DESERT RESEARCH INSTITUTE
UNIVERSITY OF NEVADA

in cooperation with

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EXTENSION OF THE EAST RANGE FAULT BY GRAVITY EXPLORATION

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INTRODUCTION

Geophysical studies were initiated in 1959 in the Humboldt River Basin near Winnemucca, as part of the Humboldt River Research Project sponsored by the Nevada Department of Conservation and Natural Resources. The geophysical portion of the project, carried out in conjunction with hydrologic studies, was begun by G. M. Wilson in 1959, and continued in subsequent years by the writers. In part the data in this report have been taken from Wilson's report (1960).

In the early phases of the project it was noted that the low-water flow of Humboldt River increased in the area of the lower Hillyer and lower McNinch ranches (Figure 1) approximately 10 miles southwest of Winnemucca; this area is herein called the Rose Creek constriction of Humboldt River. The increase in flow occurred in spite of the fact that there are no surface tributaries along this stretch of the river. To explain this it was proposed that part of the gain of the river might be due to a buried bedrock high acting as a partial barrier to the down-gradient movement of ground water. In addition it was necessary to calculate the depth of alluvial fill so that the ground-water underflow out of the study area could be determined with some precision for the water budget. A gravity survey was made to study the depth and configuration of the bedrock in the Rose Creek constriction. This report is primarily concerned with the results of the gravity survey.

Several salient features of the bedrock configuration, as revealed by the gravity survey, were checked by seismic refraction surveys. Also, one test hole was drilled to bedrock; this hole was located on a gravity high.

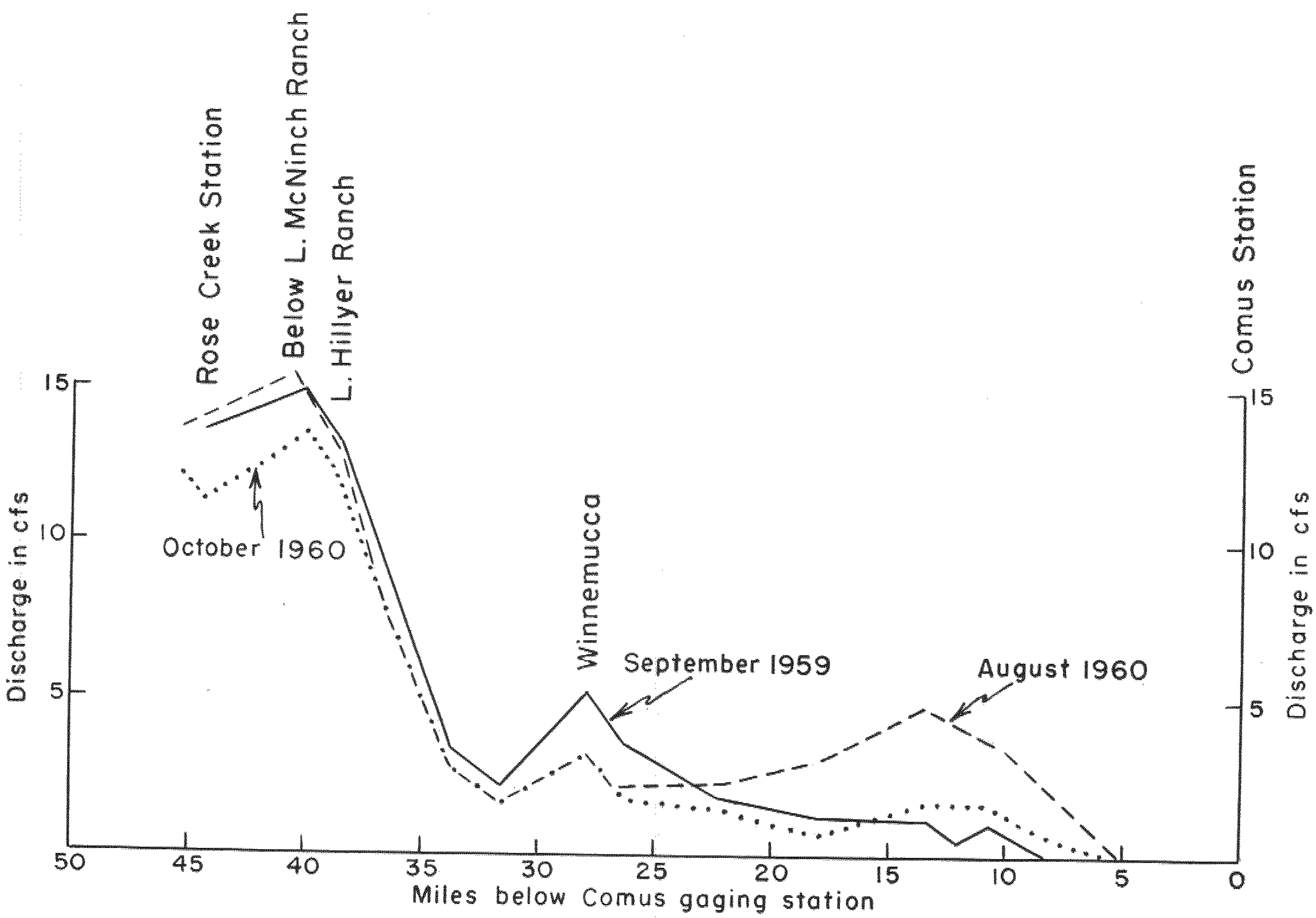


Figure 1. Hydrograph of flow in Humboldt River between Comus and Rose Creek Gaging Stations.

SURFACE GEOLOGY

The consolidated rocks of the area are described in detail by Ferguson, Muller, and Roberts (1951) and Willden (1961). The following interpretations have been largely drawn from these sources. Since the geology of the adjacent ranges is not within the scope of this paper, only a general summary is presented.

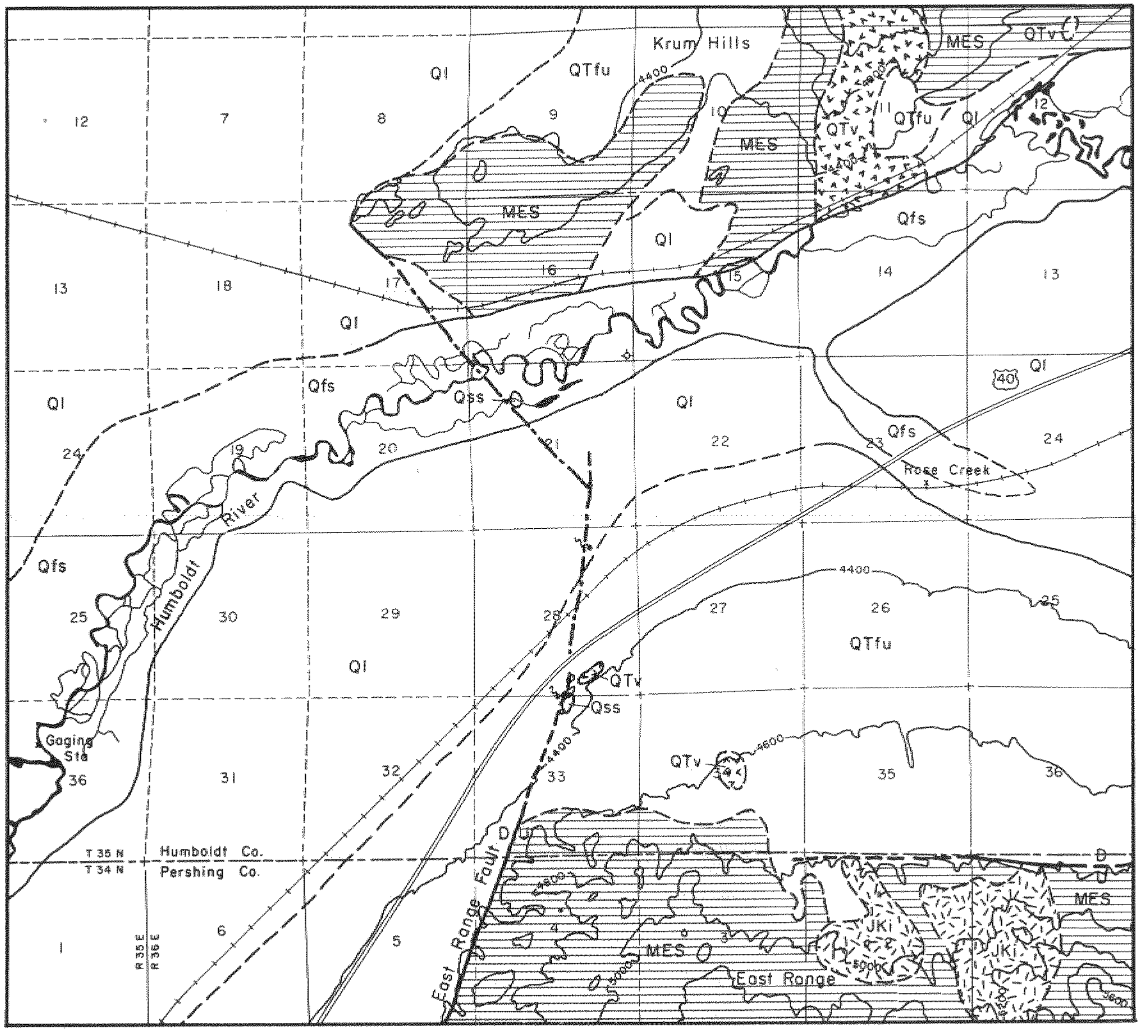
The ranges within the study area, the East Range and the Krum Hills, consist of a great thickness of Triassic rocks which were intruded by late Jurassic or Cretaceous plutonic rocks. The Ranges are of the block-faulted type typical of the Basin and Range physiographic Province. The pre-plutonic rocks were strongly deformed by folding and thrusting. Tertiary and Quaternary subaerial and lacustrine deposits and volcanic rocks are present along the flanks of the ranges. One basalt flow forms a louderback on the north side of Humboldt River.

Three Basin and Range type faults are present in the immediate area, the first only partially mapped by the writers is north of the river, the second bounds the north side of the East Range, and the third bounds the west side of the East Range. This paper deals with the extension of the latter, the so called East Range Fault, under the lacustrine and fluviatile deposits of late Quaternary and Recent age. This fault, as mapped by Ferguson, et al. (1951), from surface evidence is shown on the geologic map (Figure 2) ; the East Range Fault extends along the western flank of the East Range northward to about Sec. 33, T. 35 N., R. 36 E. Gravity data suggest that the fault extends further northward beneath the alluvium of Quaternary and Recent age to the vicinity of the section line between Secs. 21 and 28, T. 35 N., R. 36 E., where it may be cut off by a cross fault.

GRAVITY SURVEY

All gravimetric observations were made with a Worden "Educator" gravity meter with a scale constant of 0.4657 milligals per division. From previous work with this meter it is felt that the probable error of observation, including the drift-removal process, is somewhat less than 0.20 milligal. All elevations were obtained by differential leveling. Horizontal positions were obtained using a variety of methods, including: traversing (both with chain and odometer), map and photo identifying well sites and ends of traverses, and using a Nevada Highway Department traverse. The gravity map (Figure 3) shows the simple Bouguer anomaly data contoured. For the Bouguer density 2.67g/cc was used. Errors in assumed density would lead to very small errors in the anomaly because of the small elevation range encountered in the area. No terrain corrections were made. If they had been included in the anomaly their effect would have been to increase the anomaly up to 1.5 milligals near the ranges, less (0.5 mgal.) in the flood plain.

The isogal map (Figure 3) shows a marked positive anomaly along the section line between Secs. 16 and 15, 21 and 22, and 28 and 27, which probably is produced by a northward trending buried bedrock high across the constriction. The low point or saddle is near the corner of Secs. 21, 22, 27, and 28. The anomaly drops off steeply to the west (23 mgal. in 3.5 mi.) and slightly to the east (4.5 mgal. in 2.0 mi.). The steep gradient on the west side of the high strongly suggests a normal fault as shown on the geologic map (Figure 2). It is obvious that this fault corresponds closely enough in location and strike with that of the East Range Fault, which was mapped on surface evidence, to be a continuation of that same fault.



LEGEND

0 1 2 Miles
Scale
Contour Interval 200 Feet

Qss	Spring Sinter: siliceous and calcareous spring deposits.
Qfs	Fluviatile and subaerial deposits: clay, silty clay, and silt, includes some sand, volcanic ash, and windblown material. Flood-plain and channel deposits.
Ql	Lacustrine deposits: clayey silt, silt, and fine sand with some sand and gravel deposits; clayey silt is blocky and contains ostracods. Sediments of Lake Lahontan.
QTfu	Fanglomerate, undifferentiated: poorly sorted to moderately sorted fanglomerate. Forms alluvial fans.
QTv	Volcanic rocks: lava flows ranging in composition from rhyolite to olivine basalt. Structurally deformed.
JKi	Plutonic rocks: intrusive rocks of quartz-monzonitic composition. Intrudes older rocks in the ranges.
MES	Consolidated rocks, undifferentiated: slates, limestones, and shales forming the ranges, strongly deformed by folding and faulting.

Contact, dashed where approximately located.

Fault; U, upthrown side; D, downthrown side; dashed where approximately located, dot-dash where located by geophysical exploration.

Test well

Spring

SOURCES OF DATA

Cartwright, Keros (1960), A study of the Lake Lahontan sediments in the Winnemucca area, Nevada: unpublished M.S. thesis, University of Nevada.

Ferguson, H.G., Muller, S.W., Roberts, R.J. (1951), Geologic map of the Winnemucca Quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. map GQ-11.

Willden, Ronald (1961), Preliminary geologic map of Humboldt County, Nevada: U.S. Geol. Survey Mineral Inv., Field Studies map MF-236.

Figure 2. Geologic map of the Rose Creek constriction of Humboldt River.

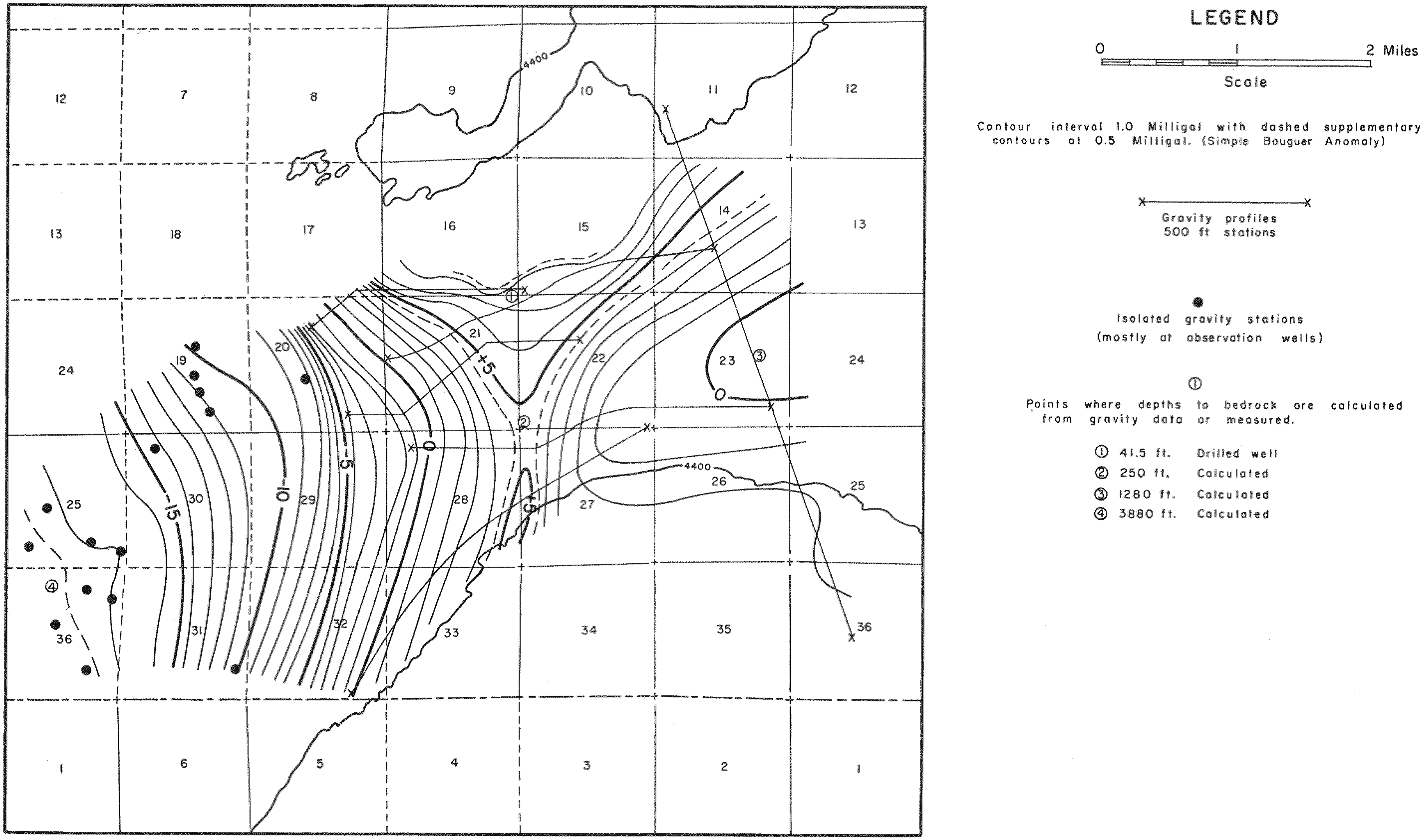


Figure 3. Gravity map of the Rose Creek constriction of the Humboldt River.

REFRACTION SURVEY

A seismic refraction profile at the southeast corner of Sec. 21, T. 35 N., R. 36 E., i.e., at site number (1) of Figure 4, verified the presence of the bedrock high (W. W. Dudley, Jr., personal communication). At this spot the depth to a high-speed (13,000 ft./sec.) horizon was only 29 feet. A well drilled at this location penetrated the unconsolidated valley fill and bottomed in slates at 41.5 ft. The difference between the two depths is probably caused by undulations in the bedrock-valley fill interface.

A very interesting seismic profile was run, some 80 ft. south of and parallel to the aforementioned one, with a Dynametric Seismic Timer. Consistent returns were obtained at 10-foot stations out to 300 ft. with this "Flintstone" unit. The data are plotted in Figure 4. This figure shows the classic refraction profile across a buried step. The difference between the depths as computed at each end of the profile, 18 ft. on the west and 11 ft. on the east, is the same as the 7 ft. obtained using the step in time discontinuity. This 7-foot escarpment, downthrown on the west, could be attributed to something prosaic, like a buried river bank. It would be more aesthetically pleasing, however, to attribute it to relatively recent movement along the extension of the East Range Fault. It is on strike and the displacement is in the proper direction.

The seismic method also proved useful in another area. The outcrop in the northwest corner of Sec. 21, marked Qss, was originally thought to be bedrock, though it does not lie on the gravity high, but rather on the west flank. A refraction survey, here, revealed that this outcrop, which does show a high velocity, has no "roots" and seems to be lying on the surface (L. D. McGinnis, personal communication). Based on this and petrographic evidence this rock has tentatively been identified as siliceous spring sinter.

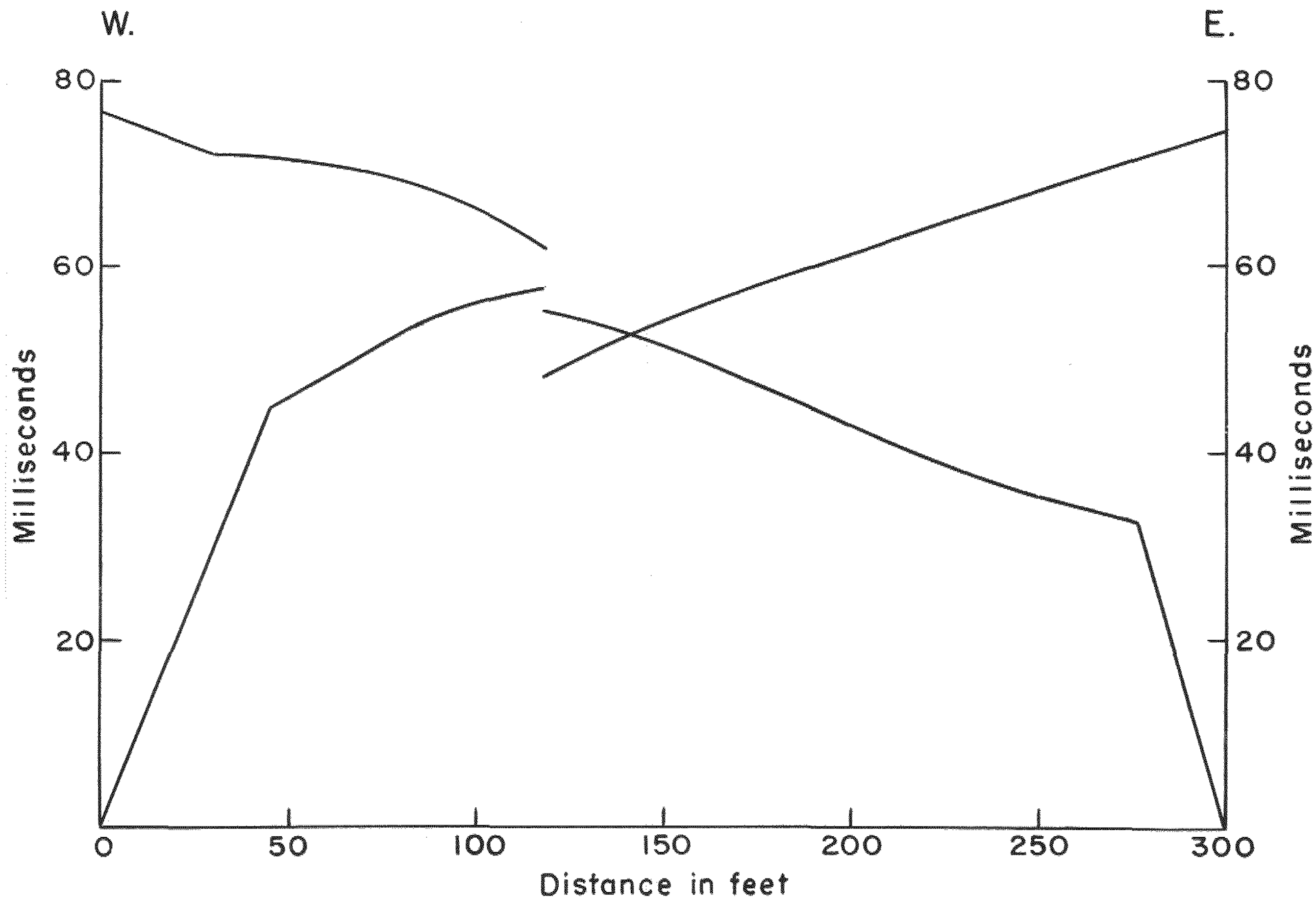


Figure 4. Seismic refraction profile near the Rose Creek constriction.

DEPTH DETERMINATIONS

Depth determinations from gravity data are difficult without regional control. Calculations were made using the infinite slab approximation, and using a graticule along a profile at right angles to the high through the saddle. A density contrast of —0.55g/cc was used. This value is in good agreement with others used in the Great Basin for the contrast between bedrock and the valley fill. Depths-to-bedrock at the four locations shown on the isogal map (Figure 3) are as follows:

1. 41.5 ft. (Lower McNinch Ranch—drilled well).
2. 250 ft. (low of saddle in the gravity high).
3. 1,280 ft. (low on the east side of the anomaly).
4. 3,880 ft. (low at Rose Creek Gaging Station).

In all cases ground surface is the elevation datum.

REFERENCES CITED

Ferguson, H. G., Muller, S. W., and Roberts, R. J., (1951), **Geology of the Winnemucca Quadrangle, Nevada:** U.S. Geol. Survey Geol. Quad. Map, GQ-11.

Willden, Ronald, (1961), **Preliminary Geologic Map of Humboldt County, Nevada:** U.S. Geol. Survey Mineral Inv., Field Studies Map MF-236.

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