Comparisons of ground magnetic values of vertical, horizontal and total-field intensity with airborne total-field measurements in the Medicine Bow, Wyoming, area

by

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Introduction

In September 1976 the authors completed two ground-level profile surveys of the inclination and total intensity of the earth's magnetic field across Muddy Mountain and Iron Mountain in the Medicine Bow, Wyoming, area. The general locations of these profiles were predetermined to allow the ground-level surveys to cross through prominent magnetic highs and lows indicated on an aeromagnetic contour map of the area.

Data Collection

The ground-level measurements were taken using an EDA[1/] fluxgate magnetometer, with the sensor mounted on the telescope of a nonmagnetic Zeiss theodolite (Model 020), for measuring inclination (dip angle), and using a Geometrics Model G-26 proton magnetometer for measuring the total intensity.

The survey plan was to make measurements at quarter-mile spacings. The rugged terrain of the survey area and the limited time available allowed us to follow this plan only to the extent indicated in Figure 7.

The measurements made during the ground-level survey were made from early morning until late evening on seven consecutive days. The number of observations of each element varied from one to three at the different stations depending on whether the station appeared to be in a smooth or highly anomalous part of the survey area.

For inclination measurements the theodolite base and telescope are leveled; then the telescope is rotated in the horizontal plane until the fluxgate indicates a null output. The telescope and sensor are then turned 90° from the null position in the horizontal plane, and rotated or "dipped" in the vertical plane until the fluxgate output is again nulled. At this point the vertical circle readings on the theodolite indicate the inclination.

1/ Use of brand names in this report is for descriptive purposes only and in no way constitutes endorsement by the U.S. Geological Survey.

The theodolite is readable to 0.1 minute. Calibration and standardization measurements indicate that the repeatability and reliability of the inclination measurements are better than ± 0.2 minutes. The proton magnetometer used for total-intensity measurements has an accuracy of ± 1 gamma.

Horizontal and vertical intensity values were computed for each ground station using the measured inclination and total-intensity values. Because of the small observing inaccuracies, the computed horizontal and vertical intensity values are thought to be accurate to ± 2 to 3 gammas.

The aeromagnetic measurements collected for the contour map (U.S. Geological Survey Open-File Report 76-687 ~~689, 1975~~) were obtained using a Model ASQ-10 digital fluxgate magnetometer system mounted in a twin-engine Convair 240 aircraft. The aircraft navigation equipment consisted of a Marconi Doppler unit and a roll-stabilized AS-5 strip camera.

The airborne fluxgate magnetometer readings were usually compared with a proton magnetometer before and after each survey flight. This type of data control can yield a survey accuracy of approximately ± 25 gammas in the absolute value of the total intensity measurements. The aeromagnetic survey was performed at a nominal barometric altitude of 12,000 feet (3937 meters).

Data Presentation

This report presents the data observed and computed without any interpretation. The data are to be used in later publications that will report on the feasibility of using magnetic component values derived from total-intensity data, along with a given set of assumptions, for anomaly analysis and interpretation.

Table 1 gives the observed and computed magnetic data, the positions and elevations of the ground stations, and the aeromagnetic values over the ground stations as derived from the contour map. The elevation data were taken from the Foxpark, Woods Landing, Albany, and Lake Owen, Wyoming, 7 1/2 minute USGS quadrangle sheets (map series V874).

The values given in Table 1 for F_2, the aeromagnetic values, were derived using the following method:

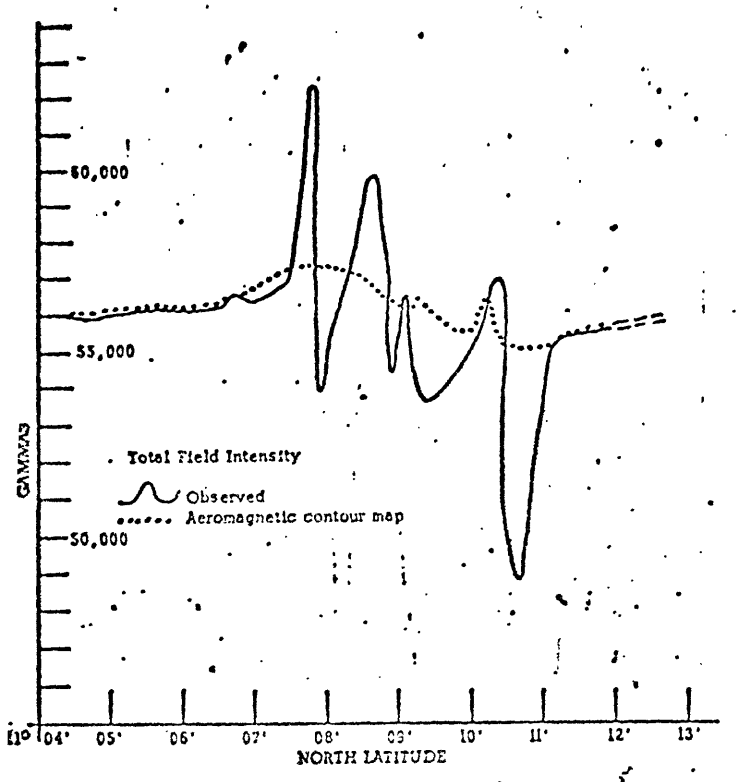
The ground observation points were plotted on the aeromagnetic contour map and the magnetic values were taken off the contour map. These values were added to 52,800 gammas, the map base value. Secular change (-300 gammas) was added to the above values to put the ground-observed values and aeromagnetic-contour-map values at the same epoch. This value of secular change was derived from the data files compiled for the production of magnetic charts by the U.S. Geological Survey.

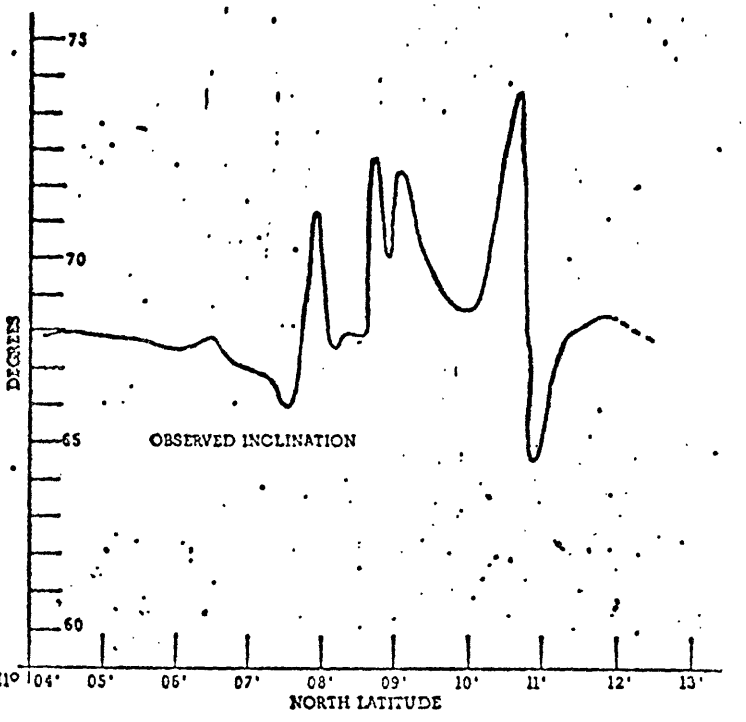
Figure 1 presents profiles of the observed and aeromagnetic-map-derived total intensity, the observed inclination, and the computed vertical and horizontal intensities across Muddy Mountain.

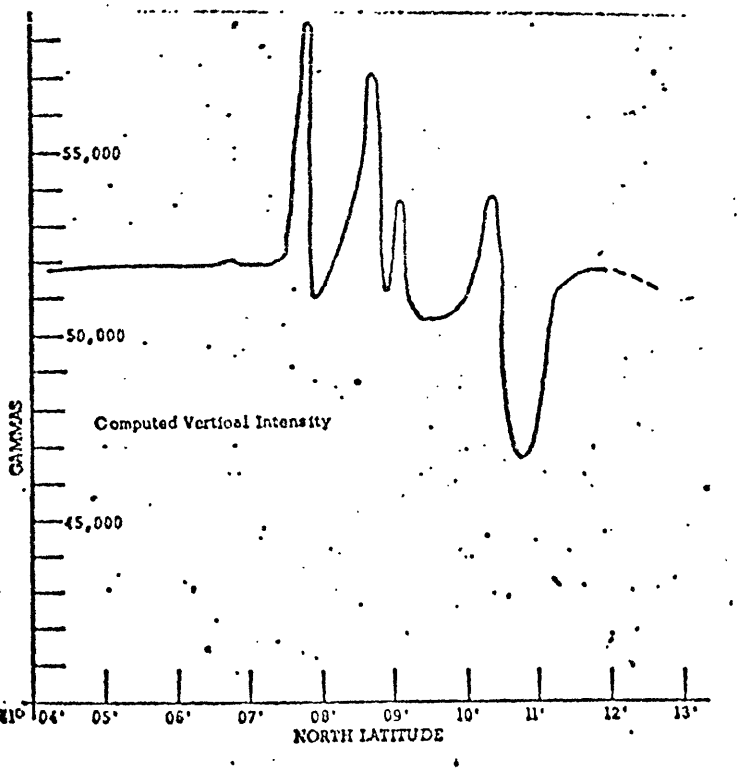
Figure 2 presents the same profiles across Iron Mountain.

Figure 3 shows the portion of the aeromagnetic contour map in the area of the ground survey.

Figure 4 shows positions of the ground observation stations. This figure is included to show that the profiles are not straight.







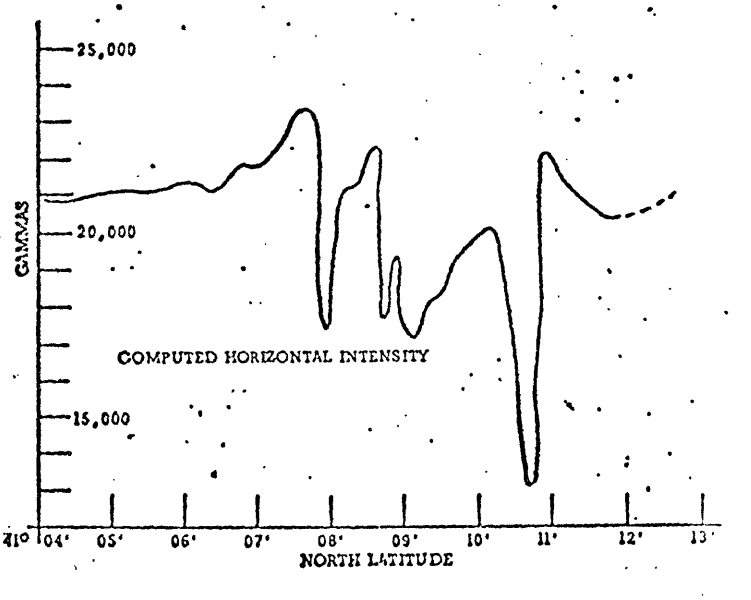
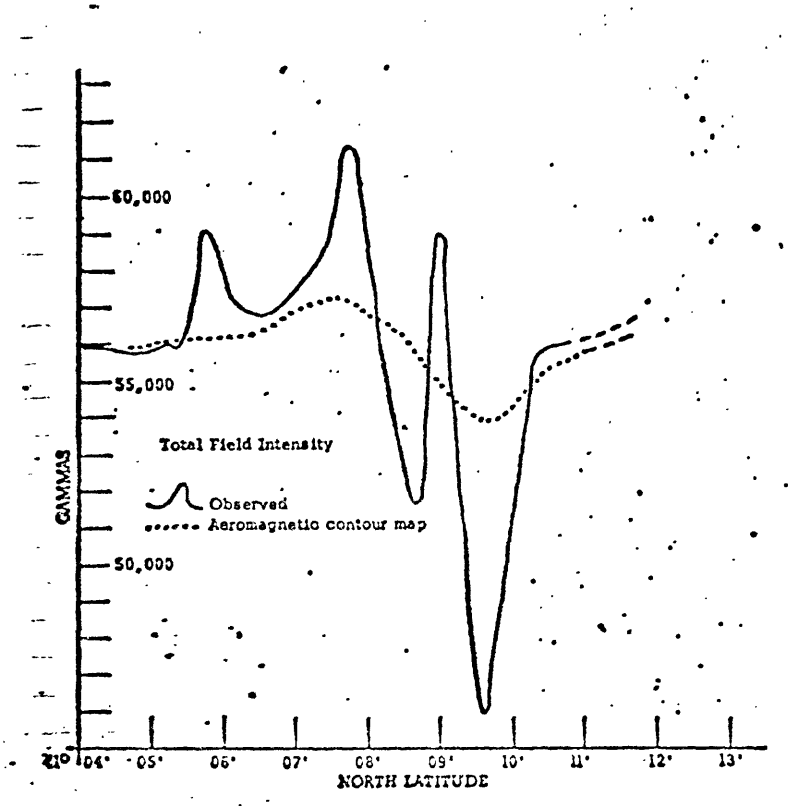
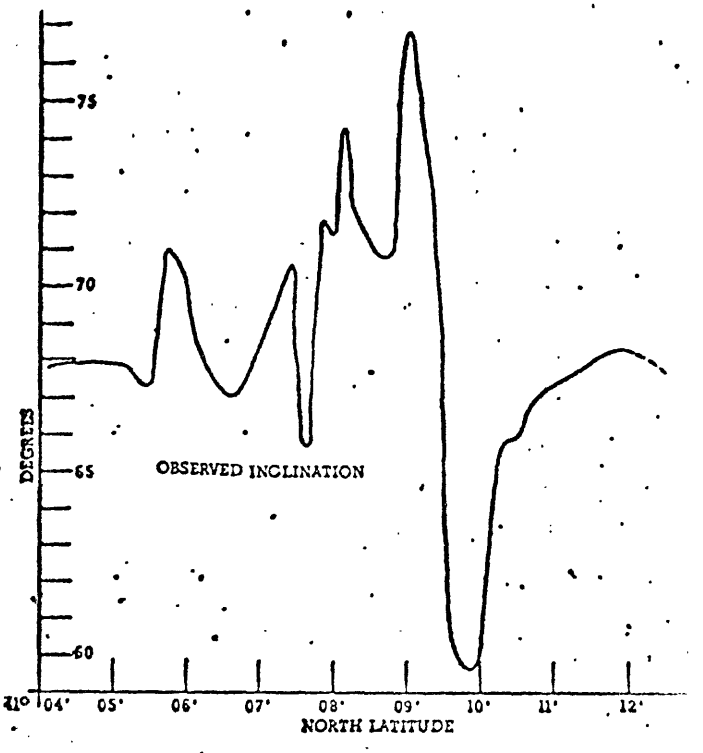
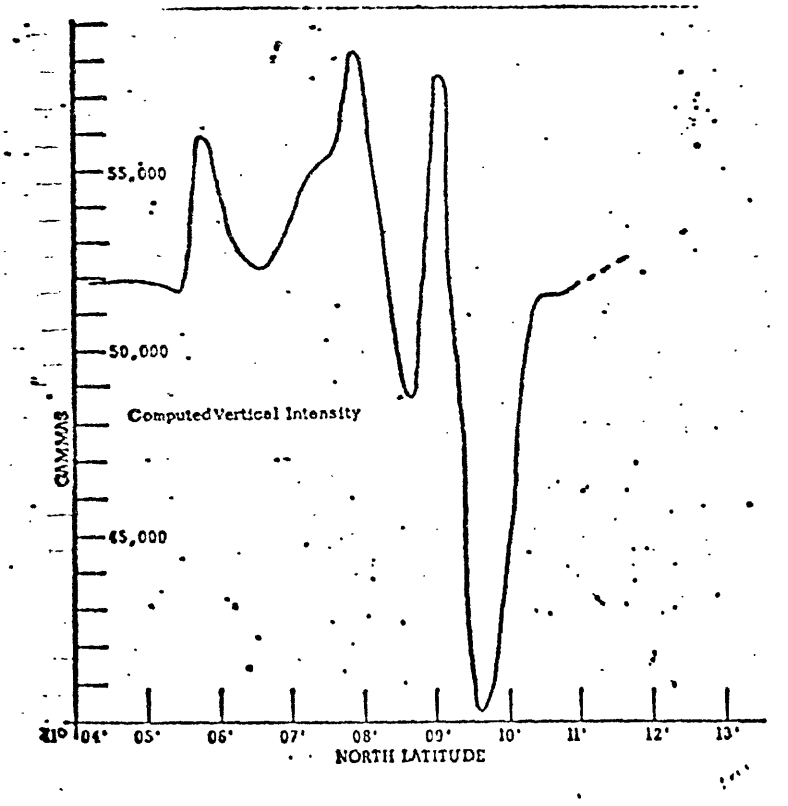


Figure 1
Magnetic Profiles Across Muddy Mountain







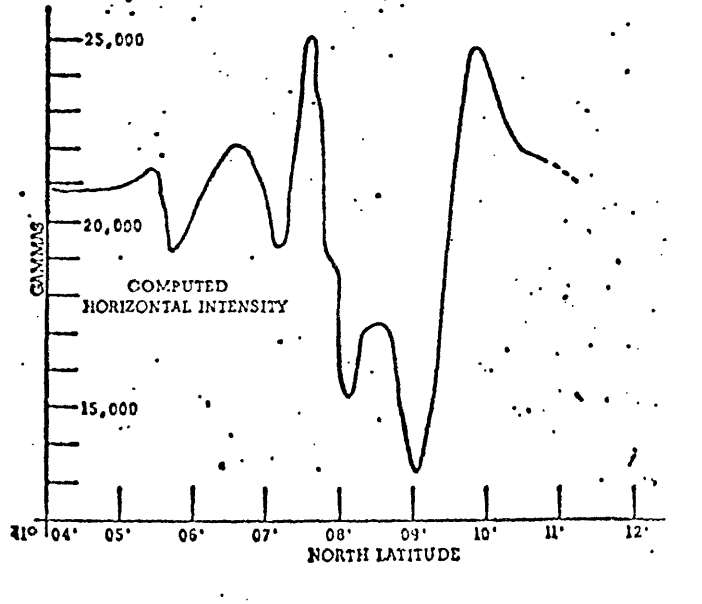
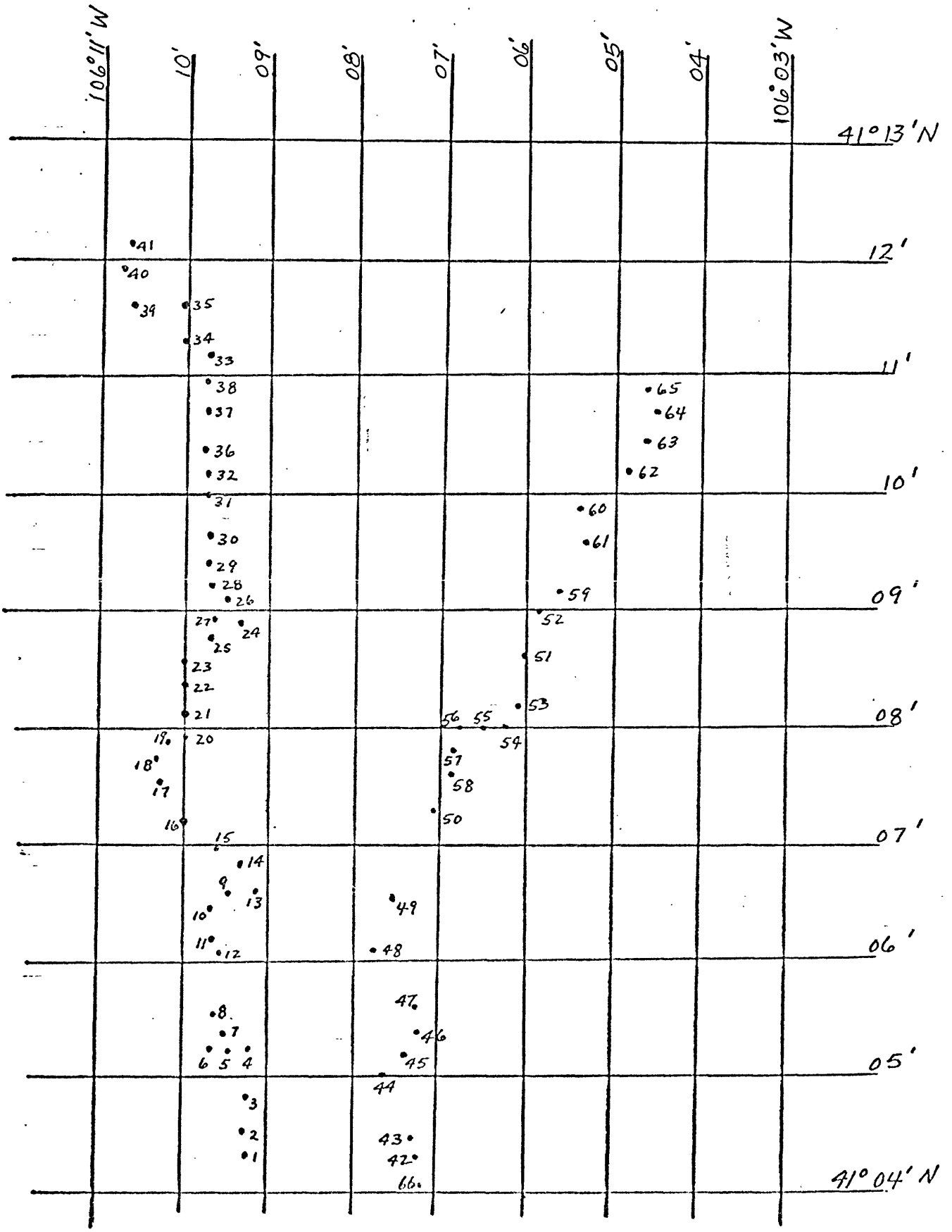
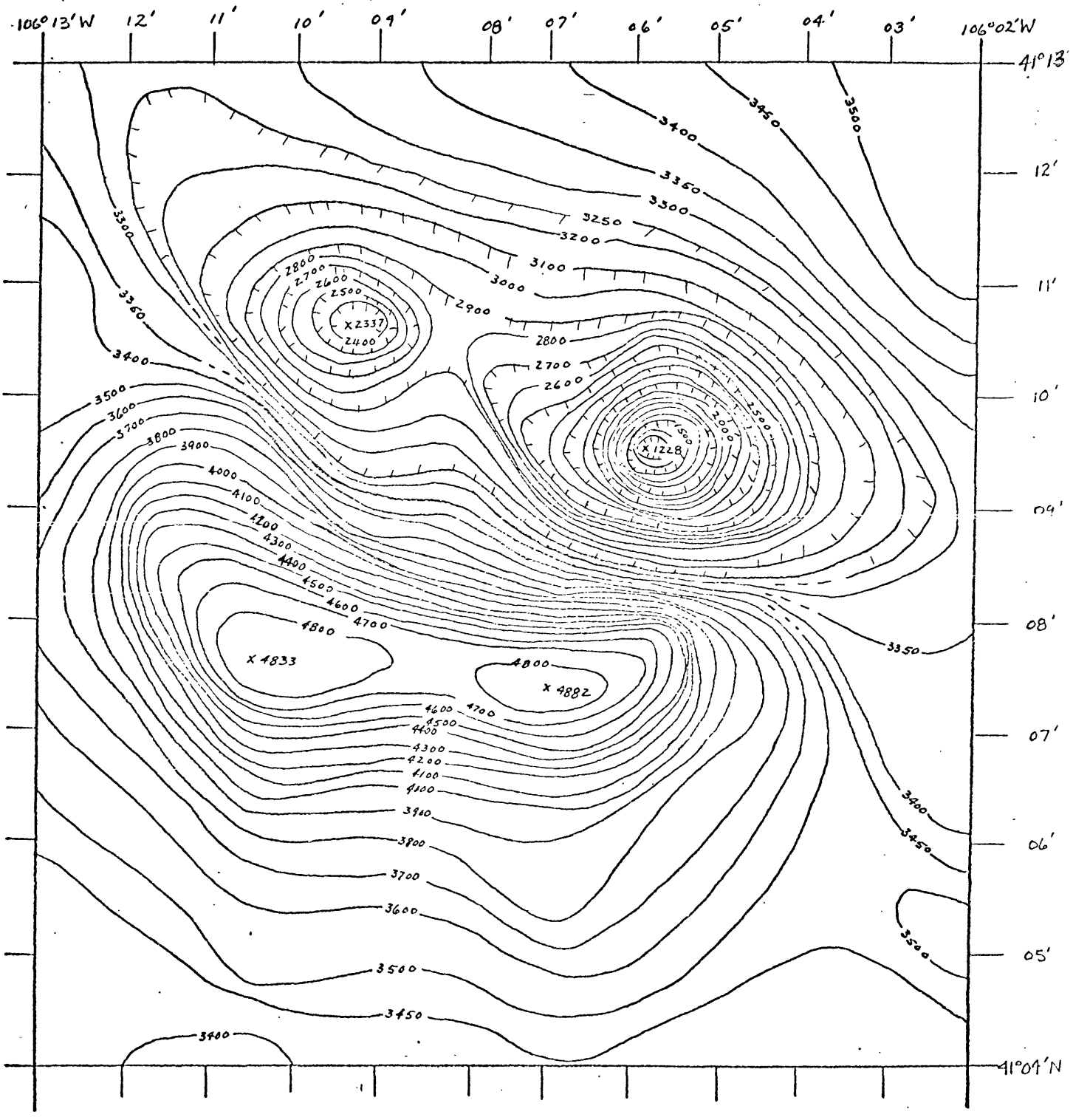


Figure 2
Magnetic Profiles Across Iron Mountain



LOCATIONS OF GROUND LEVEL OBSERVATIONS



AEROMAGNETIC CONTOUR MAP
(Base Map Value is 52,800 Gammas)

Figure 3

Table 1

Ground Level Station Locations and Magnetic Values

Station	Latitude	Longitude	Elevation	Inclination	Horizontal Intensity	Vertical Intensity	Total Intensity F_1	Total Intensity F_2
1	41°04.2'	106°09.3'	9060 Feet 2972 Meters	67°58.6'	20969	51839	55919	55930
2	04.5	09.3	9060 2972	67°58.9	20985	51891	55974	55950
3	04.8	09.3	9065 2974	67°53.1	21068	51845	55962	55985
4	05.2	09.3	9060 2972	67°28.3	21459	51733	56007	56050
5	05.2	09.5	9070 2976	67°48.3	21161	51866	56017	56050
6	05.2	09.7	9075 2977	67°48.3	21161	51866	56017	56060
7	05.3	09.7	9065 2974	67°47.0	21179	51858	56014	56075
8	05.6	09.6	9060 2972	67°46.1	21203	51874	56040	56110
9	06.6	09.5	8900 2920	67°14.9	21771	51914	56294	56500
10	06.5	09.7	8960 2940	67°48.0	21205	51964	56124	56425
11	06.2	09.7	9040 2966	67°33.6	21420	51866	56115	56310
12	06.1	09.6	9010 2746	67°30.7	21477	51850	56122	56260
13	06.7	09.2	8875 2912	67°11.3	21866	52035	56450	56500
14	06.8	09.4	8840 2900	67°08.0	21993	52007	56443	56660
15	06.9	09.7	8840 2900	67°04.1	21972	51935	56392	56800
16	07.3	10.0	8800 2887	66°39.4	22436	51989	56626	57100
17	07.5	10.4	8865 2908	65°55.6	23220	51972	56924	57320
18	07.7	10.4	8890 2917	67°26.6	23359	56236	60894	57380
19	07.8	10.2	8910 2923	68°48.5	22662	58452	62691	57380
20	07.9	10.0	8915 2925	71°22.5	17164	50929	53744	57325
21	08.1	10.0	8825 2895	67°35.0	21321	51685	55910	57370
22	08.4	10.0	9050 2969	67°56.8	21378	52770	56936	57150

F_1 - Ground level total intensity values

F_2 - Airborne contour map values plus 52,800 gammas (base map value) minus 300 gammas secular change

Table 1
(Con't)

Ground Level Station Locations and Magnetic Values

Station	Latitude	Longitude	Elevation	Inclination	Horizontal Intensity	Vertical Intensity	Total Intensity F_1	Total Intensity F_2
23	41°08.6'	106°10.0'	9100 2986	67°55.5	22420	55283	59657	57000
24	08.9	09.4	9100 2986	70°31.2	18104	51179	54287	56300
25	08.7	09.7	9085 2981	72°52.4	17582	57056	59704	56700
26	09.1	09.6	9160 3005	72°24.6	17008	53684	56280	56200
27	08.9	09.6	9125 2994	69°55.2	19382	53021	56453	56400
28	09.3	09.7	9270 3041	70°18.2	18087	50523	53663	56250
29	09.5	09.7	9380 3077	69°56.5	18419	50445	53702	56100
30	09.7	09.7	9460 3104	68°56.4	19445	50498	54112	55750
31	10.0	09.7	9470 3107	68°37.4	19878	50782	54534	55550
32	10.2	09.7	9470 3107	68°56.4	20142	52309	56053	56425
33	11.2	09.7	9058 2972	67°09.2	21482	50987	55328	55200
34	11.3	10.0	9215 3023	67°44.4	20943	51167	55287	55350
35	11.6	10.1	9276 3043	67°57.6	20809	51400	55452	55550
36	10.4	09.7	9540 3130	71°00.0	18512	53762	56860	55250
37	10.7	09.7	9400 3084	74°35.2	12919	46858	48606	55100
38	10.9	09.7	9200 3018	64°28.6	22302	46709	51760	55050
39	11.6	10.6	9380 3077	68°13.4	20572	51493	55450	55670
40	11.9	10.8	9350 3068	68°28.9	20388	51710	55584	55670
41	12.1	10.7	9175 3010	68°13.8	20620	51632	55597	55700
42	04.3	07.3	9000 2953	67°59.5	20968	51874	55952	55950
43	04.5	07.3	9015 2958	67°58.2	20973	51833	55916	55900
44	05.0	07.7	8920 2927	67°53.6	21054	51832	55945	56000

F_1 - Ground-level total intensity values

F_2 - Airborne contour map values plus 52,800 gammas (base map value) minus 300 gammas secular change

Table 1
(Con't)

Ground Level Station Locations and Magnetic Values

Station	Latitude	Longitude	Elevation	Inclination	Horizontal Intensity	Vertical Intensity	Total Intensity F_1	Total Intensity F_2
45	41°05.2'	106°07.5'	8910 2923	67°41.4	21274	51842	56041	56125
46	05.4	07.3	8750 2871	67°21.0	21578	51711	56033	56300
47	05.7	07.3	9047 2968	71°06.6	19192	56087	59280	56350
48	06.1	07.8	8900 2920	68°23.2	21141	53360	57395	56375
49	06.6	07.6	8940 2933	67°04.7	22141	52360	56849	56600
50	07.4	07.1	8810 2890	70°51.7	19257	55490	58736	57340
51	08.7	06.0	8980 2946	70°54.6	16881	48776	51615	55800
52	09.0	05.9	8975 2945	77°01.5	13292	57674	59186	54900
53	08.3	06.2	8960 2940	72°11.9	16800	52319	54950	56650
54	08.1	06.3	8960 2940	74°22.8	15193	54341	56425	56800
55	08.0	06.6	8960 2940	71°31.6	18673	55893	58930	56850
56	08.0	06.8	8955 2938	71°40.2	18714	56487	59506	56850
57	07.8	06.9	8960 2940	71°59.6	18948	58294	61296	57150
58	07.6	06.9	8935 2931	65°43.0	25163	55772	61186	57350
59	09.3	05.6	8820 2994	73°16.9	15118	50334	52555	54400
60	09.9	05.4	8580 2815	59°34.4	24889	42374	49142	54100
61	09.6	05.4	8730 2864	60°40.3	22492	40034	45920	53900
62	10.3	04.9	8240 2703	65°48.0	22867	50882	55784	55000
63	10.5	04.6	8300 2723	66°58.0	21884	51471	55930	55350
64	10.7	04.6	8165 2679	67°04.2	21807	51548	55971	55550
65	10.9	04.7	8040 2638	67°19.8	21601	51715	56045	55625
66	04.1	07.2	9000 2953	68°00.7	20962	51885	55959	55930

F_1 - Ground level total intensity values

F_2 - Airborne contour map values plus 52,800 gammas (base map value) minus 300 gammas secular change