 ± 200	16.2	19.3	-	-	+
Bodrogkeresztúr, brickyard I	1.75-2.0	16,850 ± 200	15.1	16.0	-	-	+
Bodrogkeresztúr, brickyard II	2.75-3.25	17,680 ± 200	15.9	4.25	-	-	+
Tokaj, Kereszt-mount I	1.0-1.5	17,619± 170	15.6	10.4	-	-	+
Tokaj, Kereszt-mount II	1.5-2.0	-	15.1	10.7	-	-	+
Tokaj, Csorgókút- valley I	0.5-1.0	17,213 ± 162	15.1	3.0	-	-	+
Tokaj, Csorgókút-valley II	0.75-1.0	17,504 ± 106	15.7	36.0	-	-	+
Tokaj, Patkó-mine	2.25-2.5	16,322 ± 162	14.0	+	-	-	+

* Radiocarbon data from the bedding loess layer of *Punctum pygmaeum* dominance level.

** A mammoth bone from archeological excavation in 1935. It was analysed by ^{14}C method in 1995.

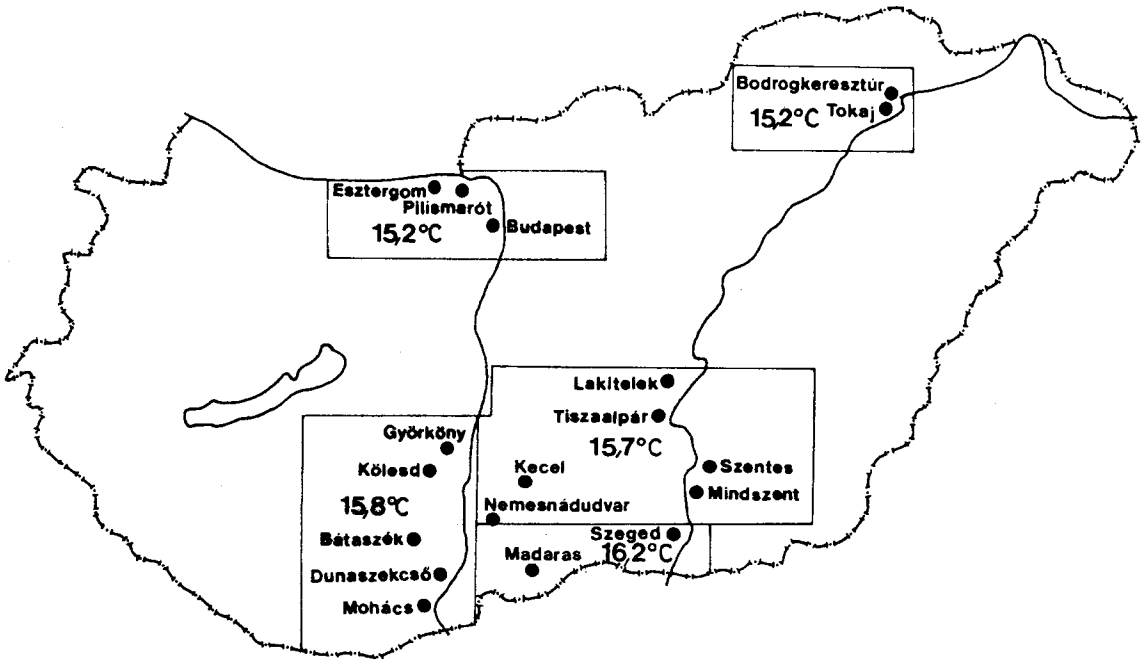

Fig. 1. The main quartermalacological loess-profiles in Hungary and the palaeoclimatological condition of Ságvár-Lascaux interstadial.