GC2024-SG018

Lithospheric magnetic anomalies over the Anatolian Plate (Turkey) as a reflection of the crust-mantle interaction processes

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Solicited talk

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In the last decades, ability of the lithospheric magnetic field data for studies the deep structure of the Earth is evident. Sources of this part of the geomagnetic field are located in the crust and uppermost mantle, i.e., up to depths where the temperature reaches the Curie point temperature of lithospheric magnetic minerals.

The Alpine-Himalayan orogenic belt, which includes Anatolia, has an extremely complex lithospheric structure. It is composed of groups of folded belts, terranes and crystalline massifs (microcontinents) with Precambrian basement. Tectonic activity is very high there, and its nature is interpreted as interplate interaction and (or) mantle processes. In many aspects, Anatolia can be considered as a "younger version" of the Tibetan Plateau, which lithospheric magnetic anomalies were analyzed by us previously. In the western part of the Anatolian province, the subduction of the African lithosphere under the Eurasian Plate is taking place in a northern direction. In the eastern part, the process of convergence between the Arabian Plate in the south and the Eurasian Plate in the north occurs. An overlap of these ongoing tectonic processes causes intense seismic activity, widespread volcanism and movements of the Anatolian Plate to the west.

Lithospheric magnetic anomaly (LMA) maps based on satellite data are used in the complex interpretation of large-scale geological and tectonic formations as they carry out information about the deep layers of the Earth's lithosphere magnetization and reflect the magnetic properties of regional tectonic structures associated with the topography of the Curie surface, geothermal regime and the history of tectonic development of the lithosphere at different levels. In order to study the LMA over the territory of the Anatolian Plate and its surroundings, detailed maps of anomalies of the lithospheric magnetic field were constructed based on the CHAMP satellite data. Measurements at the lowest possible orbit were used for the maps construction that allowed us to increase the resolution by getting closer to the sources of the field.

The obtained results show that regional lithospheric magnetic anomalies have a complex pattern with positive and negative areas of various shapes and amplitudes that is due to the tectonic structure of the territory. In our distribution of the lithospheric field, one can observe the consequences of tectonic processes which took place earlier and (or) are currently developing. In particular, the spatial distribution of lithospheric anomalies, constructed according to the CHAMP data, correctly reflects the superposition of collision processes. In addition, an observed change in the sign of anomalies as well as a sharp decrease in the LMA values, can be probably explained by the fact that a part of the Arabian lithosphere, sinking to the north, is being breaking away, that leads to the replacing this part of the plate with ascending hot asthenosphere substance, causing the recent volcanism. At the same time, mantle heating of the lower crust occurs, the Curie isotherm rises, and as a result the loss of the initial magnetization of the lower crust appears.

Maps of the lithospheric magnetic field and their analysis show that the images of lithospheric magnetic anomalies clearly correlate with modern ideas about the location of large-scale geological and tectonic structures of the Earth's crust in the region of the Anatolian Plate. In addition, their localization coincides with other geophysical data, such as seismic wave velocity. The results show that satellite magnetic observations add valuable information to regional tectonic studies.