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Естествени геофизични полета в Турция и геодинамика – връзки и корелации

Бойко Рангелов[1], Мехмет Салих Байрактутан[2], Емил Ойнаков[3]

[1] Минно-геоложки Университет, София, България
[2] Университет в Игдир, Игдир, Турция
[3] Национален Институт по Геофизика, География и Геодезия, Българска Академия на Науките, София, България

Ключови думи: Естествени геофизични полета, корелации, геодинамика

Резюме: Естествените геофизични полета са ценен източник на информация за повърхностните и по-дълбоки слоеве на земната кора, представляваща най-активната в геодинамично отношение част от геофизичния разрез. В тези дълбочини (включително и горната мантия и астеносферата) се проявяват ефектите на всички ендогенни процеси и техните последици върху земната кора – блоково разчленяване, разломна мрежа, активни геодинамични процеси (земетресения, вулкани, премествания на земната повърхност и др.). При правилна интерпретация, наличието или отсъствието във взаимната корелация и взаимоотношенията между различните полета, могат да послужат за евристични оценки на различни геодинамични параметри, които от своя страна са полезни в практиката за изучаване на геодинамиката на Турция.

Natural geophysical fields in Turkey and geodynamics – relationships and correlations

Boyko Ranguelov[1], Memet Salih Bayraktutan[2], Emil Oynakov[3]

[1] Mining and Geology University, Sofia, Bulgaria
[2] Igdir University, Igdir, Turkey
[3] National Institute of Geophysics, Geography and Geodesy, Bulgarian Academy of Sciences, Sofia, Bulgaria

Introduction

The natural geophysical fields usually include – gravity and magnetic, geothermal and radioactivity fields. The gravity and magnetic fields are natural potential fields and they and/or their transformations and anomalies reflect the geology peculiarities, structural conditions and contain other useful information frequently used for the deeper investigations. The thermal field contains conductive and convective components. The radioactivity is formed by several dominant isotopes such as 238U, 232Th, 40K, 137Cs, 226Ra, etc. In this study we used the regional maps of gravity field (Bouguer anomaly (BA), which reflects the density inhomogeneity of the upper part of the Earth's crust) and magnetic field (the total vector (T) measured by aeromagnetic mapping) which reflect the magnetic properties of the rock formations on the territory of Turkey. The spatial correlation analysis is performed. Other geophysical fields considered can help the geodynamic study, because they reflect deeper or shallower horizons of the earth crust. That's why the investigations of their relationships are an important task.

Initial data and information

The public maps and information to get the digital and/or analogue data are used (see Internet sources in the References).

For the calculations of the correlation of gravity and magnetic fields two maps are explored (Ates et al. 1999): the Bouguer gravity anomaly map (fig. 1) and the Aeromagnetic map (total vector) of Turkey (fig. 2).

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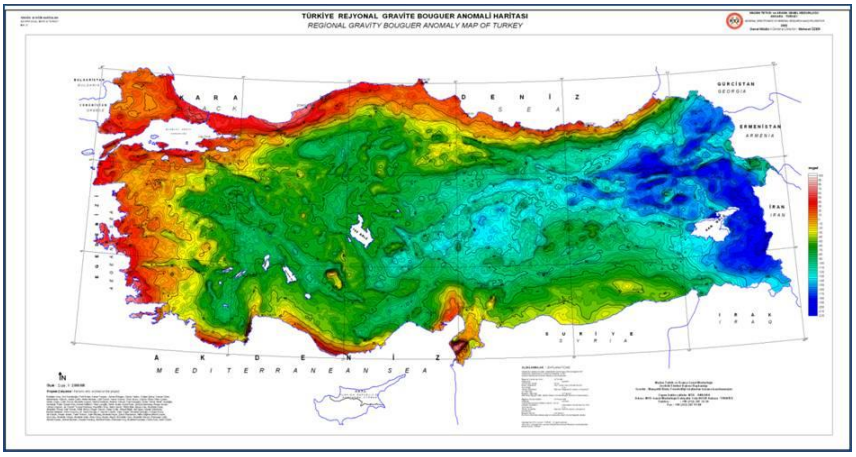


Figure1. The gravity map of Turkey (Bouguer anomaly in mGal).

The overview of the Bouguer anomaly map shows a regional change from high positive anomaly values from about 100 mGal in the western part down to – 220 mGal in the East. Clear positive belts are located in the northern and eastern parts of the country. The middle part of the country is dominated by negative values – around -100 mGal, reaching values of about -220 mGal in the most eastern part. In the south some positives values are observed. The relative narrow transition zones (about "relative 0") are located in the surroundings of the positive areas.

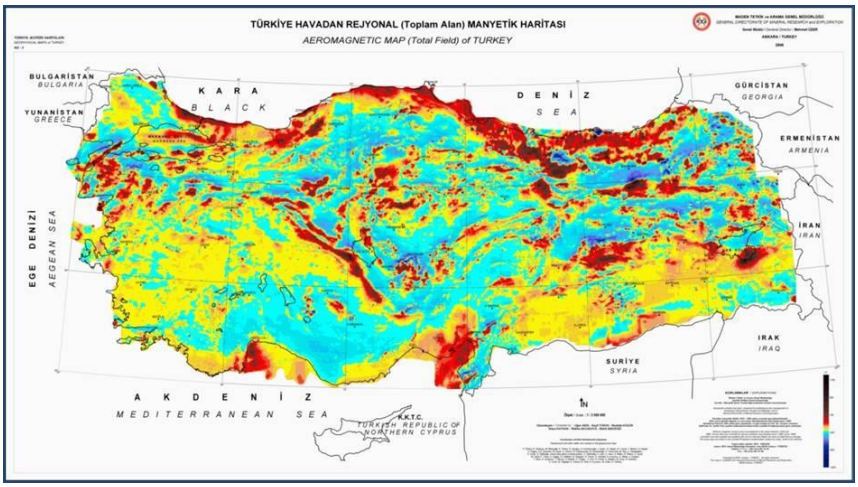


Figure 2. Aeromagnetic map (total vector in nT) of Turkey.

The aeromagnetic map of the total vector presents much more mosaic picture. Large areas of negative anomalies are interrupted by sharp lineaments of positive anomalies located in the North, some places in the South and many local anomalies (some like belts, some like spots) are distributed randomly.
The map of the geothermal field is presented at 1000 meters depth. It reflects the deeper thermal sources and is used mostly for the geothermal potential assessment (fig. 3).

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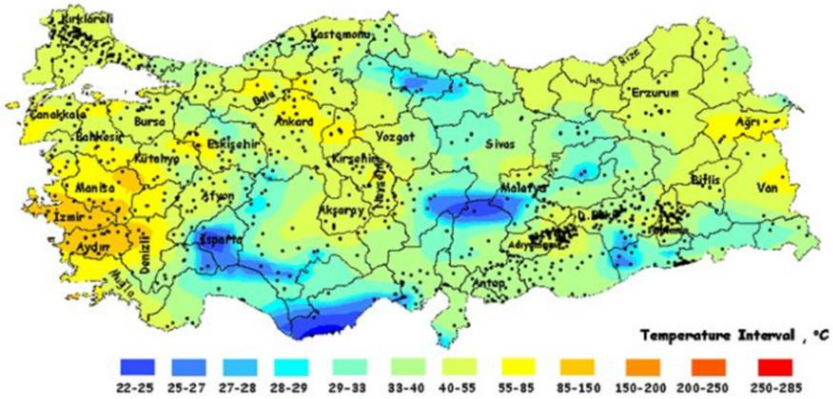


Figure 3. Geothermal field at 1000 m depth.

The radioactivity maps – vice versa – reflect the surface distribution of some longer half-time decay isotopes (fig. 4). The methodology used for data processing and correlation coefficient is a moving spatial 2D window which allows the evaluation of the correlation between the different fields (Shakil et al. 2016).

Results and discussion

Such a combination of the Gravity and the Magnetic fields are promising to try to calculate the correlation between them and other natural fields. The analysis of the spatial correlation coefficients enables the researcher to obtain additional useful information about the features of the geo-fields, to distinguish the areas with the presence and absence of correlation between the features. In addition, along with other information, the values of correlation coefficients can be effectively used in geological zoning tasks. The correlation coefficient characterizes the degree of linear dependence between the two random variables.

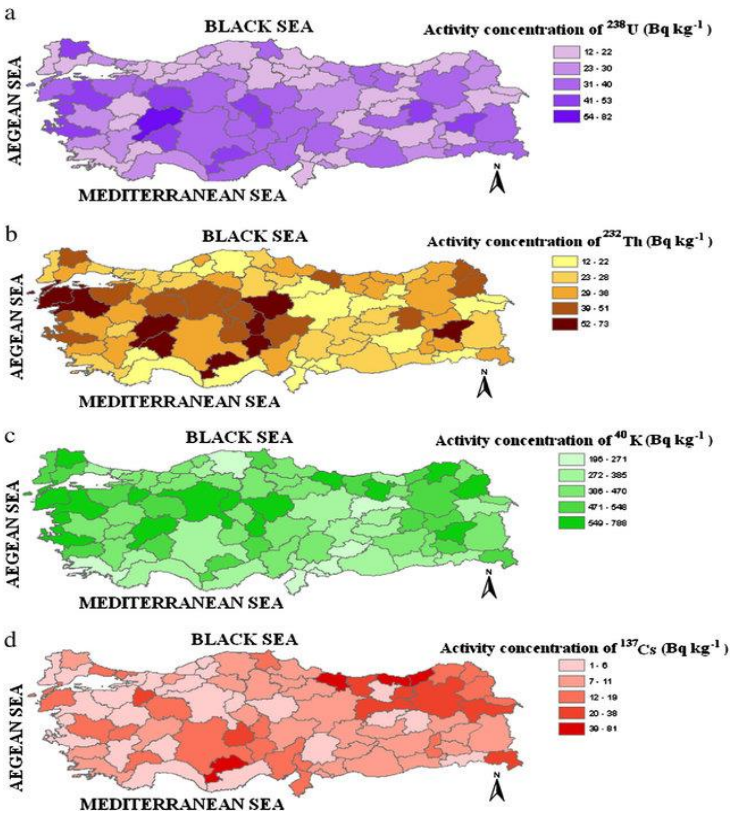


Figure 4. Four surface radioactivity maps of Turkey – isotopes 238U, 232Th, 40K and 137Cs.

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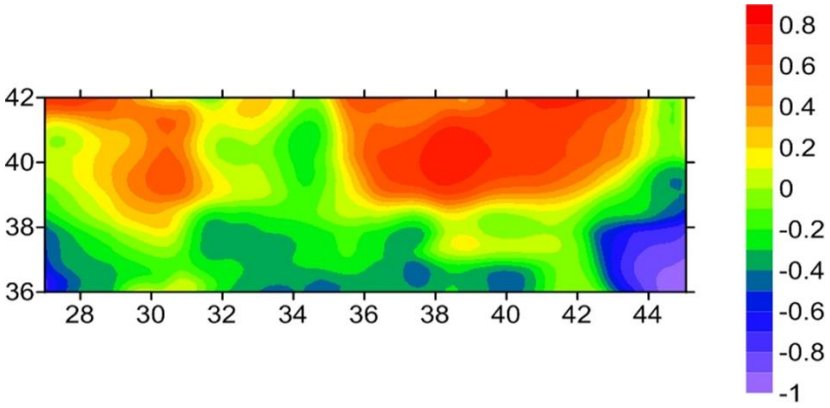


Figure 5. The digital spatial correlation map between the magnetic total vector and Bouguer anomalies in Turkey.

About 63% of the area is covered by the correlation coefficient ranging between from -0.4 to +0.4 (fig. 5). This means practically very low or missing correlation. The main part of this area is located in the central part of Turkey. In the periphery the correlation increases. About 25% of the values of the correlation coefficient are in the range from +0.6 to +1.0 and from -0.6 to -1.0. The higher correlation is located to the northern part of central Turkey. It is a huge positive correlation anomaly between the positive gravity and positive magnetic anomalies –0.8 and above reach the values of the correlation coefficient. Similar in intensity, but negative correlation is presented in the SE part of Turkey. Here the fields are presented by intensive negative gravity gradient and relatively calm geomagnetic field. Another intensive positive correlation is observed in the northeast of Turkey. The dominant natural field is the gravity, and the total field is presented again by positive separated magnetic anomalies. The important fact is that the local magnetic anomalies located in the central part of Turkey do not correlate with the relatively calm gravity field in the same area. The same is valid as well as for the local geomagnetic anomalies located in the eastern part. The interpretation of these peculiarities will be subject of detailed future research. Other fields (thermal and radioactivity) are also considered.

Conclusion

The spatial relations between the gravitational field (Bouguer anomalies) and the magnetic field (total vector) for the territory of Turkey are performed.

The obtained results show that the correlation between the Bouguer anomalies and the total magnetic field vector is associated with a relatively low positive and negative correlation. The geothermal field and radioactivity are also considered.

The best correlation, as expected, is between the T and the BA. This could be explained by the close relationship between both in these areas of Turkey, where for the two fields the positive anomalies are observed. The future investigations are related to the detailed interpretation of the obtained results.

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