# Importance of geoconservation of the loess "cave" in Surduk village as rare pseudokarst landform in the loess-paleosol sequences of Vojvodina (N Serbia)

Tin Lukić[1], Slobodan B. Marković[1], Thomas Stevens[2], Djordjije A. Vasiljević[1], Biljana Basarin[1], Nebojša Milojković[1], Lazar Lazić[1], Igor Obreht[1], Jasmina Đorđević[1]

[1] *Department of Geography, Tourism and Hotel Management, Faculty of Science, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad*

[2] *Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX, UK*

Pseudokarst caves occur in various- magmatic, metamorphic and sedimentary-rocks and represent many genetical types. The development of these caves is closely related to processes of rock formation or postdiagenetic reconstruction, mainly denudation processes such as erosion and weathering (e.g. Urban and Otęska-Budzyn, 1998).

Loess is a fine-grained, clastic sedimentary rock primary of aeolian origin which covers nearly 10 % of Earth's surface. Loess "caves" (piping caverns, wells, tunnels) exposed in loess cliffs are rare pseudokarst landforms that can be regarded as morphological equivalents to collapse dolines or sinkholes formed in classical karst terrains.

Vojvodina is a region in northern Serbia, located in the south-eastern part of Carpathian (Pannonian) Basin. More than 60% of this lowland area is covered by loess and loess-like sediments. Typical loess sediments in the Vojvodina region contain between 10 and 35% carbonate content. Because of its sedimentological characteristics, the significant thickness of loess-paleosol sequences, and the generally relatively dry climate in the Vojvodina region, many pseudokarst landforms have been formed and preserved on loess covered terrain. This landform variety consists of loess sinkholes, dry valleys, hanging valleys, gullies, loess runnels, "loess pyramids" and not so numerous *loess "caves"*.

The loess "cave" in Surduk village is a young pseudokarstic landform formed by piping erosion supported with carbonate dissolution. A key role in the genesis of this landform was the short distance between the initial loess sinkhole that provided a possibility for the lateral removal of loess material. The presence of the *Robinia pseudoakacia* trees around the initial depression modulated the subsequent evolution of the sinkhole. The total height of the cave is 12.10 m, and the greatest width is 3.70 m. These dimensions include height from the bottom of the cave entrance on loess cliff to the cavern roof. The height of the entrance on loess cliff is significantly smaller (8.15 m), and its greatest width is 3.10 m. The total volume is approximately 51.50 $m^3$. In the centre of the cave roof there is an erosional "cave" window to the surface, the longest axis of which is 4.15 m and the narrowest width is 1 m (Lukić et al., 2009).

During intensive fieldwork research of the loess plateaus in Vojvodina province from 1997, only four sites with similar morphology have been discovered: at

the Titel old brickyard (SE part of the Titel loess plateau), in "Veliki surduk" near Mošorin village (northern part of the Titel loess plateau), on the Potoranj site between Banoštor and Čerević villages (northern slopes of the Fruška Gora mountain) and investigated site in Surduk village (eastern part of the Srem loess plateau). Thus the processes and/or catalyst responsible for their formation must not be widespread. For example, the loess "cave" at the Titel old brickyard is very similar to that in Surduk. Both are formed on steep loess cliffs spreading to the contact between powerful last glacial loess layer V-L1 and paleosol V-S1. Because of a higher amount of clay, paleosol V-S1 is significally more resistant to erosion than porous loess layer. "Cave" window is completely exposed to erosional processes. Because loess deposits are inherently unstable the existence of the exposed loess "cave" is a temporally limited phenomenon.

The loess cliffs on Danube river bank near village of Surduk not only preserve a unique archive of Quaternary climate change, but also exhibit diverse and short-lived landforms associated with the erosion of the deposits. These landforms preserve information on the processes of loess soil erosion that could help in future attempts to limit the loss of such material through conservation programs. In addition, the attractiveness of the site led to the locality being chosen by director Emir Kusturica as the main setting of his film *"Black Cat, White Cat"*, awarded the Silver Lion for Best Direction at the Venice Film Festival. Thus there are aesthetic, cultural, conservation and past environment research reasons for developing an effective and sustainable geoconservation procedure to protect this stretch of cliff and prolong the existence of the loess "cave", thereby introducing its significance to wider audience.

**Keywords:** loess, pseudokarst landforms, Serbia, Surduk

Corresponding authors: lukic021@gmail.com/slobodan.markovic@dgt.uns.ac.rs