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LIPOVEI HILLS

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The Lipovei Hills

The Lipovei Hills are a distinct unit of the Banat Hills, the most extended piedmont units of Western Hills, located between the Mureş Valley to the north, and the Bega Valley, to the south, dominated by the Zarandului Mountains in the north and the Poiana Rusca Mountains in the east (Fig. 1), on a distance of about 75 km. Eastwards limits to Lăpugiului Hills have a sinuous trajectory along the Lăsău — Coşteiu de Sus alignment, and the westwards limit follows the Chesinţ – Bencec – Ianova alignment. The two rivers are what built these piedmont hills, which originally have deltaic, fluvial-lacustrine deposits, sedimented on the eastern coast of the Pannonian Sea in the Pliocene. In our area of interest, the appearance of the Lucareţ-Şanoviţa volcanic body determined the eastward deviation of the north-south Chizdia River. The general aspect of the volcanic area it is a plateau, extending over about 40 km^2, with a maximum altitude of 211 m at the Piatra Roşie Peak (Fig. 2).

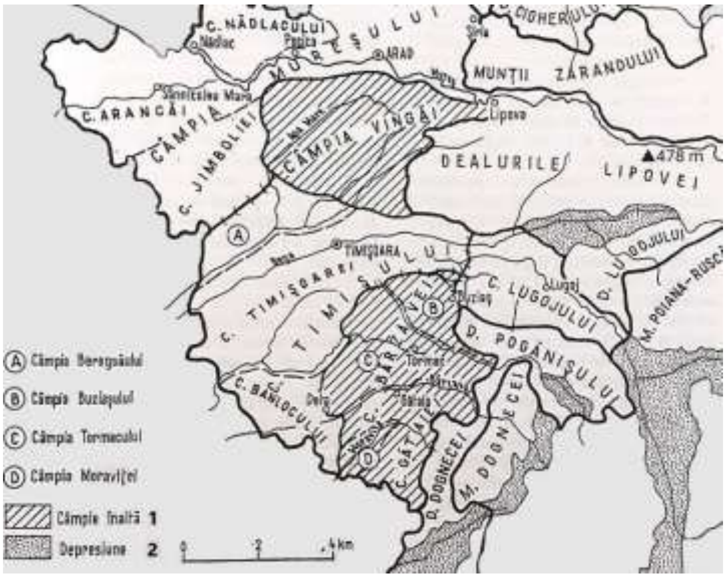

Fig. 1.The geomorphological units of the Banat area (after Badea *et al*., 2011).

The basic geological formations have a piedmont character, a character that is found in the alternation of sublittoral and fluvio-lacustrine deposits.

Except for some limited areas where rocks belonging to the Carpathian orogen occur – granites, diabases, Cretaceous deposits and Jurassic limestones east of Lipova and in the Căprioara area, Badenian-Sarmatian volcanic agglomerates in the northeastern extremity –, Pannonian sedimentary rocks are omnipresent. In our area of interest an "exotic" geological occurrence are the basalts of the Lucareţ-Şanoviţa area (Fig. 2).

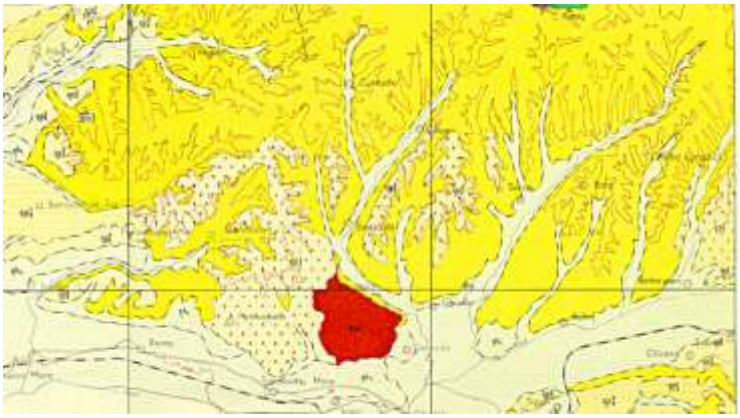

Fig. 2. The Lipovei Hills, south-western area, geological sketch: P – Pannonian; B_{qp1} – basalts; $q_{3/3}$ – Upper Pleistocene; qh_1- Lower Holocene; qh_2- Upper Holocene (from Harta Geologică a României, 1:200 000, sheet 24- Timișoara).

The geology of the Lipovei Hills were first generally reported by the Austrian geologist Theodor Fuchs in 1870 who was concerned with the fauna of Lamellibranchiatas and Gastropods, describing 52 species, most of them new for paleontology (Fuchs, 1870). An extensive description of the Pannonian deposits was then made by Hungarian geologist L. Loczy in 1882, including the fossiliferous point at Rădmăneşti (Fig. 3), representative for the Lipova Hills Pannonian lithology and stratigraphy (Loczy, 1882).

Situated in the south-eastern part of the Pannonian Basin, a classical back-arc basin, formed during Miocene times, the evolution of this area depends on the connections with the neighboring Paratethys seas, the regime oscillated between an epicontinental sea, and lacustrine regime (Fig. 4), due to phases of repeated transgressions and regressions in Pannonian time (Magyar *et al*., 1999).

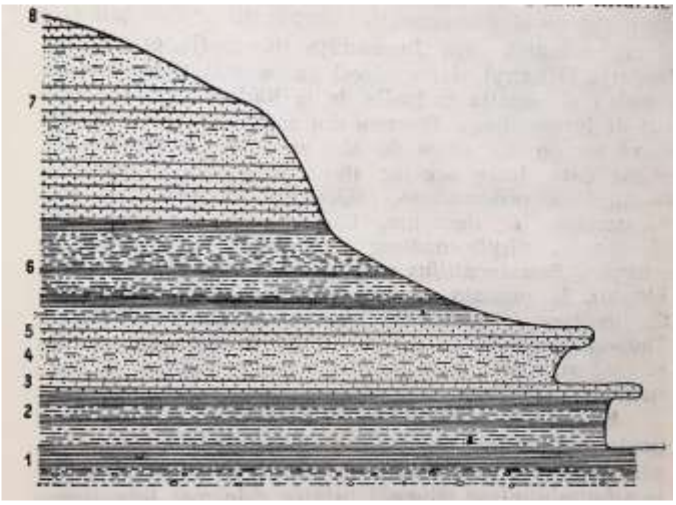

Fig. 3. Geological cross section on Pontian deposits of Rădmăneşti: 1. gray marls; 2. quartzitic sands with magnetite, concretions and *Congeria*, *Limnocardium*; 3. sandstones; 4. fossiliferous gray sands; 5. sandstones with *Unio*; 6. gray marls; 7. ferruginous sands and sandstones; 8. lehms (from Loczy, 1882).

Fig. 4. Pannonian Depression in the lacustrine basin phase, ca. 6.5 Ma. (from Magyar *et al.*, 1999)

Because the basement is of Carpathian type with the presence of a "*chessboard*" type fault system, a series of grabens and horsts are individualized (Fig. 5), these faults influencing the tectonic evolution, the manifestation of late Quaternary magmatism and the seismicity of the area, with active epicenters. Banat is the second seismic zone in Romania, Vrancea being the first.

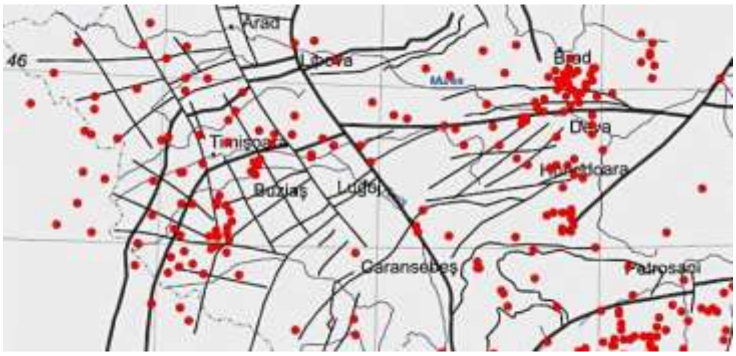

Fig. 5. Faults system and active epicenters of Banat (from Diaconescu, 2017).

The bottom sediments of Pontian age are an alternation of sandstones and sands with intercalations of gravels, sometimes conglomeratic and, more rarely, sandy clay horizons (Manea *et al.,* 1970). The Pannonian deposits continue with a succession of the massive banks of white-gray sand layers, calcareous marl banks, alternating with micaceous brownish-yellow sand layers, sometimes covered by white-gray sandbanks (Fig. 6) (Adda, 1898; Mateescu, 1937).

Fig, 6. Pannonien brownish-yellow sand layers and white-gray cross-bedding structure.

In the western part, on the edge of the contact area with the Vinga plain, Pleistocene compact loams with a prismatic structure appear (Fig. 7).

Fig. 7. Pleistocene compact loams with a prismatic structure.

The analysis of the 118 taxa led to the conclusion that the environment of formation of the Pannonian sediments in Lipova Hills was a deltaic-lacustrine one, coastal, sandy facies of the liman system, mixoligohaline type, with a salinity of 4.5 - 5.5 ‰, and 0.5 - 1.2 ‰, in the river mouth area (Gillet, Marinescu, 1971).

The basaltic eruptive Lucareţ-Şanoviţa area were first reported by the Hungarian geologist L. Loczy in 1882, and K. Adda (1898) made a first more detailed analysis of the area, specifying some geologica land mineralogical characteristics. The volcanic rocks cover Pliocene deposits and consist in a basal pyroclastic sequence and two lava flows, 12-16 m thick in central area, arround Piatra Roşie eruptive center and 2-3 m thick in the peripheral area (Fig. 6), which correspond to a paroxismal phase (Szegedi, 1993), separated by a mass of agglomerates with scoria basalt elements (Savul, Nichita, 1944).

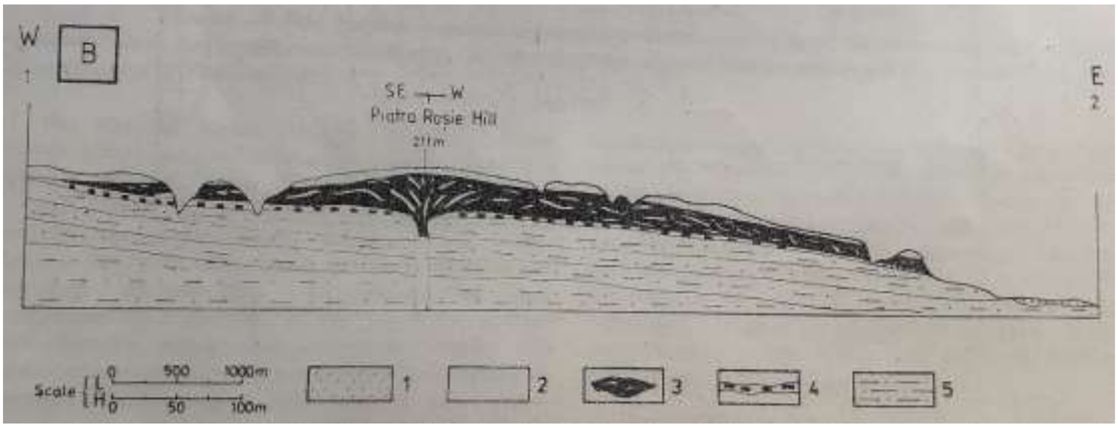

Fig. 8. Geological section W-E of the Lucareţ basaltic area: alluvial terraces; 2. Quaternary deposits; 3. basaltic lava; 4. pyroclastics; 5. pliocene deposits (from Segedi, 1993).

The basalt lava flows are presented as vertical-prismatic, ovoid-spheroidal structures (Fig. 9), as horizontal plates or granular structures. The basalts are basalts with plagioclase feldspars with olivine, put in place by a Vulcano-type manifestation, or Strombolian manifestation, associated with a major fault Lipova-Lucareţ-Buziaş-Vršac (Mateescu, 1937) and Recaş-Cuieş crustal fracture (Savu *et al*., 1994).

Fig. 9. Prismatic and spheroidal separations of the Lucaret- Şanovita basalts.

The Lipovei Hills geomorphological landscape appear as a main interfluve sloping from the east, where the highest altitudes are, the Dâmbul Gomila (478 m a.s.l.), to the west, at the contact with the Vinga piedmont plain, at about 200 m altitude. The general configuration is of typical hills (Fig. 10) – with interfluves located at a fairly close altitude, which is assimilated with the status of a tableland, ***the Lipovei Tableland*** -, with a main slightly asymmetrical interfluve, shorter towards the Mures and more extended southwards, towards the Bega. The Bega tributary hydrographic network, oriented north-south, deepened into the old piedmont, erosion being stimulated by the Timiş-Bega Plain subsidence area, thus individualizing secondary parallels rounded interfluves with the same orientation, the "do-ab" or "Riedel" type interfluves (Fig. 11).

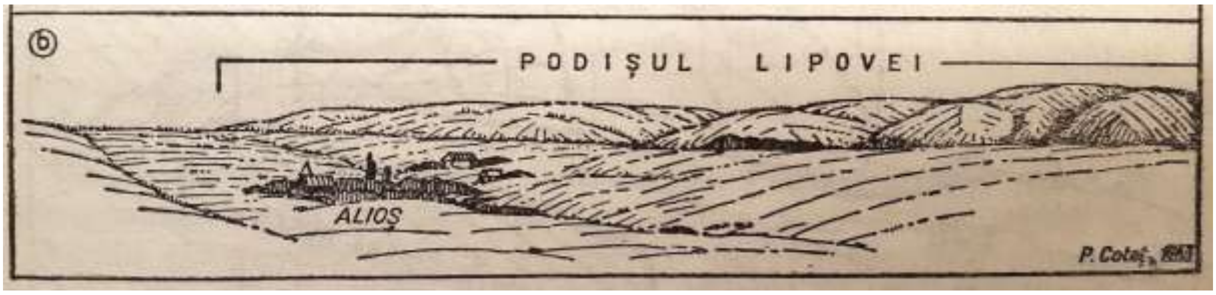

Fig. 10. General aspect of the western part of the Lipovei Hills.

Fig. 11. The Lipova Hills: "Riedel" type interfluve.

In 1912, the Polish geologist Ludomir Sawicki first identified 4 erosion levels, partly confirmed by E. Vespremeanu (1972). A first level, the 350 m level, appears insular only in the eastern part, the others, unfolding in the form of glacis steps, at 300, 275 and 250 m (Vespremeanu, 1998), (Fig. 12).

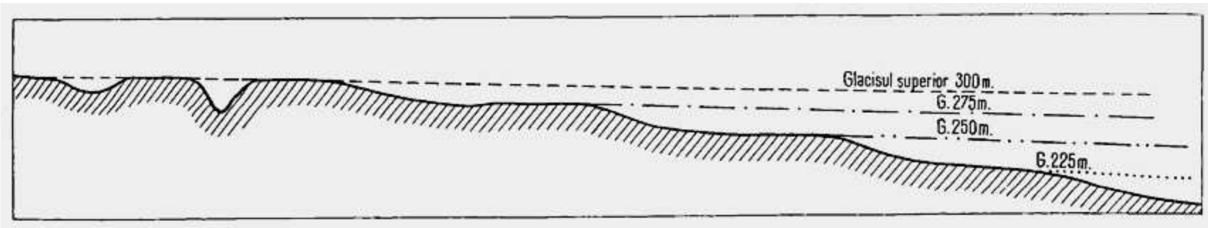

Fig. 12. Erosional levels in the Lipovei Hills (from Vespremeanu, 1998).

In the northern part The Mureş Valley presents several terraces, T1: 6 - 12 m; T2: 18 - 25 m; T3: 50 - 60 m, T4: 80 - 90 m, with good continuity and, sporadically, in the form of patches T5: 100 - 110 m. (Vespremeanu, 1972).

The existence of clayey sand horizons and clay lenses explains the presence of landslides, shallow landslides, some active, others partially stabilized or stabilized (Fig. 13).

Fig. 13. Buzad active landslide, Cuvejdia partially stabilized and Labasinţ stabilized landslide.

In order to know and understand the dynamics of these landslides, the characteristics of the geological substrate, geophysical investigations such as Ground Penetrating Radar - GPR, Electrical Resistivity Tomography – ERT (Fig. 14) and Electromagnetic induction (EM) in DF mode (frequency domain) (Fig. 15) (Şerban, 2018).

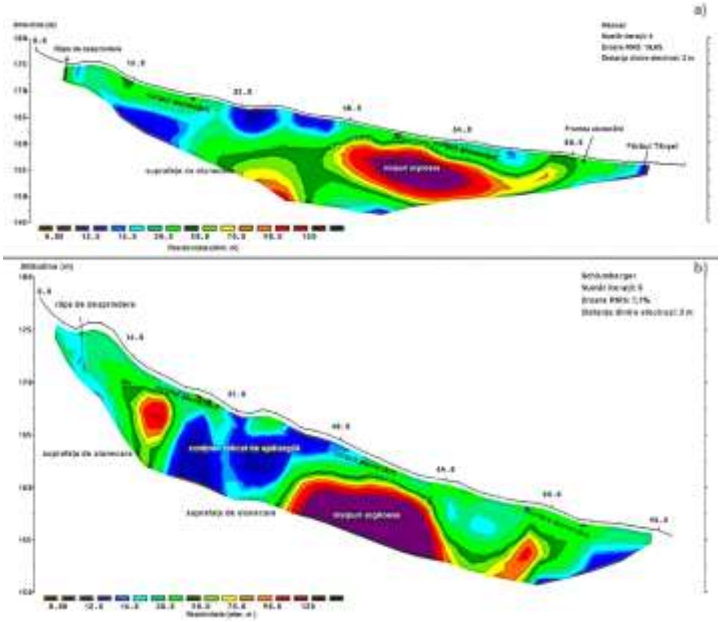

Fig. 14. Buzad landslide (March 2014): ERT investigations images in Wenner & Schlumberger configurations (from Şerban, 2018).

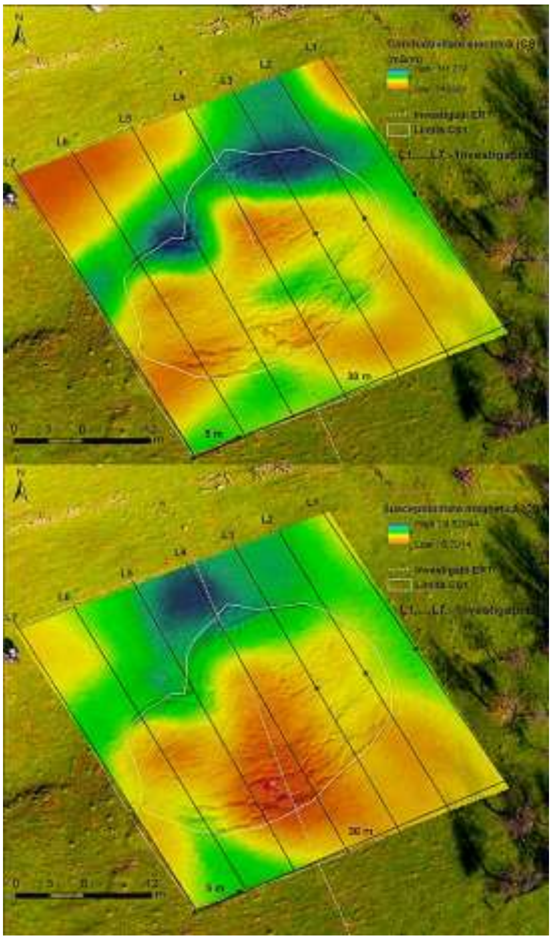

Fig. 15. Cuvejdia 2 landslide: Electromagnetic induction images, electrical conductivity & magnetic susceptibility (from Şerban, 2018).

The use of such investigation methods provides new data on these morphodynamic processes.

The current geomorphological landscape bears the imprint of over 2000 years of habitation, evidence being the Hallstatt settlement at Herneacova, as well as the agro-terrace system (Fig. 16) present in the agricultural domain of all the villages in this hilly region.

Fig. 16. The agro-terraces near Bencecu de Sus village.

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