

STATE OF SOUTH DAKOTA
Archie Gubbrud, Governor

STATE GEOLOGICAL SURVEY

ALLEN F AGNEW, STATE GEOLOGIST

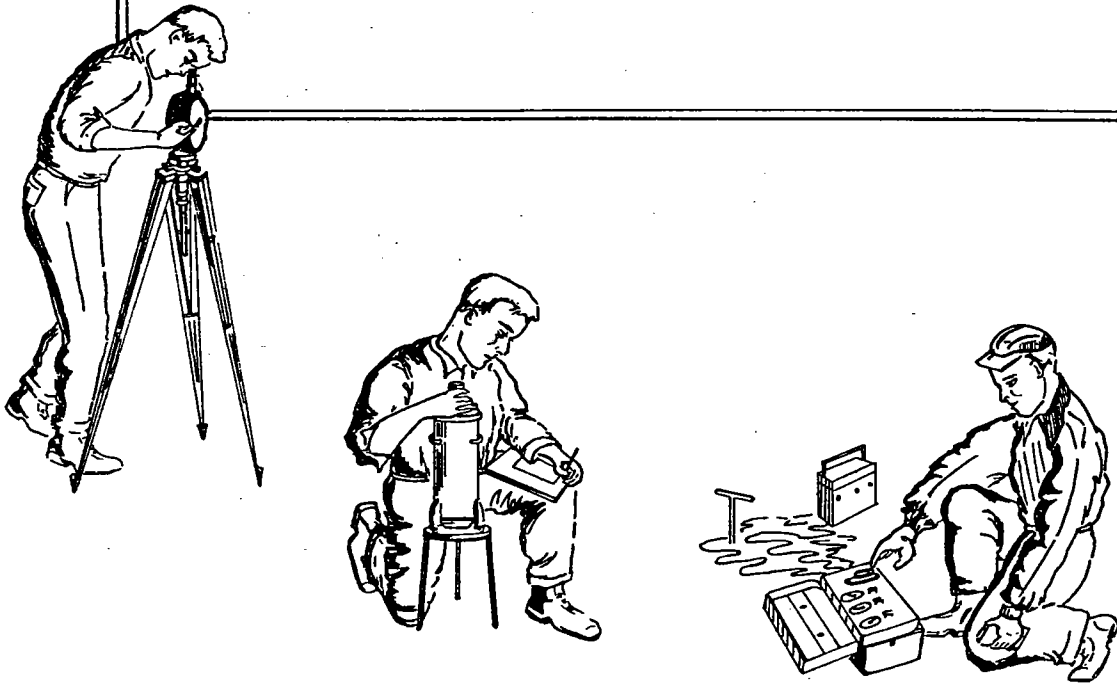
Report of Investigations

No. 88

GRAVITY MEASUREMENTS EAST OF THE BLACK HILLS AND ALONG A LINE FROM RAPID CITY TO SIOUX FALLS SOUTH DAKOTA

by

Daniel Lum



State Geological Survey Union Building, University
Vermillion, South Dakota June, 1961

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TABLE OF CONTENTS

	Page
Abstract	1
Introduction	2
Acknowledgments	2
Field Observations	2
Reduction of Data	4
Gravity Profile Results	5
Bouguer Anomaly Map Results	8
Summary	8
References	9
Appendix	10

LIST OF ILLUSTRATIONS

	Page
FIGURE	
1. Gravity traverse and survey area	3
2. Areal plot and profile of gravity traverse	6
PLATE	
1. Map showing gravity data and Bouguer anomaly contours (red)	Pocket

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ABSTRACT

Gravity measurements were carried out in South Dakota during the summer of 1959 by the State Geological Survey, as part of a regional gravity study which is being supported by a National Science Foundation grant. A Simple Bouguer gravity anomaly map was compiled from data of more than 500 stations in an area of approximately 2500 square miles. A gravity traverse was established from the Black Hills eastward onto the Sioux Uplift.

The configuration of the basement surface and the variations of intrabasement lithology, as suggested by the gravity measurements and some magnetic studies, are discussed. Interpretations of the gravity data are preliminary at this time.

INTRODUCTION

This paper gives the preliminary results of gravity measurements made in South Dakota during the summer of 1959 by the State Geological Survey as part of a regional gravity study which is supported by a National Science Foundation grant. A gravity traverse was established across the State from the Black Hills eastward onto the exposed Precambrian quartzite of the Sioux Uplift. Gravity observations were made in an area east of Rapid City, covering about 2500 square miles (fig. 1). This area lies between latitudes $43^{\circ}45'$ N. and $44^{\circ}30'$ N. and longitudes $102^{\circ}00'$ W. and $103^{\circ}15'$ W.

The studies were undertaken with the hope that gravity observations might aid in understanding some of the regional geological structures and structural trends. The subsurface geology in the central and south-central part of the State is not well known, and few wells have penetrated to the Precambrian basement. This is a geologically interesting area that includes the southern end of the Williston Basin flanked by the Black Hills to the west, the Sioux Uplift to the east, and the Kennedy Basin of Nebraska to the south. It is hoped that the work presented in this paper will stimulate and guide future studies by others in this part of the State, and that the gravity measurements which have been tied to the National Gravity Network will serve as a base to which additional gravity work may be tied.

ACKNOWLEDGMENTS

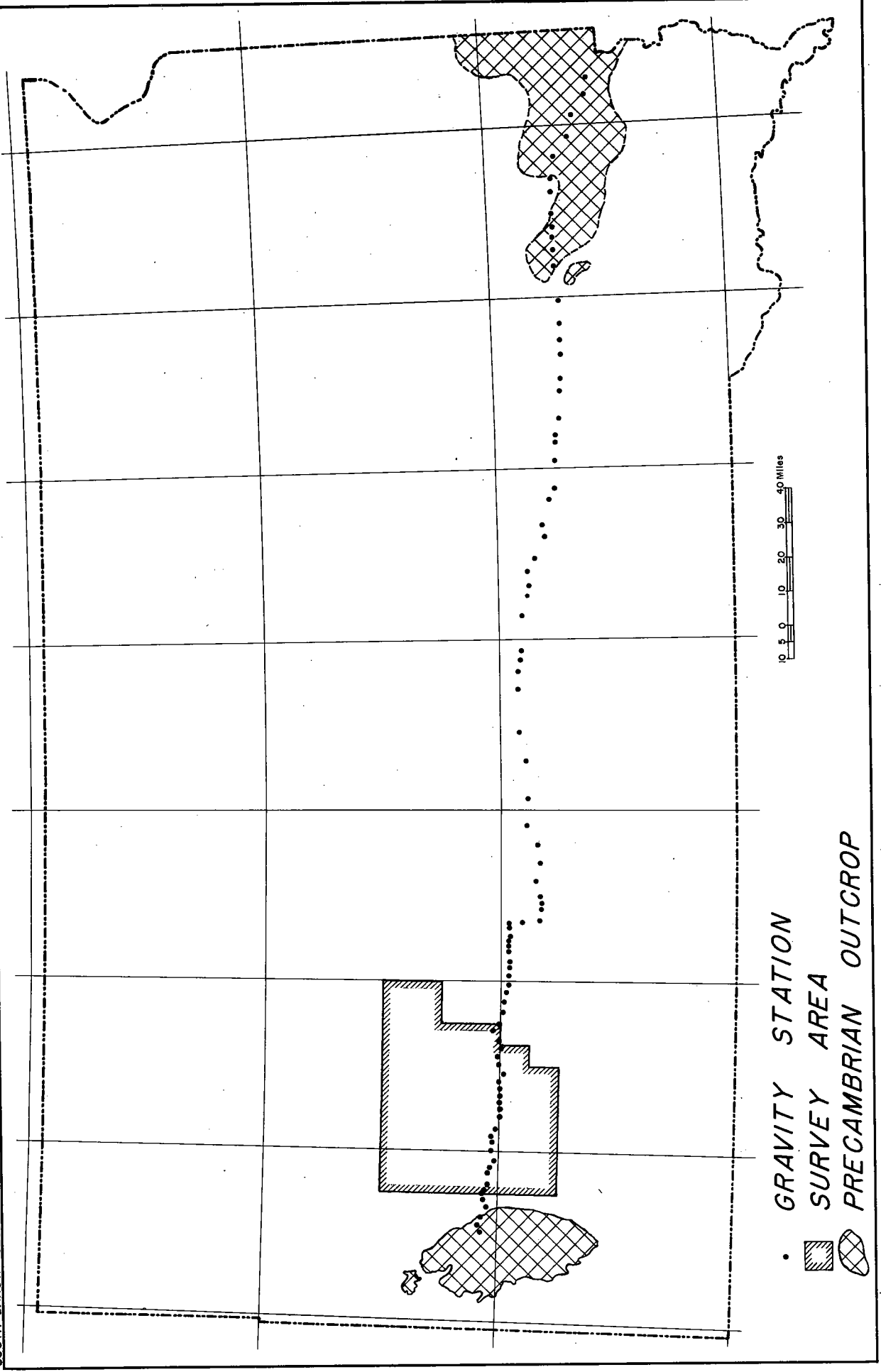
The work in this report has been supported by the National Science Foundation under research grant No. 7606. The writer wishes to express his sincere thanks to Dr. Allen F. Agnew, State Geologist, for his close and kind support of this work. Robert A. Benson ably assisted the writer in the field, including the operation of the gravimeter, and Lee Bess assisted in the data reduction.

FIELD OBSERVATIONS

A World-Wide gravimeter having a sensitivity of 0.10840 milligals per division was used to make all gravity observations. The calibration constant of the instruments was checked against the Hot Springs and Rapid City airport gravity values of Woollard (1958) and thus permits integration of the gravity data with the national gravity network.

The primary base station for all gravity readings is the Rapid City airport value of 980.2510, based on the Potsdam datum. This value is stated only to the nearest tenth of a milligal but the gravimeter measurements were read to the nearest hundredth of a milligal; therefore, the primary base value is assumed to be 980.25100.

A total of 597 gravity observations were made along the traverse across the State and in the regional survey. The station interval along the traverse varied from 1 to 12 miles depending upon the availability of federal bench marks, and in the area east of Rapid City a station spacing of 2 and 3 miles was maintained where possible. Base stations spaced about 35 miles apart along the traverse were established by the method of "looping" described by Nettleton (1940), and were tied



GRAVITY TRAVERSE AND SURVEY AREA

to the primary base. Base stations also were established for the regional survey. Thus the "drift" of the instrument was determined by reoccupying nearby bases several times during each day. The precision of the field measurements is estimated from repeat readings made at 24 random gravity stations. The differences in drift-corrected readings had a standard deviation of 0.05 milligals, which gives a probable error of 0.04 milligal--well within the limits of accuracy necessary for the purposes of this gravity study.

The elevations of the traverse stations were all taken from U. S. Coast and Geodetic Survey level-lines, and the elevations used in the areal survey were taken from U. S. Geological Survey topographic maps including bench marks, road intersections, and other useful elevations. Elevations of most stations are believed to be accurate to within 1 foot.

REDUCTION OF DATA

To make interpretations of geologic structure from gravity observations it is necessary to compare the observed gravity with the theoretical gravity at any location; the difference is called a gravity anomaly. The Simple Bouguer gravity anomaly, which is used in this paper, is determined as the observed gravity minus the theoretical gravity corrected for the effects of the shape and rotation of the earth, the elevation, and the included rock mass above sea level.

The theoretical gravity at sea level was calculated from the International Gravity Formula of 1930 which takes into account the effects of the shape and rotation of the earth. The variation of gravity with latitude in the area of this survey is about 1.5 milligals per minute of latitude. Therefore, the location of each station must be obtained as accurately as possible. The latitudes of most gravity stations were obtained to the nearest 0.01 minute from U. S. Geological Survey 7½-minute topographic quadrangle maps, and stations outside these maps are believed to be accurate to the nearest 0.1 minute.

Corrections for the gravity effect of elevation (free-air correction) and the effect of included mass above sea level (Bouguer correction) were combined to form the elevation correction factor. For an assumed density of 2.67 grams per cubic centimeter for the included mass, the correction factor is 0.06 milligal per foot; this value was used for the data reduction.

Terrain corrections account for the variations of topography from the infinite horizontal slab of included mass assumed in the Bouguer correction. It was necessary to apply this correction to stations located in the Black Hills. Using a zone chart prepared according to the Bullard modification of the Hayford-Bowie method (Swick, 1942), and using U. S. Geological Survey topographic maps, terrain corrections were made for nine stations out to zone I, whose outer radius is approximately 5¼ miles. A density of 2.67 g/cc was assumed in the computations. The largest correction was 4.4 milligals and all others were less than 0.8 milligal. Therefore, no additional terrain corrections were considered necessary for regional interpretations.

A Simple Bouguer anomaly map with a contour interval of 2 milligals, and a gravity profile across the State were obtained from the reduced data. The accuracy of the gravity measurements estimated from the several sources of error is within 0.1 milligal for most stations, and 0.2 milligal for others with less accurately known altitudes.

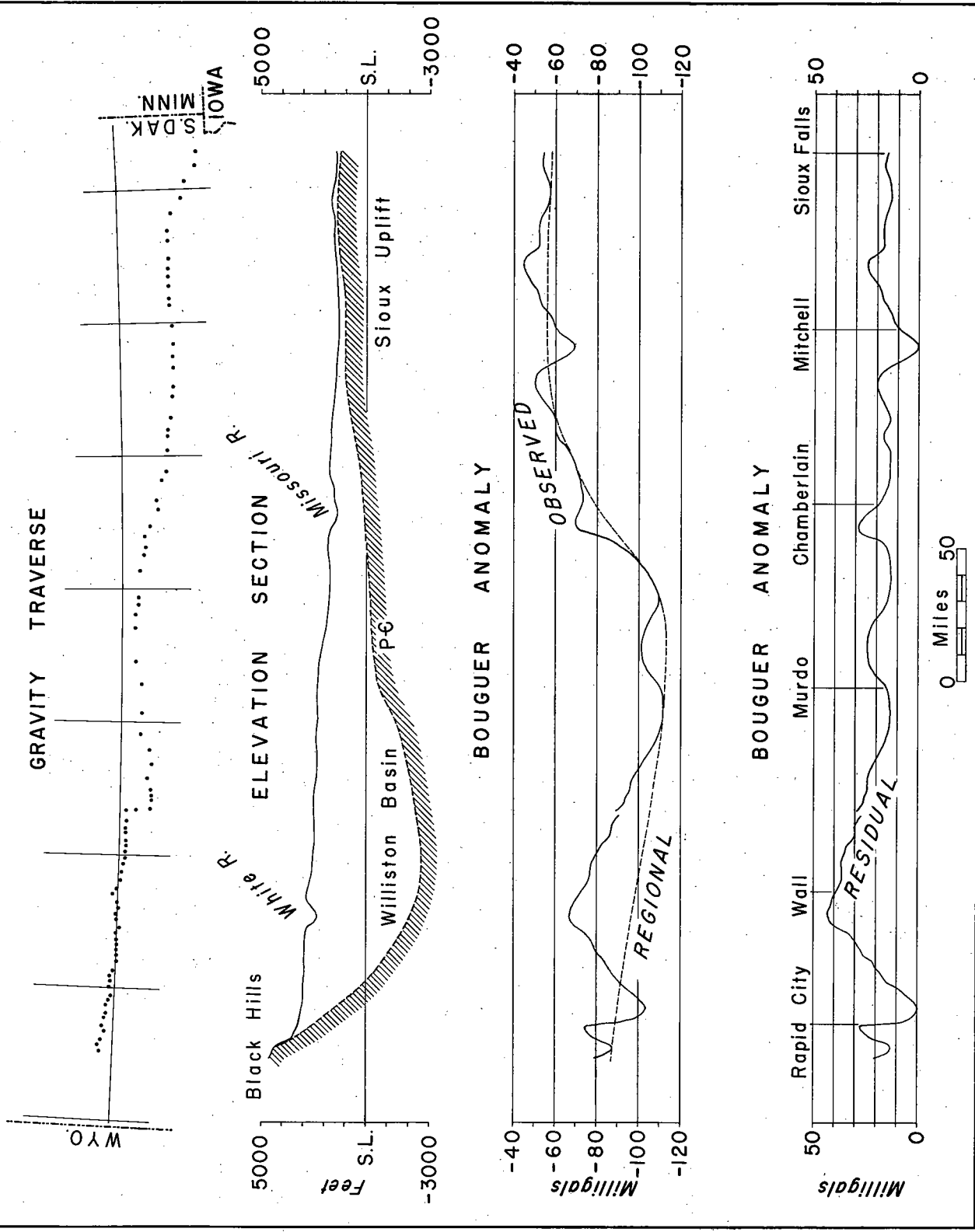
GRAVITY PROFILE RESULTS

The gravity profile is presented together with the topographic relief, the interpolated Precambrian surface, and the observed, regional, and residual Bouguer gravity (fig. 2). Unfortunately, the subsurface geology over most of the area traversed by the gravity profile is not well known. The dominant feature of the sediments on the eastern flank of the Williston Basin is the thinning of the section eastward by the overlapping of older formations by younger beds, and the thinning of the individual formations. In the south-central part of the State no wells penetrate the Precambrian basement.

The regional gravity which has been interpreted as a smooth average curve of the observed gravity shows a very large gravity minimum in the center of the gravity profile. There is a decrease in gravity of 40 milligals westward from the Sioux Uplift over a distance of about 50 miles. This gives a regional gravity gradient of 0.9 milligal per mile, which is much larger than would be expected from structural relief of the basement surface or from density contrasts within the sedimentary rocks involved. Nor can the basement topography be correlated with the anomaly. For a regional gravity minimum of this nature, it is probable that the principal cause lies at depth. Of the several explanations of the cause, the two most reasonable hypotheses are (1) a down-warping of crustal layers caused by forces in the earth and (2) the occurrence of a large granitic rock mass. The crustal-warp hypothesis is that of Glennie (1932) in which he postulated that broad negative anomalies are caused by downward flexures in the crustal layers, and positive anomalies by upward flexures in the crustal layers. Although this hypothesis provides a reasonable explanation, the steep gravity gradient indicates that the origin of the anomaly lies closer to the surface, and therefore the second hypothesis (Garland, 1950) is probably more nearly correct; thus, the regional gravity minimum is caused largely by a thickening of the granitic layer. Other writers who postulate changes in thickness of the granitic layer as the cause of such regional anomalies include Ansel (1937), Evans and Crompton (1946), and Bott (1954).

The residual gravity, which is obtained by removing the regional gravity from the observed gravity, reveals several large anomalies. A gravity minimum of 13 milligals occurs just west of Mitchell. From magnetic measurements by Jordan (1940), there does not seem to be any magnetic effect associated with this gravity anomaly, and the logical interpretation would be to relate it either to an intrusive granitic body in more dense metamorphic rocks or to a thickened section of quartzite in granite. The fact that the area is known to be underlain by quartzite suggests that the anomaly is caused by a thickening of the quartzite rather than by an intrusive granitic body.

A large positive anomaly of 15 milligals is located immediately west of Chamberlain. This anomaly is too large to be caused by either basement topography or by structure in the sedimentary rocks. Therefore, it is probably caused largely by a density contrast in the basement rocks. There does not appear to be any magnetic effect related to the gravity anomaly which would suggest intrusive rocks of intermediate or more mafic character within the basement.



AREAL PLOT AND PROFILE OF GRAVITY TRAVERSE

A broad positive anomaly of 11 milligals superimposed on the regional gravity minimum, occurs just east of Murdo. The origin of this positive anomaly is possibly related to the origin of the well-known Stanley County magnetic high, 45 miles to the north. This possible relationship is suggested by the vertical intensity magnetic contours which trend south-southeast from Stanley County into the area east of Murdo. The magnetic data suggest material of higher magnetic susceptibility, and thus a rock body of intermediate or more mafic character is indicated. Precambrian data from several wells in Stanley County showed quartzite, granite, and diorite in the basement rocks.

The maximum depth of the center of mass of the gravity disturbance can be determined from the "half-width" value of the gravity anomaly. The "half-width" value is the horizontal distance from the center of the anomaly to its flank at the point where the amplitude is half the maximum value. Therefore, it can be seen that the depth to the center of mass of the disturbance is not likely to be more than 11.5 miles. Furthermore, it is possible to estimate the size of the disturbance, using the amplitude of the anomaly and some reasonable assumption for the density contrast between the material causing the anomaly and the adjacent material. With a half-width value of 11.5 miles and an amplitude of 11 milligals, the size of the disturbing body can be calculated on the basis of a horizontal cylinder with a density differential of 0.17 (granite to diorite). The radius of the body would then be 17,500 feet, and the top of the cylindrical mass would be 43,000 feet below the surface. An approximate check can be made, using the amplitude of the observed vertical intensity magnetic anomaly by computing the magnetic effect for such a body as that indicated in the gravity calculations. The polarization contrast is 0.0062-0.0016-0.0046 and with the values of the gravity figure, the computed magnetic anomaly is 241 gammas. This value compares well with the observed value of about 200 gammas.

A large positive anomaly of more than 20 milligals is centered near Wall, the western part of which is located on the Bouguer Anomaly Map. The anomaly is too large to be caused principally by local structures or by the topography of the basement surface. It is therefore probable that density variations within the basement are largely the cause. It is also possible that the cause is more deep-seated because the positive anomaly is fairly extensive. David White (1924) in a study of isostatic anomalies in the northern Great Plains discussed the possibility that in the area either relatively dense rocks are present in the basement, or that the outer crust is undercompensated--that is--overloaded.

At the edge of the Black Hills at Rapid City there is a steep gravity gradient associated with a gravity high immediately west of Rapid City and a gravity low immediately southwest. A 20-milligal change in gravity is present across a distance of 5 miles. This amounts to a gradient of 4 milligals per mile. The anomalies are probably related to steep folding or possibly faulting in the area. However, further studies are warranted before any conclusions can be reached.

The regional survey of 2500 square miles includes parts of Meade, Pennington, and Custer Counties (pl. 1). The Black Hills lie immediately west of the area, which is drained by the Belle Fourche River along the north edge and by the Cheyenne River along the east edge. The geologic sequence includes the Cretaceous Lakota sandstone to the Pierre shale, with the latter exposed throughout most of the surveyed area. The buried Precambrian surface slopes eastward into the Williston Basin.

The gravity data were contoured as a simple Bouguer anomaly map with a contour interval of 2 milligals (pl. 1). The contours trend north-east around the gravity maximum located in the southeast corner of the map. This gravity maximum was included in the discussion of the gravity profile. In the southwest part of the map an elongate north-trending gravity minimum terminates immediately northeast of Rapid City. From an examination of the gravity map of the United States (Lyons, 1950), it appears that this minimum is continuous into Nebraska. A very local elongate positive anomaly occurs within the gravity minimum almost at right angles to the northward trends. This anomaly is related to a local anticlinal structure. The steep gravity gradient shown on the gravity profile occurs on the northwest side of the gravity minimum.

No attempt has been made to relate the several minor anomalies to local geological structures or density contrasts in the sedimentary rocks mainly because insufficient subsurface information is available. But, in regard to the small local anomalies, it must be pointed out that the Belle Fourche and Cheyenne Rivers have eroded several hundred feet below the surrounding uplands, causing some gravity anomalies which can be seen as irregularities in the gravity contours crossing the area of the two rivers. These anomalies are due to error between the actual mean rock density and the assumed mean rock density of 2.67 used in reducing the gravity data to Bouguer gravity anomaly values. The assumed mean density of 2.67 appears to be too high, because the anomalies are positive in sign for a valley relief. However, for regional gravity studies as intended in the present work, it is common practice to use an assumed density of 2.67 in the data reduction.

SUMMARY

The major gravity anomalies discussed in this paper are believed to be related largely to density contrasts within the Precambrian basement rocks. A regional gravity minimum is believed to be related to the occurrence of a large granitic rock mass or a thickening of the granitic layer. A thickened section of quartzite is probably the cause of a negative anomaly located in the Sioux Uplift area, and a positive anomaly east of Murdo appears to be related in origin to the Stanley County magnetic high.

These preliminary results of the gravity observations have pointed to problems of academic as well as economic interest. It is believed that this and future gravity work will stimulate interest in and add to our geologic knowledge of western South Dakota.

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APPENDIX
GRAVITY STATIONS

Principal Facts

Base Station: Rapid City Municipal Airport, Entrance to terminal lobby from the field, g-980.2510 gal., referred to Commerce building base, Washington, D. C., g-980.1190 gal.

Theoretical Gravity: International gravity formula, $\gamma_0 = 980.63227192 - 2.58615717 \cos 2\phi + 0.0028852446 \cos 4\phi$

Assumed density for Bouguer anomaly: 2.67 g/ cc

B= Bench Mark

* = Tied by looping

Description of Traverse Bases

Station	Location	Bouguer Anomaly (assumed density 2.67 g/ cc) in milligals
Sioux Falls	South entrance to High School, W. 12th Street BM G5 1925. 1441.7'	-54.79
Salem	South wall, east of east entrance, Salem High School, BM C6 1925. 1526.8'	-52.53
Mitchell	East entrance, Jr. High School, BM U6 1925.1310.6'	-60.33
White Lake	Southeast corner of center pedestal, water tank, BM H7 1925. 1647.4'	-60.02
Chamberlain	N. end of E. entrance, top of step, High School, 15' south of BM Z7 1925.1466.2'	-72.86
Kennebec	West entrance to courthouse BM M8 1925.1690.3'	-104.29
Murdo	NW leg of water tank, BM F9 1925.2325.5'	-110.60
Kadoka	SE corner leg of water tank, BM Y9 1925.2457.5'	-95.39

Station	Location	Bouguer Anomaly (assumed density 2.67 g/ cc) in milligals
Wall	W. edge of sidewalk, 6' E of NE corner Am. Legion Memorial, 2817'	-73.44
New Underwood	1/2 miles W. New Underwood, see New Underwood 7 1/2-min. quad., U. S. G. S., BM R131. 2869'	-88.01

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
Sioux Falls	43 ° 32.64N	96 ° 41.32W	1442 B	980.35672	980.49802	- 54.79
T1	43 33.71N	96 49.84W	1442 B	.35889	.49962	- 54.22
T2	43 37.39N	96 56.72W	1568 B	.35409	.50514	- 56.98
T3	43 38.64N	97 04.58W	1699 B	.34779	.50702	- 57.30
T4	43 41.90N	97 11.2 W	1477 B	.36957	.51194	- 53.76
T5	43 42.25N	97 18.37W	1589 B	.36499	.51246	- 52.14
Salem	43 43.45N	97 22.75W	1525 B	.37024	.51426	- 52.53
T6	43 43.41N	97 30.90W	1452 B	.38265	.51420	- 44.44
T7	43 43.48N	97 35.82W	1387 B	.38496	.51431	- 46.14
T8	43 43.41N	97 38.80W	1386 B	.38307	.51420	- 47.98
T9	43 43.41N	97 43.65W	1363 B	.38117	.51420	- 51.26
T10	43 43.48N	97 49.43W	1330 B	.38200	.51431	- 52.52
T11	43 43.44N	97 53.23W	1304 B	.38095	.51425	- 55.07
Mitchell	43 43.41N	98 01.63W	1309 B	.37534	.51420	- 60.33
T12	43 42.38N	98 08.98W	1369 B	.36095	.51266	- 69.58
T13	43 42.60N	98 15.5 W	1411 B	.36500	.51299	- 63.34
T14	43 42.58N	98 20.74W	1424 B	.37384	.51296	- 53.69
T15	43 42.65N	98 24.31W	1460 B	.37436	.51306	- 51.11
T16	43 43.03N	98 28.16W	1525 B	.36870	.51363	- 53.44
T17	43 43.01N	98 32.93W	1563 B	.36380	.51360	- 56.03
White Lake	43 43.75N	98 42.79W	1647 B	.35588	.51471	- 60.02
T18	43 44.45N	98 47.69W	1628 B	.35676	.51576	- 61.33
T19	43 44.72N	98 51.16W	1694 B	.34678	.51617	- 67.76
T20	43 44.72N	98 51.26W	1784 B	.33797	.51617	- 71.17
T21	43 46.59N	99 10.09W	1548 B	.35386	.51897	- 72.24

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
Chamberlain	43° 48.39N	99° 19.79W	1466 B	980.36086	980.52167	- 72.86
T22	43 47.71N	99 24.57W	1360 B	.36829	.52064	- 70.76
T23	43 50.84N	99 31.44W	1789	.34582	.52537	- 72.22
T24	43 52.15N	99 35.74W	1784	.33310	.52733	- 87.20
T25	43 52.46N	99 39.93W	1789	.32501	.52780	- 95.46
Kennebec	43 54.00N	99 51.7 W	1690 B	.32443	.53011	-104.29
T26	43 54.67N	100 03.33W	1767 B	.31558	.53111	-109.52
T27	43 55.60N	100 11.05W	1830	.31793	.53251	-104.79
T28	43 54.81N	100 07.59W	1793 B	.31590	.53132	-107.85
T29	43 55.76N	100 17.55W	1950 B	.31369	.53275	-102.07
T30	43 55.70N	100 32.3 W	2279 B	.29268	.53266	-103.25
Murdo	43 53.3 N	100 43.2 W	2326 B	.27891	.52906	-110.60
T31	43 53.37N	100 56.47W	2337 B	.27724	.52916	-111.71
T32	43 53.65N	101 05.29W	2398 B	.27705	.52958	-108.66
T33	43 50.70N	101 12.90W	2286 B	.28342	.52516	-104.59
T34	43 50.19N	101 19.37W	2359	.28273	.52439	-100.13
T35	43 51.00N	101 25.33W	2380	.28640	.52561	- 96.42
Kadoka	43 50.05N	101 30.53W	2458	.28132	.52418	- 95.39
T36	43 50.16N	101 33.10W	2376	.28830	.52435	- 93.50
T37	43 50.16N	101 34.80W	2468 B	.28329	.52435	- 92.99
T38	43 50.16N	101 38.49W	2455 B	.28786	.52435	- 89.20
T39	43 51.88N	101 39.64W	2451	.29302	.52693	- 86.86
T40	43 55.23N	101 39.65W	2421	.29949	.53195	- 87.21
T41	43 57.92N	101 39.64W	2381	.30240	.53601	- 90.76
T42	43 57.96N	101 42.03W	2524	.29441	.53607	- 90.23
T43	43 58.09N	101 44.45W	2354	.30783	.53626	- 87.20
T44	43 57.98N	101 46.79W	2319	.31092	.53610	- 86.05
T45	43 57.76N	101 48.60W	2477 B	.30075	.53577	- 86.41
T46	43 57.94N	101 50.95W	2347 B	.30969	.53604	- 85.54
T47	43 57.83N	101 53.94W	2405	.30976	.53587	- 81.82
T48	43 58.13N	101 56.35W	2449	.30881	.53632	- 80.58
T49	43 58.37N	101 58.76W	2480	.30874	.53668	- 79.15
T50	43 58.28N	102 01.46W	2496	.30915	.53656	- 77.65
T51	43 58.65N	102 04.73W	2543	.30722	.53710	- 77.31
T52	43 59.01N	102 07.13W	2597	.30526	.53764	- 76.57
T53	43 59.23N	102 10.62W	2684 B	.30211	.53797	- 74.83
Wall	43 59.64N	102 14.50W	2817 B	.29614	.53859	- 73.44
T54	44 00.55N	102 16.05W	2795	.30047	.53995	- 71.79
T55	44 03.76N	102 22.14W	2382	.33581	.54479	- 66.07
T56	44 04.82N	102 24.94W	2302	.34174	.54639	- 66.54

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
T57	44° 04.19N	102° 27.08W	2356	980.33728	980.54544	- 66.81
T58	44 06.00N	102 30.46W	2804	.30607	.54816	- 73.86
T59	44 05.76N	102 33.00W	2800	.30534	.54780	- 74.47
T60	44 05.76N	102 36.47W	2907	.29525	.54780	- 78.14
T61	44 05.77N	102 38.88W	2889	.29484	.54781	- 79.64
T62	44 05.77N	102 41.29W	2882	.29394	.54781	- 80.96
T63	44 05.78N	102 46.09W	2908	.28504	.54783	- 88.32
T64	44 05.77N	102 48.51W	2858	.28763	.54781	- 88.71
New						
Underwood	44 05.44N	102 49.97W	2839 B	.28903	.54732	- 87.96
T65	44 06.66N	102 56.96W	2993	.28216	.54915	- 87.42
T66	44 06.66N	102 59.38W	2987	.28167	.54915	- 88.27
T67	44 06.65N	103 05.41W	3049	.27707	.54913	- 89.13
T68	44 06.66N	103 07.85W	3085	.27553	.54915	- 88.53
Rapid						
City	44 05.98N	103 09.22W	3191 B	.26717	.54813	- 89.51
T69	44 05.14N	103 11.47W	3243	.26527	.54687	- 87.03
T70	44 04.83N	103 13.82W	3247 B	.27064	.54640	- 80.95
T71	44 04.71N	103 15.70W	3294	.27398	.54622	- 74.61
T72	44 03.69N	103 17.56W	3385 B	.26495	.54468	- 76.64
T73	44 02.83N	103 20.49W	3526	.24843	.54337	- 83.39
T74	44 03.92N	103 09.04W	4282	.20002	.54503	- 88.10
T75	44 04.47N	103 29.30W	4621	.18851	.54586	- 80.10
T76	44 04.92N	103 26.44W	4308 B	.20024	.54654	- 87.83

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
* Airport	44° 02.55N	103° 03.55W	3164	980.25100	980.54296	-102.12
* Base #1	44 05.57N	102 52.16W	2869 B	.28737	.54751	- 88.01
S1	44 06.21N	102 52.14W	2943	.28306	.54848	- 88.84
S2	44 05.78N	102 49.72W	2854	.28835	.54783	- 88.25
S3	44 05.78N	102 47.31W	2878	.28636	.54783	- 88.80
S4	44 04.80N	102 45.50W	2776	.29394	.54636	- 85.87
S5	44 04.03N	102 45.51W	2811	.29120	.54520	- 85.35
S6	44 04.04N	102 47.32W	2835	.28804	.54522	- 87.09
S7	44 04.04N	102 49.73W	2909	.28256	.54522	- 88.13
S8	44 01.42N	102 49.73W	3129	.26506	.54126	- 88.47
S9	44 01.42N	102 47.32W	3090	.26837	.54126	- 87.50
S10	44 00.54N	102 49.73W	3066	.26878	.53994	- 87.21
S11	44 00.55N	102 52.16W	3090 B	.26611	.53995	- 88.45
S12	44 02.30N	102 52.16W	3187	.26091	.54258	- 90.46
S13	44 04.92N	102 52.15W	2902	.28428	.54654	- 88.15
S14	44 07.59N	102 52.15W	3013 B	.28008	.55055	- 89.69
S15	44 07.52N	102 49.73W	3013	.27846	.55044	- 90.85
S16	44 07.52N	102 47.31W	3016	.27818	.55044	- 91.31
S17	44 09.25N	102 49.73W	2796	.29429	.55304	- 90.99
S18	44 10.77N	102 51.01W	2727 B	.30111	.55533	- 90.61
S19	44 10.99N	102 49.73W	2704	.30386	.55566	- 89.57
S20	44 10.99N	102 47.62W	2649	.30692	.55566	- 89.81
S21	44 10.99N	102 45.40W	2703	.31004	.55566	- 83.45
S22	44 12.74N	102 46.11W	2719	.31184	.55829	- 83.32
S23	44 12.73N	102 48.52W	2790	.30444	.55827	- 86.44
S24	44 12.96N	102 50.94W	2866 B	.29974	.55862	- 86.93
S25	44 14.47N	102 49.74W	2786	.30708	.56088	- 86.65
S26	44 14.57N	102 52.15W	2885 B	.30292	.56103	- 85.02
S27	44 12.80N	102 44.90W	2697 B	.31399	.55838	- 82.58
S28	44 12.73N	102 43.70W	2634	.31846	.55827	- 81.78
S29	44 14.47N	102 43.70W	2667	.31787	.56088	- 83.00
S30	44 14.47N	102 41.94W	2658	.31773	.56088	- 83.68
S31	44 10.92N	102 44.91W	2710 B	.31005	.55556	- 82.92
S32	44 09.16N	102 44.91W	2877 B	.28832	.55290	- 91.97
S33	44 07.56N	102 44.91W	3021 B	.28069	.55050	- 88.56
S34	44 05.77N	102 44.43W	2912 B	.28695	.54751	- 85.85
S35	44 05.77N	102 42.50W	2896	.29181	.54781	- 82.25
S36	44 05.77N	102 40.08W	2891	.29395	.54781	- 80.41
S37	44 07.45N	102 37.68W	2971 B	.29271	.55033	- 79.37
S38	44 05.64N	102 37.69W	2899 B	.29475	.54762	- 78.94

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S39	44 ° 04' 03N	102 ° 37' 67W	2818	980.29705	980.54520	- 79.08
S40	44 02.32N	102 37.64W	2672 B	.30431	.54261	- 77.99
S41	44 04.04N	102 40.80W	2810	.29769	.54522	- 78.94
S42	44 03.19N	102 42.50W	2775	.29882	.54392	- 78.61
S43	44 01.43N	102 42.50W	3020	.27988	.54127	- 80.20
S44	44 00.56N	102 41.30W	2992	.28090	.53997	- 79.56
S45	44 01.54N	102 44.32W	3062 B	.27445	.54144	- 83.28
S46	44 04.08N	102 52.16W	2981 B	.27775	.54528	- 88.68
S47	44 07.51N	102 42.30W	2983	.28804	.55042	- 83.41
S48	44 07.51N	102 40.08W	3010	.28843	.55042	- 81.40
S49	44 09.25N	102 40.07W	2935	.29546	.55303	- 81.48
S50	44 09.25N	102 37.67W	2869	.30061	.55303	- 80.29
S51	44 10.99N	102 37.67W	2824	.30378	.55566	- 82.45
S52	44 11.00N	102 39.48W	2839	.30314	.55568	- 82.21
S53	44 10.99N	102 42.30W	2737	.31045	.55566	- 81.00
S54	44 12.72N	102 40.07W	2727	.31120	.55826	- 83.45
S55	44 12.73N	102 37.67W	2765	.30797	.55827	- 84.41
S56	44 17.08N	102 46.09W	2753	.31459	.56483	- 85.07
S57	44 17.07N	102 48.51W	2795	.31124	.56481	- 85.82
S58	44 15.33N	102 49.73W	2793	.30771	.56217	- 86.89
S59	44 15.34N	102 47.27W	2763 B	.31180	.56219	- 84.62
S60	44 21.00N	102 50.27W	2333	.34843	.57071	- 82.31
S61	44 21.79N	102 51.78W	2501 B	.33785	.57189	- 83.99
S62	44 22.38N	102 50.50W	2583 B	.33446	.57279	- 83.36
S63	44 22.37N	102 48.77W	2584	.33641	.57277	- 81.33
S64	44 21.95N	102 46.35W	2473 B	.34231	.57213	- 81.45
S65	44 23.24N	102 51.79W	2623	.33178	.57409	- 84.94
S66	44 24.91N	102 51.80W	2712 B	.32871	.57659	- 85.17
S67	44 24.11N	102 50.59W	2650	.33268	.57539	- 83.72
S68	44 24.10N	102 46.32W	2573	.33879	.57538	- 82.22
S69	44 25.36N	102 47.54W	2680	.33400	.57727	- 82.48
S70	44 27.57N	102 48.79W	2643	.33901	.58058	- 83.00
S71	44 29.30N	102 49.41W	2731	.33454	.58321	- 84.82
S72	44 27.57N	102 46.96W	2715	.33344	.58058	- 84.25
S73	44 29.30N	102 45.76W	2679	.33689	.58321	- 85.59
S74	44 27.57N	102 43.33W	2719	.33082	.58058	- 86.63
S75	44 29.31N	102 43.34W	2783	.32821	.58322	- 88.04
S76	44 27.57N	102 40.93W	2743	.32786	.58058	- 88.15
S77	44 29.31N	102 40.94W	2757	.32904	.58322	- 88.77
S78	44 25.84N	102 40.93W	2655	.33187	.57799	- 86.83

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S79	44° 23' 24N	102° 41' 49W	2544	980.33577	980.57409	- 85.69
S80	44 25.89N	102 44.54W	2666 B	.33379	.57806	- 84.32
S81	44 24.54N	102 43.73W	2601 B	.33565	.57604	- 84.34
* S82	44 17.07N	102 31.66W	2601	.32200	.56481	- 86.76
S83	44 27.57N	102 37.54W	2738	.32773	.58058	- 88.58
S84	44 29.31N	102 38.50W	2743	.32955	.58322	- 89.10
S85	44 24.54N	102 39.71W	2584	.33441	.57604	- 86.60
S86	44 17.06N	102 34.07W	2624	.32079	.56480	- 86.58
S87	44 17.07N	102 36.47W	2655	.31968	.56481	- 85.84
S88	44 17.07N	102 38.91W	2676	.31844	.56481	- 85.82
S89	44 18.81N	102 38.88W	2748	.31553	.56742	- 87.02
S90	44 18.70N	102 42.19W	2782 B	.31256	.56726	- 87.79
S91	44 17.07N	102 41.71W	2711	.31608	.56481	- 86.08
S92	44 17.08N	102 43.68W	2716	.31629	.56483	- 85.59
S93	44 15.33N	102 38.28W	2584	.32239	.56217	- 84.75
S94	44 29.31N	102 36.08W	2702	.33191	.58322	- 89.20
S95	44 26.71N	102 37.32W	2699 B	.32924	.57929	- 88.12
S96	44 24.97N	102 37.31W	2564 B	.33580	.57668	- 87.05
S97	44 23.45N	102 36.90W	2532 B	.33568	.57440	- 86.81
S98	44 28.45N	102 33.70W	2697 B	.33198	.58191	- 88.12
S99	44 26.70N	102 33.70W	2618 B	.33477	.57928	- 87.44
S100	44 28.89N	102 30.08W	2694 B	.33409	.58258	- 86.86
S101	44 26.77N	102 30.06W	2670 B	.33144	.57938	- 87.75
S102	44 23.67N	102 30.02W	2442 B	.34261	.57473	- 85.61
S103	44 24.98N	102 30.07W	2552 B	.33725	.57670	- 86.34
S104	44 24.09N	102 33.70W	2530 B	.33691	.57536	- 86.66
S105	44 20.68N	102 35.99 W	2582 B	.32810	.57023	- 87.22
S106	44 18.81N	102 36.27W	2720 B	.31693	.56742	- 87.30
S107	44 20.01N	102 32.67W	2668 B	.32147	.56922	- 87.68
S108	44 18.80N	102 32.23W	2682	.31887	.56741	- 87.63
S109	44 15.57N	102 30.62W	2463 B	.32991	.56253	- 84.85
S110	44 14.20N	102 35.29W	2683 B	.31443	.56048	- 85.08
S111	44 14.14N	102 32.87W	2619 B	.31918	.56039	- 84.08
S112	44 12.72N	102 35.37W	2705	.31230	.55826	- 83.67
S113	44 12.72N	102 30.46W	2687	.31560	.55826	- 81.45
S114	44 10.98N	102 32.86W	2714	.31217	.55565	- 80.65
S115	44 10.98N	102 35.28W	2747	.30932	.55565	- 81.52
S116	44 09.24N	102 35.28W	2820	.30414	.55302	- 79.69
* S117	44 07.50N	102 35.36W	2959 B	.29420	.55041	- 78.68
S118	44 07.50N	102 32.94W	2915 B	.29789	.55041	- 77.63

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S119	44° 07.49N	102° 31.02W	2847 B	980.30317	980.55039	- 76.41
S120	44 01.42N	102 30.45W	2580 B	.31630	.54126	- 70.17
S121	44 02.28N	102 32.86W	2797	.30002	.54255	- 74.72
S122	44 02.30N	102 34.79W	2736 B	.30241	.54258	- 76.02
S123	44 04.03N	102 35.28W	2836	.29831	.54520	- 76.74
S124	44 04.51N	102 30.45W	2787 B	.30595	.54592	- 72.76
S125	44 05.76N	102 31.83W	2834	.30280	.54780	- 74.97
S126	44 05.76N	102 35.28W	2907	.29594	.54780	- 77.45
S127	43 53.11N	102 38.47W	2682 B	.29753	.52877	- 70.33
S128	43 54.71N	102 38.39W	2640 B	.30059	.53117	- 72.19
S129	43 56.06N	102 38.34W	2691 B	.29808	.53320	- 73.67
S130	43 57.72N	102 38.34W	2782 B	.29291	.53571	- 75.88
S131	43 59.67N	102 38.18W	2875 B	.28794	.53863	- 78.20
S132	43 59.68N	102 40.53W	2983 B	.27993	.53866	- 79.76
S133	43 58.17N	102 41.87W	2904	.28208	.53638	- 80.07
S134	43 59.68N	102 42.96W	2963 B	.27990	.53866	- 80.99
S135	43 58.17N	102 44.29W	2927	.27827	.53638	- 82.50
S136	43 53.39N	102 41.35W	2504	.30549	.52919	- 73.47
S137	43 54.76N	102 41.75W	2513	.30492	.53125	- 75.56
S138	43 54.98N	102 43.95W	2562 B	.30006	.53158	- 77.81
S139	43 55.88N	102 48.99W	2669	.29009	.53293	- 82.71
S140	43 58.17N	102 46.71W	2916	.27667	.53638	- 84.76
S141	43 59.67N	102 45.42W	2953	.27736	.53863	- 84.10
S142	43 59.67N	102 47.32W	2984	.27397	.53863	- 85.63
S143	43 58.61N	102 48.90W	2975	.27334	.53704	- 85.21
S144	43 58.18N	102 51.48W	2882 B	.27895	.53640	- 84.54
S145	43 56.44N	102 46.10W	2765	.28521	.53378	- 82.68
S146	43 49.44N	102 36.98W	2683 B	.29115	.52327	- 71.15
S147	43 46.69N	102 38.09W	2976 B	.26503	.51913	- 75.54
S148	43 46.68N	102 39.36W	2962	.26504	.51911	- 76.36
S149	43 46.79N	102 41.96W	2586 B	.29012	.51927	- 74.00
S150	43 48.43N	102 41.25W	2547	.29663	.52173	- 72.29
S151	43 48.42N	102 38.42W	2886 B	.27526	.52172	- 73.31
S152	43 50.16N	102 39.36W	2779	.28606	.52435	- 71.56
S153	43 46.61N	102 35.70W	2851 B	.27349	.51900	- 74.46
S154	43 46.26N	102 33.39W	2808 B	.27529	.51848	- 74.72
S155	43 47.56N	102 33.39W	2802	.27839	.52042	- 73.92
S156	43 46.10N	102 31.22W	2784	.27595	.51824	- 75.26
S157	43 48.23N	102 30.59W	2936 B	.26892	.52143	- 76.36
S158	43 50.21N	102 30.99W	2879 B	.27705	.52443	- 74.64

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S159	43 ° 51.98N	102 ° 30.99 W	2862 B	980.28114	980.52708	- 74.23
S160	43 51.60N	102 32.79W	2847 B	.28246	.52651	- 73.24
S161	43 49.23N	102 34.54W	2933 B	.27286	.52295	- 74.11
S162	43 51.90N	102 35.02W	2792 B	.28799	.52696	- 71.46
S163	43 51.91N	102 37.13W	2772 B	.29097	.52698	- 69.69
S164	43 51.89N	102 38.78W	2722	.29370	.52696	- 69.94
S165	43 46.88N	102 44.33W	2741	.28051	.51941	- 74.45
S166	43 47.75N	102 43.70W	2734 B	.28243	.52071	- 74.24
S167	43 49.02N	102 43.12W	2717 B	.28563	.52264	- 74.00
S168	43 50.64N	102 42.52W	2691 B	.28925	.52507	- 74.37
S169	43 51.97N	102 41.90W	2494 B	.30492	.52707	- 72.51
S170	43 54.28N	102 51.50W	2773 B	.28117	.53053	- 82.98
S171	43 55.83N	102 51.50W	2857 B	.27608	.53286	- 85.36
S172	43 57.51N	102 53.10W	2769 B	.28480	.53540	- 84.46
S173	43 57.32N	102 56.32W	2884	.27335	.53511	- 88.73
S174	43 57.32N	102 54.51W	2836	.27717	.53511	- 87.79
S175	43 59.06N	102 53.91W	2977	.27172	.53772	- 87.39
S176	43 58.71N	102 56.33W	2870 B	.27612	.53720	- 88.88
S177	43 59.69N	102 59.13W	2911 B	.26940	.53867	- 94.61
S178	43 56.93N	102 59.91W	3058 B	.25620	.53453	- 94.85
S179	43 58.64N	102 59.87W	3029 B	.25967	.53709	- 95.69
S180	44 06.22N	102 53.35W	2908	.28562	.54849	- 88.40
S181	44 06.67N	102 56.11W	3004	.28127	.54917	- 87.66
S182	44 04.93N	102 54.55W	2943	.28179	.54656	- 88.19
S183	44 04.92N	102 56.96W	3033	.27507	.54654	- 89.50
S184	44 06.67N	102 58.17W	2996	.28178	.54917	- 87.63
S185	44 06.66N	103 01.26W	3055 B	.27585	.54915	- 90.01
S186	44 06.78N	103 04.21W	3035	.27801	.54933	- 89.23
S187	44 06.87N	103 06.90W	3070 B	.27701	.54947	- 88.26
S188	44 04.92N	103 05.41W	3333	.24834	.54654	- 98.23
S189	44 03.13N	103 05.41W	3199 B	.24887	.54382	-103.02
S190	44 04.05N	103 05.41W	3273	.24722	.54523	-101.64
S191	44 01.43N	103 06.73W	3025 B	.25622	.54127	-103.56
S192	44 01.87N	103 05.45W	3021	.25754	.54193	-103.14
S193	44 03.18N	103 01.79W	3200	.25174	.54390	-100.17
S194	44 04.48N	103 00.58W	3349	.24707	.54588	- 97.88
S195	44 03.23N	102 59.40W	3226 B	.25365	.54398	- 96.78
S196	44 03.18N	102 56.97W	3271	.25399	.54390	- 93.66
S197	44 03.18N	102 54.57W	3248	.25788	.54390	- 91.15
S198	44 01.42N	102 54.57W	3132	.26288	.54126	- 90.47

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S199	44° 01.42N	102° 56.97W	3068	980.26436	980.54126	- 92.83
S200	44 01.46N	102 59.38W	3074 B	.25999	.54132	- 96.90
S201	44 04.44N	102 59.37W	3340 B	.24935	.54582	- 96.08
S202	44 01.02N	103 03.06W	2970 B	.26151	.54066	-100.96
S203	43 51.55N	102 51.74W	3179 B	.25130	.52643	- 84.40
S204	43 51.53N	102 48.74W	3178 B	.25455	.52640	- 81.18
S205	43 49.55N	102 51.53W	2944 B	.26667	.52343	- 80.13
S206	43 49.49N	102 47.91W	2961	.26901	.52334	- 76.68
S207	43 48.59N	102 48.82W	2902 B	.27131	.52198	- 76.56
S208	43 45.52N	102 51.42W	3174 B	.24676	.51737	- 80.18
S209	43 47.22N	102 51.79W	2972 B	.26277	.51991	- 78.83
S210	43 45.15N	102 49.15W	2861 B	.26910	.51687	- 76.06
S211	43 45.57N	102 46.73W	2806	.27415	.51744	- 74.94
S212	43 46.82N	102 46.72W	2782 B	.27819	.51932	- 74.22
S213	43 46.87N	102 45.36W	2788 B	.27744	.51939	- 74.68
S214	43 47.42N	102 48.27W	2785 B	.27896	.52021	- 74.16
S215	43 52.06N	102 59.32W	3037 B	.25361	.52720	- 91.38
S216	43 50.31N	102 59.95W	3062	.24968	.52458	- 91.18
S217	43 50.37N	102 57.50W	2945 B	.26040	.52466	- 87.57
S218	43 50.36N	102 55.27W	2937 B	.26365	.52465	- 84.79
S219	43 48.61N	102 54.22W	2853	.26910	.52201	- 81.74
S220	43 49.70N	103 09.50W	3243 B	.23520	.52366	- 93.89
S221	43 48.64N	103 08.70W	3292 B	.23030	.52206	- 94.25
S222	43 45.15N	102 56.34W	3045	.24938	.51681	- 84.74
S223	43 45.11N	102 53.66W	3158 B	.24464	.51676	- 82.64
S224	43 45.24N	102 58.16W	2997 B	.25030	.51695	- 86.84
S225	43 45.84N	103 00.50W	3059 B	.24416	.51785	- 90.16
S226	43 46.02N	103 02.88W	3081 B	.24084	.51812	- 92.43
S227	43 46.90N	103 04.74W	3122	.23706	.51944	- 95.07
S228	43 46.05N	103 07.12W	3262 B	.22539	.51817	- 97.06
S229	43 47.66N	103 07.12W	3236 B	.23050	.52057	- 95.92
S230	43 48.21N	103 10.71W	3503	.21328	.52141	- 97.95
S231	43 46.47N	103 09.26W	3363 B	.21762	.51879	- 99.40
S232	43 46.52N	103 10.70W	3465 B	.20971	.51887	-101.27
S233	43 45.21N	103 13.12W	3503 B	.20592	.51691	-100.81
S234	43 46.90N	103 13.10W	3510	.20704	.51944	-101.81
S235	43 48.64N	103 13.10W	3439	.21527	.52206	-100.46
S236	43 49.94N	103 13.23W	3356 B	.22503	.52402	- 97.64
S237	43 52.25N	103 12.98W	3454	.22557	.52749	- 94.68
S238	43 50.34N	103 11.33W	3303 B	.23212	.52462	- 94.33

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S239	43 ° 46'.90N	102 ° 58'.29W	3152 B	980.24286	980.51944	- 87.47
S240	43 48.63N	102 58.57W	3163 B	.24286	.52204	- 89.41
S241	43 48.63N	103 02.35W	3247	.23339	.52204	- 93.84
S242	43 48.60N	103 05.58W	3166	.23489	.52200	- 97.16
S243	43 51.24N	103 04.73W	3262	.23230	.52597	- 97.96
S244	43 51.23N	103 07.17W	3428 B	.22062	.52595	- 99.66
S245	43 51.21N	103 09.56W	3392 B	.22459	.52592	- 97.80
S246	43 58.23N	103 07.75W	3164 B	.24478	.53648	-101.86
S247	43 54.30N	103 00.13W	3328 B	.23476	.53056	- 96.13
S248	43 55.63N	103 00.52W	3170 B	.24646	.53255	- 95.90
S249	43 57.34N	103 02.92W	3114	.24927	.53514	- 99.04
S250	43 58.21N	103 04.73W	3084	.25021	.53644	-101.20
S251	43 56.90N	103 06.11W	3287	.23590	.53448	-101.37
S252	43 59.69N	103 08.83W	3279	.23802	.53867	-103.91
S253	43 52.75N	103 00.12W	3069	.25086	.52824	- 93.24
S254	43 53.56N	103 02.32W	3103	.24663	.52945	- 96.65
S255	43 53.74N	103 04.75W	3135 B	.24504	.52972	- 96.59
S256	43 55.16N	103 05.89W	3218 B	.24273	.53185	- 96.05
S257	43 53.81N	103 07.11W	3238 B	.24191	.52983	- 93.64
S258	43 54.73N	103 08.02W	3283 B	.23995	.53120	- 94.28
S259	43 52.98N	103 14.32W	3587	.21691	.52859	- 96.47
S260	43 52.56N	103 09.52W	3450	.22045	.52795	-100.51
S261	43 53.85N	103 10.88W	3504 B	.21940	.52989	-100.25
S262	43 53.86N	103 13.11W	3583	.21794	.52990	- 96.99
S263	43 58.54N	103 13.79W	3442	.24017	.53694	- 90.26
S264	43 53.00N	103 11.92W	3486	.22259	.52861	- 96.87
S265	43 54.73N	103 11.91W	3537	.22046	.53120	- 98.52
S266	43 57.66N	103 11.62W	3362	.23866	.53562	- 95.25
S267	43 56.71N	103 09.71W	3299	.23692	.53419	- 99.33
S268	43 59.69N	103 03.00W	3034	.25521	.53867	-101.42
S269	44 08.39N	102 54.55W	3078	.27908	.55174	- 87.99
S270	44 08.40N	102 56.98W	3094	.27917	.55176	- 86.96
S271	44 08.41N	102 59.39W	3108	.27850	.55177	- 86.80
S272	44 08.40N	103 04.22W	3167	.27206	.55176	- 89.69
S273	44 08.41N	103 06.63W	3208	.27170	.55177	- 87.60
S274	44 08.46N	103 01.79W	3147 B	.27356	.55185	- 89.48
S275	44 12.77N	102 59.38W	2861	.30595	.55833	- 80.73
S276	44 11.02N	102 57.95W	2880	.30137	.55571	- 81.55
S277	44 12.75N	102 56.98W	2885	.30506	.55830	- 80.15
S278	44 11.18N	102 52.81W	2739	.30739	.55595	- 84.23

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2,67
S279	44° 11.26N	102° 55.80W	2788	980.30764	980.55607	- 81.16
S280	44 12.76N	102 54.57W	2819	.30863	.55832	- 80.56
S281	44 14.50N	102 54.57W	2938	.30309	.56093	- 81.57
S282	44 14.51N	102 56.98W	2918	.30546	.56095	- 80.41
S283	44 14.52N	102 59.38W	2925	.30280	.56096	- 82.67
S284	44 14.52N	103 06.62W	2942	.29621	.56096	- 88.24
S285	44 12.73N	103 06.62W	2927	.29382	.55828	- 88.84
S286	44 11.03N	103 05.41W	3030	.28541	.55572	- 88.52
S287	44 12.99N	103 04.21W	2886	.29746	.55866	- 88.05
S288	44 14.52N	103 04.21W	2964	.29493	.56096	- 88.20
S289	44 14.52N	103 01.80W	2997	.29482	.56096	- 86.33
S290	44 12.78N	103 01.79W	2856	.30241	.55835	- 84.59
S291	44 10.15N	103 01.83W	3092 B	.28172	.55440	- 87.17
S292	44 23.01N	102 55.46W	2634 B	.33057	.57375	- 85.14
S293	44 29.95N	103 04.25W	2794 B	.32767	.58419	- 88.88
S294	44 25.20N	103 03.07W	2499	.34416	.57703	- 82.94
S295	44 26.73N	103 04.18W	2586	.33947	.57932	- 84.70
S296	44 28.14N	103 01.45W	2773	.32804	.58144	- 87.03
S297	44 29.75N	103 00.27W	2782	.32757	.58389	- 89.40
S298	44 29.31N	102 57.82W	2749	.32958	.58323	- 88.71
S299	44 28.14N	102 55.42W	2648	.33522	.58144	- 87.35
S300	44 27.99N	102 53.00W	2690	.33463	.58122	- 85.19
S301	44 26.70N	102 57.82W	2807	.32330	.57928	- 87.57
S302	44 25.83N	102 55.42W	2775	.32332	.57797	- 88.16
S303	44 24.98N	102 56.63W	2761	.32369	.57670	- 87.36
S304	44 24.98N	102 54.20W	2726	.32573	.57670	- 87.42
S305	44 24.12N	103 06.28W	2883	.31623	.57526	- 86.21
S306	44 22.79N	103 02.93W	2829	.31976	.57342	- 83.92
S307	44 22.78N	102 59.63W	2578	.33772	.57340	- 81.01
S308	44 25.20N	103 14.78W	2994 B	.30697	.57703	- 90.43
S309	44 25.43N	103 12.35W	2965	.30980	.57737	- 89.68
S310	44 25.43N	103 09.91W	2950	.31192	.57737	- 88.46
S311	44 25.17N	103 08.01W	2926 B	.31389	.57698	- 87.54
S312	44 23.24N	103 07.55W	2859 B	.31712	.57409	- 85.44
S313	44 21.56N	103 07.51W	2735 B	.32269	.57155	- 84.77
S314	44 19.86N	103 07.88W	2880	.31015	.56900	- 86.06
S315	44 18.02N	103 09.06W	3115	.29220	.56624	- 87.15
S316	44 16.28N	103 09.05W	3176	.28527	.56360	- 87.78
S317	44 17.16N	103 10.94W	3055	.29439	.56495	- 87.27
S318	44 16.28N	103 12.66W	3089	.29042	.56360	- 87.85

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S319	44 ° 18.03N	103 ° 12.65W	3082	980.29409	980.56625	- 87.25
S320	44 18.02N	103 14.76W	3153	.28920	.56624	- 87.87
S321	44 19.34N	103 13.87W	3218	.28809	.56822	- 87.06
S322	44 20.97N	103 14.78W	2950 B	.30803	.57066	- 85.64
S333	44 21.52N	103 12.36W	2853	.31554	.57149	- 84.78
S324	44 23.25N	103 10.18W	2803	.32094	.57410	- 84.99
S325	44 23.25N	103 12.27W	2805	.32042	.57410	- 85.39
S326	44 23.37N	103 14.79W	2838	.31776	.57428	- 86.25
S327	44 26.95N	103 07.89W	2706 B	.33037	.57966	- 86.93
S328	44 28.47N	103 09.92W	2755	.32829	.58194	- 88.36
S329	44 28.12N	103 07.88W	2780 B	.32682	.58141	- 87.80
S330	44 29.83N	103 08.70W	2710	.33327	.58400	- 88.14
S331	44 29.34N	103 12.32W	2710 B	.33232	.58327	- 88.36
S332	44 28.89N	103 14.76W	2762	.32744	.58259	- 89.43
S333	44 16.27N	103 01.80W	3021	.29653	.56358	- 85.80
S334	44 16.70N	102 54.49W	2855	.31084	.56425	- 82.12
S335	44 15.36N	102 53.32W	2908	.30437	.56222	- 83.38
S336	44 17.05N	102 58.14W	2825	.31380	.56479	- 81.49
S337	44 18.88N	103 01.84W	2827	.31371	.56753	- 84.21
S338	44 17.63N	103 01.18W	3020	.29933	.56565	- 85.13
S339	44 19.66N	102 58.14W	2584	.33399	.56870	- 79.68
S340	44 18.52N	102 59.07W	2774	.31845	.56699	- 82.11
S341	44 21.50N	102 54.19W	2521	.33600	.57146	- 84.21
S342	44 21.73N	102 59.48W	2746	.32526	.57180	- 81.80
S343	44 21.94N	103 01.44W	2769	.32323	.57212	- 82.76
S344	44 19.77N	103 06.65W	2821	.31359	.56886	- 86.02
S345	44 18.18N	103 05.83W	3194 B	.28657	.56648	- 88.28
S346	44 16.27N	103 04.21W	3083	.29110	.56358	- 87.49
S347	44 04.05N	103 10.27W	3134	.26170	.54524	- 95.50
S348	44 06.67N	103 13.28W	3347	.26654	.54916	- 81.81
S349	44 08.73N	103 14.91W	3383 B	.26913	.55225	- 80.15
S350	44 11.07N	103 13.88W	3434 B	.26459	.55578	- 85.16
S351	44 12.82N	103 13.88W	3127 B	.28589	.55842	- 84.91
S352	44 14.68N	103 13.87W	3068 B	.28820	.56120	- 88.93
S353	44 12.79N	103 11.47W	3047	.28925	.55837	- 86.30
S354	44 14.54N	103 11.47W	3018	.29329	.56099	- 86.63
S355	44 14.53N	103 09.05W	2956	.29670	.56097	- 86.92
S356	44 12.79N	103 09.04W	2977	.29154	.55837	- 88.21
S357	44 10.17N	103 09.26W	3422 B	.25998	.55443	- 89.14
S358	44 08.49N	103 09.04W	3161 B	.27589	.55190	- 86.35

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S359	44 ° 11.03N	103 ° 11.46W	3173	980.27993	980.55572	- 85.42
S360	44 09.45N	103 11.46W	3212	.27522	.55335	- 85.41
S361	44 07.54N	103 11.46W	3174	.27500	.55047	- 85.04
S362	44 04.22N	103 14.00W	3317	.26625	.54549	- 80.23
S363	44 02.32N	103 11.47W	3227	.25185	.54261	- 97.15
S364	44 04.50N	103 12.38W	3216 B	.26821	.54591	- 84.75
S365	44 04.05N	103 08.34W	3175	.25410	.54523	-100.64
S366	44 02.30N	103 07.84W	3055	.25610	.54258	-103.19
S367	44 00.72N	103 07.85W	3202 B	.24405	.54021	-104.05
S368	44 02.63N	103 14.73W	3853	.22951	.54307	- 82.39
S369	44 01.39N	103 14.97W	3809 B	.22876	.54121	- 83.92
S370	44 00.12N	103 14.97W	3819 B	.22225	.53931	- 87.93
S371	44 05.16N	102 17.71W	2608 B	.32049	.54690	- 69.94
S372	43 59.67N	102 35.12W	2858 B	.29015	.53863	- 77.01
S373	43 59.02N	102 33.05W	2684 B	.30203	.53766	- 74.60
S374	43 57.52N	102 30.88W	2379 B	.32268	.53541	- 70.00
S375	43 59.03N	102 31.06W	2602	.30989	.53767	- 71.67
S376	43 59.59N	102 29.12W	2566	.31602	.53851	- 68.54
USGS Base	44 00.57N	103 10.81W	3331 B	.23856	.53998	-101.57
S377	44 01.85N	102 28.06W	2325	.33653	.54190	- 65.88
S378	44 03.89N	102 26.87W	2321 B	.33931	.54499	- 66.42
S379	44 08.24N	102 29.25W	2701	.31361	.55152	- 75.86
S380	44 11.42N	102 29.48W	2612 B	.32011	.55631	- 79.49
S381	44 14.24N	102 29.55W	2565 B	.32325	.56054	- 83.40
S382	44 14.33N	102 25.77W	2281 B	.34231	.56067	- 81.51
S383	44 13.22N	102 24.28W	2563 B	.32474	.55901	- 80.50
S384	44 11.41N	102 26.14W	2604	.32131	.55630	- 78.75
S385	44 10.00N	102 25.80W	2659 B	.31724	.55418	- 77.41
S386	44 07.91N	102 24.73W	2507 B	.32785	.55102	- 72.76
S387	44 07.50N	102 26.86W	2616 B	.32014	.55041	- 73.32
S388	44 02.50N	102 22.27W	2742 B	.31091	.54288	- 67.46
S389	43 55.92N	102 35.87W	2645	.30154	.53299	- 72.76
S390	43 53.64N	102 36.01W	2754 B	.29262	.52957	- 71.72
S391	43 53.17N	102 33.39W	2777	.28990	.52886	- 72.35
S392	43 53.59N	102 30.99W	2788 B	.28889	.52950	- 73.33
S393	43 54.77N	102 32.21W	2746 B	.29349	.53126	- 73.02
S394	43 56.05N	102 32.30W	2425 B	.31635	.53319	- 71.34
S395	43 54.49N	102 28.63W	2839	.28792	.53084	- 72.59
S396	43 54.48N	102 26.22W	2833	.28796	.53083	- 72.90
S397	43 52.73N	102 26.23W	2860 B	.28131	.52820	- 75.30

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S398	43 ° 52.76N	102 ° 28.62 W	2848	980.28290	980.52825	- 74.48
S399	43 57.08N	102 26.65 W	2456	.31963	.53475	- 67.77
S400	43 58.81N	102 26.23 W	2704	.30771	.53734	- 67.40
S401	44 00.53N	102 26.73 W	2735 B	.30840	.53992	- 67.43
S402	43 59.67N	102 23.52 W	2774	.30498	.53863	- 67.22
S403	44 07.12N	102 23.14 W	2255 B	.34528	.54984	- 69.27
S404	44 04.90N	102 23.25 W	2292	.34238	.54651	- 66.62
S405	44 22.18N	102 33.94 W	2197	.35581	.57248	- 84.86
S406	44 26.33N	102 18.52 W	2056 B	.38029	.57872	- 75.08
S407	44 28.87N	102 06.63 W	2280	.37131	.58255	- 74.45
S408	44 28.64N	102 08.28 W	2282 B	.37145	.58221	- 73.85
S409	44 26.91N	102 10.27 W	2296	.36839	.57959	- 73.45
S410	44 27.16N	102 07.83 W	2279 B	.36929	.57995	- 73.93
S411	44 29.31N	102 09.68 W	2198 B	.37844	.58322	- 72.91
S412	44 29.28N	102 12.08 W	2447	.36224	.58318	- 74.13
S413	44 27.65N	102 12.39 W	2345	.36622	.58070	- 73.79
S414	44 28.38N	102 17.64 W	2133	.37923	.58181	- 74.61
S415	44 27.62N	102 19.91 W	2449 B	.35586	.58066	- 77.87
S416	44 28.45N	102 21.35 W	2579 B	.34745	.58191	- 79.73
S417	44 29.74N	102 22.81 W	2754	.33686	.58387	- 81.78
S418	44 24.57N	102 26.68 W	2556 B	.33710	.57608	- 85.63
S419	44 27.59N	102 27.51 W	2575	.33976	.58061	- 86.36
S420	44 29.32N	102 28.09 W	2784	.32965	.58324	- 86.56
S421	44 26.29N	102 27.08 W	2514	.34195	.57866	- 85.88
S422	44 25.84N	102 22.83 W	2119	.37059	.57799	- 80.27
S423	44 24.75N	102 20.47 W	2402 B	.35294	.57635	- 79.30
S424	44 23.25N	102 20.46 W	2398 B	.35095	.57410	- 79.28
S425	44 21.47N	102 21.62 W	2428	.34509	.57141	- 80.65
S426	44 23.67N	102 23.18 W	2105	.36824	.57473	- 80.20
S427	44 22.26N	102 23.43 W	2494	.34088	.57260	- 82.09
S428	44 20.62N	102 23.13 W	2496 B	.33852	.57014	- 81.87
S429	44 18.79N	102 23.22 W	2506	.33472	.56739	- 82.32
S430	44 18.80N	102 29.21 W	2666	.32051	.56741	- 86.95
S431	44 20.62N	102 28.87 W	2565	.33045	.57014	- 85.80
S432	44 22.37N	102 28.43 W	2142 B	.36116	.57276	- 83.09
S433	44 20.61N	102 25.63 W	2587	.33005	.57012	- 84.86
S434	44 18.79N	102 26.84 W	2632	.32317	.56739	- 86.31
S435	44 15.39N	102 22.89 W	2478 B	.33072	.56226	- 82.87
S436	44 16.19N	102 25.63 W	2539	.32671	.56346	- 84.42
S437	44 17.06N	102 28.05 W	2605	.32264	.56480	- 85.87

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
* S438	44 ° 15.29N	102 ° 12.37 W	2660 B	980.32419	980.56212	- 78.33
S439	44 22.05N	102 09.63 W	2473 B	.34749	.57229	- 76.42
S440	44 22.37N	102 07.83 W	2089 B	.37346	.57276	- 73.97
S441	44 21.96N	102 03.97 W	2490	.34622	.57215	- 76.54
S442	44 20.28N	102 03.45 W	2534	.33973	.56963	- 77.87
S443	44 22.35N	102 00.03 W	2518 B	.34289	.57274	- 78.77
S444	44 20.63N	102 00.27 W	2670 B	.33048	.57015	- 79.48
S445	44 18.69N	102 01.08 W	2601	.33208	.56724	- 79.11
S446	44 17.32N	102 02.71 W	2785	.31730	.56519	- 80.80
S447	44 15.31N	102 00.41 W	2794 B	.31362	.56214	- 80.89
S448	44 15.22N	102 02.30 W	2792 B	.31332	.56201	- 81.18
S449	44 15.29N	102 05.25 W	2566 B	.32920	.56211	- 78.96
S450	44 18.32N	102 08.85 W	2520	.33616	.56669	- 79.34
S451	44 18.94N	102 05.97 W	2508	.33828	.56762	- 78.87
S452	44 20.16N	102 07.76 W	2179 B	.36270	.56945	- 76.02
S453	44 17.12N	102 06.87 W	2315	.34757	.56489	- 78.43
S454	44 16.81N	102 08.84 W	2520	.33469	.56441	- 78.53
S455	44 15.30N	102 07.66 W	2467 B	.33712	.56213	- 77.00
S456	44 15.29N	102 10.05 W	2578 B	.33023	.56211	- 77.22
S457	44 17.34N	102 11.24 W	2574	.33213	.56522	- 78.66
S458	44 22.36N	102 12.02 W	2559	.34251	.57275	- 76.71
S459	44 20.61N	102 14.77 W	2516 B	.34078	.57013	- 78.39
S460	44 20.62N	102 12.01 W	2633	.33529	.57014	- 76.88
S461	44 18.77N	102 11.26 W	2665	.32756	.56736	- 79.91
S462	44 18.77N	102 13.66 W	2740	.32173	.56736	- 81.24
S463	44 17.02N	102 13.65 W	2856	.31246	.56474	- 80.93
S464	44 25.81N	102 15.65 W	2331	.36275	.57794	- 75.34
S465	44 24.29N	102 14.48 W	2513 B	.34861	.57566	- 76.28
S466	44 23.62N	102 11.22 W	2584 B	.34319	.57466	- 76.44
S467	44 15.30N	102 14.93 W	2931 B	.30484	.56213	- 81.44
S468	44 17.89N	102 16.05 W	2595	.33011	.56604	- 80.24
S469	44 19.63N	102 16.04 W	2526	.33749	.56865	- 79.61
S470	44 21.46N	102 16.33 W	2514	.34249	.57140	- 78.08
S471	44 23.16N	102 16.80 W	2475 B	.34757	.57397	- 77.91
S472	44 20.67N	102 20.10 W	2103	.36636	.57021	- 77.68
S473	44 16.56N	102 18.70 W	2619	.32459	.56403	- 82.31
S474	44 18.17N	102 20.83 W	2135	.35901	.56738	- 80.28
S475	44 15.25N	102 19.98 W	2575 B	.32545	.56205	- 82.11
S476	44 15.33N	102 16.57 W	2842 B	.30966	.56217	- 82.00
S477	44 10.95N	102 16.06 W	2881	.30580	.55560	- 76.95

Station	Latitude	Longitude	Elev. in feet	Observed Gravity	Theoret. Gravity	2.67
S478	44° 10.96N	102° 19.68W	2594	980.32427	980.55562	- 75.72
S479	44 13.55N	102 21.75W	2176 B	.35175	.55950	- 77.20
S480	44 14.44N	102 19.62W	2258	.34750	.56084	- 77.87
S481	44 11.32N	102 22.83W	2479 B	.33049	.55616	- 76.94
S482	44 09.69N	102 21.79W	2588 B	.32375	.55370	- 74.68
S483	44 08.78N	102 19.68W	2695	.31776	.55233	- 72.88
S484	44 08.82N	102 16.84W	2540	.32790	.55239	- 72.10
S485	44 13.71N	102 15.06W	2814 B	.31143	.55974	- 79.48
S486	44 00.11N	102 21.46W	2816 B	.30224	.53929	- 68.10
S487	44 01.41N	102 21.47W	2754 B	.30851	.54124	- 67.50
S488	44 04.02N	102 20.74W	2740	.31207	.54519	- 68.73
S489	44 04.02N	102 18.47W	2738	.31159	.54519	- 69.33
S490	44 06.57N	102 20.88W	2703	.31632	.54901	- 70.52
S491	44 05.75N	102 18.47W	2718	.31521	.54778	- 69.50
S492	44 07.49N	102 18.45W	2738 B	.31484	.55040	- 71.28
S493	44 07.49N	102 16.06W	2806	.31003	.55040	- 72.01
S494	44 05.75N	102 16.06W	2805	.30902	.54779	- 70.47
S495	44 04.02N	102 16.05W	2801	.30645	.54519	- 70.69
S496	44 02.28N	102 16.05W	2807	.30274	.54255	- 71.40
S497	44 02.27N	102 18.45W	2849	.30168	.54253	- 69.92
S498	44 00.55N	102 16.05W	2795	.30048	.53995	- 71.78
S499	44 24.32N	102 04.02W	2476	.35003	.57571	- 77.13
S500	44 24.01N	102 07.31W	2033 B	.37985	.57524	- 73.42
S501	44 25.66N	102 07.24W	1989 B	.38532	.57772	- 73.07
S502	44 26.68N	102 04.83W	1985	.38648	.57925	- 73.68
S503	44 28.43N	102 03.85W	1929	.39201	.58188	- 74.14
S504	44 28.98N	102 01.59W	2195	.37406	.58273	- 76.98
S505	44 27.55N	102 01.24W	2366 B	.36091	.58055	- 77.69
S506	44 25.83N	102 01.25W	2489	.35054	.57797	- 78.10
S507	44 23.22N	102 00.04W	2487	.34620	.57406	- 78.65