THE DISTRIBUTION OF GEOMAGNETIC FIELD COMPONENTS ON THE SOUTHERN PART OF THE KOREAN PENINSULA FOR EPOCH 2010.0

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ABSTRACT

NGII(National Geography Information Institute) of Korea consigned KIGAM(Korea Institute of Geoscience & Mineral Resources) to do absolute geomagnetic measurements on 32 geomagnetic repeat stations evenly distributed on the southern part of Korean Peninsula in the year 2010 and to produce geomagnetic field components' distribution maps for the year 2010.0. The result of the processing of the measured data, i. e., the geomagnetic field components' distribution, shows a near similarity with that calculated from IGRF-11 although the latter was processed without any real geomagnetic data measured on the Korean Peninsula as an input. This implies that we installed the repeat stations on sites with good geomagnetic conditions and that our result in accordance with the IGRF represents well the regional distribution trend, i. e., it is dominated by relatively long wavelength components.

Keywords : Geomagnetism, Declination, Inclination, Total magnetic intensity, Distribution, Korean Peninsula

1 INTRODUCTION

In the year 2010, NGII (National Geography Information Institute) of Korea consigned KIGAM (Korea Institute of Geoscience & Mineral Resources) to do an absolute geomagnetic measurement project. The core work of the absolute geomagnetic measurement project was to do a new set of absolute geomagnetic measurements in 2010 on 32 geomagnetic repeat stations evenly distributed on the southern part of the Korean Peninsula, to analyze the measured data, and to produce geomagnetic field components' distribution maps for the year 2010.0, i. e., declination, inclination, and total magnetic intensity.

The activities and the results are described so that they can be used not only for the present purpose of putting the declination components on 1 : 50000 scale morphology sheets but also for future purposes, such as planning the installation of a continuous geomagnetic observatory by NGII.

2 ABSOLUTE GEOMAGNETIC MEASUREMENT ON 32 GEOMAGNETIC REPEAT STATIONS

2.1 Repeat stations and a geomagnetic observatory

Figure 1 shows the distribution of 32 geomagnetic repeat stations evenly distributed on the southern part of the Korean Peninsula. The location of the Cheongyang (CYN) Geomagnetic Observatory is also marked on the map, of which the continuously measured variation data were used for the reduction of the absolute geomagnetic measurement data. A report to IAGA about the details of this observatory is in preparation.

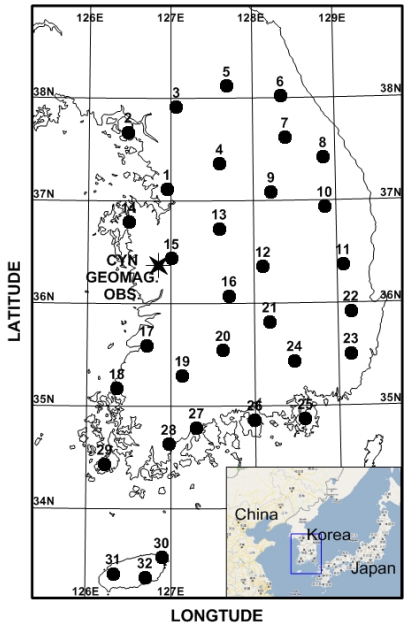

Figure 1. Location of the repeat stations (filled circles) and the reference geomagnetic observatory (filled cross).

2.2 Magnetic exploration around the site to ensure geomagnetic cleanness

It is required that a geomagnetic repeat station should be installed on a site without any considerably high artificial or natural magnetic anomaly so that the site can represent the regional or long wavelength components of the geomagnetic field. When NGII installed the repeat stations prior to 2000, they did not execute a magnetic exploration around the potential site to estimate the existence of any unwanted geomagnetic anomalies nearby. Therefore, we conducted magnetic exploration around all 32 repeat stations with a G-858 magnetometer made by the Geometrics Co. and/or a GSM-19 magnetometer made by the GEM Systems Co. with 2 sensors each. As a result of the magnetic exploration, we moved 9 stations to other geomagnetically clean places. Figure 2 shows an example of a magnetic exploration result around repeat station number 16, the total magnetic intensity distribution.

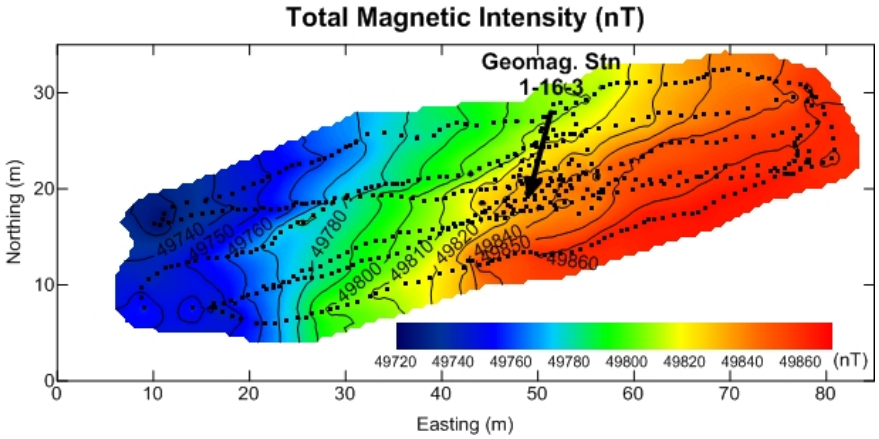

Figure 2. An example of a magnetic exploration result around the site (repeat station number 16), total magnetic intensity distribution.

2.3 Continuous magnetic measurement on repeat stations

We conducted continuous magnetic intensity measurements 1.5 m above all repeat stations for about half an hour for two purposes. One was to derive the difference in total magnetic intensity between the repeat station and the Cheongyang (CYN) Geomagnetic Observatory, of which the continuous measurement data will be used as the reference in this whole project. The other purpose was to find the standard deviation of the time series of

any differences. Figure 3 is an example of a continuous magnetic measurement result on the repeat station number 14 showing that the total magnetic intensity at the station is greater than that at the reference geomagnetic observatory at 568.24 nT and the standard deviation of the difference is 0.104 nT.

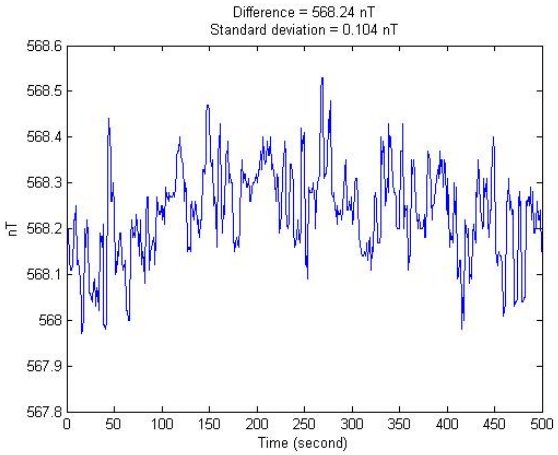

Figure 3. An example of the differences between continuous magnetic measurements at repeat station number 14 and the CYN Observatory

2.4 Absolute geomagnetic measurement in 2010

We conducted at least five sessions of absolute geomagnetic measurement on each repeat station to derive statistically credible baseline values on each geomagnetic component, i. e., declination, horizontal, and vertical components. Table 1 shows an example of absolute measurement data and the reduced baseline values to be used for further processing. As the baseline of declination at the first session seemed to be an outlier, we selected baselines by averaging each baseline of the next 5 sessions.

Table 1. An example (station no. 18) of absolute measurement data and the reduced baseline values

Session	Declin	Inclin	Corrected Total	Hbase(nT)	Dbase(nT)	Zbase(nT)	Dbase(deg)
2010-10-11-1	-7.3616	51.1182	49789.62	31246.22	-3632.63	37462.49	-6.6762
2010-10-11-2	-7.3377	51.1169	49789.37	31245.77	-3622.51	37462.76	-6.6576
2010-10-11-3	-7.3330	51.1150	49788.24	31246.30	-3622.08	37462.17	-6.6567
2010-10-11-4	-7.3325	51.1132	49784.32	31246.34	-3622.23	37460.94	-6.6570
2010-10-11-5	-7.3273	51.1106	49779.39	31246.89	-3619.40	37459.37	-6.6516
2010-10-11-6	-7.3383	51.1096	49775.34	31245.99	-3623.24	37458.77	-6.6589
Selected baseline				31246.19		37460.78	-6.6564

3 ANALYSIS AND MAPPING OF THE NEWLY MEASURED DATA IN THE YEAR 2010

We developed some computer programs to compute the daily and the monthly averaged data of declination, inclination, and total magnetic intensity at the Cheongyang Geomagnetic Observatory, and finally, we calculated the geomagnetic field components at the reference observatory, i. e., declination, inclination, and total magnetic intensity for epoch 2010.0, by combining the baseline determined from the periodically measured absolute geomagnetic data on the absolute pillar of the observatory and the continuous variation recordings automatically measured in the observatory and by averaging calculated components for each of the 15 days before and after 2010.0.

Assuming that the variation trend on the repeat stations and that on the reference observatory are almost coincident in some extent, we also reduced the baseline values of each repeat station to epoch 2010.0 and then calculated the geomagnetic field components of the repeat stations for epoch 2010.0. Table 2 shows the calculated geomagnetic field components of the repeat stations for epoch 2010.0.

Table 2. Calculated geomagnetic field components of the repeat stations for epoch 2010.0

st. no.	epoch (yr)	long (E, deg.)	lat (N, deg.)	intens. (nT)	decl. (deg.)	incl. (deg.)
1	2010.0	126.95303	37.11242	50618.2	-7.7160	53.4620
2	2010.0	126.47878	37.66592	51053.2	-7.8299	54.2483
3	2010.0	127.06978	37.91458	50983.7	-7.9253	54.4268
4	2010.0	127.59636	37.35753	50605.5	-7.8795	53.6289
5	2010.0	127.68672	38.11567	50852.5	-7.9188	54.5541
6	2010.0	128.34689	38.01517	50713.8	-8.1651	54.2836
7	2010.0	128.39581	37.61236	50470.0	-7.8028	53.8105
8	2010.0	128.85594	37.41547	50485.3	-8.1020	53.3046
9	2010.0	128.21972	37.08294	50279.8	-7.9700	53.1586
10	2010.0	128.86628	36.93381	49994.2	-7.8079	53.0062
11	2010.0	129.07569	36.36994	49500.3	-7.6169	52.1042
12	2010.0	128.11050	36.35533	50072.5	-7.5875	52.2522
13	2010.0	127.58635	36.72492	50236.9	-7.6935	52.9003
14	2010.0	126.49109	36.78949	50730.4	-7.5268	53.3803
15	2010.0	127.00827	36.43775	50216.8	-7.5727	52.5817
16	2010.0	127.69975	36.07086	49837.6	-7.4334	52.0365
17	2010.0	126.71614	35.58778	50128.5	-7.4189	51.6436
18	2010.0	126.36211	35.16959	49787.6	-7.3162	51.0602
19	2010.0	127.13956	35.29669	49633.2	-7.4554	51.0376
20	2010.0	127.62511	35.53947	49255.3	-7.2651	51.3607
21	2010.0	128.18742	35.81497	49422.2	-7.4548	51.6163
22	2010.0	129.15722	35.91528	49414.6	-7.6831	51.4900
23	2010.0	129.14802	35.50220	49015.3	-7.4820	50.7495
24	2010.0	128.47383	35.43617	49208.3	-7.2174	50.8911
25	2010.0	128.59287	34.87030	49014.9	-7.1107	50.5861
26	2010.0	127.99539	34.86200	48724.8	-7.0003	50.5292
27	2010.0	127.30494	34.78706	49123.6	-6.9525	50.6766
28	2010.0	126.97783	34.62731	48953.0	-7.4266	50.6087
29	2010.0	126.22381	34.43192	49483.1	-6.1715	50.4996
30	2010.0	126.89417	33.52450	not	fully	meas.
31	2010.0	126.32972	33.36453	49514.0	-5.9022	48.6960
32	2010.0	126.70166	33.32728	48496.7	-6.7162	49.0450

During the analysis of the absolute measurement data, we found that the repeat stations 28, 29, 30, 31, and 32 have very different geomagnetic field components from the IGRF trend.

For the no. 28 and 29 stations, which are located on the southern coast, we did not know such facts for the analysis step. However, at the mapping step, we omitted the two stations' data and suggested that NGII consign KIGAM to do new absolute measurements on other potential stations if the present results of the two stations show a real regional trend.

For the no. 30 station, which is located in Jeju Island and is covered mainly by basalt flow, we have already noticed that it shows very strange values. Therefore, we selected another two stations and conducted absolute measurements to discover if either station could represent the region. The result was such that the data of the three stations show very different components. Therefore, we concluded temporarily that the cover of Jeju Island contains strong remnant magnetization, of which the directions are not the same for individual blocks, especially near the surface because of their movement in random directions after the acquisition of the remnant magnetization. Thus, we omitted the three stations' data for mapping and also suggested that NGII consign KIGAM to do further work on Jeju Island, for example, measurement by a vector magnetometer to discover the proper distribution of the components of the geomagnetic field.

Figure 4 shows the geomagnetic field components' distribution for epoch 2010.0 on the southern part of the Korean Peninsula. The Kriging interpolation method was used to obtain contour maps. The thin line on each geomagnetic field component's distribution map is the contour of that of the newly and really measured data, and the thick line is that calculated from the IGRF-11, opened to the public by the IAGA, which did not use the really measured data on the Korean Peninsula as those data were never reported to the IAGA. Comparing the two kinds of contour lines, we find a near similarity between the two, especially for the central part where there are relatively densely located repeat stations, implying that the newly measured data set would represent well the regional trend of the geomagnetic field on the southern part of the Korean Peninsula.

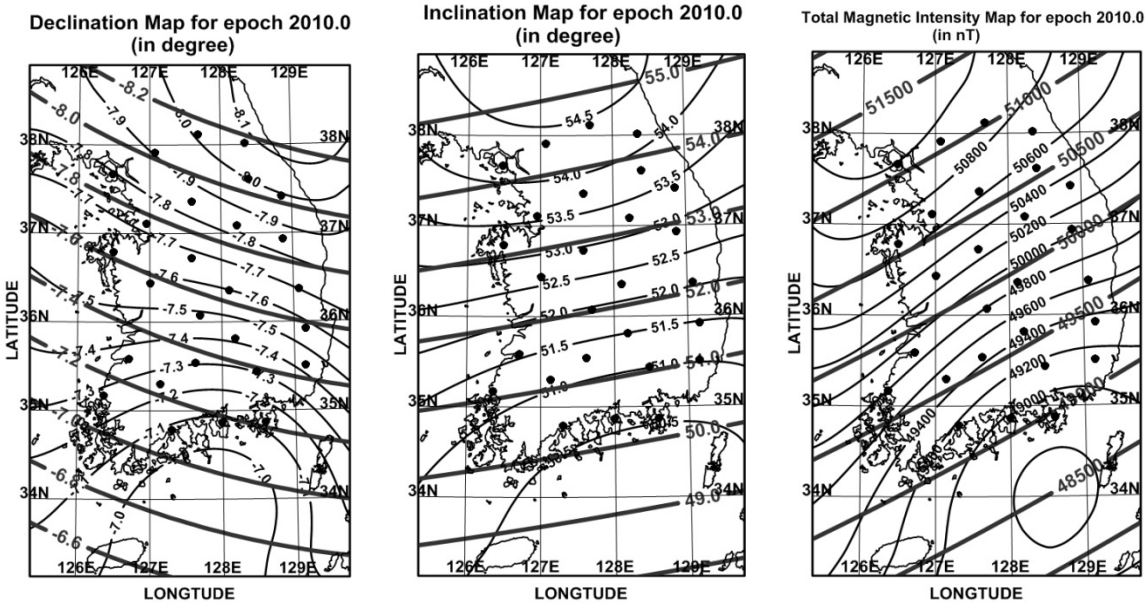

Figure 4. The geomagnetic field component distribution at epoch 2010.0 on the southern part of the Korean Peninsula. From left to right: declination, inclination, and total magnetic intensity. Thin line: reduced from newly and really measured data; thick line: calculated from IGRF-11.

4 CONCLUSION

We presented the processed results of the new absolute geomagnetic measurement data set acquired in 2010 on 32 repeat stations on the southern part of the Korean Peninsula by the geomagnetic field components' distribution maps of declination, inclination, and total magnetic intensity on the southern part of the Korean Peninsula for epoch 2010.0.

Comparing these results with those calculated from IGRF-11, we found a near similarity between the two, especially for the central part where there are relatively densely located repeat stations although the latter did not contain the really measured data on the Korean Peninsula as those data were never reported to IAGA.

This implies that the newly measured data set would represent well the regional trend of the geomagnetic field on the southern part of the Korean Peninsula.

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