THE MOESIAN PLATFORM: STRUCTURAL AND TECTONIC FEATURES INTERPRETED ON REGIONAL GRAVITY AND MAGNETIC DATA

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Abstract. Compilation of gravity maps from Romania and Bulgaria provided geophysical data with very good regional coverage, making possible enhanced data processing and cross-border geological interpretation of gravity data on the Moesian Platform.

By merging the available gravity data into a unique dataset, a Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria was produced. When applying filtering techniques, the residual gravity anomaly map of the Moesian Platform provided valuable information on the Intramoesian Fault segments in both Romania and Bulgaria. Large and deep geological structures of the Moesian Platform were interpreted on gravity anomalies at crustal depths based on density contrasts as compared with the neighbouring background.

Aeromagnetic data processing using different filtering methods in Oasis montaj software, resulted in a series of other magnetic maps and offered new possibilities of interpreting the available data.

Key words: Moesian Platform, Intramoesian Fault, gravity data re-processing, aeromagnetic data filtering, gravity and magnetic data interpretation

1. INTRODUCTION

Since only gravity and magnetic maps provide geophysical data that cover the entire Moesian Platform, enhanced data processing and interpretation was carried out aiming to detect the Intramoesian Fault at crustal depths in a regional framework, as part of the PhD thesis *Intramoesian Fault: Geophysical Detection and Regional Active (Neo)Tectonics and Geodynamics* (Stanciu, 2020, unpublished). Other interesting structural and tectonic features of the Moesian Platform were depicted during the regional gravity and magnetic data processing and interpretation.

Integrated gravity and magnetic geophysical methods are generally used, especially in applied geophysics for oil and gas accumulations, to detect structural and tectonic features of the basement and at the sedimentary cover level. Data processing of regional datasets may provide significant information about deeper structures, situated in-depth toward the Moho boundary.

Throughout history (during time), the Intramoesian Fault proved to be a complex and complicated tectonic target at both local and regional scales (in space), being differently located on maps, as emphasized in Stanciu and Ioane (2021). This regional fault had a large variety of names and was identified so far as fault, fracture or tectonic contact. The *"Intramoesian"* name, given by M. Săndulescu in 1984, illustrates this fault mostly accepted geotectonic role: separating the Moesian Platform in two distinct tectonic compartments, westward and eastward, with different petrographic facies and geological age, referred to as: Danubian and Dobrogean (Paraschiv, 1979), Wallachian/ Wallachian-Prebalkan and Dobrogean sectors (Săndulescu, 1984; Visarion *et al.*, 1988; Săndulescu and Visarion, 2000), West and East Moesia (Oaie *et al.*, 2005; Seghedi *et al.*, 2005a,b), or Wallachian Platform, South Dobrogean Platform and Central Dobrogean Massif (Mutihac and Mutihac, 2010).

The Intramoesian Fault belongs to the NW-SE faults system of the Moesian Platform, interpreted by Săndulescu (2009) and Săndulescu and Visarion (2000) as related to the postulated westward drift of Moesia due to Western Black Sea opening, with an essential role in the achievement of the Carpathian double-bend, which occurred within Cretaceous through Miocene.

The NW-SE fault system of the Moesian Platform is relatively transverse to the East Carpathians Bend Zone and consists of strike-slip faults of ages ranging from Paleozoic to Cretaceous (*e.g.*, Burcea *et al.*, 1965, 1966; Cornea and Polonic, 1979; Paraschiv, 1979; Săndulescu, 1974, 1984; Visarion *et al.*, 1988; Săndulescu and Visarion, 2000; Visarion and Beşuţiu, 2001; Dinu *et al.*, 2005). This fault system is characteristic for the Eastern Moesia and was identified as "Dobrogea strike" by Săndulescu (1974).

The Moesian Platform plunges step-like below the Carpathian thrust wedge as well as below the Balkan thrust wedge, within the frame of a W-E parallel faults system. According to Săndulescu (1984), this faults system was generated and, in part, reactivated in the Neogene. It is typically developed in Western Moesia, and was identified as "Oltenia strike" by Săndulescu (1974). It is recognised as the most significant in terms of geological conditions for oil and gas accumulation in the Moesian Platform (*e.g.*, Paraschiv, 1979; Pene *et al.*, 2006). Noteworthy is the Craiova – Balş – Optaşi faults system of the horst-like structure known as the *„Oltean Threshold"*. Within this area, based on borehole data from Barbu and Dăneţ (1970, in Ciocîrdel and Georgescu, 2007) and Mutihac and Mutihac (2010), the basement reaches depths ranging from 1940 m (Priseaca well) to 3715 m (Străjeşti well). Northward, the crystalline basement deepens up to 10-12 km beneath the Getic Depression. In the southern part of the Oltean Threshold there are predominantly east-west trending tectonic structures, except for the Balş tectonic block, elevated NNE-SSV (Visarion *et al.*, 1988).

2. REGIONAL GRAVITY DATA: RE-PROCESSING, FILTERING AND INTERPRETATION

Gravity geophysical method is generally used to detect structural and tectonic features of the basement and at the sedimentary cover level.

At an early stage of this study, significant information on the Intramoesian Fault transect in Romania and Bulgaria have been obtained by interpreting published gravity maps:

- Nicolescu and Roşca (1992) Bouguer anomaly map of Romania;
- Bouguer gravity map built on 5' x 7.5' mean values (Ioane and Ion, 1992);
- Bouguer gravity anomaly map of Bulgaria (Trifonova *et al.*, 2013);
- Gravity residual map of Romania (Ioane and Atanasiu, 2000);
- Gravity stripped map of Romania (Ioane and Ion, 2005);
- Vertical gravity gradient map of Bulgaria calculated by Trifonova *et al.* (2013);
- The total horizontal gradient of Bouguer gravity anomalous field of Bulgaria (Trifonova *et al.*, 2013);
- Composite map of the gravity anomaly (Bouguer gravity onshore, Free Air gravity offshore) for the Western Black Sea, Romania and Bulgaria (Dimitriu *et al.*, 2016).

An important step toward gravity data processing and interpretation was the analysis of the Bouguer (on-shore) and Free-Air (off-shore) composite gravity map for Romania and Bulgaria, based on gravity data: Bouguer (on-shore) Romania (Nicolescu and Roşca, 1992), Bouguer (on-shore) Bulgaria (Trifonova *et al.*, 2013) and Free-Air (off-shore) Western Black Sea (Dimitriu *et al.*, 2016). The interpreted transect of the Intramoesian Fault published in Stanciu *et al.* (2016) utilized gravity features observed on three areas along the fault, situated in Romania and Bulgaria:

(**a**) the western limit of a regional high gravity, developed NW-SE between Ploieşti and the Danube River (Romania);
(**b**) a weak gravity horizontal gradient trending WNW-ESE from Silistra to Dobrich (Bulgaria);
(**c**) a weak gravity horizontal gradient trending W-E from Dobrich toward Shabla (Bulgaria).

The Bouguer gravity anomaly maps of Nicolescu and Roşca (1992) and Trifonova *et al.* (2013) were digitized using Blue Marble Geographics Global Mapper software, and further reprocessed using Geosoft Oasis montaj software. Each set of Bouguer gravity anomaly data was gridded individually. Data reprocessing was carried out on 500 m resolution grids, using Minimum Curvature gridding method. The Romanian and Bulgarian Bouguer gravity anomaly grids were merged using Boolean Operations function and some existing gaps were filled using OM90 – a custom software module developed by the U.S. Geological Survey (U.S.G.S., 2007). By merging the available gravity data into a unique dataset, covering the Moesian Platform in both Romania and Bulgaria, a Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria was produced. When applying filtering techniques, the residual gravity anomaly map of the Moesian Platform provided valuable information on the Intramoesian Fault segments in both Romania and Bulgaria, as well as on some other concealed tectonic features and geological structures of the Moesian Platform.

The residual gravity anomaly map of the Moesian Platform was calculated within the GM-SYS 3D module, using a filter of passing the wavelengths greater than 60000 m on the Bouguer gravity anomaly map of the Moesian Platform (Romania and Bulgaria). For data interpretation, the processed grid images were exported as georeferenced .tiff files and integrated in an ESRI ArcMap geodatabase.

The resulted Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria (Fig. 1) illustrates large gravity variations, exceeding 150 mGal, from the low anomalies located in the northern part (Getic Depression, Carpathian Foredeep, Focşani Depression) to the high anomalies contoured in the eastern (Central Dobrogea, the North Bulgarian Uplift) and south-western parts (Oltenian Threshold). A remarkable gravity low overlaps the Getic Depression (ca. -125 mGal), while the highest Bouguer gravity anomaly values are corresponding to Central Dobrogea (ca. +30 mGal).

Considering the regional character of the resulted Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria, the observed gravity anomalies are considered to represent to a large extent effects of significant density contrasts within the crust.

The Bouguer gravity anomalies illustrate, considering the morphology and regional decrease of values intensity, the northward thickening of the sedimentary cover and the deepening of the consolidated crust, including the crystalline basement, the upper and the lower crust of the Moesian Platform. The northward deepening of the platform beneath the Carpathian Foredeep is illustrated using 3D gravity stripping technique in Ioane *et al.* (2005) study.

The contoured regional high gravity anomalies situated in Central Dobrogea, the north-eastern part of Bulgaria and the Oltenian Threshold are interpreted as effects of large geological high density uplifted structures, such as the Dobrogean Horst (outcropping Histria Formation, ankimetamorphic Ediacaran turbidites – *e.g.*, Mirăuţă, 1969; Oaie, 1998; Seghedi, 1998; Seghedi *et al.*, 2005a,b), the North-Bulgarian Uplift (uplifted Palaeozoic sedimentary formations – *e.g.*, Boncev, 1974; Paraschiv, 1975; Zagorchev *et al.*, 2009) and the Balş-Optaşi Uplift (uplifted metamorphic basement, Palaeozoic formations and magmatic structures; sometimes including Triassic high density dolomites, associated with oil and gas accumulations – *e.g.*, Gavăt *et al.*, 1939, 1974; Paraschiv, 1978; Savu and Paraschiv, 1985; Seghedi *et al.*, 2001, 2005a; Barbu and Dăneţ, 1970, in Ciocîrdel and Georgescu, 2007; Mutihac and Mutihac, 2010).

At this scale, the effects of the sedimentary cover or faults are cumulated with the much stronger effect of the morphology of the lower crust – upper mantle limit.

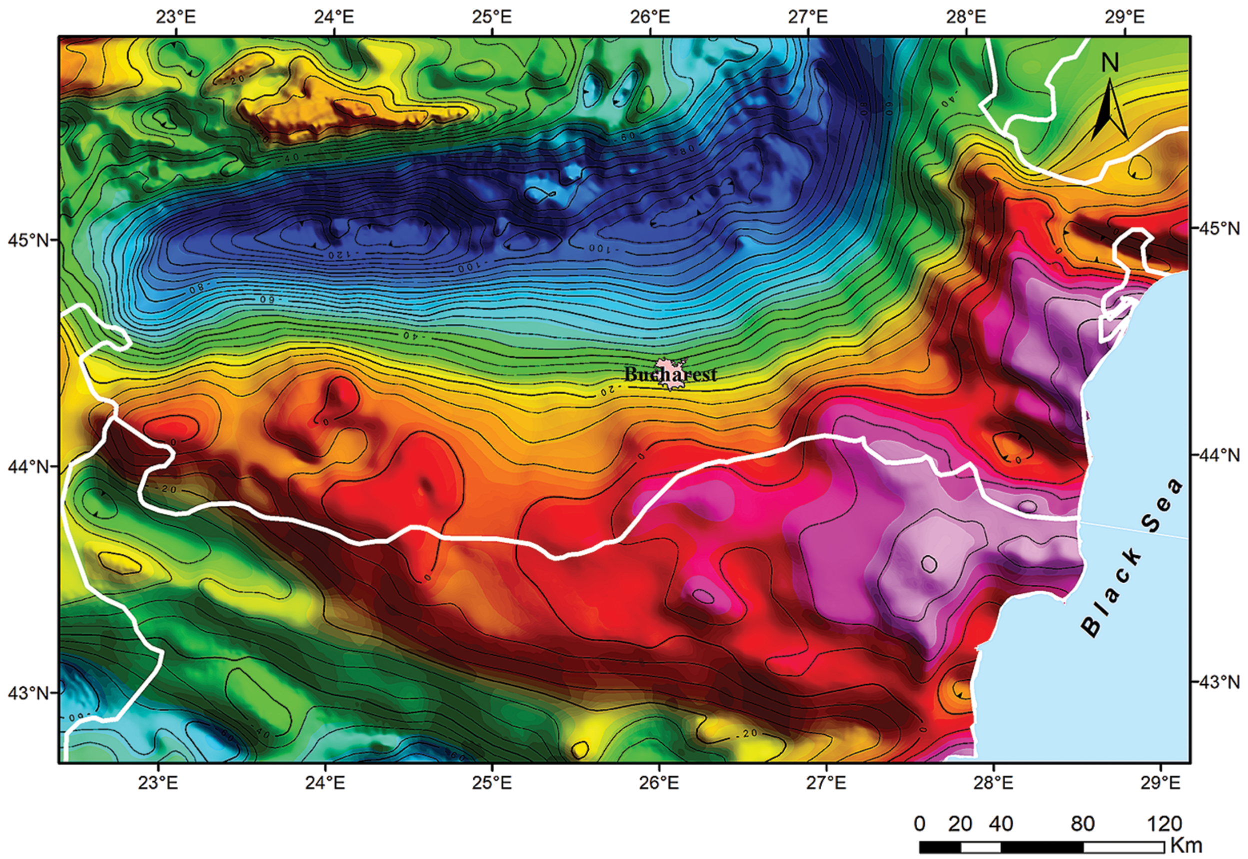

Fig. 1. Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria, re-processed using Oasis montaj software, based on Nicolescu and Roşca (1992) and Trifonova *et al.* (2013) maps (from Stanciu, 2020, unpublished). Red and purple = high gravity anomalies; blue = low gravity anomalies.

However, in the eastern part of the Moesian Platform, several NW-SE trending lineaments with rapid variation in Bouguer gravity values are interpreted as effects of faults (Fig. 2). Amongst them, the effects of Capidava-Ovidiu and Peceneaga-Camena faults on Bouguer gravity can be easily recognised in Dobrogea, where they have been geologically mapped, and in the exterior of the East Carpathians Bend Zone, where the geological structures and tectonic features are concealed beneath thick Quaternary formations.

The Peceneaga-Camena Fault, depicted on Bouguer gravity anomaly map (turquoise line in Fig. 2) at the north-eastern border of the Moesian Platform, separates the platform from the North Dobrogea Orogen. This fault was described in Seghedi *et al.* (2005a) as "a fundamental terrane boundary". Seismic refraction data (Socolescu *et al.*, 1975; Rădulescu and Diaconescu, 1998) indicated a ca. 10 km throw in Moho discontinuity of Central Dobrogea vs. the North-Dobrogean Orogen, along the Peceneaga-Camena Fault. Its south-eastern prolongation was traced up to 100 km on the Romanian shelf (Dinu *et al.*, 2005). Considering reflection seismic data and borehole data interpretation, the Peceneaga-Camena Fault is associated by Dinu *et al.* (2003) with a large number of smaller scale strike-slip faults, active during Upper Albian – Cenomanian. Active seismicity associated with the Peceneaga-Camena Fault was interpreted by Visarion and Beşuţiu (2001) as an argument for its active neotectonics.

Parallel to the Peceneaga-Camena Fault, ca. 20 km to the south, another crustal fault is interpreted on Bouguer gravity (beige line in Fig. 2) crossing Central Dobrogea on NW-SE trending.

The Capidava-Ovidiu Fault (yellow lines in Fig. 2) separates the uplifted Central Dobrogea from the Southern Dobrogea (*e.g.*, Dumitrescu and Săndulescu, 1968; Săndulescu, 1984; Avram *et al.*, 1998).

The Palazu Mare Fault (orange line in Fig. 2) (Visarion *et al.*, 1979), interpreted in this study as NW-SE trending, reaching the Black Sea in Eforie area, has been described by Oczlon *et al.* (2007) as the southern boundary of the Palazu terrane, a proximal Baltican sliver in the basement of South Dobrogea. The northward delineation of this terrane is considered the Capidava-Ovidiu Fault by the quoted authors.

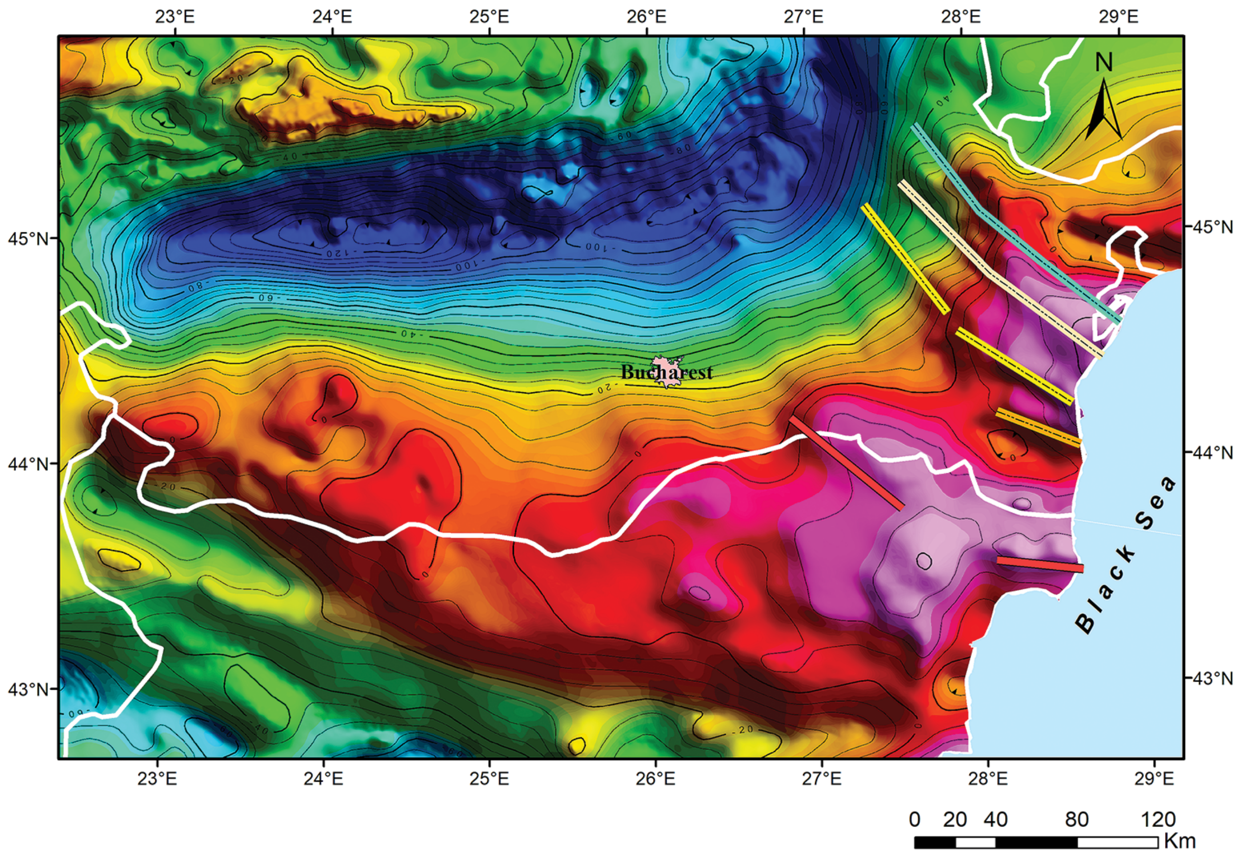

Fig. 2. Bouguer Gravity Anomaly Map of the Moesian Platform in Romania and Bulgaria, re-processed using Oasis montaj software, based on Nicolescu and Roşca (1992) and Trifonova *et al.* (2013) maps (modified from Stanciu, 2020, unpublished). Red and purple = high gravity anomalies; blue = low gravity anomalies. Red lines = Intramoesian Fault segments; orange line = Palazu Mare Fault; yellow lines = Capidava-Ovidiu Fault segments; beige line = crustal fault; turquoise line = Peceneaga-Camena Fault.

There are no high intensity horizontal gradients on the Bouguer Gravity Anomaly Map in Romania to illustrate the regional development of the Intramoesian Fault, probably due to the deep location of the crystalline basement and also due to thick undifferentiated sedimentary formations covering both compartments of the Moesian Platform north of the Danube River, since Late Miocene. South of the Danube River, in Bulgaria, segments of horizontal gradient of gravity anomalies trending NW-SE from Silistra toward Dobrich and W-E from Dobrich to Tyulenovo are interpreted on the Bouguer Gravity Anomaly Map as gravity effects of the Intramoesian Fault (red lines in Fig. 2), depicted at the sedimentary cover/crystalline basement discontinuity depths.

The residual gravity anomaly map of the Moesian Platform (Romania and Bulgaria) illustrates significant gravity anomalies (Fig. 3), interpreted as being mainly due to depth variations at the top of the metamorphic basement and sedimentary cover thickness variations:

- The Strehaia Uplift and the Balş-Optaşi Uplift are nicely contoured in the north-western part of the Moesian Platform.
- The low residual gravity anomaly contoured in the central part of the Moesian Platform (east of Bucharest) was interpreted as the effect of a NW-SE graben structure, situated between Videle-Bucharest, Silistra-Călăraşi-Urziceni and the North Bulgarian uplifted tectonic blocks. Such interpretation is consistent with the graben structure interpreted east of Bucharest by Paraschiv (1983) at the level of Middle-Late Carboniferous (Vlaşin Formation) in figure 4.
- The W-E high residual Bouguer gravity anomaly located along the Danube, at the Romanian-Bulgarian border (south of Bucharest city), is interpreted as the effect of an uplifted structure, separated from the Videle-Bucharest uplift by the W-E trending Argeş Fault.

Although it is not clearly depicted on the residual Bouguer gravity anomaly map, the Argeş Fault has been interpreted based on seismic reflection data (Răbăgia *et al.*, 2000) south of Bucharest, along the Argeş river. The neotectonic study in the Bucharest area presented by Răbăgia *et al.* (2000) is illustrating the Argeş Fault as a tectonic feature affecting the Quaternary sedimentary formations up to the topographic surface.

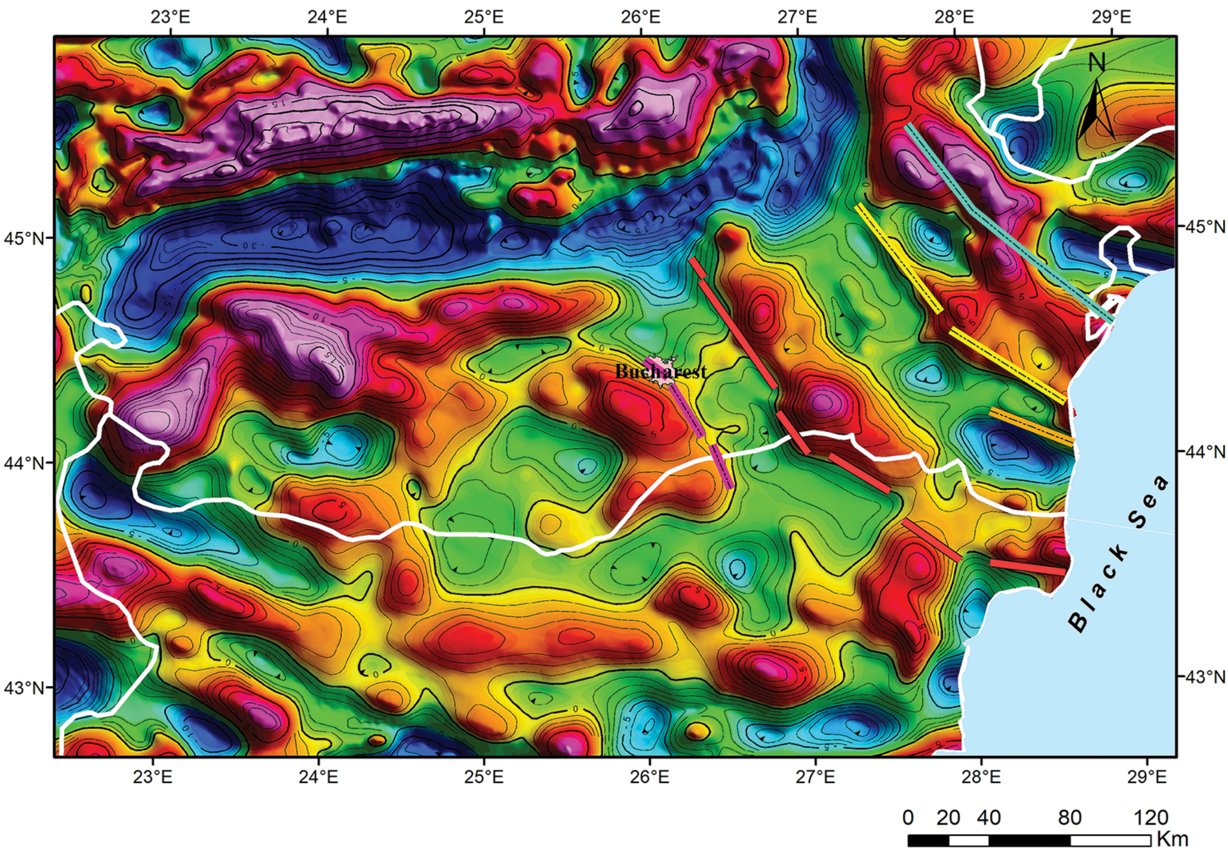

Fig. 3. The Residual Gravity Anomaly Map of the Moesian Platform (Romania and Bulgaria), calculated using GM-SYS 3D module of Oasis montaj software, using the Bouguer gravity anomaly map of the Moesian Platform (Romania and Bulgaria) (modified from Stanciu, 2020, unpublished). Red and purple = high gravity anomalies; blue = low gravity anomalies. Red lines = Intramoesian Fault segments; purple dashed line = crustal fault; orange line = Palazu Mare Fault; yellow lines = Capidava-Ovidiu Fault segments; turquoise line = Peceneaga-Camena Fault.

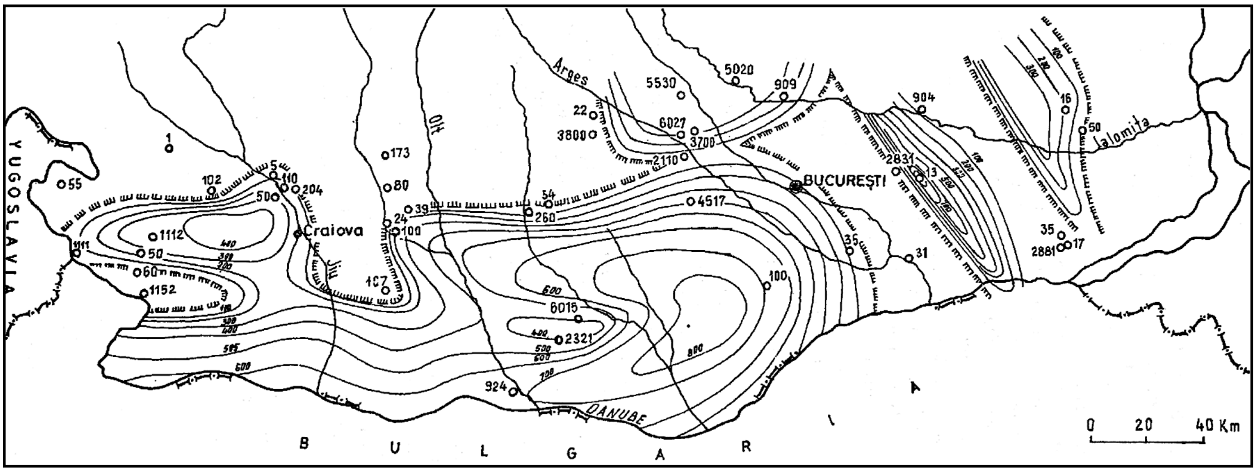

Fig. 4. Isopachs map of the Middle-Late Carboniferous (Vlaşin Formation) (from Paraschiv, 1983).

The residual gravity anomalies allowed the interpretation on several segments of the Intramoesian Fault (red lines in Fig. 3) at the western limit of the Silistra-Călăraşi uplifted tectonic block:

- A NW-SE trending segment along the Mostiştea river;
- A NW-SE trending segment crossing the Danube west of Silistra;
- Two NW-SE trending segments from Silistra toward Dobrich;
- A W-E trending segment in NE Bulgaria, reaching the Black Sea coastline in Tyulenovo area.

Another NW-SE trending crustal fault (purple line in Fig. 3) is interpreted at the western limit of the graben structure, "crossing" Bucharest, the capital city of Romania.

Capidava-Ovidiu Fault segments (yellow lines in Fig. 3) are interpreted at the north-eastern limit of another NW-SE elongated depressionary area at the basement level, developed between the Black Sea and the East Carpathians Bend Zone. South of the Capidava-Ovidiu Fault, the Palazu crustal fault (orange line in Fig. 3) is depicted on the residual Bouguer gravity anomaly as well.

The Peceneaga-Camena Fault (turquoise line in Fig. 3) is interpreted at the north-eastern limit of the high gravity anomaly situated at the NW-SE contact between the Central Dobrogea tectonic block and the North Dobrogea Orogen, the latter being mostly characterized by an intense low gravity anomaly corresponding to the Tulcea tectonic zone (thick sedimentary cover and acidic magmatic intrusions).

Magnetic data interpretation started from various ground and airborne magnetics, as well as satellite magnetic published maps:

- Global Magnetization Map, based on measurements of the magnetic field made by NASA satellites Magsat, OGO-2, OGO-4, and OGO-6 (Puruker *et al*., 1997, in Ioane and Caragea, 2015);
- Vertical Component Magnetic Anomalies Map of Romania ΔZ_a (Airinei *et al*., 1983);
- Total intensity anomaly map of Romania, scale 1:1000000 (Beşuţiu *et al*., 2008);
- Horizontal gradient anomalies of the vertical component of the magnetic field map (Ioane and Atanasiu, 1999);
- The Vertical Component Magnetic Anomalies Map ΔZ_a of the Bulgarian territory (Trifonova *et al*., 2012);
- The composite map of the magnetic anomaly for the Western Black Sea, Romania and Bulgaria (Dimitriu *et al*., 2016).

All of the mentioned magnetic data were analysed and interpreted by the authors in several articles (Ioane and Caragea, 2015; Caragea and Ioane, 2015; Stanciu *et al*., 2016; Stanciu and Ioane, 2016a,c; Stanciu and Ioane, 2020).

3. REGIONAL AEROMAGNETIC DATA: FILTERING AND INTERPRETATION

Aeromagnetic data (total intensity scalar of the geomagnetic field) for the Romanian part of the Moesian Platform were downloaded (in ASCII format), using the online resources of Oasis montaj, from the World Digital Magnetic Anomaly Map (WDMAM) version 2.0, which is also available freely at http://wdmam.org/. Unfortunately, Bulgarian aeromagnetic data are not included in WDMAM, therefore the aeromagnetic data representation and further processing were completed only on Romanian part of the Moesian Platform. For Romania, L. Beşuţiu (Romanian Academy Institute of Geodynamics „Sabba S. Ştefănescu") is recognized as aeromagnetic data contributor for WDMAM 2.0 (http://wdmam.org/, accessed 2018).

Consistent with the Vertical Component Magnetic Anomalies Map ΔZ_a (Airinei *et al*., 1983), the aeromagnetic map of the Moesian Platform in Romania illustrates effects of geological structures with high magnetic properties, starting downward from the metamorphic basement level.

While in the western part of the Moesian Platform the high magnetic anomalies are interpreted as the effect of magmatic intrusions and uplifted metamorphic basement, a steep gradient of the total magnetic field in the central part of the Moesian Platform is interpreted as indicating a segment of the Intramoesian Fault (red line in Fig. 5).

When processing aeromagnetic data in Oasis montaj, MAGMAP – Step-by-step method was used to apply several filters, such as Differential Reduction to the Pole (DRTP), Pseudo-Gravity (PSG), and the Analytic Signal (AS), aiming to depict the path of the Intramoesian Fault. All MAGMAP filters are applied in the Fourier (wavenumber) domain. First a Fourier transform was created then the application of filters was straightforward.

The Differential Reduction to the Pole (DRTP) represents a technique that reduces a grid of total field magnetic data to the geomagnetic pole, taking into account the regional variations in the direction of the geomagnetic field and the regional magnetisation of the crust (Arkani-Hamed, 1988; Swain, 2000). The Differential Reduction to the Pole (DRTP) reduces the regional magnetic anomalies to the geomagnetic pole, using the local directions of the geomagnetic field and crustal magnetization (Arkani-Hamed, 1988).

In applying the Differential Reduction to the Pole (DRTP) filter to the aeromagnetic map of the Moesian Platform in Romania, a pseudo-inclination of 20° was used, the results being illustrated in figure 6. When compared to the aeromagnetic map of the Romanian Moesian Platform (Fig. 5), the high magnetic anomalies in the Western Moesia, interpreted as due to magmatic intrusions and uplifted metamorphic basement are better contoured, whereas the steep gradient of the total field, interpreted as indicating the path of the Intramoesian Fault, does not change its morphology (red line in Figs. 5 and 6).

The use of the Analytic Signal (AS) filtering technique (Nabighian, 1972; 1974) offers the advantage that it produces maxima directly over the edge of the buried dipping contact that causes the magnetic anomaly (Nabighian, 1972). Also, its amplitude is independent of magnetization direction and body dip (Pilkington and Keating, 2004). The disadvantages of the analytic signal are that it is more sensitive to noise than other filtering methods (MacLeod *et al.*, 1993; Pilkington and Keating, 2004) and the resulted anomalies are relatively much broader than the lateral extent of the buried target (Reci *et al.*, 2011).

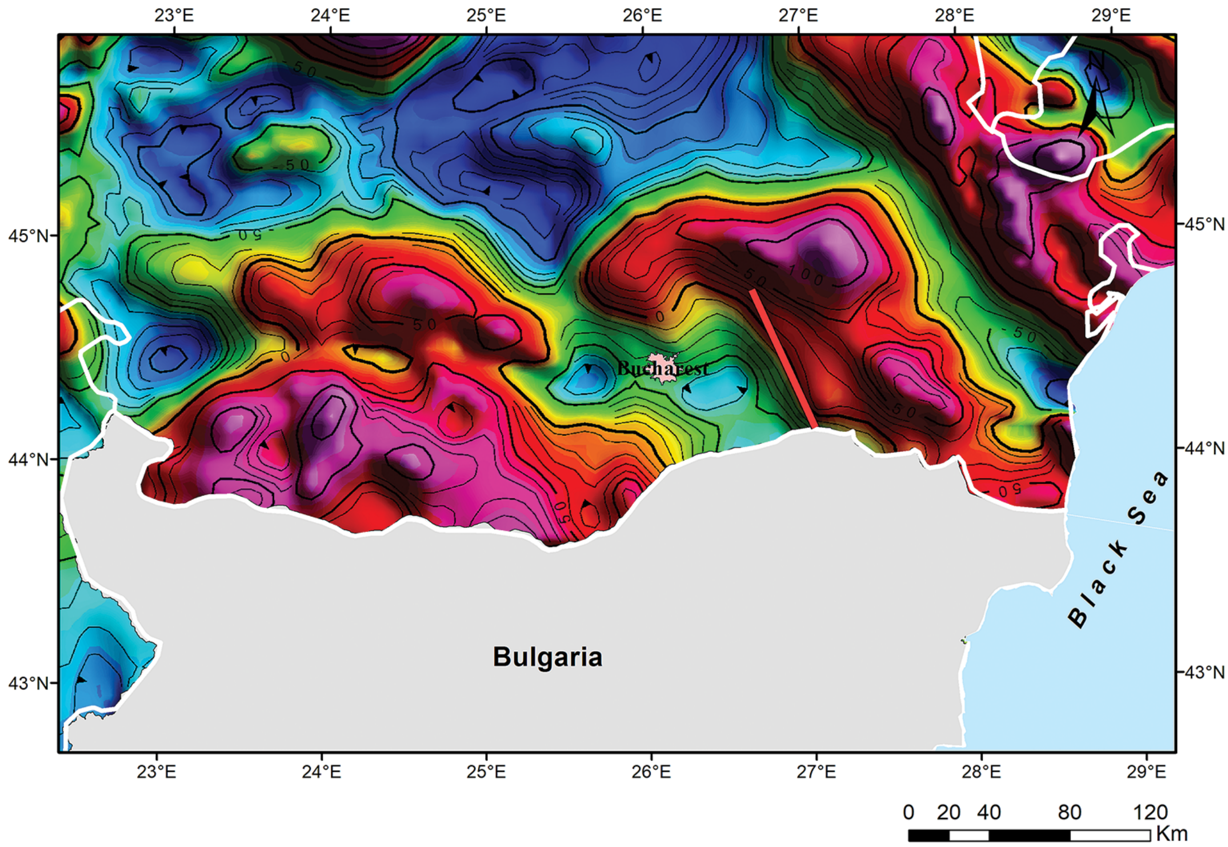

Fig. 5. The Aeromagnetic Map of the Moesian Platform (Romania) (detail from WDMAM 2.0, obtained by accessing the online resources of Oasis montaj, 2018) (modified from Stanciu, 2020, unpublished). Red and purple = high aeromagnetic anomalies; blue = low aeromagnetic anomalies. Red line = Intramoesian Fault segment.

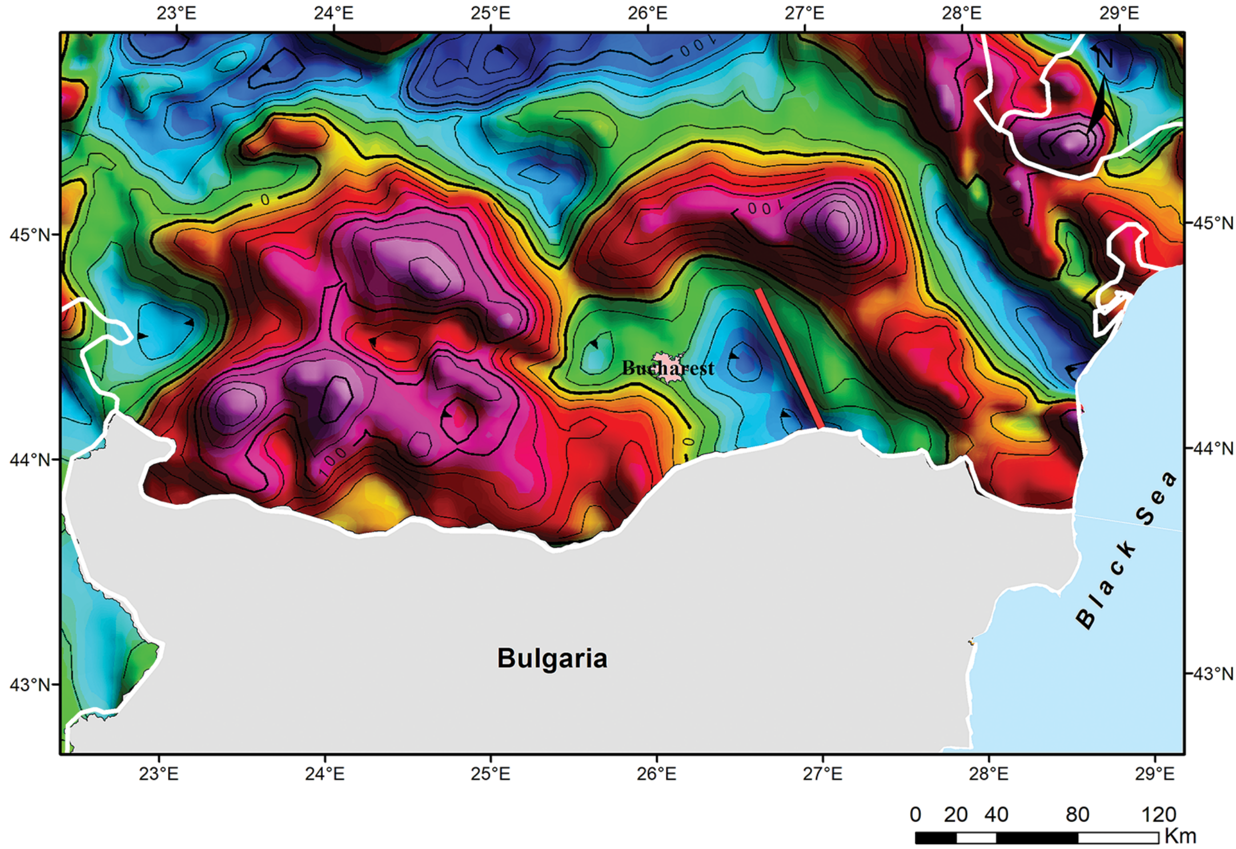

Fig. 6. The Differentially Reduced to the Pole aeromagnetic map of the Moesian Platform (Romania), (aeromagnetic data from WDMAM 2.0, obtained by accessing the online resources of Oasis montaj, 2018) (modified from Stanciu, 2020, unpublished). Red and purple = high aeromagnetic anomalies; blue = low aeromagnetic anomalies. Red line = Intramoesian Fault segment.

The Analytic Signal (AS) filter has been applied to the Aeromagnetic Map of the Moesian Platform in Romania, as well as to the Differentially Reduced to the Pole Aeromagnetic Map of the Moesian Platform in Romania, the results being illustrated in figures 7 and 8. The main observation is that the Analytic Signal anomalies are better expressed when applied to the Differentially Reduced to the Pole Aeromagnetic Map of the Moesian Platform in Romania.

Segments of the Intramoesian Fault were interpreted based on the Differentially Reduced to the Pole Aeromagnetic Analytic Signal Map of the Moesian Platform in Romania (red lines in Fig. 8), considered as due to magnetic contrasts at an acute angle: North of Ploieşti, along the Mostiştea river and in the Mostiştea lake area. The segment of the Intramoesian Fault situated along the Mostistea Valley, interpreted on the Analytic Signal anomalies map obtained from the Differentially Reduced to the Pole aeromagnetic map of the Romanian Moesian Platform, shows a good correlation with the reflection seismic data interpretation from Burcea *et al.* (1965, 1966).

Two other interesting tectonic features were observed during the processing and interpretation stage of the DRTP Analytic Signal anomalies:

(**1**) a NW-SE trending DRTP Analytic Signal anomalies east of the Intramoesian Fault, which may indicate a fault (blue lines in Fig. 8);

(**2**) a NW-SE trending DRTP Analytic Signal anomalies west of Bucharest, consistent with the High Seismicity Limit, as interpreted based on regional seismicity data (Stanciu and Ioane, 2016b, 2017a,b, 2019, 2021) (grey line in Fig. 8).

The Pseudo-Gravity filter enhances the anomalies associated with deep geomagnetic sources (Pratt and Shi, 2004). An image of the output from applying the pseudo-gravity FFT filter available in Oasis montaj is shown in figure 9. The maximum pseudo-gravity anomaly in Western Moesia is interpreted as the broad effect of magmatic intrusions and uplifted metamorphic basement, while the steep gradient in the central part of the Moesian Platform is considered as the effect of the Intramoesian Fault at metamorphic basement level. A similar effect is interpreted along the Peceneaga-Camena Fault.

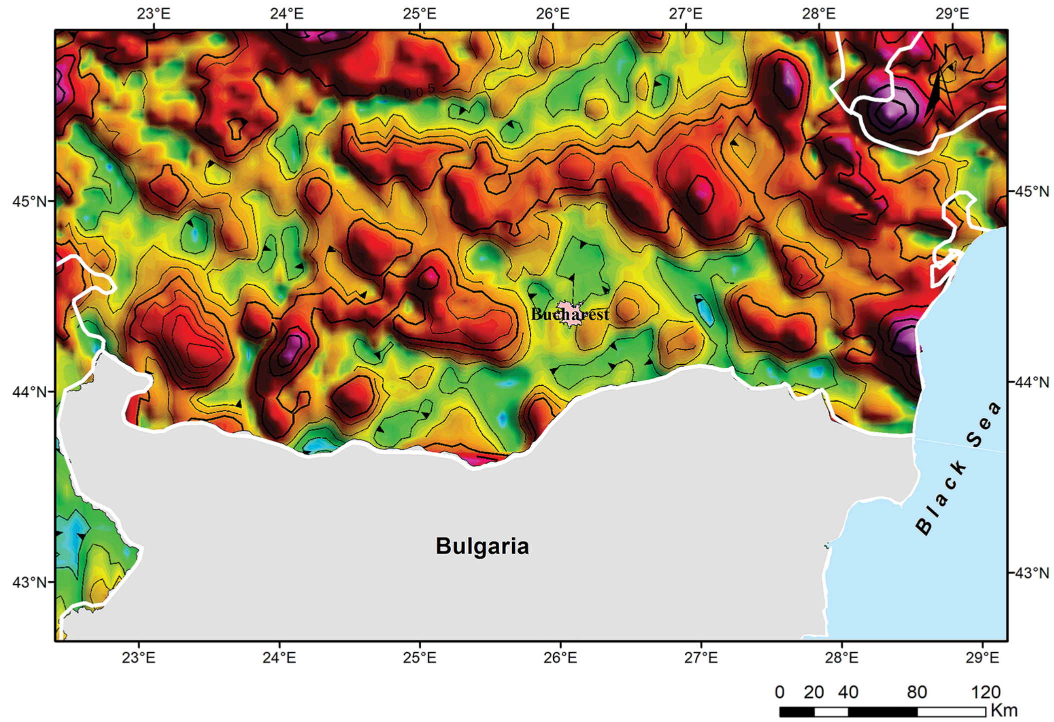

Fig. 7. The Aeromagnetic Analytic Signal Map of the Moesian Platform in Romania (aeromagnetic data from WDMAM 2.0, obtained by accessing the online resources of Oasis montaj, 2018) (modified from Stanciu, 2020, unpublished). Red and purple = high aeromagnetic analytic signal anomalies; green and blue = low aeromagnetic analytic signal anomalies.

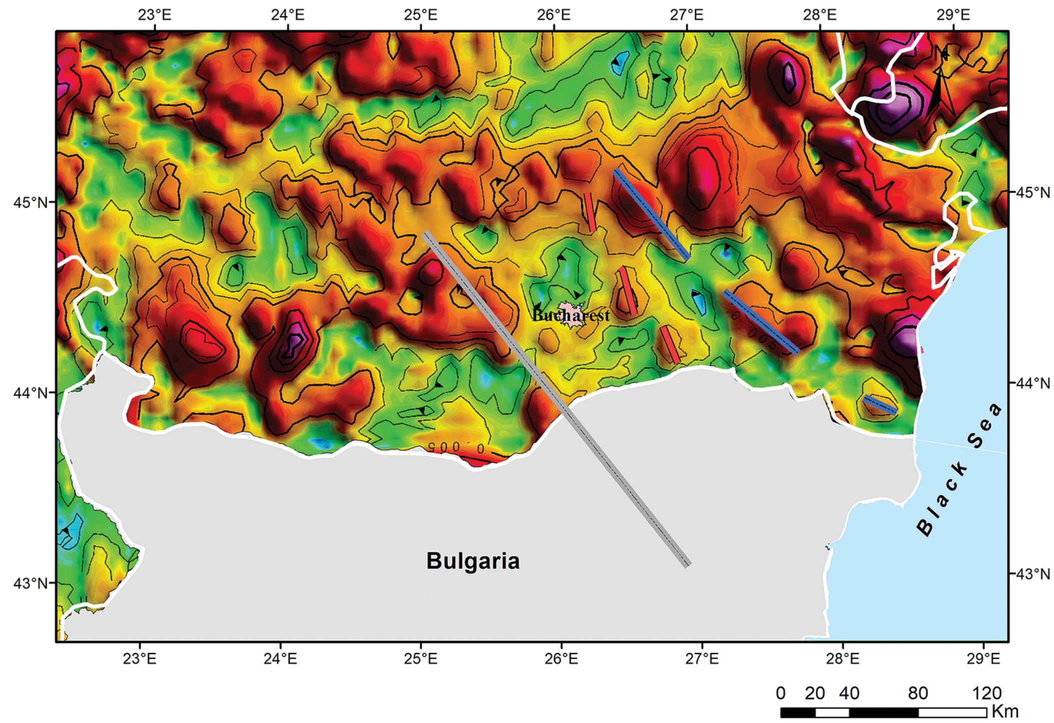

Fig. 8. The Differentially Reduced to the Pole Aeromagnetic Analytic Signal Map of the Moesian Platform in Romania, (aeromagnetic data from WDMAM 2.0, obtained by accessing the online resources of Oasis montaj, 2018) (modified from Stanciu, 2020, unpublished). Red and purple = high aeromagnetic analytic signal anomalies; green and blue = low aeromagnetic analytic signal anomalies. Red lines = Intramoesian Fault segments; blue lines = fault, as inferred from the Analytic Signal anomalies; gray line = Moesian Platform High Seismicity Limit, as interpreted on regional seismicity data in Stanciu and Ioane (2016b, 2017a,b, 2019, 2021).

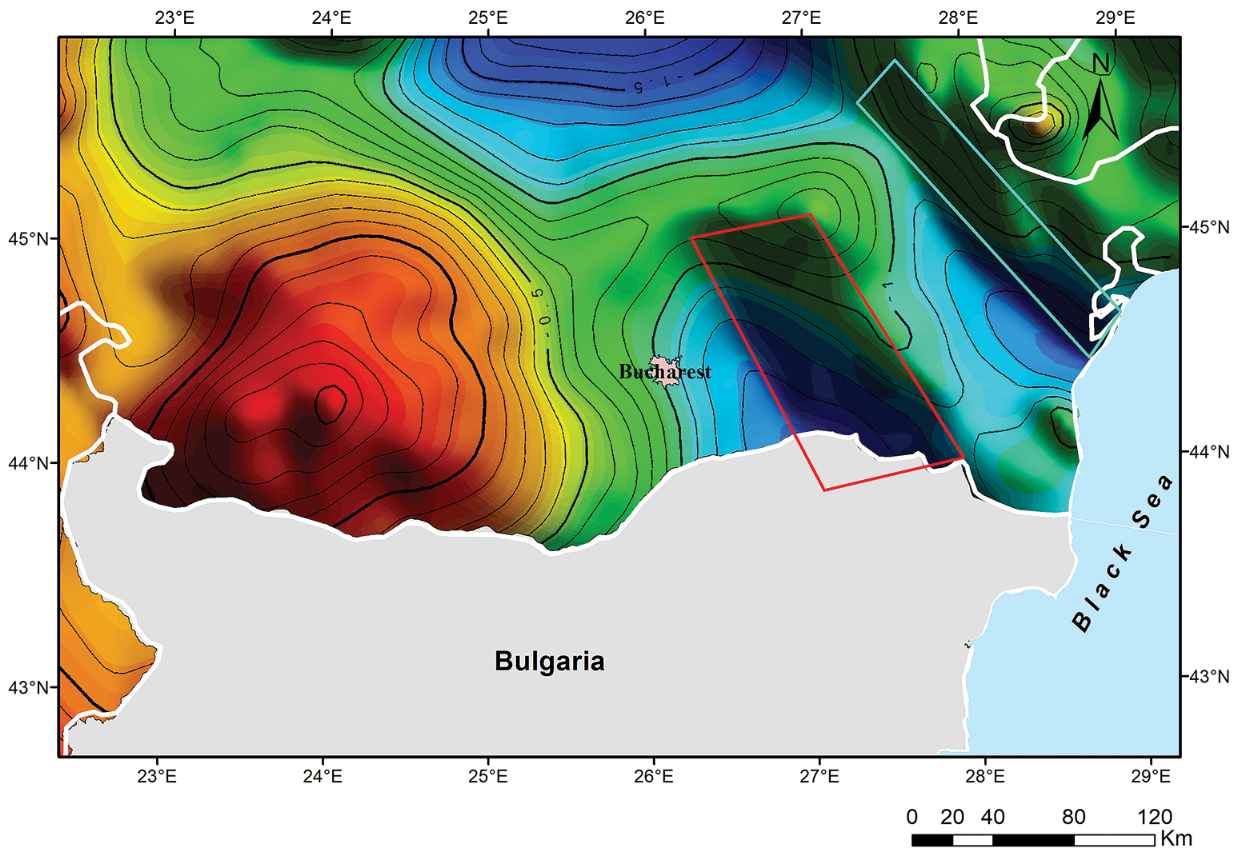

Fig. 9. The Pseudo-Gravity filter applied to the Aeromagnetic Map of the Moesian Platform in Romania, calculated in Oasis montaj (aeromagnetic data from WDMAM 2.0, obtained by accessing the online resources of Oasis montaj, 2018) (modified from Stanciu, 2020, unpublished). Red = high aeromagnetic pseudo-gravity anomalies; blue = low aeromagnetic pseudo-gravity anomalies. Red polygon = the effect of the Intramoesian Fault at the level of metamorphic basement; turquoise polygon = the effect of the Peceneaga-Camena Fault at the level of metamorphic basement.

4. CONCLUSIONS

Compilation of gravity maps provides geophysical data with very good regional coverage, making possible enhanced data processing and geological interpretation. Data processing techniques, such as filtering or gravity stripping, are usually employed to extract the needed geophysical and geological information from the Bouguer gravity anomalies.

Geological interpretation of Bouguer gravity data provides structural and tectonic features of the explored areas. Large and deep geological structures may be interpreted on gravity anomalies at crustal depths based on density contrasts as compared with the neighbouring background.

Bouguer gravity data re-processing using Oasis montaj software resulted in new Bouguer gravity anomaly map of the Moesian Platform (Romania and Bulgaria) and new Bouguer gravity residual map of the Moesian Platform (Romania and Bulgaria).

An important step in making possible the detection of the Intramoesian Fault from the Carpathians to the Black Sea across the Moesian Platform was represented by merging the available gravity data into a unique dataset, covering the Moesian Platform in both Romania and Bulgaria, and producing the Bouguer gravity anomaly map of the Moesian Platform (Romania and Bulgaria).

The Moesian Platform gravity residual map shows a quite good applicability for detecting the Intramoesian Fault at crustal depths, providing valuable information on the Intramoesian Fault segments in both Romania and Bulgaria.

The residual Bouguer gravity anomaly map of the Moesian Platform in Romania and Bulgaria, illustrates the Intramoesian Fault as the eastern fault of a NW-SE graben structure, along the Mostiştea valley, and continuing in Bulgaria. The western fault of the NW-SE graben is interpreted to be located beneath Bucharest, the capital city of Romania, and crossing the Danube River in the Argeş confluence area.

The Capidava-Ovidiu and Peceneaga-Camena regional faults may be interpreted both on the Bouguer gravity anomaly map and the residual gravity anomaly map in Dobrogea, where they have been geologically mapped, and outer of the East Carpathians Bend Zone, where the geological structures and tectonic features are concealed beneath thick Quaternary formations.

The Aeromagnetic Map of the Moesian Platform in Romania illustrates a steep gradient of the total magnetic field, which allowed the interpretation of the Intramoesian Fault as trending NW-SE along the Mostiştea river. While Western Moesia is marked by the high magnetic anomalies interpreted on borehole data as due to the magmatic intrusions and uplifted metamorphic basement, Eastern Moesia is characterised by NW-SE trending magnetic anomalies, their intensities suggesting the presence of large, deep-seated magmatic intrusions.

Aeromagnetic data processing using different filtering methods in Oasis montaj software, resulted in a series of other magnetic maps and offered new possibilities of interpreting the available data:

- The Differentially Reduced to the Pole Aeromagnetic Anomalies Map of the Moesian Platform in Romania;
- The Aeromagnetic Analytic Signal Anomalies Map on the Moesian Platform in Romania;
- The Differentially Reduced to the Pole Aeromagnetic Analytic Signal Map of the Moesian Platform in Romania;
- The Pseudo-Gravity filter applied to the Aeromagnetic Map of the Moesian Platform in Romania.

Short segments of the Intramoesian Fault were interpreted on the Differentially Reduced to the Pole Aeromagnetic Analytic Signal Map of the Moesian Platform in Romania, considered as due to magnetic contrasts at an acute angle: North of Ploieşti; along the Mostiştea river; in the Mostiştea lake area.

A NW-SE trending Analytic Signal anomalies east of the Intramoesian Fault may indicate a fault.

A smoothed image of the aeromagnetic anomalies in the Moesian Platform is presented in the pseudo-gravity filtered map of the Meosian Platform in Romania. The higher intensity magnetic anomalies in Western Moesia, as compared to Eastern Moesian, suggest that these magmatic intrusions develop in-depth on a larger area and are dominated by intermediate to basic petrographic composition. The shadowing way of illustrating the elongated boundaries between high and low magnetic anomalies depicts accurately the Intramoesian and Peceneaga-Camena fault zones.

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