

IOWA GEOLOGICAL SURVEY

S.J. Tuthill, Director and State Geologist

REPORT OF INVESTIGATIONS

A Gravity Interpretation of
Blackhawk County

by

Donald P. Heitzman

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The University of Iowa

REPORT OF INVESTIGATIONS

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Iowa City, Iowa

S.J. Tuthill, Director and State Geologist

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A GRAVITY INTERPRETATION OF
BLACKHAWK COUNTY, IOWA

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ABSTRACT

A ground gravity survey of Blackhawk County, Iowa was conducted in the summer of 1971 in order to obtain more information regarding the Iowa basement complex. Blackhawk County lies on the eastern flank of the Mid-continent Gravity High and was found to contain a very steep gradient of 67 milligals. A close simularity between the Bouguer gravity and aeromagnetic maps lead to the interpretation of five anomalous features as well as several major fault structures.

INTRODUCTION

The Iowa basement complex is rapidly becoming of major interest due to its association with the Midcontinent Gravity High. Since well data is extremely sparse, geophysical techniques emerge as the most economic alternative in the delineation of the basement structures. Petroleum-bearing structures, structures for the storage of natural gas, and the potential for future mining facilities provide the incentives for these studies.

The objective of the survey was to combine gravitational and aeromagnetic data to delineate the structures in the basement complex of Blackhawk County. The base station used as the primary base station to tie the survey was part of the Iowa gravity base station network of the Iowa Geological Survey, and was located at the Waterloo Municipal Airport. The observed gravity at the station was given as 980.302465 gals (Hase, Cambell, and Van Eck, 1969).

The instrument used in the survey was a Worden gravity meter made available through the courtesy of Orville J. Van Eck, Assistant State Geologist, Iowa Geological Survey. The gravity reduction program GRAVAS was set up by Dan J. Gockel, United States Geological Survey, Iowa City, Iowa, to run on the University of Iowa's IBM 360/65 computer. I am also indebted to Dr. Kenneth F. Clark, associate professor, Department of Geology, University of Iowa; the Department of Geology, University of Iowa, for supplementing

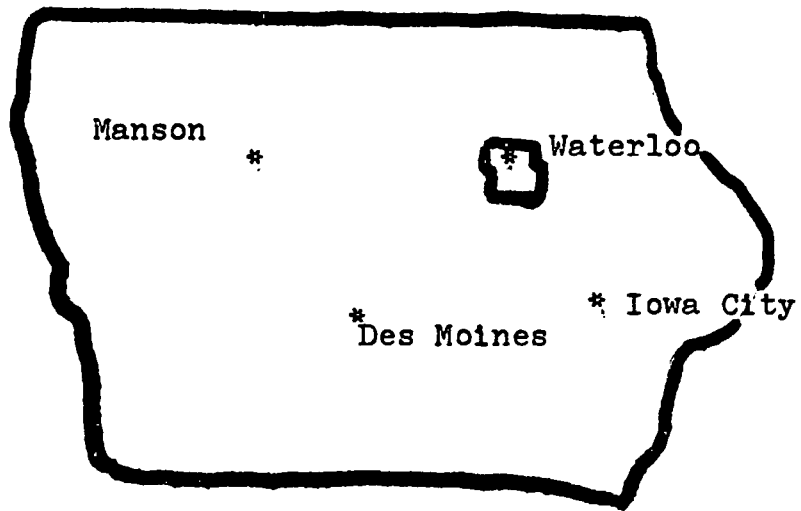


Fig.1. Location of Study Area.

computer time; and the Society of Sigma Xi, for a Grant-in-Aid of research.

INSTRUMENTATION AND SURVEY METHOD

The gravity measurements were made with the Worden gravity meter #751 during the summer of 1971 in Blackhawk County Iowa (Fig. 1). Approximately 3,500 observations were made and recorded at 598 stations. The traverses began and ended on pre-established secondary base stations which ^{were} tied to the primary base station at the Waterloo Municipal Airport. The station spacing of the 30 traverses were at mile intervals and taken along county road intersections wherever possible. Each station was marked with a

wooden florescent stake, and a 100% return was conducted on every traverse.

Approximately half of the station elevations used in the raw gravity reductions were taken from topographic maps. The remaining were obtained via an altimeter survey. It is believed that all stations are know within three to five feet, although anomalous errors may be present.

The raw field data was reduced by the computer program GRAVAS obtained from the Iowa Geological Survey. The program was written in FORTRAN and designed to reduce land gravity meter observations to corrected observed gravity, free air and simple Bouguer anomaly values (Army Map Service, 1967). The program was run on the University of Iowa's IMB 360/65 computer.

The following twelve cross sections and profiles were taken at various points of the Bouguer gravity map to demonstrate the relationships between the gravitational and aeromagnetic data. The first nine cross sections contain the five gravity positive anomalies and their structural relationships with the clastic basins and the en echelon configuration of the basement. The last three profiles demonstrate the basement fault complex, and confirms the en echelon pattern. The five anomalies were subjected to calculations fitting density contrasts to the known effect in milligals (Table I). The Cedar Falls West anomaly and the La Porte City East anomaly were

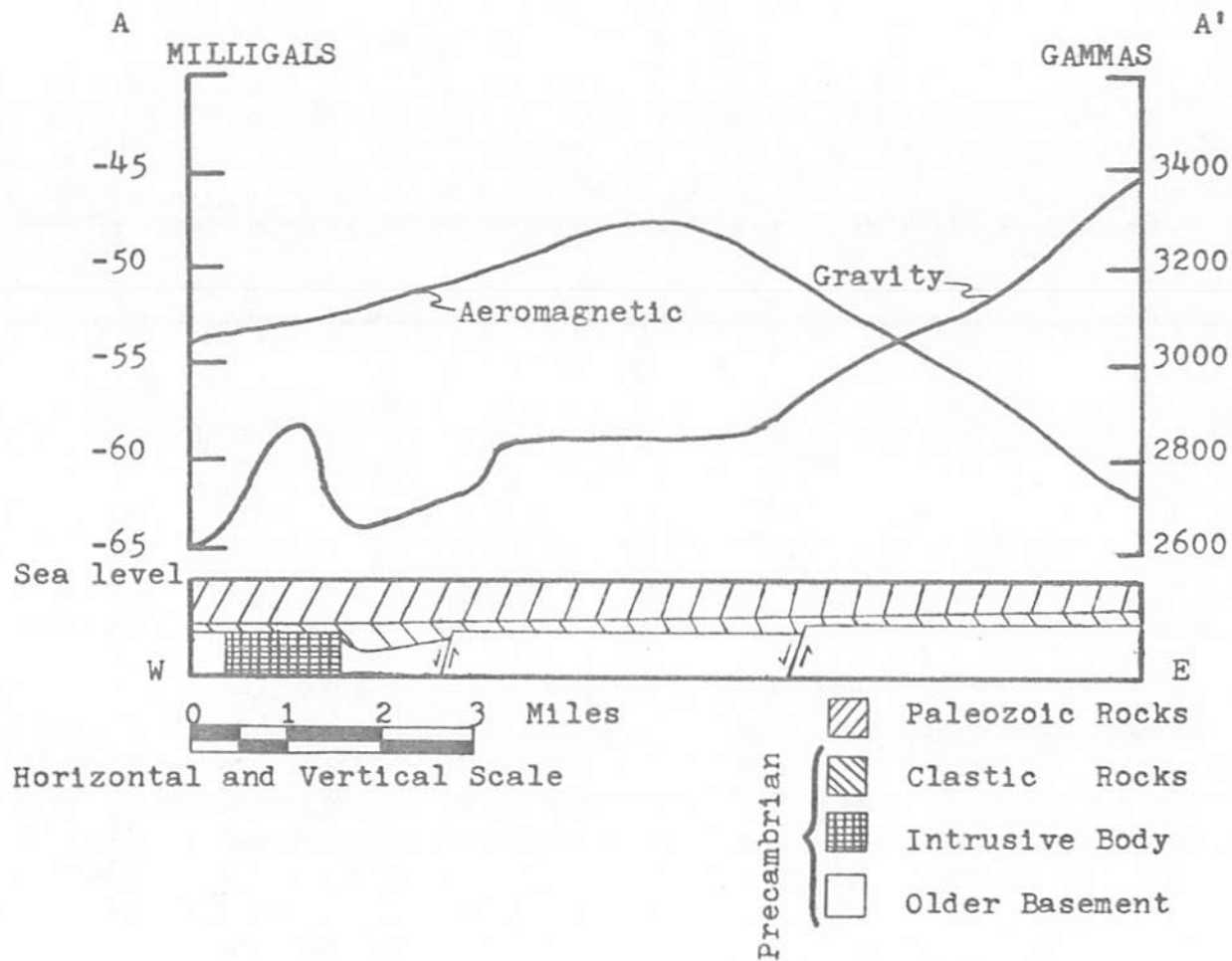


Figure 2. Cross section A-A' with corresponding gravity and aeromagnetic profiles.

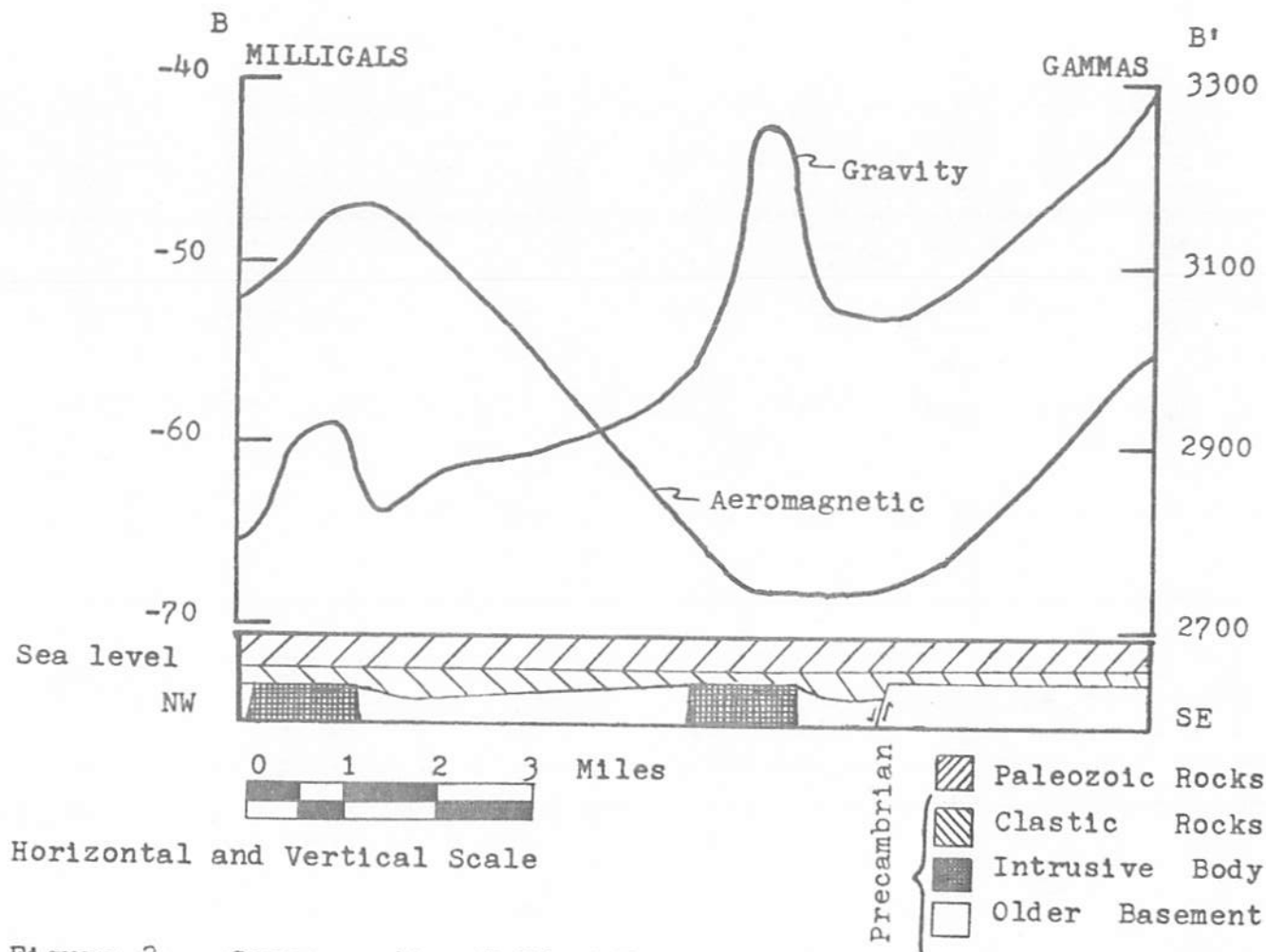


Figure 3. Cross section B-B' with corresponding gravity and aeromagnetic profiles.

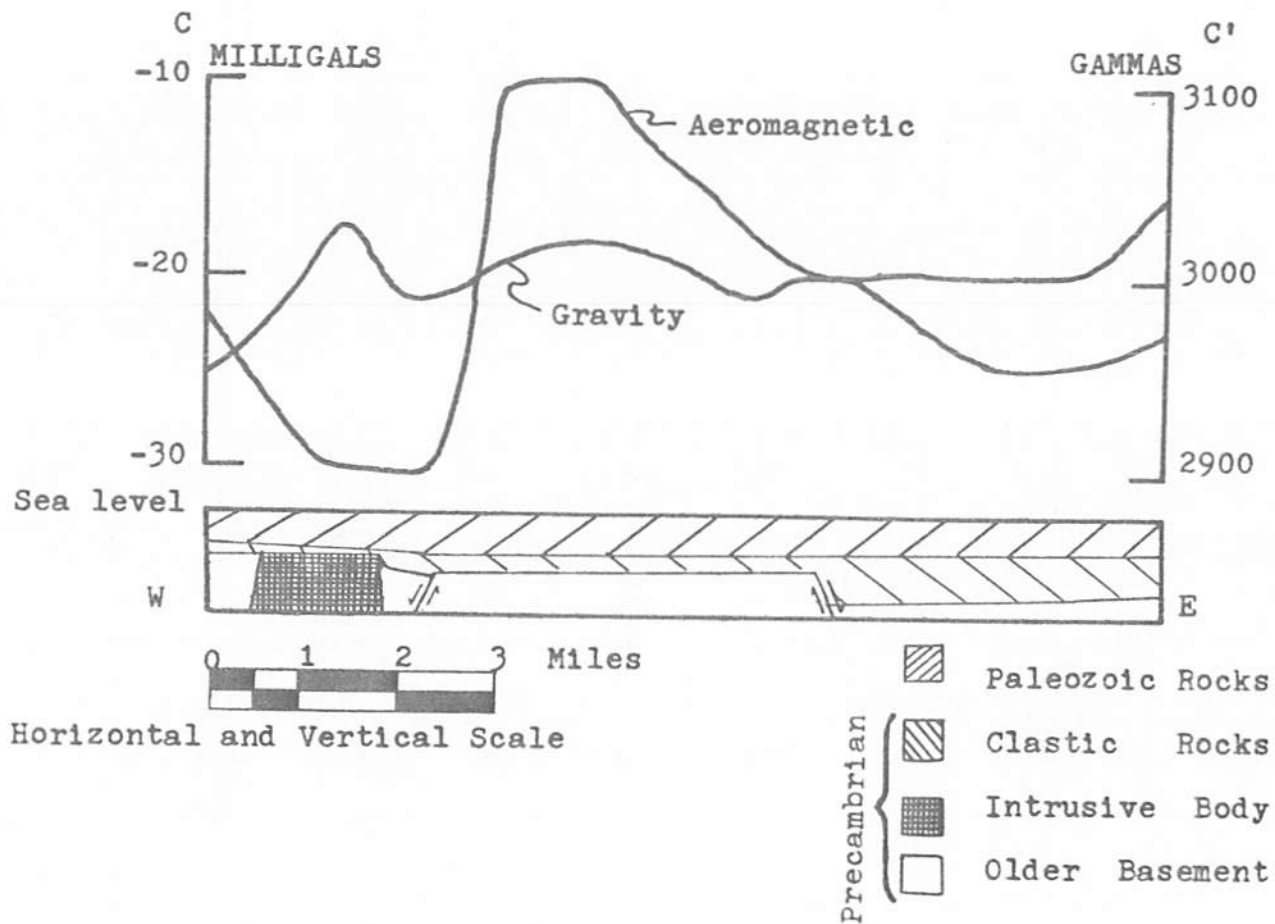


Figure 4. Cross section C-C' with corresponding gravity and aeromagnetic profiles.

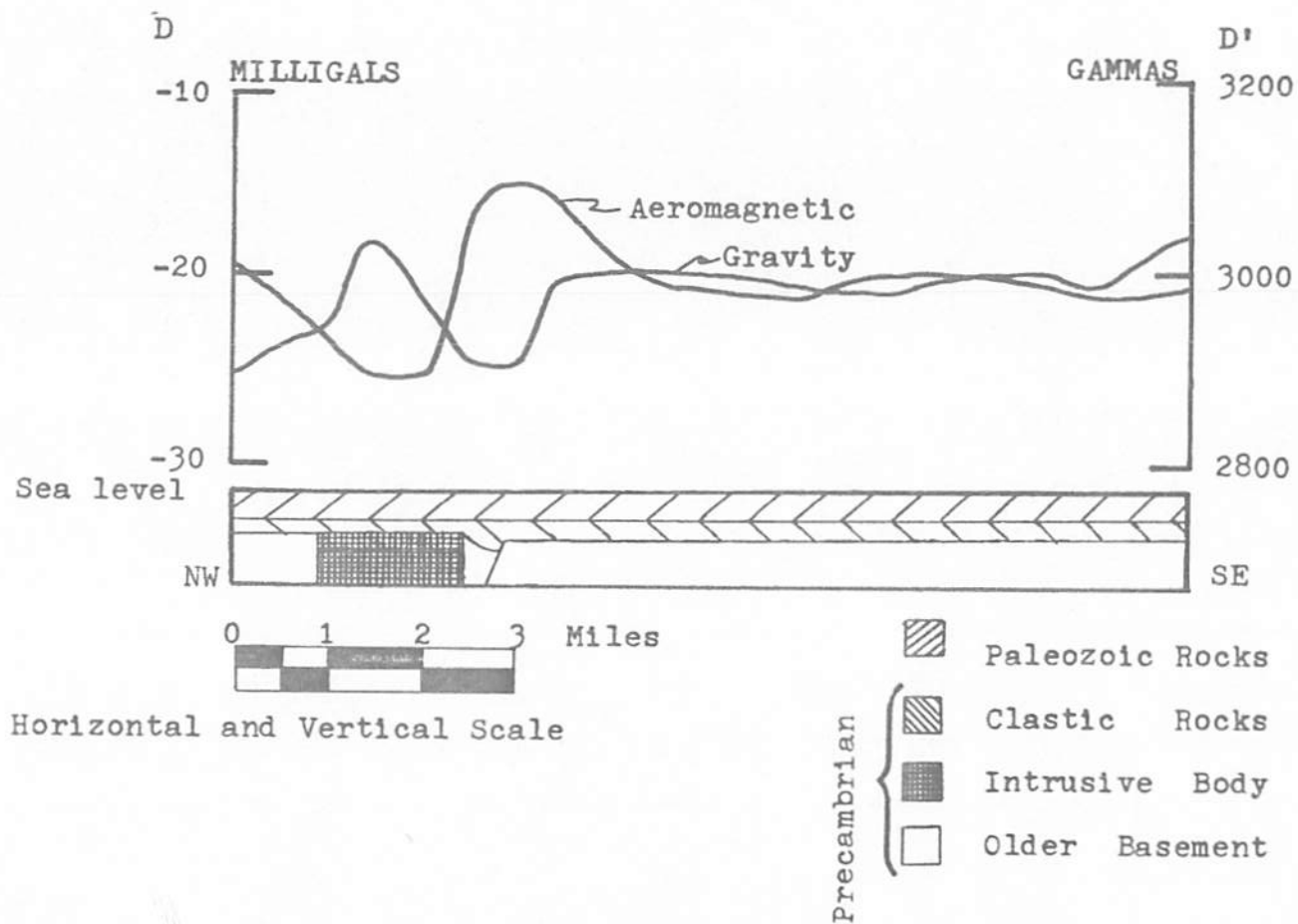


Figure 5. Cross section D-D' with corresponding gravity and aeromagnetic profiles.

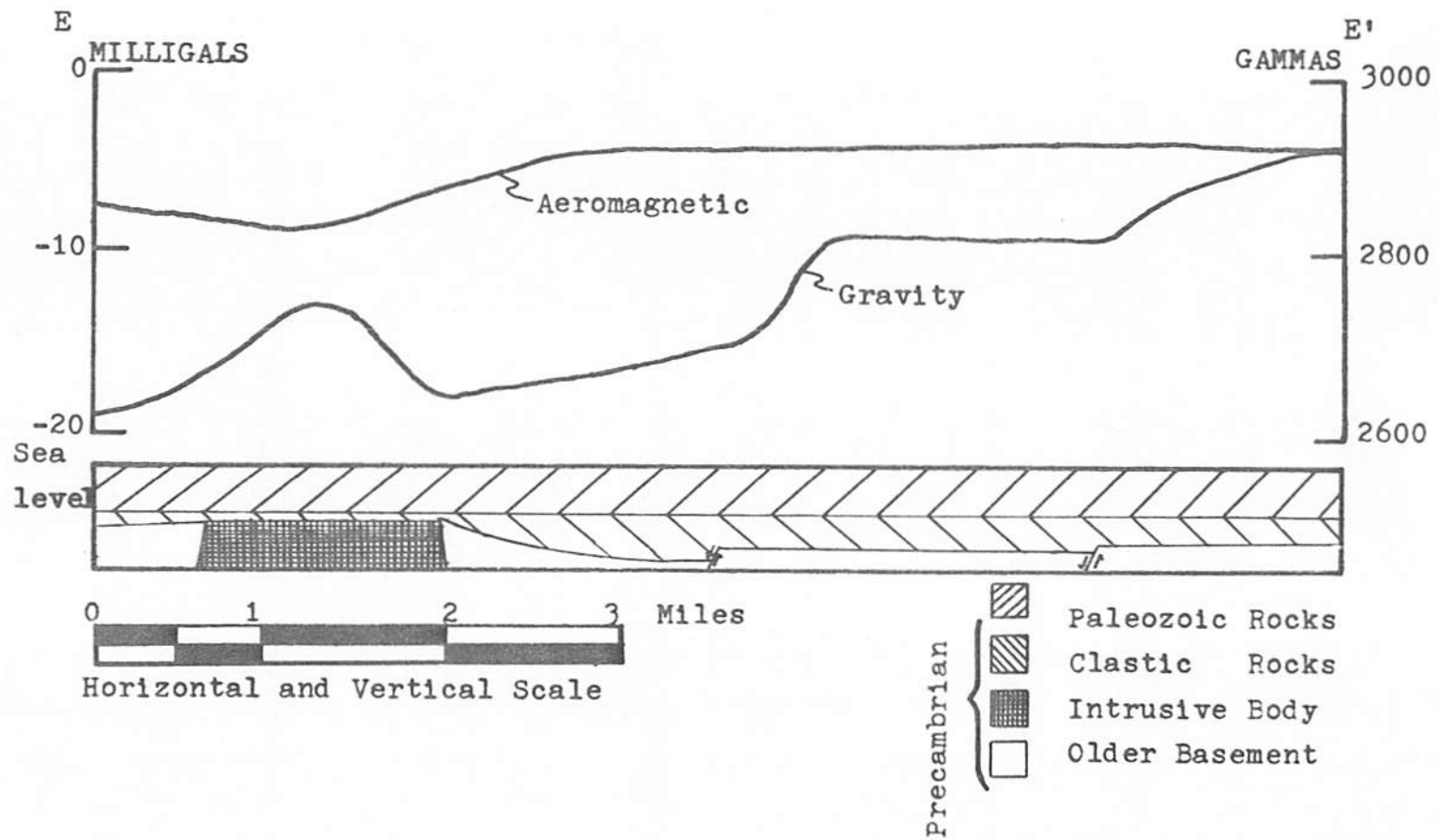


Figure 6. Cross section E-E' with corresponding gravity and aeromagnetic profiles.

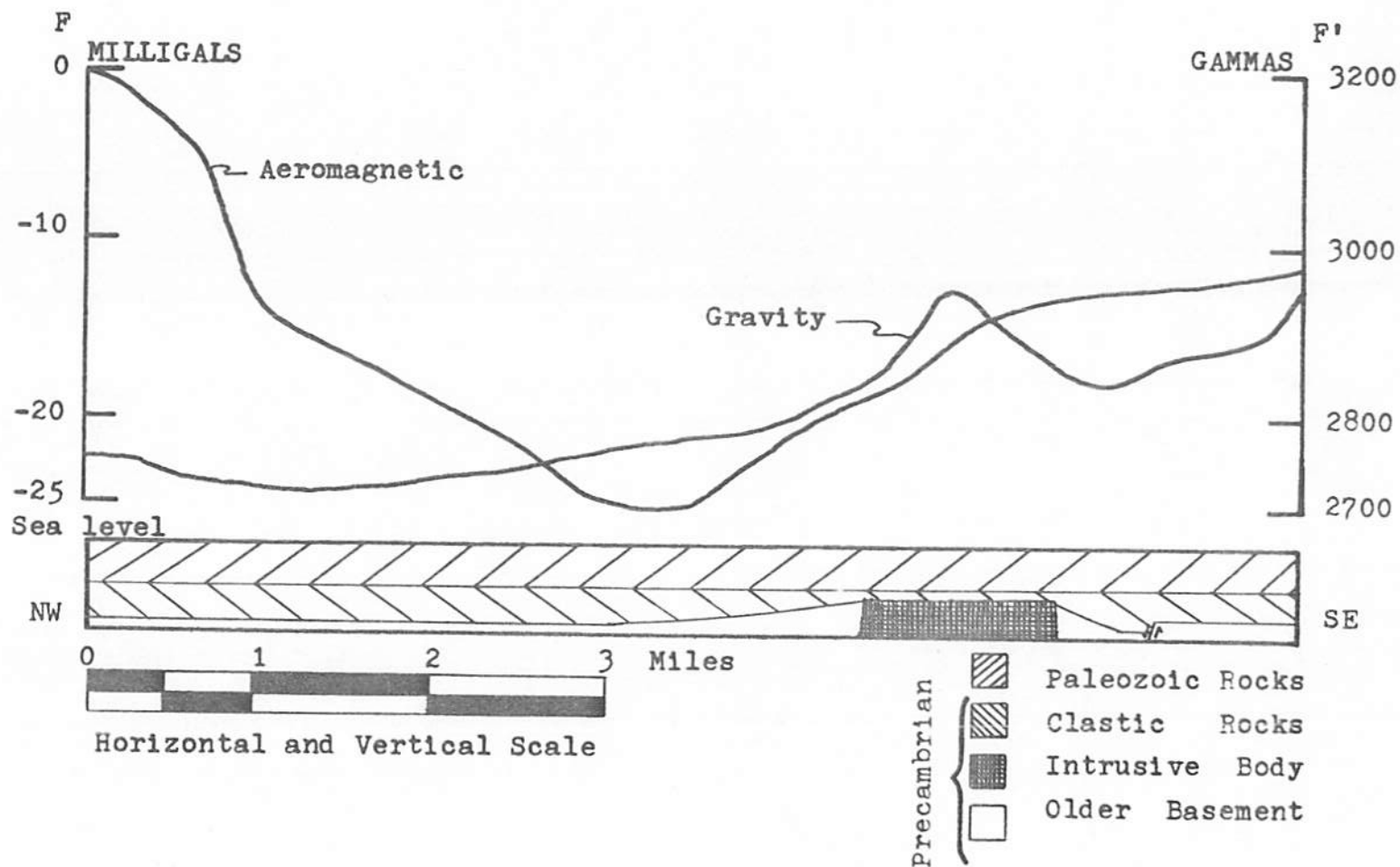


Figure 7. Cross section F-F' with corresponding gravity and aeromagnetic profiles.

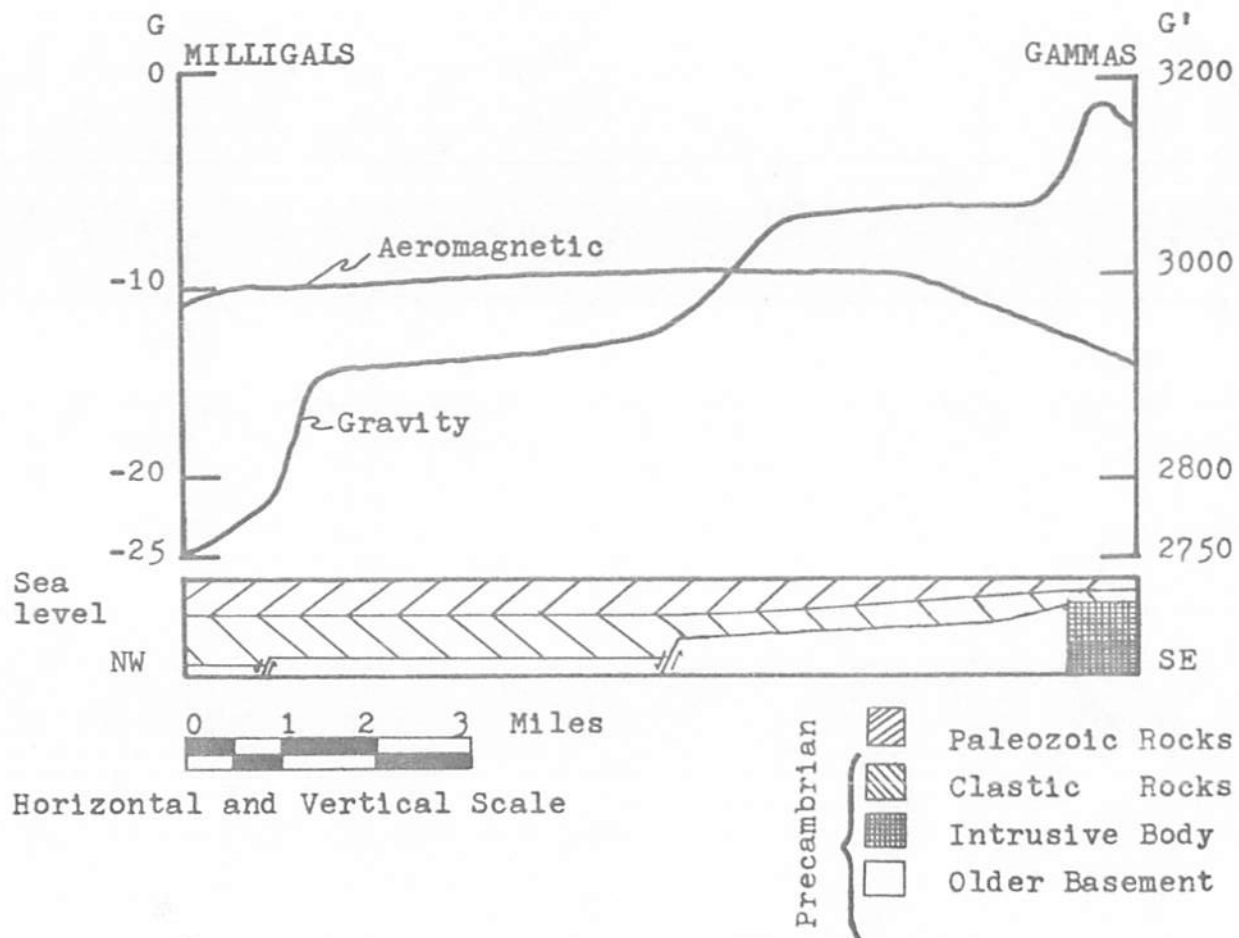


Figure 8.. Cross section G-G' with corresponding gravity and aeromagnetic profiles.

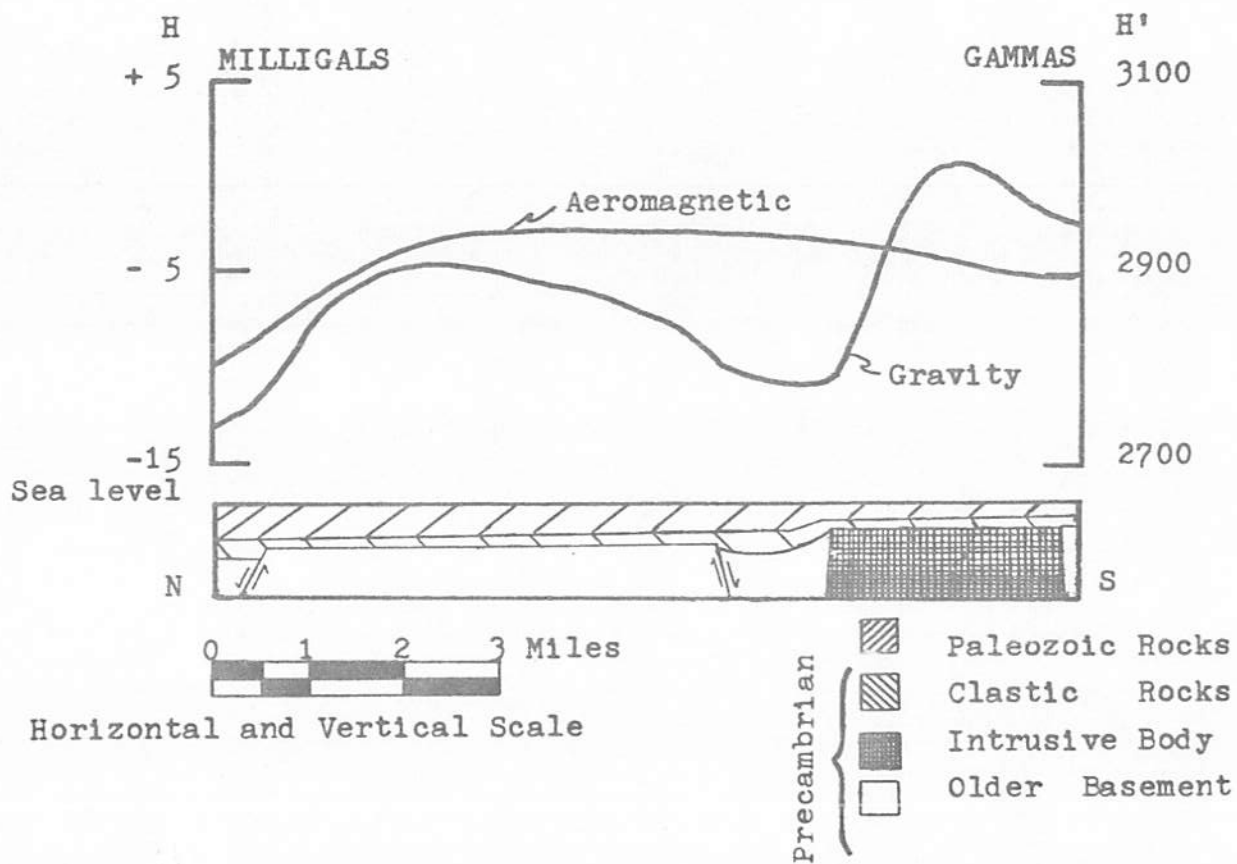


Figure 9. Cross section H-H' with corresponding gravity and aeromagnetic profiles.

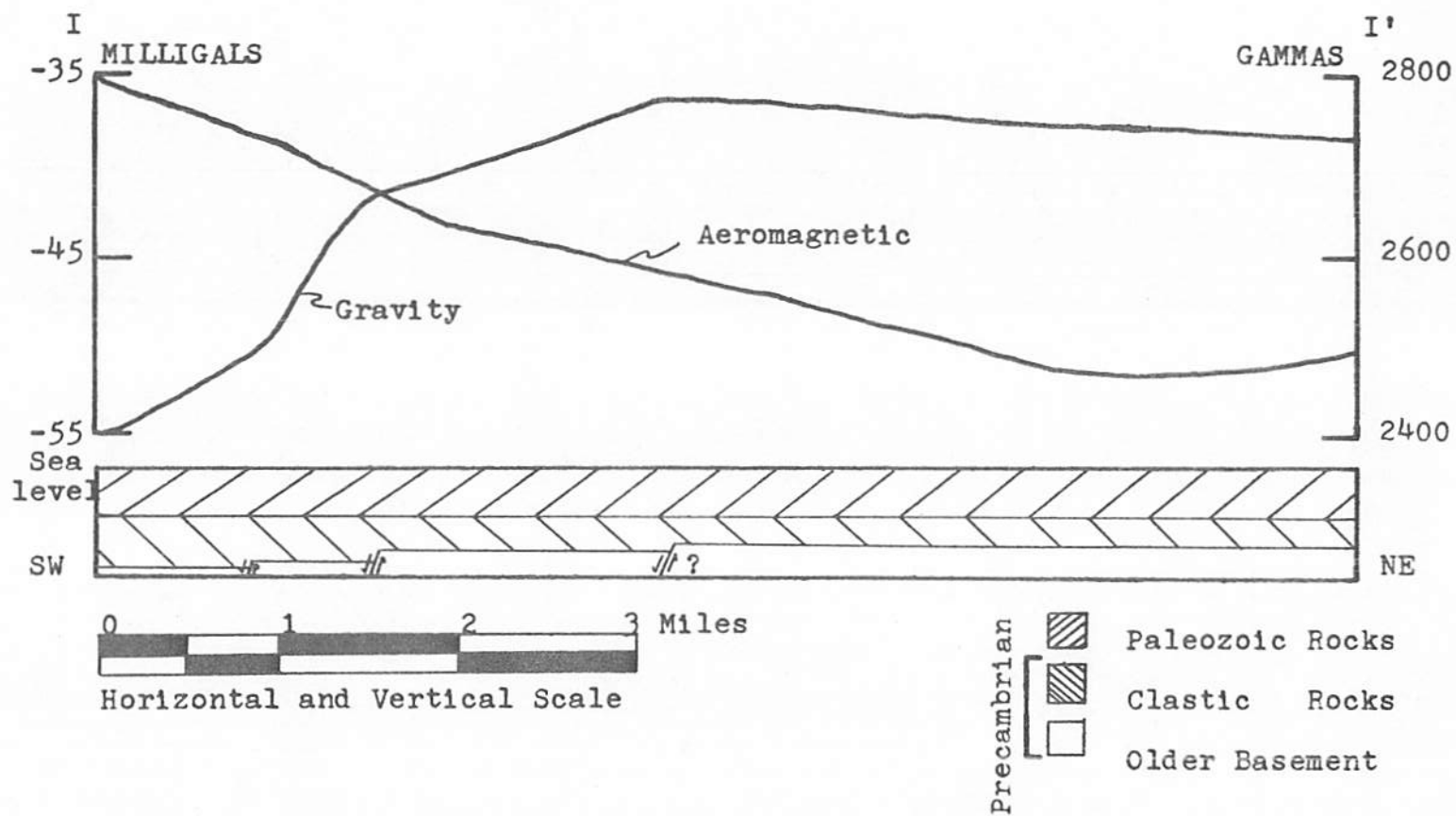


Figure 10. Cross section I-I' with corresponding gravity and aeromagnetic profiles.

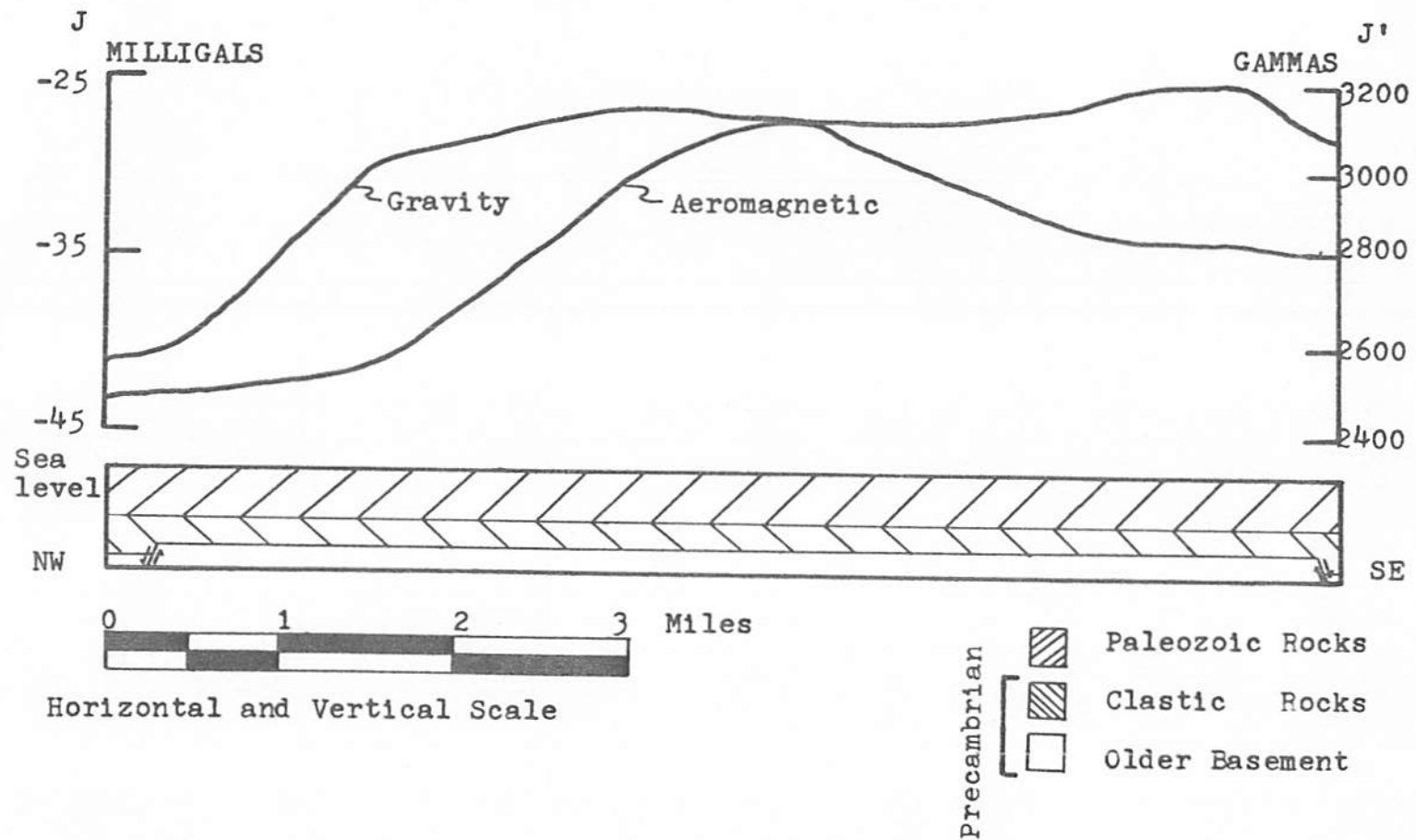


Figure 11. Cross section J-J' with corresponding gravity and aeromagnetic profiles.

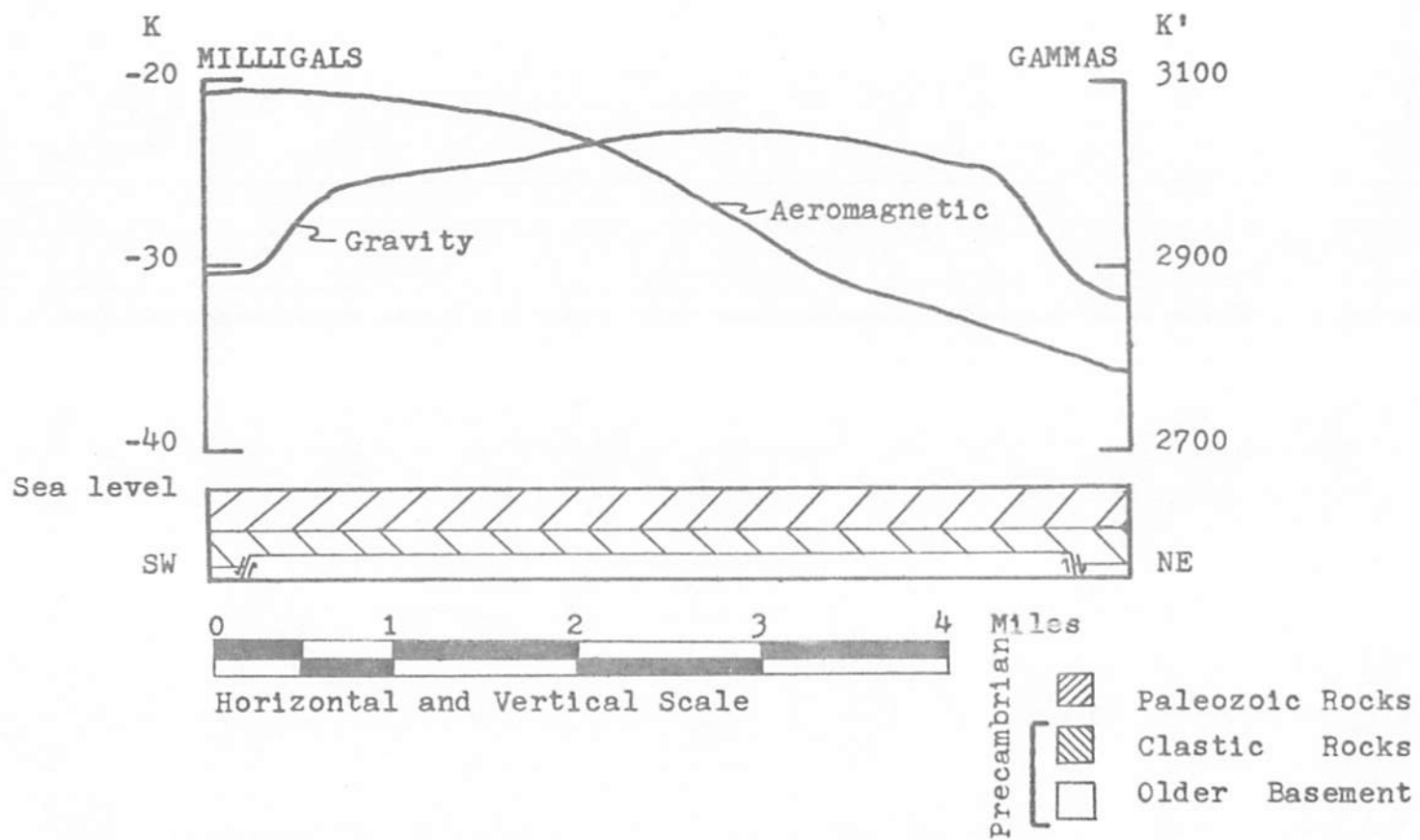


Figure 12. Cross section K-K' with corresponding gravity and aeromagnetic profiles.

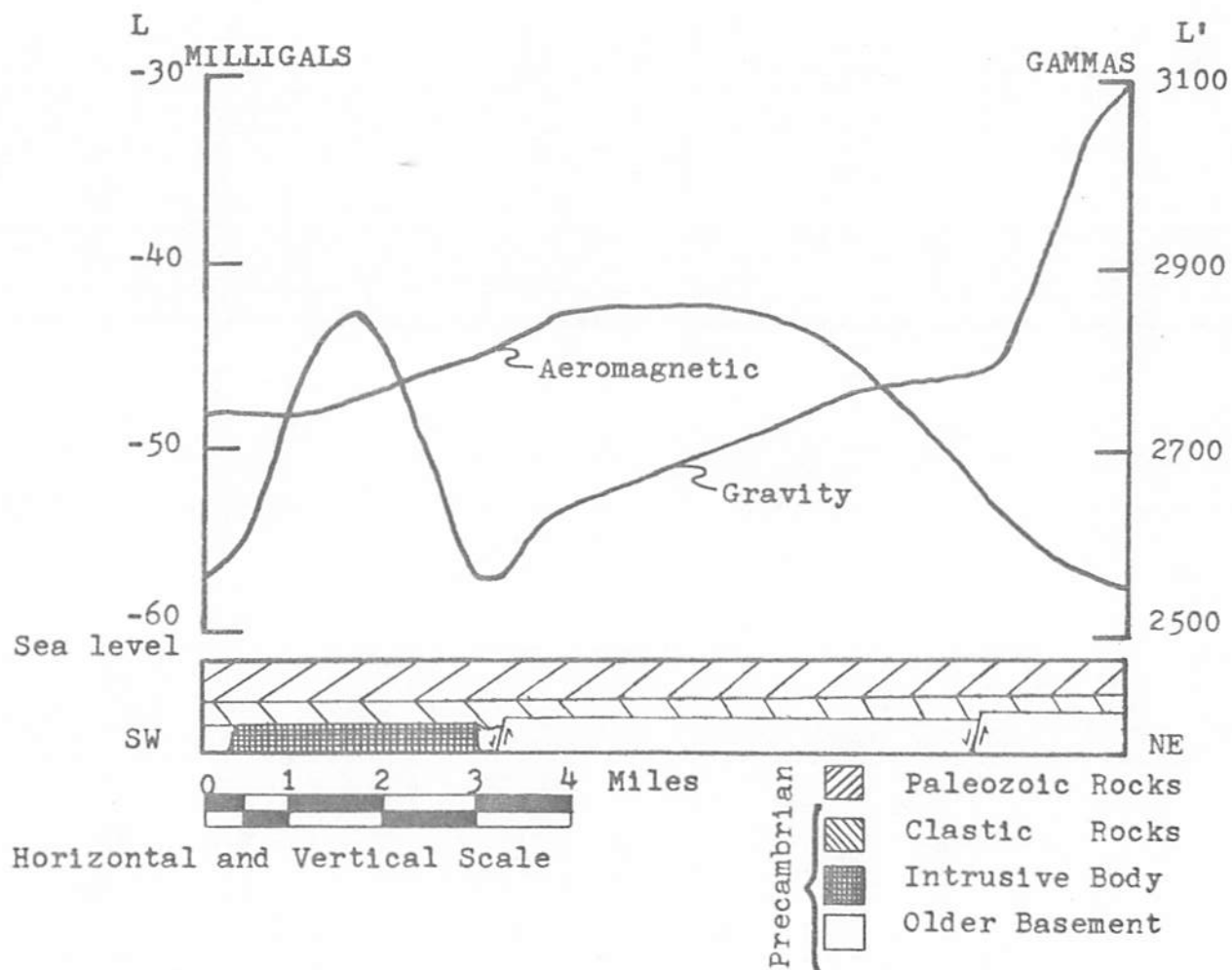


Figure 13. Cross section L-L' with corresponding gravity and aeromagnetic profiles.

postulated as syenite or diorite intrusives with the older Precambrian basement as the host rock. The Cedar Falls South anomaly, the Waterloo anomaly, and the Gilbertville anomaly all were postulated as granite-like intrusives into Keweenawan clastics.

RESULTS

The results of the survey can be summarized as follows:

1. The Blackhawk County Bouguer gravity map was found to have a very steep gradient of 67 milligals, ranging from -66 in the northwest to +1 in the southeast. This confirms the suggested basement configurations on the east side of the Midcontinent Gravity High by the basement map of the United States (A.A.P.G., The Tectonic Map of the U.S., 1968). The gravity high in the southeast corner of the county supports the postulated presence of Keweenawan igneous rocks in this area.
2. It was shown that there was a striking similarity between the Bouguer gravity map and the aeromagnetic map of Blackhawk County. The linear features and anomalies all appeared in the same relative locations and along the same trends.
3. The Bouguer gravity map depicts five positive anomalies trending in a linear northwest-southeast pattern. These

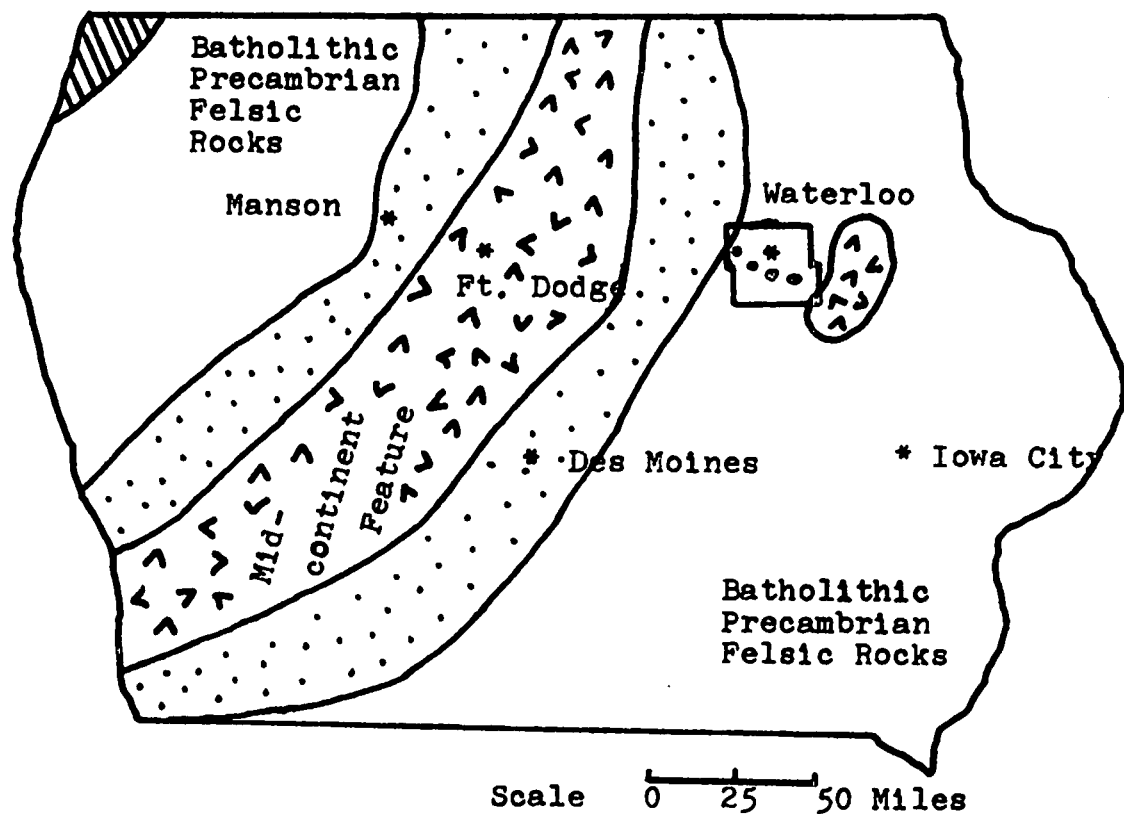
Table I. Compilation of fitted density contrasts to the known gravitational effect together with a postulated source which produces the anomalies.

ANOMALY	CALCULATED DENSITY CONTRAST	RESULTING EFFECT milligals	KNOWN EFFECT milligals	POSTULATED INTRUSIVE	POSTULATED HOST ROCK
Cedar Falls West	0.20	7.1	7	syenite; diorite	older basement
Cedar Falls South	0.38	15.0	15	granite-like	clastics
Waterloo	0.30	8.0	8	granite-like	clastics
Gilbertville	0.35	8.0	8	granite-like	clastics
La Porte City East	0.25	6.0	6	syenite;	older
	0.08	2.0	2	diorite	basement

Note: The resulting and known effect of the La Porte City East anomaly was taken from the Bouguer gravity map (Pl.III) and the profiles, the first value being from the Bouguer map and the second value from the profiles.

anomalies are suggested as intrusive bodies due to shape, closure patterns, associations with faulted terrane, calculated contrast and corresponding theoretical gravity profiles. These intrusives may be correlatable in part with the Iowa Plutonic Complex of Lidiak (Lidiak, 1966).

4. The linear features are suggestive of faulted areas, and are arranged in a basement en echelon configuration.
5. Basins of Keweenawan clastics were depicted by gravity and magnetic profiles and determined to overlie the intrusives. In general, the basins tended to flank the eastern margins of the intrusives.
6. All five anomalies retained their identity when subjected to a trend-surface analysis which regressed to the sixth order. The Gilbertville anomaly became the most outstanding of all the anomalies in terms of shape, magnitude and location throughout the six regressions.
7. The three faults postulated by Aero Service Inc. from their aeromagnetic data were also depicted from the gravity profiles. A major fault trending northeast-southwest was determined to extend approximately an additional seven miles to the southwest towards Hudson. In addition, smaller faults were depicted by the gravity data in areas of strong linear features on the Bouguer gravity map and provided a better understanding of the en echelon pattern of the basement.
8. Figure 14 summarizes the regional basement geologic relations which became evident from previous geologic literature and the results of this survey.







- 
 Keweenawan clastics (gravity low of King and Zeitz flanking midcontinent high).
- 
 Keweenawan igneous of midcontinent high.
- 
 Souix Quartzite formation.
- 
 Older Precambrian (including Iowa plutonic complex of Lidiak, 1966 of probable Elsonian age (1460-1280 m.y.)).

Figure 4. Regional basement geologic relations in Iowa confirmed by gravity study of Blackhawk County (modified from King and Zeitz (1971), King (1969), Lidiak (1966), and Basement Map of United States (1968)). Local anomalies overlain by Keweenawan clastics are indicated diagrammatically.

CONCLUSIONS

More information concerning the Iowa basement complex has been uncovered via geophysical techniques. Previous unknown and/or unconfirmed structures have now been confirmed and located such that they may be studied in detail by any interested party for evaluation of future economic potential.

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APPENDIX

PRINCIPAL FACTS AT GRAVITY BASE STATIONS

PRINCIPAL FACTS AT GRAVITY BASE STATIONS

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
1001	42 33.0	-92 23.3	265.481	980302.465	-53.867
1000	42 32.5	-92 32.7	276.149	980288.093	-65.392
2000	42 29.6	-92 29.6	291.694	908287.490	-58.294
3000	42 38.6	-92 20.3	284.684	980312.266	-48.684
4000	42 34.3	-92 20.3	279.807	980308.369	-47.094
5000	42 33.4	-92 10.7	299.009	980 319247	-31.093
6000	42 28.2	-92 10.7	289.865	980322.711	-21.635
7000	42 23.9	-92 21.4	277.673	980312.639	-27.663
8000	42 20.5	-92 27.4	300.533	980290.382	-40.334
9000	42 20.5	-92 13.1	284.074	980319.999	-13.953
1	42 38.6	-92 19.1	296.571	980311.517	-47.095
2	42 38.6	-92 17.8	309.068	980310.688	-45.467
3	42 38.6	-92 16.6	307.849	980312.200	-44.195
4	42 38.6	-92 15.5	299.099	980315.648	-42.485
5	42 38.6	-92 14.4	308.458	980315.427	-40.848
6	42 38.6	-92 13.1	307.544	980316.325	-40.130
7	42 38.6	-92 12.4	301.448	980319.550	-38.103
8	42 38.6	-92 11.8	308.153	980319.867	-36.468
9	42 37.7	-92 20.3	298.705	980307.471	-49.373
10	42 37.7	-92 19.1	295.352	980310.194	-47.310
11	42 37.7	-92 17.8	303.886	980310.649	-45.176
12	42 37.7	-92 16.6	306.020	980311.930	-43.476
13	42 37.7	-92 15.5	296.266	980315.341	-41.982
14	42 37.7	-92 14.4	301.753	980315.666	-40.579
15	42 37.7	-92 13.1	305.410	980315.994	-39.531
16	42 37.7	-92 12.4	298.095	980320.120	-36.844
17	42 37.7	-92 11.8	306.934	980319.581	-35.645
18	42 36.7	-92 20.3	291.999	980307.401	-49.263
19	42 36.7	-92 19.1	297.790	980308.304	-47.221

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
20	42 36.7	-92 17.8	301.143	980309.893	-44.973
21	42 36.7	-92 16.6	305.715	980310.937	-43.030
22	42 36.7	-92 15.5	294.742	980314.598	-41.526
23	42 36.7	-92 14.4	298.095	980316.268	-39.197
24	42 36.7	-92 13.1	301.143	980316.767	-38.099
25	42 36.7	-92 12.4	300.838	980319.868	-35.057
26	42 36.7	-92 11.8	304.191	980320.619	-33.648
27	42 35.8	-92 20.3	290.780	980313.686	-41.869
28	42 35.8	-92 19.1	300.020	980314.726	-37.832
29	42 35.8	-92 17.8	304.191	980316.159	-36.758
30	42 35.8	-92 16.6	299.924	980317.269	-36.488
31	42 35.8	-92 15.5	297.485	980321.995	-32.241
32	42 35.8	-92 14.4	293.828	980325.176	-29.779
33	42 35.8	-92 13.1	294.133	980327.376	-27.519
34	42 35.8	-92 12.4	293.523	980329.447	-25.568
35	42 35.8	-92 11.8	302.667	980327.745	-25.472
36	42 35.5	-92 20.3	281.026	980315.409	-41.613
37	42 35.5	-92 19.1	300.838	980314.366	-38.762
38	42 35.5	-92 17.8	300.838	980317.844	-35.284
39	42 35.5	-92 16.6	303.886	980319.862	-32.666
40	42 35.5	-92 15.5	295.961	980323.465	-30.621
41	42 35.5	-92 14.4	299.009	980324.622	-28.865
42	42 35.5	-92 13.1	298.095	980325.809	-27.857
43	42 35.5	-92 12.4	291.389	980328.332	-26.653
44	42 35.5	-92 11.8	295.047	980327.577	-26.689
45	42 35.5	-92 19.1	284.684	980318.598	-37.705
46	42 34.3	-92 17.8	286.512	980322.002	-32.143
47	42 34.3	-92 16.6	305.410	980320.684	-29.746
48	42 34.3	-92 15.5	282.550	980326.630	-28.294
49	42 34.3	-92 14.4	290.475	980325.040	-28.326

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
50	42 34.3	-92 13.1	291.999	980325.782	-27.285
51	42 34.3	-92 12.4	295.352	980325.162	-27.245
52	42 34.3	-92 11.8	294.473	980327.244	-25.343
53	42 33.4	-92 20.3	282.550	980315.702	-37.874
54	42 33.4	-92 19.1	282.245	980320.610	-33.026
55	42 33.4	-92 17.8	283.769	980324.446	-28.890
56	42 33.4	-92 16.6	298.705	980323.432	-26.968
57	42 33.4	-92 15.5	286.817	980325.559	-27.178
58	42 33.4	-92 14.4	278.283	980327.886	-26.528
59	42 33.4	-92 13.1	279.197	980328.032	-26.203
60	42 33.4	-92 12.4	293.523	980325.270	-26.148
61	42 33.4	-92 11.8	297.485	980325.436	-25.203
62	42 32.5	-92 20.3	278.283	980317.903	-35.163
63	42 32.5	-92 19.1	268.529	980325.110	-29.873
64	42 32.5	-92 17.8	275.540	980327.720	-25.885
65	42 32.5	-92 16.6	295.047	980321.445	-28.325
66	42 32.5	-92 15.5	285.903	980327.441	-24.126
67	42 32.5	-92 14.4	278.283	980328.746	-24.320
68	42 32.5	-92 13.1	277.978	980329.266	-23.860
69	42 32.5	-92 12.4	282.855	980327.773	-24.394
70	42 32.5	-92 11.8	290.170	980327.152	-23.576
71	42 38.6	-92 21.4	289.865	980309.062	-50.869
72	42 38.6	-92 22.5	284.379	980308.694	-52.315
73	42 38.6	-92 23.8	288.341	980307.286	-52.944
74	42 38.6	-92 25.0	286.817	980306.922	-53.608
75	42 38.6	-92 26.2	274.625	980308.721	-54.206
76	42 38.6	-92 27.4	272.187	980308.381	-55.026
77	42 37.7	-92 27.4	270.663	980305.895	-56.462
78	42 37.7	-92 26.2	274.625	980306.141	-55.437
79	42 37.7	-92 25.0	291.389	980303.420	-54.862
80	42 37.7	-92 23.8	285.903	980305.591	-53.770

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
81	42 37.7	-92 22.5	299.314	980303.738	-52.986
82	42 37.7	-92 21.4	293.218	980306.597	-51.325
83	42 36.7	-92 21.4	299.009	980303.655	-51.630
84	42 36.7	-92 22.5	291.999	980303.108	-53.555
85	42 36.7	-92 23.8	299.314	980300.473	-54.752
86	42 36.7	-92 25.0	294.133	980300.126	-56.118
87	42 36.7	-92 26.2	267.920	980303.035	-58.363
88	42 36.7	-92 27.4	268.225	980303.677	-57.661
89	42 35.8	-92 27.4	268.225	980300.232	-59.057
90	42 35.8	-92 26.2	270.358	980301.389	-58.180
91	42 35.8	-92 25.0	290.170	980298.493	-57.189
92	42 35.8	-92 23.8	279.197	980302.372	-55.460
93	42 35.8	-92 22.5	283.769	980303.313	-53.619
94	42 35.8	-92 21.4	288.951	980304.214	-51.700
95	42 35.5	-92 21.4	290.780	980302.548	-52.557
96	42 35.5	-92 22.5	272.492	980302.719	-55.982
97	42 35.5	-92 23.8	288.646	980298.692	-56.832
98	42 35.5	-92 25.0	280.112	980298.578	-58.624
99	42 35.5	-92 26.2	266.091	980300.004	-59.955
100	42 35.5	-92 27.4	266.700	980298.879	-60.960
101	42 34.3	-92 27.4	267.005	980297.535	-60.445
102	42 34.3	-92 26.2	265.177	980298.807	-59.533
103	42 34.3	-92 25.0	266.700	980299.527	-58.513
104	42 34.3	-92 23.8	274.321	980300.312	-56.230
105	42 34.3	-92 22.5	265.481	980304.575	-53.705
106	42 34.3	-92 21.4	269.739	980306.877	-50.564
107	42 33.4	-92 21.4	274.016	980306.081	-49.172
108	42 33.4	-92 22.5	265.786	980304.993	-51.878
109	42 33.4	-92 25.0	264.872	980299.537	-57.514
110	42 33.4	-92 26.2	264.567	980298.249	-58.862
111	42 24.8	-92 21.4	286.817	980313.609	-26.243

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
112	42 25.7	-92 21.4	292.913	980315.094	-24.907
113	42 26.5	-92 21.4	287.732	980318.191	-24.028
114	42 27.4	-92 21.4	276.759	980321.197	-24.527
115	42 28.2	-92 21.4	288.037	980317.199	-27.507
116	42 28.9	-92 21.4	269.749	980320.080	-29.270
117	42 29.5	-92 21.4	262.128	980320.090	-31.657
118	42 23.9	-92 22.5	288.951	980308.113	-29.972
119	42 23.9	-92 23.8	284.684	980307.013	-31.910
120	42 23.9	-92 25.0	295.961	980300.851	-35.856
121	42 23.9	-92 26.2	288.341	980298.385	-39.820
122	42 23.9	-92 27.4	289.256	980294.028	-43.997
123	42 24.8	-92 26.2	277.978	980302.314	-39.276
124	42 24.8	-92 25.0	294.437	980303.495	-34.860
125	42 24.8	-92 23.8	283.160	980311.216	-29.335
126	42 24.8	-92 22.5	286.512	980311.570	-28.342
127	42 27.4	-92 22.5	284.074	980315.810	-28.476
128	42 27.4	-92 23.8	263.653	980312.681	-35.620
129	42 27.4	-92 25.0	263.653	980311.808	-36.493
130	42 27.4	-92 26.2	282.245	980299.998	-44.648
131	42 26.5	-92 26.2	280.721	980304.297	-39.300
132	42 26.5	-92 25.0	269.749	980310.797	-34.957
133	42 26.5	-92 23.8	278.893	980313.279	-30.677
134	42 26.5	-92 22.5	294.133	980312.980	-27.980
135	42 25.7	-92 22.5	289.561	980313.256	-27.405
136	42 25.7	-92 23.8	277.673	980312.656	-30.342
137	42 25.7	-92 25.0	284.074	980307.027	-34.712
138	42 23.2	-92 21.4	280.721	980310.162	-28.492
139	42 22.2	-92 21.4	291.389	980305.013	-30.046
140	42 21.4	-92 21.4	274.016	980306.345	-30.932
141	42 21.4	-92 22.5	287.427	980302.566	-32.074
142	42 21.4	-92 23.8	295.961	980299.268	-33.694

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
143	42 21.4	-92 25.0	292.609	980297.787	-35.835
144	42 21.4	-92 26.2	311.201	980291.858	-38.108
145	42 22.2	-92 26.2	301.448	980294.450	-38.632
146	42 22.2	-92 25.0	306.629	980296.216	-35.847
147	42 22.2	-92 23.8	293.523	980301.439	-33.201
148	42 22.2	-92 22.5	291.999	980303.414	-31.525
149	42 23.2	-92 22.5	292.609	980305.845	-30.472
150	42 23.2	-92 23.8	301.143	980301.213	-33.427
151	42 23.2	-92 25.0	298.400	980297.930	-37.248
152	42 23.2	-92 26.2	300.533	980294.554	-40.205
153	42 32.5	-92 31.0	297.485	980289.899	-59.391
154	42 32.5	-92 29.6	280.417	980289.937	-62.709
155	42 33.4	-92 29.6	278.893	980292.138	-62.157
156	42 33.4	-92 30.4	282.855	980291.824	-61.691
157	42 33.4	-92 31.0	282.245	980289.183	-64.452
158	42 33.4	-92 32.7	276.759	980293.376	-61.338
159	42 35.0	-92 32.7	267.615	980295.973	-62.937
160	42 35.0	-92 31.8	267.615	980297.499	-61.410
161	42 35.0	-92 30.4	270.053	980298.351	-61.080
162	42 35.8	-92 30.4	266.700	980299.732	-60.557
163	42 35.8	-92 31.0	270.053	980297.435	-62.194
164	42 35.8	-92 31.8	272.492	980297.326	-61.824
165	42 35.8	-92 32.7	275.844	980295.895	-62.595
166	42 36.7	-92 32.7	268.834	980298.657	-62.560
167	42 36.7	-92 31.8	270.968	980300.908	-59.890
168	42 36.7	-92 30.4	269.139	980299.888	-61.270
175	42 31.6	-92 32.7	384.379	980286.562	-63.956
176	42 31.6	-92 31.8	281.636	980286.413	-64.645
177	42 31.6	-92 30.7	298.705	980286.353	-61.350
178	42 31.6	-92 29.6	282.245	980288.542	-62.397

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
179	42 31.6	-92 28.8	288.341	980291.817	-57.923
180	42 32.5	-92 28.5	289.561	980291.817	-59.032
181	42 32.7	-92 26.7	259.081	980297.671	-59.470
182	42 33.4	-92 27.4	263.957	980297.396	-59.835
183	42 33.8	-92 28.8	265.786	980298.162	-59.309
184	42 34.4	-92 28.8	265.177	980298.480	-59.860
185	42 35.5	-92 28.8	268.834	980298.676	-60.743
186	42 35.8	-92 28.8	279.502	980298.466	-59.305
187	42 36.7	-92 28.8	271.577	980302.889	-57.789
188	42 38.6	-92 28.8	302.362	980307.321	-50.153
189	42 38.6	-92 29.6	272.797	980307.465	-55.822
190	42 37.7	-92 28.8	271.272	980305.570	-56.668
191	42 28.9	-92 29.6	284.074	980288.515	-58.018
192	42 28.2	-92 29.6	298.095	980285.647	-57.081
193	42 28.2	-92 28.8	289.256	980290.029	-54.437
194	42 20.9	-92 28.5	288.341	980290.814	-42.898
195	42 29.8	-92 28.5	287.122	980291.534	-55.749
196	42 30.7	-92 28.5	284.684	980292.362	-56.748
197	42 30.7	-92 29.6	290.170	980288.518	-59.514
198	42 30.7	-92 30.7	292.609	980286.161	-61.391
199	42 29.8	-92 30.7	280.417	980285.355	-63.246
200	42 28.9	-92 30.7	270.358	980284.720	-64.510
201	42 28.2	-92 30.7	302.057	980281.833	-60.116
202	42 28.2	-92 31.8	305.410	980279.758	-61.532
203	42 28.9	-92 31.8	307.239	980281.785	-60.194
204	42 29.8	-92 31.8	293.828	980284.785	-61.179
205	42 30.7	-92 31.8	302.667	980286.921	-58.653
206	42 30.7	-92 32.7	303.277	980285.040	-60.415
207	42 29.8	-92 32.7	304.801	980284.510	-59.297
208	42 29.9	-92 32.7	308.153	980282.439	-60.859
209	42 28.2	-92 32.7	308.763	980279.888	-60.743

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
210	42 27.4	-92 31.8	302.972	980282.055	-58.516
211	42 27.4	-92 30.7	306.629	980282.099	-57.572
212	42 27.4	-92 29.6	305.105	980283.844	-56.307
213	42 27.4	-92 28.8	296.876	980289.926	-51.843
214	42 27.4	-92 27.4	287.122	980294.425	-49.261
215	42 26.5	-92 27.4	280.112	980297.244	-46.473
216	42 26.5	-92 28.8	302.362	980286.651	-52.692
217	42 26.5	-92 29.6	307.239	980282.947	-55.437
218	42 26.5	-92 30.7	306.020	980281.362	-57.262
219	42 26.5	-92 31.8	293.523	980283.211	-57.869
220	42 25.7	-92 31.8	302.362	980282.740	-55.404
221	42 25.7	-92 30.7	306.629	980281.884	-55.421
222	42 25.7	-92 29.6	291.084	980286.541	-53.821
223	42 25.7	-92 28.8	280.721	980291.743	-50.656
224	42 25.7	-92 27.4	268.834	980298.776	-45.959
225	42 24.2	-92 28.8	268.529	980294.398	-48.151
226	42 24.2	-92 29.6	294.133	980285.916	-51.599
227	42 24.2	-92 30.7	298.705	980283.754	-52.863
228	42 24.2	-92 31.8	300.229	980281.077	-55.240
229	42 23.6	-92 31.8	292.609	980282.508	-54.409
230	42 23.6	-92 30.7	283.465	980287.811	-50.903
231	42 23.6	-92 29.6	272.187	980291.856	-49.075
232	42 23.6	-92 28.8	274.321	980292.216	-48.296
233	42 22.7	-92 29.6	276.149	980289.005	-49.800
234	42 34.3	-92 10.7	299.009	980321.710	-29.978
169	42 37.7	-92 29.6	270.358	980302.549	-59.868
170	42 37.7	-92 31.0	270.053	980303.194	-59.282
171	42 37.7	-92 32.7	275.235	980300.984	-60.475
172	42 38.6	-92 32.7	273.406	980296.356	-66.811
173	42 38.6	-92 31.8	269.749	980303.125	-60.761
174	42 38.6	-92 31.0	268.225	980304.655	-59.530

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
235	42 34.3	-92 9.6	296.266	980321.005	-31.222
236	42 34.3	-92 8.5	283.769	980324.813	-29.871
237	42 35.5	-92 8.5	282.550	980326.030	-30.693
238	42 35.5	-92 9.6	284.379	980324.640	-31.723
239	42 35.5	-92 10.7	301.448	980321.654	-31.353
240	42 35.8	-92 10.7	301.143	980323.786	-29.730
241	42 35.8	-92 9.6	284.684	980326.259	-30.494
242	42 35.8	-92 8.5	279.197	980329.001	-28.830
243	42 36.7	-92 10.7	310.592	980322.302	-30.706
244	42 36.7	-92 9.6	284.074	980327.156	-31.065
245	42 36.7	-92 8.5	288.037	980329.748	-27.694
246	42 36.7	-92 7.3	297.790	980329.043	-26.481
247	42 37.7	-92 7.3	295.656	980329.328	-28.115
248	42 37.7	-92 8.5	299.314	980329.329	-27.396
249	42 38.6	-92 10.7	304.801	980324.650	-32.344
250	42 37.7	-92 10.7	311.811	980321.664	-32.603
251	42 38.1	-92 9.6	300.838	980327.849	-29.175
252	42 38.6	-92 8.5	304.801	980330.425	-26.569
253	42 38.6	-92 7.3	308.763	980331.766	-24.450
254	42 38.6	-92 6.2	310.896	980332.174	-23.622
255	42 37.7	-92 6.2	302.362	980332.489	-23.635
256	42 36.7	-92 6.2	302.667	980332.389	-22.177
257	42 35.6	-92 6.2	307.849	980330.318	-21.580
258	42 34.2	-92 6.2	304.801	980326.228	-24.321
259	42 33.4	-92 6.2	290.780	980327.643	-24.314
260	42 33.4	-92 9.6	292.609	980322.228	-29.370
261	42 33.4	-92 8.5	288.341	980323.999	-28.438
262	42 33.4	-92 7.3	283.465	980327.196	-26.200
263	42 32.5	-92 6.2	286.817	980325.599	-25.789
264	42 32.5	-92 8.5	304.191	980320.756	-27.216

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
265	42 32.5	-92 9.6	300.838	980320.311	-28.321
266	42 32.5	-92 10.7	299.924	980318.920	-29.891
267	42 31.4	-92 10.7	296.571	980320.074	-27.748
268	42 31.4	-92 9.6	303.581	980318.854	-27.590
269	42 31.4	-92 8.5	300.229	980322.001	-25.102
270	42 31.4	-92 6.2	297.485	980325.442	-22.200
271	42 30.7	-92 6.2	297.485	980326.038	-20.555
272	42 30.7	-92 7.3	297.790	980323.612	-22.922
273	42 30.7	-92 8.5	295.961	980321.941	-24.952
274	42 30.7	-92 9.6	300.229	980319.990	-26.064
275	42 30.7	-92 10.7	296.876	980319.851	-26.862
276	42 32.5	-92 21.4	275.540	980307.073	-46.533
277	42 32.5	-92 22.5	263.043	980306.342	-49.720
278	42 32.5	-92 23.8	263.653	980303.434	-52.508
279	42 32.5	-92 25.0	264.567	980300.629	-55.133
290	42 31.6	-92 22.5	260.909	980308.257	-46.876
291	42 31.6	-92 21.4	271.882	980309.820	-43.156
292	42 31.6	-92 20.3	270.053	980313.820	-39.516
293	42 31.6	-92 19.1	272.492	980318.229	-34.626
294	42 31.6	-92 17.8	289.561	980318.338	-31.162
295	42 31.6	-92 16.6	290.475	980319.447	-29.874
296	42 31.6	-92 15.5	286.817	980319.824	-30.215
297	42 31.6	-92 14.4	269.139	980323.995	-29.520
298	42 31.6	-92 13.1	273.101	980322.957	-29.779
299	42 31.6	-92 12.4	284.160	980321.760	-28.999
300	42 31.6	-92 11.8	297.790	980318.626	-29.256
301	42 30.7	-92 11.8	291.999	980319.625	-28.047
302	42 30.7	-92 12.4	293.828	980318.953	-28.359
303	42 30.7	-92 13.1	296.876	980319.942	-26.771
304	42 30.7	-92 14.4	267.310	980324.519	-28.007

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
305	42 30.7	-92 15.5	267.310	980324.898	-27.628
306	42 30.7	-92 16.6	276.759	980323.751	-26.917
307	42 30.7	-92 17.8	274.625	980323.200	-27.887
308	42 30.7	-92 19.1	267.920	980321.319	-31.087
309	42 30.7	-92 20.3	264.567	980319.077	-33.988
310	42 30.7	-92 21.4	259.081	980315.374	-38.770
311	42 30.7	-92 22.5	256.642	980313.443	-41.181
312	42 28.2	-92 9.6	287.427	980323.752	-22.074
313	42 28.2	-92 8.5	291.389	980323.530	-20.517
314	42 28.2	-92 7.3	291.999	980323.146	-20.781
315	42 28.2	-92 6.2	292.913	980325.153	-18.594
316	42 28.2	-92 5.1	295.656	980322.848	-20.360
317	42 28.9	-92 5.1	296.571	980322.634	-21.442
318	42 28.9	-92 6.2	300.838	980325.998	-17.240
319	42 29.9	-92 6.2	299.619	980327.215	-17.761
320	42 29.9	-92 7.3	299.314	980324.004	-21.031
321	42 28.9	-92 7.3	298.705	980324.416	-19.241
322	42 28.9	-92 8.5	291.694	980322.750	-22.285
323	42 29.9	-92 8.5	299.009	980321.291	-23.805
324	42 29.9	-92 9.6	298.705	980319.710	-25.445
325	42 28.9	-92 9.6	295.352	980321.262	-23.054
326	42 28.9	-92 10.7	303.277	980321.337	-21.421
327	42 29.9	-92 10.7	307.849	980319.986	-23.371
328	42 28.9	-92 11.8	301.143	980322.515	-20.662
329	42 28.9	-92 12.4	294.437	980324.074	-20.422
330	42 28.9	-92 13.1	293.523	980322.961	-21.714
331	42 28.9	-92 14.4	274.321	980328.488	-19.963
332	42 28.9	-92 15.5	261.214	980329.322	-21.706
333	42 28.9	-92 16.6	270.053	980328.074	-21.216
334	42 28.9	-92 17.8	256.032	980330.143	-21.904
335	42 28.9	-92 19.1	257.556	980328.315	-23.432

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
336	42 29.9	-92 19.1	257.556	980324.183	-29.062
337	42 29.9	-92 17.8	260.604	980327.180	-25.466
338	42 29.9	-92 16.6	265.177	980328.342	-23.405
339	42 29.9	-92 15.5	266.700	980327.434	-24.014
340	42 29.9	-92 14.4	277.064	980326.378	-23.032
341	42 29.9	-92 13.1	282.245	980325.464	-22.927
342	42 29.9	-92 12.4	297.790	980320.924	-24.411
343	42 29.9	-92 11.8	294.437	980323.285	-22.709
344	42 27.4	-92 5.1	296.876	980324.176	-17.593
345	42 27.4	-92 6.2	294.437	980324.638	-17.611
346	42 27.4	-92 7.3	292.609	980322.153	-20.455
347	42 27.4	-92 8.5	288.951	980322.198	-21.130
348	42 27.4	-92 9.6	272.492	980325.076	-21.487
349	42 27.4	-92 10.7	281.636	980323.402	-21.363
350	42 27.4	-92 11.8	291.389	980319.018	-23.830
351	42 27.4	-92 12.4	287.427	980319.442	-24.185
352	42 27.4	-92 13.1	266.396	980324.188	-23.574
353	42 28.2	-92 13.1	282.245	980324.128	-21.716
354	42 28.2	-92 14.4	286.529	980328.507	-20.034
355	42 28.2	-92 15.5	262.128	980330.735	-19.065
356	42 28.2	-92 17.8	257.556	980330.901	-19.797
357	42 27.4	-92 17.8	256.032	980331.231	-18.568
358	42 27.4	-92 15.5	256.032	980330.780	-19.019
359	42 28.2	-92 11.8	289.865	980321.781	-22.565
360	42 28.2	-92 12.4	273.406	980324.400	-23.182
361	42 21.4	-92 27.4	295.047	980292.392	-40.751
362	42 22.2	-92 27.4	294.742	980292.049	-42.351
363	42 22.2	-92 28.8	295.961	980288.721	-45.439
364	42 21.4	-92 28.8	285.598	980290.760	-44.240
365	42 20.5	-92 28.8	299.314	980289.148	-41.808

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
366	42 19.6	-92 28.8	304.496	980285.719	-42.870
367	42 18.7	-92 28.8	297.485	980285.967	-42.652
368	42 17.8	-92 28.8	296.266	980285.944	-41.568
369	42 17.8	-92 29.6	303.277	980280.214	-45.920
370	42 18.7	-92 29.6	307.239	980280.956	-45.746
371	42 19.6	-92 29.6	309.068	980281.943	-45.747
372	42 20.5	-92 29.6	302.362	980283.605	-46.751
373	42 21.4	-92 29.6	289.561	980286.080	-48.141
374	42 22.2	-92 29.6	276.149	980288.449	-49.607
375	42 22.2	-92 30.7	290.475	980284.063	-51.176
376	42 21.4	-92 30.7	285.903	980284.060	-50.880
377	42 20.5	-92 30.7	301.143	980280.593	-50.003
378	42 19.6	-92 30.7	310.287	980277.769	-49.681
380	42 17.8	-92 30.7	306.325	980278.061	-47.473
381	42 17.8	-92 31.8	310.592	980273.499	-51.197
382	42 18.7	-92 31.8	309.373	980273.598	-52.684
383	42 19.6	-92 31.8	305.105	980275.740	-52.729
384	42 20.5	-92 31.8	293.523	980278.918	-53.176
385	42 21.4	-92 31.8	285.598	980281.766	-53.234
386	42 22.2	-92 31.8	277.064	980283.894	-53.983
387	42 23.2	-92 31.8	278.283	980284.173	-54.961
388	42 27.4	-92 14.4	255.118	980327.400	-22.579
389	42 26.5	-92 14.4	290.475	980321.186	-20.493
390	42 26.5	-92 13.1	277.673	980321.035	-23.161
392	42 26.5	-92 11.8	283.465	980319.301	-23.757
393	42 26.5	-92 10.7	281.331	980321.186	-22.291
394	42 26.5	-92 9.6	271.882	980323.459	-21.876
395	42 26.5	-92 8.5	290.170	980321.156	-20.583
396	42 26.5	-92 7.3	291.694	980323.062	-18.377
397	42 26.5	-92 6.2	291.694	980327.806	-13.634

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
398	42 26.5	-92 5.1	293.828	980328.480	-12.540
399	42 25.7	-92 5.7	276.759	980330.714	-12.464
400	42 25.7	-92 7.3	276.149	980327.652	-15.646
401	42 25.7	-92 8.5	283.769	980323.914	-17.885
402	42 25.7	-92 9.6	282.245	980321.213	-20.886
403	42 25.7	-92 10.7	270.663	980323.759	-20.617
404	42 25.7	-92 11.8	270.358	980322.367	-22.070
405	42 25.7	-92 12.4	283.769	980321.158	-20.642
406	42 25.7	-92 13.1	268.225	980236.148	-20.425
407	42 24.8	-92 5.7	283.425	980320.442	-20.070
408	42 24.8	-92 7.3	293.828	980324.468	-14.006
409	42 24.8	-92 8.5	290.780	980321.002	-18.071
410	42 24.8	-92 9.6	283.465	980322.227	-18.284
411	42 24.8	-92 10.7	282.855	980225.698	-14.934
412	42 24.8	-92 11.8	278.283	980329.364	-12.166
413	42 24.8	-92 12.4	282.855	980333.711	- 6.920
414	42 23.9	-92 5.1	281.940	980333.525	- 5.938
415	42 23.9	-92 5.7	278.893	980335.374	- 4.688
416	42 23.9	-92 6.2	277.064	980335.248	- 5.174
417	42 23.9	-92 7.3	275.235	980331.138	- 9.643
418	42 23.9	-92 8.5	284.379	980330.075	- 8.909
419	42 23.9	-92 9.6	272.187	980325.895	-15.486
420	42 23.9	-92 10.7	277.368	980322.605	-17.757
421	42 23.9	-92 11.8	277.064	980322.146	-18.275
422	42 23.9	-92 12.4	293.828	980325.325	-11.800
423	42 23.2	-92 12.8	268.529	980323.457	-17.594
424	42 23.2	-92 12.4	273.711	980323.364	-16.669
425	42 23.2	-92 11.8	277.978	980322.224	-16.969
426	42 23.2	-92 10.7	266.396	980326.968	-14.503
427	42 23.2	-92 9.6	275.844	980326.564	-13.049
428	42 23.2	-92 8.5	277.978	980329.331	- 9.862

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
429	42 23.2	-92 7.3	274.321	980331.838	- 8.074
430	42 23.2	-92 6.2	274.930	980335.641	- 4.152
431	42 23.2	-92 5.7	275.540	980335.071	- 4.602
432	42 23.2	-92 5.1	276.149	980334.916	- 4.637
433	42 19.0	-92 11.8	256.947	980236.257	-12.782
434	42 19.8	-92 10.7	253.899	980326.742	-12.094
435	42 20.5	-92 10.7	260.909	980328.830	- 9.676
436	42 21.4	-92 10.7	283.465	980325.930	- 9.490
437	42 21.4	-92 11.8	264.262	980327.873	-11.322
438	42 21.4	-92 12.4	257.252	980325.746	-14.827
439	42 22.2	-92 11.8	298.705	980325.715	- 7.906
440	42 22.2	-92 12.4	262.738	980324.505	-16.187
441	42 22.2	-92 12.8	258.166	980324.195	-17.396
442	42 22.2	-92 10.7	264.262	980327.372	-13.020
443	42 22.2	-92 9.6	270.358	980328.503	-10.691
444	42 21.4	-92 9.6	274.625	980327.907	- 9.250
445	42 20.5	-92 9.6	252.375	980331.074	- 9.110
446	42 20.5	-92 8.5	271.272	980329.033	- 7.435
447	42 21.4	-92 8.5	271.272	980329.624	- 8.192
448	42 22.2	-92 8.5	275.540	980329.094	- 9.082
449	42 22.0	-92 7.3	251.156	980334.152	- 8.518
450	42 21.4	-92 7.3	249.022	980332.371	- 9.820
451	42 20.5	-92 7.3	240.488	980333.722	- 8.799
452	42 20.5	-92 6.2	244.450	980331.410	-10.332
453	42 20.5	-92 5.1	252.985	980330.228	- 9.836
454	42 21.4	-92 5.1	263.348	980331.816	- 7.558
455	42 21.8	-92 5.1	265.481	980330.824	- 8.730
456	42 22.2	-92 5.1	270.053	980332.422	- 6.832
457	42 21.8	-92 6.2	257.556	980335.257	- 5.855
458	42 19.6	-92 5.1	292.304	980332.020	1.034

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
459	42 18.7	-92 5.1	272.492	980329.788	- 3.746
460	42 18.0	-92 5.1	267.005	980328.198	- 5.366
461	42 18.7	-92 6.2	288.951	980331.422	- 1.125
462	42 19.8	-92 6.2	267.310	980328.501	- 7.698
463	42 19.8	-92 7.3	249.632	980332.945	- 6.730
464	42 19.0	-92 7.3	249.937	980332.280	- 6.137
465	42 19.6	-92 8.5	255.728	980332.245	- 5.932
466	42 19.0	-92 9.1	256.032	980330.605	- 6.614
467	42 19.6	-92 9.6	246.889	980332.095	- 7.819
468	42 20.5	-92 10.1	254.509	980328.953	-10.812
469	42 18.7	-92 10.7	244.450	980325.510	-13.537
470	42 19.0	-92 9.6	240.488	980331.860	- 8.414
471	42 18.7	-92 9.6	242.317	980331.034	- 8.432
472	42 17.8	-92 9.6	245.365	980330.632	- 6.887
473	42 17.8	-92 9.1	244.450	980331.237	- 6.462
474	42 17.8	-92 10.7	246.889	980327.723	- 9.496
475	42 18.7	-92 11.8	247.803	980324.361	-14.027
476	42 20.5	-92 26.2	296.571	980293.520	-37.975
477	42 20.5	-92 25.0	276.759	980294.812	-40.578
478	42 20.5	-92 23.8	292.304	980298.020	-34.313
479	42 20.5	-92 22.5	282.855	980301.134	-33.058
480	42 20.5	-92 21.4	290.475	980300.679	-32.014
481	42 19.6	-92 21.4	276.149	980302.097	-32.065
482	42 18.7	-92 21.4	293.218	980296.945	-32.514
483	42 17.8	-92 21.4	296.571	980296.060	-31.392
484	42 17.8	-92 22.5	295.047	980295.536	-32.216
485	42 18.7	-92 22.5	300.533	980294.016	-34.005
486	42 19.6	-92 22.5	281.062	980299.645	-33.558
487	42 19.6	-92 23.8	302.057	980293.547	-35.521
488	42 18.7	-92 23.8	295.656	980293.037	-35.942

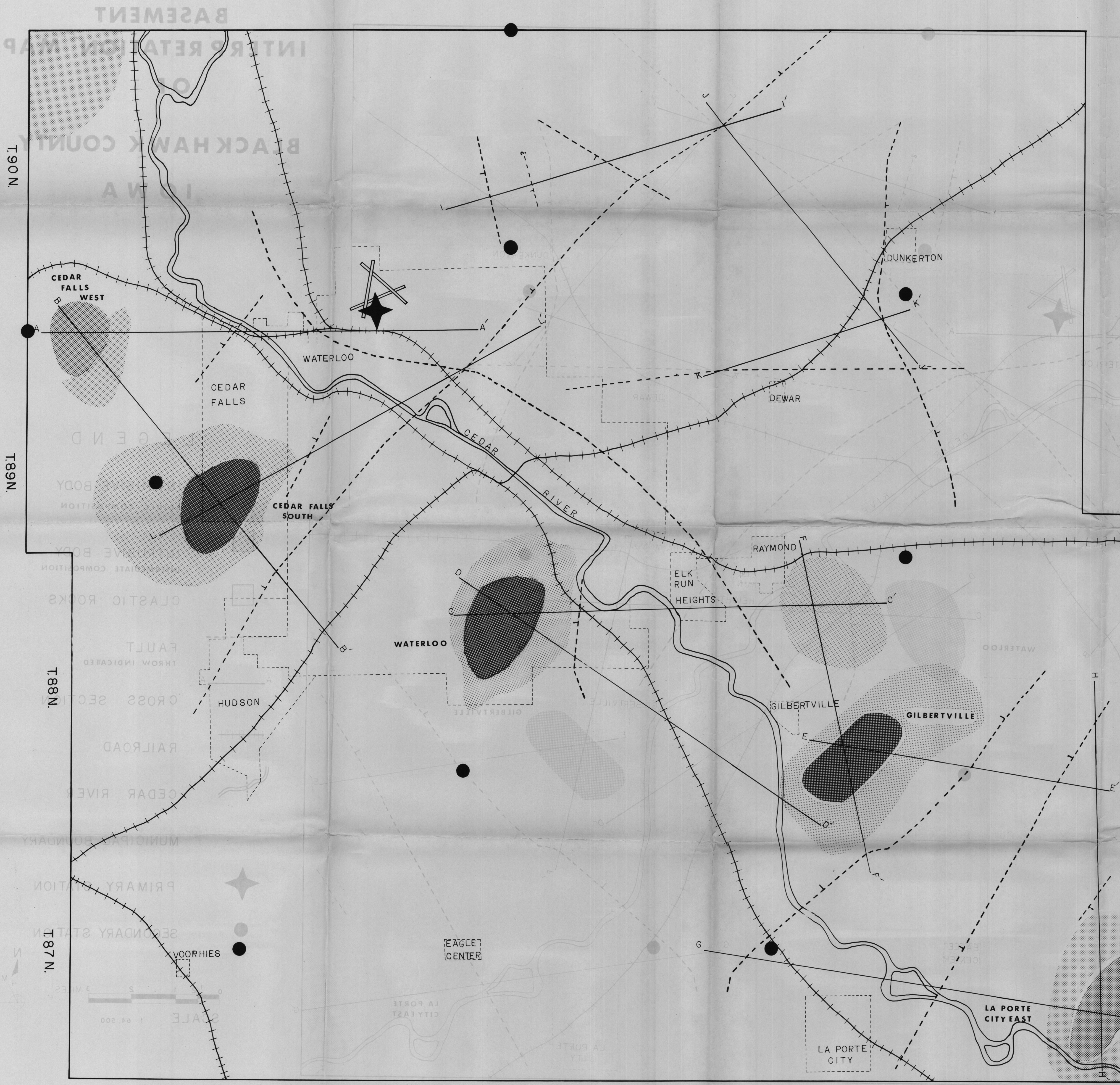
STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
489	42 17.8	-92 23.8	302.972	980290.226	-35.967
490	42 17.8	-92 25.0	301.143	980288.981	-37.572
491	42 18.7	-92 25.0	306.325	980289.181	-37.701
492	42 19.6	-92 25.0	298.400	980292.593	-37.194
493	42 19.6	-92 26.2	293.218	980292.205	-38.601
494	42 18.7	-92 26.2	284.074	980292.565	-38.691
495	42 17.8	-92 26.2	285.598	980290.805	-38.805
496	42 17.8	-92 27.4	297.485	980286.807	-40.466
497	42 18.7	-92 27.4	303.277	980286.886	-40.595
498	42 19.6	-92 27.4	305.410	980287.631	-40.778
499	42 23.9	-92 20.3	277.978	980314.002	-26.240
500	42 23.2	-92 20.3	278.588	980312.987	-26.086
501	42 22.2	-92 20.3	283.160	980307.405	-29.272
502	42 21.4	-92 20.3	270.358	980308.017	-29.979
503	42 21.4	-92 19.1	263.348	980310.670	-28.705
504	42 22.2	-92 19.1	262.433	980312.762	-27.990
505	42 23.2	-92 19.1	273.711	980313.299	-26.734
506	42 23.9	-92 19.1	284.684	980314.585	-24.338
507	42 23.9	-92 17.8	279.197	980319.573	-22.429
508	42 23.2	-92 17.8	279.502	980313.752	-25.142
509	42 22.2	-92 17.8	260.300	980314.199	-26.973
510	42 21.4	-92 17.8	273.406	980310.137	-27.260
511	42 21.4	-92 16.6	264.567	980313.711	-25.424
512	42 22.2	-92 16.6	258.166	980316.063	-25.528
513	42 23.2	-92 16.6	255.728	980320.131	-23.437
514	42 23.9	-92 16.6	256.947	980323.153	-21.289
515	42 23.9	-92 15.5	252.375	980323.841	-21.434
516	42 23.2	-92 15.5	253.899	980321.090	-22.837
517	42 22.2	-92 15.5	265.177	980316.174	-24.070
518	42 21.4	-92 15.5	260.909	980315.903	-23.950
519	42 21.4	-92 14.4	252.985	980319.176	-22.236

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
520	42 21.8	-92 13.1	253.289	980319.937	-22.014
521	42 22.2	-92 14.4	253.594	980320.338	-22.152
522	42 23.2	-92 14.4	255.728	980323.005	-20.563
523	42 23.2	-92 13.1	252.985	980322.430	-21.677
524	42 23.9	-92 14.4	254.509	980324.623	-20.233
525	42 24.8	-92 14.4	253.594	980325.093	-21.291
526	42 24.8	-92 20.8	284.684	980313.505	-26.767
527	42 24.8	-92 20.3	291.999	980314.421	-24.413
528	42 24.8	-92 19.1	275.844	980319.956	-22.054
529	42 24.8	-92 17.8	267.615	980322.537	-21.090
530	42 24.8	-92 16.6	258.471	980325.021	-20.404
531	42 24.8	-92 15.5	252.985	980325.103	-21.401
532	42 24.8	-92 14.9	252.985	980324.939	-21.565
533	42 25.9	-92 15.5	252.070	980325.389	-22.943
534	42 25.9	-92 16.6	252.680	980327.146	-21.065
535	42 20.5	-92 14.4	259.995	980315.654	-23.032
536	42 20.5	-92 15.5	273.406	980311.325	-24.724
537	42 20.5	-92 16.6	284.379	980307.472	-26.420
538	42 20.5	-92 17.8	276.759	980307.676	-27.714
539	42 20.5	-92 19.1	274.321	980306.709	-29.160
540	42 20.5	-92 20.3	280.112	980304.063	-30.668
541	42 19.6	-92 20.3	287.732	980300.825	-31.060
542	42 18.7	-92 20.3	283.465	980299.910	-31.467
543	42 17.8	-92 20.3	282.550	980298.593	-31.615
544	42 17.8	-92 19.1	296.266	980297.035	-30.477
545	42 18.7	-92 19.1	275.844	980303.066	-29.808
546	42 19.6	-92 19.1	274.930	980305.191	-29.211
547	42 19.6	-92 17.8	276.149	980306.208	-27.954
548	42 18.7	-92 17.8	290.475	980301.477	-28.521
549	42 17.8	-92 16.6	284.989	980302.172	-27.557

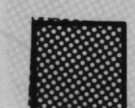
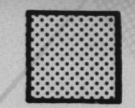
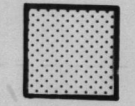
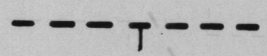
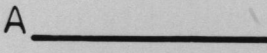
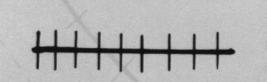

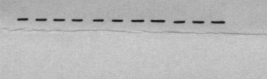
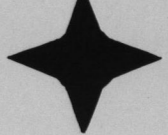

STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
550	42 17.8	-92 16.6	284.989	980302.172	-27.557
551	42 18.7	-92 16.6	284.989	980304.489	-26.588
552	42 19.6	-92 16.6	276.759	980307.864	-26.178
553	42 19.6	-92 15.5	266.091	980311.241	-24.899
554	42 18.7	-92 15.5	289.561	980304.811	-25.366
555	42 17.8	-92 15.5	265.177	980307.792	-25.832
556	42 17.8	-92 14.4	275.844	980311.513	-20.014
557	42 18.7	-92 14.4	279.502	980309.806	-22.349
558	42 19.6	-92 14.4	280.721	980310.032	-23.231
559	42 19.6	-92 13.1	280.417	980315.836	-17.487
560	42 18.7	-92 13.1	272.492	980313.398	-20.136
561	42 17.8	-92 13.1	271.272	980316.335	-16.091
562	42 18.7	-92 12.4	249.632	980320.638	-17.390
563	42 17.8	-92 12.4	246.889	980321.639	-15.580
564	42 19.6	-92 12.4	277.368	980320.348	-13.575
565	42 25.7	-92 20.3	275.844	980317.707	-25.650
566	42 25.7	-92 19.1	276.454	980322.491	-20.747
567	42 25.7	-92 17.8	278.893	980322.571	-20.187
568	42 25.7	-92 16.6	256.032	980326.579	-20.674
569	42 26.5	-92 16.6	254.204	980329.626	-19.184
570	42 26.5	-92 17.8	259.081	980328.901	-18.951
571	42 26.5	-92 19.1	244.755	980325.019	-25.649
572	42 26.5	-92 20.3	281.940	980321.707	-21.650
573	42 27.4	-92 20.3	295.656	980324.995	-17.014
574	42 27.4	-92 19.1	259.081	980328.963	-20.237
575	42 28.2	-92 19.1	259.995	980327.938	-22.280
576	42 28.2	-92 20.3	266.700	980322.606	-26.295
577	42 28.2	-92 22.5	286.817	980315.737	-29.208
578	42 28.2	-92 23.8	262.128	980315.313	-34.487
579	42 28.2	-92 25.0	264.567	980309.725	-39.595

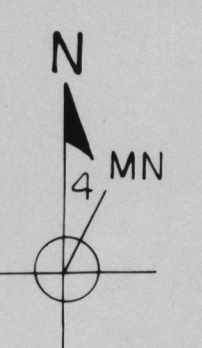
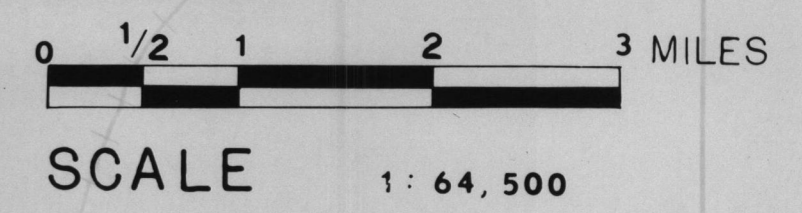
STATION	LATITUDE	LONGITUDE	ELEV. (M)	OBSERVED G	BOUGUER
580	42 28.2	-92 26.2	274.016	980298.028	-49.434
581	42 28.2	-92 27.4	286.817	980291.850	-53.095
582	42 28.9	-92 26.7	293.218	980293.521	-51.214
583	42 29.4	-92 25.0	281.940	980302.572	-45.130
584	42 29.4	-92 22.5	259.995	980315.825	-36.191
585	42 30.7	-92 22.5	268.834	980315.085	-37.141
586	42 30.7	-92 23.8	289.561	980300.827	-47.324
587	42 30.7	-92 25.0	271.272	980296.820	-54.927
588	42 30.7	-92 26.7	267.615	980298.476	-53.989
589	42 29.8	-92 26.7	269.139	980293.739	-57.079

BASEMENT INTERPRETATION MAP OF BLACKHAWK COUNTY IOWA



LEGEND

-  INTRUSIVE BODY
ACIDIC COMPOSITION
-  INTRUSIVE BODY
INTERMEDIATE COMPOSITION
-  CLASTIC ROCKS
-  FAULT
THROW INDICATED
-  CROSS SECTION
-  RAILROAD
-  CEDAR RIVER
-  MUNICIPAL BOUNDARY
-  PRIMARY STATION
-  SECONDARY STATION



R.14W.

R.13W.

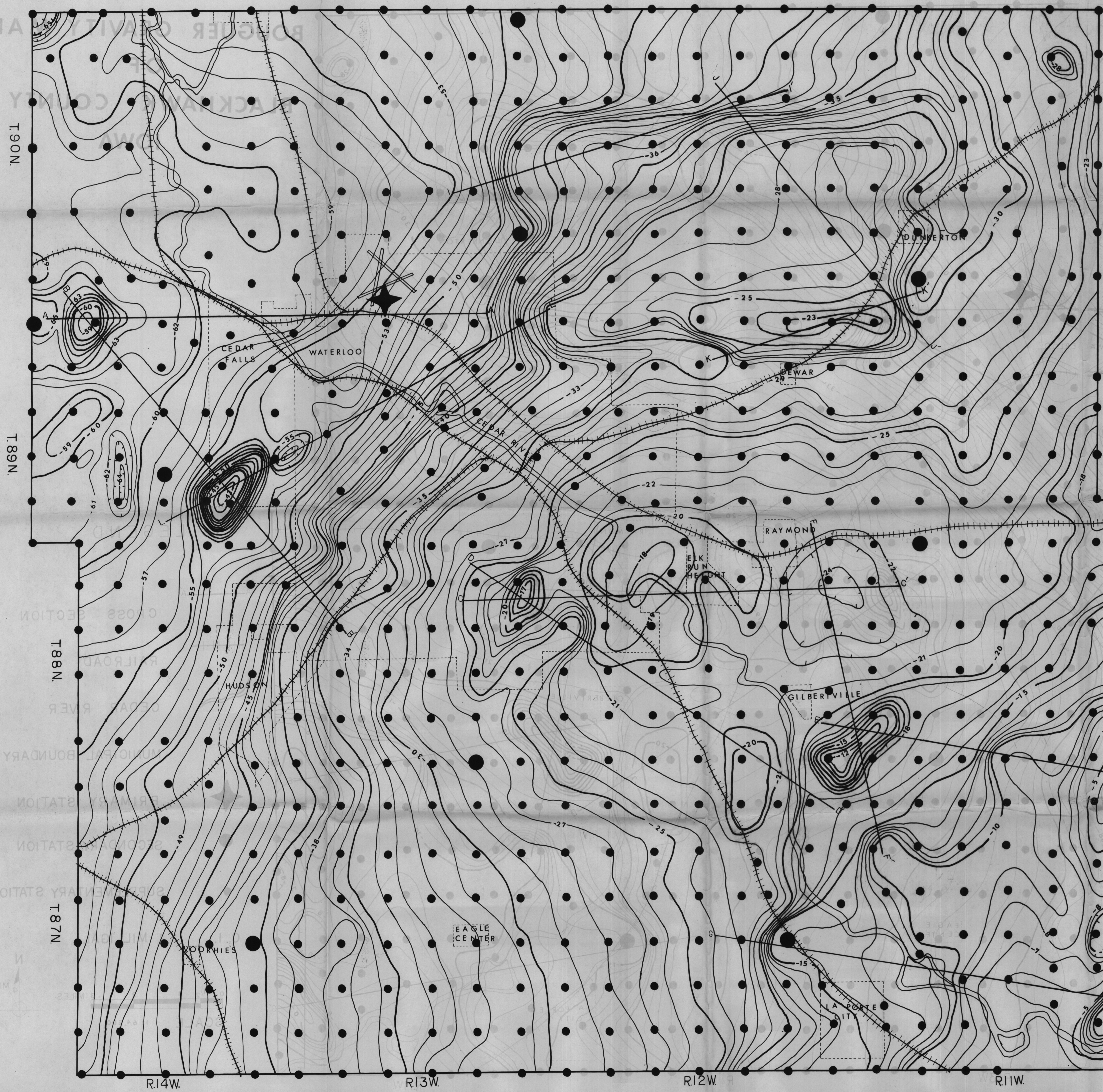
R.12W.

R.11W.

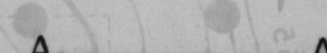
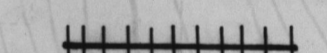
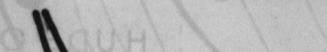
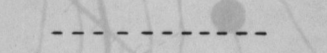
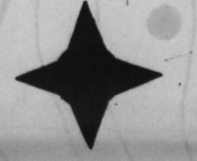

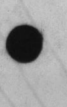
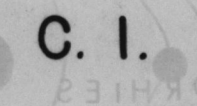
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BOUGUER GRAVITY MAP OF BLACKHAWK COUNTY IOWA



LEGEND

-  CROSS SECTION
-  RAILROAD
-  CEDAR RIVER
-  MUNICIPAL BOUNDARY
-  PRIMARY STATION
-  SECONDARY STATION
-  SUPPLEMENTARY STATION
-  1 MILLIGAL

