FUŞTEICA CAVE: A GEOLOGICAL APPROACH

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Abstract. Among the caves in the northwestern part of Oltenia, Fuşteica Cave is peculiar by the linear aspect of the ENE-WSW trended gallery and by the presence of a large volume of gravels with sandy-argillaceous matrix draping its entire length. Structural data on the fault plane along the gallery and the associated fissures in the host carbonate massive, related with the cave morphology and the underground waters drainage, support the tectonic control of the karstification processes. Petrographic data on pebbles from gravels and XRD data on argillaceous fraction from matrix show that the source area of the sedimentary fill is the Tismana granite.

Keywords: Fuşteica Cave, tectonic control, source area.

Rezumat. Peştera Fuşteica: o abordare geologică. Între peşterile din nord-vestul Olteniei, Peştera Fuşteica se individualizează prin aspectul liniar al galeriei, cu direcţie ENE-WSW, şi prin prezenţa unui volum mare de pietrişuri cu matrice nisipos-argiloasă pe toată lungimea sa. Date structurale privind planul de falie din lungul galeriei şi fisurile asociate din masivul carbonatic gazdă, corelate cu morfologia peşterii şi drenajul apelor subterane, susţin controlul tectonic al proceselor de carstificare. Date petrografice privind galeţii din pietrişuri şi date de difracţie RX obţinute pe fracţia argiloasă din matrice arată că aria sursă a umpluturii sedimentare este granitul de Tismana.

Cuvinte cheie: peştera Fuşteica, control tectonic, arie sursă.

INTRODUCTION

Fuşteica Cave is located in the carbonate massive in the southwestern extremity of the Vâlcan Mountains, Gorj County, Isvarna village. It is an easily accessible cave, with a width of 3 m and 5 m high entrance, located at 216 m altitude. The gallery has 1270 m in length, with +10 m difference in level. Characteristic for this cave is the linear development on a single gallery with ENE-VSV general direction (Fig. 1b), the height of which varies from 2.5 m to 7 m. Over its entire length, there are thick deposits of red terrigenous sediments, well preserved near the walls. The present paper tries to demonstrate the important role of tectonics in the cave formation and to contour the source area of its sedimentary fill.

GEOLOGIC AND TECTONIC SETTING

Fuşteica Cave is developed in Barremian-Aptian limestones representing the upper term of the carbonate Mesozoic cover lying on the metamorphic-magmatic basement of the Vâlcan Mountains. The basement rocks mainly consist in amphibolite gneisses of the Drăgşan Series, mica gneisses and micashists of the Lainici-Păiuş Series, and granitic rocks of the Tismana batholith. The sedimentary cover in Fuşteica Cave region is directly lying on granites.

The Tismana batholith consists in porphyritic granites with K-feldspar (microcline) phenocrysts, diorites, granodiorites and aplitic granites (BERZA, 1978). The granitic rocks in Fuşteica Cave area are covered by Lower Jurassic clastic formations represented by conglomerates and quartzo-feldspathic sandstones with interbedded silty clays, Middle Jurassic-Aptian carbonate formations, and Cenomanian-Middle Turonian formations, represented by marls, marly limestones and silty clays (POP et al., 1975). The lower part of the carbonate formations (Middle Jurassic-Neocomian) mainly consists in bedded limestones and dolomites while the upper one (Barremian-Aptian) is bearing massive Urgonian limestones (POP, 1973).

In the Alpine nappe system of the South Carpathians, result of the Middle Cretaceous (Austrian) and Late Cretaceous ("Laramian") tectogeneses, the Vâlcan Mountains belong to the Lower Danubian Units (IANCU et al., 2005). In Tismana - Baia de Aramă region, the Vâlcan Mountains join the bending area of the South Carpathians due to the Moesian microplate translation towards WNW, accommodated by Pre-"Laramian" compressions and Post-"Laramian" lateral faults (AIRINEI, 1983). Such lateral faults are E-W to ENE-WSW trended in the northern part of the Mehedinţi Plateau, and ENE-WSW to NE-SW trended in the southwestern part of the Vâlcan Mountains, some of these being seismically active (ATANASIU, 1961). For our discussion, the most important faults in this region are the Izverna fault, the Balta-Baia de Aramă tectonic trench, and the Motru fault (Fig. 1a).

The movement on the Izverna fault is a dextral strike-slip, with E-W direction on Izverna-Ponoarele sector and NE-SW direction on Ponoarele-Apa Neagră sector, where the fault joins Balta-Baia de Aramă tectonic trench, with the same direction and sense of movement (IANCU et al., 1986). The ENE-WSW to NE-SW trended faults on the southwestern border of the Vâlcan Mountains must represent the eastward prolongation of both Izverna and Balta-Baia de Aramă faults.

The two faults are intersected by the Motru fault on the Motru Valley, near Apa Neagră village, where the carbonate rocks show an extreme cataclastic deformation, visible in the quarry on the right slope of the valley. The movement on the Motru fault is a normal dip-slip, with the eastern block of the Vâlcan Mountains up-lifted towards the western block of the Mehedinţi Mountains and Plateau. A lot of secondary parallel faults occur in the up-lifted tectonic block affecting both the Tismana batholith and its sedimentary cover.

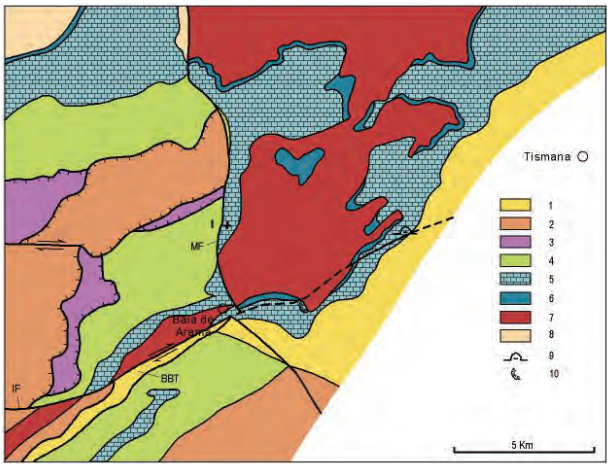

Figure 1a. Simplified geological map of Tismana-Baia de Aramă region. After NĂSTĂSEANU et al. (1968) and POP et al. (1975). 1- Tertiary sedimentary deposits; 2 - Getic Nappe; 3 - Severin Nappe. Danubian Mesozoic cover: 4 - Cenomanian-Middle Turonian non-carbonate cover; 5 - Middle Jurassic-Aptian carbonate cover; 6 - Lower Jurassic sandstones and conglomerates. Danubian basement: 7 - Tismana granite; 8 - Lainici-Păiuş Series. 9 - Fuşteica Cave; 10 - Apa Neagră Quarry. Abbreviation: BBT - Balta - Baia de Aramă tectonic trench; IF - Izverna fault; MF - Motru fault.

Figure 1b. Fuşteica Cave. After BURGHELE-BĂLĂCESCU & AVRAM (1966).

TECTONIC CONTROL OF THE KARSTIFICATION

The ENE-WSW general direction of Fuşteica Cave is coincident with the direction of a fault plan measured at the gallery entrance. The linear geometry of the gallery and its angular transverse cross section, of a tight and tall corridor with ogival ceiling (Fig. 2a), suggest the tectonic control of the karstification processes leading to the cave formation. The few issued data on this topic suggest the cave was formed along stratification and related fissures (BURGHELE-BĂLĂCESCU & AVRAM, 1966).

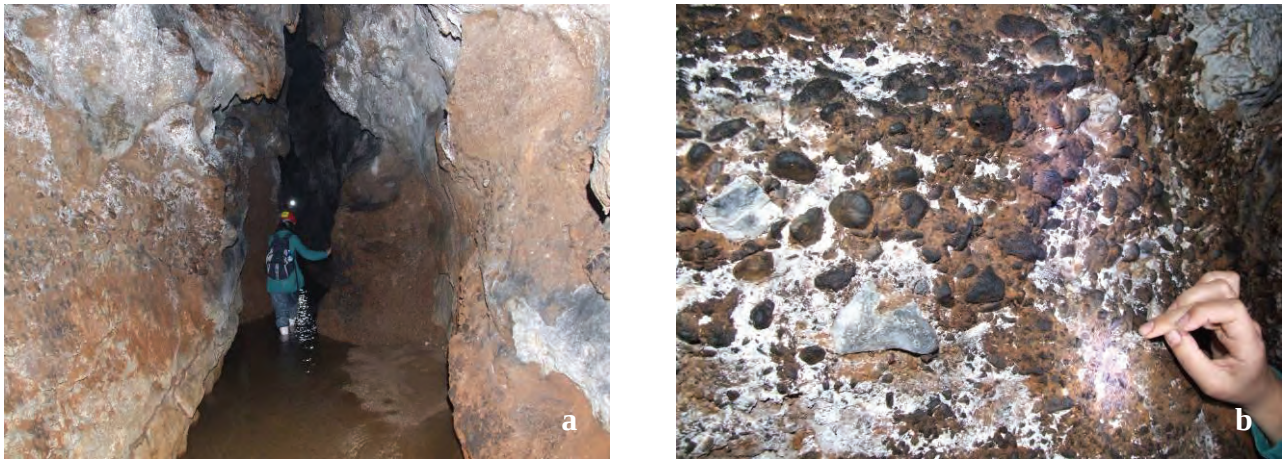

Figure 2. Thick deposits of weakly consolidated gravels with sandy-argillaceous matrix in Fuşteica Cave: a) general view; b) detail with calcareous (angular, gray) and silicates (rounded, dark) pebbles (photo: C. Munteanu).

Without denying the role of bedding in the water infiltrations inside the carbonate rocks, I consider that the faults are more important structural discontinuities for karstification. A strong reason for the tectonic control of karstification is the NE-SW underground drainage of karstic waters on the southwestern border of the Vâlcan Mountains, across the natural stream of surface waters (RĂDULESCU et al., 1987) but coincident with the main tectonic lines in this area.

Preliminary structural measurements in the carbonate massive hosting Fuşteica Cave show that the directions of the planar discontinuity correspond to the directions of the gallery sectors diverting from the general direction ENE-WSW. The structural discontinuities at the entrance of the gallery and Apa Neagră quarry, represent:

- a fault plane along the cave, with NE/ENE-SW/WSW direction (340°/80°);
- low-angle shear fissures, with NE/ENE-SW/WSW direction (170°/60°);

- tension fissures, with NW-SE direction (50°-60°/40°-55°);
- bedding surfaces, with NNE-SSW direction and ESE dip (110°/20°-40°);
- fissures parallel to the Motru fault, with N-S direction (270°/70°).

The low-angle shear fissures and the tension fissures are genetically related to the fault along the cave. Their orientation towards the fault plane shows a dextral strike-slip movement in transpressive tectonic regime (e.g. SANDERSON & MARCHINI, 1984). Quite informative, these data point out the role of tectonic discontinuities in the cave formation, more important than the role of stratification.

SOURCE AREA OF SEDIMENTARY FILL

The sedimentary fill of Fuşteica Cave consists in thick deposits of gravels well preserved near the walls (Fig. 1a), with quartzo-feldspathic sandstones, microconglomerates, limestones and granites pebbles into a red sandy-argillaceous matrix (Fig. 2b). The sandstones and the microconglomerates contain many clasts of quartz and microcline and lithoclasts of granites. The microscope examination of the granitic pebbles shows the biotite chloritisation and the advanced sericitization of plagioclase, contrasting with the fresh microcline (Fig. 3). The selective alteration of feldspars is a characteristic process for the Tismana granite. It is clear the granitic pebbles were provided by the Tismana batholith, directly or reworked from detrital sedimentary formations lying near the cave, Early Jurassic ("Lias") in age or younger (Miocene and Pleistocene).

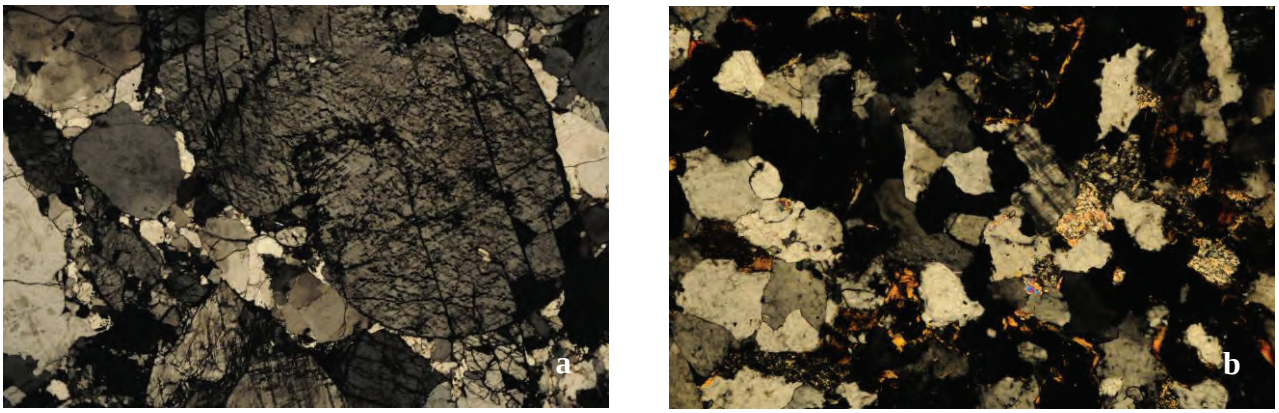

Figure 3. Microphotographs (N+, 30x) in pebbles from gravels: a) microconglomerates with rounded clasts of K-feldspar; b) aplitic granite (original).

The XRD analysis of the matrix pointed out the presence of K-feldspar, quartz and clay minerals. In the argillaceous fraction separated from matrix there were identified illite (67.5%), kaolinite (18%), vermiculite (8.3%), smectite (5.5%) and chlorite (0.7%). Quantitative information exclusively refers to proportions among clay minerals.

The high illite proportion in the argillaceous fraction is the result of the advanced sericitization of plagioclase in the Tismana granite (Fig. 4a). The fact that the K-feldspar is fresh (Fig. 4b), especially the microcline, explains why this is the most non-argillaceous mineral in the composition of analysed samples, beside quartz.

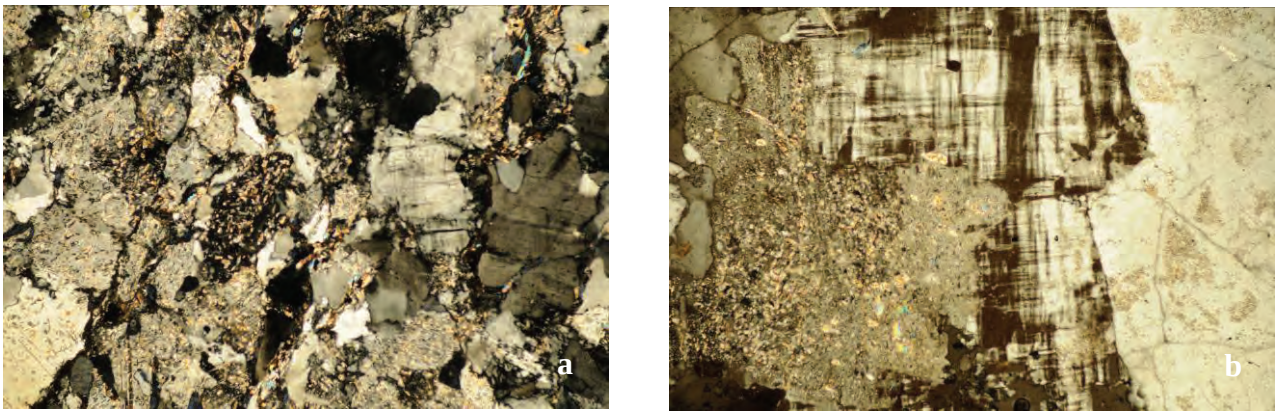

Figure 4. Selective weathering processes in the Tismana granites: a) general view; b) detail with sericitised plagioclase and fresh microcline. Microphotographs (N +, 30x) (original).

CONCLUSIONS

The karstification processes that led to Fuşteica Cave formation were tectonically controlled by a fault plane trended ENE-WSW on Apa Neagră sector, representing the Izverna fault prolongation eastward from the Motru Valley. The fault plane is accompanied by fissures of tectonic origin along which different oriented sectors of gallery formed. A small part of these short sectors formed on stratification. Other arguments for tectonic control are the galley morphology and the ENE-WSW direction of the underground waters drainage on the southern slope of the Vâlcan Mountains, coincident with the gallery direction.

In an advanced stage of its development, Fuşteica Cave was completely or almost filled with sediments. This event probably took place during the Pleistocene, when the host carbonate massive was covered by fluviatile gravels, now preserved as remnants of the Gornoviţa surface erosion (POP et al., 1975), at 400 m altitude, more than 100 m higher than their outcropping level in the Motru Valley. For the transportation and the deposition of such a large volume of sediments to the entire length of the gallery, an important stream water was required, also involving a western entrance, now buried by the Pleistocene gravels in the Motru Valley.

The petrographic and mineralogical study of the sediments from Fuşteica Cave shows that the main source area is the Tismana batholith. The cataclastic deformation related to fractures favoured the weathering and erosion processes in order to supply the detrital material.

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