

Geomagnetic Data of the Republic of Macedonia Obtained in 2004

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Abstract

During 2004, measurements of the geomagnetic field were carried out on the existing network of repeat stations (15 points) of the Republic of Macedonia. The equipment used was from the Royal Observatory, Dourbes, consisting of: 1 Diflux/GPS receiver type FLM3/A serial 001, 1 Proton magnetometer Geometrics G816 (electronics + sensor) serial 1579, 1 Geodetic Tripod and 1 Monocular digital compass KVH Data scope II pn#01-0162 Serial 02070033 and the equipment from the Faculty of Mining and Geology, Stip: 1 Diflux type LEMI 203 (from Tempus JEP Project “Geomagnetic measurements and quality standards”) and proton magnetometers Bison and Geometrics. The territory of the Republic of Macedonia is relatively small, but from the point of view of its geology it is very complex and differentiated. The relief consists of high mountain massifs of up to 2700 m separated by blocks of subsidence and depressions. The field measurements included observation of the total vector of the geomagnetic field F , declination D , and inclination I . All parameters of the geomagnetic field of the Republic of Macedonia were calculated based on the measurements. Based on the results of the elements of the geomagnetic field and observations carried out in 2004, it can be determined that: the total vector F varies about 800 nT, the inclination I varies less than 2 degrees, and the declination D is less than 1 degree.

1. Introduction

Modern geomagnetic measurements in the Republic of Macedonia started in 2002. They were carried out by the Department of Geology and Geophysics at the Faculty of Mining and Geology in Stip in cooperation with the Royal Meteorological Institute – Geomagnetic Observatory in Dourbes, Belgium. A grid of 15 repeat sta-

tions was formed and a site for the future Geomagnetic Observatory in the country was selected.

Within the Tempus Project IB_JEP-17071-2002 “Geomagnetic measurements and quality standards”, during the period from 2003 to 2004, training was carried out for 8 persons (4 for geomagnetic measurements) in the Dourbes Observatory as well as practical measurements in the territory of the Republic of Macedonia. The Tempus Project made it possible for a large number of engineers to learn the issues related to geomagnetic investigations.

In 2002, observing of several repeat stations was carried out in the Republic of Macedonia in order to define the site for the future Geomagnetic Observatory. The repeat stations in Mts. Galicica, Ponikva and Plackovica were studied several times. The analyses of the physical and other parameters indicated that the most appropriate location for the construction of the future Observatory is Mt. Plackovica.

In 2003 a complete survey on 15 repeat stations on Macedonia was performed. The same was done in 2004.

2. Measurements in Macedonia in 2004

In August 2004, measurements of D, I, and F were carried out on the grid of repeat stations (Rasson and Delipetrev, 2004). The names and the geographic coordinates of the 15 repeat stations are given in Table 1, and Fig. 1 shows the map of repeat stations. Measured and calculated components of the geomagnetic field in 2004 and standard deviations are given in Table 2 and Table 3, respectively. Figures 2-5 show maps resulting from these measurements.

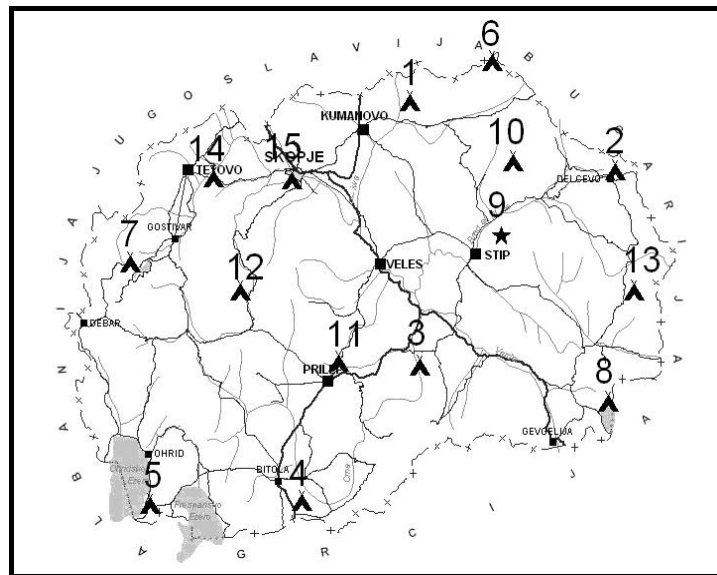


Fig. 1. Map of repeat stations in the Republic of Macedonia.

Table 1
Geographic coordinates of repeat stations

Repeat station	Geographic latitude	Geographic longitude	Altitude
Bajlovce	42° 13' 16"	21° 55' 17"	592 m
Crna Skala	41° 59' 41"	22° 47' 28"	833 m
Gradot Island	41° 23' 15"	21° 57' 06"	317 m
Egri	40° 57' 56"	21° 26' 54"	626 m
Galicica	40° 57' 23"	20° 48' 51"	1684 m
Luke	42° 20' 39"	22° 16' 29"	1180 m
Mavrovo	41° 42' 58"	20° 43' 38"	1418 m
Nikolic	41° 15' 54"	22° 44' 36"	300 m
Plackovica	41° 47' 41"	22° 18' 13"	677 m
Ponikva	42° 01' 35"	22° 21' 29"	1618 m
Prilep lake	41° 24' 11"	21° 36' 32"	870 m
Sv. Marija Precesna	41° 37' 38"	21° 11' 36"	837 m
Slivnica	41° 36' 54"	22° 51' 46"	1252 m
Tetovo-Zelino	41° 59' 09"	21° 04' 46"	522 m
Vodno	41° 58' 40"	21° 24' 57"	569 m

Table 2
Measured and calculated parameters of the geomagnetic field in 2004

Repeat Station	D (°)	I (°)	F (nT)	H (nT)	X (nT)	Y (nT)	Z (nT)
BAI	2.997	59.269	46758.4	23893.9	23861.3	1249.1	40192.4
CRN	3.260	58.883	46920.4	24247.8	24208.5	1378.9	40169.2
EGR	3.097	57.765	46430.1	24765.7	24729.5	1338.1	39273.6
GAL	2.955	57.694	46291.2	24740.2	24707.3	1275.3	39125.4
GRA	3.576	58.083	46438.4	24551.3	24503.5	1531.3	39417.7
LKA	3.337	59.390	47036.7	23950.4	23909.8	1394.3	40482.4
MVR	3.058	58.577	46561.4	24275.2	24240.6	1294.9	39732.7
NIK	3.146	58.203	46594.8	24551.2	24514.2	1347.3	39601.9
PLC	3.229	58.619	46679.2	24307.0	24268.4	1369.2	39851.3
PON	2.868	58.994	46825.7	24121.1	24090.9	1206.7	40135.0
PRP	3.101	58.277	46665.8	24537.7	24501.7	1327.5	39693.8

Table 2 (continuation)

Repeat Station	D (°)	I (°)	F (nT)	H (nT)	X (nT)	Y (nT)	Z (nT)
SLI	3.442	58.509	46696.9	24392.8	24348.8	1464.5	39819.5
SMP	3.137	58.443	46562.2	24368.2	24331.7	1333.4	39676.5
TET	3.186	58.762	46747.1	24242.8	24205.3	1347.4	39969.7
VOD	3.274	58.787	46740.1	24221.5	24181.9	1383.5	39974.5

Table 3

Standard deviation

Repeat Station			Standard deviation		
No.	Code	Locality	D (°)	I (°)	F (nT)
1.	BAI	BAILOVCE	0.008	0.003	2.129
2.	CRN	CRNA SKALA	0.015	0.006	2.696
3.	EGR	EGRI	0.011	0.002	3.257
4.	GAL	GALICICA	0.004	0.001	2.110
5.	GRA	GRADOT island	0.018	0.004	0.918
6.	LKA	LUKA	0.011	0.002	5.794
7.	MVR	MAVROVO	0.008	0.004	0.558
8.	NIK	NIKOLIC	0.007	0.000	2.204
9.	PLC	PLACKOVICA	0.007	0.003	3.754
10.	PON	PONIKVA	0.003	0.006	2.709
11.	PRP	PRILEP lake	0.008	0.003	2.858
12.	SLI	SLIVNICA	0.002	0.008	1.472
13.	SMP	ST MARIA PRE	0.010	0.004	2.956
14.	TET	TETOVO	0.001	0.002	0.401
15.	VOD	VODNO	0.011	0.002	4.386

3. Geomagnetic Observatory in the Republic Macedonia in Mt. Plackovica

The Republic of Macedonia does not possess an operating Geomagnetic Observatory. It is important to say that over the past years the Faculty of Mining and Geology worked on a project for establishing a geomagnetic observatory with a net of repeat stations (Delipetrov 1991). The location for the Geomagnetic Observatory was

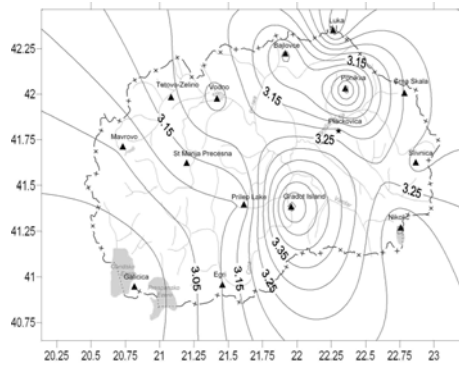


Fig. 2. Map of measured values of declination (in deg) of the geomagnetic field, epoch 2004.5.

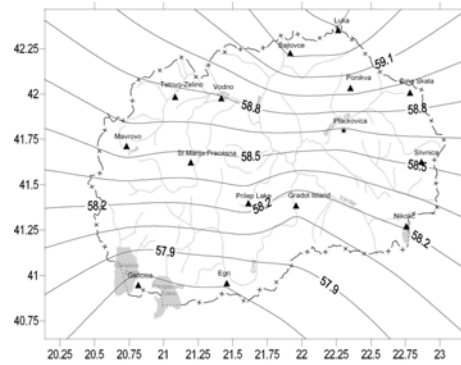


Fig. 3. Map of measured values of inclination (in deg) of the geomagnetic field, epoch 2004.5.

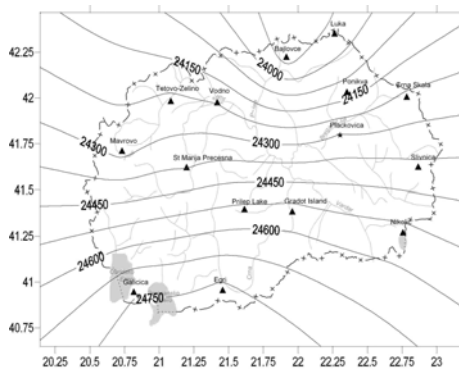


Fig. 4. Map of measured values of horizontal intensity (in nT) of the geomagnetic field, epoch 2004.5.

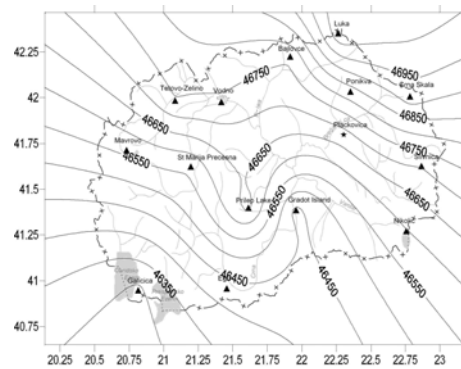


Fig. 5. Map of measured values of total intensity (in nT) of the geomagnetic field, epoch 2004.5.

decided after measurements carried out on the repeat stations network. A detailed geomagnetic map of the terrain was also compiled. Owing to the fact that the population in the area is not dense and the stable gradient of the geomagnetic field, excellent conditions for the operation of the Observatory are provided (Fig. 6).

The implementation of Tempus project under the title “Geomagnetic measurements and quality standards” during the period 2003–2006 intensified the activities for establishing the Geomagnetic Observatory. The following equipment was purchased within the project: Theodolite Zeiss 010 A, Theodolite LEMI 203, and Variometer LEMI 008.

The equipment will be used in the Geomagnetic Observatory and in measurements of the repeat stations network. The equipment is of the highest quality and in accordance with INTERMAGNET standards.



Fig. 6. Satellite image of the terrain of the Geomagnetic Observatory Plackovica.

Parallel to the measurements of the geomagnetic field on the repeat stations network, the following services for the Geomagnetic Observatory at Plackovica (Fig. 7) were completed:

1. The construction site for the Observatory was acquired, the size being 10 hectares. The land was given by the Government of the Republic of Macedonia,
2. A proposal plan for the construction of the Geomagnetic Observatory was developed (Velkovska, 2005), (see Fig. 8),
3. Technical facilities for the staff in the Geomagnetic Observatory (offices, living facilities, sanitation) were constructed,
4. Power supply was installed to the existing facilities,
5. An access road was constructed to the facilities of the Geomagnetic Observatory.

4. Conclusion

Measurements carried out in 2004 on the existing network of repeat stations have been presented in maps (Figs. 2-5). Each component varies within the intervals listed in Table 4.

The Observatory in Plackovica provides good accommodation conditions for the personnel, and currently we are in the stage of constructing absolute and variometer huts.



Fig. 7. Geomagnetic Observatory, Plackovica – implementation carried out so far.

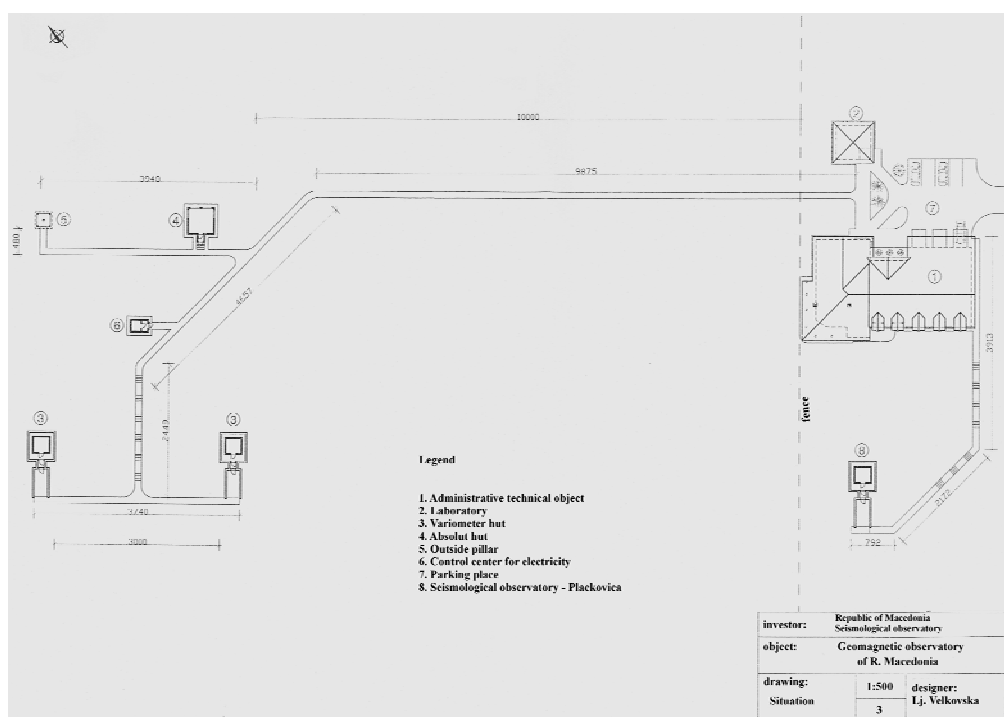


Fig. 8. Schematic plan of the Geomagnetic Observatory Plackovica.

Table 4
Maximum and minimum values of repeat stations

$2,868^{\circ} < D < 3,576^{\circ}$
$57,694^{\circ} < I < 59,390^{\circ}$
$46291,2 \text{ nT} < F < 47036,7 \text{ nT}$
$23893,9 \text{ nT} < H < 24765,7 \text{ nT}$
$23861,3 \text{ nT} < X < 24729,5 \text{ nT}$
$1206,7 \text{ nT} < Y < 1531,3 \text{ nT}$
$39125,4 \text{ nT} < Z < 40482,4 \text{ nT}$

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