Geophysical Research Abstracts, Vol. 7, 10294, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10294

The effect of the recent differential vertical movements on the course of Cinca-Csíkgát Creek, Hungary – a case study

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Introduction

Southeast of the Transdanubian Range, Hungary between the Lake Balaton and Lake Velencei, parallel to the Mid-Hungarian Shear Zone and to the Balaton line several Paleozoic formations crop out among the Late Miocene (Pannonian) and Quaternary sediments. The elevation of the terrain is between 100 to 300 meters a.s.l. The landscape is dominated by the gentle hilly forms mixed with characteristic NNW-SSE oriented elongated, incised valleys. The incised valley density is low in comparison to the surrounding hilly area, e.g., the Velence Hills or Somogy Hills. The area is bordered by Lake Balaton and the Lake Velencei west and east respectively, but in the north and in the south there are also extended flat-lying areas at the very same elevation (ca. 110 m a.s.l.), though there is no major lake in these depressions. The eventual course of the valleys is SSW, dewatering the area into the main trunk channel of the Pannonian basin, the River Danube. Smaller creeks of the eastern side of the area are dewatered to the Sárvíz, a very straight watercourse having a tectonically preformed wide alluvial valley. The clayey and partly sandy material, mostly of Miocene (Pannonian, 6-8Ma) age dominating the geological setting of the topmost layer mixed with Pleistocene loess provide fine-grained sediment discharge filling the valleys partly with mud (Sárvíz = muddy water).

In contrast to this relatively uniform drainage network, in the southern part of the hilly landscape where it is bordered by a small flat-lying basin, the Cinca-Csíkgát Creek show interesting and somewhat surprising geomorphic and hydrologic properties.

The watercourse of the Cinca-Csíkgát Creek and its catchment

The area of the Cinca-Csíkgát catchment is situated east of Lake Balaton, next to the so-called Balatonfő region. The size of the parallelogram-shaped catchment is approximately 270 km^2. At its NW corner the locality of Berhida, the epicentre of a significant earthquake in 1985 can be found. The increased seismicity is confined into a N-S directed elongated area, the so-called Berhida line. The longer sides of the area are 18 km long in NNW-SSE direction while the shorter, 15 km long sides are EW-directed. The hilly landscape of the catchment is dominantly composed of Pannonian sand and subordinately gravel, but there are some outcrops of the Paleozoic basement. In the central part of the catchment, the phyllites of Balatonfőkajár, NE of it the Paleozoic conglomerate of Füle and at the NE corner of the catchment Mesozoic limestone of Polgárdi can be found. The western part of the watershed is the Kenese plateau (on the opposite side of the plateau is Lake Balaton), in northern side there are valley divides to the tributaries of Veszprémi Séd river, in the eastern direction an elevated plateau, and in southern direction there are also valley divides in somewhat elevated position.

The Cinca-Csíkgát creek is the trunk stream of this small basin. It originates in the NE corner of the catchment, and flows in SSE direction, parallel to the watershed. After 10 km, it turns to southwest. On this run the creek takes tributaries from SSE and NNW direction. This section of the creek is now partly canalized. The creek crosses the locality of Lepsény with a meandering course. The flattest and lowest part of the whole water catchment is north of this village. Surprisingly, the creek reaches this flat after crossing the elevated terrain at the village.

On the lowest part of the basin the creek takes further tributaries from NNE and N direction, and the whole area was originally a moor. (The construction of the motorway M7 somewhat changed the water table: local people report, that as late as in the 1920s one could swim in the creek, what nowadays is not possible because of the shallow, somewhat muddy water.)

The outflow of the basin is in southern direction, near the SW corner of the catchment. Since the exit point of the basin is in elevated position forming a barrier, the outflow is sort of a small, somewhat incised “gorge”. Of course, since the bedrock of the creek is sand and clay, the walls of this gorge are not steep at all. The outflow is straight and about 1 km long, and after that, the gorge widens and the creek starts meandering though in incised position of at least 10-meter elevation difference. This sinuous section is about 2 km long and 400 meter wide. The section consists of four well-developed meanders. South of these meanders the valley is again more ore less straight.

Evaluation of the development catchment and its relation with vertical movements

In the following we outline a possible evolution of the Cinca-Csíkgát river course and catchment that has implications on the Late Quaternary/Holocene evolution of the area. We assume here, that the recently measurable differential vertical movements, derived from repeated precise leveling, are real processes exceeding the measuring error of this geodetic method.

The north and south divides of the Cinca-Csíkgát catchment are saddles in the valleys, and the upper part of the tributaries follows a NNW-SSW direction. This indicates a post-Pannonian valley system with the same orientation. This is a well known feature further to the SW, in the Somogy Hills, though none of the explanations of this very common direction in Transdanubia is satisfactory. (A comprehensive summary was provided by GERNER (1994).) The remnant of this river system can be observed as paleochannels on the Kenese plateau, at the western divide. It is important to underline, that the water divide between the Lake Balaton and the Cinca-Csíkgát catchments is situated very close to the Lake Balaton, where the elevated plateau has a significant, almost vertical wall, the so-called *Kenese-magaspart*. In consequence of these geomorphic features all four sides of the catchment are considerably elevated above the typical elevation (ca. 110 m a.s.l.) of the basin.

We interpret this behaviour in the following way: vertical uplift along an E-W axis could have caused that the valleys are divided into two subsystems: one with creeks flowing to north and the other with south-oriented flows.

A similar uplift at the southern edge of the catchment can be responsible for the split of the southern valleys. Probably this uplift was differential in time or in space, and this dammed the original course of Cinca in the SE corner of the catchment, and forced the creek to turn west, and to take other tributaries (also dammed by uplift). At the outflow the water discharge has been strong enough to compensate the effect of the uplift, thus deepened the "gorge".

River dynamics and differential uplift

The EW-directed axis of the suggested uplift in the "gorge" is probably near to the point where the planform of the creek changes from straight to meandering. A very similar interpretation was presented by TIMÁR (2003) at a straight-meandering planform change of the Tisza River, East Hungary. Here, like in the case of the River Tisza, though in smaller scale, the creek tried to compensate the effect of the uplift in the "gorge": the upper part straightened, and the lower part became meandering, to keep the slope angle constant. As the uplift continued, the meandering part deepened in the Pannonian sandy substrate, and the shape of meanders became fixed. Using the

estimation method of DURY (1976), the size of meanders indicate a much more humid climate, or a water catchment size in the order of 3000 km^2 which exceed by far the present catchment, but it is plausible, if we consider a major subrecent, Late Pleistocene/Holocene rearrangement of the drainage system.

Conclusions and outlook

The presented geomorphic model is at the moment a working hypothesis to explain the unexpected planform and course of the Cinca-Csíkgát. Since the outcrops of the Paleo-Mesozoic formations are more or less in-line with our assumed axis of differential vertical uplift, other preliminary geophysical data also support the presence of active faulting, the area is suitable for a further in-depth geomorphic, geophysical and sedimentary studies to decide if our working hypothesis can be verified or not.

The results of these studies are very important, because if we understand the development of catchment of Cinca-Csíkgát creek, these processes could answer a so far unanswered question, how Lake Balaton was formed. Lake Balaton also has valley divides (abandoned outflow channels) in south, and its present outflow – the Sió channel – forms also a similar "gorge".

Acknowledgements. This is a contribution of the Hungarian National Scientific Fund grants OTKA T047104 and TS 044765. These studies were carried out during BSz's Békésy György Postdoctoral Fellowship.

References

DURY, G. H. (1976): Discharge prediction, present and former, from channel dimensions. *J. Hydrol.* **30**, 219-245.

GERNER, P. (1994): Dél-Dunántúli tektonikai modellek a magyar földtani szakirodalom alapján. *Földtani Közlöny* **124**(3), 381-399.

TIMÁR, G. (2003): Controls of channel sinuosity changes: a case study of the Tisza River, the Great Hungarian Plain. *Quaternary Sci. Rev.* **22**, 2199-2207.