УКРАЇНСЬКИЙ АНТАРКТИЧНИЙ
ЖУРНАЛ
УАЖ № 8, 43-46 (2009)

**УДК 531.14:550.831(084.4)(1-923)**

# ATLAS OF THE ANTARCTIC DEEP STRUCTURE WITH THE GRAVIMETRIC TOMOGRAPHY

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**Atlas of the Antarctic deep structure with the Gravimetric Tomography** / Greku R.Kh., Gozhik P.F., Litvinov V.A., Usenko V.P., Greku T. R.; – Kiev, 2009. – 69 pp. – ISBN 978-966-02-4937-0.
The Atlas contains results of a deep structure modeling of the Antarctic and the South Ocean regions. Initial data are spherical harmonics of the EGM96 global geoid model. Dense heterogeneities are calculated using the gravimetric tomography technology. 3D images of vertical and lateral sections on different depths are presented.
Proceeding compiling, computer design: "Geographika".

**Атлас глубинного строения Антарктики по данным гравиметрической томографии** / Р.Х. Греку, П.Ф. Гожик, В.А. Литвинов, В.П. Усенко, Т.Р. Греку; – Киев, 2009. – 69 с.
Атлас содержит результаты моделирования глубинного строения Антарктики и регионов Южного океана. Исходными данными являются сферические гармоники глобальной модели геоида EGM96. Плотностные неоднородности рассчитаны, используя метод гравиметрической томографии. Представлены 3Д изображения вертикальных и латеральных разрезов на различных глубинах.
Компьютерная верстка, макетирование: предприятие "Географика"
ISBN 978-966-02-4937-0

Geotectonic researches are constrained by the shortage of the deep Earth's interior data in most cases. This problem relates especially to such key remote and inaccessible areas as Antarctic and Arctic. A known informative source of such data is the seismic tomography technology [1] in which signals of earthquakes and explosions are used. Our gravimetric tomography technique [2] is based on realization of theoretical approach by Prof. H. Moritz [3] that the Earth's equipotential surfaces coincide with surfaces of the constant density and on usage of his algorithm of determination of the harmonic dense anomalies through the spherical harmonics of the gravity potential.

Moreover, we used a well-known extracting procedure of certain harmonics [4, 5] for determination of a residual (differential) geoid and for mapping of structures, which disturb the geopotential in different layers.

Experienced geophysicists have made approximate evaluations of disturbing layers depths using the geoid harmonics. So, it was noted in the work [6] that the density inhomogeneities at the center of the Earth are responsible for harmonics of about $2<n<5$, the lower mantle is responsible for the range of $2<n<20$, and the upper mantle for the range of $2<n<100$. It is supposed in another reference work [7], that harmonics of up to 8 degrees are probably caused by the impact of masses located in depths of more than 1000 km, and from 8 to 22 in depths of 50–300 km. These assessments of a logical conformity between number of harmonics and depth of disturbing layer motivated us to determine a numeric dependence in this relationship.

Thus, the gravimetric tomography method includes the solution of the following tasks:

1. Determination of harmonic density of anomalous disturbing masses by the geoid spherical functions.

2. Determination of the relationship between degrees of harmonic series expansion of the geoid topography and depths of disturbing layers of the Earth.

3. Creation and displaying of the structured model of dense inhomogeneities for the studied region.

The Atlas contains information on anomalous dense heterogeneities computed with the gravimetric tomography method using the EGM96 global geopotential model of the geoid. 3D images of vertical cross-sections and maps of lateral slices on different depths of the Antarctic lithosphere plate within 30°S are presented. Tectonic structure, intraplate and interplate processes of the Antarctic region are shown on the world maps [8] and at the sections along the Antarctic Plate's boundary [9] on spreading mid-ocean ridges at a distance more than 40,000 km.

The primary link of the mantle plume located in the Ross Sea area with the North America thinning structure is noted at a depth of 5300 km. New information about penetrating of the Ross plume thinning hot masses into the colder crust and the lithosphere in the Australian-Antarctic Discordance and the Nazca Ridge areas was obtained from several vertical sections. Rift channels for rise of thinning material in the West Antarctic Rift System along the meridians 90°W and 170°W [10] are shown. The channels of deep matter from the Weddell subduction zone up to the Bransfield rift system are discovered. Regional features of the Scotia Sea's deep structure and the Pacific and Atlantic mantle flows are shown along 58°S.

Atlas includes 61 maps and vertical cross-sections, some explanations and interpretation of images in English and Russian languages. The following topics are in the atlas:

**I Gravimetric Tomography method and initial data**

I.1 Gravimetric Tomography

I.2 Geoid topography by the EGM96 geopotential model

I.3 Differential geoid topography due to the disturbing layer of 50 km thickness

**II Interaction of Antarctica with other regions**

II.1 Distribution of dense (yellow) and thinning (blue) structures at a depth of 5300 km

II.2 Distribution of global dense inhomogeneities at a depth of 5300 km in the Lambert projection

II.3 Distribution of dense and thinning structures at depths of 5300 km, 2800 km and 1500 km

II.4 Distribution of dense anomalies along the Earth's axis of revolution between the North and South Poles

**III Transformation of the Earth's structure in different depths within the Antarctic lithosphere plate**

III.1 Lateral slices of anomalous dense inhomogeneities at depths of 1500 km, 467 km, 118 km and 59 km

III.2 Lateral slice at a depth of 22 km

III.3 Lateral slice at a depth of 10 km

III.4 Lateral slice at a depth of 5 km

III.5 Lateral slice at a depth of 0.7 km

**IV Antarctic lithosphere boundary**

IV.1 Deep structure of the Antarctic Plate boundary zone

IV.2 The Australian-Antarctic Discordance (AAD) anomalous structure

IV.3 Vertical cross-section of dense heterogeneities along the meridian of 124°E crossing the AAD

IV.4 Detailed fragment of the APB within the American-Antarctic and the Africa-Antarctic Ridges

**V Trans Antarctic vertical sections**

V.1 Scheme of the sections

V.2 Section along meridians of 190°E – 44°E. Range of depths is 140–2800 km

V.3 Section along meridians of 190°E – 44°E. Range of depths is 1–2800 km
V.4 Detail image of the section along the meridian of 190°E between latitudes of 60°S–90°S
V.5 Detailed image of the section along the meridian of 44°E between latitudes of 30°S–90°S
V.6 Features of the West Antarctic Rift System
V.7 Section along meridians of 90°W – 90°E
V.8 Section along meridians of 108°W – 72°E
**VI Sections crossing the West Antarctic**
VI.1 Section along 65.25°S crossing the Antarctic Peninsula (Graham Land)
VI.2 Section along 68°S crossing the Antarctic Peninsula (Transit Zone)
VI.3 Section along 71°S crossing the Antarctic Peninsula (Palmer Land)
VI.4.1 Section along the direction of Drake Strait-Deception I-Antarctic Peninsula-Weddell Sea
VI.4.2 Section along the direction of Drake Strait-Deception I-Antarctic Peninsula-Weddell Sea. Depths are shown from the sea surface
VI.5.1 Link of the Bransfield Basin with the Weddell Sea along 62.4°S
VI.5.2 Link of the Bransfield Basin with the Weddell Sea along different cross-sections
**VII Detailed structural maps of the West Antarctic**
VII.1 Density lateral slice at a depth of 5 km
VII.2 Density lateral slice at a depth of 0.7 km
**VIII Regional structural features of the Scotia Plate**
VIII.1 Distribution of dense heterogeneities along the central latitude of 58°S between depths of 1–100 km
VIII.2 Section along the 58°S between depths of 390–2800 km
VIII.3 Section along the meridian of 60°W
VIII.4 Section along the meridian of 43°W
VIII.5 Section along the meridian of 28°W
26 References

The Atlas is prepared during the International Polar Year 2007–2009 within the framework of the POLENET Project.

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