

QUANTITATIVE INTERPRETATION OF GRAVITY DATA IN THE VIENNA BASIN REGION BY MEANS OF THE QUASI-SINGULAR-POINTS METHOD

I. S. ELISEEVA¹, W. SEIBERL², P. SLAPANSKY², R. PAŠTEKA³, R. ARNDT²

¹*VNIIGeofizika Moscow, Russia*

²*Geological Survey of Austria, Vienna, Austria*

³*Comenius University Bratislava, Slovakia*

Abstract: The proposed contribution is focused on the application of the Quasi-Singular-Points method on data from interpretation line across Vienna Basin and its surrounding areas. QSP-method is intended for interpretation of potential functions in conditions of complete absence of a priori geological information such as physical rock properties, depth of the basic horizons. etc. In the studied area, which has a very high content on geological information the properties of the QSP-method were studied - a large amount of known density boundaries were detected, some of obtained solutions are in question and have to be studied more in the future.

Key words: direct interpretation, Bouguer anomaly, density contacts, Euler deconvolution method

Introduction

The information content of regional gravity data for geological interpretation purposes plays an important role during last decades of geological-geophysical interpretation. On the other side, the inherent ambiguous behaviour of the inverse problem in gravimetry still influences the area of a useful interpretation of gravity data. In the present stage of geophysical methodology, the approximative solution of the inverse problem in applied gravimetry can be obtained only by means of an additional information adoption. This additional information may have a mathematical-physical content or it can introduce geological limits to the obtained solution (e.g. stripped gravity maps). The last mentioned methods (based on geological corrections) achieved excellent results in regions with a high content of geological-geophysical information. But the group of so called direct interpretation methods (based on introduction of a mathematical-physical constrain) plays an important role in regions with lower level on geological information. For testing of one typical method from this group (so

called Quasi-Singular-Points method) a region of high content of geological information was selected to show the capabilities and reserves of such a type of interpretation method.

Methodology

An important contribution to so called direct interpretation methods in gravimetry and magnetometry is build by so called singular points methods (also the very popular Euler deconvolution method (Reid et al., 1990) in the Western school can be understood from special point of view as a singular points method). Among all developed and published methods of singular points (excellent overview in Tafeev, Sokolov, 1981) in Russian geophysical school the Bereskin's total normalised gradient method has found its stable place in practical solving of geological problems (Bereskin, 1988). During 1980's and in the beginning of 1990's this method was developed for the determination of subhorizontal density contacts with microrelief - so called quasi singular points method (Eliseeva, 1995). The method of quasi-singular points (QSP) is based on the utilisation of excellent filter properties of the total normalised gradient operator in interactive analysis of profile data spectra. The parameters of the non-linear filter are varied with the aim to separate parts of the whole signal, which can be connected with the position of subhorizontal density contacts (with singularities, which are connected with the microrelief of these boundaries). The interpreted field is then continued in the bottom half-space and so called zones of maximum values are recognised and traced. Special analyse of these zones, based on analytical and empirical lows yields position of subhorizontal (and in addition also subvertical) boundaries. The most important fact of this method that it is intended for interpretation of potential functions in conditions of complete absence of a priori information such as physical rock properties, depth of the basic horizons. etc. - the position and depth information is obtained only from the spectrum analysis and special filtered downwards continuation. The QSP method is in principle suitable for solving of so called structural inverse problems (in the sense of Strakhov's categories), which are simulating a position of various subhorizontal layers and the difficulty of its solution is rather high - the so called deconvolution methods can recognise only the upper boundary.

Typical demonstration of above mentioned properties of the QSP-method is displayed in the Fig. 1, where in the upper part the results of a spectral analysis are shown (cosine Fourier coefficients A_n together with the shape of the adapted non-linear filters $1/\square_n$). In the lower part the reader can see the positions of obtained quasi-singular points, which indicate the position of the searched subhorizontal density boundary.

Results

Obtained QSP-solutions on the interpretation line, which crosses the main structure of Vienna Basin and units of Eastern Alps are displayed in the Fig. 2 (position of the line - lower right part of the Fig. 2). The reader can see that a large amount of existing known density boundaries were detected - the most important estimates are connected with overfaults of molasse and flysh zone, boundaries of the Vienna Basin and important faults of the region (Diendorfer, Bisamberg, Engelhartstettener). The most important known boundaries (in an atectonic sense) are displayed in the Fig. 2 and numbered by 1 - 3. The most important subhorizontal dipping boundary is the base of tertiary molasse sediments in the depths from 1 to 1.5 km (interval 81 - 95 km of the line). Some of obtained solutions are in question - e.g. the important cluster of solutions in the frame of Vienna Basin sedimentary filling (depths from 1 to 1.5 km on the 140 - 152 line km) or the estimates on 70 - 80 km of the line (depths of 1.4 - 1.8 km) do not respect the known dip of the Moravikum unit in this region. These problems have to be studied more in the future.

References

- Berezkin V. M., 1988. Total gradient method in geophysical exploration, Nedra, Moscow (in Russian)
- Eliseyeva I. S., 1995. Methodical rules for the interpretation of gravimetrical and magnetometrical data by means of quasi-singular points method. VNIIGeofizika Moscow (in Russian)
- Reid, A. B., Allsop, J. M., Granser, H., Millet, A. J., Somerton, I. W., 1990. Magnetic interpretation in three dimensions using Euler deconvolution. *Geophysics*, 55, 80 - 91
- Tafeev G. P., Sokolov K. P., 1981. Geological interpretation of magnetic anomalies, Nedra, Leningrad (in Russian)

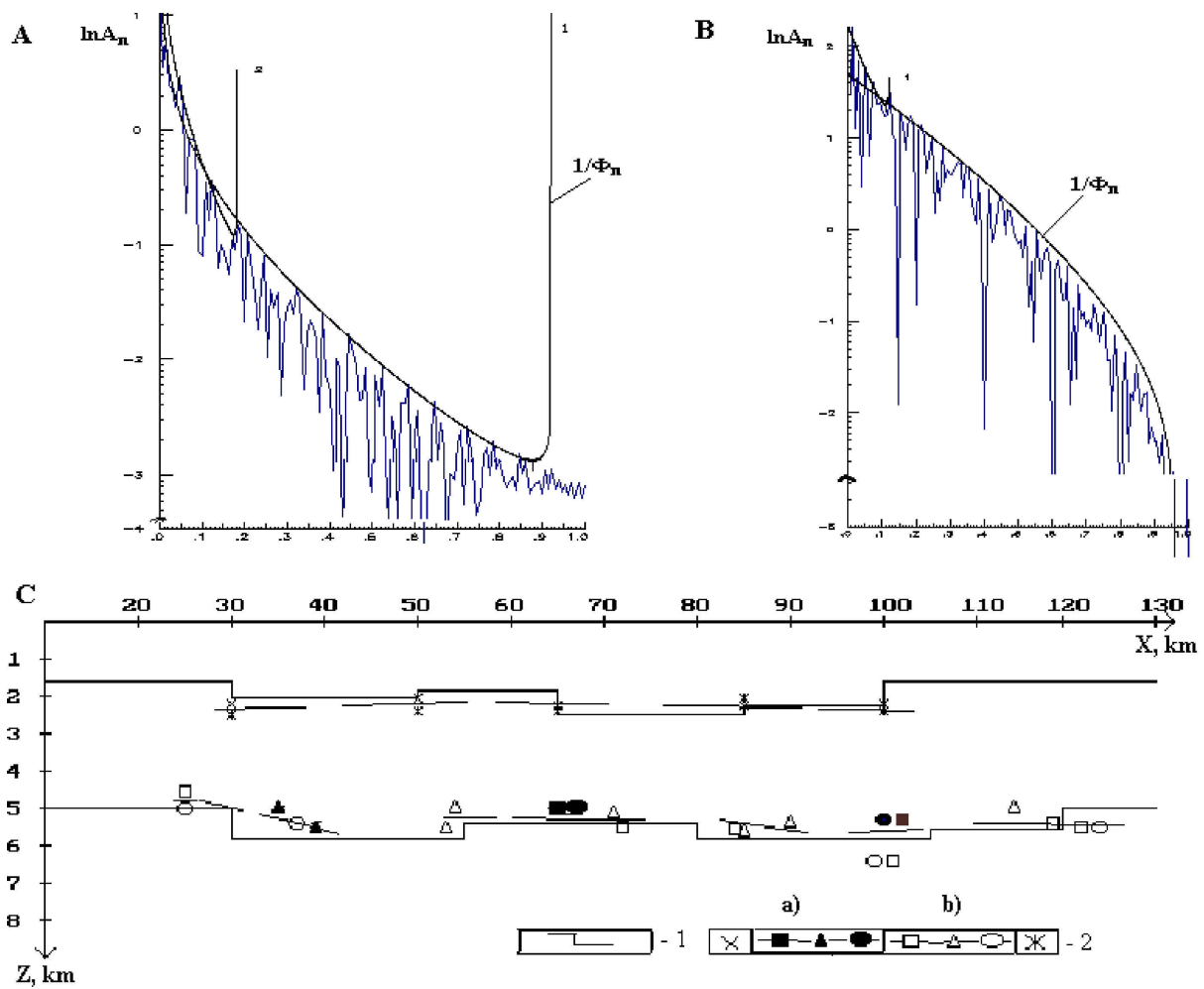


Fig.1 The analysis of gravity (A) and magnetic (B) peak spectrum and results of QSP method (C) for the 3-layers model. 1 - the model subhorizontal boundary; 2 - subhorizontal boundary according the QSP method data: a) gravity; b) magnetic

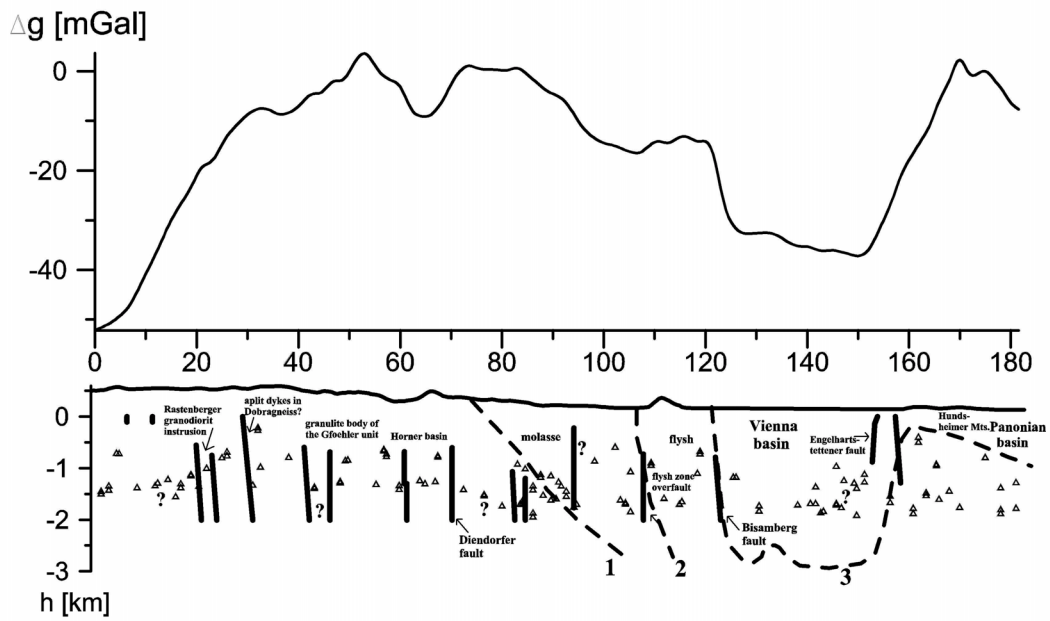


Fig. 2 Results from interpretation of gravity data by means of the QSP method

- \triangle - subhorizontally oriented density boundaries
- $/$ - subvertically oriented density boundaries
- \dashv - known important density boundaries from other geological-geophysical disciplines
 - 1 - molasse tertiary sediments base
 - 2 - flysh nappe overfault
 - 3 - tertiary sediments base in Vienna Basin

