THE INTRAMOESIAN FAULT: EVOLUTION IN TIME AND SPACE*

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The name *Intramoesian Fault* was introduced in the scientific literature by Mircea Săndulescu in 1984. Săndulescu (1984) described the fault as being a sinistral transcrustal fault, after several dextral–sinistral displacement variations during geological time. The fault was located in the central part of the Moesian Platform, displaying NW–SE direction; it was continued south of the Danube river up to the Bulgarian Black Sea shelf, and northward underneath the Getic Nappe. Although this is the most accepted model of the Intramoesian Fault, used by many researchers as marker for the Moesian Platform compartments delineation, the Intramoesian Fault proved to be a complex and complicated tectonic target both at local and regional scale (in Space), being differently located on maps throughout history (in Time).
The geological mapping of the Intramoesian Fault was not possible, as it does not outcrop and has no topographic expression, being concealed beneath a thick Neogene sedimentary cover, traces of regional faulting being hidden totally.
This intriguing tectonic structure, still subject of debate, had a large variety of names and was identified so far as fault, fracture or tectonic contact.
An extended documentation on the Intramoesian Fault and the Moesian Platform was carried out within the PhD Thesis “Intramoesian Fault: geophysical detection and regional active (neo)tectonics and geodynamics”, Doctoral School of Geology, Faculty of Geology and Geophysics, University of Bucharest. This PhD study offered the framework for a focused research on geophysical detection of the Intramoesian Fault and its regional tectonics and geodynamics, analysing and integrating a large number of geophysical and geodetic data, as well as geomorphological and geological observations.
An updated regional tectonic and geodynamic model was developed within this study, showing that the Intramoesian Fault is composed of a number of segments, laterally displaced by several active regional NE–SW, N–S and W–E faults systems. Due to repeated junctions with the younger NE–SW strike-slip faults, and due to a NE–SW transcurrent fault in the Vrancea wrench tectonics system (Ioane, Stanciu, 2018), the Intramoesian Fault is displaced south–westward in the area close to the Carpathians. North of the Danube, a north–eastward displacement of the Intramoesian Fault was interpreted as due to an indentation of an Argeş – Danube Promontory along the Argeş (W–E) and Gabrovo – Veliko Tarnovo (NE–SW) faults.

Key words: Intramoesian Fault, Moesian Platform, regional tectonics, regional geodynamics.

INTRODUCTION

The Intramoesian Fault has been described as a NW–SE transcrustal strike-slip fault, located in the central part of the Moesian Platform (*e.g.*, Săndulescu, 1984; Visarion *et al.*, 1988; Săndulescu, 2009), acting as a deep regional tectonic contact (*e.g.*, Ioane, Caragea, 2015), which separates the Moesian Platform in two compartments, distinct in terms of basement petrographic (*e.g.*, Mutihac, 1982) and physical properties (*e.g.*, Gavăt *et al.*, 1939, 1974; Socolescu *et al.*, 1974; Airinei *et al.*, 1983), geotectonic history and geological affinities (*e.g.*, Oczlon *et al.*, 2007). As it does not outcrop and has no geomorphological expression, the geological mapping of the Intramoesian Fault was not possible, being differently located on maps (*e.g.*, Dumitrescu, Săndulescu, 1970; Paraschiv, 1979; Mutihac, 1982; Săndulescu, 1984; Visarion *et al.*, 1988; Tărăpoancă, 1996; Visarion, Beşuţiu, 2001; Shanov *et al.*, 2005; Zugrăvescu,

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Damian, 2006; Săndulescu, 2009; Rogozhin *et al.*, 2009), and remaining as an intriguing tectonic structure, still subject of debate.

Although accepted on both the Romanian and Bulgarian territories, there are few geological and geophysical studies *(e.g.*, Tărăpoancă, 1996; Shanov *et al.*, 2005; Rogozhin *et al.*, 2009; Stanciu *et al.*, 2016) dedicated to this concealed tectonic feature, from which the pattern of its deep structure can be inferred. This fact accentuates the importance and necessity to analyse and interpret the available geophysical data, integrated with geological and other relevant data, both on Romanian and Bulgarian territories (often incomplete because of the Romanian–Bulgarian state border area) using a common methodological approach, aiming an enhanced knowledge of its geometry, segmentation and dynamics.

THE INTRAMOESIAN FAULT IN TIME AND SPACE

The name *Intramoesian Fault* was introduced in the scientific literature by Mircea Săndulescu (1984), its path being interpreted based on previous borehole and geophysical data from Paraschiv (1983), Visarion and Săndulescu (unpublished), Visarion *et al.* (1981). Săndulescu (1984) described the fault as being a sinistral transcrustal fault, after several dextral-sinistral displacement variations during geological time. The fault was located in the central part of the Moesian Platform, displaying NW–SE direction; it was continued south of Danube river up to the Bulgarian Black Sea shelf, and northward underneath the Getic Nappe, as illustrated in Figure 1. This is the most accepted model of the Intramoesian Fault, used by many researchers as marker for the Moesian Platform compartments delineation.

An earlier model of the Intramoesian Fault within the Moesian Platform fault systems framework was carried out by Visarion and Săndulescu (unpublished), as mentioned by Săndulescu (1984). In this map reissued by Săndulescu in 1984, the fault appears as the *"Intramoesian fracture"* (Fig. 2).

When interpreting the tectonic framework of the Moesian Platform based on geophysical measurements results from Barbu (1965), Săndulescu (1974) emphasized *"the major Călăraşi – Fierbinţi fault"* as tectonic limit between the dominant NW–SE fault system he named "Dobrogea strike" in Eastern Moesia and the dominant W–E fault system he named "Oltenia strike" in Western Moesia.

The Intramoesian Fault was probably represented for the first time on the Tectonic Map of Romania in 1970, crossing the Moesian Platform from Gruiu–Fierbinţi area (NW), toward Călăraşi and Mangalia (SE). At that time, this regional tectonic feature had no tagged name (Fig. 3).

Early editions of the tectonic map (Dumitrescu, Săndulescu, 1962; Dumitrescu *et al.*, 1962) featured a N–S tectonic fracture going roughly from Pucioasa to Alexandria, towards Svishtov (Bulgaria), named by Mrazec and Popescu-Voiteşti (1911) *Dâmboviţa Line*.

Mrazec and Popescu-Voiteşti (1911) considered that the *Dâmboviţa Line* separates the tectonic domains of Getic Depression (Romania and Bulgaria) and Romanian Plain (north of Danube), while another fracture (*Danube Line*) is represented as a tectonic limit, separating the Romanian Plain from the Prebalcanic Plateau (East and South of Danube, Romania and Bulgaria), as represented in Figure 4.

One of the first models of the Intramoesian Fault was carried out by Burcea *et al.* (1965, 1966), based on seismic reflection data processing and interpretation. The quoted authors illustrated the fault they identified as *F14 – main fracture* at the top Cretaceous formations (Fig. 5) and at Jurassic base formations, in the central part of the Moesian Platform, on NW–SE trending from the Pericarpathian Fault toward the Danube, along the Mostiştea river. At that time, it was considered that the F14 fracture displaced the Pericarpathian Fault in Ploieşti city area.

When analysing within a georeferenced environment (*i.e.*, ESRI ArcMap) the Intramoesian Fault transects as interpreted by Burcea *et al.* (1965, 1966) at the top Cretaceous structural map and at the base Jurassic structural map, an eastward dip of the fault can be inferred (Fig. 6).

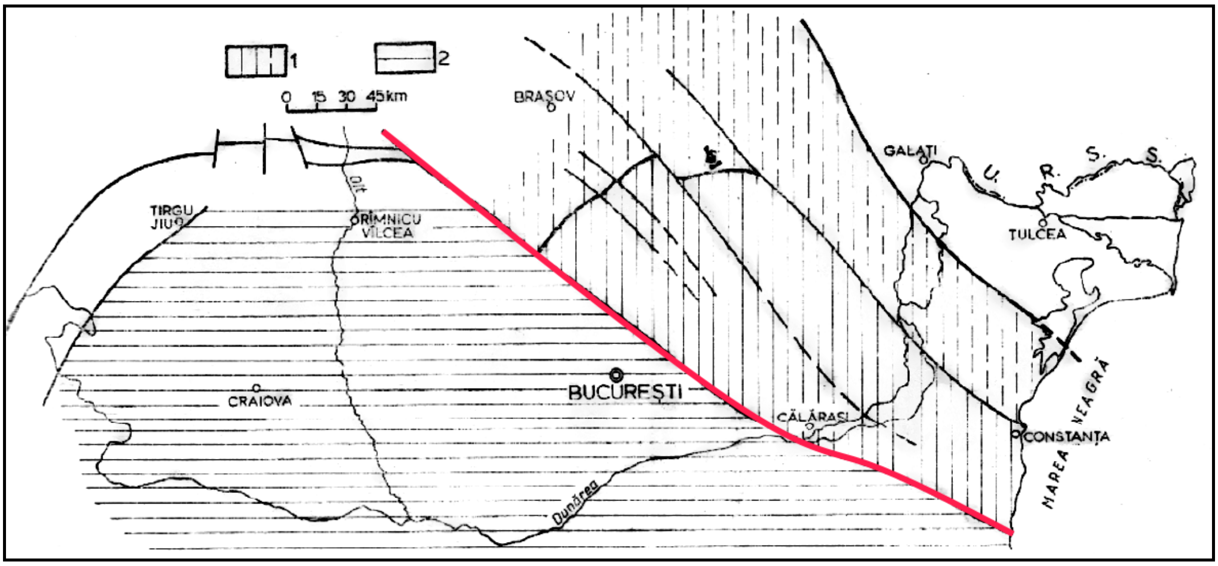

Fig. 1 – *The Intramoesian Fault* (red line) and the main compartments of the Moesian Platform: 1 = Dobrogean; 2 = Wallachian (Wallachian-Prebalkan) (Săndulescu, 1984).

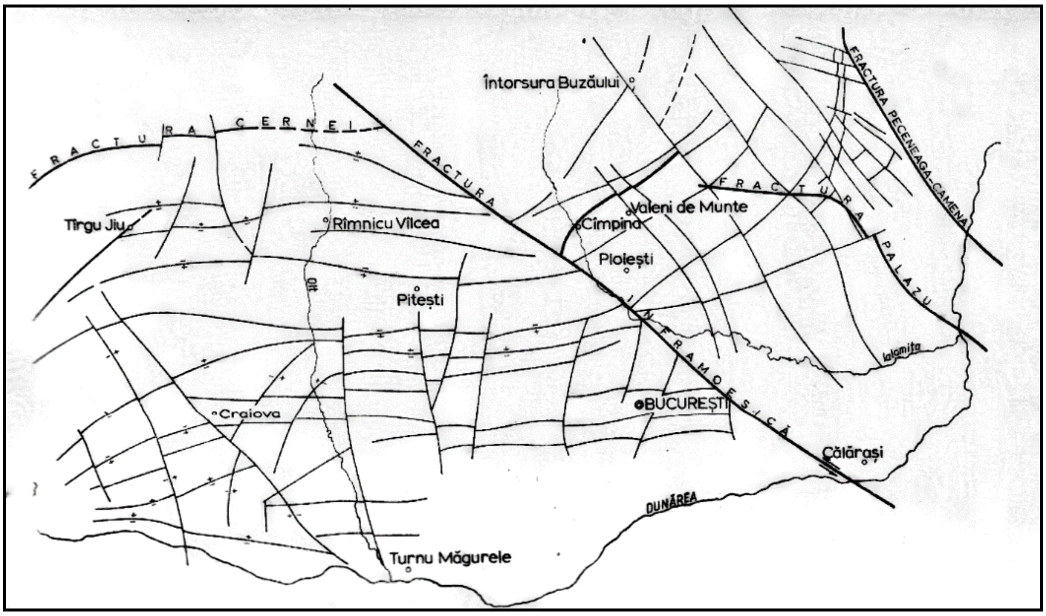

Fig. 2 – The *Intramoesian fracture* within the Moesian Platform fault systems framework (Visarion, Săndulescu – unpublished, in Săndulescu, 1984).

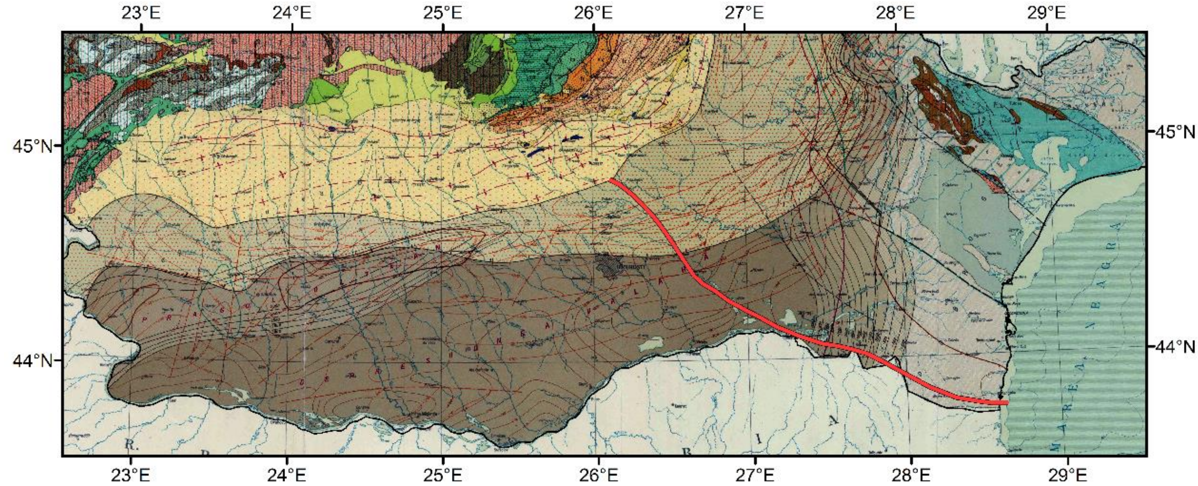

Fig. 3 – The Intramoesian Fault (red line) on the tectonic map of Romania, scale 1:1.000.000 (detail, Dumitrescu, Săndulescu, 1970).

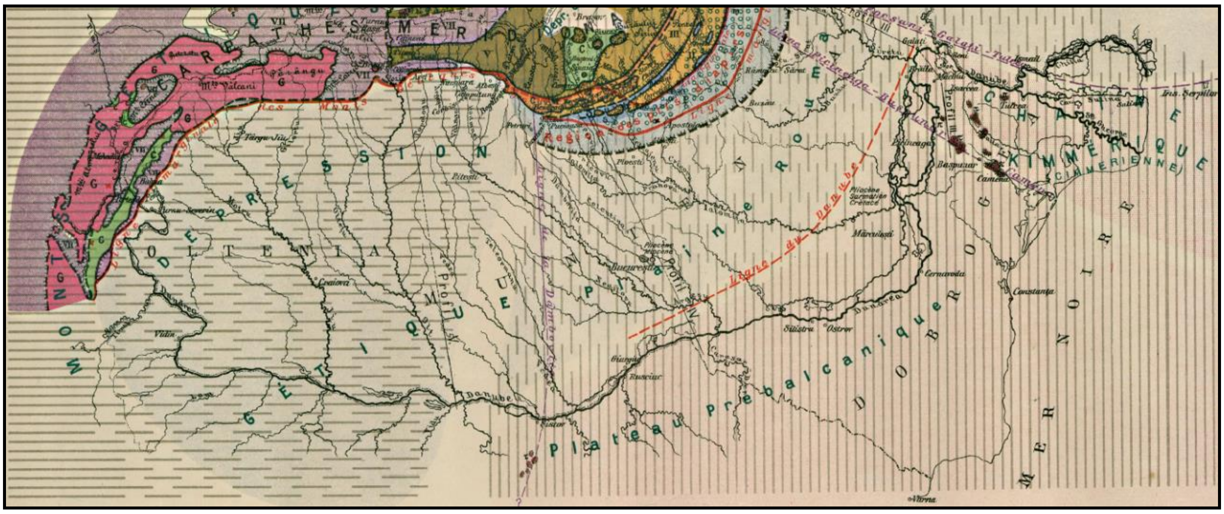

Fig. 4 – Detail on the Moesian Platform, as represented on the tectonic map of the Eastern and Southern Carpathians (Mrazec, Popescu-Voiteşti, 1911). *Dâmboviţa Line* (purple line) is represented as a tectonic feature separating the Getic Depression (Romania & Bulgaria) and Romanian Plain (north of Danube).

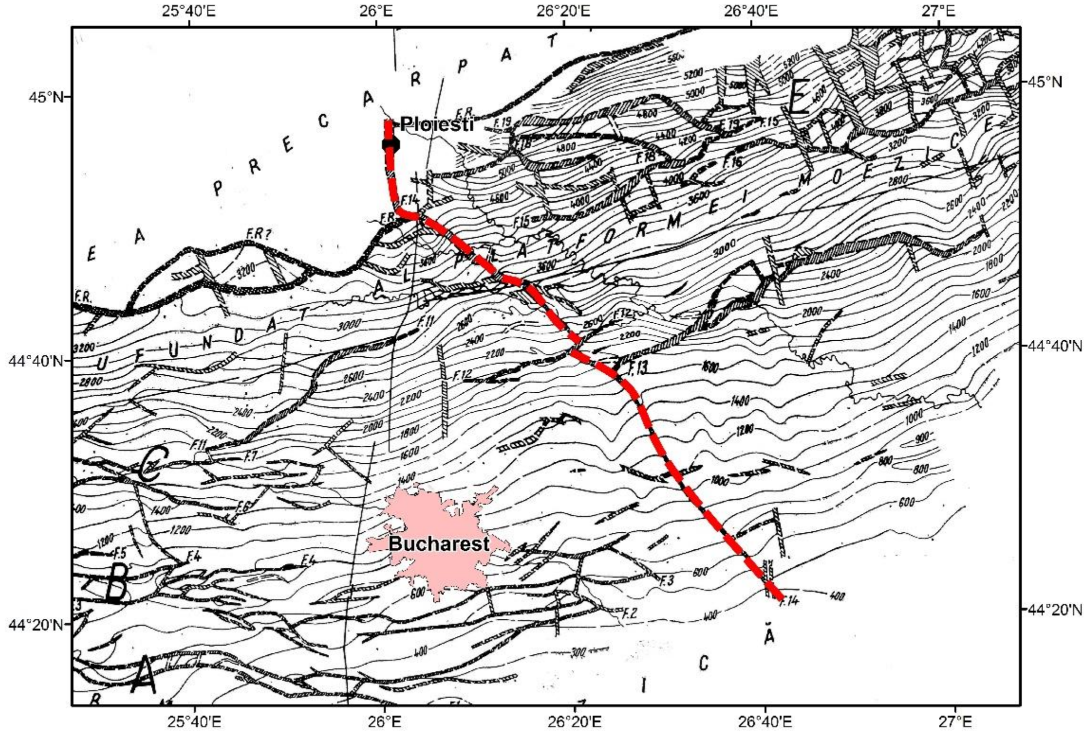

Fig. 5 – The Intramoesian Fault, interpreted on seismic reflection data as *F14 main fracture* (red dashed line) at top Cretaceous (Burcea *et al.*, 1966).

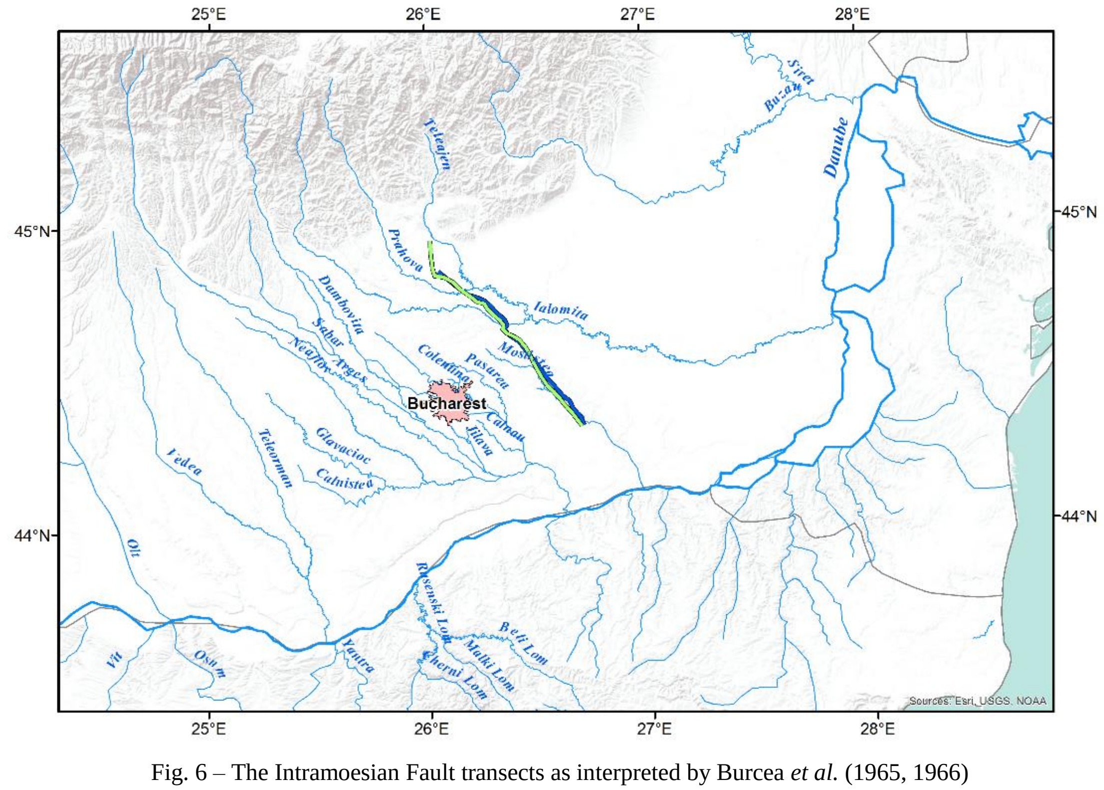

Fig. 6 – The Intramoesian Fault transects as interpreted by Burcea *et al.* (1965, 1966) at the top Cretaceous structural map (green line) and at the base Jurassic structural map (blue line).

Burcea *et al.* (1965, 1966) geophysical and geological models illustrated a throw of 700–1,000 m affecting sedimentary formations up to Jurrasic–Cretaceous, the eastern compartment of the Intramoesian Fault being lower than the western one. On a regional scale W–E profile, in Gruiu – Lacu Turcului area, Burcea *et al.* (1965, 1966) interpreted a deep “fracture”, developing from 1000 m (Dacian) to more than 6,000 m (Silurian) in depth (Fig. 7). The “F14 – main fracture” features a ca. 800 m lowered eastern compartment, as interpreted at Sarmatian – Cretaceous limit and Jurassic – Carboniferous limit.

Based on geophysical and borehole data, Popescu *et al.* (1967) interpreted the Intramoesian Fault as the *Fierbinţi Fault* (Fig. 8) with NW–SE trending from Tinosu to Fierbinţi and further south-eastward along Mostiştea valley. *Fierbinţi Fault* was considered to be of Hercynian age and active at least until the Middle Miocene (Sarmatian). A throw of 1,000 m in the pre-Jurassic formations was interpreted between the two compartments of the *Fierbinţi Fault*, the Carboniferous formations of the western compartment being in contact with the Triassic formations of the eastern compartment.

Ciocârdel *et al.* (1967) illustrated on the Map of regional faults of Romania a NW–SE tectonic feature crossing the Moesian Platform from Târgovişte area, to Gruiu–Fierbinţi area and further along Mostiştea valley, crossing the Danube in Bulgaria, toward Dobrich area, and reaching the Black Sea in Durankulak area (Fig. 9). In the north-eastern part Bulgaria, this major fault is interpreted as displaced by N–S trending faults.

Based on borehole and seismic data, Paraschiv (1975, 1979) represented the Intramoesian Fault as a NW–SE tectonic feature he named *Turtucaia–Olteniţa* (1975), or *Belciugatele Fault* (1979) crossing the Moesian Platform (Fig. 10).

Rădulescu *et al.* (1976) prolonged the fault towards Câmpulung-Muscel, based on seismic reflection data, considering a sinistral slip of the fault, in order to advocate subduction of Eastern Moesia in the East Carpathian Bend Zone.

Cornea and Polonic (1979) interpretation of the Intramoesian Fault based on gravity data (Gavăt *et al.*, 1966) and seismic reflection data from Burcea *et al.* (1965, 1966) is represented as *the Tinosu–Fierbinţi–Călăraşi Fault* (Fig. 11). The published seismotectonic model suggests a sinistral displacing of the Pericarpathian Fault (Bibeşti – Tinosu Line), at the junction with the Intramoesian Fault. South-eastward, the *Tinosu–Fierbinţi–Călăraşi Fault* is represented up to the Danube Fault. Frequent earthquakes, up to 30 km depth, are associated in the Gruiu–Belciugatele sector with this fault.

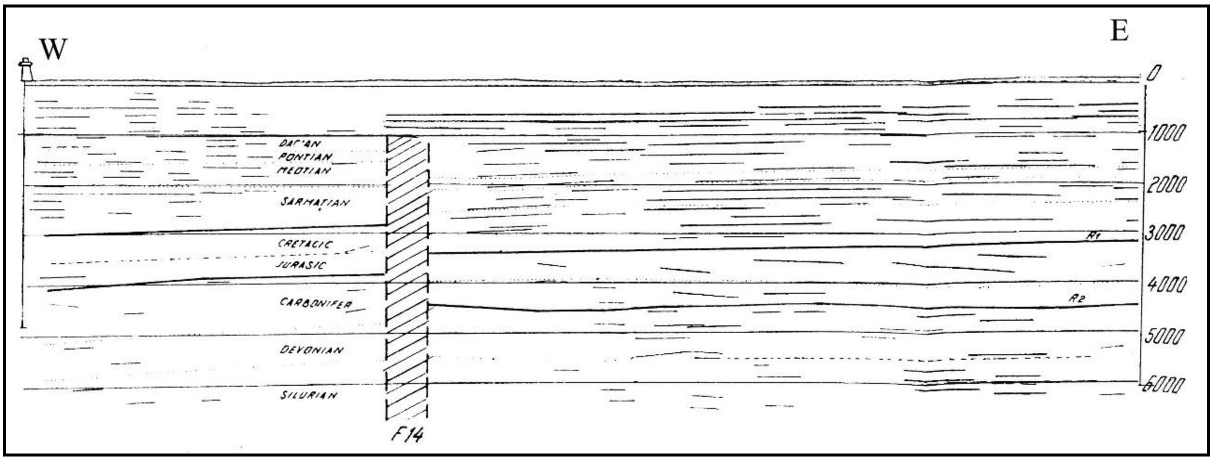

Fig. 7 – Detail on the geological interpretation of seismic reflection data on a regional W–E profile, in Gruiu – Lacu Turcului area (modified from Burcea *et al.*, 1966).

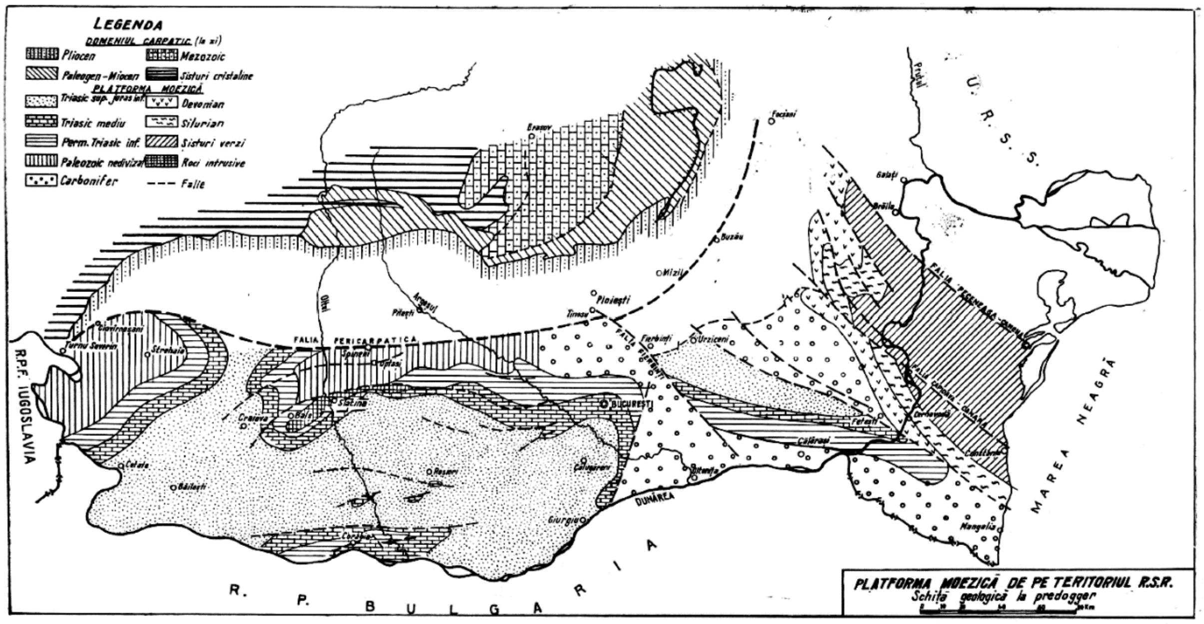

Fig. 8 – *Fierbinţi Fault*, as interpreted on the Moesian Platform geological map (Popescu *et al.*, 1967).

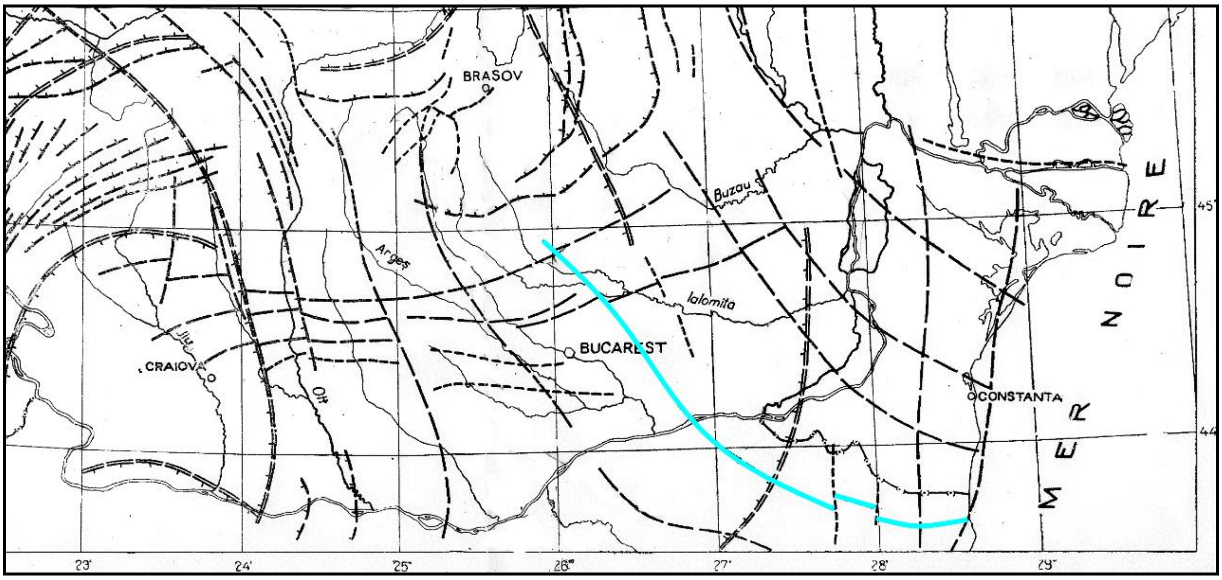

Fig. 9 – Detail from the Map of regional faults of Romania (Ciocârdel *et al.*, 1967), showing a NW–SE tectonic feature (turquoise line) crossing the Moesian Platform from Târgovişte area, to Gruiu–Fierbinţi area, along Mostiştea valley, crossing the Danube in Bulgaria, and reaching the Black Sea in Durankulak area.

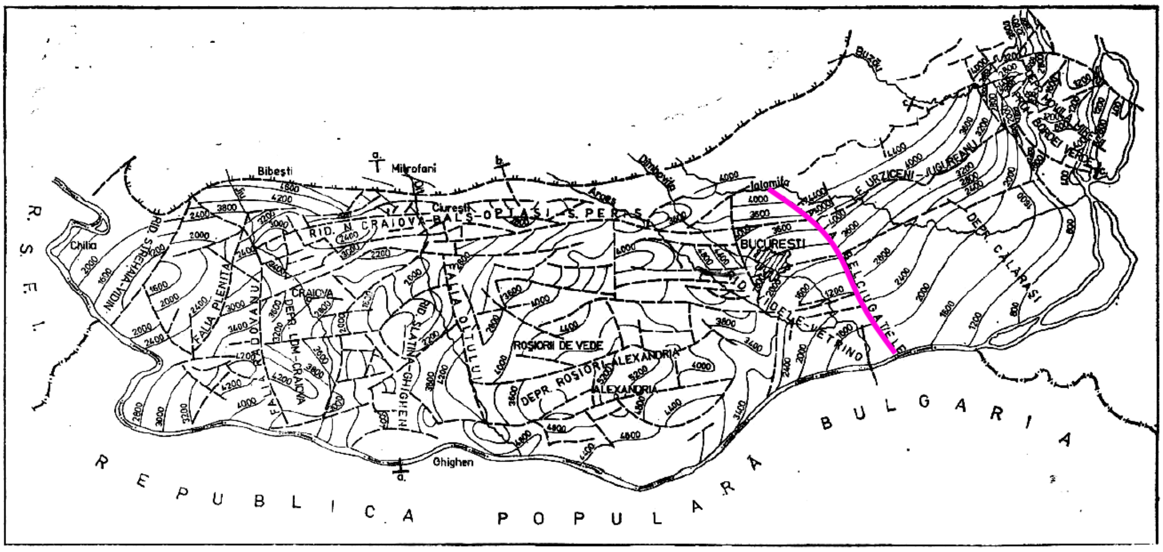

Fig. 10 – Morpho-structural map of the Moesian Platform at the pre-Permian base (Paraschiv, 1979), showing *Belciugatele Fault* (magenta line) as a NW–SE tectonic feature crossing the Moesian Platform from Gruiu–Fierbinţi area, toward the Danube, along Mostiştea valley.

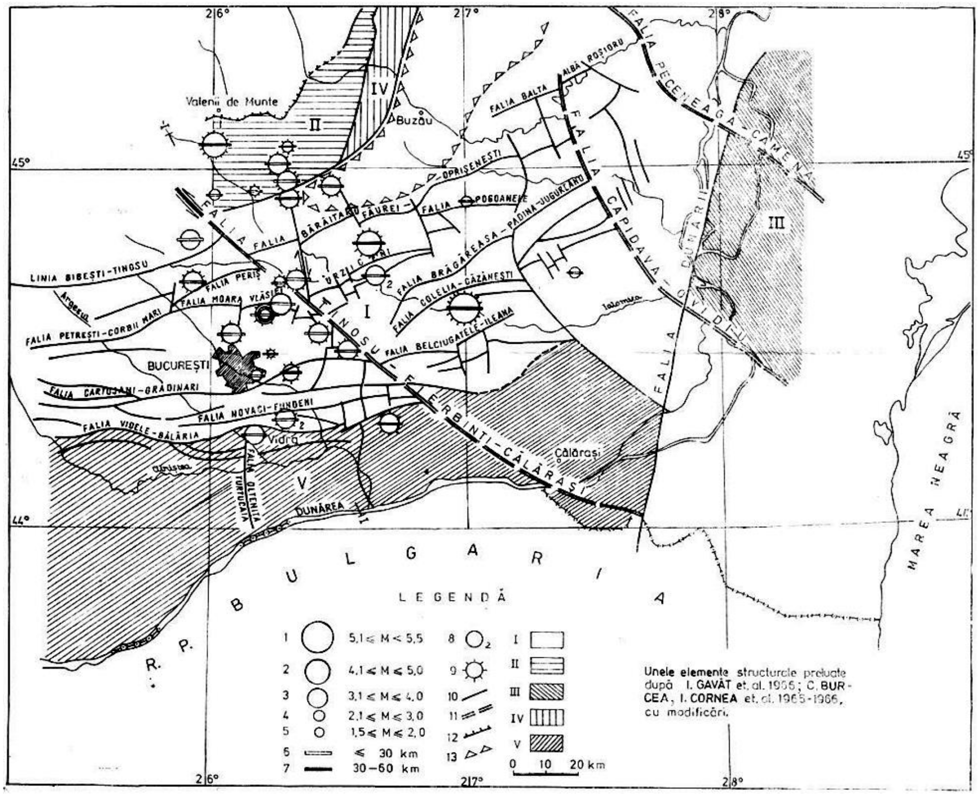

Fig. 11 – The Intramoesian Fault (*Tinosu–Fierbinţi–Călăraşi Fault*) on the seismotectonic map of the eastern part of the Moesian platform (Cornea, Polonic, 1979). 1–5 = earthquakes magnitudes; 6–7 = earthquakes depth; 8 = historical epicentre; 9 = detected epicentre; 10 = fault; 11 = crustal fault; 12 = thrust line; 13 = maximum subsidence; I = continuous subsidence; II = continuous uplift; III = stable areas, IV = Mio-Pliocene subsidence areas, uplifted in Quaternary; V = Mio-Pliocene uplifted areas, subsided in Quaternary.

Furthermore, a NW–SE geological model built by Cornea and Polonic (1979) on Ploieşti – Bucharest – Olteniţa profile, based on seismological researches and seismic surveys, illustrates Tinosu–Fierbinţi Fault ca. 30 km south-east of Ploieşti city, reaching Moho depth and cutting through the Neogene sedimentary cover to the surface (Fig. 12).

Vasile Mutihac (1982) named the fault as *Fierbinţi Fault* and, based on geological data from boreholes, illustrated its path on the geological map of the Moesian Platform at the Permian base as crossing the Moesian Platform from Gruiu–Fierbinţi area in the north-west, toward Belciugatele, Olteniţa, Dulovo (Bulgaria) and Dobrich (Bulgaria) in the south-east (Fig. 13). Mutihac described the *Fierbinţi Fault* as the in-depth western limit of the Dobrogean greenschists, considering it represents a major tectonic feature of the Moesian Platform, separating two compartments with different basement facies and geological age. Another fault, similar in shape and parallel to the Fierbinţi Fault, is illustrated crossing the Moesian Platform from Ciureşti, Videle, Giurgiu, towards Vetrino.

Visarion *et al.* (1988) published a detailed tectonic model of the Moesian Platform (Fig. 14), illustrating the Intramoesian Fault as a NW–SE regional tectonic feature, crossing the Southern Carpathians and reaching Tyulenovo at the Black Sea shore. Its path is considered by the quoted authors to be highlighted by frequent earthquake occurrences (Cornea, Polonic, 1979), a geothermic regime contrast between the eastern and western compartment (Paraschiv, Cristian, 1976) and a steep gradient of the magnetic anomalous field (Airinei *et al.*, 1983).

Calotă *et al.* (1988) synthetic geological model is one of the few published geological models across the Intramoesian Fault (Fig. 15). Summing up borehole data in the vicinity of the Intramoesian Fault, Calotă *et al.* (1988) interpreted a throw of 700–1000 m affecting sedimentary formations up to Upper Cretaceous. Starting Late Miocene (Tortonian/Badenian), more than 2000 m thick, undifferentiated sedimentary cover conceals vertical fault displacements.

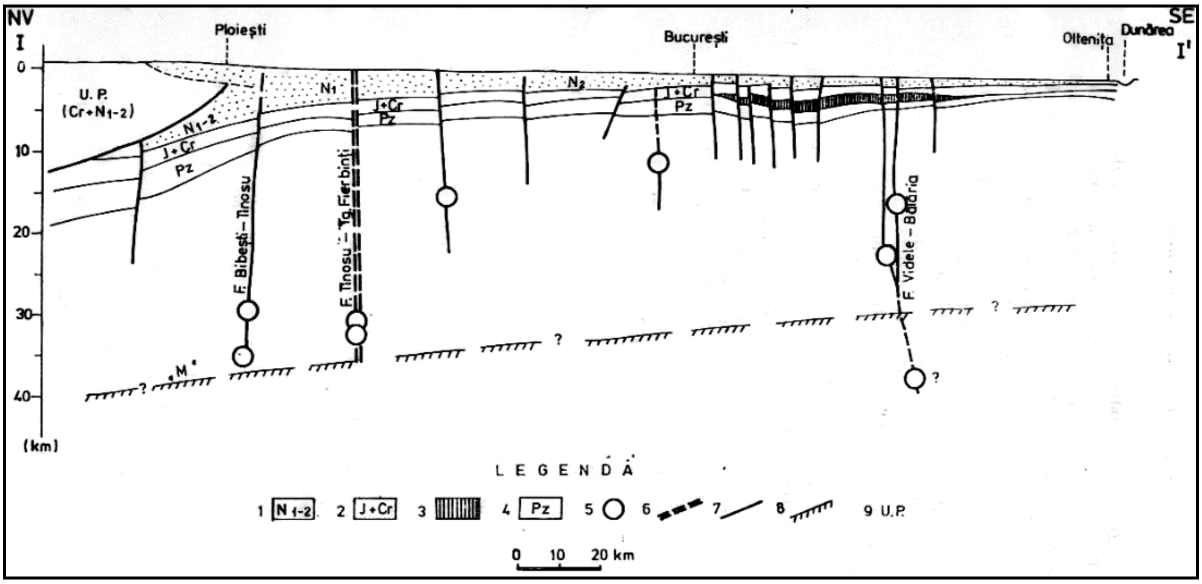

Fig. 12 – Geological model on the Ploieşti – Bucharest – Olteniţa line, based on seismological researches and seismic surveys (Cornea, Polonic, 1979). 1 = Paleogene–Neogene formations; 2 = Jurassic–Cretaceous formations; 3 = Triassic formations; 4 = Palaeozoic formations; 5 = earthquakes hypocentres; 6 = crustal fracture; 7 = major fracture; 8 = Mohorovicic discontinuity; 9 = Pericarpathian Unit.

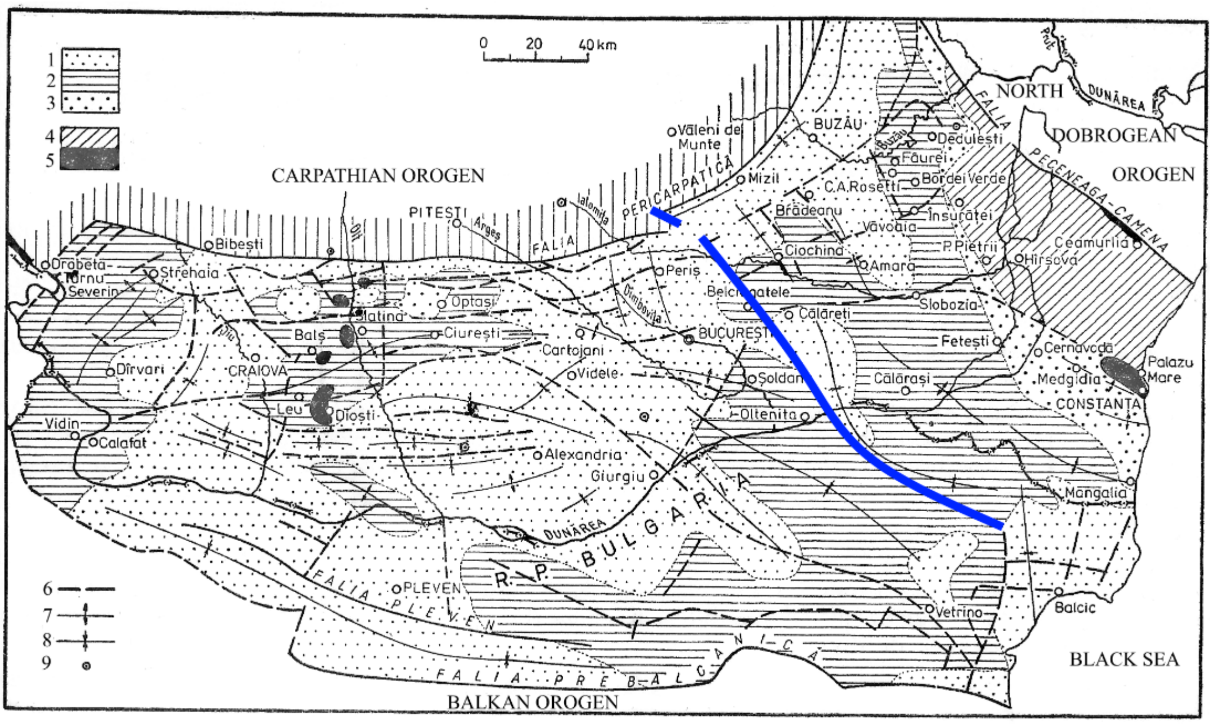

Fig. 13 – The Intramoesian Fault (blue line) on the geological map of the Moesian Platform at the Permian base, as interpreted by Mutihac (1982). Sedimentary cover: 1 = Middle Carboniferous; 2 = Upper Devonian – Lower Carboniferous; 3 = Lower Palaeozoic. Basement: 4 = green schists; 5 = crystalline basement. Structural features: 6 = faults; 7 = uplifted structures; 8 = subsided structures; 9 = boreholes.

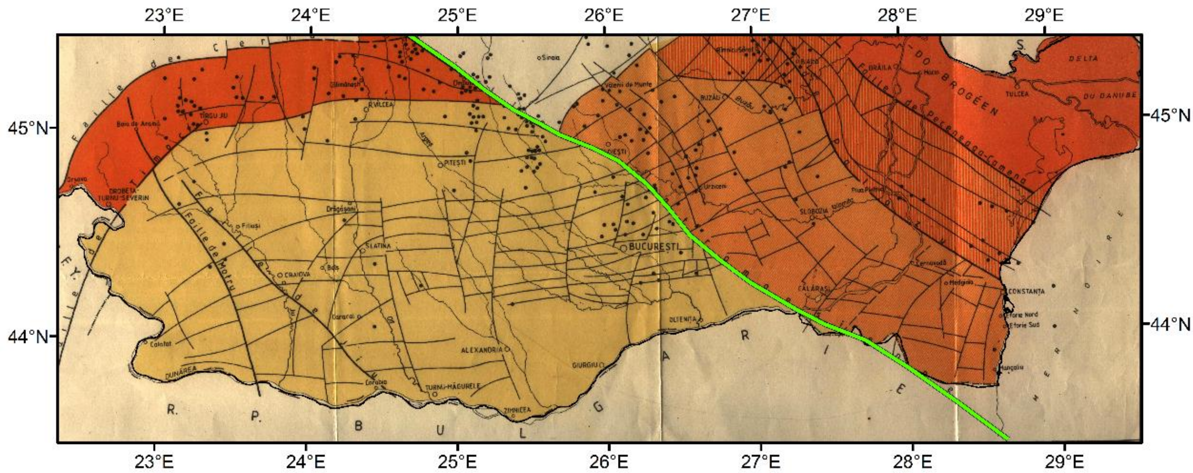

Fig. 14 – The Intramoesian Fault (green line) on the tectonic map of the Moesian Platform, as interpreted by Visarion *et al.* (1988).

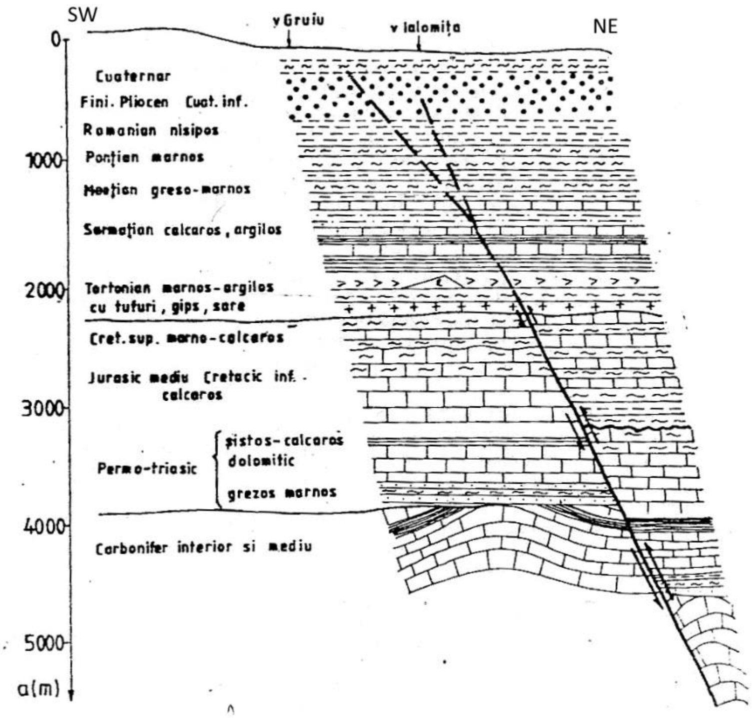

Fig. 15 – Calotă *et al.* (1988) synthetic geological model across the Intramoesian Fault area in Gruiu geodynamic polygon.

The dynamics of the two compartments of the Intramoesian Fault was interpreted by the quoted authors based on repeated gravity measurements performed before and after the 30 August 1986 Vrancea earthquake. Considering the 1984 and 1987 epochs, the authors observed significant temporal changes in the distribution of gravity values and calculated a 20 m upward in-depth displacement of the eastern compartment with respect to the western compartment. The measured gravity variation was interpreted as due to the 30 August 1986 Vrancea earthquake (7.1 Mw, ROMPLUS Earthquake Catalogue – Oncescu *et al.*, 1999 updated), considering no topographic level changes were determined at that time.

Enescu and Enescu (1992) interpreted that earthquakes with foci located under the Moho discontinuity (subcrustal earthquakes) do not confine just beneath Vrancea area, but occur also along the Intramoesian Fault and "under" its eastern compartment (Fig. 16), implying a higher mobility of the eastern compartment, which the authors considered as due to an active subduction process in the Eastern Carpathians Bend area of the lithospheric block between the Intramoesian Fault and the Peceneaga – Camena Fault. The Intramoesian Fault is here interpreted at the SW limit of the zone of the intermediate depth Vrancea earthquakes. However, within the Moesian Platform, the Intramoesian Fault model as illustrated in Figure 16 is not respecting the western limit of the subcrustal earthquakes (*i.e.*, the epicentre of the earthquake with focal depth of 71 km).

Enescu and Enescu (1992) also considered a south-eastward continuation of the Intramoesian Fault and Peceneaga – Camena Fault into the Black Sea, reaching close to the North Anatolian Fault (Fig. 17). The fault path was interpreted by the quoted authors based on the deep earthquakes hypocentres, indicating active tectonics along it.

Results of a neotectonic study in the Bucharest area, presented by Răbăgia *et al.* (2000), revealed a complex fault system in the central part of the

Moesian Platform. The quoted authors interpreted the Intramoesian Fault on an N–S seismic line, located in the vicinity of Gruiu locality (Fig. 18 – left). The discussed seismic section (also found in Tărăpoancă, 2004) is illustrating the Intramoesian Fault as a tectonic feature affecting the sedimentary formations up to the topographic surface, in a negative (?) flower structure. Tărăpoancă (2004) interpreted the Intramoesian Fault as a dextral fault, active during most of the Neogene. A downward displacement of the eastern compartment, affecting the pre-Pontian sedimentary formations, is easily observed on the seismic section (Fig. 18 – right).

Zugrăvescu and Damian (2006) neotectonic study, based on seismic and borehole data, integrated with topographic information from the Physical map of Romania, scale 1:750000, 1974 edition, considered the *"Fierbinţi – Intramoesian Fault"* an appropriate name, taking into account both Săndulescu (1984) structural concept on the fault, but also the repeated thermal waters emergences observed in Fierbinţi area during the strong 1940 and 1977 earthquakes, which the authors associated with the fault. Seismic data from 1/32/89 line on NE–SW direction (Moara Vlăsiei – Valea Brazii), as well as the two morphostructural maps built at top Cretaceous, respectively at top Pontian based on borehole data, were taken in consideration by Zugrăvescu and Damian (2006) when interpreting north of Belciugatele a slightly elevated western compartment as compared to the eastern compartment.

The Fierbinţi – Intramoesian Fault model was illustrated by Zugrăvescu and Damian (2006) on NW–SE direction, trending from Gruiu, along Mostiştea valley, towards Danube (Fig. 19).

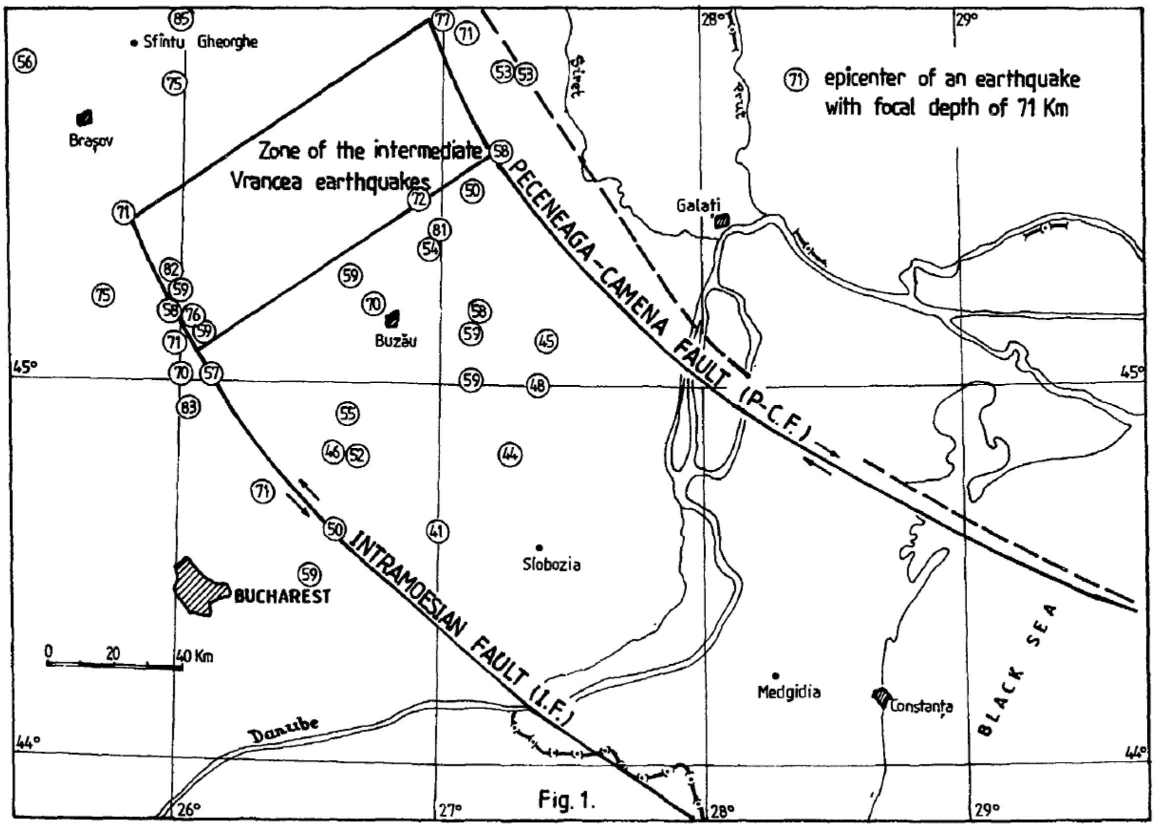

Fig. 16 – Enescu & Enescu (1992) geotectonic model regarding the subduction process in Vrancea area. The *Intramoesian Fault (I.F.)* is shown starting at the limit of the Vrancea area, towards Călărași.

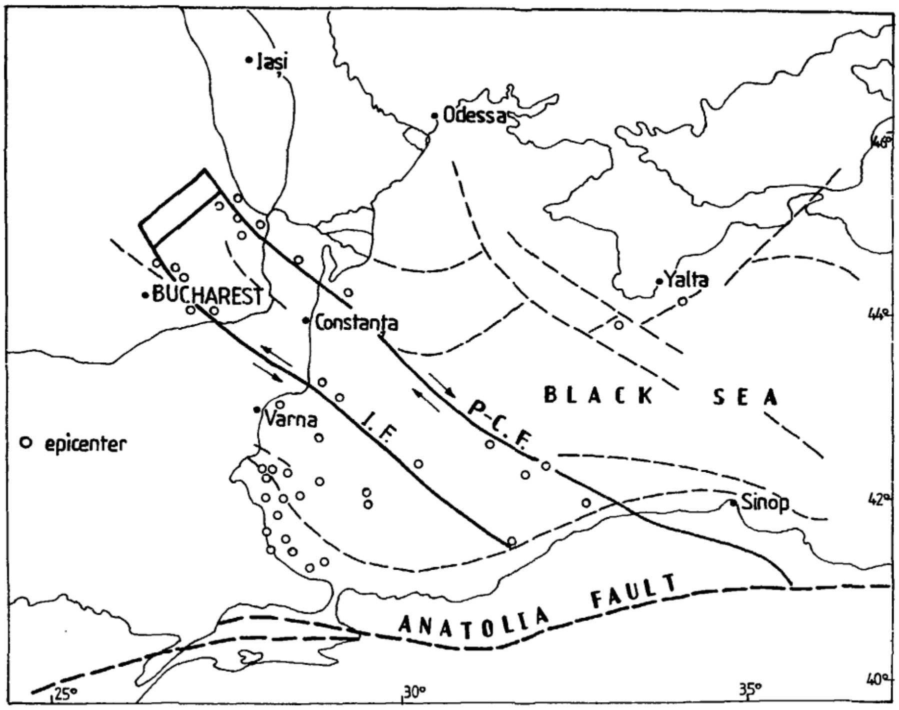

Fig. 17 – *The Intramoesian Fault (I.F.)* within the Western Black Sea and the Carpathian Foreland geotectonic framework (Enescu, Enescu, 1992).

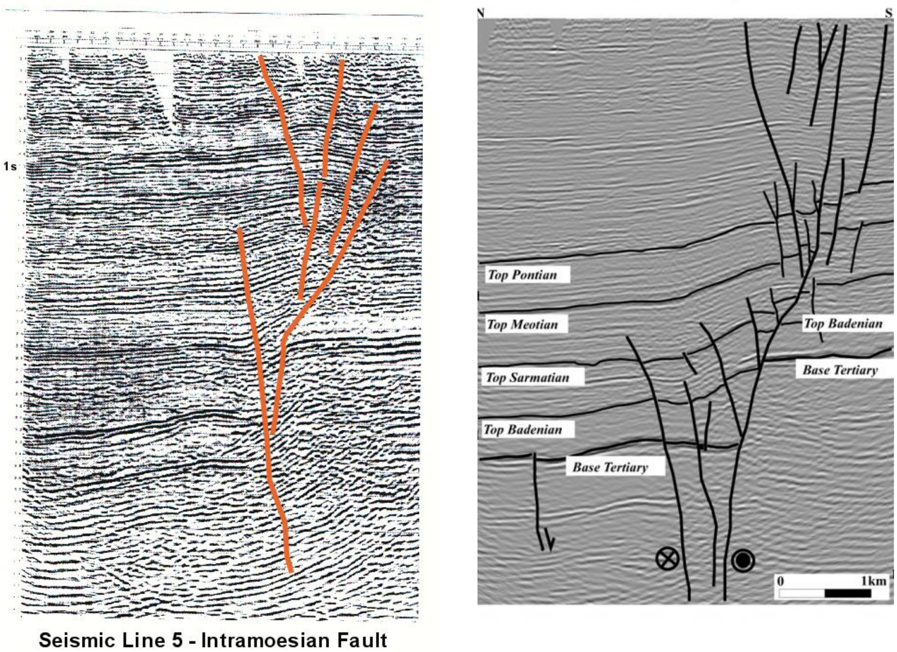

Fig. 18 – The Intramoesian Fault interpreted on a seismic section in Gruiu area (left – Răbăgia *et al.*, 2000; right – Tărăpoancă, 2004).

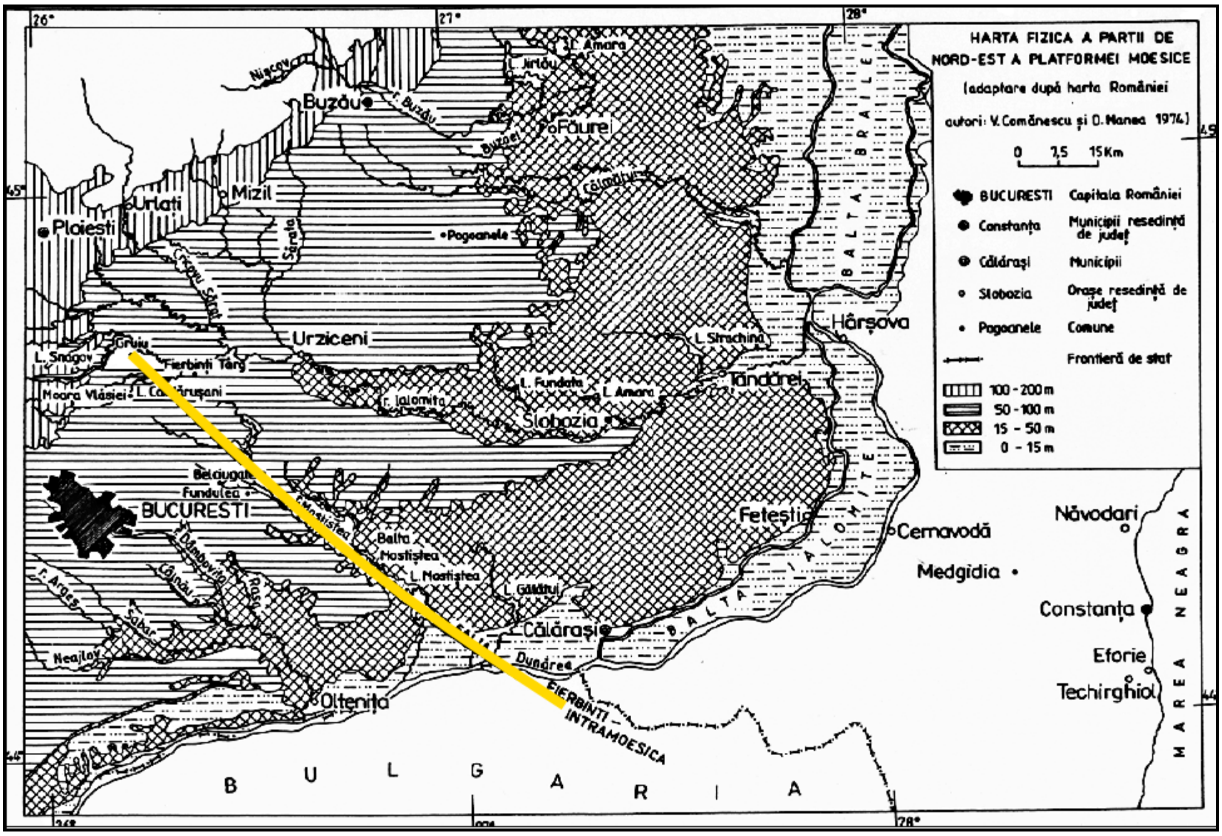

Fig. 19 – *Fierbinți – Intramoesian Fault* (yellow line) after Zugrăvescu & Damian (2006).

Mircea Săndulescu (2009) geotectonic model on the Western Black Sea and the Carpathian Foreland shows the Peceneaga – Camena, the Capidava – Ovidiu and the Intramoesian faults prolongate south-eastward in the Black Sea (Fig. 20). Considering (based on gravimetric and seismic data) that the oceanic-type crust specific for the Western Black Sea was generated by extensional tectonic processes affecting the Moesian Domain, Săndulescu (2009) postulates the western Black Sea rifting caused the Moesian Platform westward and north-westward drifting along the Peceneaga – Camena, the Capidava – Ovidiu and the Intramoesian faults.

Ducea and Roban (2016) proposed a dextral strike-slip fault system in the South Carpathians, referred to as the *Transcarpathian Fault System*, considered active since Mid-Cretaceous, with a total dextral offset of 150 km on Getic – Supragetic nappes. According to Ducea and Roban (2016), the Transcarpathian Fault System separates two segments of the Carpathian orocline with different tectonic histories. When addressing the Getic – Supragetic nappes discontinuity, the quoted authors emphasized the two nappes consisting of basement rocks of different metamorphic grade and age: high-grade Variscan metamorphism in the Getic nappes (amphibolite and locally granulite facies) vs. low-grade Variscan–Ordovician metamorphism in the Supragetic nappes (greenschist and locally amphibolite facies). Although their documentation is mostly based on exposures in the South Carpathians, Ducea and Roban (2016) considered as plausible the Transcarpathian Fault System southeastward continuation as the Intramoesian Fault (Fig. 21).

Based on field geological observations, Stelea (2017) proposed a *NW–SE fault zone* in the Făgăraş Mountains area, consisting of parallel and braided vertical faults along an interpreted path of the Intramoesian Fault (Fig. 22), between the Sebeşul de Jos (Sibiu County) and Nucşoara (Argeş County) localities. The author also describes accompanying NW–SE secondary fractures in the NW–SE fault zone western compartment, towards Olt valley, which he interpreted as the surface expression of a half flower structure.

On the territory of Bulgaria, the Intramoesian Fault is known mainly under the name of the *Silistra–Belgun Fault* (*i.e.*, Shanov *et al.*, 2005; Rogozhin *et al.*, 2009; Botoucharov, 2016).

Summarizing the available geophysical data for the Intramoesian Fault detection on the Bulgarian territory, Shanov *et al.* (2005) interpreted that the Intramoesian Fault path is separated in at least 3 segments from Silistra to Durankulak, but admitted the regional fault could be located more southern than the trace in Figure 23.

Based on geophysical data interpretation, constrained with field studies on its geomorphological expression on the surface, seismotectonic data, paleo-seismological surveys on sections crossing its supposed location, radiocarbon analysis on samples, and microseismic soundings, Rogozhin *et al.* (2009) illustrated the *"zone of the Intramoesian Fault"* as represented by two faults (Silistra–Ezeret and Srebyrna–Shablin), which change orientation from W–NW in the vicinity of the Black Sea to NW orientation towards Silistra (Fig. 24). Rogozhin *et al.* (2009) postulated that the two faults are clearly expressed in the surface topography as two parallel, linear, dry valleys, traced 30 km from the Black Sea up to Izvorovo area (north of Dobrich), the distance between the two valleys being 5–6 km.

Both faults of the discussed Intramoesian Fault zone present *en échelon* faults morphologically expressed, while the narrow tectonic block located between the two crustal faults is considered to have suffered 8–12 m downward movements, and the resulted graben is filled with tectonically disturbed Quaternary loams (Rogozhin *et al.*, 2009). Furthermore, Rogozhin *et al.* (2009) described an N–S fault system, displacing the Intramoesian Fault in Bulgaria into separated segments, with a horizontal throw of up to 1 km.

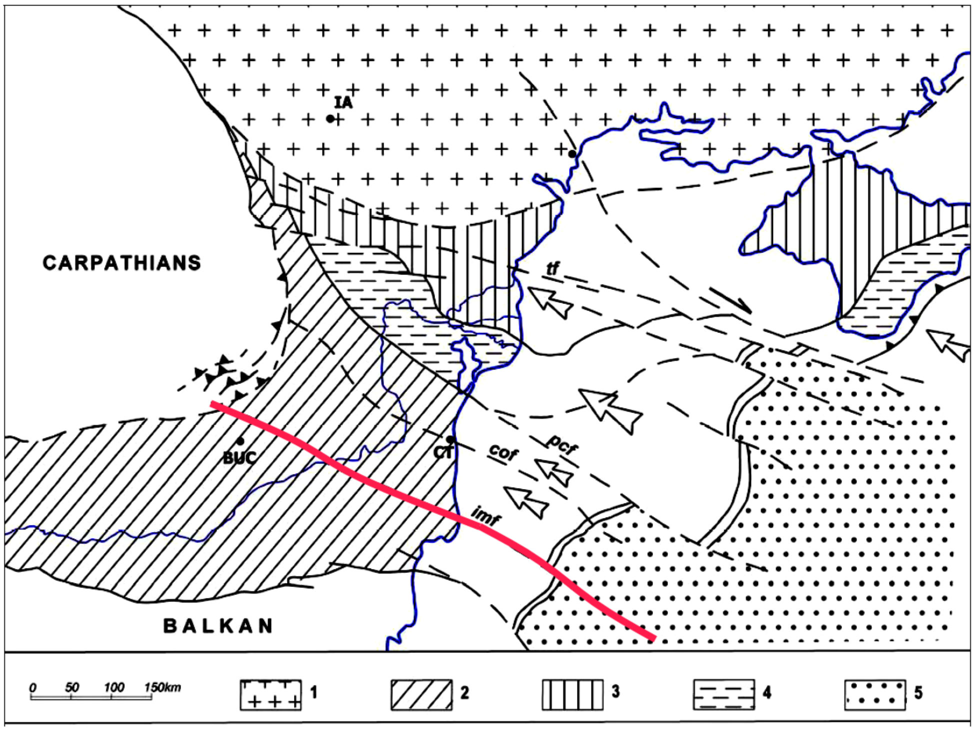

Fig. 20 – *The Intramoesian Fault* (red line) within the Western Black Sea and the Carpathian Foreland geotectonic framework (Săndulescu, 2009). 1 = East European Craton; 2 = Moesian Platform; 3 = Scythian Platform; 4 = North Dobrogea – South Crimea Cimmerian Chain; 5 = Lower Pleistocene structures; pcf = Peceneaga-Camena Fault; imf = Intramoesian Fault (red line); tf = Trotuş Fault; cof = Capidava-Ovidiu Fault.

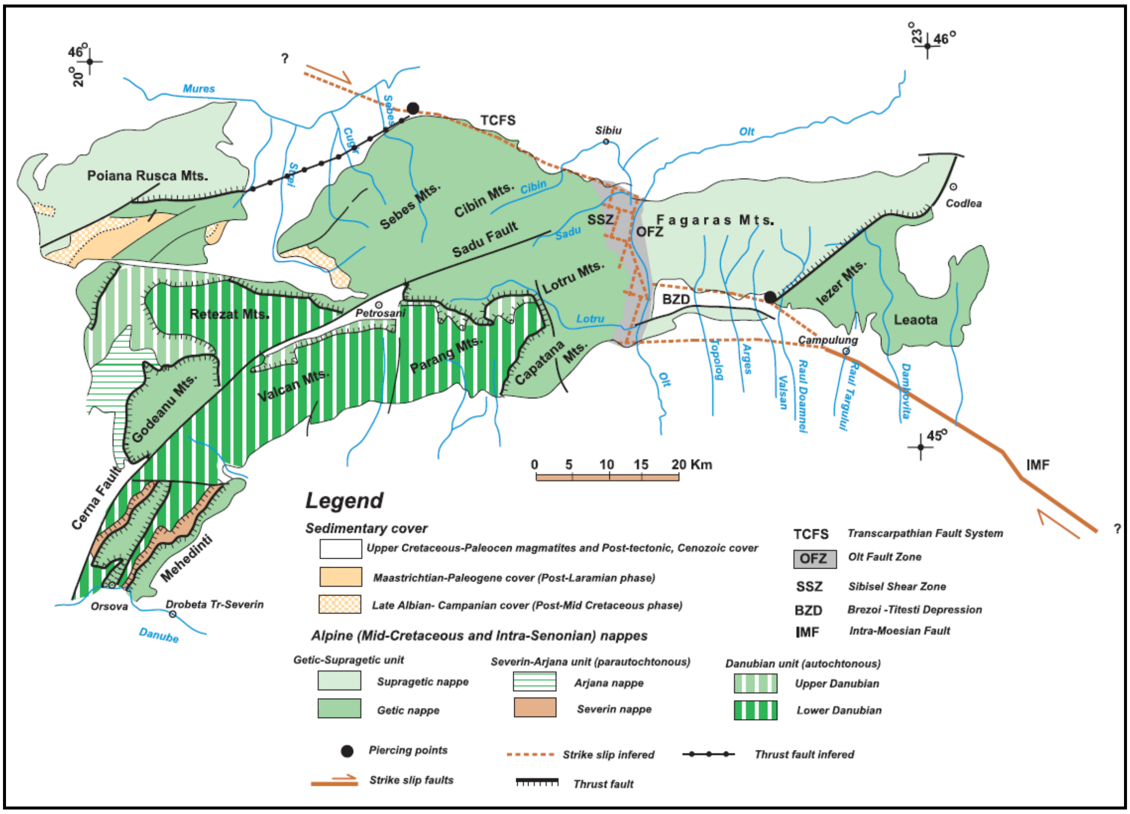

Fig. 21 – The Intramoesian Fault within the Transcarpathian Fault System (Ducea, Roban, 2016).

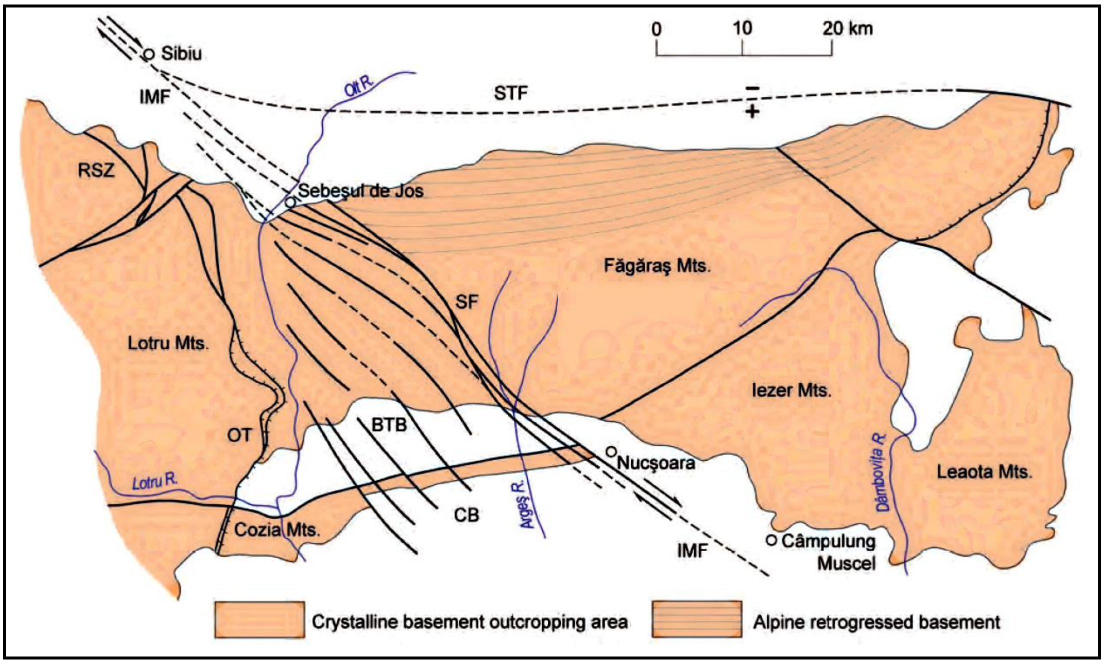

Fig. 22 – *NW–SE fault zone* in the Făgăraş Mountains and related secondary faults, suggesting a deep half flower structure in the western compartment (Stelea, 2017). IMF = Intramoesian Fault; SF = Scara Fault; STF = South Transylvanian Fault; RSZ = Răşinari Shear Zone; OT = Olt Valley thrust faults; BTB = Brezoi-Titeşti Basin; CB = Călimăneşti Basin.

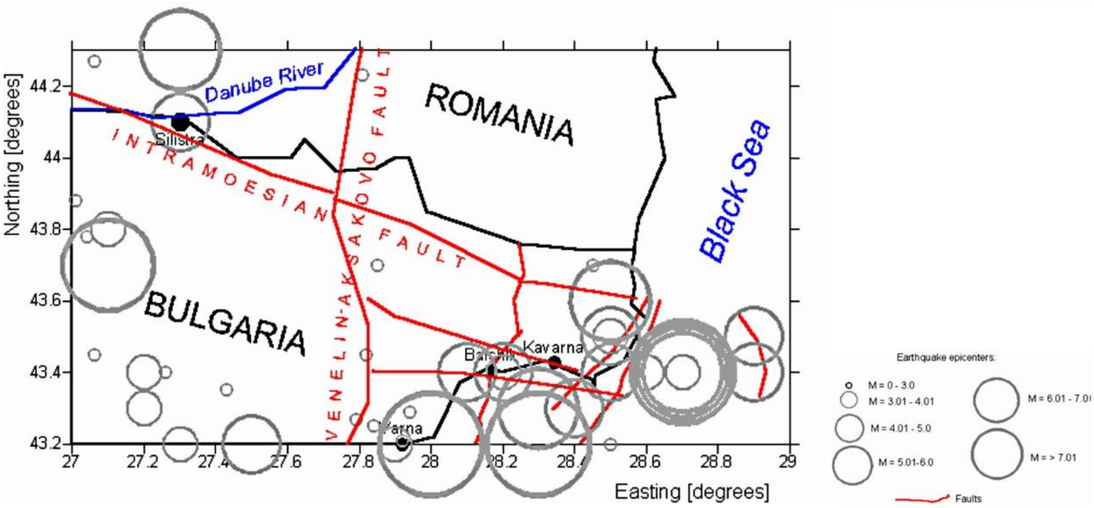

Fig. 23 – The Intramoesian Fault on Bulgarian territory, the regional tectonic framework and earthquakes epicentres (Shanov *et al.*, 2005).

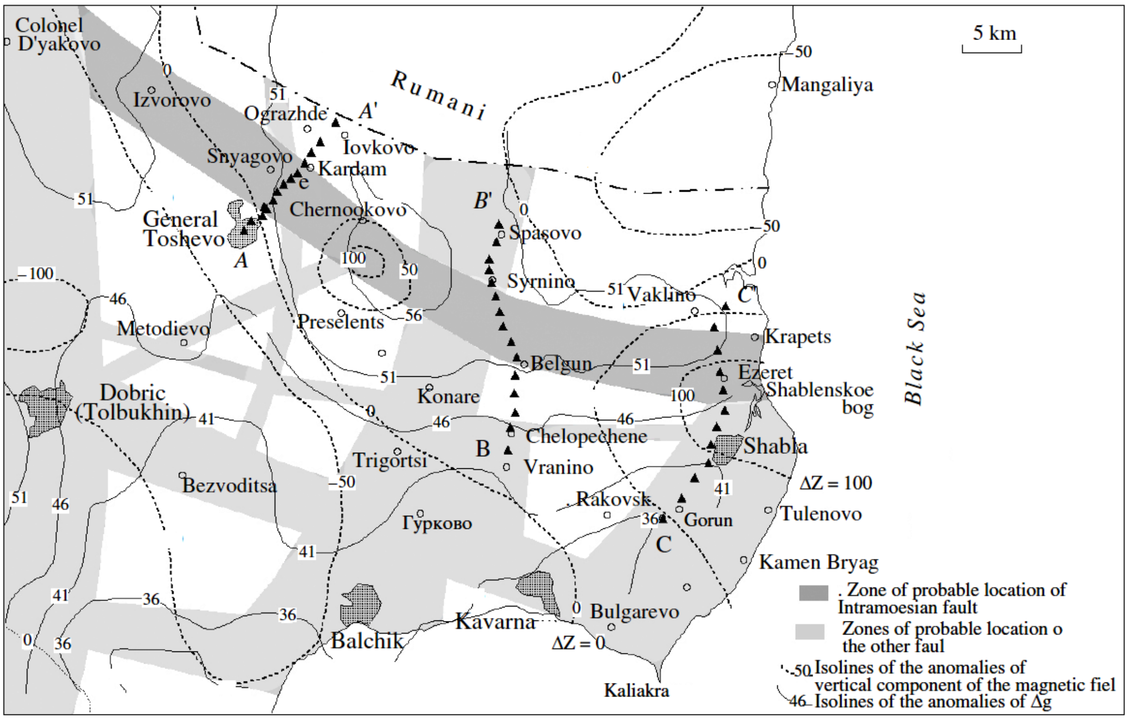

Fig. 24 – The Intramoesian Fault (dark grey zone) in Bulgaria, according to Rogozhin *et al.* (2009).

When addressing the East European Platform western boundary, Ioane and Caragea (2015) considered the Intramoesian Fault as a regional tectonic contact. Based on integrated interpretation of gravity and magnetic data, Ioane and Caragea (2015) considered the eastern compartment of the Moesian Platform to have East European Platform affinities, in terms of high magnetic properties and higher density than the western compartment (Fig. 25).

The PhD study "Intramoesian Fault: geophysical detection and regional active (neo)tectonics and geodynamics" (Stanciu, 2020 – unpublished) offered the framework for a focused research on geophysical detection of the Intramoesian Fault, analysing and integrating a large quantity of geological and geophysical data, as well as field observations.

Stages of the geophysical detection of the Intramoesian Fault research results have been published and presented in 2015 at the GEO2015 Symposium in Bucharest (*Geophysical and Geological Detection of the Intramoesian Fault* – Caragea, Ioane, 2015), in 2016 at the AAPG European Regional Conference & Exibition in Bucharest (*Geophysical Detection of the Intramoesian Fault in Romania* – Stanciu, Ioane, 2016), and at the 16th International Multidisciplinary Scientific GeoConference on Earth & Geosciences SGEM2016 in Albena, Bulgaria (*The Intramoesian Fault as Interpreted on Geophysical, Hg Spectrometry and Seismicity Data* – Stanciu *et al.*, 2016). The integrated interpretation of gravity, magnetic and refraction and reflection seismic data offered the possibility to interpret the position of the Intramoesian Fault at crustal depths.

First attempts of geophysical detection of the Intramoesian Fault at lithospheric depths based on seismic tomography data have been presented and discussed in 2018 at the XXI International Congress of the CBGA, Salzburg, Austria (*The Intramoesian Fault: tectonic contact at crustal and lithospheric depths* – Stanciu, Ioane, 2018a) and at the GEOSCIENCE 2018 Symposium in Bucharest (*The Intramoesian Fault: tectonic contact at crustal and lithospheric depths?* – Stanciu, Ioane, 2018b).

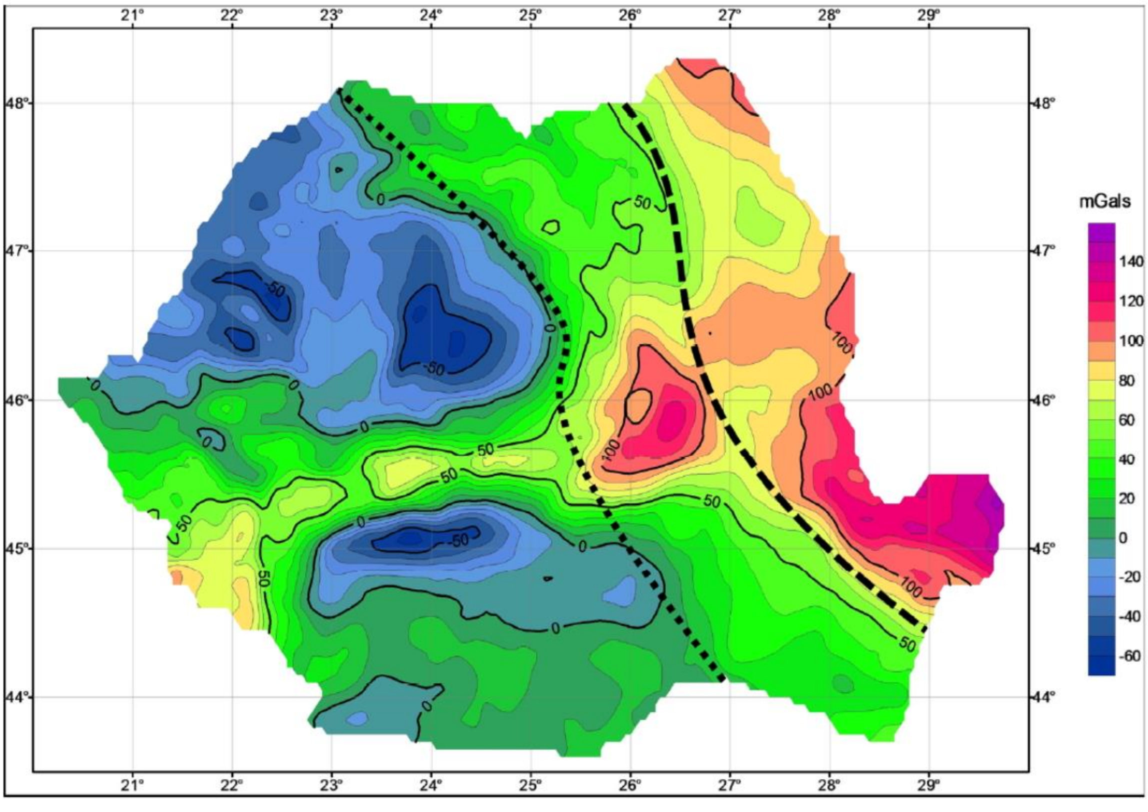

Fig. 25 – East European Platform western boundary at crystalline basement depths (black dashed line) and at lithospheric depths black dotted line as interpreted on the Gravity stripped map of Romania (Ioane, Caragea, 2015).

Local and regional seismicity associated with the Intramoesian Fault analysis has been published in 2017 in Geo-Eco-Marina journal (*Regional seismicity in the Moesian Platform and the Intramosesian Fault* – Stanciu, Ioane, 2017a), published and presented in 2017 at the

GEOSCIENCE 2017 Symposium in Bucharest (*On the Seismicity, Geodynamics and Neotectonics of the Moesian Platform* – Stanciu, Ioane, 2017b) and in 2019 at the 19th International Multidisciplinary Scientific GeoConference on Earth & Geosciences SGEM2019 in Albena, Bulgaria (*Seismicity associated to the Intramoesian Fault: inferences from regional tectonics and geodynamics* – Stanciu, Ioane, 2019), when a new geodynamic model of the region crossed by the Intramoesian Fault was proposed (Fig. 26).

During the PhD study research (Stanciu, 2020 – unpublished), an inclined contact between the Moesian Platform compartments was interpreted as a High Seismicity Boundary, separating the eastern high seismicity compartment from the western low seismicity compartment. This tectonic contact is inclined eastward, its near-surface edge being located close to the Piteşti–Ruse lineament, along the Argeş river, while its in-depth end being located at the Moho depth, along the geologically interpreted position of the Intramoesian Fault (*e.g.*, Stanciu, Ioane, 2017a).

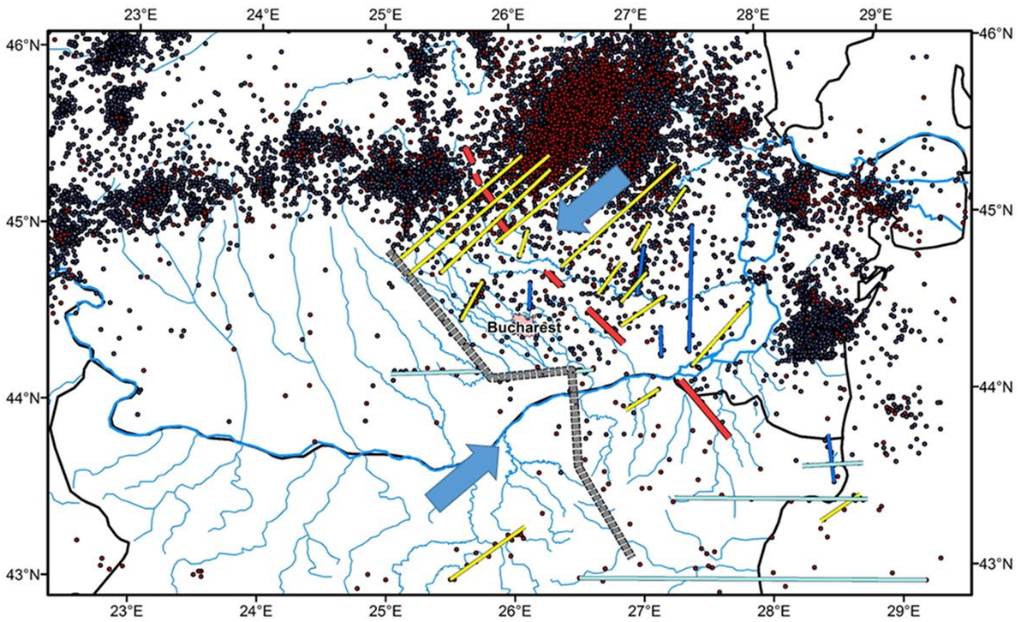

Fig. 26 – The Intramoesian Fault (red line) as interpreted on seismicity (black & red dots) and reflection seismics within the newly built regional geodynamic model and an updated (neo)tectonic framework (Stanciu, Ioane, 2019). Dashed grey line = western boundary of the high seismicity sector; yellow line = NE–SW fault system; dark blue = N–S fault system; light blue = W–E fault system; blue arrows = main horizontal displacement along regional strike-slip faults.

The Intramoesian Fault transect, as interpreted on geophysical data, has been integrated with the regional tectonic and geodynamic framework mostly developed within the PhD study (Stanciu, 2020 – unpublished), the result being the tectonic and geodynamic model of the Intramoesian Fault area represented in Figure 27. A number of segments of the Intramoesian Fault have been interpreted based on geological and geophysical data, its northern and southern extremities differing from the classic geological maps. Several active regional fault systems, having NE–SW, N–S and W–E trending, interpreted based on geophysical and seismicity data, are displacing the Intramoesian Fault segments, especially NE–SW strike-slip faults. Due to successive junctions with the younger NE–SW strike-slip faults, the Intramoesian Fault was displaced toward south-west in the area close to the East Carpathians Bend Zone, and toward north-east in the area north of the Danube.

This model is in good agreement with the wrench tectonics system and geodynamic model for Vrancea area (Ioane, Stanciu, 2018), which includes a NE–SW trending transcurrent fault developed between Prut and Danube rivers, crossing the Moesian Platform and displacing towards SW crustal and lithospheric structures. Moreover, Kotzev *et al.* (2002) results of GPS measurements carried out in Bulgaria advocate for geodynamic horizontal displacements toward north-east in the central part of the Moesian Platform, in the Svishtov–Ruse area.

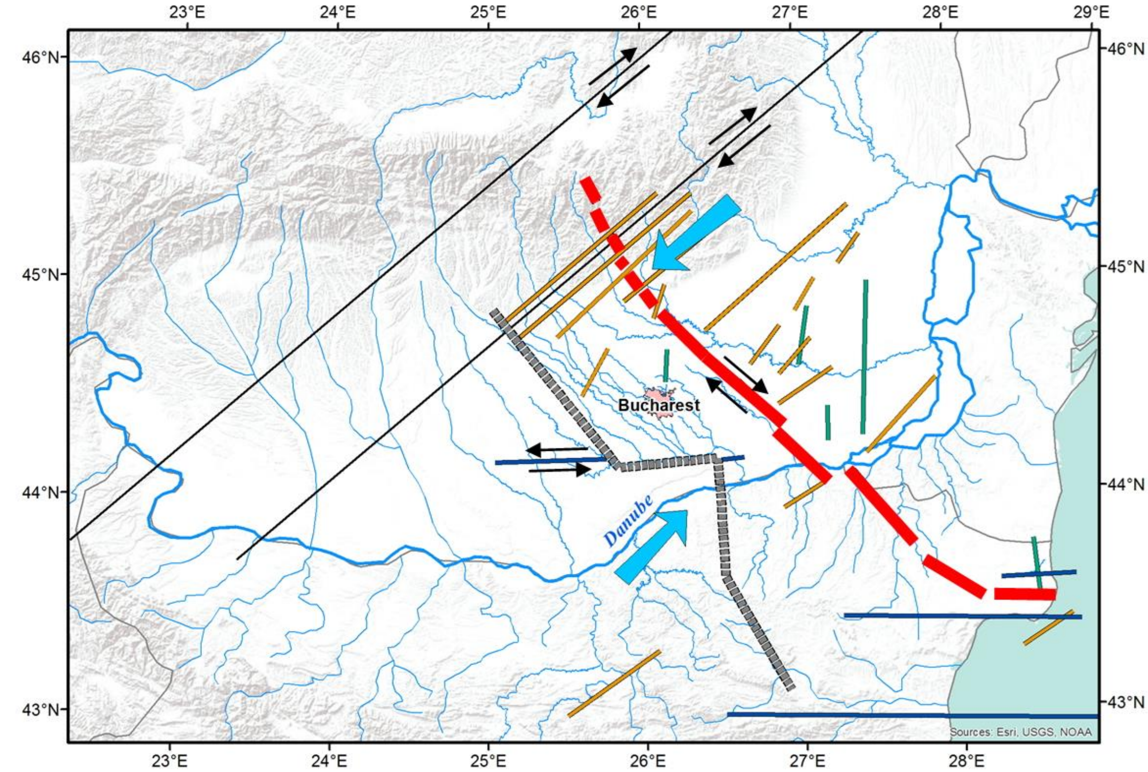

Fig. 27 – Tectonic and geodynamic model of the Intramoesian Fault area (Stanciu, 2020, unpublished). Red lines = segments of the Intramoesian Fault as interpreted on geophysical data; orange lines = NE-SW fault system; dark blue lines = W-E fault system; green lines = N-S fault system; dashed grey line = western limit of high seismicity eastern Moesian Platform compartment (High Seismicity Boundary); black lines = transcurrent faults of the Vrancea wrench tectonics model (Ioane, Stanciu, 2018); blue arrows = horizontal displacements due to wrench tectonics processes.

CONCLUSIONS

Throughout history (in time), the Intramoesian Fault proved to be a complex and complicated tectonic target both at local and regional scale (in space), being differently located on maps. This regional fault had a large variety of names and was identified so far as fault, fracture or tectonic contact.

Even though they did not targeted the Intramoesian Fault, results of the reflection seismics surveys offered valuable insights on its location and geometry in the sedimentary cover (*e.g.*, Burcea *et al.* 1965, 1966; Răbăgia *et al.*, 2000; Tărăpoancă, 2004).

The integrated interpretation of geophysical data with geological and tectonic information for the Moesian Platform, carried out in the context of “Intramoesian Fault: geophysical detection and regional active (neo)tectonics and geodynamics” PhD study (Stanciu, 2020 – unpublished), proved to represent a powerful tool when detecting the Intramoesian Fault and building a new regional tectonic and geodynamic model.

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