GEOMAGNETIC RESEARCHES IN THE EASTERN PART OF NORTH MACEDONIA

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A b s t r a c t: Republic of North Macedonia, according to current knowledge, has deposits of gold that were exploited in the past. Existence of contemporary geophysical methods, especially high precision magnetometers, gives relatively easy and very efficient possibility for defining the area of alluvial terraces, not only on the existing rivers but, also, in the old riverbeds. To define the most prospective areas for detailed research, bearing in mind that the gold and accompanying heavy precious metals are non-magnetic, which are of exploitation interest, almost always, paragenetic, magnetite is present with them. Magnetite as a mineral have the highest magnetic level, according to that is easy detectable. Areas with registered anomalies should be investigated with this method and core drilling in order to define depth of the ore.

Key words: geomagnetism; anomaly; gold; deposits; analysis

INTRODUCTION

Geomagnetic method is based on measurements of the geomagnetic field elements on an area. Generally, geomagnetic field can be divided in two components:

– anomalous geomagnetic component that reflects the influence of rock masses on the investigation area, and

– component that origin from the normal geomagnetic field generated in the Earth's core.

Anomalous component of the geomagnetic field consists of regional part that reflects deep seated magnetic structures and which influence covers larger area; and local anomalous component that is generated from factors which are seated in the shallow part under the Earth's surface and their influence is feel on a small area. In exploration of mineral raw materials is essential to separate regional from local component, because the local anomalous component of the field is directly connected with the mineral raw material. The depth to which geophysical measurements can be conducted in exploration of ore deposits is defined with the dimensions and shape of the ore body and measurable differences in the physical properties between the ore and the surrounding rocks. Generally, it can be conducted to depth of about 120 m.

GEOLOGICAL STRUCTURE OF THE INVESTIGATION AREA

The investigation area is located in the eastern part of the Republic of North Macedonia and belongs to the Serbian-Macedonian massif. The geological structure is represented, mostly, by Pliocene sediments, Paleozoic gneisses, and Precambrian schists and gneisses (Figure 1) [2].

Two mica stripped gneisses (Gmb) – These gneisses are the most spreaded Precambrian rocks on this terrain. They are present on the central and north slopes of the Plačkovica mountain, north and northeast parts of Maleševski Mountains and the southeast parts of the mount of Preseka.

In the part of mt. Plačkovica, in these rocks are present hydrothermal alterations followed by polymetallic mineralization of copper, lead and zinc.
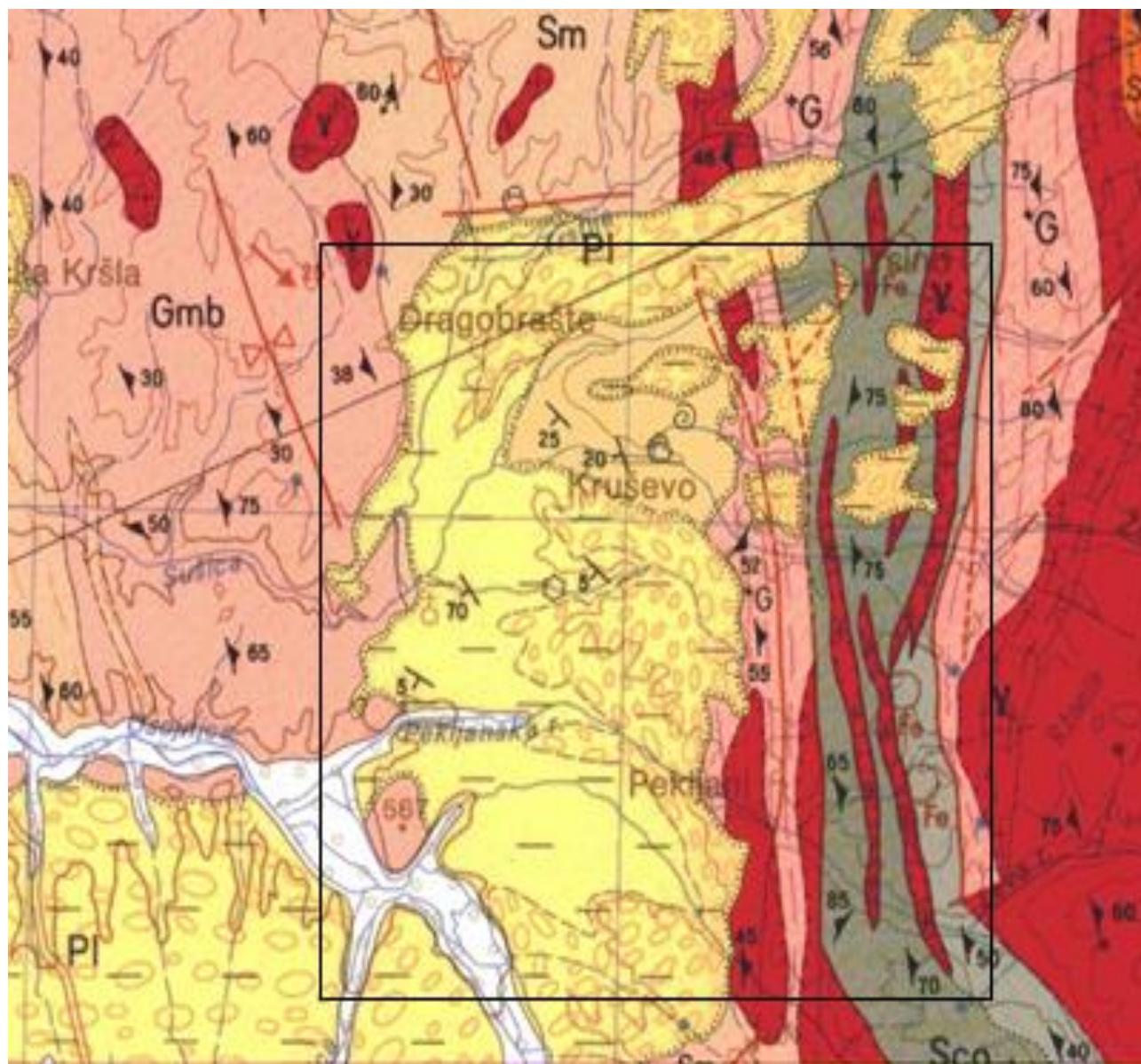
Fig. 1. Geological map of the wider vicinity of the researched terrain [3]
Pl – Pliocene clays, subclays and sands; G – Paleozoic orthogneisses; Sco – Ryphean-Cambrian quartz-sericite-chlorite schists;
Sm – Precambrian micaschists; Gmb – Precambrian two mica stripped gneisses

Macroscopically, they are granular with grey color, with stripped texture and expressed schistosity. Their composition is represented by quartz, plagioclasse, biotite, muscovite, and rarely epidote and garnet.

Micaschists (Sm) – These rocks are present in the southwest slopes on mt. Plačkovica. They have strongly expressed schistosity and have yellow-brown color. The structure is lepidogranoblastic. They are composed of quartz, biotite, muscovite, and as secondary mineral appear chlorite. As accessory mineral is present garnet, rarely tourmaline.

Quartz-sericite-chlorite schists (Sco) – This kind of schists appear in the central southeast and west parts of the terrain. On mt. Plačkovica occured above the albitized chlorite-muscovite schists.

These rocks have phylitic look with grey-greenish color, perfect schistosity and large thickness. The structure is lepidogranoblastic and their composition is presented by sericite, quartz, chlorite, epidote, coisite, and limonite matter.

Orthogneisses (G) – These are very strong, compact rocks with yellowish-white color. The structure is granoblastic to porphyroblastic, and their composition is quartz-feldspar where main minerals are quartz, potassium feldspars, and plagioclases.

Facies of clays, subclays and sands (Pl) – These sediments occupy the largest terrain. They

appear west of the villages of Pekljani, Sofino, and Kruševo.

In this series are present grey-green poor sandy clays, kaolinized clays with different colors with dirt bands of bituminous clays, coal clays, marl clays, and sands. The thickness of this facies is about 100 m.

MATERIALS AND METHODS

In order to study the geomagnetic structures of the field in the research area, the measurement of the total vector of the geomagnetic field along certain profiles with relatively high density of measuring points was performed [7, 8].

The measurements were performed using Bison and Geometrics proton magnetometers.

One of the instruments (Geometrics), which has the ability to automatically measure with high density, was used as a base station for measuring daily variations and obtaining a magnetogram of the same.

Geomagnetic measurements with a proton magnetometer have a simple procedure. The fact is that it is so simple that people forget the usual warnings that need to be taken into account to make accurate magnetic measurements. We can single out the following steps [1]:

1) Position the magnetometer sensor where measurement is required.

2) Ensure that the measuring point is free of high magnetic gradients or strong RF fields, such as those generated by high voltage main lines.

3) Orient the sensor exactly in the direction of the field.

4) Connecting to the electronics and placing it at a sufficient distance so as not to create magnetic perturbations on the sensor.

5) Setting the sensor to the local value of the field.

6) Make sure that the observer working with the instrument is not magnetic.

7) Perform the measurement by pressing the measurement button.

Former investigations on this terrain

In the last several years investigations were made on the alluvion of the river of Pekljanska, where was determined endogene mineralization of gold [4]. These research were aimed to define morphological forms of golden aggregates and their chemical composition.

These investigations showed presence of golden aggregates. From the total of 12 samples taken, 19 gold aggregates were found in six of them, which were tested for their chemical composition and morphological characteristics. The size of the gold aggregates ranges from about 400 to about 900 microns.

According to the chemical composition, the gold is characterized by a high purity that ranges from 930 to about 990, which ranks it in the group of high-grade and very high-grade gold.

RESULTS AND DISCUSSION

In order to study the geomagnetic field structures in the research area, the total vector of the geomagnetic field was measured along certain profiles with a relatively high density of measurement points [5, 6].

From the previous knowledge about the investigation area that alluvial gold was found in the Pekljanska river, the purpose of this research is to measure the magnetic environment of the Pekljanska river.

The measurements were performed using Bison and Geometrics type proton magnetometers.

One of the instruments (Geometrics), which has the possibility of automatic high-density measurement, was used as a base station for measuring daily variations and obtaining a magnetogram of them.

Total of 478 measuring points on the magnetic field were measured at a height of 1 m and 2 m from the surface of the earth (Figure 3), three profiles oriented north – south, one profile along the Pekljanska river and the other along the river that connects the village of Kruševo and the village of Trsino (Figure 2).
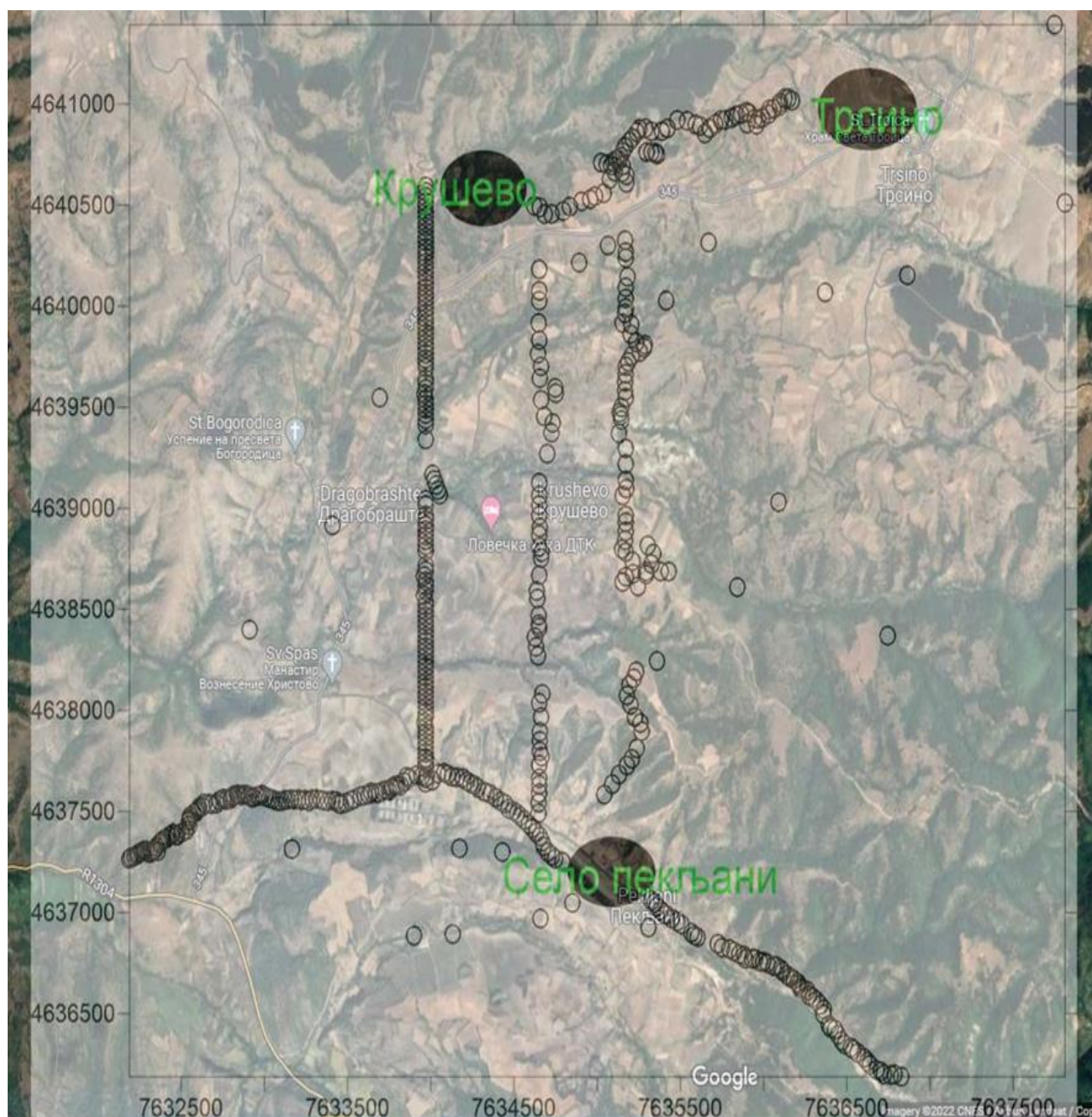
Fig. 2. Measured geomagnetic points

Table 1 shows the measuring points with their coordinates and the measured values, the daily variation and the calculated values for the given terrain.

From the performed measurements and the calculations and reduction of the data, appropriate maps for the investigation area were made from Table 1.

Figures 3 and 4 show the map of the total magnetic field of the investigated area with measu-

rements on 1 m and 2 m from the surface of the terrain.

Figure 5 shows the map of the magnetic field of the research area with the mean value of the measurements from 1 m and 2 m from the surface of the terrain.

On the maps are visible two anomalies, one in the northern part, the other in the southern part (on the Pekljanska river) of the investigation area, and a smaller anomaly that stretches from north-south.
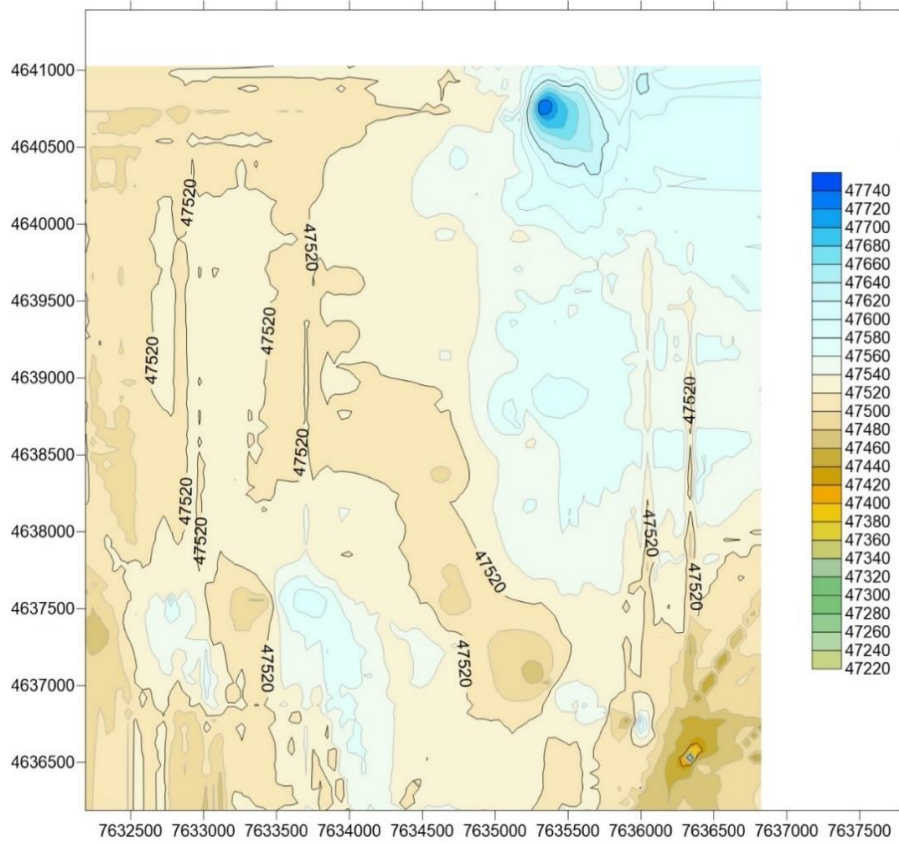
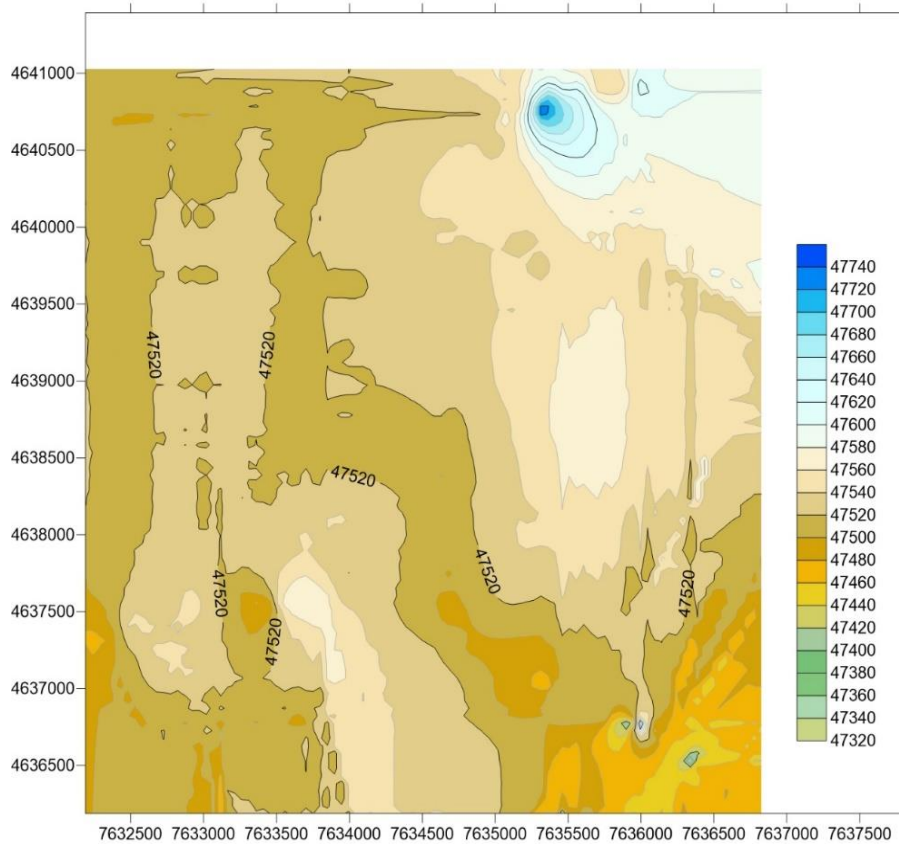**Fig. 3.** Map of the total magnetic field with measurements on 1 m from the surface of the terrain

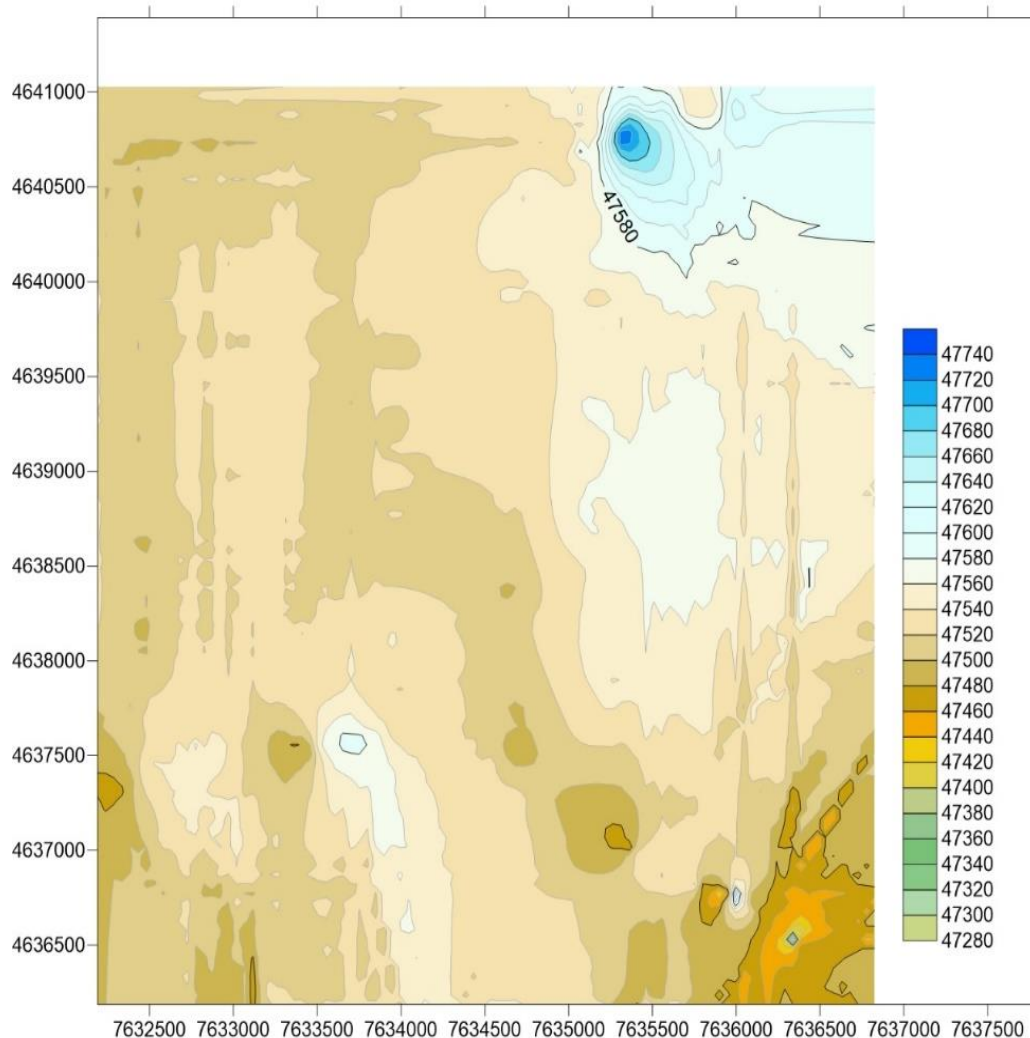**Fig. 4.** Map of the total magnetic field with measurements on 2 m from the surface of the terrain

Fig. 4. Map of the total magnetic field with mean value from the measurements on 1 m and 2 m from the surface of the terrain

CONCLUSION

From the conducted research and field measurements of the magnetic field and from previous knowledge in the vicinity of the Pekljanska river, we can conclude that:

The investigation area is located in the eastern part of the Republic of North Macedonia and belongs to the Serbian-Macedonian massif.

The geological structure is represented, mostly, by Pliocene sediments, Paleozoic gneisses, and Precambrian schists and gneisses.

The former investigations showed presence of alluvial gold in the Pekljanska river, so this research was performed to determine magnetic environment on this area.

About 500 measurements of the magnetic field have been made, at 1 and 2 meters from the earth's surface, which means that the space has been explored in detail.

Table 1 shows the measurement results. From the results were made maps of the total magnetic field.

On the maps are visible two anomalies, one along the Pekljanska river on the south and one on the north.

The previous knowledge and the analyses of the magnetic field on the research area are a sufficient indicator for the continuation and deepening of the research of metallic mineral resources

T a b l e 1

*Measured points with their coordinates, measured values of the total field, the daily variation
and the calculated values for the given terrain*

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7632189	4637266	47485	47486	47506.9	47392.5	47485.5	47449.7	35.8	35.3	36.3
7632201	4637274	47458	47470	47413.2	47343.5	47464	47378.35	85.65	79.65	91.65
7632219	4637276	47459	47468	47385.3	47592.8	47463.5	47489.05	−25.55	−30.05	−21.05
7632232	4637284	47460	47466	47506.9	47564.3	47463	47535.6	−72.6	−75.6	−69.6
7632246	4637292	47465	47470	47413.2	47572.6	47467.5	47492.9	−25.4	−27.9	−22.9
7632259	4637301	47482	47480	47385.3	47351.8	47481	47368.55	112.45	113.45	111.45
7632273	4637305	47471	47478	47354.9	47381.1	47474.5	47368	106.5	103	110
7632290	4637305	47473	47479	47446.5	47661.9	47476	47554.2	−78.2	−81.2	−75.2
7632302	4637295	47478	47484	47353.7	47367.6	47481	47360.65	120.35	117.35	123.35
7632317	4637296	47470	47480	47391.3	47361.3	47475	47376.3	98.7	93.7	103.7
7632331	4637302	47470	47479	47412	47448.1	47474.5	47430.05	44.45	39.95	48.95
7632343	4637311	47478	47482	47490.2	47343.5	47480	47416.85	63.15	61.15	65.15
7632351	4637325	47480	47484	47426.9	47373	47482	47399.95	82.05	80.05	84.05
7632359	4637304	47489	47490	47438.8	47494.4	47489.5	47466.6	22.9	22.4	23.4
7632374	4637345	47488	47493	47444	47391.1	47490.5	47417.55	72.95	70.45	75.45
7632385	4637353	47475	47495	47386.4	47456.5	47485	47421.45	63.55	53.55	73.55
7632396	4637361	47500	47505	47389.8	47406.7	47502.5	47398.25	104.25	101.75	106.75
7632410	4637367	47505	47511	47383.3	47335.4	47508	47359.35	148.65	145.65	151.65
7632424	4637377	47483	47497	47400.2	47411.1	47490	47405.65	84.35	77.35	91.35
7632438	4637381	47528	47531	47396.1	47379	47529.5	47387.55	141.95	140.45	143.45
7632450	4637390	47518	47529	47385	47368.1	47523.5	47376.55	146.95	141.45	152.45
7632467	4637381	47517	47528	47311.6	47467.3	47522.5	47389.45	133.05	127.55	138.55
7632477	4637380	47537	47541	47401.8	47433.7	47539	47417.75	121.25	119.25	123.25
7632501	4637397	47553	47549	47396.6	47396.8	47551	47396.7	154.3	156.3	152.3
7632527	4637406	47522	47537	47459.3	47383.6	47529.5	47421.45	108.05	100.55	115.55
7632552	4637431	47535	47549	47528.4	47394	47542	47461.2	80.8	73.8	87.8
7632546	4637451	47539	47548	47451.7	47399.5	47543.5	47425.6	117.9	113.4	122.4
7632549	4637461	47549	47533	47461.9	47531.2	47541	47496.55	44.45	52.45	36.45
7632554	4637476	47547	47553	47331.1	47369.7	47550	47350.4	199.6	196.6	202.6
7632576	4637493	47516	47537	47375.7	47476.7	47526.5	47426.2	100.3	89.8	110.8
7632591	4637500	47528	47529	47351	47357.9	47528.5	47354.45	174.05	173.55	174.55
7632601	4637509	47533	47527	47433.9	47382.4	47530	47408.15	121.85	124.85	118.85
7632611	4637521	47518	47525	47333.8	47476.5	47521.5	47405.15	116.35	112.85	119.85
7632626	4637525	47543	47531	47396.2	47470.7	47537	47433.45	103.55	109.55	97.55
7632639	4637538	47546	47531	47387.1	47371	47538.5	47379.05	159.45	166.95	151.95
7632667	4637540	47582	47534	47393	47344.3	47558	47368.65	189.35	213.35	165.35
7632682	4637537	47544	47530	47550.9	47382.9	47537	47466.9	70.1	77.1	63.1
7632712	4637539	47538	47535	47429.2	47422.1	47536.5	47425.65	110.85	112.35	109.35
7632732	4637553	47532	47531	47353.2	47410.6	47531.5	47381.9	149.6	150.1	149.1
7632752	4637566	47552	47523	47577.4	47432.2	47537.5	47504.8	32.7	47.2	18.2

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7632763	4637558	47585	47520	47383.8	47398.3	47552.5	47391.05	161.45	193.95	128.95
7632780	4637556	47617	47529	47410.8	47447.3	47573	47429.05	143.95	187.95	99.95
7632798	4637560	47553	47531	47385.6	47373.5	47542	47379.55	162.45	173.45	151.45
7632805	4637571	47519	47524	47385.9	47450.4	47521.5	47418.15	103.35	100.85	105.85
7632816	4637579	47518	47533	47411	47315.3	47525.5	47363.15	162.35	154.85	169.85
7632833	4637585	47547	47532	47387.6	47719.4	47539.5	47553.5	–14	–6.5	–21.5
7632845	4637582	47548	47538	47382.6	47356.7	47543	47369.65	173.35	178.35	168.35
7632859	4637581	47538	47549	47459.6	47378.8	47543.5	47419.2	124.3	118.8	129.8
7632874	4637582	47557	47545	47383.7	47406.6	47551	47395.15	155.85	161.85	149.85
7632890	4637584	47540	47546	47423.9	47345	47543	47384.45	158.55	155.55	161.55
7632908	4637577	47532	47549	47378.9	47396.8	47540.5	47387.85	152.65	144.15	161.15
7632924	4637570	47539	47550	47369.5	47359.6	47544.5	47364.55	179.95	174.45	185.45
7632939	4637570	47544	47548	47325	47389.9	47546	47357.45	188.55	186.55	190.55
7632955	4637575	47551	47548	47326.3	47368.9	47549.5	47347.6	201.9	203.4	200.4
7632969	4637575	47534	47543	47438.3	47397.3	47538.5	47417.8	120.7	116.2	125.2
7632987	4637582	47520	47534	47338.7	47349.1	47527	47343.9	183.1	176.1	190.1
7633009	4637574	47527	47533	47394.4	47378.5	47530	47386.45	143.55	140.55	146.55
7633030	4637565	47514	47532	47396.1	47548	47523	47472.05	50.95	41.95	59.95
7633048	4637563	47513	47530	47403.6	47364.4	47521.5	47384	137.5	129	146
7633066	4637553	47506	47525	47406.3	47334.7	47515.5	47370.5	145	135.5	154.5
7633085	4637550	47500	47522	47451.7	47433	47511	47442.35	68.65	57.65	79.65
7633103	4637551	47509	47521	47362	47403.5	47515	47382.75	132.25	126.25	138.25
7633124	4637559	47514	47520	47400.6	47327.2	47517	47363.9	153.1	150.1	156.1
7633140	4637559	47520	47515	47434.5	47431.7	47517.5	47433.1	84.4	86.9	81.9
7633162	4637561	47511	47513	47439.7	47518	47512	47478.85	33.15	32.15	34.15
7633182	4637558	47501	47510	47415.2	47509.3	47505.5	47462.25	43.25	38.75	47.75
7633203	4637560	47499	47510	47400.3	47357.6	47504.5	47378.95	125.55	120.05	131.05
7633225	4637555	47481	47502	47412.2	47463.8	47491.5	47438	53.5	43	64
7633243	4637557	47486	47494	47534.5	47384.4	47490	47459.45	30.55	26.55	34.55
7633268	4637552	47493	47501	47316	47440	47497	47378	119	115	123
7633287	4637561	47481	47484	47335.8	47368	47482.5	47351.9	130.6	129.1	132.1
7633313	4637562	47472	47485	47369.8	47534.7	47478.5	47452.25	26.25	19.75	32.75
7633338	4637559	47557	47514	47318.3	47413	47535.5	47365.65	169.85	191.35	148.35
7633359	4637553	47464	47475	47396.1	47521.8	47469.5	47458.95	10.55	5.05	16.05
7633383	4637551	47524	47483	47423.5	47399.9	47503.5	47411.7	91.8	112.3	71.3
7633409	4637554	47474	47484	47328.8	47380.2	47479	47354.5	124.5	119.5	129.5
7633431	4637550	47499	47485	47507	47427.4	47492	47467.2	24.8	31.8	17.8
7633447	4637540	47528	47514	47434.8	47378	47521	47406.4	114.6	121.6	107.6
7633460	4637537	47458	47441	47418.8	47452.4	47449.5	47435.6	13.9	22.4	5.4
7633491	4637542	47566	47540	47415.1	47428.7	47553	47421.9	131.1	144.1	118.1
7633521	4637553	47553	47542	47347.8	47405.2	47547.5	47376.5	171	176.5	165.5
7633540	4637562	47579	47568	47349.9	47475	47573.5	47412.45	161.05	166.55	155.55
7633579	4637578	47587	47567	47364.3	47475.1	47577	47419.7	157.3	167.3	147.3
7633600	4637579	47552	47568	47387.1	47355.4	47560	47371.25	188.75	180.75	196.75

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7633628	4637582	47600	47580	47304	47421	47590	47362.5	227.5	237.5	217.5
7633642	4637596	47591	47580	47363.1	47350.4	47585.5	47356.75	228.75	234.25	223.25
7633672	4637590	47587	47581	47372.9	47396.4	47584	47384.65	199.35	202.35	196.35
7633690	4637592	47594	47586	47380.7	47460.9	47590	47420.8	169.2	173.2	165.2
7633712	4637602	47581	47578	47400.7	47550.1	47579.5	47475.4	104.1	105.6	102.6
7633730	4637604	47594	47558	47468.5	47473.4	47576	47470.95	105.05	123.05	87.05
7633747	4637603	47582	47579	47370.6	47423.5	47580.5	47397.05	183.45	184.95	181.95
7633763	4637614	47600	47574	47459	47440.9	47587	47449.95	137.05	150.05	124.05
7633771	4637621	47582	47572	47591.9	47404.9	47577	47498.4	78.6	83.6	73.6
7633784	4637628	47522	47587	47341.4	47364.1	47554.5	47352.75	201.75	169.25	234.25
7633801	4637631	47565	47557	47523.4	47476.8	47561	47500.1	60.9	64.9	56.9
7633818	4637628	47595	47578	47514.3	47530	47586.5	47522.15	64.35	72.85	55.85
7633840	4637646	47556	47549	47531.2	47395.4	47552.5	47463.3	89.2	92.7	85.7
7633855	4637673	47544	47545	47436	47403.1	47544.5	47419.55	124.95	124.45	125.45
7633874	4637666	47549	47544	47378	47397.4	47546.5	47387.7	158.8	161.3	156.3
7633914	4637681	47539	47536	47389.1	47526.9	47537.5	47458	79.5	81	78
7633948	4637677	47542	47537	47429.5	47449.1	47539.5	47439.3	100.2	102.7	97.7
7633978	4637677	47528	47528	47356	47399.3	47528	47377.65	150.35	150.35	150.35
7634010	4637652	47529	47530	47421	47350.9	47529.5	47385.95	143.55	143.05	144.05
7634044	4637687	47538	47531	47444.7	47348.3	47534.5	47396.5	138	141.5	134.5
7634080	4637692	47533	47526	47428.1	47407.9	47529.5	47418	111.5	115	108
7634104	4637683	47527	47527	47416.9	47393.8	47527	47405.35	121.65	121.65	121.65
7634128	4637673	47536	47523	47430	47394.2	47529.5	47412.1	117.4	123.9	110.9
7634156	4637669	47537	47526	47421.7	47489.7	47531.5	47455.7	75.8	81.3	70.3
7634196	4637665	47530	47527	47513.7	47394.7	47528.5	47454.2	74.3	75.8	72.8
7634218	4637650	47529	47524	47414.7	47412.7	47526.5	47413.7	112.8	115.3	110.3
7634238	4637638	47528	47522	47428.9	47412.7	47525	47420.8	104.2	107.2	101.2
7634261	4637630	47538	47528	47534.9	47489.5	47533	47512.2	20.8	25.8	15.8
7634284	4637618	47538	47522	47391.1	47438.3	47530	47414.7	115.3	123.3	107.3
7634319	4637599	47523	47518	47431.9	47462.8	47520.5	47447.35	73.15	75.65	70.65
7634336	4637594	47528	47521	47431.9	47533.5	47524.5	47482.7	41.8	45.3	38.3
7634357	4637586	47526	47517	47452.5	47542.5	47521.5	47497.5	24	28.5	19.5
7634389	4637569	47521	47514	47568.9	47453.7	47517.5	47511.3	6.2	9.7	2.7
7634419	4637549	47545	47521	47494.4	47367	47533	47430.7	102.3	114.3	90.3
7634444	4637539	47523	47512	47494.2	47458.2	47517.5	47476.2	41.3	46.8	35.8
7634467	4637515	47521	47507	47523.2	47413.1	47514	47468.15	45.85	52.85	38.85
7634497	4637504	47521	47508	47433.2	47548.7	47514.5	47490.95	23.55	30.05	17.05
7634519	4637490	47535	47506	47390.4	47472.3	47520.5	47431.35	89.15	103.65	74.65
7634539	4637476	47542	47519	47531.4	47411.4	47530.5	47471.4	59.1	70.6	47.6
7634565	4637458	47526	47505	47540.3	47505.8	47515.5	47523.05	−7.55	2.95	−18.05
7634590	4637436	47533	47509	47455.3	47450.8	47521	47453.05	67.95	79.95	55.95
7634610	4637416	47514	47501	47481.2	47455.5	47507.5	47468.35	39.15	45.65	32.65
7634632	4637394	47524	47506	47481	47557.1	47515	47519.05	−4.05	4.95	−13.05
7634656	4637378	47516	47503	47519.7	47541	47509.5	47530.35	−20.85	−14.35	−27.35

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7634670	4637352	47519	47507	47530.1	47477.3	47513	47503.7	9.3	15.3	3.3
7634678	4637327	47535	47518	47489.4	47599.8	47526.5	47544.6	–18.1	–9.6	–26.6
7634703	4637300	47530	47507	47495.7	47405.5	47518.5	47450.6	67.9	79.4	56.4
7634730	4637282	47539	47507	47513.7	47452.8	47523	47483.25	39.75	55.75	23.75
7634746	4637265	47546	47506	47640.7	47508.4	47526	47574.55	–48.55	–28.55	–68.55
7634793	4637250	47514	47498	47463.2	47725.5	47506	47594.35	–88.35	–80.35	–96.35
7635325	4637061	47465	47474	47456.6	47457.5	47469.5	47457.05	12.45	7.95	16.95
7635343	4637048	47533	47485	47478.3	47430.6	47509	47454.45	54.55	78.55	30.55
7635359	4637030	47457	47436	47605.3	47458.3	47446.5	47531.8	–85.3	–74.8	–95.8
7635380	4637010	47485	47511	47388.1	47446.1	47498	47417.1	80.9	67.9	93.9
7635403	4636994	47554	47526	47461.1	47529.3	47540	47495.2	44.8	58.8	30.8
7635418	4636990	47515	47510	47373	47386.9	47512.5	47379.95	132.55	135.05	130.05
7635448	4636971	47566	47513	47447.6	47507.4	47539.5	47477.5	62	88.5	35.5
7635480	4636956	47541	47519	47373.3	47556.8	47530	47465.05	64.95	75.95	53.95
7635506	4636940	47558	47524	47451.7	47419.4	47541	47435.55	105.45	122.45	88.45
7635565	4636900	47540	47502	47446.8	47471.1	47521	47458.95	62.05	81.05	43.05
7635584	4636887	47499	47507	47390.8	47454.4	47503	47422.6	80.4	76.4	84.4
7635602	4636880	47571	47508	47431.7	47505.3	47539.5	47468.5	71	102.5	39.5
7635723	4636845	47532	47517	47452.8	47416.7	47524.5	47434.75	89.75	97.25	82.25
7635752	4636827	47570	47523	47462.9	47429.8	47546.5	47446.35	100.15	123.65	76.65
7635795	4636820	47480	47478	47495.8	47426	47479	47460.9	18.1	19.1	17.1
7635825	4636807	47486	47454	47343.8	47417.6	47470	47380.7	89.3	105.3	73.3
7635855	4636792	47507	47443	47496	47409.3	47475	47452.65	22.35	54.35	–9.65
7635884	4636787	47488	47466	47439.1	47437.2	47477	47438.15	38.85	49.85	27.85
7635890	4636772	47426	47375	47407.7	47497.3	47400.5	47452.5	–52	–26.5	–77.5
7635931	4636773	47496	47432	47503.2	47450.3	47464	47476.75	–12.75	19.25	–44.75
7635950	4636770	47477	47429	47439.9	47383	47453	47411.45	41.55	65.55	17.55
7635979	4636758	47630	47647	47392.9	47397	47638.5	47394.95	243.55	235.05	252.05
7635997	4636757	47640	47759	47514.9	47459.6	47699.5	47487.25	212.25	152.75	271.75
7636024	4636749	47570	47536	47379.7	47463.9	47553	47421.8	131.2	148.2	114.2
7636059	4636733	47548	47527	47445.4	47420	47537.5	47432.7	104.8	115.3	94.3
7636078	4636736	47486	47460	47469.2	47423.9	47473	47446.55	26.45	39.45	13.45
7636103	4636721	47505	47484	47384.9	47344.5	47494.5	47364.7	129.8	140.3	119.3
7636114	4636709	47541	47541	47418.5	47407.4	47541	47412.95	128.05	128.05	128.05
7636140	4636689	47487	47472	47444.9	47388.7	47479.5	47416.8	62.7	70.2	55.2
7636159	4636678	47464	47452	47421.4	47475.6	47458	47448.5	9.5	15.5	3.5
7636180	4636667	47483	47489	47425	47406.7	47486	47415.85	70.15	67.15	73.15
7636202	4636654	47465	47462	47468	47478.4	47463.5	47473.2	–9.7	–8.2	–11.2
7636213	4636644	47462	47453	47411.7	47436.6	47457.5	47424.15	33.35	37.85	28.85
7636217	4636628	47472	47456	47452.4	47512.2	47464	47482.3	–18.3	–10.3	–26.3
7636238	4636621	47457	47452	47420.8	47409.1	47454.5	47414.95	39.55	42.05	37.05
7636264	4636611	47460	47460	47405.3	47455.3	47460	47430.3	29.7	29.7	29.7
7636273	4636591	47462	47453	47429	47377.6	47457.5	47403.3	54.2	58.7	49.7
7636295	4636578	47459	47452	47378.3	47402.8	47455.5	47390.55	64.95	68.45	61.45

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7636317	4636565	47496	47482	47398.1	47422.8	47489	47410.45	78.55	85.55	71.55
7636340	4636543	47100	47262	47452.8	47413	47181	47432.9	–251.9	–332.9	–170.9
7636363	4636521	47484	47464	47491.2	47433.9	47474	47462.55	11.45	21.45	1.45
7636359	4636497	47457	47457	47422.5	47473.6	47457	47448.05	8.95	8.95	8.95
7636391	4636444	47481	47457	47386.8	47388.1	47469	47387.45	81.55	93.55	69.55
7636403	4636427	47473	47461	47412.3	47484.6	47467	47448.45	18.55	24.55	12.55
7636428	4636420	47483	47465	47412.6	47512.1	47474	47462.35	11.65	20.65	2.65
7636448	4636396	47470	47462	47485.2	47403	47466	47444.1	21.9	25.9	17.9
7636469	4636366	47478	47463	47473.4	47420.5	47470.5	47446.95	23.55	31.05	16.05
7636489	4636348	47472	47470	47580.4	47405	47471	47492.7	–21.7	–20.7	–22.7
7636523	4636331	47463	47464	47393.9	47364.2	47463.5	47379.05	84.45	83.95	84.95
7636541	4636322	47489	47472	47434.4	47483.2	47480.5	47458.8	21.7	30.2	13.2
7636565	4636308	47499	47500	47399.7	47422.1	47499.5	47410.9	88.6	88.1	89.1
7636606	4636280	47481	47464	47554.8	47419.5	47472.5	47487.15	–14.65	–6.15	–23.15
7636623	4636263	47485	47470	47374.6	47453.6	47477.5	47414.1	63.4	70.9	55.9
7636639	4636246	47495	47469	47456.4	47413.9	47482	47435.15	46.85	59.85	33.85
7636680	4636220	47481	47474	47411.5	47512.4	47477.5	47461.95	15.55	19.05	12.05
7636706	4636215	47489	47473	47540.5	47394.7	47481	47467.6	13.4	21.4	5.4
7636725	4636198	47486	47475	47369.6	47460.6	47480.5	47415.1	65.4	70.9	59.9
7636764	4636195	47482	47477	47436.7	47446.6	47479.5	47441.65	37.85	40.35	35.35
7636786	4636200	47511	47474	47452.4	47422.8	47492.5	47437.6	54.9	73.4	36.4
7636826	4636188	47505	47473	47411.3	47388.5	47489	47399.9	89.1	105.1	73.1
7635360	4640750	47728	47722	47467.3	47393.8	47725	47430.55	294.45	297.45	291.45
7635348	4640758	47746	47727	47411.4	47350.7	47736.5	47381.05	355.45	364.95	345.95
7635328	4640761	47795	47775	47455.6	47328	47785	47391.8	393.2	403.2	383.2
7635328	4640761	47709	47718	47344.6	47429.1	47713.5	47386.85	326.65	322.15	331.15
7635297	4640762	47717	47706	47419.2	47425.5	47711.5	47422.35	289.15	294.65	283.65
7636169	4641018	47594	47588	47365.4	47383.9	47591	47374.65	216.35	219.35	213.35
7636150	4641026	47611	47608	47379.4	47343	47609.5	47361.2	248.3	249.8	246.8
7636125	4641028	47617	47618	47402.4	47347.2	47617.5	47374.8	242.7	242.2	243.2
7636096	4641004	47610	47607	47341.4	47395.1	47608.5	47368.25	240.25	241.75	238.75
7636098	4640989	47579	47608	47467.7	47463.3	47593.5	47465.5	128	113.5	142.5
7636060	4640977	47624	47617	47356.9	47395.3	47620.5	47376.1	244.4	247.9	240.9
7636034	4640974	47617	47618	47460.4	47382.7	47617.5	47421.55	195.95	195.45	196.45
7636030	4640951	47618	47614	47362.9	47355.8	47616	47359.35	256.65	258.65	254.65
7635994	4640932	47639	47629	47376.7	47371.1	47634	47373.9	260.1	265.1	255.1
7635967	4640925	47629	47634	47371.3	47395.7	47631.5	47383.5	248	245.5	250.5
7635944	4640927	47602	47600	47331.7	47360.1	47601	47345.9	255.1	256.1	254.1
7635955	4640900	47623	47619	47338	47366.8	47621	47352.4	268.6	270.6	266.6
7635900	4640904	47559	47559	47420.4	47291	47559	47355.7	203.3	203.3	203.3
7635913	4640953	47574	47574	47378.7	47553.6	47574	47466.15	107.85	107.85	107.85
7635897	4640961	47570	47569	47396.6	47338.8	47569.5	47367.7	201.8	202.3	201.3
7635864	4640950	47559	47554	47373.2	47371.3	47556.5	47372.25	184.25	186.75	181.75
7635837	4640943	47539	47538	47414.3	47342.2	47538.5	47378.25	160.25	160.75	159.75

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7635810	4640930	47548	47544	47409.2	47386.2	47546	47397.7	148.3	150.3	146.3
7635770	4640922	47542	47544	47341.3	47509.2	47543	47425.25	117.75	116.75	118.75
7635744	4640919	47549	47544	47515	47357	47546.5	47436	110.5	113	108
7635711	4640904	47558	47554	47352.3	47336.1	47556	47344.2	211.8	213.8	209.8
7635676	4640880	47564	47561	47374.8	47363.6	47562.5	47369.2	193.3	194.8	191.8
7635647	4640855	47617	47607	47385.4	47443.1	47612	47414.25	197.75	202.75	192.75
7635619	4640892	47607	47603	47309.4	47364.7	47605	47337.05	267.95	269.95	265.95
7635592	4640898	47634	47620	47370.3	47391	47627	47380.65	246.35	253.35	239.35
7635540	4640918	47617	47613	47398	47409	47615	47403.5	211.5	213.5	209.5
7635480	4640919	47594	47598	47384.4	47442	47596	47413.2	182.8	180.8	184.8
7635421	4640881	47643	47639	47388.2	47363.7	47641	47375.95	265.05	267.05	263.05
7635390	4640867	47693	47687	47398.5	47448.4	47690	47423.45	266.55	269.55	263.55
7635326	4640866	47658	47659	47405.2	47392.3	47658.5	47398.75	259.75	259.25	260.25
7635288	4640880	47622	47617	47321.7	47409.8	47619.5	47365.75	253.75	256.25	251.25
7635252	4640876	47609	47604	47364	47409.9	47606.5	47386.95	219.55	222.05	217.05
7635239	4640863	47609	47607	47439.2	47387.5	47608	47413.35	194.65	195.65	193.65
7635213	4640833	47583	47589	47370.2	47370.9	47586	47370.55	215.45	212.45	218.45
7635194	4640812	47561	47564	47439.6	47367.3	47562.5	47403.45	159.05	157.55	160.55
7635168	4640789	47553	47554	47362.5	47381	47553.5	47371.75	181.75	181.25	182.25
7635152	4640762	47573	47569	47409.7	47484.7	47571	47447.2	123.8	125.8	121.8
7635139	4640738	47566	47558	47374	47416	47562	47395	167	171	163
7635115	4640725	47551	47548	47372.2	47334.2	47549.5	47353.2	196.3	197.8	194.8
7635096	4640714	47555	47544	47368.5	47389.1	47549.5	47378.8	170.7	176.2	165.2
7635082	4640695	47543	47539	47395.7	47442.1	47541	47418.9	122.1	124.1	120.1
7635056	4640701	47639	47639	47368.8	47374.6	47639	47371.7	267.3	267.3	267.3
7635023	4640709	47529	47527	47407.4	47416.4	47528	47411.9	116.1	117.1	115.1
7635023	4640709	47529	47528	47357.2	47319	47528.5	47338.1	190.4	190.9	189.9
7635130	4640725	47548	47550	47389.1	47360.3	47549	47374.7	174.3	173.3	175.3
7635154	4640695	47574	47570	47415.1	47454.6	47572	47434.85	137.15	139.15	135.15
7635150	4640664	47468	47569	47389.4	47321.9	47518.5	47355.65	162.85	112.35	213.35
7635176	4640649	47583	47580	47477.2	47352.6	47581.5	47414.9	166.6	168.1	165.1
7635174	4640609	47577	47570	47377.3	47414.5	47573.5	47395.9	177.6	181.1	174.1
7635106	4640667	47654	47549	47416.7	47438.9	47601.5	47427.8	173.7	226.2	121.2
7635077	4640630	47551	47549	47388.7	47411.2	47550	47399.95	150.05	151.05	149.05
7635038	4640558	47539	47534	47380.8	47386.5	47536.5	47383.65	152.85	155.35	150.35
7634989	4640544	47543	47534	47400.8	47436.3	47538.5	47418.55	119.95	124.45	115.45
7634956	4640529	47543	47531	47401.8	47422.3	47537	47412.05	124.95	130.95	118.95
7634906	4640519	47549	47539	47406	47390.4	47544	47398.2	145.8	150.8	140.8
7634835	4640491	47560	47548	47355	47376.1	47554	47365.55	188.45	194.45	182.45
7634794	4640470	47556	47538	47424	47389.6	47547	47406.8	140.2	149.2	131.2
7634725	4640457	47579	47550	47341	47348.4	47564.5	47344.7	219.8	234.3	205.3
7634685	4640456	47556	47549	47415.9	47376.6	47552.5	47396.25	156.25	159.75	152.75
7634656	4640490	47542	47538	47357.9	47388.1	47540	47373	167	169	165
7634622	4640497	47541	47533	47379.7	47505.2	47537	47442.45	94.55	98.55	90.55

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7634648	4637491	47495	47494	47432.8	47515.4	47494.5	47474.1	20.4	20.9	19.9
7634649	4637542	47494	47495	47387	47483.4	47494.5	47435.2	59.3	58.8	59.8
7634652	4637591	47490	47492	47392.2	47521.6	47491	47456.9	34.1	33.1	35.1
7634653	4637630	47511	47506	47492.4	47624	47508.5	47558.2	–49.7	–47.2	–52.2
7634651	4637665	47497	47499	47508.5	47537.7	47498	47523.1	–25.1	–26.1	–24.1
7634651	4637730	47501	47503	47462.6	47450.5	47502	47456.55	45.45	44.45	46.45
7634665	4637771	47489	47494	47433	47455	47491.5	47444	47.5	45	50
7634655	4637799	47504	47504	47493.9	47533.1	47504	47513.5	–9.5	–9.5	–9.5
7634655	4637849	47516	47516	47580.3	47491.5	47516	47535.9	–19.9	–19.9	–19.9
7634656	4637892	47513	47511	47584.5	47465.6	47512	47525.05	–13.05	–12.05	–14.05
7634664	4637969	47510	47513	47649.2	47629.9	47511.5	47639.55	–128.05	–129.55	–126.55
7634652	4638038	47514	47513	47516.3	47500.2	47513.5	47508.25	5.25	5.75	4.75
7634670	4638082	47516	47512	47509.9	47626	47514	47567.95	–53.95	–51.95	–55.95
7634644	4638269	47521	47518	47755.4	47463.7	47519.5	47609.55	–90.05	–88.55	–91.55
7634634	4638313	47494	47501	47617.6	47538.9	47497.5	47578.25	–80.75	–84.25	–77.25
7634625	4638364	47496	47500	47483.4	47563.9	47498	47523.65	–25.65	–27.65	–23.65
7634651	4638409	47490	47498	47628.5	47664	47494	47646.25	–152.25	–156.25	–148.25
7634649	4638425	47500	47502	47672.3	47553.7	47501	47613	–112	–113	–111
7634648	4638471	47512	47517	47552.3	47754.4	47514.5	47653.35	–138.85	–141.35	–136.35
7634640	4638554	47505	47507	47618.9	47575.4	47506	47597.15	–91.15	–92.15	–90.15
7634636	4638591	47507	47510	47581.9	47640	47508.5	47610.95	–102.45	–103.95	–100.95
7634651	4638668	47515	47514	47561	47771.8	47514.5	47666.4	–151.9	–151.4	–152.4
7634661	4638752	47518	47518	47480.1	47666.7	47518	47573.4	–55.4	–55.4	–55.4
7634668	4638782	47517	47512	47621.1	47608.7	47514.5	47614.9	–100.4	–97.9	–102.9
7634651	4638809	47528	47527	47764.2	47674.6	47527.5	47719.4	–191.9	–191.4	–192.4
7634651	4638868	47519	47520	47862.6	47702.8	47519.5	47782.7	–263.2	–263.7	–262.7
7634652	4638966	47522	47525	47758.9	47707.7	47523.5	47733.3	–209.8	–211.3	–208.3
7634652	4639014	47525	47527	47764.5	47648.3	47526	47706.4	–180.4	–181.4	–179.4
7634652	4639064	47517	47521	47622.3	47751.8	47519	47687.05	–168.05	–170.05	–166.05
7634651	4639127	47549	47529	47761.3	47721.8	47539	47741.55	–202.55	–192.55	–212.55
7634699	4639269	47524	47522	47766.6	47769.2	47523	47767.9	–244.9	–243.9	–245.9
7634727	4639373	47520	47522	47643.3	47764.8	47521	47704.05	–183.05	–184.05	–182.05
7634734	4639423	47524	47528	47658.4	47746.2	47526	47702.3	–176.3	–178.3	–174.3
7634682	4639456	47536	47524	47694.1	47604.1	47530	47649.1	–119.1	–113.1	–125.1
7634661	4639536	47529	47530	47681.5	47741.6	47529.5	47711.55	–182.05	–182.55	–181.55
7634751	4639571	47529	47529	47681.6	47761.9	47529	47721.75	–192.75	–192.75	–192.75
7634748	4639595	47534	47532	47915.1	47697.1	47533	47806.1	–273.1	–272.1	–274.1
7634654	4639643	47540	47540	48173.8	47599.3	47540	47886.55	–346.55	–346.55	–346.55
7634661	4639701	47530	47529	47850.5	47729.8	47529.5	47790.15	–260.65	–260.15	–261.15
7634645	4639765	47542	47539	47736.8	47742	47540.5	47739.4	–198.9	–197.4	–200.4
7634652	4639832	47528	47529	47666.2	47738.8	47528.5	47702.5	–174	–174.5	–173.5
7634648	4639917	47546	47546	47777.2	47648.1	47546	47712.65	–166.65	–166.65	–166.65
7634658	4636971	47533	47536	47686.1	47726.7	47534.5	47706.4	–171.9	–173.4	–170.4
7634650	4640029	47534	47533	47855	47775	47533.5	47815	–281.5	–281	–282

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7634652	4640075	47541	47545	47712	47728.2	47543	47720.1	–177.1	–179.1	–175.1
7634650	4640183	47553	47548	47713.9	47717.5	47550.5	47715.7	–165.2	–162.7	–167.7
7634890	4640214	47538	47542	47902.7	47686.9	47540	47794.8	–254.8	–256.8	–252.8
7635064	4640301	47560	47549	47633.8	47719.3	47554.5	47676.55	–122.05	–116.55	–127.55
7635166	4640326	47556	47548	47818.3	47683.1	47552	47750.7	–198.7	–194.7	–202.7
7635170	4640266	47574	47546	47649.4	47658	47560	47653.7	–93.7	–79.7	–107.7
7635171	4640236	47562	47546	47727.6	47761	47554	47744.3	–190.3	–182.3	–198.3
7635184	4640145	47593	47546	47754.3	47588.8	47569.5	47671.55	–102.05	–78.55	–125.55
7635172	4640092	47580	47553	47739.5	47604.5	47566.5	47672	–105.5	–92	–119
7635173	4640038	47561	47543	47668.5	47606.9	47552	47637.7	–85.7	–76.7	–94.7
7635172	4639990	47572	47543	47705.9	47601.8	47557.5	47653.85	–96.35	–81.85	–110.85
7635166	4639964	47536	47540	47659.6	47778.8	47538	47719.2	–181.2	–183.2	–179.2
7635153	4639916	47534	47537	47753.8	47659.1	47535.5	47706.45	–170.95	–172.45	–169.45
7635204	4639908	47528	47530	47807.5	47562.9	47529	47685.2	–156.2	–157.2	–155.2
7635204	4639908	47521	47529	47593.7	47621.9	47525	47607.8	–82.8	–86.8	–78.8
7635201	4639862	47555	47536	47697.7	47657	47545.5	47677.35	–131.85	–122.35	–141.35
7635235	4639821	47559	47546	47595.2	47624.4	47552.5	47609.8	–57.3	–50.8	–63.8
7635284	4639809	47544	47540	47604.3	47689.9	47542	47647.1	–105.1	–103.1	–107.1
7635283	4639795	47532	47535	47542.7	47570.4	47533.5	47556.55	–23.05	–24.55	–21.55
7635256	4639773	47566	47532	47625.1	47630.4	47549	47627.75	–78.75	–61.75	–95.75
7635208	4639754	47535	47541	47705.7	47646.8	47538	47676.25	–138.25	–141.25	–135.25
7635185	4639726	47534	47538	47741.9	47642.1	47536	47692	–156	–158	–154
7635170	4639704	47578	47547	47621	47651.1	47562.5	47636.05	–73.55	–58.05	–89.05
7635172	4639667	47544	47547	47619.2	47570.7	47545.5	47594.95	–49.45	–50.95	–47.95
7635166	4639626	47542	47546	47653.6	47640.7	47544	47647.15	–103.15	–105.15	–101.15
7635166	4639581	47563	47542	47592.2	47567.9	47552.5	47580.05	–27.55	–17.05	–38.05
7635172	4639548	47564	47544	47679.4	47561.7	47554	47620.55	–66.55	–56.55	–76.55
7635144	4639500	47560	47554	47519.7	47741.2	47557	47630.45	–73.45	–70.45	–76.45
7635136	4639474	47545	47536	47622.9	47735.8	47540.5	47679.35	–138.85	–134.35	–143.35
7635141	4639459	47548	47539	47669.2	47652.2	47543.5	47660.7	–117.2	–112.7	–121.7
7635146	4639436	47548	47540	47596	47568.8	47544	47582.4	–38.4	–34.4	–42.4
7635131	4639371	47591	47550	47595.7	47584	47570.5	47589.85	–19.35	1.15	–39.85
7635172	4639296	47570	47551	47545.7	47504.7	47560.5	47525.2	35.3	44.8	25.8
7635173	4639218	47565	47555	47561.4	47515.2	47560	47538.3	21.7	26.7	16.7
7635173	4639136	47559	47550	47712	47505.6	47554.5	47608.8	–54.3	–49.8	–58.8
7635175	4639097	47565	47548	47539.3	47537.8	47556.5	47538.55	17.95	26.45	9.45
7635154	4639065	47558	47549	47589.5	47643	47553.5	47616.25	–62.75	–58.25	–67.25
7635170	4638966	47567	47552	47568.8	47601.2	47559.5	47585	–25.5	–18	–33
7635171	4638931	47579	47550	47564.4	47550.3	47564.5	47557.35	7.15	21.65	–7.35
7635170	4638888	47587	47552	47607.7	47430.7	47569.5	47519.2	50.3	67.8	32.8
7635169	4638842	47546	47544	47599.4	47475.6	47545	47537.5	7.5	8.5	6.5
7635150	4638798	47606	47543	47603.4	47564.9	47574.5	47584.15	–9.65	21.85	–41.15
7635172	4638783	47566	47545	47494.6	47472.9	47555.5	47483.75	71.75	82.25	61.25
7635211	4638738	47548	47547	47467.9	47529.4	47547.5	47498.65	48.85	49.35	48.35

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7635304	4638816	47594	47554	47527.4	47495.2	47574	47511.3	62.7	82.7	42.7
7635339	4638775	47586	47557	47486.1	47627.5	47571.5	47556.8	14.7	29.2	0.2
7635328	4638725	47569	47551	47639	47528.6	47560	47583.8	−23.8	−14.8	−32.8
7635292	4638688	47555	47545	47603.4	47584.1	47550	47593.75	−43.75	−38.75	−48.75
7635244	4638612	47533	47544	47436.7	47427.3	47538.5	47432	106.5	101	112
7635214	4638678	47551	47543	47432.7	47473.7	47547	47453.2	93.8	97.8	89.8
7635173	4638662	47596	47542	47456.8	47607.1	47569	47531.95	37.05	64.05	10.05
7635154	4638635	47556	47543	47568.3	47461.4	47549.5	47514.85	34.65	41.15	28.15
7635295	4638674	47559	47544	47480.2	47512.6	47551.5	47496.4	55.1	62.6	47.6
7635381	4638686	47571	47563	47518.5	47573.7	47567	47546.1	20.9	24.9	16.9
7635428	4638689	47572	47569	47490	47515.2	47570.5	47502.6	67.9	69.4	66.4
7635233	4638193	47562	47542	47597.8	47597.8	47552	47597.8	−45.8	−35.8	−55.8
7635220	4638159	47561	47530	47456.1	47482.9	47545.5	47469.5	76	91.5	60.5
7635194	4638126	47562	47535	47545.5	47440.6	47548.5	47493.05	55.45	68.95	41.95
7635180	4638075	47555	47544	47604.8	47440.5	47549.5	47522.65	26.85	32.35	21.35
7635200	4638028	47550	47540	47749.1	47432.5	47545	47590.8	−45.8	−40.8	−50.8
7635225	4637968	47560	47547	47458.8	47543.6	47553.5	47501.2	52.3	58.8	45.8
7635261	4637939	47544	47545	47436.5	47414.9	47544.5	47425.7	118.8	118.3	119.3
7635266	4637898	47540	47536	47465.9	47543.2	47538	47504.55	33.45	35.45	31.45
7635238	4637814	47560	47536	47449.8	47432.1	47548	47440.95	107.05	119.05	95.05
7635210	4637760	47556	47529	47493	47448.5	47542.5	47470.75	71.75	85.25	58.25
7635178	4637728	47528	47526	47477.4	47449	47527	47463.2	63.8	64.8	62.8
7635130	4637683	47529	47528	47435.7	47439.6	47528.5	47437.65	90.85	91.35	90.35
7635089	4637637	47535	47532	47535.5	47486.9	47533.5	47511.2	22.3	23.8	20.8
7635041	4637582	47514	47521	47506.4	47486.9	47517.5	47496.65	20.85	17.35	24.35
7633971	4640566	47514	47516	47433.9	47438.5	47515	47436.2	78.8	77.8	79.8
7633971	4640541	47515	47515	47524.1	47431.4	47515	47477.75	37.25	37.25	37.25
7633971	4640516	47514	47514	47497.1	47438.3	47514	47467.7	46.3	46.3	46.3
7633971	4640491	47522	47523	47432.3	47436.2	47522.5	47434.25	88.25	87.75	88.75
7633971	4640466	47524	47523	47441.7	47442.1	47523.5	47441.9	81.6	82.1	81.1
7633971	4640441	47530	47528	47444	47436.1	47529	47440.05	88.95	89.95	87.95
7633971	4640416	47525	47524	47435.8	47427.4	47524.5	47431.6	92.9	93.4	92.4
7633971	4640391	47515	47516	47435.8	47427.4	47515.5	47431.6	83.9	83.4	84.4
7633971	4640366	47522	47522	47435.4	47435.2	47522	47435.3	86.7	86.7	86.7
7633971	4640341	47523	47520	47436.6	47443	47521.5	47439.8	81.7	83.2	80.2
7633971	4640319	47539	47535	47441.1	47435	47537	47438.05	98.95	100.95	96.95
7633971	4640291	47521	47524	47430.7	47435.6	47522.5	47433.15	89.35	87.85	90.85
7633971	4640241	47523	47524	47438.9	47449.1	47523.5	47444	79.5	79	80
7633971	4640216	47530	47529	47441.3	47441.3	47529.5	47441.3	88.2	88.7	87.7
7633971	4640191	47520	47522	47439.1	47445.2	47521	47442.15	78.85	77.85	79.85
7633971	4640166	47523	47522	47431.6	47447.9	47522.5	47439.75	82.75	83.25	82.25
7633971	4640141	47523	47523	47440	47428.4	47523	47434.2	88.8	88.8	88.8
7633971	4640116	47521	47521	47429.1	47441.6	47521	47435.35	85.65	85.65	85.65
7633971	4640091	47523	47523	47449.3	47435.2	47523	47442.25	80.75	80.75	80.75

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7633971	4640066	47522	47520	47444.5	47445.5	47521	47445	76	77	75
7633971	4640041	47521	47521	47444.5	47445.5	47521	47445	76	76	76
7633971	4640016	47523	47522	47439.7	47442	47522.5	47440.85	81.65	82.15	81.15
7633971	4639991	47526	47525	47441.9	47428.9	47525.5	47435.4	90.1	90.6	89.6
7633971	4639966	47531	47530	47446.2	47444.8	47530.5	47445.5	85	85.5	84.5
7633971	4639941	47529	47530	47446.2	47444.8	47529.5	47445.5	84	83.5	84.5
7633971	4639916	47532	47530	47442.3	47423.8	47531	47433.05	97.95	98.95	96.95
7633971	4639891	47526	47525	47441.7	47436.1	47525.5	47438.9	86.6	87.1	86.1
7633971	4639866	47528	47527	47441.7	47436.1	47527.5	47438.9	88.6	89.1	88.1
7633971	4639841	47525	47523	47443.3	47441.2	47524	47442.25	81.75	82.75	80.75
7633971	4639816	47529	47528	47430.5	47448	47528.5	47439.25	89.25	89.75	88.75
7633971	4639791	47523	47522	47442.2	47439.5	47522.5	47440.85	81.65	82.15	81.15
7633971	4639766	47527	47523	47452.5	47447.3	47525	47449.9	75.1	77.1	73.1
7633971	4639741	47521	47521	47443.1	47442	47521	47442.55	78.45	78.45	78.45
7633971	4639716	47518	47517	47450.5	47445.7	47517.5	47448.1	69.4	69.9	68.9
7633971	4639695	47520	47523	47438.4	47448.4	47521.5	47443.4	78.1	76.6	79.6
7633971	4639638	47502	47497	47453.5	47439.9	47499.5	47446.7	52.8	55.3	50.3
7633971	4639616	47517	47516	47437	47451.2	47516.5	47444.1	72.4	72.9	71.9
7633971	4639591	47507	47506	47444.7	47440.6	47506.5	47442.65	63.85	64.35	63.35
7633963	4639566	47517	47516	47455.9	47441.6	47516.5	47448.75	67.75	68.25	67.25
7633971	4639541	47522	47522	47438	47439.7	47522	47438.85	83.15	83.15	83.15
7633971	4639516	47526	47525	47445.7	47450.7	47525.5	47448.2	77.3	77.8	76.8
7633971	4639491	47522	47523	47447.9	47436.9	47522.5	47442.4	80.1	79.6	80.6
7633971	4639466	47528	47528	47453.9	47446.3	47528	47450.1	77.9	77.9	77.9
7633971	4639441	47528	47529	47451.2	47447.2	47528.5	47449.2	79.3	78.8	79.8
7633971	4639416	47526	47523	47442.6	47452.6	47524.5	47447.6	76.9	78.4	75.4
7633971	4639341	47515	47522	47451.7	47450.4	47518.5	47451.05	67.45	63.95	70.95
7634011	4639166	47519	47517	47441.7	47449.1	47518	47445.4	72.6	73.6	71.6
7634021	4639141	47536	47535	47449.8	47438.9	47535.5	47444.35	91.15	91.65	90.65
7634031	4639116	47530	47527	47449.2	47449	47528.5	47449.1	79.4	80.9	77.9
7634042	4639091	47513	47514	47444	47435.8	47513.5	47439.9	73.6	73.1	74.1
7634055	4639066	47515	47517	47449	47456.6	47516	47452.8	63.2	62.2	64.2
7633971	4639041	47515	47513	47450.7	47448	47514	47449.35	64.65	65.65	63.65
7633971	4639016	47529	47528	47453.7	47455	47528.5	47454.35	74.15	74.65	73.65
7633971	4638966	47529	47528	47445.5	47451.9	47528.5	47448.7	79.8	80.3	79.3
7633971	4638941	47528	47521	47455.1	47451.8	47524.5	47453.45	71.05	74.55	67.55
7633971	4638916	47519	47521	47454.9	47443.9	47520	47449.4	70.6	69.6	71.6
7633971	4638891	47519	47518	47449.3	47446.4	47518.5	47447.85	70.65	71.15	70.15
7633971	4638866	47519	47519	47448	47456.9	47519	47452.45	66.55	66.55	66.55
7633971	4638841	47503	47502	47448	47449.6	47502.5	47448.8	53.7	54.2	53.2
7633971	4638816	47521	47532	47451.6	47454	47526.5	47452.8	73.7	68.2	79.2
7633971	4638791	47523	47521	47452.3	47454	47522	47453.15	68.85	69.85	67.85
7633971	4638716	47519	47517	47449.3	47449.8	47518	47449.55	68.45	69.45	67.45
7633971	4638691	47519	47519	47443.7	47457.7	47519	47450.7	68.3	68.3	68.3

y	x	M1	M2	dv1	dv2	ΔM1M2	ΔDV	ΔDV, ΔM1M2	m1ΔDV	m2ΔV
7633957	4638666	47518	47517	47454.3	47445.8	47517.5	47450.05	67.45	67.95	66.95
7633971	4638641	47519	47518	47452.3	47459.5	47518.5	47455.9	62.6	63.1	62.1
7633971	4638616	47513	47514	47449.5	47449.1	47513.5	47449.3	64.2	63.7	64.7
7633971	4638591	47511	47512	47455.9	47448.2	47511.5	47452.05	59.45	58.95	59.95
7633958	4638570	47511	47510	47456.5	47451.5	47510.5	47454	56.5	57	56
7633971	4638541	47511	47511	47449.4	47449.3	47511	47449.35	61.65	61.65	61.65
7633971	4638516	47514	47512	47443.9	47453	47513	47448.45	64.55	65.55	63.55
7633971	4638491	47519	47516	47445.9	47453.1	47517.5	47449.5	68	69.5	66.5
7633971	4638466	47513	47512	47452.6	47448.3	47512.5	47450.45	62.05	62.55	61.55
7633971	4638441	47512	47513	47450.1	47461.1	47512.5	47455.6	56.9	56.4	57.4
7633971	4638416	47509	47509	47449	47449.7	47509	47449.35	59.65	59.65	59.65
7633971	4638391	47526	47526	47455.6	47451	47526	47453.3	72.7	72.7	72.7
7633971	4638366	47518	47518	47456.6	47453.1	47518	47454.85	63.15	63.15	63.15
7633971	4638341	47527	47527	47462.5	47451.4	47527	47456.95	70.05	70.05	70.05
7633971	4638316	47531	47530	47456.4	47445.2	47530.5	47450.8	79.7	80.2	79.2
7633971	4638291	47534	47532	47451.2	47462	47533	47456.6	76.4	77.4	75.4
7633971	4638266	47533	47532	47451.2	47462	47532.5	47456.6	75.9	76.4	75.4
7633971	4638241	47533	47533	47459.6	47458	47533	47458.8	74.2	74.2	74.2
7633971	4638216	47541	47539	47452.6	47454.1	47540	47453.35	86.65	87.65	85.65
7633971	4638191	47533	47533	47440.8	47450.3	47533	47445.55	87.45	87.45	87.45
7633971	4638166	47540	47540	47448.3	47469.1	47540	47458.7	81.3	81.3	81.3
7633971	4638141	47541	47538	47457.9	47458.9	47539.5	47458.4	81.1	82.6	79.6
7633971	4638116	47544	47543	47457.9	47458.9	47543.5	47458.4	85.1	85.6	84.6
7633971	4638091	47537	47538	47440.7	47453.3	47537.5	47447	90.5	90	91
7633971	4638066	47541	47542	47457.1	47460.8	47541.5	47458.95	82.55	82.05	83.05
7633971	4638041	47539	47537	47452.9	47460.1	47538	47456.5	81.5	82.5	80.5
7633971	4638016	47537	47538	47452.9	47460.1	47537.5	47456.5	81	80.5	81.5
7633971	4637991	47538	47537	47457.6	47455.9	47537.5	47456.75	80.75	81.25	80.25
7633971	4637966	47539	47538	47458.3	47456	47538.5	47457.15	81.35	81.85	80.85
7633963	4637941	47531	47531	47450.6	47452.3	47531	47451.45	79.55	79.55	79.55
7633971	4637916	47524	47530	47458.8	47450.7	47527	47454.75	72.25	69.25	75.25
7633971	4637891	47520	47521	47452	47446.6	47520.5	47449.3	71.2	70.7	71.7
7633971	4637866	47518	47518	47453.6	47453.6	47518	47453.6	64.4	64.4	64.4
7633971	4637841	47514	47519	47458.6	47454.3	47516.5	47456.45	60.05	57.55	62.55
7633971	4637816	47528	47528	47458.6	47454.3	47528	47456.45	71.55	71.55	71.55
7633971	4637791	47532	47530	47449.3	47453.8	47531	47451.55	79.45	80.45	78.45
7633971	4637766	47509	47508	47459.8	47452.9	47508.5	47456.35	52.15	52.65	51.65
7633971	4637741	47530	47529	47454.4	47458.5	47529.5	47456.45	73.05	73.55	72.55
7633971	4637716	47519	47517	47443.2	47464.8	47518	47454	64	65	63
7633971	4637666	47517	47517	47456.6	47453.3	47517	47454.95	62.05	62.05	62.05
7633971	4637641	47520	47520	47453.4	47456.3	47520	47454.85	65.15	65.15	65.15

M1– measurement on 1 m above the ground; M2 – measurement on 2 m above the ground; dv1 – daily variation on the terrain, dv2 – daily variation on the mount of Plačovica; ΔM1M2 – mean value from M1 and M2; ΔDV – mean value of daily variation; ΔDV,ΔM1M2 – model with mean values; m1ΔDV – model on measurement on 1 m with mean daily variation; m2ΔDV – model on measurement on 2 m with mean daily variation.

REFERENCES

[1] Fauzi Yul Chaidir, Okta Dwi Puspita, Gilvandro Rumahorbo, Hafiz Hamdalah (2021): Analysis of geomagnetic and geoelectric data to identify the potential of gold deposits (case study: Randu Kuning, Wonogiri, Central Java). *IOP Conf. Series: Earth and Environmental Science* **830** (2021) 012052. DOI:10.1088/1755-1315/830/1/012052

[2] *Interpreter of the Geological Map of the Republic of Macedonia,* sheet Delčevo, 1 : 100 000.

[3] *Geological Map of the Republic of Macedonia,* sheet Delčevo, 1 : 100 000.

[4] Stefanova, V., Aleksandrov, M., Serafimovski, T., Tasev, G., Mirčovski, V. (2016): Results of the preliminary gold prospecting tests in the alluvium of Pekljanska Reka, Vinica. *Special Issue of Geologica Macedonica*, **4** (2). pp. 635–642.

[5] Alarifi, S. S., Kellogg, J. N., Ibrahim, E. (2020): Gravity, aeromagnetic and electromagnetic study of the gold and pyrite mineralized zones in the Haile mine area, Kershaw, South Carolina. *Journal of Applied Geophysics*, Vol. **178**, Pages 104044

[6] Gobashy, M. M., Abbas, E. A. S., Soliman, K. S. et al. (2022): Mapping of gold mineralization using an integrated interpretation of geological and geophysical data–a case study from West Baranes, South-Eastern Desert, Egypt. *Arab J Geosci* **15**, 1692. https://doi.org/10.1007/s12517-022-10955-0

[7] Magnetometer – Space Instrumentation and Observation (I) syllabus (2011): IRSL Ionospheric Radio Science Laboratory, Taiwan.

[8] Auster, Hans Ulrich (2008): How to measure Earth's magnetic field, *Physics Today* **61**, 2, 76. https://doi.org/10.1063/1.2883919

Р е з и м е

ГЕОМАГНЕТНИ ИСТРАЖУВАЊА ВО ИСТОЧНИОТ ДЕЛ НА РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

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Клучни зборови: геомагнетизам; аномалија; злато; наоѓалиште; анализа

Република Северна Македонија, според досегашните сознанија, има наоѓалишта на злато кои биле експлоатирани во минатото. Постоењето на современи геофизички методи, особено магнетометри со висока прецизност, дава релативно лесна и многу ефикасна можност за дефинирање на простирањето на алувијалните тераси, не само над постојните реки, туку и во старите речни корита. За да се дефинираат најперспективните области за детално истражува-

ње, се зема предвид дека златото и придружните тешки метали кои се од интерес за експлоатација се немагнетни, речиси секогаш парагенетски, и дека кај нив е присутен магнетит. Магнетитот како минерал има највисоко магнетно ниво, според тоа е лесно забележлив. Областите со регистрирани аномалии треба да се истражат со овој метод и со дупчење за да се дефинира длабочината на рудата.