TECTONICS OF PLIO-PLEISTOCENE COAL-BEARING DEPOSITS FROM MOTRU-JIU AREA

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Abstract. The coal mining works occurring in the westernmost sector on the Southern Carpathians Foredeep relieved several tectonic features of the Pliocene-Quaternary deposits. There are folded structures (anticlines and synclines), faults, and crevasses. The majority of major faults are parallel to the Carpathian orogene. While the folded structures and the faults are exclusively a result of the late Cenozoic geological evolution, the crevasses may be consequences both of natural processes as well as of mining works. The folded structures and the faults influence the coal mining works (beds dipping, lateral continuity of strata).

Keywords: SW Romania, Southern Carpathians Foredeep, Pliocene-Pleistocene coal, tectonics.

Rezumat. Tectonica depozitelor plio-pleistocene purtătoare de cărbuni din sectorul Motru-Jiu. Lucrările miniere de extracţie a lignitului din sectorul occidental al Avanfosei Carpaţilor Meridionali au evidenţiat o serie de particularităţi tectonice ale depozitelor plio-pleistocene. Sunt prezente atât structuri cutate (anticlinale şi sinclinale), falii şi crevase. Majoritatea faliilor majore sunt paralele cu rama Orogenului Carpatic. În vreme ce structurile cutate şi faliile sunt exclusiv rezultatul evoluţiei geologice din Cenozoicul terminal, crevasele pot fi mai degrabă rezultatele, în egală măsură, a proceselor naturale şi a influenţelor lucrărilor miniere. Structurile cutate şi faliile influenţează lucrările de extracţie a cărbunilor (înclinări ale stratelor, continuitatea laterală a stratelor).

Cuvinte cheie: SV României, Avanfosa Carpaţilor Meridionali, cărbune pliocen-cuaternar, tectonică.

INTRODUCTION

In Romania, the main area for coal mining is located in Oltenia (NĂSTĂSEANU, 1984; ŢICLEANU & PĂTRUŢOIU, 1987), in the Southern Carpathians Foredeep (SĂNDULESCU, 1984). The majority of coal is Pliocene and Pleistocene, the coal beds belonging either to the Jiu-Motru Formation (ANDREESCU et al., 1985), or to Cândeşti Formation. The coal is a result of the last part of the geological evolution of the Dacian Basin (JIPA & OLARIU, 2009). The stratigraphy of the Dacian Basin was recently refined by ANDREESCU et al. (2010).

The Foredeep evolved as a foreland basin occurred after the Upper Cretaceous folding events of the Southern Carpathians. The Plio-Pleistocene molasse, with thicknesses of several thousands meters, forms a large, slightly waved monocline draping older Cenozoic formations. In spite of its external uniformity, the Pliocene monocline is deformed and fragmented. In the Carpathians Foredeep the last main tectonic event leading to such effects happened in Lower Pleistocene, known as the "Wallachian Phase" (SĂNDULESCU, 1994). The Motru-Jiu area is just a part of this monocline, bounded by the Motru and the Jiu rivers, in Gorj District.

In fact, the geological history and the tectonic events that influenced the Motru-Jiu area is long and diverse. Several phases are documented: i. the uppermost Cretaceous ("Laramian", "Senonian") with main events: the overthrust of Supragetic and Getic Nappes over Severin Nappe and Danubian Units, followed by the genesis of the first Southern Carpathians Foredeep (SĂNDULESCU, 1984) as consequence of dextral deformation of the Southern Carpathians (RATSCHBACHER et al., 1993); ii. Pyrenean and Savian (Paleogene): increase of basin subsidence, advanced evolution of the Foredeep, sedimentation of the Paleogene-lower Burdigalian sequences (ROBAN & MELINTE, 2005); iii. Styrian (early/middle Miocene boundary, i.e. late Burdigalian/Badenian); iv. Moldavian (lower Sarmatian, i.e. intra-Volhynian) and Attic (Sarmatian), with genesis of east-west trended anticlines; v. Rhodanian (Meotian) with emerging tendencies of large areas located near the basin border; vi. Slavonian (late Pontian/Dacian boundary); vii. post-Dacian (early Romanian); viii. "Wallachian" (*sensu* STILLE, 1924: late Romanian/early Pleistocene; HYPPOLITHE & SĂNDULESCU, 1996 enlarged the "Wallachian Phase", considering it as a sequence of the tectonic events lasting from "middle Tortonian to early Pleistocene").

Tectonics of the Jiu-Motru Area

In this contribution we will stress out that the northern side of Rovinari coal area was strongly faulted, by faults associated to valley anticlines. Erosion, balking, rock alteration, bending of rock bed edges etc. all are recorded in the area of study.

1. Folded structures

Rovinari coal mining area is crossed from north to south by several anticlines and synclines.

Câlnic–Tg-Jiu syncline bounds to north the Pliocene coal deposits from Gârla and Tismana I areas. It has large amplitude, involving the coal beds labeled III, IV, and V north to Gârla open pit, and V, VI, VII north to Tismana I in Şomăneşti area. The survey carried out by Tg. Jiu Petroleum Trust recorded all these coal beds. The recent geological exploration carried out by drillings at Buduhala and Teleşti, pointed out the southward pitching of the Pontian (latest

Miocene; Fig. 1). In some situations, the erosion put directly in contact the Pontian and the Quaternary deposits (e.g. the Jiu River, at Tg. Jiu dam). Also, at Şomăneşti, the Quaternary deposits cover the early Romanian.

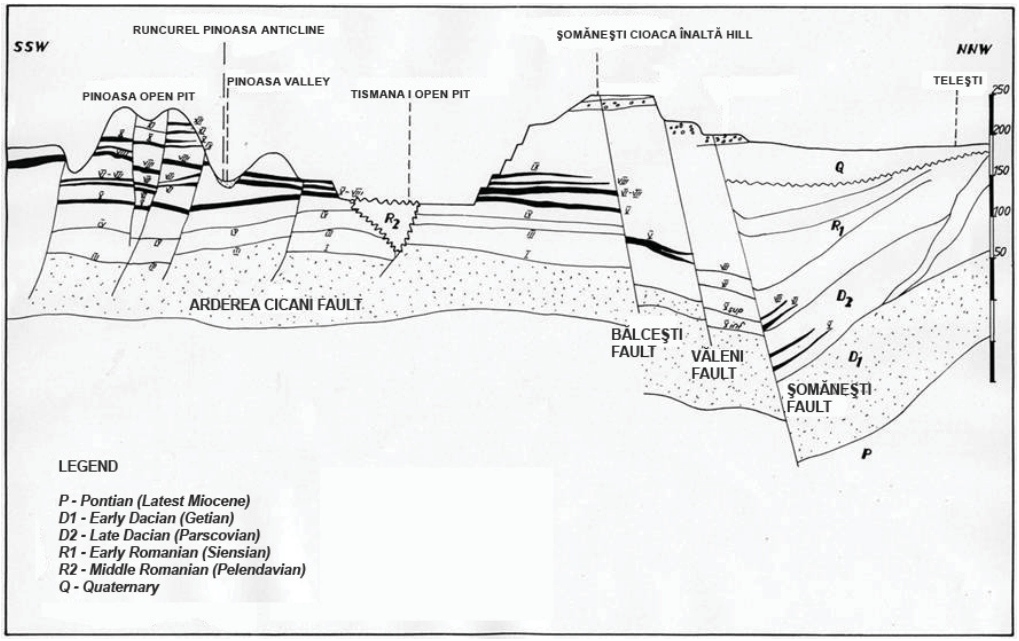

Figure 1. Geological section between Pinoasa and Teleşti.
Figura 1. Secțiune geologică între Pinoasa şi Teleşti.

The Runcurel-Pinoasa-Rovinari anticline (Fig. 2) is the most bumpy structure from Rovinari area, trended on 15 km west-east. There, the most numerous boreholes for geological survey had been done, at Tismana, Pinoasa, Gârla, and Rovinari-East areas. The correlation of faults from the right bank of the Jiu River with the ones from the left side is still on progress.

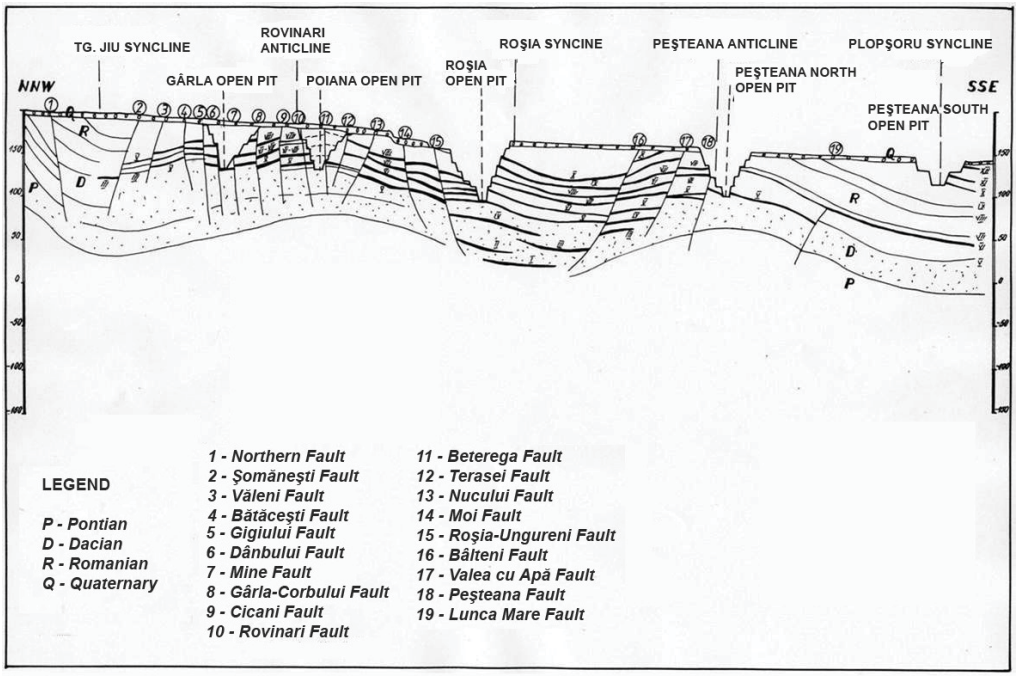

Figure 2. Geological section between Târgu Jiu and Plopşoru.
Figura 2. Secțiune geologică între Târgu Jiu şi Plopşoru.

The Roşia–Vlăduleni syncline crosses Roşia open pit, sinking the coal beds by 50-60 m, sometimes even more than the situation from Pinoasa open pit, due to a fault system. Among these faults, Roşia-Ungureni fault is the most important (Fig. 2). Due to the lowered level of the open pit floor to the local erosion base, the pressure of the artesian aquifer is strong (6-7 atm.), therefore coal mining is extremely difficult.

The Peşteana anticline is bounded by two faults located at the limit with Vlădureni syncline, which can be observed in Peşteana North open pit where the coal beds V, VI-VII, and partially VII are exposed. The tectonic deformations are rarer than in Rovinari.

The Plopşoru syncline begins in Peşteana South open pit, where the coal beds X, XI, and XII are exposed and continues southward to Plopşoru Sărdăneşti. It is devoid of faults.

2. Disjunctive structures

2.1. Fissures, cracks

These are structures occurred due to cracky response of several rocks on mechanical constraints. The amount of fissures is named fissure system. The fissures may be related to faults, but can occur also distinctly. When related to faults, they can be useful to indicate the direction of slipping of the fault blocks.

The survey carried out in Jilț area lead to data on the coal bed X microtectonics, in Tehomir and Dragoteşti mining areas. The fissures are of areal extension, with two main classes:

i. a first one including sharp outlined fissures, with 1 to 3 mm openings, mostly filled by clay or sand, trended in dominance WNW-ESE. This class includes the main fissural direction, recorded in all studied mining areas;

ii. a second class refers to NNE-SSW trends, recorded in underground mines as Cojmăneşti, Dragoteşti, and Mătăsari, as well as in the small open pit from Mătăsari. These fissures are less distinct than the previous ones. They are always associated to the ones of the first class. Commonly, they are separated by 0.02 to 0.88 m, with a mean of 0.3 to 0.5 m.

2.2. Faults

In Rovinari mining area, one can observe: i. conform normal faults and ii. inverse faults. The inverse faults are rarer and occur when the cover block is laying in an abnormal way on the basal block. The faults may occur either solely, or grouped. The majority of the major fault is trended parallel to the Carpathian Orogene. There are also present growth faults (ANINOIU, 2004), as well as faults following the main river directions, related to the "valley anticlines" (BULIGA, 2000) (Figs. 3-6).

CONCLUSIONS

The tectonic structures reported from the coal mining areas located between the Jiu and the Motru rivers refer to folds (anticlines and synclines), faults or simply cracks and fissures. While some of cracks or fissures are obviously due to the coal mining works, larger tectonic structures are rather related to major tectonic events occurred in the Pliocene or the Pleistocene. Both Figs 2 and 3 evidence such paradigms. They are possible signatures of the "Wallachian phase", more exactly its last effects, as long as this tectonic event gained in the last two decades a longer time span (HYPPOLITHE & SĂNDULESCU, 1996) than presumed before (STILLE, 1924; DUMITRESCU & SĂNDULESCU, 1968).

REFERENCES

ANDREESCU I., ȚICLEANU N., PANĂ IOANA, PAULIUC S., PELIN M., BARUS T. 1985. *Stratigraphie des dépôts pliocènes à charbons – zone est d'Oltenie (secteur Olt-Jiu).* Analele Universității Bucureşti. **34**: 87-96.

ANDREESCU I., CODREA V., LUBENESCU V., PETCULESCU A., ŞTIUCĂ E. 2010. *New developments in the Upper Pliocene – Pleistocene stratigraphic units of the Dacian Basin (Eastern Paratethys), Romania.* Quaternary stratigraphy and paleontology of the Southern Russia: connections between Europe, Africa and Asia. Abstract volume 2010 annual meeting INQUA-SEQS, Rostov-on-Don. Russia. June 21-26. Rostov-on-Don: 21-23.

ANINOIU D. 2004. *Geologia structurală a depozitelor pliocen-cuaternare din bazinul minier Rovinari*. Edit. Academica „Constantin Brâncuşi". Tg. Jiu. 137 pp.

BULIGA S. L. 2000. *Anticlinale de vale în depozitele pliocene cu cărbuni din sectorul Motru-Gilort*. Gorjul geografic. Tg-Jiu. **2**: 165-172.

DUMITRESCU I. & SANDULESCU M. 1968. *Problèmes structuraux fondamentaux des Carpates roumaines et de leur avant-pays*. Annuaire du Comité Géologique. Bucureşti. **36**: 195-218.

JIPA D. C. & OLARIU C. 2009. *Dacian Basin. Depositional architecture and sedimentary history of a Paratethys Sea.* Geo-Eco-Marina Special Publication. Bucharest. **3**: 1-264.

HIPPOLYTE J.C. & SĂNDULESCU M. 1996. *Paleostress characterization of the „Wallachian" phase in its type area, southeastern Carpathians, Romania.* Tectonophysics. Austin. **263**: 235-249.

NĂSTĂSEANU S. 1984. *Geology of the main coal deposits in Romania.* Anuarul Institutului de Geologie şi Geofizică. Bucureşti. **64**: 195-204.

RATSCHBACHER L., LINZER H.-G., MOSER F., STRUSIEVICZ R. O., BEDELEAN H., HAR N., MOGOŞ P.-A. 1993. *Cretaceous to Miocene thrusting and wrenching along the central South Carpathians due to a corner effect during collision and orocline formation.* Tectonics. **12**(4): 855-873.

ROBAN R. D. & MELINTE M. C. 2005. *Paleogene Litho- and Biostratigraphy of the NE Getic Depression (Romania),* Acta Palaeontologica Romaniae. Bucureşti. **5**: 423-439.

SĂNDULESCU M. 1984. *Geotectonica României*. Edit. Tehnică. Bucureşti. 336 pp.

SĂNDULESCU M. 1994. *Overview on Roumanian Geology*. In: „ALCAPA II", Romanian Journal of Tectonics and Regional geology. Bucharest. **75**(2): 3-16.

STILLE H. 1924. *Grundfragen der Vergleichenden Tektonik*. Borntraeger. Berlin. 443 pp.

ȚICLEANU N. & PĂTRUȚOIU I. 1987. *Zăcămintele de ligniți din Oltenia*. In: Petrescu I., Mărgărit Gh., Nicorici E., Nicorici M., Bițoianu C., Duşa A., Țicleanu N., Pătruțoiu I., Todros C., Munteanu A., Ionescu M., Buda A.: Geologia zăcămintelor de cărbuni. Edit. Tehnică. Bucureşti. **2**: 297-336.

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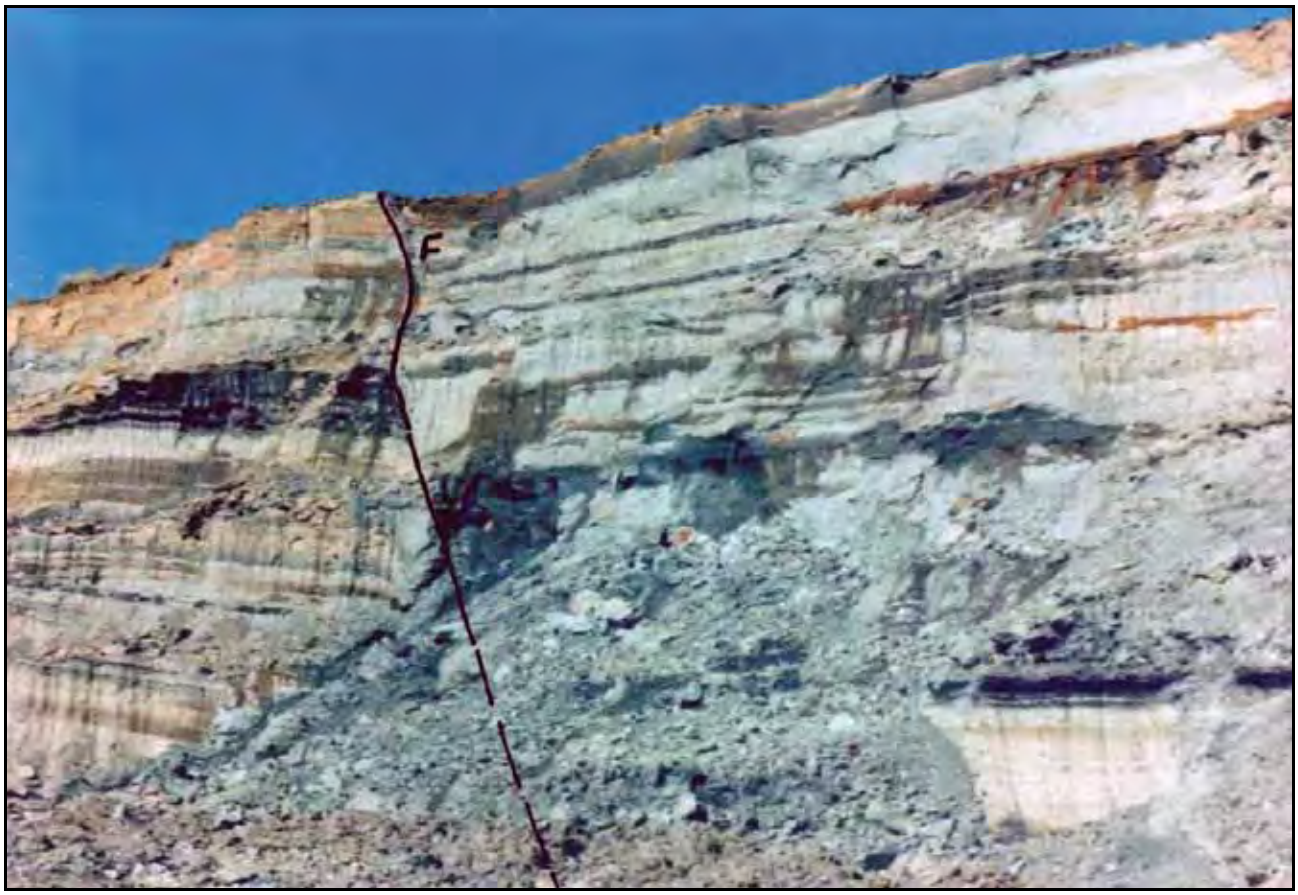

Figure 3. Normal fault, XII-XIII coal beds, Pinoasa mining area (photo: D. Aninoiu).
Figura 3. Falie conformă normală, stratele XII-XIII, perimetrul Pinoasa (foto: D. Aninoiu).

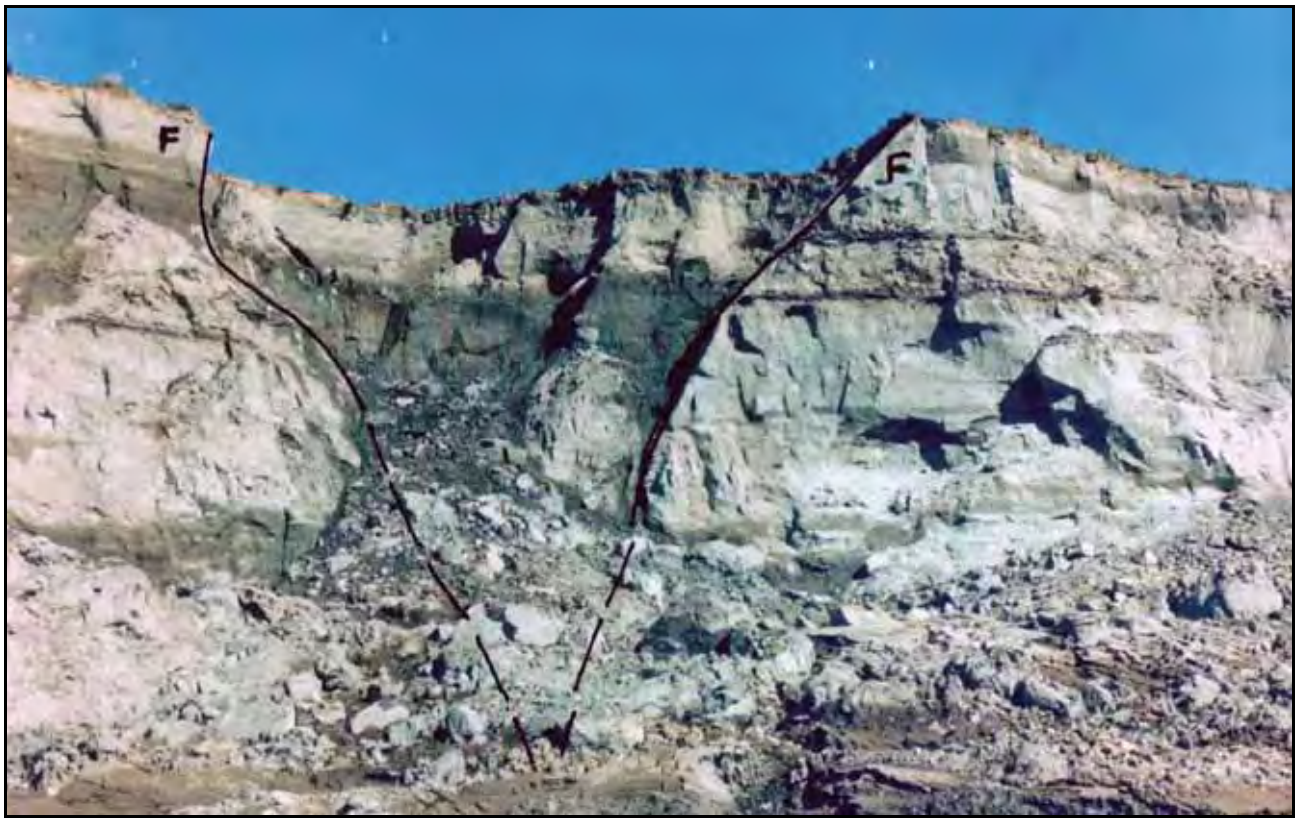

Figura 4. Falie în Y, coperiş str, XII, perimetrul Pinoasa (foto:D. Aninoiu).
Figure 4. Y-shaped fault, cover of XII coal bed, Pinoasa area (foto: D. Aninoiu).

Figure 5. Fault system with talus landslide, XII coal bed, Pinoasa area (photo: D. Aninoiu).
Figura 5. Sistem de falii însoțite de alunecări de taluze, stratul XII, perimetrul Pinoasa (foto: D. Aninoiu).

Figure 6. Boncea fault - separation of the excavation block involving X-XI coal beds, Pinoasa area (photo: D. Aninoiu).
Figura 6. Falia Boncea cu desprinderea blocului de excavare ce afectează stratele X-XI, perimetrul Pinoasa (foto: D. Aninoiu).