3.13.8. UPPER WATERSHED OF GEOAGIU RIVER (THE METALIFERI MOUNTAINS)

In the upper section of Geoagiu river watershed, in Metaliferi Mountains, carbonate deposits make up a continuous ridge, 10 km long, between Cheile Cibului and Almaşu Mic de Munte settlements (Fig. 8.1). The ridge is 2 km wide and is transversally crossed by Cib and Glod streams which shaped extremely spectacular gorges: Cibului gorge and Glodului gorge respectively (P. COCEAN, 1988).

Cib stream cuts a 1.4 km long canyon in limestones, hold up by steep areas. Lapies, towers and detrital hillslope materials accompany the shapes of karstic relief. Before going out the canyon, on the right side, we notice a fall, 3-4 m high, fed by thermal waters from Feredeul Băcâii spring.

Going along Glodului gorge is highly difficult since it means crossing the stream several times and going up the steep sides of the mountain to avoid narrow areas downstream and upstream the canyon, covered by boulders and whirlpools. At the downstream part of gorge (Fig. 8.1), a spring with a 2-3 l/s debits comes up from the Eastern side, while a few dozens metres upstream, in the opposite wall, another spring, Tămăduirii spring, also known as Feredeul Glodului spring, shows up, of an average debit of 8 l/s. Over the spring, a cave opens up, yet it is blocked by rocks and acting as a overflow cavity.

Downstream Ardeu village, Glodului stream, further known as Ardeu stream, cuts Tithonian limestones in the Eastern extreme side of Pleşa Mare hill as a narrow short canyon known as Ardeului gorge.

South of the limestone ridge mentioned above, a compact block of Tithonian limestones comes up (3 × 1.5 km) connected to the most Southern deposits in Apuseni Mountains tectonic structure. Known as Pleşa Mare, this block, clearly visible given its height and steep relief of the hillsides, is transversally cut by Geoagiu river waters which build up a wild canyon, Madei gorge.

8.1. Stratigraphic and structural framework

The area revealed in this article is placed in the central sector of Metaliferi Mountains and is made up of sedimentary and eruptive formations. The current structural view is based on studies undertaken by GH. MANTEA and C. TOMESCU (1986), researchers who pointed out for the first time the position of Tithonian limestones in the overthrust structure, personalizing Ardeu Nappe, a tectonic unit thrust over Căpâlnaş-Techereu Nappe (LUPU, 1972), built into a volcanic ophiolitic formations at the bottom and a series of lower cretaceous deposits in the upper section.

Căpâlnaș-Techereu Nappe

Mesozoic volcanic formations cover large sourfaces of Metaliferi Mountains, being placed during three stages, the Jurassic (Oxfordian), the Oxfordian-Neocomian and the Barremian-Aptian one. In the explored perimeter, the products of the second stage of magmatism are present, being represented by quartz-based adesite mixed with horneblende constituents, pyroxenes and biotites with layers of brecia and pyroclastic conglomerates alternating with cinerites and basaltic and andesite lavas.

North of Pleşa Ardeului hill, in the area of Picui-Blidărea, outcrop the Valea Dosului Beds (Aptian), consist of alternating grey micaceous sandstones in centimetric layers, quartzitic conglomerates, sandy clays and siltites with beds of calcareous conglomerates.

Ardeu Nappe

The constitution of this structural unit includes a series of carbonate deposits connected to

the lower Oxfordian-Aptian interval, with Dumbrăviţa limestones (Oxfordian-Kimmeridgian) at the bottom, Ardeu limestones (Tithonian) and Băcâia limestones (Urgonian) in the upper part.

Dumbrăviţa limestones are represented by red and green nodular limestones in ammoniticorosso facies of a 40 m average thickness.

Ardeu limestones are most of the carbonate structure developed in Ardeu-Cib interfluve. They are white-yellow, massive, granulous limestones similar to those developed in Stramberg facies. They are 150 thick, cover Dumbrăviţa limestones and are transgressively covered by Ecocretacic limestones in Urgonian facies.

Băcâia limestones (lower Barremian-Bedoulian) are 6 m thickness and are covered by unlayered grey-blackish limestones 40-50 m deep.

The structural setting of Ardeu-Cib is marked by plicative elements, and the disjunctive ones are secondary. The tectonic element conferring a spectacular aspect of the structural overview is represented by Ardeu Nappe built of a Oxfordian-Bedoulian limestones sequence overthrust Căpâlnaş-Techereu Nappe deposits.

The deposits of Ardeu unit are separated in several blocks by vertical faults, the most remarkable being the Întrepietre-Ruptura fault, headed ENE-WSW and Cib fault, headed NNE-SSW.

In the North-East, East and South, the limestone deposits is surrounded by predominant clay deposits of Valea Mică-Galda (Santonian-Campanian) and Bozeş (Santonian-Maastrichtian) nappes.

A red continental mollasic formation is represent by the Almaşu Mare gravels (Miocene-Lower Paleogene), with a continental-lacustral and laguna-like sedimentation, consist of slightly cemented and well rolled gravels (quartzites, ophyolites and limestones) surrounded by a brick red micaceous argillaceous matrix (BORCOŞ M., MANTEA GH., 1964). The literature mentions the presence of gypsum lenses in gravels. The presence of a sulphate-chloride type spring in Tina Sărată from Valea Roşie stream can being explained also by the presence of gypsum and salt lenses in the gravels in this area.

In Cheile Cibului - Almaşu Mic de Munte limestone ridge, two areas with well developed carbonate deposits are include: Pleşa Ardeului and Glodului gorge - Pleşa Moşului (Fig. 8.1).

8.2. Pleșa Ardeului area

Pleşa Ardeului area, present in the interfluve between Cib and Ardeu streams, is morphologically dominated by the summit with a similar name (855.1 m), a limestone massive surrounded by steep areas, 300-400 m over talwegs in neighbouring streams. The interfluve looks like a limestone plateau, partially covered by lapies and dolines.

The relief of the limestone plateau goes in the central section of Blidărea-Picui, shaped in the Aptian friable sandstone-clay deposits of the tectonic structure of Căpâlnaş - Techereu Nappe. The area is crossed by a temporary stream, Blidărea, placed at the contact with Tithonian limestones. The downstream section of the plateau (Picui) is slightly bent to the South, towards temporary ponors from where the water of springs in Aptian detritic deposits goes underground.

Detritic deposits in Blidărea - Picui depression are extended in the upper part of Întrepietre brook basin too. Aquifer reservoir in this area are discharged in low-debit springs feeding the superficial flow (Fig. 8.1, no.1) and the permanent ponor in the right side of the stream (Fig. 8.1, no.2).

Pleşa Ardeului karst massive has aquifer reservoir drained towards the supplies of Cib and Ardeu streams. Discharges measured by I. POVARĂ and V. HOROI (1993) in successive hydrometric sections placed on Cib and Ardeu streams, during 1991-1992 period, pointed a gradual raise of debits from upstream to downstream, according to the raise of the surface of watershed. Superficial courses do not feed karst aquifer, but are fed by them.

The areas where limestone outcrops are lack of a superficial flow, the amount of water coming from rainfalls are being completely infiltrated. Besides such surfaces, the soil is very thin and undeveloped, having no filtration or temporary retain ability for infiltrated waters. The karst plateau is covered by pastures (about 75%) and scattered leaf tree woods.

Aquifer reservoir in detritic Aptian deposits in Căpâlnaş-Techereu unit inside Blidărea-Picui area contribute to feeding karst aquifers in the Eastern side of Pleşa Ardeului massive, and such deposits are fed by rainfalls. They feed the karstic aquifer

based on a direct transfer of water underground and via the ponors fed by springs in Picui area and the upper reservoir of Întrepietre stream.

The discharge of the karst aquifer in the Eastern side of Pleşa Ardeului massive is mainly done by Feredeul Băcâii spring. The reservoir in the Întrepietre perimeter are probably discharged through the Subcetate spring (Fig. 8.2, no.3).

Feredeul Băcâii spring comes from Tithonian limestones on the right side of Cib stream, before the stream goes out of the canyon. It is located at 430 m absolute altitude and comes from a crack widened up by waters. The supply is cached in a concrete pool, and the water travels via a pipe to bottling unit of mineral water in Băcâia, located nearby.

The water of the South-Eastern ponor in Blidărea-Picui was marked with fluorescein. The tracer came up in Feredeu Băcâii and breack-through curve for tracer in the spring indicates a swift flow in well-shaped karst voids.

In hydrological studies, Feredeul Băcâii water is mentioned as having 24-25°C. In raining season, mainly when snow melts, the contribution of cold waters with a low mineralization is felt at the supply section through a lowered temperature and mineralization. This is also attributed to a swift transit of infiltrated waters, as proved by the tracing.

The water of Feredeul Băcâii is a $CaHCO_3$ type. A sample of water in 1974 indicates a 532,4 mg/l mineralization, slightly higher than the average of karst waters. Its thermal composition makes it being considered a mesothermal water (20-36°C) with a mix of deeper waters warmed up by a geothermal flow, as well as karst waters.

8.3. Glodului gorge - Pleșa Moșului area

From Cheile Glodului westwards, the width of the limestone ridge is gradually reduced from 2.5 to 1 km at Pleşa Moşului and further, to Almaşu Mic de Munte, for 3 km, the limestones make up a calcareous stripe of 1 km width. These limestones, come on the interflueve from Geoagiu river and its tributary, Almaşu, are positioned in dominant altitude over the surrounding relief with negatively influences for their hydrologic potential (Fig. 8.1).

West to Cheile Glodului, their steep relief turns into a karst mild plateau split by wide hills in three depressions, Găuri, Fântânele and Lungoaia.

The accumulation of underground water in Almaşu Mare gravels deposits, which partially covers the plateau, are discharged through springs of low debits feeding a superficial flow which infiltrates in the limestones through impenetrable ponors or small caves.

The flow of water going into Gaura fără Fund cave in Găuri depression (Fig. 8.1, no. 4) was labelled by I. POVARĂ and V. HOROI in 1991, the tracer reaching Izvorul Tămăduirii (Feredeul Glodului) with a supposed 37 m/hour speed. The authors consider the waters in the other two depressions may reach the same spring.

8.4. Pleșa Mare Area

The block of Tithonian limestones in Pleşa Mare (Fig. 8.1) is transversally crossed by the waters of Geoagiu river, and they create a spectacular abrupt-walled canyon, known as Madei gorge. The canyon splits the block of limestone in two pieces looking like conical massive towers with well-bent sides and small plateaus at the top, Pleşa Mare (711.7 m) in the East, and Dosul (684.6 m) in the West. The limestones in the Western side of Dosul hill are cut by Roşia stream, a flow of a temporary character shaping a section of the canyon known as Roşiei gorge.

Downstream Madei gorge, on the right bank, at the bottom of a vertical wall shaped in massive Tithonian limestones, a karst spring of 15 l/s emerges with an average temperature of 13.5°C. The spring called by locals "Apa Acră" ("Sour Water"), has the main physic-chemical characteristics in Table 1. (Samples analysed at 15 November 1996).

At about 15 meters upstream this spring, in an area of limestones stratification intensely solved by water, there is a temporary spring with a chemical composition similar to the spring downstream.

We think Apa Acră spring is fed by infiltrations taking place on Dosul hill and mainly by aquifer reservoir in Almaşu Mare gravels (m_2-pg_1), deposits widely spread in the medium and upper watershed of Roşia stream. The high contents in sulphates and chlorides in the spring water in Tina

Source	pH	T °C	EC µS/cm	Cl^-	SO_4^{--}	HCO_3^-	Na^+	K^+	Ca^{++}	Mg^{++}	CO_2*
				ppm							
Apa Acră spring	6.54	13.9	990	35.5	30.7	768.7	44.1	3.3	216.4	17.0	352.0
Spring in Tina Sărată	6.44		5340	70.9	864.1	3843.6	1585.0	43.8	153.9	62.7	677.6

* CO_2 as dissolved gas

Table 8.1. Main physical and chemical characteristics of springs (analyses performed in S.C. Prospecțiuni S.A. Laboratory in 1974 year).

Sărată (Fig. 8.1 and Table 8.1) being attributed to the lens of gypsum and salt known as being present in such rocks.

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