Contributions to the GIS Background of Field Surveys in Archaeologically Less Known Areas

Zoltán CZAJLIK[1] – Balázs HOLL[2]

[1]Institute of Archaeological Sciences, Eötvös Loránd University, Budapest
[2]Hungarian National Museum, Budapest
[1]czajlik@ludens.elte.hu
[2]balazs@hnm.hu

Abstract

This paper will present the most important GIS-related aspects of a project aimed at the study of prehistoric iron metallurgy in north-east Hungary, carried out in 2000–2002. The creation of an appropriate topographic and hydrological reconstruction played an important role both in the implementation of the project design and the interpretation of the archaeological data. The high-resolution elevation model of the Szendrő Basin was complemented by a hydrological reconstruction created with a simulation program. We carried out the floodplain analysis of the various rivers in the area and determined the maximum water level through the analysis of the location of the known sites. Through the calculation of the depth of the riverbeds and the velocity of the water-flow, we managed to identify the areas suitable for human occupation and to determine the possible locations of ancient fords and roads. During our survey, we were able to verify prehistoric and early Roman Age occupation in all dry areas, often with the help of the presence of large amounts of iron slag.

Keywords

GIS, prehistoric iron, elevation model, hydrological reconstruction

1. Introduction

It is a commonplace that research of mountainous and archaeologically less known areas lags behind the study of areas more affected by large-scale investments and construction projects, even in countries where there have been extensive archaeological surveys. GIS plays a significant role in designing projects for the research of such areas because it enables the most efficient use of available resources and the faster investigation of these zones.

2. “Iron” sites in the Szendrő Basin

The area between the Sajó and Bódva Rivers and the Hungarian–Slovakian border was first surveyed by Gyula Nováki in the 1950s, who searched for the relics of early iron metallurgy. Nováki (Nováki 1969) and his colleagues excavated several smelting sites dating from the early Árpádian Age in the 1960s. By continuing the study of this area, we hoped to gather evidence for prehistoric iron metallurgy. We first combed the archaeological literature for earlier research data and found that while the Rudabánya area is often described as one of the centres of prehistoric copper and iron mining owing to the region’s copper and iron sulphide deposits (recently Hellebrandt 2003), there is nothing in the archaeological record to confirm these claims. The most important sites, such as the one with slag deposits and Celtic pottery finds at Szuhogy, quoted by Nándor Kalicz (Kalicz 1957), and the Celtic iron furnace uncovered at Edelény in 1900 (Heckenast *et al.* 1968, 15) can no longer be identified (Czajlik 1998–1999, 518).

According to a passage in Tacitus’ *Germania* on the Cotini *“Retro Marsigni, Cotini, Osi, Buri terga Marcomanorum Quadorumque claudunt. … partem tributorum Sarmatae, partem Quadi ut alienigenis imponunt; Cotini, quo magis pudeat, et ferrum effodiunt”*. (Tacitus: Germania 43,1: *“Nor less powerful are the several people beyond them; namely, the Marsignians, the Gothinians, the Osians and the Burians, who altogether enclose the Marcomanians and Quadians behind. … Upon them as upon aliens their tribute is imposed, partly by the Sarmatians, partly by the Quadians. The Gothinians, to heighten their disgrace, are forced to labour in the iron mines.”* – translated by Thomas Gordon, http://www.fordham.edu/halsall/basis/tacitus-germanygord.html.) It can be identified with this area in the light of the region’s geology since the ore deposits extend from the Rudabánya area to the Slovakian Ore Mountains. (Slovakian research

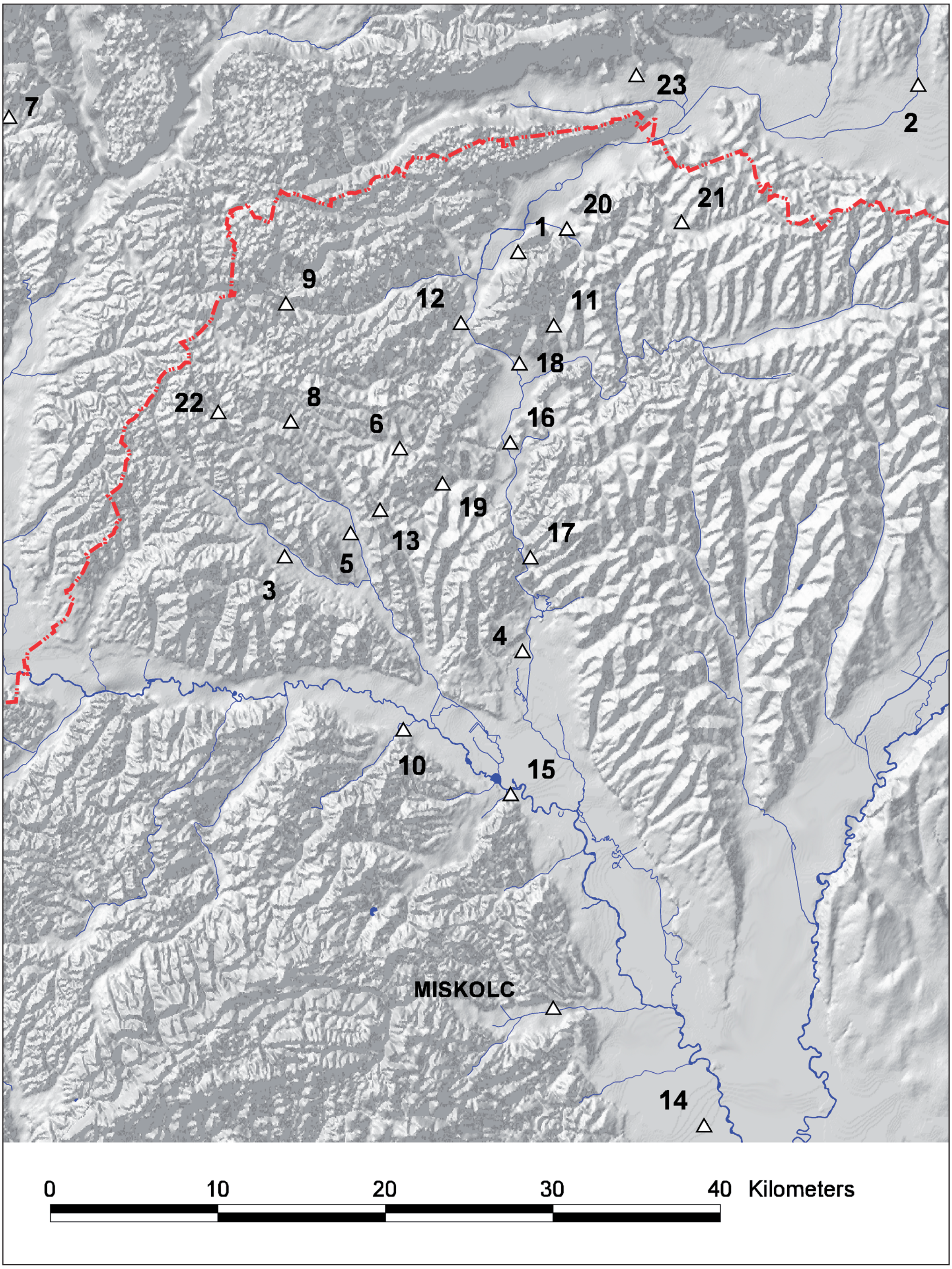

Fig. 1. Villages with slag sites in the region between the Sajó and Bódva rivers and the Hungarian–Slovakian border; 1. Bódvarákó, 2. Čečejovce, 3. Dövény, 4. Edelény, 5. Felsőkelecsény, 6. Felsőtelekes, 7. Gemersky Sad, 8. Imola, 9. Jósvafő, 10. Kazincbarcika, 11. Martonyi, 12. Perkupa, 13. Rudabánya, 14. Sajópetri, 15. Sajószentpéter, 16. Szendrő, 17. Szendrőlád, 18. Szalonna, 19. Szuhogy, 20. Tornaszentandrás, 21. Tornaszentjakab, 22. Trizs, 23. Zádielské Dvorniky-Zádiel.

locates the Cotini to a region more to the north-west: Pieta 1982, 207–217.)

The preliminary studies indicated that with the exception of a handful of Árpádian Age sites with slag remains and a few caves of the karst region in the north (E.g. the Baradla Cave at Aggtelek, Holl 2007), virtually no prehistoric sites were known from this area. We identified several prehistoric hillforts during the field survey.

The high forest coverage and the abandonment of formerly cultivated areas, resulted in their being overrun with weeds. This meant that there were few surface finds to be collected. In order to gain an overall picture of the area's archaeology, we extended the survey area to include the region north of Szendrő in the Bódva Valley, where arable farming was still practised, enabling the collection of surface finds.

3. The dynamic model

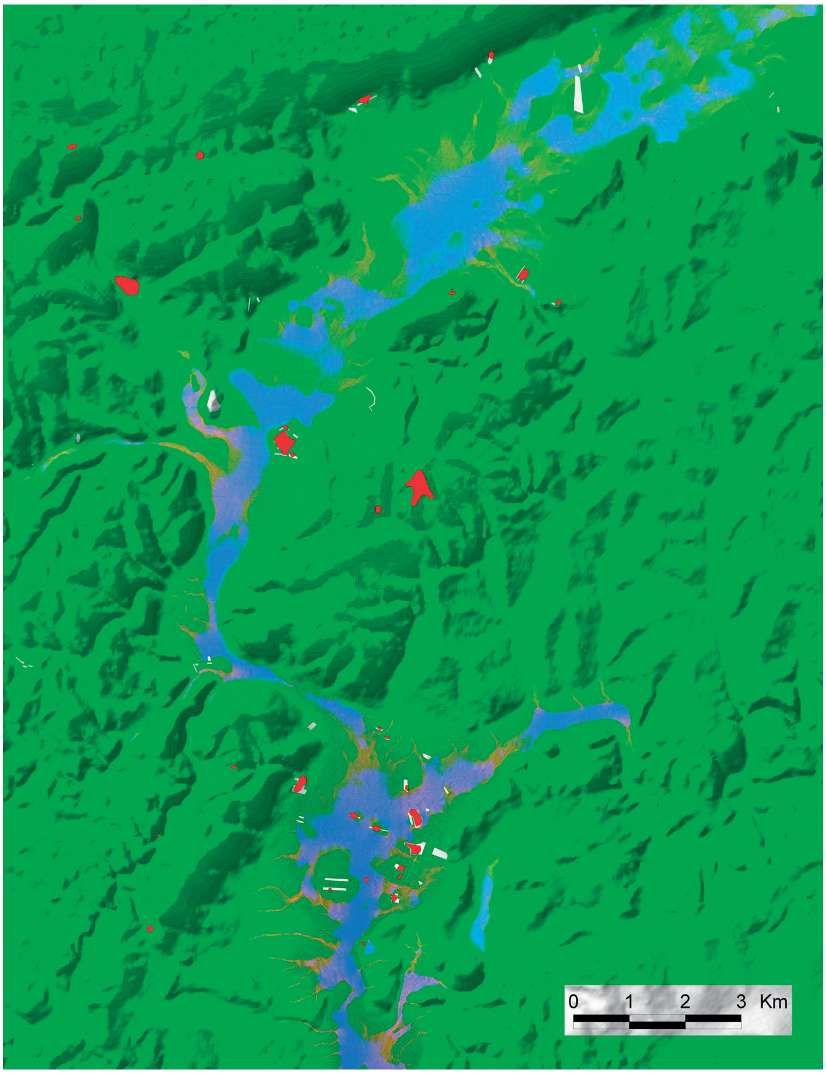

Fig. 2. The dynamic model of the Bódva section between Szendrő and the Hungarian–Slovakian border, with the levees, the surveyed area (white) and the location of one-time settlements (red).

The reconstruction of the area's one-time topographic and hydrological conditions was instrumental to designing the research project and the interpretation of the archaeological data. Similarly to the models designed for Mediterranean Alluvial Plains (Fiz and Orengo 2008, with further literature) and certain regions of the Great Hungarian Plain (Czajlik *et al.* 1997, 153; Gillings 1998, 122–125; Tímár 2004), we began by studying satellite photos and old maps of the region. However, this proved inadequate owing to the escarpments in the studied valley section. The high-resolution elevation model of the Szendrő Basin was complemented by the hydrological reconstruction created with a simulation program. The input data in the software was developed as part of the project. This included a terrain model (100m²/cell DTM) that was based on the area's 1:10,000 topographics map (filtered to exclude modern interventions and improved in terms of the refinement of the inclination data of level area). Additionally, the terrain was also based on data of precipitation and water inflow, enabling the calculation of the velocity of the water-flow and the depth of riverbeds.

We determined the maximum water levels through the analysis of the location of known sites. By calculating the depth of the riverbeds and the velocity of the water-flow, we could identify the areas suitable for human occupation and determine the possible locations of ancient fords and roads. The GIS model thus contained the above hydrological model and the archaeological field data.

We continuously tested the reliability of the GIS model during the field survey. We mapped the areas surveyed together with the extent of the sites and the "empty" zones. The reliability of the model was verified by our findings: we found evidence of prehistoric and early Roman Age settlements on almost every water-free levee, together with iron slag remains indicating early iron metallurgy (see *Fig. 3*). In contrast, the control survey of the periodically inundated areas, again identified from the elevation model, did not yield one single site, and the few finds collected during this survey had been quite obviously redeposited by the River Bódva.

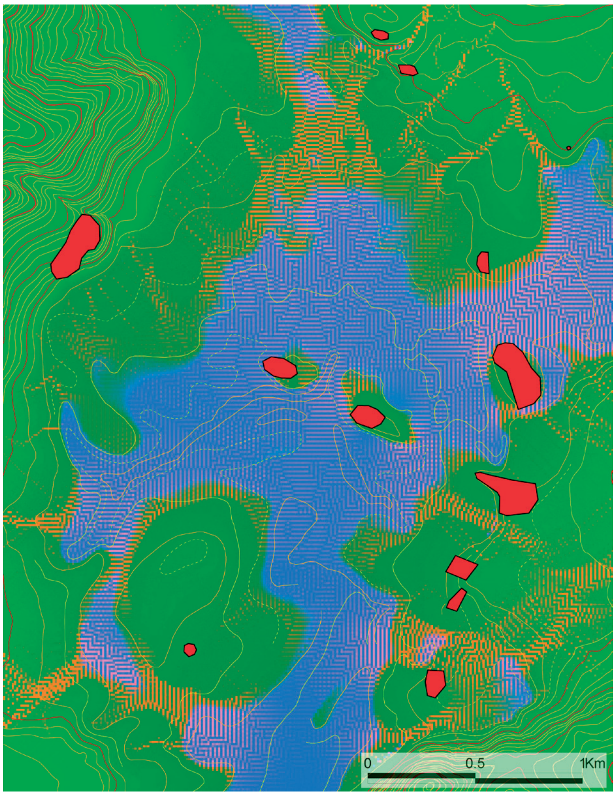

Fig. 3. The northern part of the Szendrő Basin, with the levees and the location of one-time settlements (red).

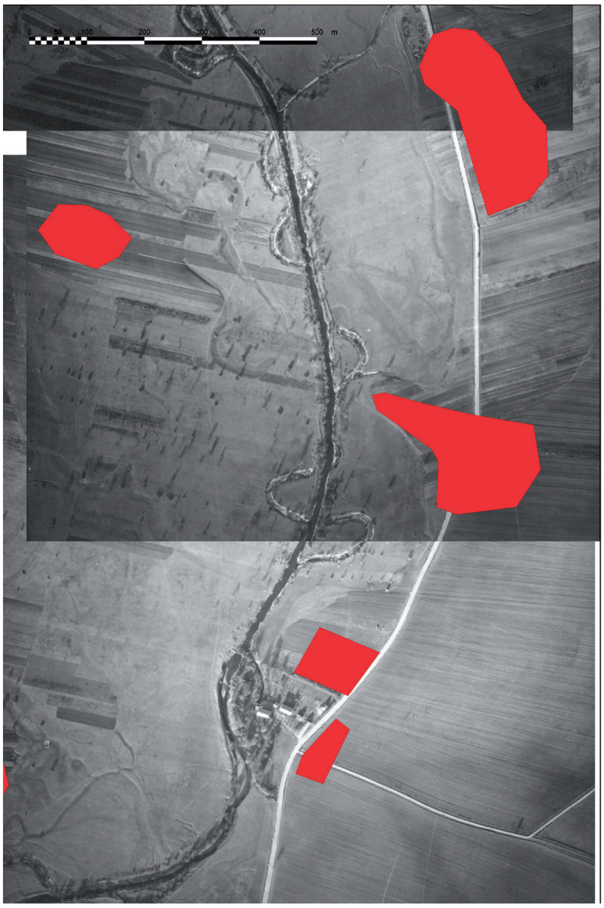

Fig. 4. Early iron slag sites in the northern part of the Szendrő Basin, projected onto an aerial photograph from the 1950s showing the pre-regulated bed of the River Bódva.

4. Iron metallurgy in the river valleys

The location of early iron smelting sites in the river valley, rather near the iron ore deposits exploited during the Middle Ages in the Rudabánya area, did not come as a surprise in knowledge of the Hallstatt D/La Tène A period settlement at Čečejovce near the River Bódva, where evidence of iron metallurgy has been found (Miroššayová 1995). The local ore deposits exploited by the smiths of the settlement were also identified near Čečejovce (Mihok 1994). The iron ores mined for in the Szendrő Basin were secondary ores redeposited by the River Bódva, which flows through areas with metal ore deposits.

In the light of the substantial amount of slag unearthed on the Scythian settlement at the Salgótarján–Industrial Park II site in 2000 and on the Celtic settlement at Sajópetri–Hosszú-dűlő in 2002–2003 (Czajlik – Molnár 2007), we extended data collection to the entire Northern Mountain Range. The dating of the 52 slag sites associated with metallurgical activity (Czajlik *et al.* 2003, 123) is uncertain and the precise chronological position of these sites can only be established through their excavation. One of the slag sites in the Szendrő Basin can be dated to the Scythian period, while six others can be broadly dated to the Iron Age and the Roman Age (Czajlik 2002, 12) (*Fig. 4*).

The archaeological record thus indicates metalworking activity in north-east Hungary well before the Hun period. However, with the exception of the Börzsöny Mountains, very little is known about the prehistoric and pre-Hun period settlement history of the Northern Mountain Range: no more than a handful of hillforts are known. This is especially striking if compared to the adjacent regions in Slovakia and the Great Hungarian Plain.

5. Other findings of the research project

The natural fording places along the studied river section could be clearly identified from the hydrological reconstruction of the River Bódva. Even though the river can hardly be regarded as being a major waterway, the siting of possible fords provided valuable information. The pre-regulation maps show that the River Bódva broadened and meandered along some sections and flowed more rapidly with hardly any changes in its bed in others. The river's flow was impeded by escarpments in several spots (e.g. Perkupa Gate, Szendrőlád Gate), which also acted

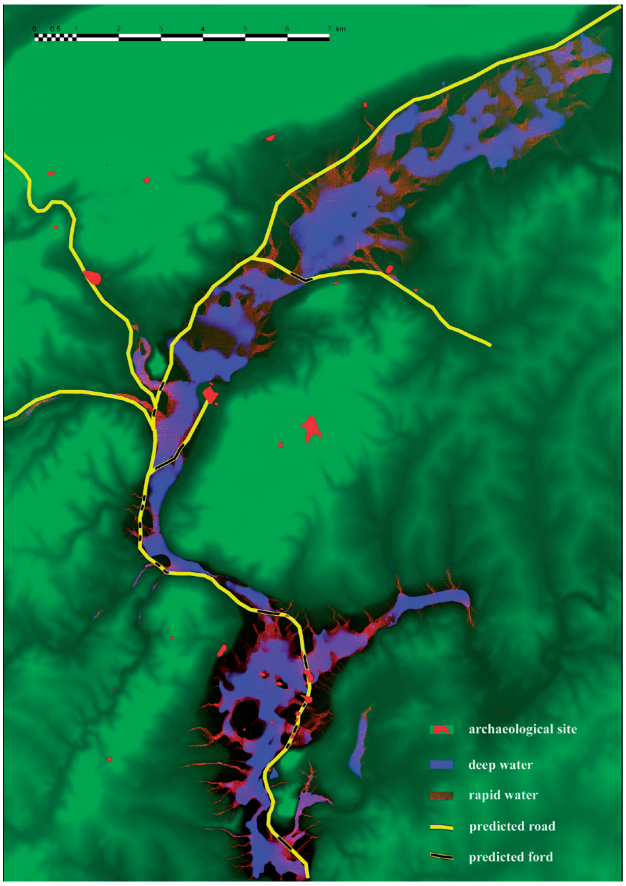

Fig. 5. Reconstruction of fording places and the early road based on the dynamic model.

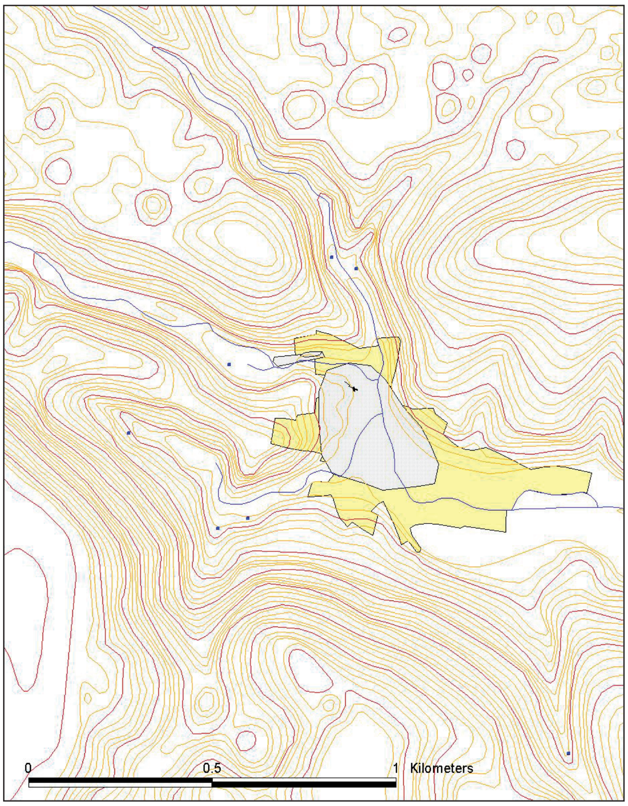

Fig. 6. Reconstruction of prehistoric settlement nuclei at Jósvafő (white).

as natural fording places. The model clearly shows that the broadening, meandering section of the river virtually spread across the entire valley, forming a formidable obstacle to any traffic. The position of the levees outlines a road in the northern part of the Szendrő Basin, which, similarly to the fording places, practically corresponds to the line of the modern road. The presumed age of the settlements established on the levees suggests that this road existed in the Roman Age, and it is possible that it had originally emerged some time during the Iron Age.

Since the Szendrő Basin and its broader area is still characterised by archaic settlement patterns, we could confidently assume a medieval origin for most settlements prior to our survey. At Szalonna and Jósvafő, we confirmed that the hills of the elevation model formed the nucleus of the prehistoric occupation of a particular settlement (*Fig. 6*). As a result, we could determine the areas where prehistoric occupation could be expected in other villages too (e.g. Szín). The hydrological data indicated that there was a correlation between the continuous occupation of areas suitable for human settlement and the karstic nature of the higher-lying zones. Areas with water sources, suitable for permanent human occupation, only evolved in the larger valleys. Owing to the karstic nature of the area, every effort was made to detract as little as possible from arable lands suitable for farming, which even today is restricted to the river valleys.

6. Summary

The dynamic model used in the research project eliminates the problems often arising from models based on a static hydrological reconstruction, which often yield unreliable data, especially in the case of rivers with a steep gradient, since in these static models the lower valley sections are “covered” with water, while the upper sections remain “dry”.

The project offered a case study on how the construction of a GIS model can contribute to a better knowledge of archaeologically less known and less easily researched regions before the start of the actual fieldwork, to planning field surveys, to interpreting the archaeological relevance of the geological conditions of the area and to the identification of similar areas. A GIS reconstruction enables the identification of the elements of archaic settlement patterns and of prehistoric settlement nuclei, and in fortunate cases, some of the prehistoric routes can be reconstructed too.

Acknowledgement

The paper was supported by Magyary Zoltán Grant and the Hungarian Research Fund (K 43762, NK 68824).

References

Czajlik, Zoltán, Balázs Holl and Ádám Marton (1997). Az M3-as autópálya régészeti leletmentéseinek térinformatikai feldolgozása Hajdú-Bihar megyében - The GIS Processing of the Rescue Excavations Associated with the M3 Motorway in Hajdú-Bihar County. In: Kovács Tibor - Anders Alexandra - Raczky Pál (eds.) *Utak a Múltba - Paths into the Past - Az M3-as autópálya régészeti leletmentései - Rescue Excavations on the M3 Motorways*, Budapest, 153–155.

Czajlik, Zoltán (1998–1999). Quellen zur prähistorischen Eisengewinnung in Ostungarn. In: „...und sie formten das Eisen." Ur-, frühgeschichtliche und mittelalterliche Eisengewinnung und -verarbeitung. Internationales ÖGUF-Symposion, Linz–Freinberg, 27–30. 10. 1998. *Archaeologica Austriaca* 82–83 (1998–1999), 515–519.

Czajlik, Zoltán (2002). Neue Ergebnisse in der Forschung der frühen Eisenverhüttung Nordostungarns (Aggtelek – Rudabánya Gebirge). *Communicationes Archaeologicae Hungariae* 22, 5–14.

Czajlik, Zoltán and Ferenc Molnár (2007). Sidérurgie: Miklós Szabó (dir.), *L'habitat de l'époque de La Tène à Sajópetri–Hosszú-dűlő*. Budapest: L'Harmattan, 263–270.

Czajlik, Zoltán, Ferenc Molnár, Árpád Kovács and György Lovas (2003). Őskori vassalakok anyagvizsgálata Északkelet-Magyarországról: 1. A szkítakori vaskohászat nyomai Salgótarján–Ipari Park II lelőhelyen, 2. Vassalakok anyagvizsgálata Szendrő–Pap-réve és Szendrő–Rakaca-patak lelőhelyekről. – The analysis of prehistoric iron slag samples from North-East Hungary. 1. Traces of Scythian period iron metallurgy at Salgótarján, Industrial Park II site. 2. The analysis of iron slag samples from Szendrő, Pap-réve and Rakaca-patak sites. *Régészeti Kutatások Magyarországon – Archaeological Investigations in Hungary 2001,* Budapest, 117–129.

Fiz, Ignacio and Hector A. Orengo (2008). Simulating Communication Routes in Mediterranean Alluvial Plains. In: Axel Posluschny Karsten Lambers and Irmela Herzog (eds.) *Layers of Perception. Proceedings of the 35th International Conference on Computer Applications and Quantitative Methods in Archaeology (CAA). Berlin, Germany, April 2–6, 2007.* Bonn: Dr. Rudolf Habelt GmbH, 316–321.

Gillings, Mark (1998). Embracing uncertanity and challenging dualism in the GIS-based study of a plaeo-flood plain. *European Journal of Archaeology* 1(1), 117–144.

Holl, Balázs (2007). A Baradla-barlang régészeti kutatása – Archaeological survey of the Baradla cave. *Archaeológiai Értesítő* 132, 267–288.

Heckenast, Gábor, Gyula Nováki, Gábor Vastagh and Elemér Zoltay (1968). *A magyarországi vaskohászat története a korai középkorban.* Budapest.

B. Hellebrandt, Magdolna (2003). A vasművesség kezdetei Észak-Magyarországon. In: Gyula Viga, Szilvia Andrea Holló, Edit Cs. Schwalm: *Vándorutak – Múzeumi örökség. Tanulmányok Bodó Sándor tiszteletére, 60. születésnapja alkalmából.* Budapest: Archaeolingua, 285–295.

Kalicz, Nándor (1957). Rudabánya őskora. In: Endre Pantó (ed.) *Rudabánya ércbányászata.* Budapest, 6.

Mihok, Lubomir (1994). K počiatkom výroby železa – Zu den Anfängen der Eisengewinnung. *Slovenska Archeologica* 42, 69–90.

Nováki, Gyula (1969). Archäologische Denkmäler der Eisenverhüttung in Nordostungarn aus dem X.–XII. Jahrhundert. *Acta Archaeologica Academiae Scientiarum Hungaricae* 21, 299–331.

Miroššayová, Elena (1995). K počiatkom výroby a spracovania železa na východnom Slovensku – On beginnings of Iron metallurgy in Eastern Slovakia. *Študijné Zvesti* 31, 9–50.

Pieta, Karol (1982). *Die Púchov Kultur*. Nitra.

Tímár, Gábor (2004). Space and GIS technology in palaeoenvironmental analysis. *Antaeus* 27, 135–144.