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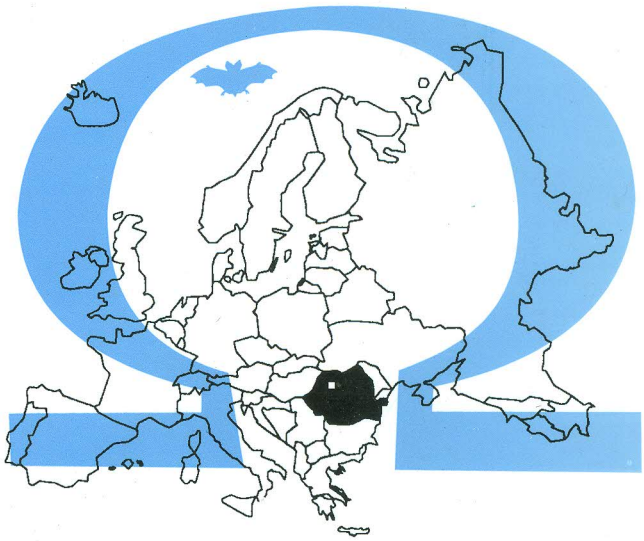

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The Hydrogeology of Apuseni Mountains - A Brief Overview

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Limestone deposits from Apuseni Mountains outcrop on a total surface of 1074 km^2 (Bleahu & Rusu, 1964) and represent circa 10.5% of the total surface of these mountains. They deveop mostly in Pădurea Craiului Mountains (330 km^2), Bihor Vlădeasa Mountains (236 km^2), Codru Moma Mountains (165 km^2), Trascău Mountains (87 km^2), Poieni Plateau (45.5 km^2) and the crystalline "island" of Rapolt (25.8 km^2). In the above mentioned areas they they form compact surfaces totalizing 891 km^2. They are mostly represented by sedimentary limestones and dolostones; their metamorphic correspondents do not surpass 10% of the total outcropping surface of the carbonate deposits.
In the Apuseni Mountains there have been done 165 tracer labellings, of which 108 have been done by the author, alone or in collaboration with other researchers; the rest of 52 tracings have been performed by the researchers from the "E. Racoviţă" Speological Institute. The longest drainage, of 11.55 km, is between the streamsinks of Peştişel creek and the Aştileu spring, in Pădurea Craiului Mountains (Orăşeanu, 1991).

In the general context of the Romanian karst, Apuseni Mountains stand out either by the high density of their karst areas, and by their diverse and beautiful landscape. Karst genesis is linked to the uplift periods of the Bihor carbonate platform, namely in the Upper Triassic, Upper Jurassic and especially the present stage, which began in Paleogene. Karst of the second generation is well known due to bauxite exploration and exploitation.

The dynamic resources of groundwaters in the karst areas of the Apuseni Mountains, equivalent to the mean multiannual cummulated flowrates of the karst sources (sources surveyed with flowrates bigger than 1 *l/s,* sistematically studied measured in expeditions or esteemed) have thefollowing values: Pădurea Craiului Mountains *4.48* m^3/s, Bihor Vlădeasa Mountains (without Valea Seacă area) - 3.87 m^3/s, Codru Mama Mountains - 2.10 m^3/s, Poieni Plateau - *0.81* m^3/s, Trascău Mountains - 0.75 m^3/s and the crystalline "island" of Rapolt *-0.034* m^3/s. The cummulated value of these resources is of 11.84 m^3/s and was calculated forthe period 1978-1998 (Orăşeanu, 2000).

Padurea Craiului Mountains

The Pădurea Craiului Mountains lie in the north-western part of the Apuseni Mountains. They appear in the form of a digitation, extending far towards west,

almost reaching Oradea (for further details on karst geology of this unit see the presentation from the field trip guide).

Up to now, 74 tracer labellings have been performed by various authors pinpointed 78 general directions of f10w of underground waters. The apparent velocity of these labellings stood at 46 m/hour. The relatively high value of this velocity and the interpretation of the curves showing the passage of tracers through monitoring sections indicate a mixed circulation: channels and fissures (Orăşeanu, 1991).

From a chemical point of view, the underground waters in this massif are rich in calcium-carbonate and calcium-magnesium waters. The only exception is represented by the waters in the lower course of the Mişid brook where calcium-sulfate-rich waters are to be found (with a pH values up to 3). Their low pH is due to local oxidation of pyrite by percolating water (Vălenaş & lurkiewicz, *1980/81).*

Bihor-Vladeasa Mountains

As a consequence of the great diversity of the geological and tectonic settings of the bedrock, the karst systems are of binary type, with a large variety in size and hydrological parameters (e.g., Galbena and Tăuz springs) (Orăşeanu, 1996). The karst spring f10w rates extend over a very wide range, with a 550 *lls* maximum mean multiannual value recorded in the case of Galbenei spring over the hydrologic year October 1984-Septemb~r 1985. More than 62 tracer labellings were accomplished up ta the present in the karst of Bihor-VIădeasa Mountains. An ave rage of 45 *m/h* of flow velocity was recorded.

The water of the karst systemsis of calcium bicarbonate, calcium-magnesium bicarbonate, ahd magnesiumcalcium bicarbonate type, depending on the chemical composition of the traversed bedrock (limestones *and/or* dolomites), with TDS values ranging between 125 and 529.7 mgll. Larger TDS content was recorded for those springs that either have their supply derived exclusively from large extent carbonate formations, or include a small nonkarstic catchment basin that supplies part of a large karst system (e.g., Ocoale, Apa Caldă). The karst systems of smalt dimensions and with a larger contribution of the nonkarstic catchment basins have lower TDS content (for example, the karst system of the western slopes of the VIădeasa Mountains.

Codru-Moma Mountains

In the Codru-Moma Mountains (western part of Bihor Massif) the karst terrains cover a surface of about 165 km^2 as foltows: Dumbrăvi`a de Codru-Moneasa area (62 km^2), CIăptescu area (13 km^2), and Vaşcău Plateau (90 km^2).

The complex hydrogeological research conducted in the Moneasa area indicates the presence within the deposits of the Finiş Nappe of a large hydrogeological karst system, which is partialty thermalized at its southern

terminus where the contact with the impermeable rocks of the Moma Nappe occur.

The chemistry of the cold and thermal waters at Moneasa is calcic-magnesian with low mineralization. In time the chemical composition of the water of the thermal springs fluctuates substantially. The most significant variation was recorded in the case of the ionic species Na+and 504-. These variations show that cald waters are the origin of the thermal waters at Moneasa (Orăşeanu, 1987).

Vascau Plateau

Vaşcău Plateau is reputed for being the place where the first tracing in Romania was made by Mihu'ia, in 1904 (OrăşeanUl 2000). It has a compact closed surface of 73.3 km , one of the largest in Romania (Orăşeanu 1985). To determine the f10wdirections of the groundwaters and the parameters of these f1ows,there have been done 15 tracer labellings. The average apparent velocity of the tracers (first arrival) was 81.4 *m/h.* Boiu spring discharges most of the plateau waters. Tracer labellings showed that it extends its influence area to the southwestern part of the Vaşcău Plateau, from Câmpeneasca Cave to Ponoraş and 5făraş spring, next to Zugău Valley. Ponors through which the karst system is fed are situated at distances of 1.7-8.15 km from Boiu spring.

Poieni Plateau

Poieni Plateau lies south of Arieşul Mic river. on a surface of 88 km^2 and represents the area with the largest extension of crystalline limestones in Metaliferi Mountains (45.5 km^2). In its whole, Poieni karst Plateau has practically no surface waters, due either to rapid infiltration of rain waters, and to the absence of a cover of impervious rocks in the neighbouring areas or at higher altitudes.

Trascau Mountains

In the Trascău Mountains limestones outcrop on a surface of circa 87 km^2, of which 19.2 km^2 are crystalline limestones. Water accumulations located in carbonate deposits are allimented exclusively from rainwater.

The strong tectonic and morphologic fragmentation of the limestones from Trascău Mountains is hydrogeologically reflected by'the presence of numerous karstic systems with a limited extension, discharging through low flow sources. Most springs are of lithological contact type due to the "suspended" position of limestones with respect to the neighbouring valleys. 5prings appear on valley slopes and are frequently situated high above the local base level. The average flowrates of the main sources were: Valea Morii spring (Lunca Arieşului village) - 25.8 *Ils,* Şipote - 25.8 l/s, Huda lui Papară Cave - 234 Ils and lezerului spring - 94 l/s.

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