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Geo-pedological and climatic impact on the distribution and organization of Neolithic settlements in Eastern Croatia (Western Syrmia)

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ABSTRACT – *This paper analyzes a sampling of settlement patterns in the extreme eastern periphery of Croatia during the prehistoric period. The layout of present-day settlements from Vukovar to Ilok and the local, very specific relief, indicate a degree of mutual interaction. The combination of a series of components such as deep ravines (known locally as* surduk*) and high loess terraces indicates a unique structure which has been apparent from prehistory to the most recent history.*

IZVLEČEK – *V članku analiziramo poselitvene vzorce na skrajnem vzhodnem obrobju Hrvaške v času prazgodovine. Tloris današnjih naselij med Vukovarom in Ilokom ter lokalen, zelo specifičen relief, nakazujeta medsebojni vpliv. Kombinacija elementov, kot sta globoka soteska (lokalno znana kot surduk) in visoka puhlična terasa, nakazuje edinstveno poselitveno strukturo, ki ji sledimo od prazgodovine do najbolj nedavne zgodovine.*

KEY WORDS – *Eastern Croatia; Neolithic; loess; ravines; settlements*

The geographical territory of Eastern Croatia has witnessed very intense activity. Trade routes intersected here, with the associated intermingling of influences, and prehistoric cultures significantly influenced one another. This is a place where the old and new met, and evidence of these long-past contacts can be found underground.

Geology and hydrology

In Eastern Slavonia and Syrmia (Srijem), people say that the soil is so fertile that "seeds land upside down and still sprout". When agriculture was at its peak in this region (in the 1980s), few other zones could generate better crop yields than the zone bordered by the cities of Đakovo to the west and Zemun to the east. The reason for this is the specific, very fertile soil which exerted an influence on prehistoric human communities that far surpassed its fertility: loess. It characterized the entire surface of Eastern Croatia.

This loess was created by the settlement of dust raised and conveyed by winds in the wake of the erosion of the Alpine massif and the mountains of Slavonia, rich in muscovite (*Galović 2005.221*). The Pannonian plain is an area with the highest concentration of loess and similar sediments in Europe, and its thickness varies depending on the region (Fig. 1). The sedimentation of loess in the form of flattened slabs (tablelands) is a 'trademark' of what is known as 'flat Slavonia', *i.e.* the fertile plain of the eastern section of Croatia as an integral component of the South Pannonian zone. Loess and its derivatives cover approximately 35.7% of Croatia's total surface area, reaching thicknesses of up to 30 meters. It was generally formed during the younger Pleistocene (*Galović 2005.7; Galović et al. 2009.85*) (Fig. 2). The extreme south-eastern Slavonian plain has been shaped by two major rivers: the Drava and Danube. The Danube, flowing in from the north, runs through raised loess terrain, which considerably impedes its progress, creating spill-over, while the Drava flows

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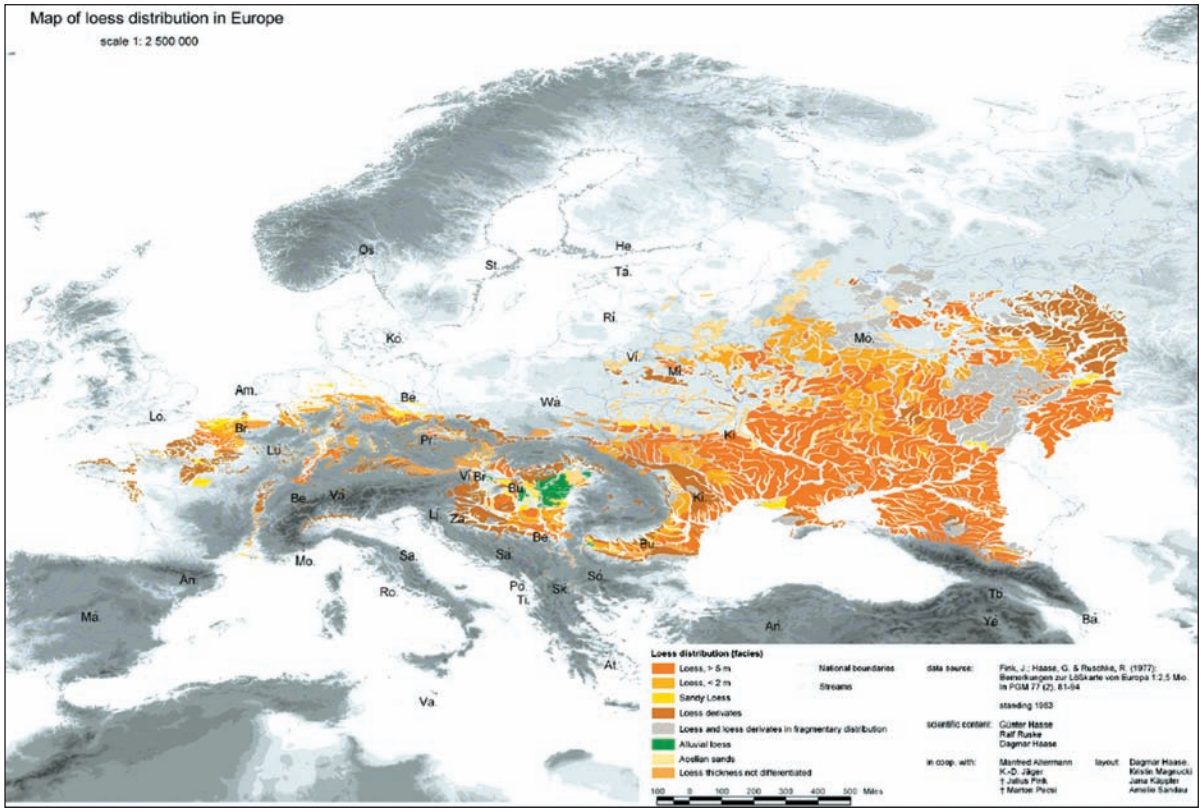

Fig. 1. Map of loess sediments of Eurasia (based on* Hasse et al 2007*).

into it on its right bank. The interacting hydro-dynamics of these two rivers, wherein the low waters of the Drava are halted by the high waters of the Danube, create a unique wetland known as Kopački rit (*Galović 2005.2*), one of the most important habitats for wading birds in Europe. This interchange between a lower, inundated zone with a raised, drier zone created the current relief picture of Eastern Slavonia and Syrmia, with the Drava and Danube flowing on their northern and eastern peripheries. In geological terms, two categories of sediment are present in this area's relief: Pleistocene loess and Holocene alluvial sediments (*Galović 2005.1*). The alluvial sediments pertain to the lowest terrain, which are inundated and damp, and thus quite suitable for the growth of forests of, among others, the famed local oak trees. Eastern Slavonia is bordered by a third river in the south: the Sava. The entire territory bordered by the Drava, Sava and Danube is divided into three geotectonic units: the eastern section of the Drava depression in the north, the Slavonia-Syrmia depression in the south, and the plain of Đakovo, Vinkovci and Vukovar between them (*Bačani et al. 1999.141*). The tablelands are slightly higher than the local relief, and thus ideal for cultivation, because they do not flood as easily, something of which prehistoric populations were well aware. In morphological and structural-tectonic terms, these are complex structures which are separated from the depressions by sharply divided systems of deep fissures which reach down to the tertiary bedrock (*Bačani et al 1999.141*). The Vukovar tableland, which will be covered most extensively here, is the easternmost tableland in Croatia. This is an asymmetric tectonic block, covered by an average of 22 meters of loess sediment. The north-eastern section leans slightly toward the Danube, which begins to undercut it here, so that it terminates in a steep and entirely vertical break which extends parallel to the Danube from Vukovar to Ilok (*Mutić 1990.53*). It extends from the so-called Vinkovci tectonic hub of the fissure (from the north-west, the north-south fissure from Našice to Vinkovci, and the other fissure from the western side along the Vrpolje-Mikanovci-Vinkovci line) (*Mutić 1990.35*), up to the Mohovo-Bapska-Šid fissure, where it crosses into the western foothills of Fruška Gora (*Galović 2005.36*). The principal and best-known branch of the Vukovar tableland, 22 meters high, on which much research has been conducted, is the so-called Gorjanović (Gorjanović-Kramberger) profile, slightly downstream from central Vukovar (*Gorjanović-Kramberger 1912. 29; Galović I. & Mutić 1984.299*). The Gorjanović profile is particularly significant because it has seen the longest period of continuous development of loess sediments on dry land, in contrast to that of

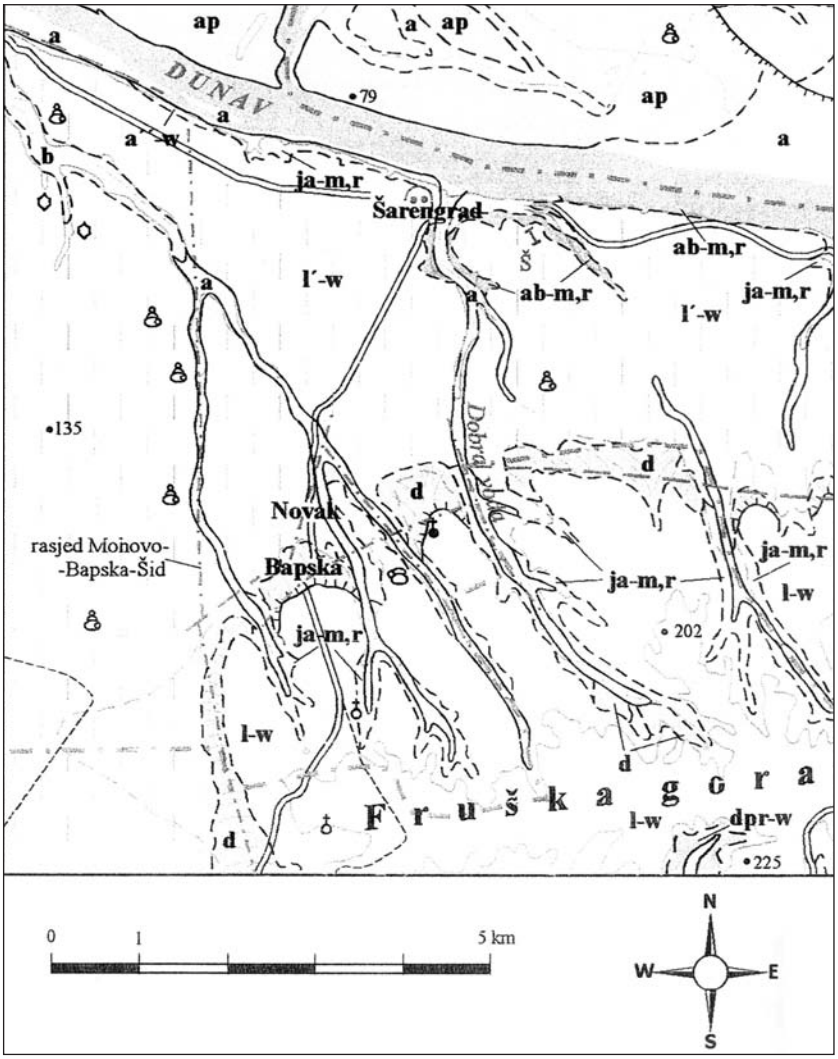

Fig. 2. Loess sediments of the eastern section of the Vukovar plain (based on* Galović 2005*).

Vinkovci and Đakovo, where sedimentation proceeded partially or entirely under water (*Mutić 1990. 52*), and which is why the latter contain a higher share of clay (*Mutić 1990.71*). Radiocarbon dating of the Gorjanović profile has ascertained an age of 33 000 to 16 600 years.[1] The sequence of loess on it constitutes a deposit of fine, dusty, terrigenous material formed under stable, dry and hot climatic phases (*Mutić 1990.52–53*). Its most important features are the high content of dusty fractions (64–83%) and the high content of calcium carbonate ($CaCO_3$) (*Osnovna Geološka Karta L 34–99, 1983.19*). Viewed vertically, these are light-yellow layers, interspersed with dark and thinner offshoots which represent warming or interglacial periods, best seen when one goes downstream along the Danube from Vukovar. Almost immediately after it passes the Gorjanović profile, the Danube veers sharply leftward, after which one reaches Vučedol, one of the best-known sites of Croatian archaeology.

The western foothills of Fruška Gora, which form the eastern boundary of the Vukovar tableland, largely consist of metamorphic rock and serpentinite (*Osnovna Geološka Karta L 34–99, 1983.13*), meaning rocks which are potentially sound materials for making Neolithic implements. Serpentinites are generally associated with the streams in the villages around Neštin (Serbia), while the metamorphic rock appears on the surface in the form of sericitic-chloritic shales and calcschist. The territory along the Mohovo-Bapska-Šid line lies on riverine-lacustrine (JA–RW), and riverine-palustrine (AB–RW) sediments, which were discovered in the steep ravines from Opatovac to Neštin (*Osnovna Geološka Karta L 34–99, 1983.17*) (Figs. 2 and 3). This accounts for the entire series of sources of potable water in the immediate vicinity of the Late Neolithic tell of Gradac in Bapska, which were vitally important to the village (as confirmed in testimony from older residents of Bapska), and certainly to the residents of the Neolithic settlement at Bapska.[2]

Climatic and ecological changes on the Vukovar tableland

Climatic variations prompted numerous processes which influenced the geomorphology, sedimentation, pedogenesis and similar processes which exert the greatest impact on plant and animal development (*Poje 1986.19*). Since prehistoric people were quite dependent on these changes, the climate consider-

1 There are no data on calibration.

2 During excavations in 2009, attempts will be made to ascertain the age of these two sources to establish whether the spring and stream were at this site during the existence of the prehistoric settlement.

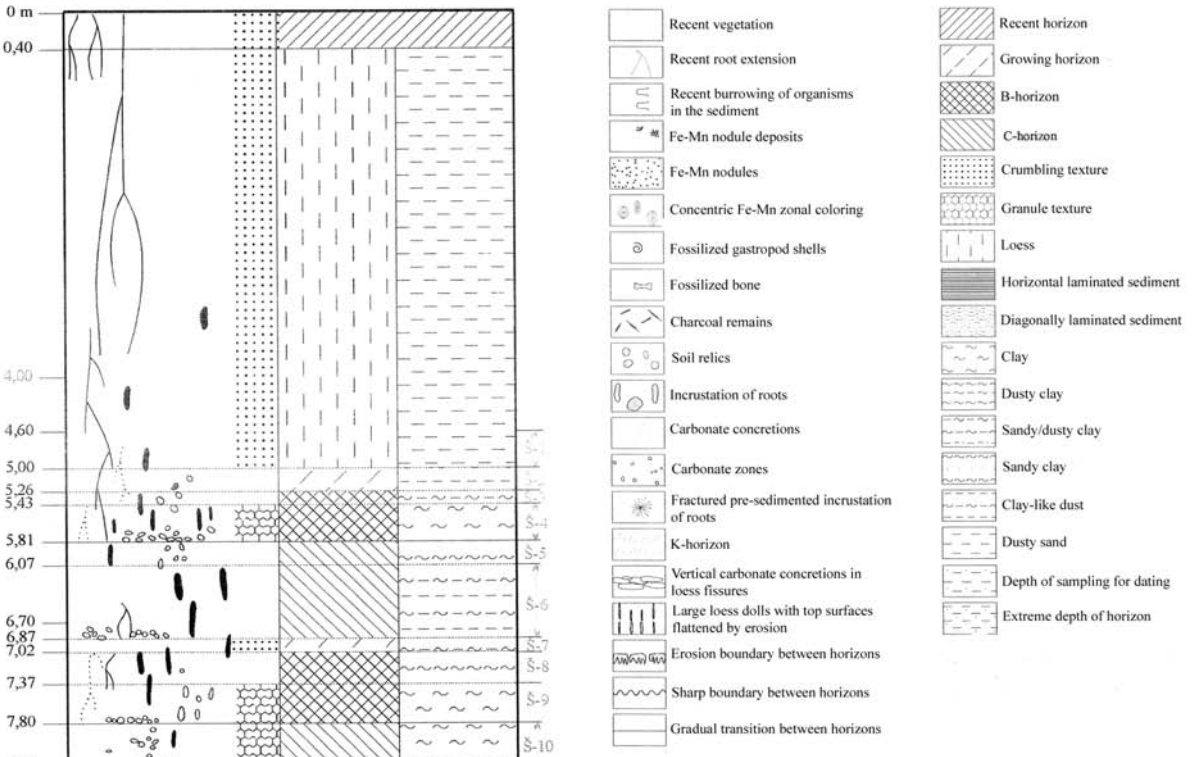

Fig. 3. Loess profile in Šarengrad (based on Galović 2005).

ably altered their lives. The quaternary is a geological period which abounded in extreme oscillations in temperature and climate. From the Brunhes/Matuyama palaeomagnetic boundary (0.73 mil. years), there were eight glacial-interglacial transitions, and a total of seventeen during the Holocene (*Poje 1986.19*), so the old division of the quaternary into four Alpine glacial phases (1909) no longer stands in the geological literature (*Rukavina 1983.199*), even though it can still be found in archaeological discourse. During the Holocene, and even during the Neolithic, some relatively significant climate changes occurred in this region. During the Boreal (*c.* 8000–6000 calBC), the climate remained within the framework of the continental: warm and dry summers, and cool and dry winters, while during the Atlantic period, winters were warmer and wetter, and summers similarly cooler and wetter. During the transition from the Atlantic to the Sub-Boreal, the continental formula of the Boreal was restored (*Link 2006.6*).

Loess is a soil in which quaternary climatic changes can be best observed (*Poje 1986.20*). The aforementioned lighter and darker yellowish layers are actually the first visual markers indicating the intensity of climate change over the past thirty-five thousand years.[3] As stated, the dark layers indicate a warming

3 Using state-of-the-art methods, it is possible to ascertain when an individual grain of quartz was last exposed to daylight. During conveyance by wind, the electrons in the grain's crystal lattice are excited by photons in sunlight. When a grain falls into a sediment (covering other grains), the electrons begin to lose energy and 'drop' to lower energy levels, and this marks the point of departure for measuring sedimentation (*Galović 2005.56*).

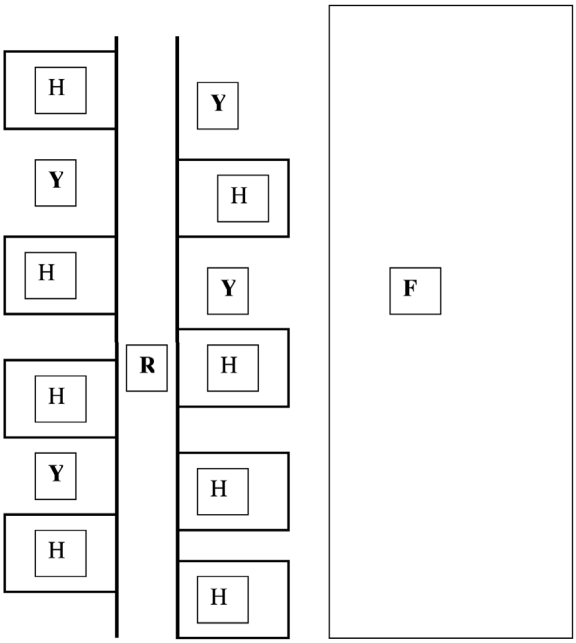

Fig. 4. Very simplified schematic for the organization of villages in Slavonia and Baranja (H = house; Y = yard; R = road; F = field).

period and higher moisture, and even stagnation in the conveyance of dusty substances. Under these damp conditions, calcium carbonate dissolved much more quickly, contributing to the formation of various loess concretions in the lower loess horizons (*Mutić 1990.53*), while so-called loess 'dolls' are one of these manifestations which can also be found in archaeological research. It is worth noting that among the igneous materials (apatite, zircon, amphibole, biotite, etc.), the Gorjanović profile also contains traces of volcanic glass (obsidian), thus indicating vestiges of volcanic activity in the Eastern Carpathians (Harghita-Calimani mountains in Romania) (*Mutić 1990.54*).[4]

The Danube bank from Vukovar to Ilok

The situation described above indicates that this zone was ideal for settlements of Neolithic and other prehistoric and historical communities. Western Syrmia is thus a slightly elevated 'island' of exceptionally fertile soil bordered by the Danube to the north. This raised character affords protection from floods during seasons when the Danube is swollen with melt-water from Alpine zones. The Fruška Gora highlands play a crucial role in this eco-system: their configuration and genesis ensure a constant inflow of potable water, entirely independent of the dry months and the associated variations in the levels of the Danube and nearby Bosut and Sava Rivers, while their geological base is a source of outstanding stone materials for tool-making.

Besides its fertile plain, Eastern Croatia is also known for its specific type of settlement (village) development, which is common to almost the entire lowland area of the southern part of the Pannonian plains. These so-called *šorovi* (*šor* – a village lane) denote the building of settlements along a single main thoroughfare, along which the houses are arranged regularly in a line on each side (Figs. 4, 5).

An exception in this regard is the area between Vukovar and Ilok. The specific relationship between the relief, geology and large rivers altered the general pattern here, which is apparent in both the present and prehistoric organization of settlements. When this model is examined more closely, one can conclude that it is the only one possible, and that the tradition is probably rooted in prehistoric times. It has already been noted that this right bank of the Danube is furrowed with intense riverine erosion, so it is steep along its whole length. On a clear

Fig. 5. Satellite image of a village in Slavonia-Baranja (Sotin).

4 Traces of obsidian are also visible in samples from the Vinkovci tableland (*Mutić 1990.73*). Those obsidian traces are of course, in the shape of dust.

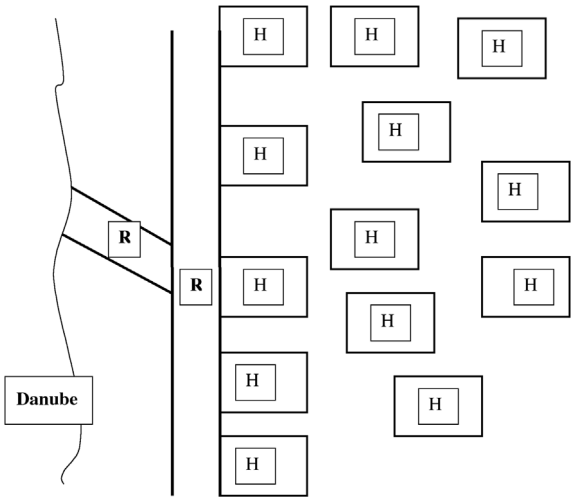

Fig. 6. Very simplified schematic of a village in a ravine (H = house; R = road).

day, the foothills of Fruška Gora can easily be seen from Vučedol, the well-known Eneolithic site, as the intervening area is entirely flat (a distance of roughly 40km as the crow flies). The view is not even impeded by any modern settlements, because with the exception of Sotin, there are none – only endless fields and vineyards. The terrain is entirely flat, interrupted only occasionally by ravines, which gently descend to the Danube from high terraces. If one sets off by road from Vukovar toward Ilok, the first such ravine can be seen immediately after leaving Vukovar, and it leads along the Danube to Vučedol (Figs. 7, 8). There are no modern settlements here, except about a dozen weekend cottages. The Vučedol plateau is slightly elevated above the surrounding terrain of the Vukovar tableland, which extends farther eastward. There was a prehistoric here, followed by cultivated surfaces toward the east. The Vučedol ravine is partially visible as a sandy approach to the banks of the Danube on the left of Figure 7. After Vukovar and Vučedol, one arrives in Sotin, a settlement 3km farther on which is rich in prehistoric remains, and which was also the site of an exceptionally important Roman-era settlement. The emergence of the contemporary village links the medieval tradition with Antiquity, when a very important Roman crossing of the Danube *limes* was located here. Today's Sotin is the successor settlement to this Roman-era predecessor.[5] This fact alone indicates that Sotin did not emerge in the aforementioned 'traditional' manner, but was influenced by the presence of the Roman army, which regularly applied its own methods for building settlements. After Sotin, the terrain is flat until the next major ravine, considerably larger than its Vučedol counterpart. The road which runs parallel to the Danube (approx. 100m above sea level) intersects this ravine at a right angle and enters Opatovac, descending into the settlement located therein (approx. 75m above sea level). The centre of Opatovac is located at the lowest point of the ravine's floor, *i.e.* almost at the level of the Danube. As soon as the ravine begins to ascend on its other side (farther eastward), houses become rarer, completely disappearing after one leaves the settlement. This is followed by fields until Mohovo, and then Šarengrad, which, based on the aforementioned model, are identical to the situation described in Opatovac. Excluding Sotin and its different origin, Opatovac, Mohovo and Šarengrad are the only settlements from Vukovar to Ilok associated with the right bank of the Danube, and all three are in ravines (Figs. 6, 6a).

Fig. 6a. Satellite image of a village in a ravine (Opatovac).

5 Sotin also has two small ravines which descend to the Danube.

Why is so?

Fig. 7. Aerial view of Vučedol.

The reasons, which immediately become apparent, are very practical. Loess, as a very friable and sandy soil, drains well and does not retain water. Since the banks are steep, approximately 25 to 35 meters above the Danube, a settlement built anywhere else would require wells at least that deep to obtain water. Beside a river abundant in water (and fish), this would have been absurd, as it was crucial simply to control and settle access to the river. Communication with the Danube was simplest from ravines which gently descended to its banks. Settlements thus emerged precisely at such sites. The cold north-east winter winds certainly played a role in this selection of ravines as ideal habitation sites. There are many more reasons: the streams which flow through these ravines, and the possibility of building hoards/basements in the vertical loess faces, which are today mainly used as wine cellars, *etc.* These key factors for establishing settlements were also shared by the prehistoric communities, which is apparent in the lack of prehistoric settlements on the upper terraces more distant from the ravines. During tours of the terrain in these upper sections, the appearance of prehistoric ceramics has been recorded only along the river itself, directly above the ravines, while the wider area is only known by cases of numerous hoards (Šarengrad, Lovas) (*Brunšmid 1900; Vinski 1958*). Besides these sporadic finds with the character of hoards, which by their very nature are normally found outside the perimeter of settlements, the remaining area of the terraces above the ravines in this region are, as far as we know, almost entirely archeologically sterile. However, the advantages offered by ravines have one very negative aspect as a counterweight. The ideal availability of water and shelter from turbulent weather carry a price: the settlements have exceptionally unfavourable strategic locations. They are located in a narrow area, with flat terraces above them on both sides. In cases of threat, they are almost impossible to defend. Lying below any invaders, they are entirely helpless in any type of military manoeuvre. This situation has been confirmed even in the most recent history. During the Cold War tensions in neighbouring Hungary (October 1956), the army of the former Yugoslavia dug in at Vučedol itself (Fig. 9)[6]. Traces of a military trench are visible in the profiles of the Vučedol archaeological test dig. Had the

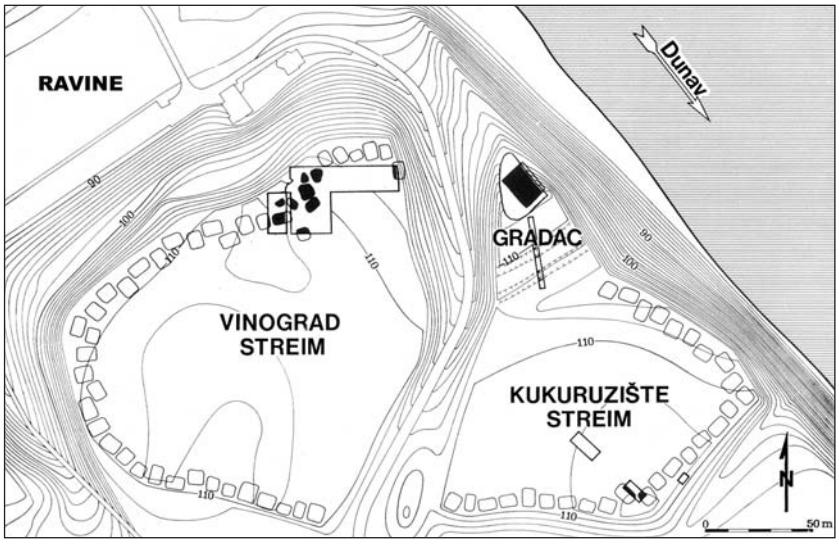

Fig. 8. Vučedol site. The two squares on the image next to the field are test trenches from the last 1980s (based on* Durman 1988*).

6 We would like to thank A. Durman (Archaeology Department, University of Zagreb) for turning our attention to the modern military trench in test dig V–87, thereby prompting a line of thought which, in its own way, resulted in this text.

USSR, heading the Warsaw Pact, moved armoured formations towards Bačka and Syrmia, the territory from Ilok to Vukovar would have been evacuated due to the impossibility of defending these settlements, *i.e.* the entire area. The situation with armoured vehicles was the same in Croatia's Homeland War in 1991. As in the hypothetical case in 1956, Croatia's territory in 1991 was defended from Vukovar, which was the first line of combat. To be sure, the strategic positions which were relevant 5000 years ago are still relevant to this day.

Fig. 9. Traces of a military trench from the late 1950s in research test pit V–87, northern profile. Marked with arrows (photograph: M. Burić).

What is the current situation of prehistoric settlements in this part of Croatia? Vučedol, Ilok and Bapska (Fig. 10) are large prehistoric settlements erected at the very edges of ravines, which is a key common feature. Access to water from the ravine and fish from the river were thus controlled, and the surroundings were also overseen, with their seemingly endless expanse of fields containing excellent soil and space for pasturing. The construction of prehistoric settlements at the edge of ravines eliminated the negative components of digging wells, *i.e.* the problem of the water supply, the importance of which to the functioning of a settlement needs no further discussion. The settlement of the ravines in this manner demonstrates a set of rules which are rooted in prehistoric times, as seen in the examples of Vučedol, Bapska and Ilok as prehistoric settlements in one direction, and in the other direction in Opatovac, Mohovo and Šarengrad as modern settlements. All of them have in common a ravine as the axis of their organization (Figs. 7, 11). Besides these larger archaeological settlements which have been, some more, some less, researched over the past seventy years, Neolithic ceramics were also registered along the actual shoreline of the Danube, again along the edges of ravines and near the river. A preliminary field inspection conducted by a team from the Archaeology Institute in Zagreb resulted in the discovery of a group of Starčevo finds between Opatovac and Ilok (oral communication from Darija Ložnjak-Dizdar and Marko Dizdar). The prehistoric settlement in Bapska (Gradac) is particularly interesting among these settlements because, as opposed to the two mentioned above, it is not on the Danube itself. Located four kilometres south of Šarengrad, but also on the edge of a ravine in which there are roughly twenty sources of potable water over a one kilometre stretch (Fig. 10). Erected on a loess ridge 188m above sea level, it integrates all of the aforementioned ad-

Fig. 10. Gradac in Bapska. The elevations of both sides of the ravine and several local sources of water are (WS) marked (photograph: M. Burić).

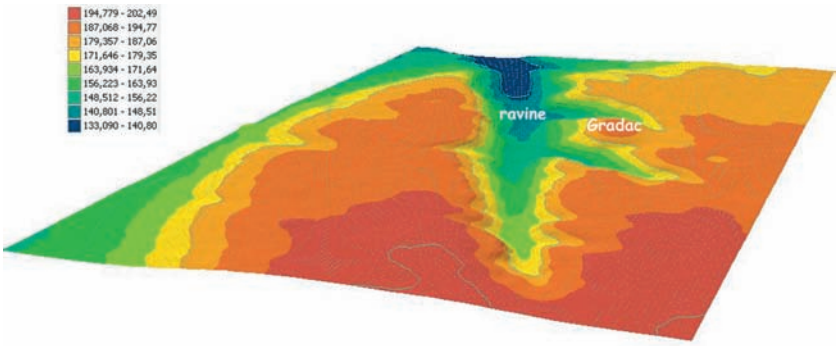

Fig. 11. Hypsometric image of Gradac in Bapska (made by A. Kuveždić 2006).

vantages except for the immediate vicinity of the Danube (Figs. 11, 12). Its strategic position is indicated by the fact that its upper archaeological layers belong to the last branch of the Vinča Culture, characterized by the turbulent time of its abandonment. The identical nature of the late Vinča ceramics from an eponymous site 114km distant leads to the conclusion that this cultural layer is that of a Vinča Culture population which withdrew westward, where it then disappeared in the period immediately after the mid-fifth millennium BC. Perhaps it is worth observing that the last culture at Gradac (Baden) was also the first culture at Vučedol, which is situated in the zone of emergence of the deep Syrmia ravines, where the space for withdrawal and defence is considerable larger and more secure. Current knowledge on the prehistoric settlements in this area regularly show a direct dependence of the organization of life on the immediate vicinity of the ravines, as their combination of shelter and access to water and fish and the strategic position of their edges raised into terraces made them ideal for settlement in the rich (pre)history of Western Syrmia. Western Syrmia, the area between Vukovar and Ilok, despite having the highest concentration of well-stratified and stratigraphically legible units in Croatia, is actually still quite under-researched. However, this can also be said of the rest of Slavonia, which, thanks to increasingly intensive rescue research in recent years, is revealing many settlements from all prehistoric periods (Kruševica-Njivice at Slavonski Šamac, Aljmaš-Podunavlje; numerous sites along the V-c motorway, such as the Đakovo-Sredanci and Belišće-Staro Valpovo sections, etc.) (*Miklik-Lozuk 2004.37, 38; Šimić 2005.7; Wiewegh & Kezunović 2005.8, 9; Šimić 2006.9, 10*).

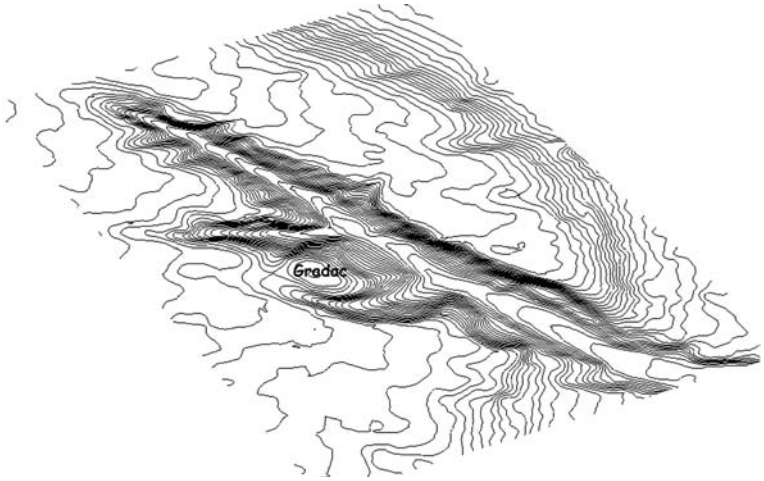

Fig. 12. Network image of Gradac in Bapska (made by A. Kuveždić 2006).

By the same token, the narrow belt along the Danube itself, in the Croatian part of Syrmia, as noted, is revealing new sites with prehistoric finds. The intensive reconnaissance of this area, conducted by the Archaeology Institute in Zagreb and ongoing for some time, marks only the beginning in this area of data-gathering without resorting to destructive archaeological methods. All the results so far, as well as much older knowledge, indicate the same cause-and-effect sampling for the selection of sites for settlement, *i.e.* the location of settlements: exclusively on the steep-sided tops of ravines in prehistoric contexts, or in lower positions as settlement cores in more recent settlements.

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