LITHOSPHERIC MAGNETIC ANOMALIES IN THE BALKAN REGION

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Abstract. The position of lithospheric magnetic anomalies, detected in total magnetic intensity of the magnetic field, has been determined for Balkan based on the data from the CHAMP satellite and the Global Earth Magnetic Anomaly Grid (EMAG2). The paper describes the technique for the satellite data processing and the ways of separation of regional lithospheric magnetic anomalies from total satellite-measured values of the geomagnetic field. The maps of magnetic field anomalies for two different altitudes have been constructed for the region of Balkan. The possible geologic and physical nature of the magnetic anomalies and their relationship with deep-seated crustal structures are considered. Preliminary interpretation of the magnetic field maps shows that the anomalies are connected with the present day large geologic and geophysical elements of the basement. The features of the lithospheric magnetic field, as a parameter reflecting the present position of tectonic structures and their physical properties, can be used for their contouring in combination with other geological and geophysical methods.

Key words: satellite magnetic observations, long-wave lithospheric magnetic anomalies, Balkan region, Rhodope.

Introduction

According to a complex of geophysical sounding, the study of the deep structure and dynamics tectonosphere active regions is the most important problem of the modern geophysics

Currently, there is a unique opportunity to investigate the magnetic anomaly (MA) field of regional lithospheric anomalies and construct the magnetic maps using data from several sources of observations at different heights above the surface of the Earth. The first source was used is satellite data (Reigber et al., 2002), and the second one is the results of the Global Earth Magnetic Anomaly Grid (EMAG2) (Maus et al., 2009).

Magnetic anomaly maps provide insight into the subsurface structure and

composition of the Earth's crust and successfully used for reconstructing the geophysical and geological models of the Earth's crust, in order to study the crustal properties and structure (Vine and Matthews, 1963; Purucker and Whaler, 2007).

Recently there was an increase of the interest in the study of large-scale (or long-wave) anomalies that are covering an area of a few hundred km. The spatial pattern of these long-wave anomalies reflects the spatial distribution of the magnetic properties and thickness of deep magnetized layers.

The analysis of the spatial distribution of the MA field shows that the anomalous part of the field significantly is decreasing at the orbital heights of satellites: the high frequency anomalies are smoothed, and only the low frequency regional anomalies with spatial periods of 400–500 km and intensity of a few dozen nT are remained.

The investigations based on the satellite magnetic measurements show that large tectonic units, such as shields, cratons, and subduction zones, are marked by positive magnetic anomalies (due to the increased magnetic susceptibility), while basins and abyssal planes produce negative anomalies are caused by crustal thinning and an elevated Curie isotherm.

At the beginning of XXI century, the possibilities for analyzing the parameters of the geomagnetic field, previously determined by the Earth's satellite vehicles, have been significantly expanded, due to launch of the unique Earth orbiter, the CHAMP satellite, which provided almost real-time highly accurate data from 2000 up to 2010 (Reigber et al., 2002).

The authors of the present paper carried out successful studies of the lithospheric MA field using the geomagnetic data from CHAMP measurements above different territories (Abramova et al., 2011; 2014).

In 2009, a large group of authors (Maus et al., 2009) has created EMAG2: a 2–arc min resolution Earth Magnetic Anomaly Grid compiled from satellite, airborne, and marine magnetic measurements. Grid resolution is of 2-arc min, the altitude above the geoid - 4 km.

The objective of this paper is to study the morphology of the regional lithospheric magnetic anomalies and its relationship with other geophysical fields, derived from the CAMP satellite measurements and constructed, according to data EMAG2 over the Balkan Peninsula. This region is of the interest due to the presence of large tectonic units of the different origin.

The sources of the lithospheric anomalous magnetic field from physical and geological - tectonic standpoints

The MA field of the continental lithosphere is very diverse. The sources of the anomalies are concentrated within some area in the lithosphere, which is referred to as the magnetoactive layer. The upper boundary of this layer either coincides with the Earth's surface or is buried at a depth of about 10 km in the blind and folded regions. The bottom boundary of the magnetoactive layer is either the isothermal surface corresponding to the Curie point of magnetite or the Moho (Arkani-Hamed and Strangway, 1986; Tanaka et al., 1999).

The attempts of geological interpretation of the satellite magnetic anomalies lead to the conclusion that they are associated with a few different sources that is equally probable. Most of the interpreters (Arkani-Hamed and Strangway, 1986; Pashkevich et al., 1994) believe that the anomalies are appearing because of the variations in the average effective magnetization of large lithospheric segments or to the changes in the thickness of the lithospheric magnetoactive layer.

The anomalies can be generated by lateral variations in the temperature of the homogeneous lithospheric layer and, correspondingly, the variations in the depth of the isothermal Curie surface for magnetite.

The lateral variations in the composition of the magnetic minerals are another source of the satellite magnetic anomalies that is equally important. The key part is played by the degree of the magnetization of the bottom crust, which significant intensity and variability are now without doubt (Pashkevich et al., 1994).

To all appearances, most of the revealed anomalies are produced by the simultaneous action of the two mentioned factors.

Within the young tectonic regions, even with low deep temperatures, the overall Earth's crust is poorly magnetized, which is believed to be associated with its more acidic composition. There are significant differences between the Pre-Riphean formations, which are the main sources for the magnetic anomalies, and the younger structures such as the Phanerozoic crust, which are typically less magnetic. The Pre-Riphean platforms include the exposed shields (cratons) and Pre-Riphean basements buried under the younger deposits. The MA fields within different platforms have different origin (Goodwin, 1996).

The CHAMP satellite magnetic data

The data on the geomagnetic field measured on the satellite board should be collected, systematized, and converted into a suitable form for further processing. Among the huge data volumes obtained, the components, that most adequately characterize the lithospheric MF, should be identified, and the maps reflecting the distribution of MA field in the studied region should be constructed, and the geophysical and geological interpretation of the revealed magnetic anomalies should be carried out.

The near-polar circular orbit of the CHAMP satellite with an inclination angle of 87.3 permitted to take measurements at each point in space in different local times, and its low altitude ensured a better resolution of the measured parameters. Owing to this orbit configuration, the satellite ensured uniform coverage of the whole globe surface with high-quality high-precision measurements. The data have a 1-s resolution in time, which corresponds to ~7 km in space. The satellite made ~14 passes per day with uniform coverage of the whole local time interval (Reigber et al., 2002).

The satellite was equipped with two magnetometers: the Overhauser scalar magnetometer (OVM), which recorded the magnitude of the total magnetic field (T), and the fluxgate FGM magnetometer, which measured three orthogonal vector components (X, Y, Z).

About 5,000 measurements of the magnetic field were included in the mapping database.

To meet the objective in the present study, we selected the measurements of the geomagnetic-field components along ~200 sweeps of the satellite orbit taken in 2008, when the CHAMP altitude was at a minimum (310–320 km). These data cover the territory between 40° and 46° north latitude and between 18° and 30° east longitude.

Methods of data processing

The technique for detecting regional lithospheric magnetic anomalies from satellite measurements above different territories includes:
– collecting and summarizing measured data and bringing them into a convenient form;
– distinguishing components for the most adequate description of the lithospheric magnetic field from huge data arrays by specially developed techniques; and
– mapping the distribution of the components of the anomalous magnetic field.

Because of the measured at satellite altitudes field is a sum of contributions from several source (external and internal) with respect to the Earth's surface, the main problem of analysis consists in correct resolution of the total magnetic field into components originating from different physical sources.

The primary satellite geomagnetic field includes the following superposed components: (i) the main geomagnetic field, generated by magnetohydrodynamic sources in the liquid part of the Earth's core; (ii) outer fields, generated by magnetospheric and ionospheric current systems; (iii) induction fields, produced by currents in the conducting layers of the crust and upper mantle; and (iv) the anomalous field, related to the magnetization of lithospheric rocks.

The lithospheric magnetic field remains after successive removal of all "excess" components from the measured values, which makes the reliability of its detection dependent on the techniques selected for description of the removed parts. This, so-called physical approach of distinguishing lithospheric data, has become almost classical. It was improved by the authors in terms of subtraction of the main magnetic field, which is usually represented by the International Geomagnetic Reference Field (IGRF), based on the total magnetic field.

Observations of the world network of magnetic observatories, which are very nonuniformly distributed over the Earth's surface, are the basic array of experimental data for IGRF models. In areas with no observatories, the SHA grid is filled with additional data (from satellite, airborne magnetic and marine surveys). In this case, a considerable part of the data is lost, and the advantage (e.g., the homogeneity of satellite measurements in space and time) is artificially violated. The selection causes problems: the quantity of discarded data is different for different days, and their position in space is also very nonuniform. As a result, several competing models are constructed, and the best one is selected every five years; which must describe the main magnetic field at each point of the globe with minimum average error.

The preset parameters of the orbit of the CHAMP satellite permit daily measurements of the geomagnetic field at the nodes of an almost uniform grid above the entire Earth's surface. This permits expansion of 14 field components obtained during the day with a second-long resolution into spherical harmonics to power and to order of

magnitude in order to construct the average daily spherical harmonic model (ADSHM) for the main magnetic field for each day rather than carry out averaging for a long time interval (one year), as it is customary (Golovkov et al., 2007). We use ADSHM coefficients in a specially developed program to eliminate the main field from experimental values.

$$U(r,\theta,\lambda) = a \cdot \sum_{n=1}^{N} \sum_{m=0}^{n} \left(\frac{a}{r}\right)^{n+1} (g_n^m \cos m\lambda + h_n^m \sin m\lambda) \times P_n^m(\cos\theta)$$

$$X = -\frac{1}{r}\frac{dU}{d\theta}; \quad Y = \frac{-1}{r\sin\theta}\frac{dU}{d\lambda}; \quad Z = -\frac{dU}{dr},$$

where U is geomagnetic potential at a point with the geographical coordinates (r, θ, λ); X, Y, and Z are the northern, eastern, and vertical components of the measured field; a, the Earth's average radius; are associated Legendre functions of power n and order m; g_n^m and h_n^m are the coefficients of the field model.

Magnetospheric current systems were approximated by the first zonal harmonic in spherical harmonic resolution, whereas ionospheric ones were approximated by linear or parabolic trends.

Geomagnetic data were selected only for the passes made by the satellite at night (LT from 22:00 to 6:00) and only on magnetically calm ($kp \le 1$ and $Dst \le 20$) days.

A specially developed program for detecting geomagnetic fields from the total quantity of the CHAMP records for Balkan was used to compile a base of experimental data on the modulus of the total vector and the components of the anomalous lithospheric magnetic field.

Mapping the anomalous lithosphere magnetic field above the Balkan territory

By applying the technique for the analysis of the CHAMP satellite data that was described above, we calculated the maps of spatial distribution of the modulus (*Ta*) and vertical component (*Za*) of the anomalous geomagnetic field at the satellite altitude of ~300 km above the Balkan territory. Maps were compiled with the use of the GMT software (Wessel and Smith, 2007) from the CHAMP data.

In order to increase the reliability of the mapping and to examine the reproducibility of the results, the authors of the article calculated the anomalous magnetic field using a few independent sets of the satellite data. A comparison of different versions of maps based on these input data showed that the spatial structure of the field is reproduced by hugely reliably.

The contour map of the modulus of the anomalous lithospheric (longwave) magnetic field Ta over the Balkan region at the altitude ~ 300 km is presented by Fig. 1. The map scale is 1: 5,000,000, the data is used in the median averaging 5 × 5 minutes.
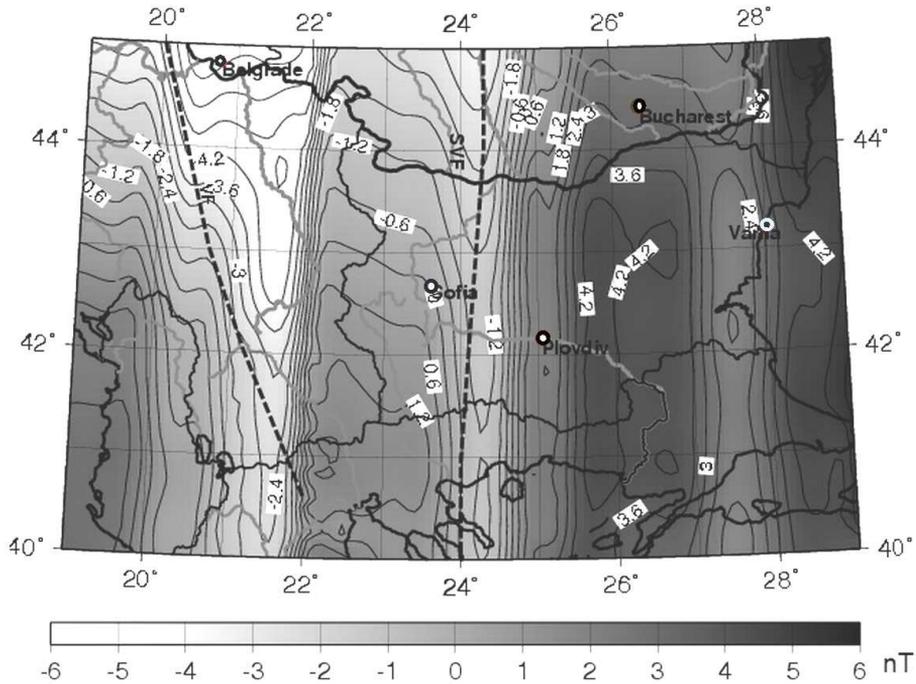
Fig. 1. Contour map of the lithospheric (longwave) anomalies of the magnetic field modulus (Ta) above the Balkan territory. The CHAMP satellite observations altitude is ~300 km. Faults: VF – fault zone Vardar; SVF - lineament Svalbard – Vardar.

Fig. 2 shows the map of the modulus Ta of the anomalous lithospheric field of the Balkan region, based on the data of Global Earth Magnetic Anomaly Grid (EMAG2) presented by (Maus et al., 2009). The altitude above the geoid is 4 km. The map scale is 1: 3,000,000, the data is used in the median averaging 5 × 5 minutes. Letters mean faults: IMF –Intra-Moesian, PBF – Predbalkan, STF –Struma, MARF Maritsa, CRF – Central Rhodopean.
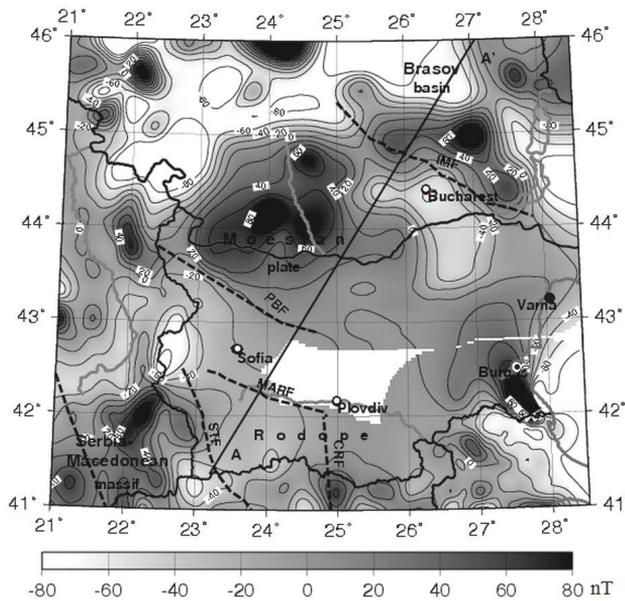
Fig. 2. Contour map of the magnetic anomalies field modulus (T_a) above the Balkan.

There are some «white spots» on the map (Fig. 2) due to the absence of airborne and marine magnetic data in the study of territory and Bulgarian shelf in the EMAG2 base. Nevertheless, there is data that allow to make the conclusions about magnetic qualities of deep immersed layers of crust of Bulgarian territory.

The map of the anomalous magnetic field at the observation altitude of 4 km (Fig. 2) differs considerably from the field distribution at the altitude of 300 km (Fig. 1).

At an altitude of 4 km, the reader could see the strong fragmentation of the positive and negative anomalies in comparison with the field on the satellite altitude. This fact makes a logical sense, since the measurements of the geomagnetic field at high altitudes works as a "low - pass filter"; in other words, it suppresses local anomalies and maintains regional anomalies in a little distorted form at the same time. Decrease of the anomalies amplitude with the altitude due to the sources parameters of lithospheric anomalies: the more the depth of the magnetized body and its horizontal dimensions, the slower decrease anomalies with the altitude. Therefore, high-altitude observations are stored anomalies caused by large-scale structures that lie at great depths.

Geologic - tectonically position and the geophysical characteristics of the Balkan area

The study of the Mediterranean – Carpathian zone, the part of which is Balkan region, is conducted by the variety of geophysical methods, including different methods of seismic tomography (Wortel & Spakman, 2000; Gvirtzman, 2002; Yanovskaya & Lyskova,

2013).

The south part of the Balkan zone was formed as a result of collision of continental lithosphere blocks of various sizes, detached from the northern fragments of Gondwana and displaced northward, through the Thetis ocean in Mesozoic and Cenozoic (Wortel and Spakman, 2000).

The region has an extremely complicated structure of the lithosphere composed groups of fold belts and crystalline arrays. The tectonic activity is continually lasting, its nature attributed interplate interaction and (or) the mantle processes. Intense folding which resulted from of tension processes, contributed to the rise of magma in the upper layers of the lithosphere and activation of the volcanism, which takes place so far (Haak et al., 1989; Galanopoulos, 1993; Spakman et al., 1988; Wortel and Spakman, 2000). At the depth of about 200 km found the low-speed area, produced, apparently, by melting of the upper mantle rocks. In the area of southern Bulgaria there is a continuation of this zone (Spakman et al., 1988). High heat flow values under the territory of the West and Central Rhodope testify of this.

On the northern edge of the Balkan velocity distribution of vertical sections on profiles crossing the South-Eastern Carpathian, suggest the presence of subduction of ancient oceanic slab from east to west under the Eastern Carpathian (Girbacea & Frisch, 1998; Wortel & Spakman, 2000; Gvirtzman, 2002; Yanovskaya & Lyskova, 2013).

For example, the results of surface-wave tomography, which were applied for the data collected at stations in Eastern and Western Europe, show that along the line passing through the zone of basin Brashov and the Vrancea area in the NE-SW direction, there is a significant change in the structure when passing through the vertical «fault», where the deep-focus earthquakes take place in the Vrancea area (Yanovskaya & Lyskova, 2013). This area, in the southeastern corner of the Carpathian Mountains, is a unique opportunity to study the final and short phase of the plate convergence, when the part of subducting lithosphere is, finally, detaches from the subducting plate and begins to sink into the mantle (Wortel and Spakman, 2000; Gvirtzman, 2002).

In the Balkan province observed almost all the features of seismogenic zones established for many seismically active regions of the Earth: (i) the increased thickness of the Earth's crust and its consolidated parts (Dachev, 1988); (ii) abnormal velocity differentiation of the section and anomalous absorption of seismic waves (Dachev & Volvovsky, 1985); (iii) regional decrease of seismic velocities in the upper part of the mantle (Dachev & Volvovsky, 1985); Yanovskaya & Lyskova, 2013); (iv) abnormal asthenosphere layer location (Dachev et al. 1985); (v) availability low- velocity layers (waveguides) (Dachev and Volvovsky, 1985); (vi) complex layered structure of the boundaries "crust - mantle" (Wortel & Spakman, 2000); (vii) the presence of layers with anomalously low conductivity in the crust and mantle (Abramova et al. 1994, 1997), (viii) the increased values of the heat flow, and so on.
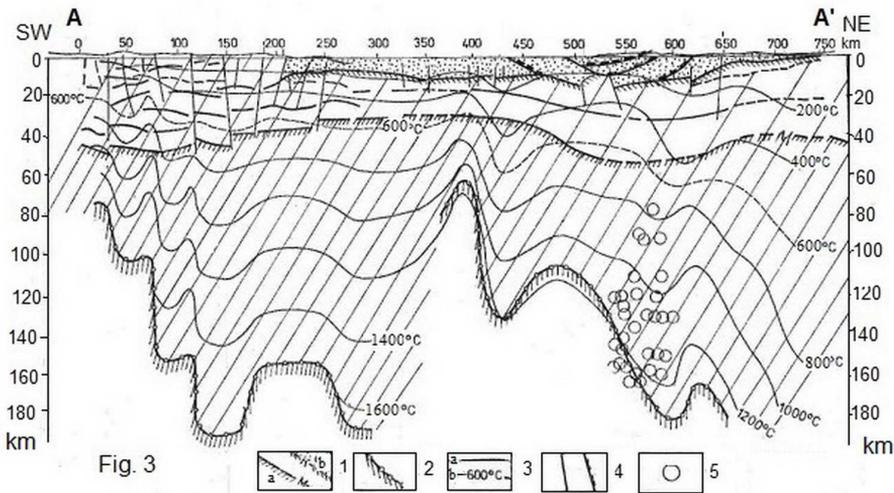
Fig. 3. The thermal model of the lithosphere along the profile Rhodope - Moesian platform - the South-Eastern Carpathians - Moldavian platform (Dachev, 1988).
1 – the lithosphere boundaries: Moho (a), sedimentary layer (b); 2 – the upper boundary of the asthenosphere layer; 3 - isotherms (a) and the Curie isotherm (b); 4 - faults (a) and thrusts (b);   5- estimated channels of intense convection heat input.

Geothermal model of the lithosphere along with the profile AA' are shown in Fig. 3 (for the profile location, see Fig. 2)**.** Profile crosses the Carpathian- Balkan region from South-Western Rhodope in Bulgaria to the Vrancea region in the Eastern Carpathians in Romania (Kutas, 1978; Demetrescu, 1982).

As shown in Fig. 3 the territory of the Southern Balkan and Eastern Carpathians is characterized by unsteady and heterogeneous thermal field, which is typical for activated alpine areas. The available experimental data for these areas is limited; however, it is known that in the southern part of the Rhodope the temperature at the Moho border rises up to 800-900º C. The lithospheric heating in this area is expressed as an abrupt increase in the asthenosphere temperature values 1200-1300 ºC, which, in turn, causes a rise of the Curie isothermal surface of magnetite and a decrease in the magnetic-layer thickness.
The some factors discussed above are expected to be manifested in the AMF behavior.

The lithospheric magnetic field maps analysis

As the figures 1 and 2 illustrate, in general, the regional background of the map is characterized by the low values of the lithospheric anomalous magnetic field that is usually characterizing the tectonically active regions.

It should be noted that the anomalous field magnitude at altitudes of 300 km is relatively small in comparison with such significant anomalies like the Kursk anomaly observing in the Voronezh Crystal massif territory (Abramova L., 2012). In this case, we can discuss the qualitative image of the lithosphere magnetic field, which is characteristic for the crust bottom.

Nevertheless, it is seen that the lithospheric AMF (Fig. 1) is divided into two positive and negative parts. The separation takes place approximately along the 25º E. This line corresponds to the position of the transcontinental lineament Svalbard – Vardar (SVF) which observed in tectonic schemes decryption of satellite images the western part of the Alpine Mediterranean belt and also corresponds to the position of the Madan-Nedelino intraformational glide (M-N) and central Rhodope fault.

It is observed negative values of the anomalous magnetic field in the Vardar fault (VF) area, apparently indicating on the activation of tectonic processes in the deepest parts of the area.

On the map (Fig. 2) it is demonstrated the mosaical structure of alternating large areas of positive and negative anomalies.

In the research of faulting and block structures of the Balkan crust the idea that it is made up of separate megablocks has been argued, which are separated by deep discontinuity (Velchev et al., 1970; Ivanov, 1981; Wortel and Spakman, 2000; Zagorchev, 2001). Megablocks vary in thickness and composition of the crust and separated by the deep faults. The latter as shown in Fig. 2, are characterized by low values of the anomalous magnetic field, for example, such as Predbalkanianian (PBF), Struma (STF), Vardar (VF), Maritsa (MARF), Intra-Moezian (IMF) etc.

In the northern part of the map AMF seismically active zone Carpathian, as a rule, characterized by negative values of the magnetic field.

In the northeastern corner of the map the positive values of the field territorially match the part of subducting from the east oceanic plate, which is bounded by Intra-Moesian fault (IMF) on the south. A significant decrease in values of the AMF is observed in the Brashov basin and the Vrancea area regions.

The mechanism of subduction of the cold lithospheric slab from the east under the Carpathian, the spread of the tearing process and the transition from partial to complete of the detachment of the subducting plate are currently actively discussed in geophysics (Wortel and Spakman, 2000; Gvirtzman, 2002). These studies suggest that the area of strong bending of the Southeastern Carpathian and detachable part of the plate is limited to two crust faults: Trotus the north and Intra-Moesian the south.

In the area of Brasov basin the root of disconnection is viscously connected with the initial lithosphere and pulls it downward. Researches exactly under this area indicates low seismic velocity anomaly (Frish et al., 1998) possibly representing heat asthenospheric material. Magmatic processes occurring in this area were discussed by Girbacea & Frish (1998).

The current research is very logical and fully corresponds to the researches in the field of tectonic structures and geophysical fields under Brashov basin and on the border of Vrancea area.

It is clearly recorded in the anomalous magnetic field: (i) tectonic bending East Carpathian (Gvirtzman, 2002), fixed by the change of sign of AMF and its significant gradient; (ii) restriction of subducting slabs from the south Intra-Moesian fault a sharp change from positive to negative values of the field; (iii) significant reduced in the value of the field in Brasov basin, due to the rise of the Curie isothermal surface of magnetite and a decrease in the magnetic-layer thickness due to the high position of the hot asthenosphere.

In the central part of the map (23º – 25.5º E and 43º - 45º N) there is an amoeboid

isometric positive anomaly with amplitude about 100 nT, which is surrounded by zones of decreased field values. The position of this anomaly corresponds to the well-known Moesian positive regional anomaly, located in the western part of the Moesian platform and on the territory of the Carpathian depression (Dachev, 1988). The anomaly has isometric shape and somewhat elongated in the north-east direction. Its length is about 200 km.

Small amplitude positive magnetic anomaly occupies a large area on the territory of Serbia-Macedonian massif.

Rhodope zone

A reflection of the large-scale tectonics can be seen in the AMF for the Rhodope example. For this purpose we used the work of R. Ivanov (1981), in which was considered the hypothesis of the Central- Rhodope nappe existence.

On the more detailed map of the Rhodope magnetic field (Fig.4) the position of the fault structures and partial massifs, taken from (R. Ivanov, 1981), are marked.
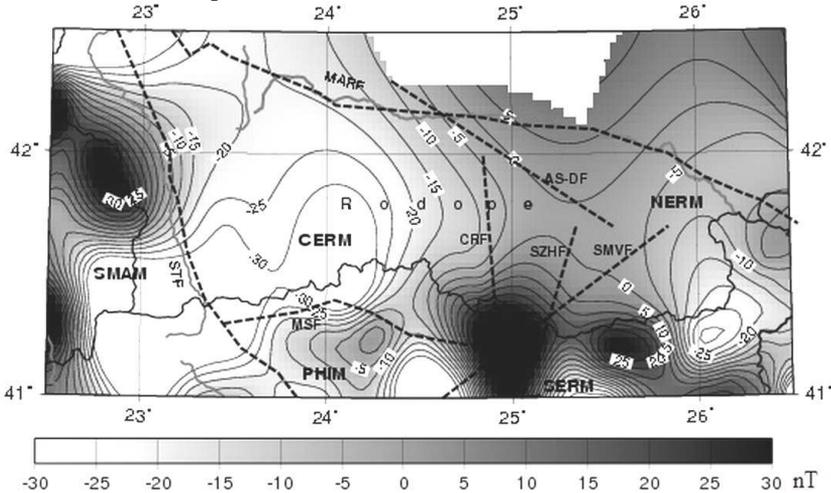
Fig. 4. Contour map of the magnetic anomalies field modulus (Ta) according to EMAG2 above the Rhodope territory. The altitude above the geoid is 4 km.
Great faults and sliding zones: SMV- Simvolon, SZH - Snezhin, MAR - Maritsa, AD - Asenovgrad-Diadovo, MSF - Mesta cryptofault, STF – Struma, RF – Rhodope fault.
CERM – Central-Rhodope (partial) massif; NERM – North-East Rhodope (partial) massif; SMAM – Serbian -Macedonian (partial) massif; SERM – South-East Rhodope (partial) massif; PHIM – the autochthonous part of the CERM

According to the author, Rhodope massif (RM) is a territory of metamorphic rocks and granites of partially overlapped by Tertiary molasse and volcanics. Tertiary molasse depression and related faults divide the array into several «partial» massifs: North-East Rhodope (partial) massif (NERM), South-East Rhodope (partial) massif (SERM), Central-

Rhodope (partial) massif, including Rila and Pirin (CERM), and Serbian -Macedonian (partial) massif (SMAM), (Fig.4).

The author considers that the whole allochthonous slab, (CERM), which was built by Rhodopsin series, covers almost the entire region of Central Rhodope, Rila and Pirin.

The great linear gravimetric transition the light mass of CERM from considerable heavier mass of SERM is interpreted as evidence «Central – Rhodope deep fault» (CRF) (Dachev, 1980), whereas the structure on the surface do not support the existence of such fault.

The consideration of AMF map reveals an amazing coincidence of the most probable borders of the CERM allochthone and anomalous magnetic map contours. As it can be seen, in general, the entire CERM area is characterized by negative AMF values.

The western boundary of the magnetic anomaly is clearly limited Struma fault and corresponds well with the assumption, that the CERM western boundary is covered by the sediments Tertiary molasse depressions along the Struma river. Here the significant gradient of changes in the anomalous magnetic field and the change of field sign from negative to positive is fixed. The positive field values describe the field of the neighboring Serbian -Macedonian massif (see Fig.2).

The northern boundary of the nappe runs along the Sredna gora zone. To the East the SE-trending Asenovgrad– Diadovci (AS-DF) fault is the margin of the allochthone of the Central- Rhodope nappe. The boundary position of the magnetic anomaly also coincides with it.

The geological map (Birk et al., 1970) suggests the existence of one large E-W striking syncline along the southern slope of the Rhodope massif, Mesta fault, (MSF on the Fig.4). The magnetic anomaly boundary is consistent exactly with MSF.

On the eastern nappe border powerful thrust folding is marked, retrogressive metamorphism and mylonitization of NNE zones with powerful serpentine layers at the border between CERM and SERM (Snezhinskiy Synclinorium) are marked.

Negative anomaly is evidence of the raising of the Curie isothermal surface of magnetite and a decrease in the lower part of the crust magnetic-layer thickness in south part of the region, which is demonstrated by the AMF maps.

As it was mentioned above, seismic data discover the presence of zones of the waveguide and electromagnetic investigation fixed the crust conductivity anomaly in Central Rhodope. Unfortunately, these data were obtained from the only one profile. The using of magnetic anomaly data affords the possibility of the extrapolation and generalization of geophysical fields in the researched area.

Conclusions

Given materials show that satellite magnetic observations add the information to regional tectonic studies. The compiled maps and analysis of the lithospheric anomalous magnetic field in Balkan area show their consistency with geological ideas of the zoned block structure of the crust in this region. Furthermore, their localization coincides with other geophysical data, like the thermal field and the field of seismic velocities.

Through the example of Central Rhodope Massif is shown the possibility of confirmation of existence of the subsurface discontinuity hidden under the sediments.

As a parameter reflecting on the <u>present-day</u> position of tectonic structures and their physical properties, the lithospheric magnetic field might be used for their description in combination with other geological and geophysical methods.

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Литосферни магнитни аномалии в Балканския регион

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Резюме. Определена е позицията на литосферните аномалии на магнитното поле на територията на Балканския регион. Ние използвахме данните от изкуствен спътник на Земята CHAMP и данните на Global Earth Magnetic Anomaly Grid (EMAG2). Статията описва метод за обработката на сателитните данни и начините за разделянето на общите регионални литосферни магнитни аномалии от сателитни измерените. Картите на магнитното поле на аномалиите за две различните височини над геоида са построени за Балканския регион. Отчитат се геоложката и тектонска природа на магнитните аномалии и връзката им с дълбоките структури на земната кора. Предварителната интерпретация на магнитните карти показва, че аномалиите се корелират с големите геоложки и геофизични елементи на земната кора. Характеристиките на литосферното магнитно поле, като параметър, отразяващ настоящото положение на тектонските структури и техните физични свойства, могат да се използват в комбинация с другите геоложки и геофизични методи.