3.14. PONOR PLATEAU (SOUTH-EASTERN PLOPIŞ MOUNTAINS)

Ionuţ GABRIAN, Negreni, nr. 177/B, Cluj County, Romania, forestier177@yahoo.com
Tudor TĂMAŞ, Department of Geology, Babeş-Bolyai University / "Emil Racoviţă" Institute of Speleology Cluj, Romania, tudor.tamas@ubbcluj.ro
Diana SAHY, NERC Isotope Geosciences Laboratory, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK, dihy@bgs.ac.uk
Bogdan P. ONAC, Department of Geology, Babeş-Bolyai University / "Emil Racoviţă" Institute of Speleology Cluj, Romania; Department of Geology, University of South Florida, USA, bonac@usf.edu

1. Introduction

Plopiş Mountains, known in the past as *Rez* or *Şes*, form a 40 km long, 7-15 km wide NNW – SSE ridge at the north-western edge of the Apuseni Mountains. They reach a maximum height of only 918 m in Măgura Mare summit and are mainly formed by crystalline rocks, with sporadic occurrences of Mesozoic sedimentary rocks (Ianovici et al., 1976). **Ponorul Negrenilor** or shortly Ponor, is a small karst plateau situated at 750-800 m asl in the SE Plopiş Mountains, at the limits of Cluj, Bihor and Sălaj counties, NW Romania (Fig. 1). Karst features are developed on Anisian-Ladinian black limestones and dolomites. The total Permian-Triassic sedimentary sequence covers about 16 km^2 of which the karst rocks occur on 2×3 km. The plateau has a climate with average annual temperatures of 6-8ºC. Annual average rainfall values are between 800 and 1000 mm.

Although the first notes on the geology of the area were written in the XIXth century (Boué 1833; von Hauer and Stache 1863), detailed investigations were done only about 100 years later (Kräutner 1938; Givulescu 1955). Speleological activities in the area have been carried out by CSA Cluj, Z Oradea and Montana Baia Mare (Rist et al., 1996).

2. Geology and structure

Plopiş Mountains are included in the north-western group of the Apuseni Mountains and the rocks building them belong to the Bihor Unit. The crystalline rocks forming the basement belong to the Someş series, of Precambrian age, and consist of micaschists and subordinately amphibolites and amphibole schists (Kräutner 1938; Givulescu, 1955; Balintoni 1997). The Permian-Werfenian deposits covering the crystalline consist of quartzitic conglomerates and sandstones, and red shales. The carbonate rocks (black bituminous limestones with dolomitic inclusions) deposited over them belong to Anisian-Ladinian. They are made up by micritic and microsparitic facies, thinly layered (Ianovici et al., 1976).

Quaternary deposits are represented by scarce gravels and also by tufa at the four karst springs discharging the plateau.

Three rhyolite outcrops are mentioned by Givulescu (1955), all occurring on the western edge of the Ponor plateau, in direct connection with the main faults in the area.

The present-day structure of the area is the result of hercynic and mesocretaceous tectonic cycles, the latter considered responsible for the folding and vertical dislocations. Two main faults were mentioned by Givulescu (1955), one N-S, along the eastern flank of the plateau, between D. Ponorului and Ponor synclines, and the second on the western flank, between the Anisian limestones in the Ponor syncline and the Permian-Werfenian deposits (NNV-SSE) down to the right side of Butgheorgheşti Valley.

3. Karst morphology

Surface karst features are quite abundant, considering the small extension of the plateau. It is worth mentioning the abundance of dolines belonging to the symmetric and asymmetric types and of sinkhole valleys, while karren are less rep-

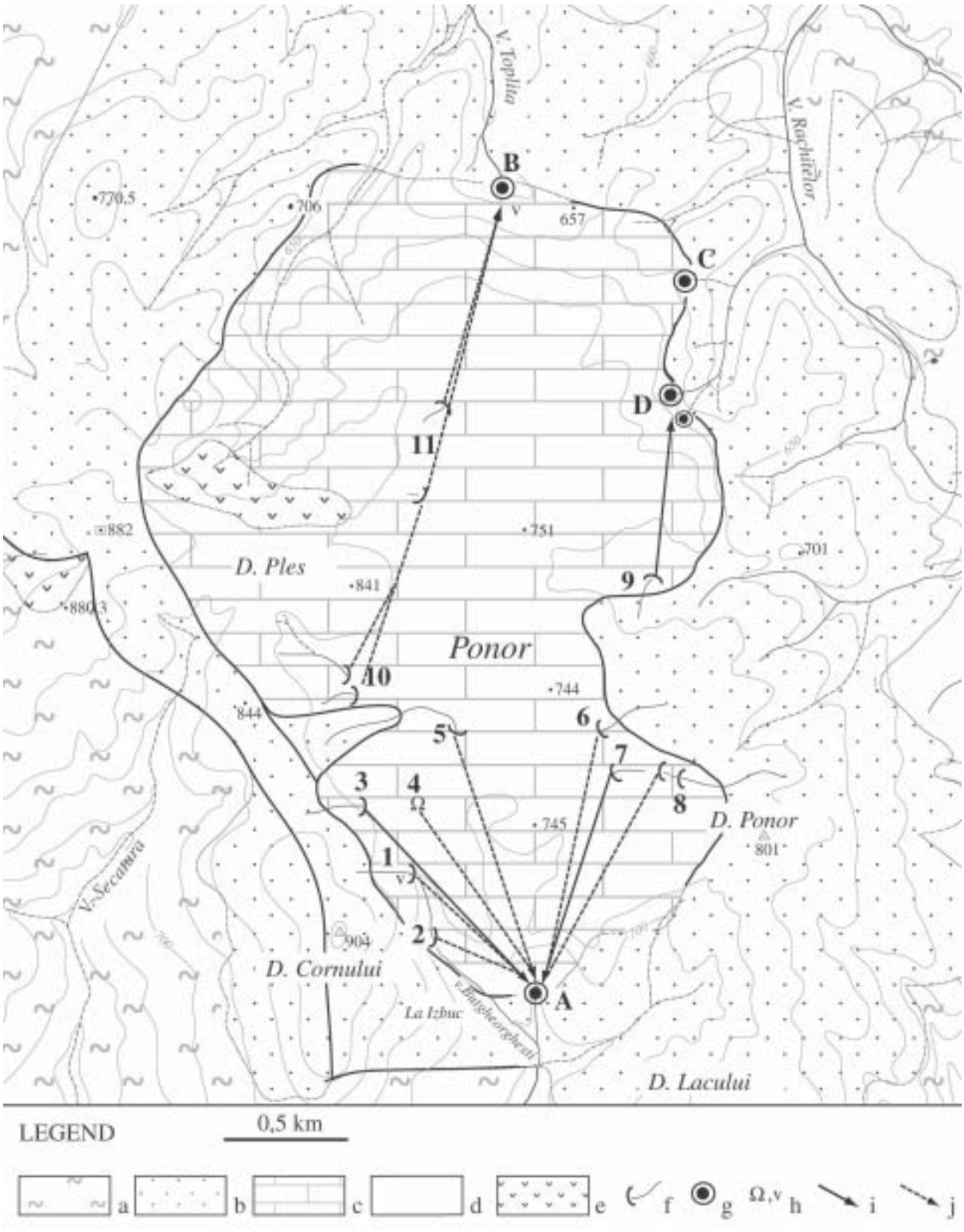

Figure 1. Geology and karst drainages on the Ponor Plateau.
Legend of numbers and letters on the map: 1-11 ponors: 1 - Avenul de sub dealul Lacului; 2 - discrete losses in Butgheorghești Valley; 3 - Holănești; 4 - Peștera de lângă Ponor; 5 - Fechetău; 6 - Tițu; 7 - Triscu; 8 - Valău; 9 - Veghinaș; 10 - Daiciu; 11 - ponors NE of D. Pleș; A-D springs: A - Izbucul Negrenilor; B - Izbucul Mare; C - Izbucul Paltinilor; D - Izbucul Mic.
Legend: a - Precambrian: crystalline rocks, predominantly micaschists; b - Permian-Werfenian conglomerates, sandstones and red shales; c - Anisian-Ladinian limestones-dolomites; d. Sarmatian clays and sands; e. rhyolites; f. ponor; g. spring; h. cave, pothole; i. demonstrated drainage; j. supposed drainage (geology after Givulescu, 1955.)

resented (Gabrian 2006). Tufa deposits occur at all four main springs draining the plateau, the widest occurrence being the one at Izbucul Mare (*B* in Fig. 1). Endokarst features are few (10 caves), but judging from the extent and depth of the drainages studied (>1 km, and a maximum depth of nearly 200 m), the main cave systems are yet to be reached. Hydrologically, the most important underground cavities are *Peştera de lângă Ponor* (*4*), the longest of the plateau (139 m), capturing underground a short allogenic surface stream, *Avenul de sub Dealul Lacului* (*1*; ~ -15 m), hydrologically connected to discrete losses in Butgheorgheşti Valley bed, and *Avenul cu Sala de la Izbucul Mare* (near B in Fig. 1, 44 m; h = -23.3 m), a former exit point for the waters of Izbucul Mare (Fig. 1).

4. Hydrogeology

The distribution of ponors and karst springs is variable, 10 of the 13 ponors occurring in the southern half of the plateau. Four karst springs drain the entire limestone surface, one to the south, tributary to the Crişul Repede River, and the other three north, towards the Barcău river basin, all situated at altitudes between 600-650 m. The most important of these springs are Izbucul Mare (*B*), north of the plateau, and Izbucul Negrenilor (*A*), with an average flowrate of 25-30 l/s (Fig. 1).

All ponors are located near the contact between limestones and werfenian impermeable rocks. They drain short independent surface streams originating from springs in werfenian rocks, at 800-850 m asl in the hills bordering the plateau. The surface streams have low flowrates (< 5 l/s) and some of them get dry during summer.

Uvalas and large dolines occurring across the whole plateau, with a larger extent in the northern half, provide direct access points for meteoric water.

So far, 4 tracing tests with fluorescein and rhodamine have been applied in order to elucidate the underground drainage directions and recharge areas for each spring (Table 1, Fig. 1). The tracers at springs were determined by visual observations and the water samples were taken at 30 minute or 1 hour intervals, according to flowrates and weather conditions. Fluorescein concentration in water samples was determined with a FASCO FP-750 fluorimeter.

Water parameters measured are very similar for all surface watercourses, with temperatures around 6°C and conductivities ranging between 100-150 µS/cm (Gabrian 2006). Water temperatures of the karst springs measured in April 2006 were 7.4-7.7°C during high flow conditions, however Puinean (2000) recorded temperatures ranging between 9.4 -10°C at Izbucul Mare. Conductivity values mesures at the karst springs range between 650 and 800 µS/cm, with the exception of Izbucul Paltinilor (*C*; >1000 µS/cm). This may point to a predominant infiltration recharge for Izbucul Paltinilor, in the northern part of the plateau where there is no surface flow.

The hydrological connection of Izbucul Negrenilor with Valău (*7*) and Holăneşti (*3*) ponors, correlated with field observations and cumulated flowrates, may point to its recharge by all 8 ponors from the south-eastern part of the plateau, including Peştera de lângă Ponor (*4*) and the discrete losses in the Butgheorgheşti Valley, close to Avenul de sub Dealul Lacului (*1*,*2*).

The only ponor with permanent flow in the NE part of the plateau is Triscu (*9*), recharging the karst system of Izbucul Mic (*D*). It is therefore probable that the recharge of Izbucul Mare (*B*) is done through the four ponors from the W side of the plateau and by water infiltrating in the large doline fields from the same sector.

No.	Ponor	alt. (m)	date	Q (l/s)	spring	Q (l/s)	alt. (m)	Length (m)	Time (hours)	Velocity (m/h)
1	Valău	741	16.04.06	<1	Negreni	30	600	1000	5	200
2	Tiţu	734	23.04.06	1-2	Negreni	30	600	1050	?	-
3	Triscu	723	29.04.06	<1	Mic	5	652	750	18.5	40.5
4	Holăneşti	793	30.04.06	2	Negreni	30	600	1190	14	85

Table 1. Underground drainages in the Ponor Plateau.

Limnology studies done at Izbucul Mare by Puinean et al. (1998) and Puinean (1999) have uncovered a high diversity of aquatic fauna, with organisms belonging to 15 taxonomic groups. The water quality estimated for Izbucul Mare from these studies was noted with 10 according to the Belgian Biotic Index (De Pauw and Vanhooren 1983; De Pauw et al., 1986; Puinean 1998), based on the high faunal diversity and on the presence of several groups of organisms sensitive to changes in water quality. As anthropic activities are reduced to low-intensity agriculture, animal husbandry and forestry, and human settlements on the plateau are mostly temporary, and based on the similar values of the water parameters measured, the water of the other three springs is believed to have the same characteristics.

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