T. Olson

EAST-WEST GRAVITY PROFILE AND REGIONAL GRAVITY POINTS ROOSEVELT SPRINGS AREA BEAVER COUNTY, UTAH

DECEMBER 1973

FOR

DAVON, INC.
429 SOUTH MAIN ST.
MILFORD, UTAH 84751

Needs a GL

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APPLIED GEOPHYSICS, INC.
SALT LAKE CITY, UTAH

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I INTRODUCTION

As an aid to understanding the geology of the Roosevelt Springs geothermal area located on the west flank of the Mineral Mountains in Beaver County Utah, Davon, Inc., contracted Applied Geophysics, Inc. to survey an east-west gravity profile and a number of isolated regional gravity points around the Mineral Range. Surveying and leveling of the gravity line was carried out during the period Dec.15-23, 1973, under the direction of crew chief Fred Hilton. The gravity measurements were made from Dec. 19 to Dec. 23 by the undersigned.

The location of the gravity profile and other pertinent information required for the survey was provided by Mr. Jack von Hoene, exploration manager for Davon, Inc., in Milford, Utah.

II DESCRIPTION OF GRAVITY SURVEY

1. Gravity Profile

The gravity profile was staked and flagged at a 250 foot interval, laid out by survey chain, along the traverse shown at the bottom of Plate 1. The major part of the line followed the county road indicated, but several miles of line were run across the sagebrush-covered alluvial plain sloping down from the Mineral Mountains. Leveling was accomplished with a Kern self-leveling instrument beginning at an elevation of 6178 feet corresponding to the road intersection in the south-east quarter of Section 3, T27S, R9W, and closing at 5011 feet at the road intersection in the northeast quarter of Section 16, T27S, R10W. The closing error was two feet, well within the accuracy limits of the elevations indicated on the topographic map.

The gravity readings along this line were made with Worden gravimeter 406 having a sensitivity of 0.0960 milligals per scale division. Ten closed loops were accomplished during a three-day period, resulting in the reading of 163 gravity stations. The maximum closure difference encountered was 0.15 milligals, and the average was 0.06 milligals. These differences were distributed assuming a linear drift with time of the gravity meter.

The gravity readings were tied to the Milford gravity base station, established by the University of Utah and the Army Map Service, and the value for this station, as per the relative gravity readings of the gravity profile, is given on Plate 1. A description of the Milford base station appears in the Appendix.

No lattitude corrections were applied to any of the readings of this survey, nor were terrain corrections made. The latter would have added considerably to the cost of the survey and were not contracted for. They were, furthermore, not necessary for the primary purpose of the survey, which was the location of basin-range faulting on the west flank of the Mineral Mountains.

2. Regional Gravity Points

One day was spent in obtaining a number of regional gravity points on the east and west flanks of the Mineral Mountains as requested by Davon consultant David D. Blackwell of Dallas, Texas. The purpose of the measurements was to augment the regional gravity coverage shown by the U.S. Geological Survey open file map of the area. These points were measured in two closed loops tied to a gravity base at road intersection 6178 in Section 3, T27S, R9W, which was in turn tied to the Milford base. The locations of the points is shown on U.S. Geological Survey 15 minute quadrangle sheets Adamsville and Beaver, Utah. A description of these points and their raw gravity values relative to the Milford base station is given in Table 1.

It should be pointed out that the elevations of these stations could be in error by several feet, and the subsequently computed Bouguer gravity values would be inaccurate by several tenths of a milligal.

III INTERPRETATION OF GRAVITY PROFILE

The gravity profile shown in Plate 1 was calculated for an assumed density of 2.67 and may be correlated with the regional gravity readings which are also calculated using this same density value. However, this density is much greater than that of the valley fill underlying the gravity profile (note the negative correlation with the dry wash crossed at station 4300), and for interpretation purposes, the profile was recomputed for a more realistic density value of 1.97. The resulting profile is shown in Plate 2, and is labeled "Simple Bouguer Gravity." The term "simple" indicates that no topographic corrections were applied.

Table 1.

RAW GRAVITY RELATIVE TO AMS MILFORD BASE STATION

Stations West Side of Mineral Range

	Elev.	Sec.	Township	Range	Gravity Relative to Milford Base (mg)
1)	*6019	21	27S	9W	-55.70
2)	*5950	28	27S	9W	-53.61
3)	*5775	29	27S	9W	-46.61
4)	6511	35	27S	9W	-94.59

Stations on East Side of Mineral Range

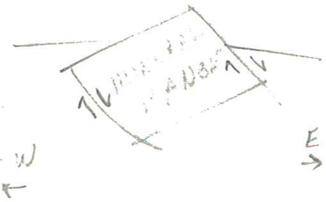
	Elev.	Sec.	Township	Range	Gravity Relative to Milford Base (mg)
5)	6036	32	28S	8W	-71.85
6)	6243	29	28S	8W	-84.55
7)	6334	20	28S	8W	-92.56
8)	*6462	21	28S	8W	-98.63
9)	6690	9	28S	8W	-110.40
10)	*6643	33	27S	8W	-110.31

Note:

Stations above 7000 feet could not be reached because of snow drifts.

* Elevations less accurate
(appear in brown on topographic map)

The most surprising fact about this gravity profile is the lack of strong gradients typical of Basin-Range faulting. From the peak of the curve at Station 51.5, corresponding to an outcrop of late Tertiary volcanic flows to the end of the profile on the west, the profile is extremely smooth and devoid of the two- to ten- milligal gravity gradients typically found over Basin-Range normal faults. Because of this it must be concluded that the Mineral Range is a west-dipping tilt block. Normal faulting of considerable throw and strong gravity gradients must therefore exist on the *east* side of the range.



A 1.2 milligal gravity gradient occurring east of the late Tertiary flows at Station 51.5 in Section 4 indicates a depth of 200 to 250 feet of valley fill immediately to the east of the outcrops. This bedrock relief could result from erosion, although a fault, down-thrown to the east, is an equally plausible explanation. The geology map of Utah (Hintze, 1963) indicates a possible fault at this locality. East of here the gravity profile approaches and enters the Mineral Range and exhibits the effects of topographic attraction from the mass of the mountain. The required topographic corrections to eliminate this effect and subsequent interpretation of the gravity profile within the range were not contracted for under the present agreement.

A closer look at the gravity profile west of the range was desired for any geological information it might offer, and a residual curve was therefore calculated by taking a running average spanning an 8000 foot horizontal distance and subtracting it from the readings at each station. Spans shorter than 8000 feet would have eliminated much, or all, of the effects of bedrock faulting, and longer spans would have eliminated information on the ends of the lines. The residual was also subjected to a short-wavelength smoothing process to eliminate minor deviations due to topographic attractions and measuring inaccuracies. The smoothing was of the type, $b'=(a+2b+c)/4$. The resulting smoothed residual, enlarged to a vertical scale 10 times greater than the original profile appears at the bottom of Plate 2. Again, only minor anomalies of one-tenth to one-fifth milligal are present, and most of these appear to be of short wavelength and thus due to effects within the valley fill itself.

However, an apparent bona-fide basement fault anomaly is visible centered at Station 23.7. This anomaly could be caused by a normal fault downthrown to the west with a throw of about 150 feet at a depth of about 3500 feet ± 500 feet. The large uncertainty (about ±15%) in calculation is due to the small amplitude of the anomaly and the effect of interference from minor anomalies within the geological section.

The total gravity relief of about 22 milligals across the valley supports this interpretation of depth to basement, and indicates that perhaps the upper range, that is 3500-4000 feet, would be closer to the actual depth to basement at this point. This measurement occurs at the minimum value of the gravity profile, closely corresponding to the deepest point of the bedrock valley between the Mineral and Rocky Ranges.

IV CONCLUSIONS AND RECOMMENDATIONS

1. Because of the absence of major normal faulting on the west flank of the Mineral Range, as proven by the gravity profile, the range appears to be a west-dipping tilt block.

2. Maximum depth to bedrock between the Mineral and Rocky Ranges along the gravity profile occurs near gravity Station 2400 in Section 15, T27S, R10W. The estimated depth of fill here is 3500-4000 feet.

3. A possible fault is located east of the outcrops of late Tertiary volcanic flows at Station 51.5 in Section 4. The throw of a fault in this locality would be about 250 feet, down thrown to the east.

4. Consideration should be given to the possibility that the Roosevelt Hot Springs are controlled by faults other than northerly trending normal faults. An aeromagnetic survey of the area would serve to define faults of all strike directions in the vicinity of the springs.

Respectfully submitted,

APPLIED GEOPHYSICS, INC.

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Chief Geophysicist

APPENDIX

GRAVITY BASE STATION NETWORK IN UTAH-1967

by

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UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
affiliated with
THE COLLEGE OF MINES AND MINERAL INDUSTRIES
University of Utah, Salt Lake City, Utah

A Joint Project by the
U. S. Army Topographic Command
Corps. of Engineers, Department of the Army
Washington, D. C. 20315

and the
Department of Geophysics
University of Utah
Salt Lake City, Utah 84112

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Figure 1. Heat flow stations in the southwestern United States. Solid triangles indicate published data by other investigators (Decker, 1969; Sass and others, 1971; Warren and others, 1969; Herrin and Clark, 1956; Birch, 1950; Birch, 1947; Lovering, 1948; Spicer, 1964; Costain and Wright, 1973). Open triangles indicate heat flow sites being cooperatively studied by MIT and NMIMT (Chessman and others) and by LASL and NMIMT (Reiter and others). Open circles indicate heat flow sites being studied by NMIMT (Sanford and others, Edwards and others, Reiter and others). Solid circles indicate sites for which heat flow data is presented and tabulated in the present manuscript. X's indicate sites demonstrating severe groundwater disturbance in the temperature log. (Base map is after the AAPG Geological Highway Map of the Southern Rocky Mountain Region, 1967).

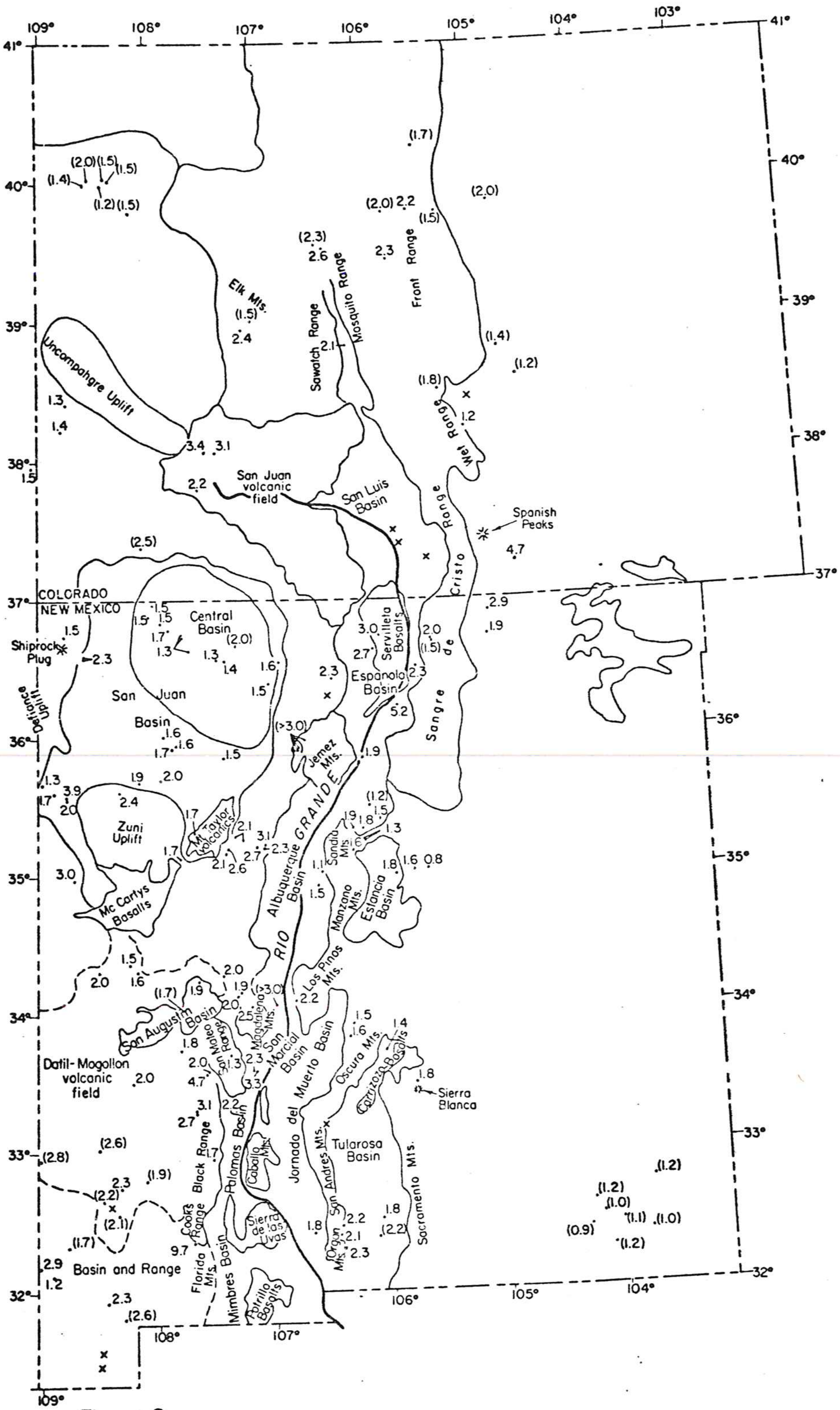


Figure 2.

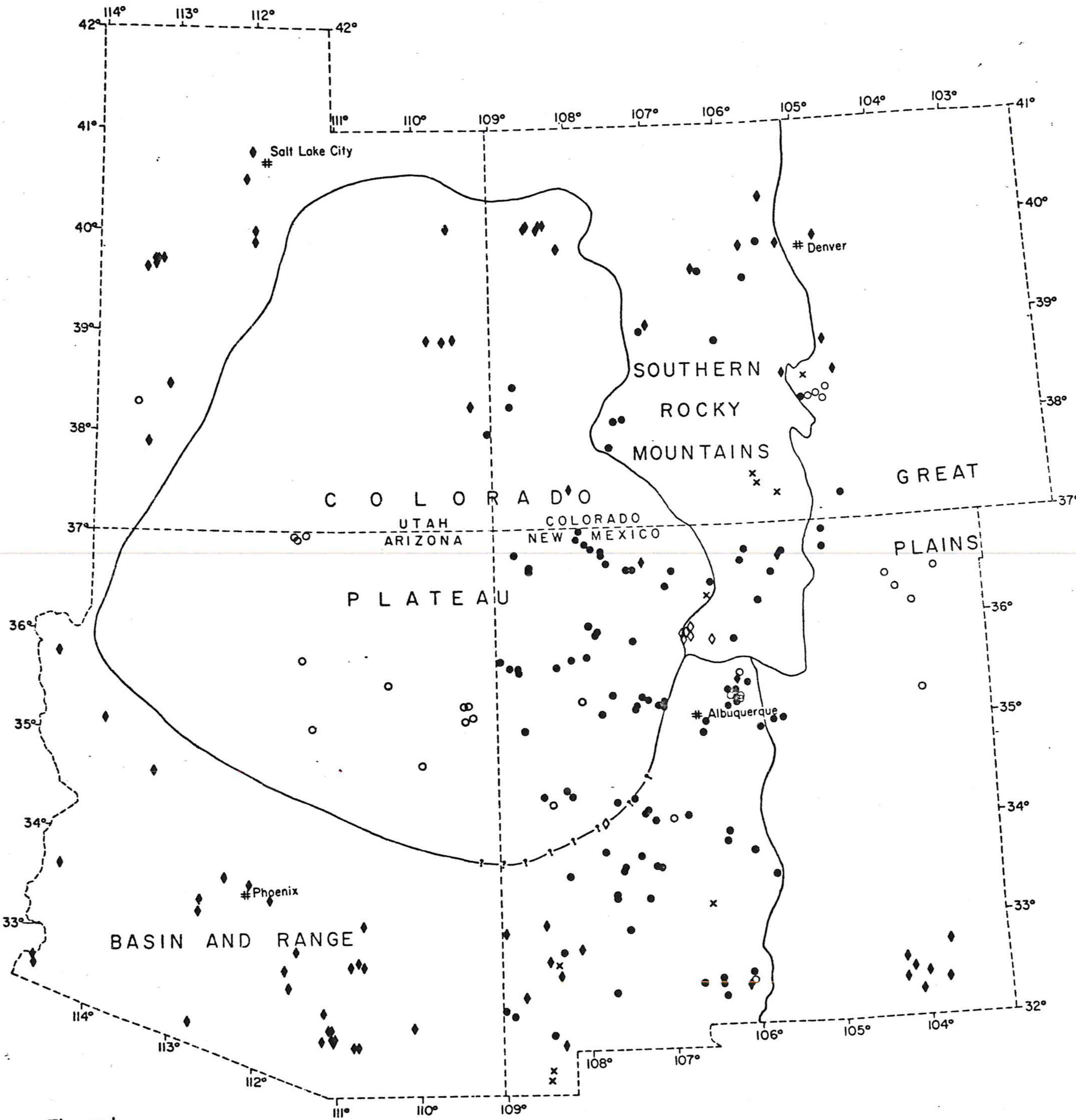
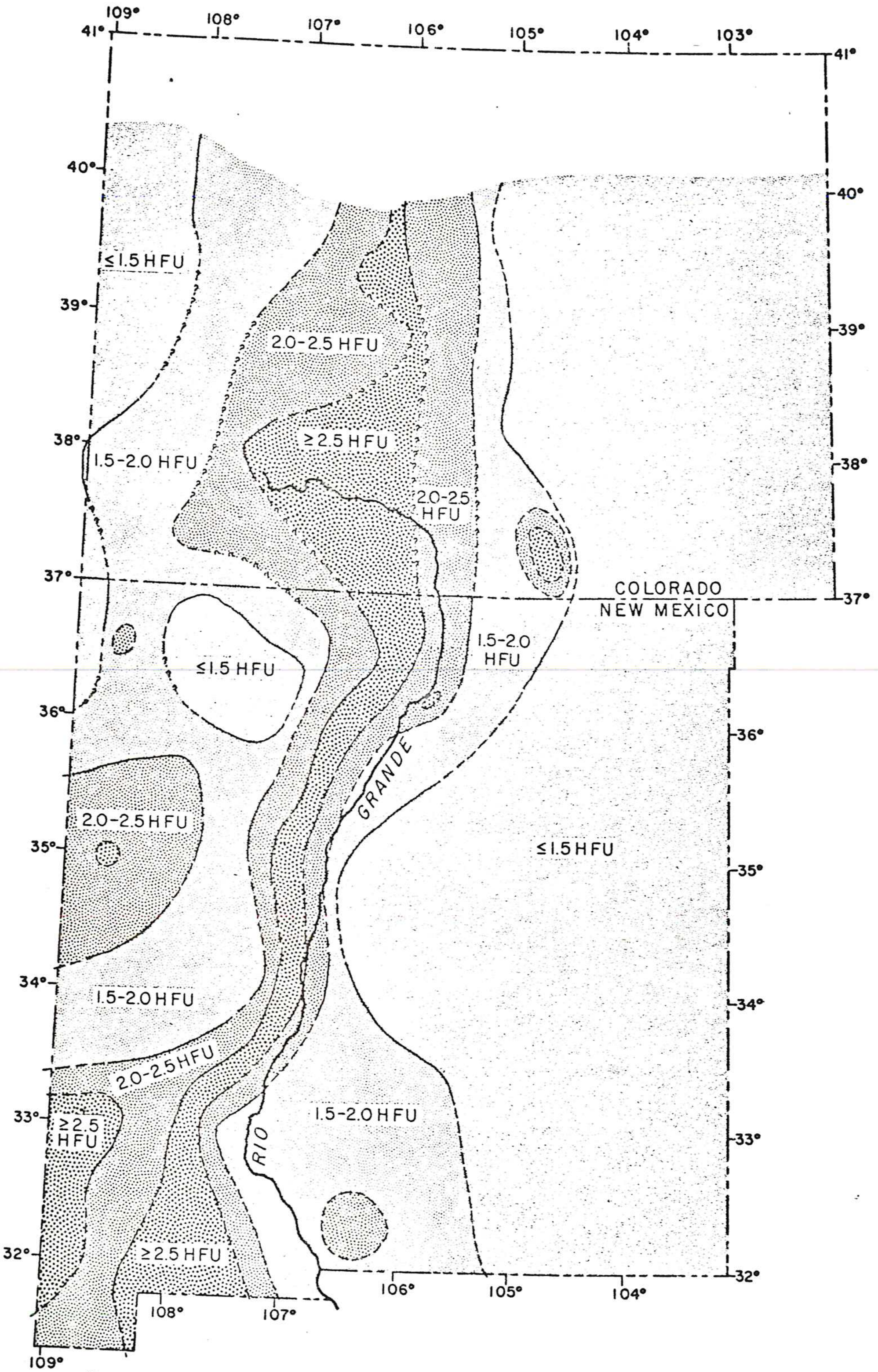

Salt Lake City
Denver
Albuquerque
Phoenix
SOUTHERN ROCKY MOUNTAINS
COLORADO PLATEAU
GREAT PLAINS
BASIN AND RANGE
UTAH
ARIZONA
COLORADO
NEW MEXICO
114°
113°
112°
111°
110°
109°
108°
107°
106°
105°
104°
103°
42°
41°
40°
39°
38°
37°
36°
35°
34°
33°
32°

Figure I.



≤1.5 HFU
2.0-2.5 HFU
≥2.5 HFU
1.5-2.0 HFU
2.0-2.5 HFU
COLORADO
NEW MEXICO
≤1.5 HFU
1.5-2.0 HFU
2.0-2.5 HFU
GRANDE
≤1.5 HFU
1.5-2.0 HFU
2.0-2.5 HFU
≥2.5 HFU
RIO
1.5-2.0 HFU
≥2.5 HFU

Figure 3.

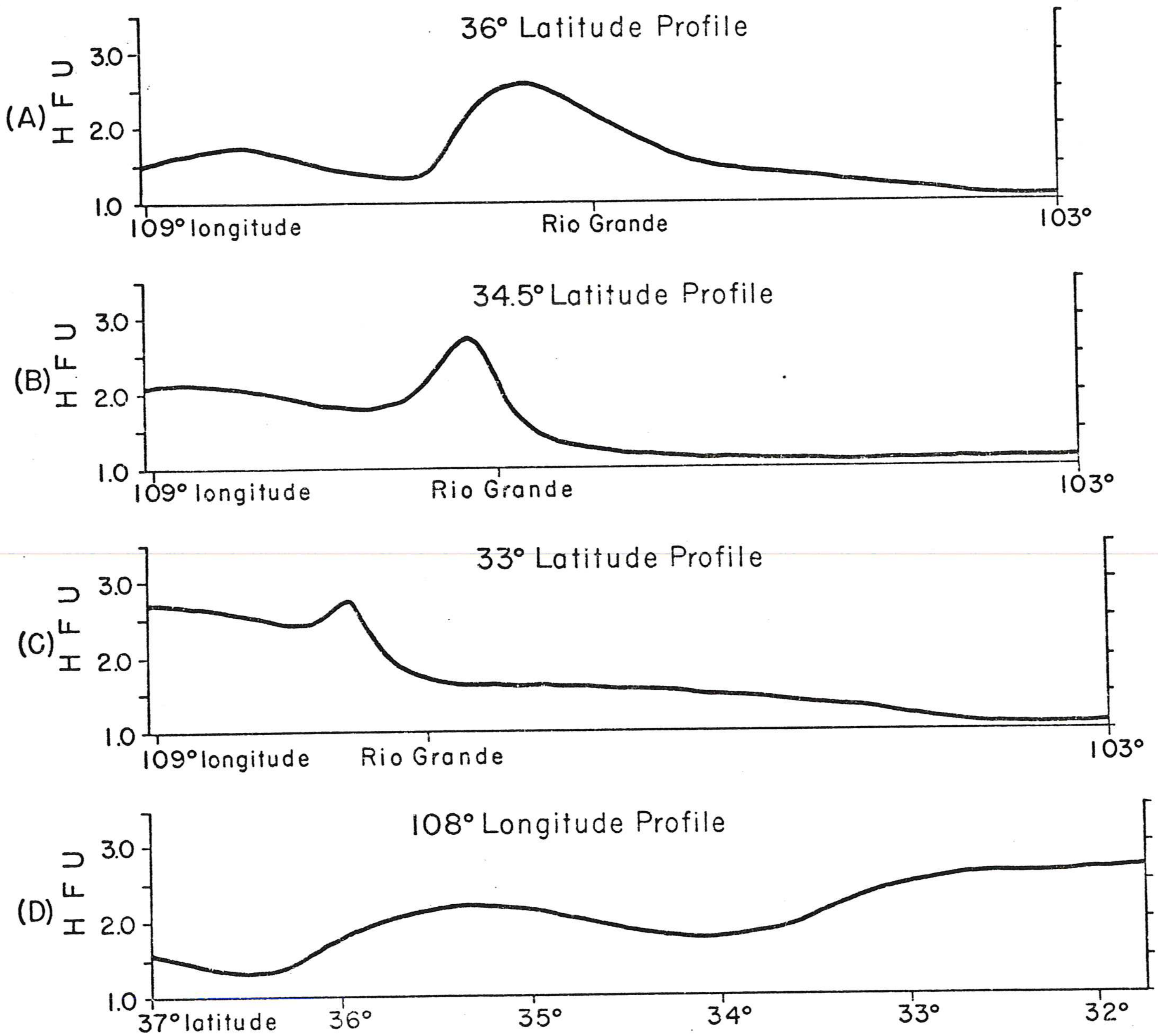

36° Latitude Profile
(A)
HFU
3.0
2.0
1.0
109° longitude
Rio Grande
103°
34.5° Latitude Profile
(B)
HFU
3.0
2.0
1.0
109° longitude
Rio Grande
103°
33° Latitude Profile
(C)
HFU
3.0
2.0
1.0
109° longitude
Rio Grande
103°
108° Longitude Profile
(D)
HFU
3.0
2.0
1.0
37° latitude
36°
35°
34°
33°
32°

Figure 4.