Heat flow refraction on structures with conductivity contrast

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This contribution is devoted to the analysis of the refraction of the heat flow caused by the subsurface structures with contrasting thermal conductivity values. We enhanced the fundamental calculation and interpretation results [Carslaw, Jaeger, 1959; Ljubimova et al., 1976; 1983; Czeremensky, 1977, …] related to these effects by some new model configurations and by qualitative and quantitative analysis of their influence on the temperature and on the heat flow density distribution. The basic refraction effects were studied on models with the disturbing bodies bounded by the coordinate surfaces and buried in homogeneous half-space or in horizontally layered media [Hvo•dara, Majcin, 1985; Hvo•dara, 2008; 2009]. These model types were supplemented by more realistic 2D and 3D disturbing model structures with the contrasting thermal conductivity coefficients (various polygonal and polyhedral bodies). They were analysed in papers of [Hvoždara, Schlosser, 1985; Majcin, 1992; Hvoždara, Valkovič, 1999, Hvoždara, 2008; Hvoždara, Majcin, 2009] and other. The great attention was paid to the model problems related to the refraction of the heat flow near the border of the sedimentary basins also combined with the refractions on the Earth's surface topography [Majcin, Polák, 1995].

The solutions of mathematical problems were presented in the exact analytical form or they were received by the numerical approaches. The boundary element method and the finite difference method were the most frequently employed in our calculations.

The calculated model temperature distributions, the surface heat flow density data and also the distributions of the heat flow density vector components are analysed also with regard to the interpretation of measured surface data, to influence on calculation of representative heat flow density and to construction of the terrestrial heat flow maps over the geological structures with different thermal conductivity coefficients. The new models show the great importance of the refraction effects on contrasting structures in all mentioned branches of the geothermics. The anomalous temperature distributions, the step changes of the heat flow density components calculated in the directions not normal to the structure boundaries characterised by the step change of the conductivity parameters and the declination of heat flow density vectors from vertical direction near these boundaries force to apply refraction effects to measurements and interpretations mainly near the sedimentary basins borders and near the vertically or aslant layered structures or such narrow contrast rock zones. Such structures are typical and frequently occurred also inside the tectonic region of the West Carpathians.

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Secular variation of the geomagnetic field in Europe for the 1985—2005 years

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Secular variation (SV) is a typical feature of the Earth magnetic field. Doing the magnetic surveys for the different purposes, creating the maps of the anomalous magnetic field, it is very important take into account the knowledge about the time spatial structure of the Earth magnetic field. Geomagnetic observatories and data measured at the repeat stations (SV points) are offers the main source of information about the time spatial structure of SV. Using this data, constructed maps of the secular variations of geomagnetic field gave us imaginations about the morphology of SV in studied regions and theirs comparison at different time let us to detect the focuses of the secular variations and investigate theirs kinematics. Auspicious conditions take place in the European region for the detail study of the SV according to the huge network of the magnetic observatories.

Spatial structure of the SV in European area is demonstrated in such papers as [Orlov et al., 1968; Pushkov, 1976; Maksymchuk et al., 2001] in which shown that the very dynamic structure of SV attend in the second part of XX century in Europe: disintegration of the Caspian (Iran) SV focus in 60th and formation of the new SV focus in central Europe in 70th [Maksymchuk et al., 2001; Maksymchuk, 2002].

The main goal of this work — compilation of the new maps of the secular variation of geomagnetic field for the European region in the beginning of XXI century and investigations of the characteristics of time spatial structure on the basis of these new maps.

As we can see from the Fig. 1—2 occurrence of the global positive focus with the epicenter in the Apennine — Balkan region is the main feature of the secular variation of the geomagnetic field during the 1985 — 1995 years in Europe. According to the data from IGRF-10 global magnetic model the intensity of this focus by *Z*-component come to the 24 nT/y during the 1985—1990 years and 22 nT/y during the 1990—1995 years. This focus was concentrated basically in all part of Central and Western Europe.

Analyzing the data from the magnetic observatories we come to conclusions that this SV focus in comparison to IGRF data not such strong but also take place in European continent. However, its struc-