WATER UPRUSH ON THE BÉKÉS-CSANÁD LOESS PLATEAU

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Abstract: In the frame of one of our research programmes we have evaluated the formation of excess water caused by natural factors on Békés-Csanád Loess Plateau in Békés County of Hungary. Damage caused by excess waters can be occurred 1.6-1.8 million hectares in Hungary, from which 60% is located in the arable-land. According to *Pálfai* (*2000*) the area affected by inundation in every 5 years on the average is 300,000 hectares. The region of the Békés-Csanád Loess Plateau is a characteristic place of the Great Hungarian Plain showing examples of excess water formation by water uprush (so-called “under flooding”).
Keywords: excess water, groundwater, water uprush

GRUNDWASSERÜBERFLUTUNG AUF DEM LÖSS PLATEAU BÉKÉS-CSANÁD

Zusammenfassung: Im Rahmen von einem unseren Forshungsprogramme haben wir die durch natürlichen Faktoren verursachte Ausbildung der Grundwasserüberflutung auf dem Löss Plateau Békés-Csanád, in Bezirk Békés, in Ungarn ausgewertet. Überschusswasserschaden in Ungarn können in 1,6-1,8 Millionen Hektaren auftreten, aus denen 60% landwirtschaftliche Flächen sind. Nach Pálfai (2000) sei alle fünf Jahre durchschnittlich 300,000 ha grosses Gebiet durch Überflutung betroffen. Die Region des Löss Plateaus Békés-Csanád kann als Referenzgebiet der Grossen Ungarischen Tiefebene betrachtet werden, wo Beispiele der Binnengewässerformationen infolge des Grundwasseranstiegs vorkommen.
Schlüsselworte: Schusswasserschaden, Grundwasser, Überflutung

1. Introduction

The Great Hungarian Plain is the largest plain in Central Europe. It has continental climate, but it is also subject to Oceanic and Mediterranean effects. In Hungary more and more problems are caused by vicissitudes of weather mainly in the agriculture. Due to basin-bottom character, large drainless areas are covered in some wet years by excess waters. In these years it is originated from local precipitation and snow-melt (mainly in spring). Damage caused by excess waters can be occurred 1.6-1.8 million hectares in Hungary, from which 60% is located in the arable-land. According to Pálfai (2000) the area affected by inundation in every 5 years on the average is 300,000 hectares. The first scientific description of water uprush was published in 1861 by József Szabó, who concluded to the existence of a deeper flooding system from the examination of different water movements of the Száraz-rivulet and the surrounding wells. Later on, during the 20th century, several well-known hydrologists studied of the origin of water uprushes (Sümeghy, 1942, 1944; Pálfai, 1981, 1983, 1986; Kiss, 1990; Tóth, 2001) with different results.

The region of the Békés-Csanád Loess Plateau is a characteristic place of the Great Hungarian Plain showing examples of excess water formation by rush up water (so-called “under flooding”), which is due to rising of ground waters. From 2002 a research program[*] is being implemented at our institute dealing with the evaluation of excess water caused by natural factors on the southern part of the Great Hungarian Plain. The main aim of the research program was to study the relationship between uprush water and excess water. Attempts have also been made in identifying those areas where the local weather condition was dominating among the other natural factors and where the uprush water appeared.

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[*] The research program is supported by the Department of Water Management of the Ministry of Agriculture and Regional Development of Hungary.

2. Factors determining and influencing water uprush

We determined those constant and variable factors, which have created the conditions of groundwater rising and caused water uprushes. The constant factors are geological structure, soil conditions and dead river-beds, while the variable factors are hydro-meteorological circumstances and groundwater conditions.

2.1. Constant factors

Geological structure of the Carpathian Basin is unique in the world. The sediment development had gone on during several million years under various circumstances. The development of the basin had started with the upheaval of the Carpathian Mountains and with the sinking of the inner territories (Figure 1). During the geological ages, the sea sediment development had taken place first and later the lakebed placer (Rónai, 1956).

Figure 1. The Carpathian Basin

The sinking on the different sub-territories was not uniform, so the stratifications are different. The sea and lakebed sediment in some places are 2,000-6,000 m thick (Figure 2).

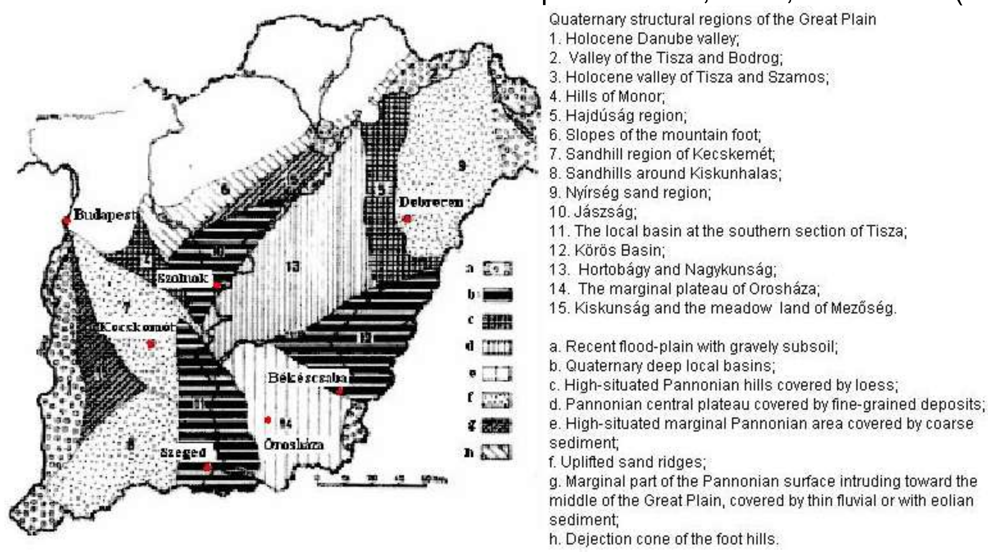

Figure 2. Geological structure

The proportion of good water carrying capacity of sand can reach 40-50%. The basin's filling up was finished by the ancestors of nowadays' rivers, especially by the River Maros (Sümeghy, 1954). On plain areas' rivers cannot keep their beds as they carry the alluvial deposit coming from mountains and hills, into the basin. If the river has enough energy - which depends on its water output and the difference between surfaces - it puts its alluvial deposit on the sides of its bed; if the river does not have enough energy then its own alluvial deposit creates temporary obstacle. That is how the alluvials are created and to the analogy of the rivers' sea mouth, called "continental delta". The Danube's alluvial in the Szigetköz is well known and morphologically the Maros is uniform in Romania and in the southern region of Békés County. From the point of view of the Southern Hungarian Plain the Maros is the most significant, its alluvial spreads from the pediment of the Transylvanian mountains to the Gádoros-Orosháza-Székkutas line (Mike, 1984; Figure 3).

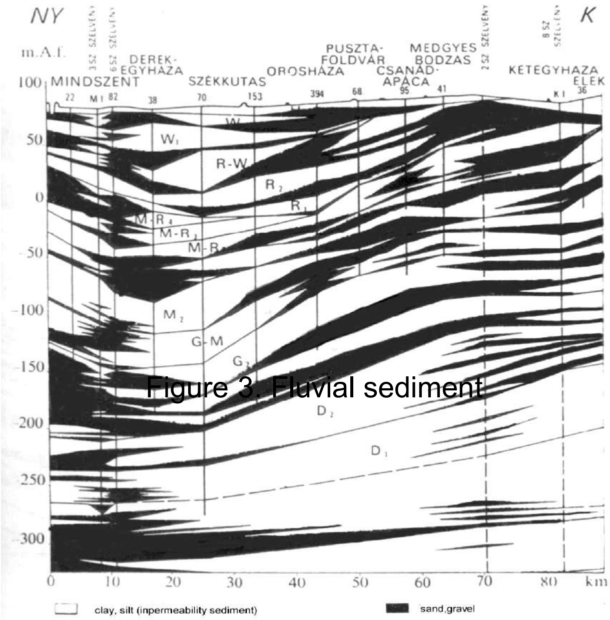

Figure 3. Fluvial sediment

The sediment of the alluvial from eastwards to southwards becomes finer. The rough-grained areas contain great amount of water. During the later movements of crusts, the different water bodies have established contact with each other and a regional system of waterflow - containing different local sub-systems - may have developed. The different systems can communicate with each other depending on the local hydro-geological factors (Tóth and Almási, 2001; Figure 4).

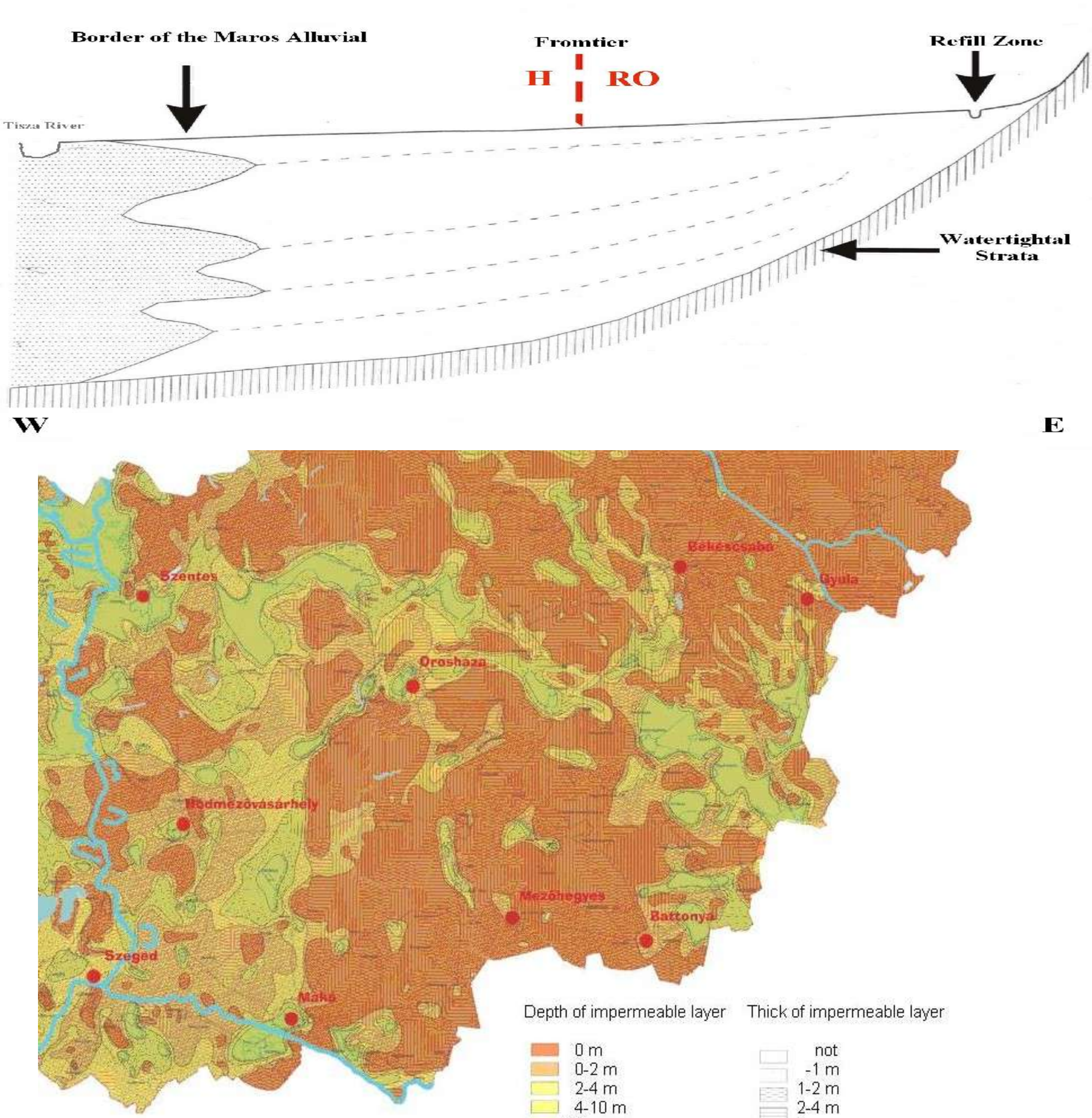

Figure 5. Position of the impermeable layer (Kuti and Müller, 2003)

The effects of dead river-beds are more important, because the water uprushes show similar appearances like a river (Figure 6).

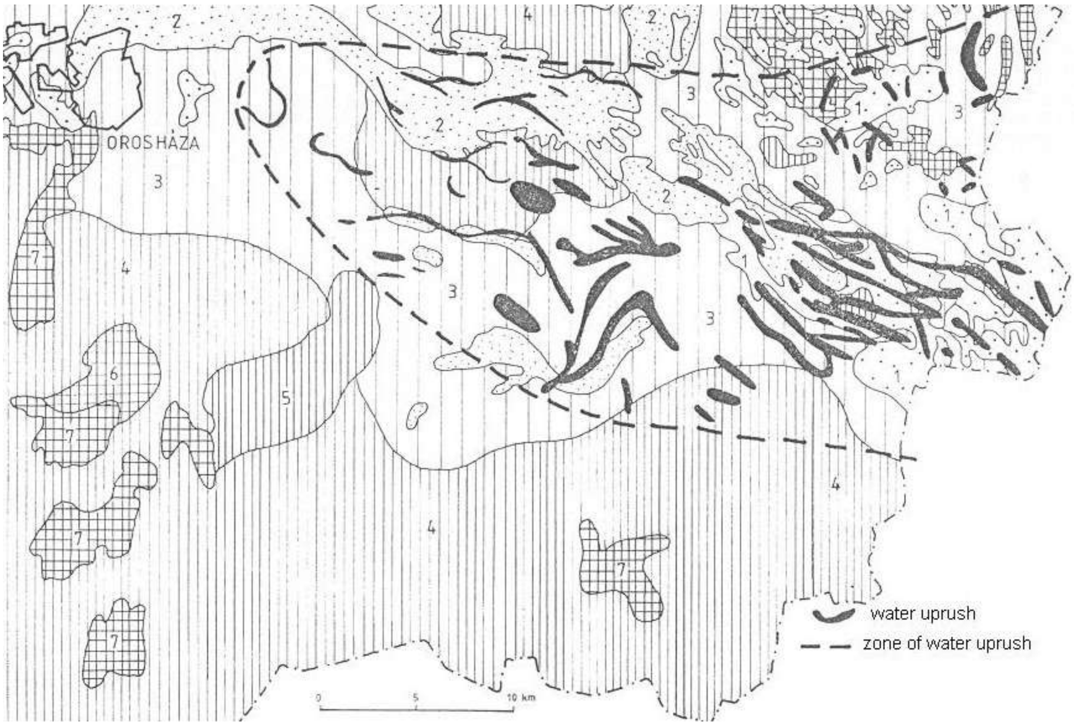

Figure 6. Water uprush on the debris cone of the Maros River in 1979 (Pálfai, 1986)

Numerous villages and towns of the studied region (Hunya, Nagykamarás, Kétegyháza, Elek, Kevermes, Orosháza and so on) are endangered by water uprushes. The main reason is that some villages settled on dead river-beds, which caused excess water damages mainly in spring (Figure 7).

Source: FÖMI

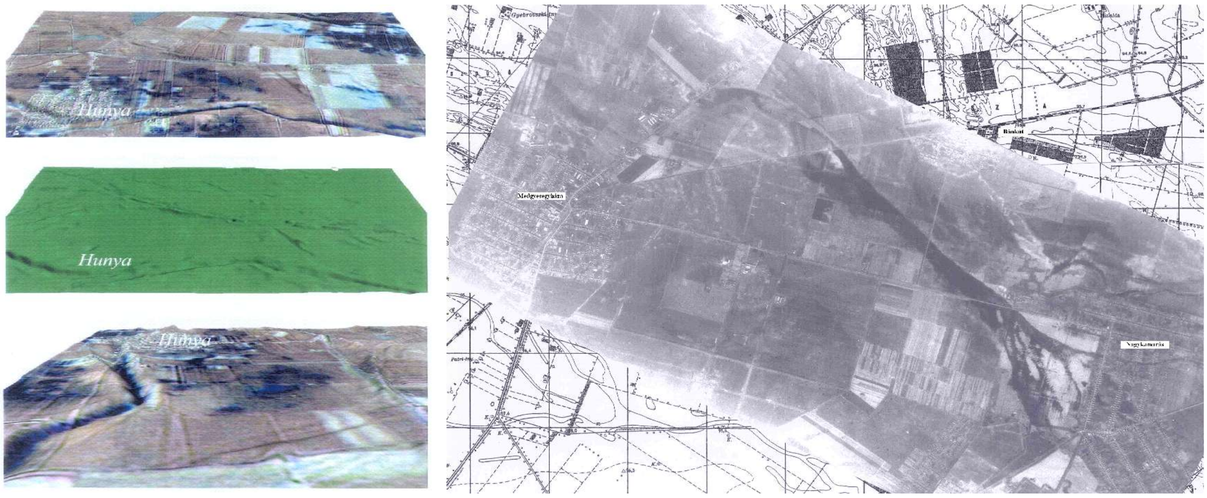

Figure 7. Dead river-beds in Hunya and between Medgyesegyháza and Nagykamarás

2.2. Variable factors

In *hydro-meteorological* respect there is a great importance of the extreme meteorological situations (accumulating of previous precipitation, low air temperature and sunshine duration and low intensity of evaporation periods). The most significant excess water hazards (in 1879-81, 1919, 1941-42, 1966, 1971, 1979-81, 1999-2000) were determined by the previous long rainy periods. For this reason the groundwater level rose progressively which was able to cause water uprush, mainly on those areas where have not to be found impermeable layer above the groundwater level (Figure 5) and the groundwater are under hydrostatic pressure (*confined groundwater*, Figure 8).

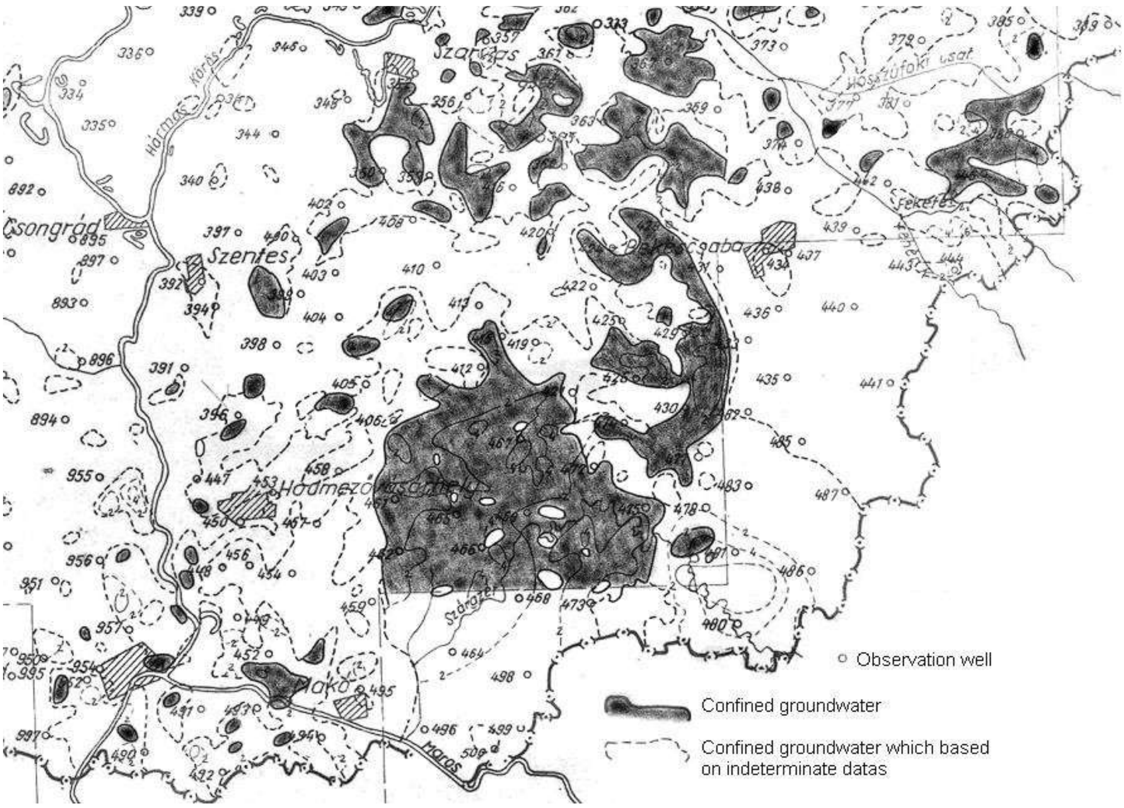

Figure 8. Position of confined groundwater (Major and Orlóci, 1981)

Some acknowledged hydro-geologists have different views about the *natural groundwater recharge*. On the one hand (Rónai, 1956; Urbancsek 1963) the natural groundwater recharge is based on the quantity of rainfall infiltration on foot hills. On the other hand (Ubell, 1959; Alföldi 1971, 1986; Juhász, 1955, 1962) there is no horizontal groundwater flow on the southern part of the Great Hungarian Plain. For this reason, rising of the groundwater level have two ways:

- infiltration of point (local) precipitation;
- spreading of pressure wave.

3. Water uprush forms

The uprushing water brings soil grains and dissolved mineral substances, which settle on the surface. According to their appearance, we can observe different forms of uprushes (Kiss, 1989):

- *Bed-Fountains of saline lakes:* In the warmer water column of saline lakes we can easily separate the uprushing cold springs, which, while keeping the bed's sediments in suspension create small cones. In winter, these parts of the lake do not freeze over. In summer, after the lake dries out, light grey sediment settle down on the bottom of the lake, while the cones are wet and darker for a long time. After full drying out, the cones become snow white, indicating the high level of dissolved salt in the uprushing water (Figure 9).

- *Marsh uprushes, soap-holes:* In marshy regions, circle smudges appear containing thin mud. In these marshes, gases originated from the decomposition of organic substances produce phenomena like sludge volcanoes'. Usually the research probe can be pushed down to 8-10 m in these smudges (Figure 10).

- *Uprushing in buildings:* These uprushes can cause the collapse of the buildings, as the water makes the walls made of clay soaked. The cellars of these buildings are usually filled with groundwater (Figure 11).

- *Overflowing wells ("Topolya" well):* In sunk or dug wells the water from the end of winter until the beginning of summer emerges to the surface and floods its area. These wells are wide spread in the southern part of the Hungarian Plain.

- *Soil humps and uprushes of sodic areas:* On sodic soiled areas, the uprushing water creates 1-2 m diameter and 20-50 cm high humps. The transported salts and mineral substances arriving at the surface dry thicker. This thick layer creates obstacle in the following period of uprush and the pressure develops. The water breaking up this layer rushes up the surface as a fountain.

- *Fresh green smudges on fields:* At summer during the droughty period, we can observe bright smudges with different vegetation, which are supplied by water uprushes (Figure 12).

- *Uprushing on plough-land:* We can observe huge smudges, which hinder agriculture production. These smudges when they are wet hinder the cultivation, and when they are dry they hinder the vegetation growth because of the high level of salt (Figure 13-14).

 

significant in these huge territories, we should consider it during strategic planning.

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