Contribution to the alluvial development of the Tarna Gap in the environs of Istenmezeje

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Summary

A Ceredi-Tarna áttöréses völgyszakasza Istenmezeje térségében egy jelenleg feltöltődő, talpas völgy; ahol a pleisztocén alluvium vastagsága 50-60 méter. A vizsgálatok a legfelső 6 méteres, az emberi tevékenységet leginkább meghatározó rétegére terjedtek ki. Fúrásminták alapján elemeztük az üledék szemcseösszetételét, kémiai jellemzőit, pollentartalmát. Megállapítottuk, hogy az aprószemű homok az uralkodó frakció, egyes rétegekben viszont jelentősen megnő az agyag és az iszapfrakció aránya. Ezen rétegek jelentős pollentartalma alapján tavi-mocsári őskörnyezet rekonstruálható, a legalsó sáv 3000-4000 éves lehet. A völgy szakaszosan töltődött fel.

Intoduction

The Ceredi-Tarna breaks through the Oligocene-Miocene sandstone rocks of the Heves-Borsod Hills and the Upper Tarna-Zagyva Interhills with an approximately north-south 12 kilometre long 200-500 metres wide valley connecting the Zabar embayment (in the north) and the Pétervására basin (in the south) (Figure 1). The settlement of Istenmezeje is situated in the central part of this valley. Short (maximum few kilometres) side valleys meet the rapidly filling floored main valley between the alluvial fans among which the Tarna River used to meander. At some places dead water lacustrine state developed in the barrier depressions between the alluvial fans and directly along the brook which periodically filled up in the function of the discharge fluctuations caused by the captures in the upper course of the Tarna River (Utasi, Z.). For a long time, the houses of the village occupied only those higher parts of the valley which lean against the hillsides. The marshes of the central parts were drained and filled up only during the water management which was started in the forties and the new bed of the Tarna River was also created at that time. The new bed was straight, roughly following the centre line of the valley and was much deeper than the original one (2-3 metres deep).

Samples were taken from several points on the artificially filled and built-up – formerly barrier marshy area – in the central part of the village for analysing the granular composition of the alluvium, for clarifying the course, pace and possibly the genesis of the deposition of the alluvium and for finding out the impact of the side-valleys on the development of the Tarna valley. The thickness of the Pleistocene sediments, which settled directly over the Oligocene-Miocene sandstone, is 50-60 metres in the centre line of the valley. The six metres deep upper layer had been examined which has a direct influence on human activities (building depth, water basis, etc.). The samples of those two boreholes proved to be the most appropriate for our study which were drilled 110 metres away from each other on the southern edge of the alluvial fan of the Kócsos valley: Borehole 1 – 20 metres away from the Tarna River; Borehole 2 – 130 metres away from the Tarna River (roughly halfway between the brook and the side of the valley) (Figure 1).

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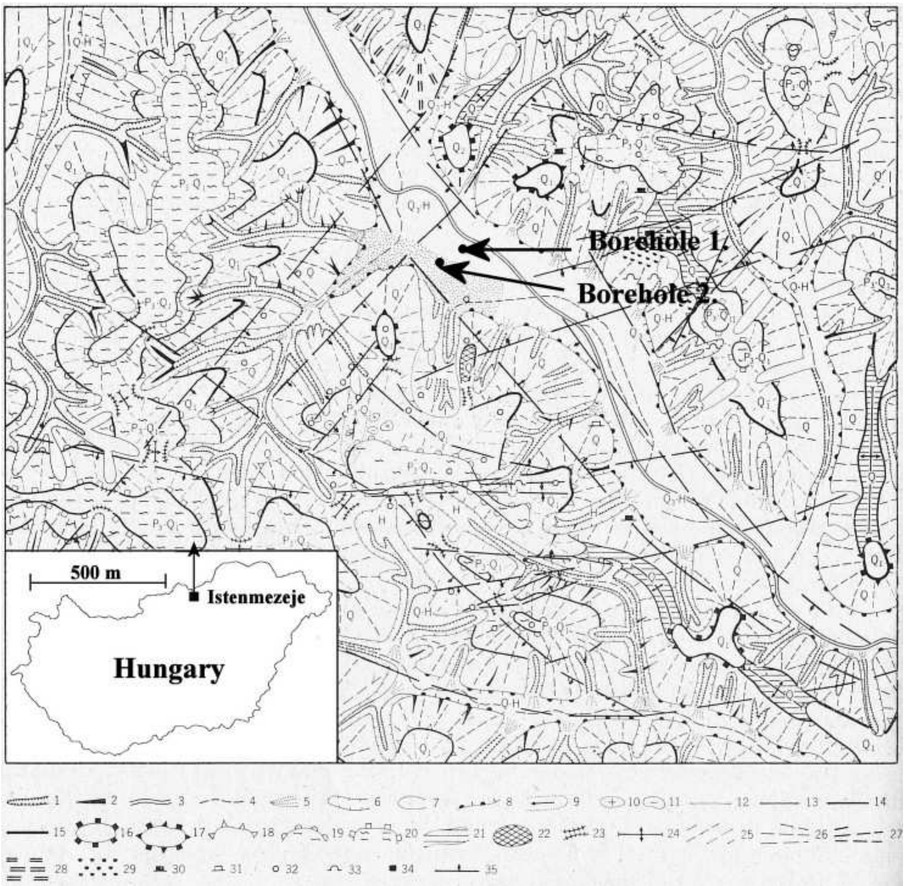

Figure 1.: Gap valley of the Tarna River in the environs of Istenmezeje (Hahn., Gy.1964.)

(1. Erosion ravine, 2. Smaller erosion gully, 3. Erosion groove, 4. Intermittent stream, 5. Alluvial fan, 6. Erosion-derasion valley, 7. Derasion valley, depression, dish, alcove, 8. Erosion broaden valley, 9. Infilled dead valley, 10. Small uplift on a denuded terrain, 11. Small depression on a denuded terrain, 12. <20 m, 13. 20-50m, 14. 50-100m, 15. >100m ground surface difference, 16. Surface and edge of terrace, 17. Edge and surface of an erosion and derasion inselberg, 18. Surface and edge of the lowest mountain escarpment, 19. Surface and edge of the middle mountain escarpment, 20. Surface and edge of the uppermost mountain escarpment, 21. Erosion-derasion interfluve, 22. Derasion inselberg, 23. Erosion-derasion saddle, 24. Watershed, 25. Erosion-derasion retrograding valleys up to 15˚, 26. Erosion-derasion retrograding valleys 15-30˚, 27. Erosion-derasion retrograding valleys over 30˚, 28. Erosion-derasion stable valleys over 30˚, 29. Slope with landslides and slumps, 30. Locale of opening a new mine, 31. Offered new mine, 32. Bore, 33. Drift gallery, 34. Shaft, 35. Fracture, P_3-Q = Upper Pliocene, Lower Pleistocene surface, Q1 = Lower Pleistocene surface, Q_2 = Middle Pleistocene surface, Q_3 = Upper Pleistocene surface, Q3-H = Upper Pleistocene and Holocene surface)

Applied methods

The samples were taken with the help of an Eikelkamp drill at every 10-20 cm. At the depth of 580-600 cm, the drill reached the level from which no more samples could be taken with it. The samples of Borehole 1 and Borehole 2 were analysed for granular composition, humus content and carbonated lime concentration. The drill traversed through darker and more cohesive layers with higher humus content in many layers of the sandy and clayey sediments having variegated structures. The macroscopic plant residues found in these layers were not sufficient for radiocarbon dating but were suitable for microscopic analysis and thus pollen analysis was accomplished.

The granular composition was determined with the application of the settling method (Kőhn-pipette method). The approved Zólyomi-Erdtman zinc-chloride acetolysis measure was followed by the determination of the pollen grains by microscope (magnified four hundred times). The results were processed with the Tilia palynology software.

Results

Physical characteristics of the sediments

The dominant fraction in the granular composition of the sediments is the fine-grained sand (0.2-0.1 mm) with its 30-40% share on average. The dominance of this range characterises the loose Pliocene sediment with varying thickness covering the Oligocene-Miocene glauconitic sandstone. These are also known from the former sand-pits along the Upper Tarna (Zabar, Pétervására). This means that the material filling up the Tarna valley had been transported for a relatively short period of time.

The same rhythms and differences in the alluviation resulting from the (former) relief are detectable when comparing the samples of the two boreholes. (Figure 2.)

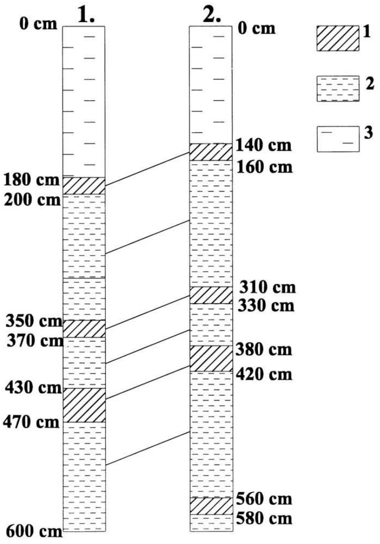

Figure 2. Main layers of the alluvium
(1. Grey clayey sand, 2. Sand, 3. Anthopogenic landfill)

The surfaces of the two sample-taking places are approximately on the same level due to an anthropogenic impact: namely that following the regulation of the Tarna River (1940s-60s) the marshes were filled up with a 1-2 m thick layer in the early seventies to gain more building sites. The material of the anthropogenic landfill was sand in which the fine-grained fraction dominated. The lower lying layers may be compared on the basis of the grey clayey zones. In both boreholes, the original surface is marked by a 20-30 cm thick grey clayey layer poor in plant residues: Borehole 1 – at 180 cm; Borehole 2 – at 140 cm. An approximately 180 cm thick sand layer accumulated below this layer. The upper 60-80 cm is a very loose homogeneous light yellow sand layer with high moisture content which contains a considerable amount of relatively intact plant residues (wooden plant pieces, root residues, leaves). The instability of the layer is well marked by those documented events which state that the well-caissons of the wells reaching these layers disappeared in the seventies, and laterally drifted into the depth.

The remaining 120 cm is more stabile and contains thin layers of quartz pebbles (Ø 1-2 mm) and the precipitation of ferrous compounds may be detected in red patches in some of the levels. The second grey clayey sand layers appear at 360 cm in Borehole 1 and at 320 cm in Borehole 2; their thickness is 40-60 cm and they are strongly cemented. The second grey clayey layer is poor in macroscopic plant residues. The layer below it – again – is a looser grey one rich in plant residues with thin gravel layers.

The third grey clayey-muddy sand layer appears at 430 cm and 380 cm respectively – comprising of a high amount of plant residues.

At the depth of 500 cm, the ratio of the mud and clay fractions decreases to a minimum in both samples. The ratio of the middle-sized grains increases besides the almost unchanging ratio of the fine-grained sand which designates a rapid fluvial fill. (Figure 3. and 4.)

Chemical characteristics of the sediments

The above explained rhythm is reflected in the chemical characteristics of the borehole samples, too. The $CaCO_3$-content shows a rather hectic picture varying between 2 and 5% and its value increases with 1-2% in the zone above the clay layers. The humus content, however, correlates with the granular composition: its average value is 0.1-0.5% reaching 2-4% in the grey fine-grained zones. Its pH value varies between 6.7 and 8 – showing no correlation with the granular composition.

Pollen analysis

Out of the two boreholes, Borehole 1 contained sufficient pollen for analysis in the lowermost muddy layer below 450 cm. (Figure 3.) The samples of Borehole 2 were basically sterile in pollen. Some pollen grains were found in the grey muddy sediment which confirmed the pollen composition of Borehole 1 (Figure 4.). No pollen may be found in the pollen sterile samples namely if the alluvium dries up or the wet, waterlogged area serving as a trap becomes a marsh and the pollen grains getting into the sediment oxidise. It does not either contain pollen if the area frequently gets fresh alluvium.

The diagram on the granular composition demonstrating the alluviation of the studied area clearly shows that the waterlogged area serving as a pollen trap might have received larger amounts of coarser sediments from time to time and the undisturbed slow fine-grained alluviation – which may have derived from a natural lacustrine devastation and fill – occasionally stopped.

The dominant tree species is the alder (Alnus) while there are some linden (Tilia), oak (Quercus), hornbeam (Carpinus) and beech (Fagus). The non-arboreal are represented by sedge (Carex), iris (Iris) and bramble (Rubus). This composition is the characteristic of the alder grove association. They are the elements of low flood plain woods along rivers. The Myrophyllum and the Pediastrum denote lacustrine state which occurs in the lower layers at 560 cm, while there are signs of devastation of the lake at 450 cm since the reed and the bulrush (Typha) appear. Then the lacustrine state disappears because a larger amount of coarser sediment got into the lake. It changed the water supply conditions and the alder wood died out. A drier period set in whose sediment was not suitable for keeping the pollens. The area might have received fresh water periodically from the Tarna River which led to a paludal state in which the pollens could not be conserved but other organic remnants and vegetable tissues survived.

The levels of the two borehole samples may be joined not only by their granular composition but also on the basis of their pollen content. The time of the formation of the lake reconstructed on the basis of the third mud layer cannot be determined exactly. Judging from plant residues, it cannot be older than 3000-4000 years. The upper grey layers, however, suggest the presence of paludal state. The natural landfill was not equable. The alluviation had slower phases when the organic matter accumulated and the fine-grained sediment mostly consisted of mud and clay. During the more rapid accumulation, the ratio of the fine- and medium-grained sand increased which is the characteristic feature of fluvial floods. The reason for this may be partly searched for in the changeability of the climate. The ferrous gley patches in the sand mark the fluctuation of the groundwater level showing that the float of the groundwater level was approximately 2 m in accordance with the regime of the Tarna River.

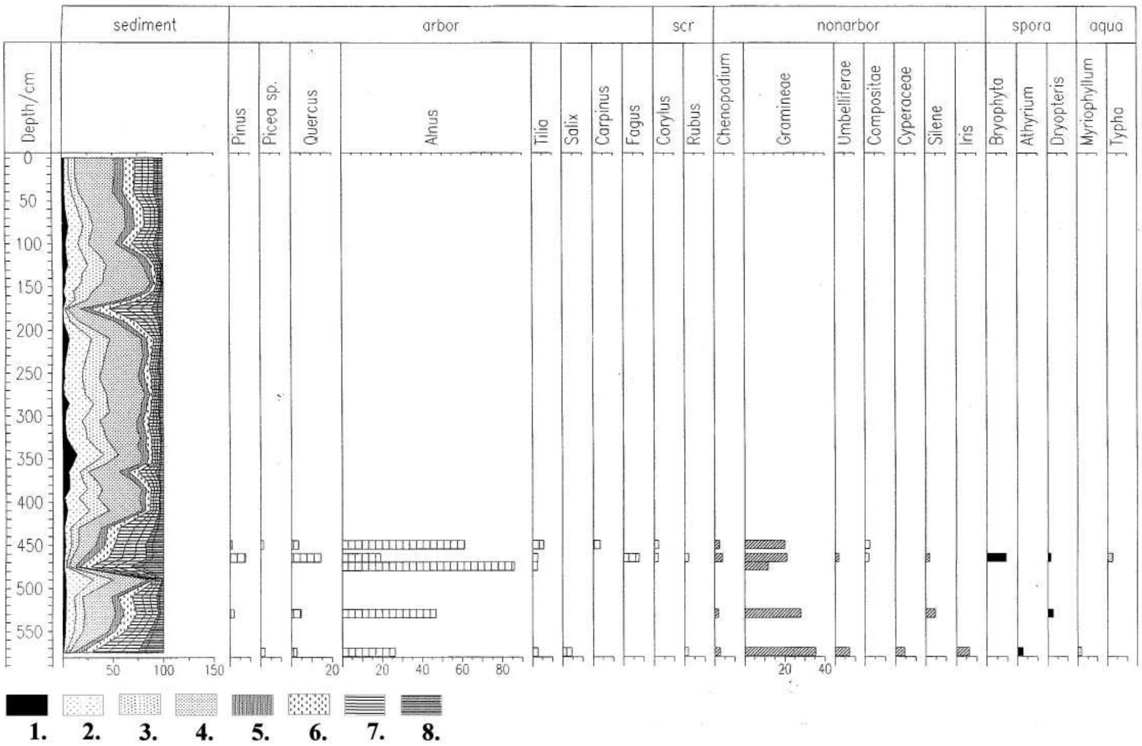

Figure 3.: Granular composition and palynology diagram of Borehole 1

(Ø Size: 1. = 4-1 mm, 2. = 1-0.63 mm, 3. = 0.63-0.2 mm, 4. = 0.2-0.1 mm, 5. = 0.1-0.05 mm, 6. = 0.05-0.02 mm, 7. = 0.02-0.00. mm, 8. =<0.002 mm)

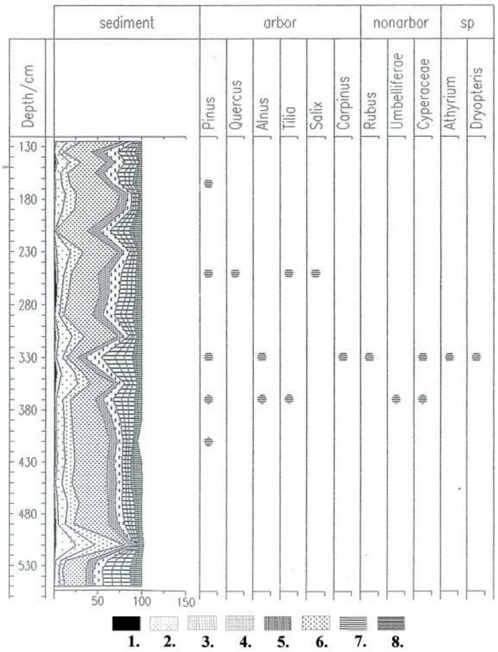

Figure 4.: Granular composition and palynology diagram of Borehole 2

(Ø Size: 1. = 4-1 mm, 2. = 1-0.63 mm, 3. = 0.63-0.2 mm, 4. = 0.2-0.1 mm, 5. = 0.1-0.05 mm, 6. = 0.05-0.02 mm, 7. = 0.02-0.00. mm, 8. =<0.002 mm)

Conclusions

The geomorphological characteristics of the gap valley of the Tarna River in the environs of Istenmezeje projected the image of a rapidly filling floored valley. It was also confirmed by the sedimentary examinations. In the past 3000-4000 years the sedimentation was 3-4 m on average which process was periodical: the lacustrine and dead water periods were followed by sharply differing rapid alluviations leaving behind sediments with varying compositions and consistencies. In the past 70 years this part of the valley had faced considerable anthropogenic influence. A number of new – and at present built-up – building sites were gained as a consequence of the artificial filling-up while cutting deeper the bed of the Tarna River led to a change in the groundwater balance. Nevertheless, this may be accompanied by dangers: the stability of the deposited sediments in the rapid alluviation periods is low and the change in the water balance also increases the lability.

References

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