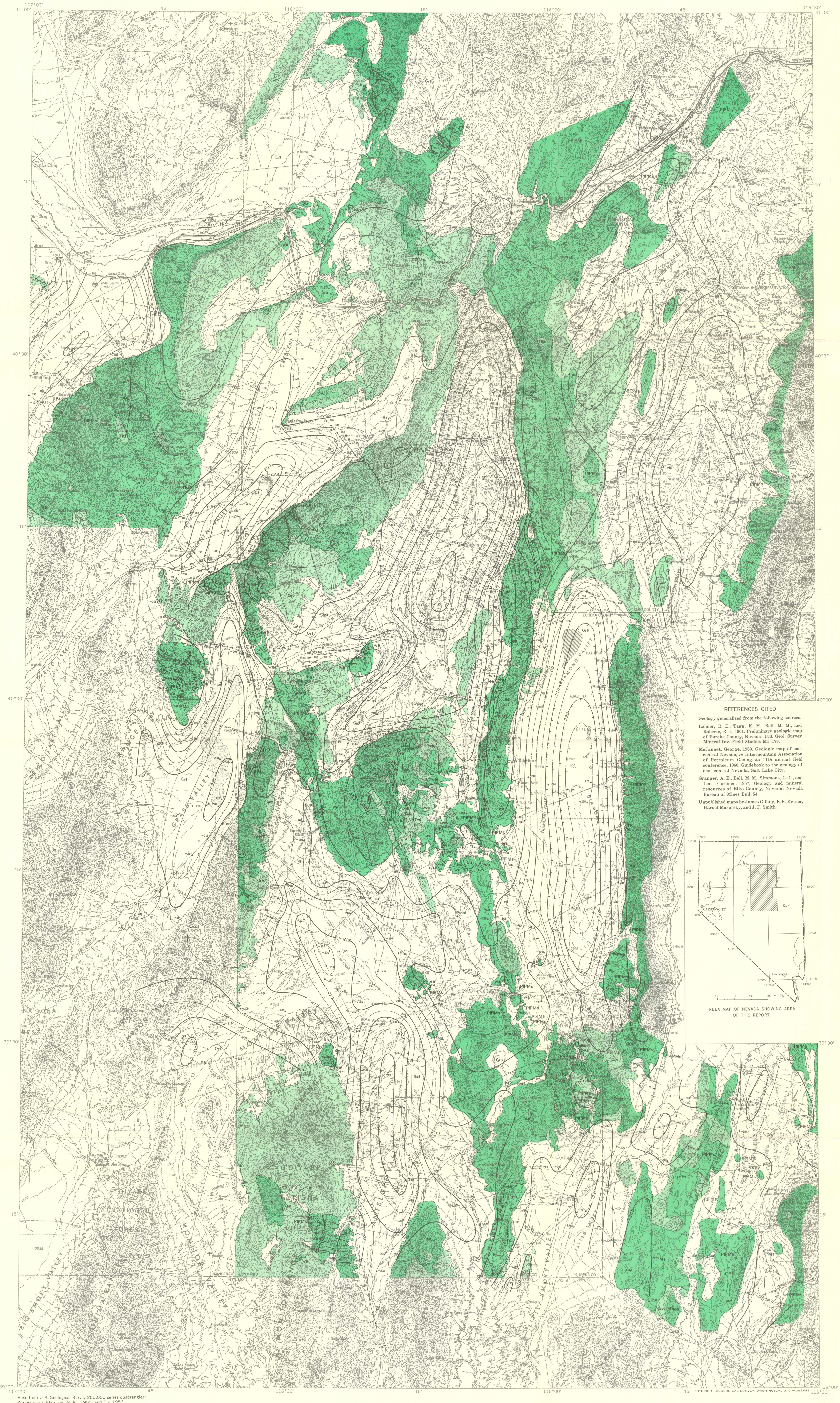

Base from U.S. Geological Survey 250,000 series quadrangles: Winnemucca, Elko, and Millet, 1955; and Ely, 1956

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—G62443

GRAVITY MAP OF EUREKA COUNTY AND ADJOINING AREAS, NEVADA

By
Don R. Mabey

SCALE 1:250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 KILOMETERS

CONTOUR INTERVAL 200 FEET
DASHED LINES REPRESENT 100-FOOT CONTOURS
TRANSVERSE MERCATOR PROJECTION

1964

EXPLANATION

Sedimentary rocks — Volcanic rocks (CENOZOIC)

Intrusive rocks (CRETACEOUS AND TERTIARY)

Sedimentary rocks (CRETACEOUS)

Sedimentary rocks. *Includes some undifferentiated Paleozoic rocks in Elko and White Pine Counties* (MISSISSIPPIAN, PENNSYLVANIAN, AND PERMIAN)

Western assemblage of sedimentary rocks — Eastern assemblage of sedimentary rocks (CAMBRIAN THROUGH DEVONIAN)

Contact
Dashed where approximately located

Fault
Dashed where approximately located

Thrust fault
Sawteeth on upper plate. Dashed where approximately located

Gravity contours
Contour interval 5 milligals. Hachured contours indicate areas of low gravity closure. Dashed where data are incomplete

Gravity station
Value is simple Bouger anomaly, in milligals

INTRODUCTION

This map is a compilation of the gravity data collected by the U.S. Geological Survey in an area of about 6,000 square miles in central Nevada, here called the Eureka County area. Most of the area is in Eureka County, but parts of Lander, Elko, White Pine, and Nye Counties are also included. The largest towns are Elko, Battle Mountain, Carlin, and Eureka.

The first gravity work by the U.S.G.S. was done in 1955 by Donald Plouff and S. W. Stewart in Crescent Valley. Subsequent work in adjoining areas was done by D. R. Mabey with the assistance of G. H. Turner, J. A. Barnett, C. H. Sandberg, and D. L. Peterson, and by D. L. Trask with the assistance of J. A. Barnett and B. V. Marshall. This text discusses the major features of the gravity anomaly map. A more detailed interpretation of some of the data will be incorporated into reports on geologic studies of parts of the area.

TOPOGRAPHY AND GENERAL GEOLOGY

The dominant topographic features of the Eureka County area are generally north-trending ranges and intervening valleys. Several of the high points in the ranges are over 10,000 feet above sea level, and 9,000-foot peaks are common. The elevations of the valley floors range from about 4,500 feet to over 6,000 feet.

The northern part of the area is drained by the Humboldt River, which flows generally westward, and the extreme southeast corner of the area drains southward into Railroad Valley. Three major closed drainage systems with sinks in Grass Valley, Diamond Valley, and Newark Valley cover most of the central and southern part.

The oldest rocks in the area of the gravity survey are sedimentary rocks of Paleozoic age. Two distinct assemblages of lower Paleozoic rocks have been brought into juxtaposition by the Roberts Mountain thrust (Merriam and Anderson, 1942). The western eugeosynclinal assemblage, probably more than 50,000 feet thick, consists predominantly of clastic sedimentary rocks and chert with minor amounts of volcanic material. The eastern miogeosynclinal assemblage is thinner and consists of limestone and dolomite, with some shale and quartzite. Younger Paleozoic rocks comprise an overlap assemblage grading from coarse clastic rocks on the west to finer sediments and marine facies on the east (Roberts and others, 1958).

Nonmarine sedimentary rocks occur in most of the valleys and locally in the ranges. These rocks are principally of Tertiary age but Cretaceous rocks are known in the Diamond Mountains. Several bodies of post-Paleozoic intrusive rock are exposed in the ranges. Tertiary volcanic and pyroclastic rocks locally several thousand feet thick are widespread over the area.

The Paleozoic rocks in the eastern assemblage have an average density of about 2.7 g per cm^3. The western assemblage is less dense, averaging about 2.6 g per cm^3. The intrusive rocks and the younger Paleozoic rocks have densities intermediate between those of the two older Paleozoic assemblages. The densities of the Cenozoic sedimentary and volcanic rocks cover a wide range. The average density for a thick accumulation of Cenozoic rocks is estimated to be between 2.2 and 2.5 g per cm^3. In estimating thickness of Cenozoic rocks from the gravity data a density contrast of 0.4 g per cm^3 between the Cenozoic rocks and the older rocks is assumed. Because the gravity data generally cannot be used to determine the kind of Cenozoic rock that produces a gravity low, the general term "fill" is used to refer to any Cenozoic material underlying a basin. Bedrock refers to pre-Cenozoic rocks.

The Roberts Mountains thrust, on which early and middle Paleozoic rocks of the western assemblage have overridden rocks of equivalent age of the eastern assemblage, is the dominant pre-Tertiary structure. The inferred eastern edge of the upper plate is approximately along a line passing through Elko and Eureka (Roberts, 1960). Erosion following post-thrust uplift and doming has produced windows as far west as the Shoshone Range.

Folding and faulting have continued intermittently since Paleozoic time, but only the late Tertiary and Quaternary Basin and Range structures produce large local gravity anomalies. Movement of several thousand feet on normal, generally north-trending, faults or fault zones separating the basins from the ranges is a principal cause of the present relief on the bedrock surface.

GRAVITY SURVEY

The gravity data are referenced to a network of base stations that includes Woollard's stations at the Las Vegas, Reno, Ely, and Tonopah airports (Woollard, 1958). Gravity observations were made with gravity meters calibrated against gravity differences of the airport base network. The data are reduced to the simple Bouguer anomaly using an elevation correction factor corresponding to a density of 2.67 g per cm^3 for the rocks above sea level. Position control for most of the gravity stations was obtained from topographic quadrangle maps published by the U.S. Geological Survey. Stations were established at bench marks, triangulation stations, and points where spot elevations had been determined in making the topographic maps. Control for additional stations was obtained by plane-table surveys by the gravity crew. Altimeters were used to determine the elevations for five stations.

The data have not been corrected for terrain effect, which is small in the basins but may be 5 mgals or more in the ranges. However, because the stations in the ranges are widely spaced, the contouring at 5-mgal intervals would not be substantially altered if the corrections for terrain effect were made.

GRAVITY ANOMALIES

The largest local anomalies are lows produced by the low-density Cenozoic rocks underlying the valleys. In the northern part of the area, relatively simple gravity lows are approximately co-extensive with the major valleys. To the south, however, the gravity anomalies in the valleys are more complex and the lows extend over only parts of the valleys. The largest variation in anomaly values between stations on bedrock is a regional decrease toward the south and east correlating wth a rise in regional topography (Mabey, 1960). The density contrast between the eastern and western assemblages of lower and middle Paleozoic rocks produces gravity anomalies, but the contrast is small and most of these anomalies are not apparent on the map because the stations in the ranges are generally too far apart to adequately define these features and the effect of the terrain in the ranges is large enough to obscure or partly obscure anomalies of this amplitude.

Steep gravity gradients along linear zones in or at the margins of basins are interpreted as indicating faults or fault zones that form the contact between Cenozoic fill and pre-Cenozoic bedrock. It is recognized, however, that many of these gradients could be produced by any steeply dipping bedrock surface. In estimating the thickness of Cenozoic fill from the gravity data, a density contrast of 0.4 g per cm^3 between the Cenozoic rocks and the older rocks is assumed.

REESE RIVER VALLEY

A northeast-trending gravity low with a maximum residual relief of about 25 mgals extends over most of the north end of Reese River Valley. The lowest values occur southeast of the topographic axis of the valley. In the northeast part of the valley a high gravity gradient indicates that a fault lies along the west front of the Shoshone Range south of the Argenta Siding. This fault extends south along the front of the alluvium embayment north of Slaven Canyon. The alluvium in the embayment is underlain at relatively shallow depths by bedrock. The gravity gradient at the south edge of the valley north of Bens Peak would be steeper if terrain corrections were applied to data in the ranges. This gradient is produced by the fault at the range front and indicates that the fill is several thousand feet thick north of the fault.

The gross structure of the north end of the Reese River Valley is an east- and southeast-tilted block containing about 5,000 feet of Cenozoic fill.

HUMBOLDT RIVER

The Humboldt River cut across the Basin and Range topography, and only locally do the gravity data indicate any structural control for the course of the river. At the north end of the Shoshone Range the gravity values drop off rapidly into the valley of the Humboldt River. The meager gravity data in this area indicate that several thousand feet of low-density material underlie the valley. To the southeast a small gravity low is produced by a local depression in the small valley north of Beowawe. Near Elko a narrow 20-mgal gravity low in the valley of the Humboldt River indicates several thousand feet of fill under the valley. Between this anomaly and Beowawe no gravity lows were observed along the river. In the area of Carlin a gravity high reveals that the fill under the valley is shallow.

CRESCENT VALLEY

A large gravity low is co-extensive with Crescent Valley. The anomaly bifurcates to the northeast with one branch to the north of Hot Springs Point and the other along the north side of the Cortez Mountains. Southwestward, the anomaly extends onto the thick section of Tertiary volcanic rocks in the north end of the Toiyabe Range. It has a maximum residual relief of about 30 mgals, indicating about 7,000 feet of fill underlying the valley. The anomaly is asymmetrical, suggesting a gross structure of a southeast-tilted block bounded by a fault along the northwestern front of the Cortez Mountains.

GRASS VALLEY

The residual relief of the gravity low in Grass Valley is about 25 mgals, which indicates about 6,000 feet of fill underlying the valley. Although there is gravity evidence of faulting in the western part of the valley, the gross structure is mainly an east-tilted block bounded on the east by a fault along the fronts of the Simpson Park Mountains and Cortez Mountains. The gravity data indicate a fault across the west end of the embayment between the two ranges, with bedrock underlying the alluvium in the embayment at relatively shallow depths. At the north end of the valley the gravity low extends onto the Tertiary volcanic rocks in the north end of the Toiyabe Range. Although the gravity coverage in the southern and western parts of Grass Valley is sparse, the data do show that the asymmetrical character of the gravity low continues to the south, and that the low extends into the embayment west of Hot Springs Point.

PINE VALLEY

An extensive gravity low covers Pine Valley and appendant valleys to the south and southwest. Three separate closures were defined indicating considerable relief on the bedrock surface along the axis in the valley. The maximum gravity relief across Pine Valley is almost 50 mgals, which is the largest of any found in valleys in the Eureka County area. This anomaly indicates a probable thickness of about 10,000 feet of Cenozoic fill in the central part of the valley. The asymmetry of the gravity anomaly and its counterparts suggests and east-to southeast-tilted block as the gross structure, as inferred by Regnier (1960). The steep gravity gradient near the front of the Sulphur Spring Range is probably produced by a fault with considerable vertical displacement. The gravity low extends over Tertiary volcanic rock in the Table Mountain area and at the north end of the Cortez Mountains, suggesting that part of the anomaly may be produced by similar volcanic rocks underlying the sediments in the valley.

In Denay Valley between the Roberts Mountains and the Simpson Park Mountains the gravity low is bounded on both sides by steep gravity gradients suggesting a graben-type structure. The indicated fault north of the Roberts Mountains is at or very near the range front, but the fault south of the Simpson Park Mountains is about a mile south of the bedrock-alluvium contact.

At the extreme northeast end of the Simpson Park Mountains the gravity data reveal that the northeast-trending fault which forms the contact between the bedrock and the alluvium continues into Pine Valley and displaces the bedrock surface down to the northwest.

DIXIE FLATS-HUNTINGTON VALLEY AREA

Between the Piñon and Sulphur Spring Ranges and the ridge of Paleozoic rock exposures to the east lies a small gravity low. This low is in an area underlain by alluvium and Tertiary volcanic rock. Variations in gravity values at the few stations established indicate considerable relief on the bedrock surface produced by a trough underlying the Cenozoic rocks in this part of the area.

A broad general area of low gravity values was mapped west of the Ruby Mountains. This low, as defined by the available data, is generally bounded by gentle gradients, but local steepening of the gradient on the west side of the valley may indicate a fault.

In the Ruby Mountains the anomaly values are about 30 mgals lower than those in the Simpson Park Mountains. This large difference is presumably related to the higher topography of the mountains to the east and may indicate partial local isostatic compensation of the Ruby Mountains.

DIAMOND VALLEY

A large gravity low with about 40 mgals of residual relief covers Diamond Valley. As in the valleys to the northwest there is an asymmetry, the lowest values being east of the center of the valley. In the north half of the valley the position of the gravity contours is inferred from very few stations and the details of the anomaly may differ substantially from that shown. An oil test (Shell, Diamond Valley No. 1) (Campbell and Hebrew, 1957) drilled east of the axis of the gravity low, revealed 7,485 feet of "valley fill" above the Paleozoic bedrock. The maximum thickness of fill in Diamond Valley is probably not much greater than this.

MONITOR, ANTELOPE, AND KOBEH VALLEYS

The broad valley complex lying between the Monitor, Antelope, and Fish Creek Ranges and the Roberts and Simpson Park Mountains contains many local gravity features, some not adequately defined by this survey. The largest anomaly is a low in the western half of Antelope Valley along the front of the Monitor Range. This anomaly indicates a narrow trough containing about 10,000 feet of low-density material. A fault is inferred from the gravity data to bound the east side of the trough. The east half of Antelope Valley is underlain at relatively shallow depths by Paleozoic rock.

Cenozoic rocks up to about 5,000 feet thick underlie most of Monitor and Kobeh Valleys. Two local gravity lows were mapped and others may exist. The complexity of the gravity anomalies in this area suggests that the buried relief on the bedrock surface may be comparable to that of the present ranges.

LITTLE SMOKY VALLEY-NEWARK VALLEY AREA

Several local gravity lows were mapped in the valleys east and west of the Pancake Range. These lows probably indicate local depressions several thousand feet deep. The gravity coverage is not detailed enough to define the gravity field associated with these small features; therefore, the nature of these depressions cannot generally be inferred. The local steep gravity gradient on the east side of the northern end of the Pancake Range probably is produced by a fault. The low gravity relief over the rest of the area indicates that large parts of the valley floors are underlain by relatively shallow fill.

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APPROXIMATE MEAN DECLINATION, 1964