GEOLOGICAL SURVEY CIRCULAR 563

Favorable Areas for Prospecting Adjacent to the Roberts Mountains Thrust in Southern Lander County, Nevada

Prepared in cooperation with the Nevada Bureau of Mines

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Favorable Areas for Prospecting Adjacent to the Roberts Mountains Thrust in Southern Lander County, Nevada

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Abstract

Recent geologic mapping by the U.S. Geological Survey of more than 2,500 square miles of a relatively little-studied part of central Nevada has outlined four areas favorable for the discovery of metallic mineral deposits. In these areas, lower Paleozoic carbonate rocks crop out below the Roberts Mountains thrust, a widespread fault in central and north-central Nevada. These areas have a stratigraphic and structural setting similar to that of the areas where large, open-pit gold deposits have been discovered recently at Carlin and Cortez in north-central Nevada.

INTRODUCTION

The recent discoveries of large open-pit gold deposits at Carlin and Cortez in north-central Nevada (Hardie, 1966; Roberts, 1966; Roberts and others, 1967; Erickson and others, 1966; Wells and others, 1967) have created interest in prospecting for similar deposits in nearby areas. During the last 2 years, mapping by the U.S. Geological Survey of more than 2,500 square miles of a largely unstudied part of north-central Nevada directly south and southwest of Cortez has outlined areas with a stratigraphic and structural setting similar to that of the areas containing the Carlin and Cortez deposits. These favorable geologic factors indicate that further prospecting is warranted in these areas.

Most of the metallic deposits in southern Lander County (table 1) and in north-central Nevada occur in pre-Tertiary sedimentary rocks. Many of these deposits are in carbonate strata exposed in windows in the Roberts Mountains thrust, a widespread fault along which siliceous and volcanic (western) assemblage rocks have been thrust eastward, perhaps as much as 100 miles, over carbonate (eastern) or transitional assemblage rocks (Roberts and others, 1958; Gilluly and Gates, 1965; Roberts, 1960, 1966). The new gold discoveries at Carlin and Cortez are both in such windows and lie below the thrust (Hardie, 1966; Erickson and others, 1966). In addition, both deposits occur mainly in altered or silicified platy limestone of the Silurian Roberts Mountains Formation. The ore bodies of the Bootstrap and Number Eight mines (Roberts, 1966; Erickson and others, 1966) near the Carlin mine are in breccias along the Roberts Mountains thrust itself as are the gold deposits at Gold Acres (Gilluly and Gates, 1965, p. 134), about 8 miles northwest of the Cortez deposits.

The Roberts Mountains thrust and the Roberts Mountains Formation in the lower plate of this thrust seem, therefore, to be particularly favorable places for metallic ore deposits in north-central Nevada. We describe here four areas within southern Lander County where the Roberts Mountains Formation crops out below the thrust. Granitic plutons that might have been a source for mineralizing solutions crop out in two of these areas and are within a few miles of the two remaining areas.

Maps of three of these areas are given in this report; a map of the fourth has already been published (Stewart and Palmer, 1967). Detailed geologic maps of most of southern Lander County at a scale of 1:62,500 are also available on open file at the U.S. Geological Survey at Washington, D. C., Denver, Colo., Salt Lake City, Utah, and San Francisco, Los Angeles, and Menlo Park, Calif., and material from which copy can be made at private expense is available at the Nevada Bureau of Mines, Reno, Nev. An index to these open-file maps is shown in figure 1.

The work on which this report is based is part of the county mapping program of the U.S. Geological Survey in cooperation with the Nevada Bureau of Mines. We wish to thank R. H. Washburn of Juniata College, Huntingdon, Pa.; D. B. MacLachlan, Bureau of Topographic and Geological Survey, Harrisburg, Pa.; and H. F. Bonham, Nevada Bureau of Mines, Reno, Nev., for use of their unpublished information.

Table 1.--Mining districts in southern Lander County and closely adjacent parts of Eureka and Nye Counties

District	Metals[1]	Recorded production[2] (dollars)	Type of deposit	Principal references
Big Creek	Sb	Unknown, but small	Veins in Valmy Formation (Ordovician) and Roberts Mountains Formation (Silurian). Quartz in fault breccia along Roberts thrust.	Hill (1915, p. 121-123) and Lawrence (1963, p. 100-108).
Birch Creek (Smoky Valley, Big Smoky)	Au, Ag, Pb, (W), (Be), (As), (Mo)	Unknown, but small	Veins in quartz monzonite and flanking metasedimentary rocks. Placer gold.	Hill (1915, p. 125-127), Lincoln (1923, p. 109-110), Vanderburg (1939, p. 36), and Hall (1962).
Cortez	Ag, Au, Cu, Pb, Zn	[3]7,799,872	Replacement deposits and fissure veins in Hamburg Dolomite (Cambrian). Large low-grade deposit in Roberts Mountains Formation (Silurian).	Gilluly and Masursky (1965, p. 97-104), Erickson and others (1966), and Roberts, Montgomery, and Lehner (1967, p. 69-74).
Gold Basin	Au, Ag	[4]19,656	Veins in Tertiary volcanic rocks.	Lincoln (1923, p. 111).
Jackson (Gold Park)	Au, Ag	[4]47,116	Veins in meta-andesite of Pablo Formation (Permian).	Kral (1951, p. 76-80).
Kingston (Sante Fe, Bunker Hill, Victorine, Summit)	Au, Ag	[4]20,749	Veins in lower Paleozoic rocks.	Hill (1915, p. 128-129) and Vandenburg (1939, p. 57-58).
New Pass	Au, Mn	[4]247,600	Gold-bearing quartz veins in upper Paleozoic and Triassic rocks. Syngenetic manganese deposits in upper Paleozoic rocks.	Lincoln (1923, p. 114), Vandenburg (1939, p. 65-67), and Trengove (1959).
Ravenswood (Shoshone)	Ag, Cu, Pb, Au,	Unknown, but small	Veins in lower Paleozoic rocks.	Hill (1916, p. 106-113).
Reese River (Austin, Amador, Yankee Blade)	Ag, Au, Pb, Cu, (Sb), (As), (Mo), (Se)	[4]18,567,250	Fissure veins in Mesozoic quartz monzonite of Austin pluton. Relatively small ore deposits in quartzite of Valmy(?) Formation (Ordovician) on north flank of pluton.	Ross (1953), Lawrence (1963, p. 109-112), and Davidson (1960).
Skookum	Ag, Au	Unknown, but small	Veins in Valmy Formation (Ordovician).	Hill (1915, p. 92-95).
Washington	Ag, Pb, (W)	[4]17,558	Veins in lower Paleozoic rocks.	Hill (1915, p. 123-125) and Kral (1951, p. 207-211).
Wild Horse	Hg	[5]135,458	Silicified Triassic limestone.	Dane and Ross (1942) and Bailey and Phoenix (1944, p. 111-113).

[1]Listed in order of importance. Metals in parentheses occur in minor amounts.
[2]Records of production are incomplete and actual production from some small districts is probably much higher than recorded figures.
[3]After Roberts, Montgomery, and Lehner (1967) and Couch and Carpenter (1943).
[4]After Couch and Carpenter (1943), Vandenburg (1939), and "Minerals Yearbook" of U.S. Bureau of Mines (1933-1955).
[5]After Dane and Ross (1942).

RAVENSWOOD WINDOW

The Ravenswood window (fig. 2) is in the Shoshone Range about 15 miles northwest of Austin. In this window Cambrian, Ordovician, and Silurian quartzite, limestone, and shale are exposed in the lower plate of the Roberts Mountains thrust, and, nearby, Ordovician and Silurian chert, shale, sandstone, and quartzite are exposed in the upper plate. The Roberts Mountains Formation crops out in two small areas in the northern part of the window and in a fairly large area directly below the Roberts Mountains thrust in the southern part of the window. The strata of the lower plate have been intruded by porphyritic quartz monzonite that crops out over an area of about 2 square miles in the central part of the window. Tertiary welded tuffs cap much of the higher part of the area, and Tertiary and Quaternary sedimentary strata and older alluvium occur both on the west and northeast parts of the range.

The old Ravenswood mining district, which has produced only a small amount of ore, is in the northern part of the window. The deposits (Hill, 1916, p. 106–113) consist of small lenslike quartz veins that are

predominantly in shale, quartzite, and limestone of Early Cambrian age. Many prospect pits in the district show abundant secondary copper minerals. The deposits, according to Hill (1916, p. 109), contain chalcopyrite, galena, and tetrahedrite, all of which are said to carry silver and a little gold. Some prospects are in the southern part of the window, a few of them along the thrust where the Ordovician Valmy Formation is thrust over the Silurian Roberts Mountains Formation.

CALLAGHAN WINDOW

The Callaghan window is in the Toiyabe Range about 15 miles north of Austin. Its geology has been described in detail previously (Stewart and Palmer, 1967) and is only briefly considered here. Lower plate strata are exposed in an area of about 40 square miles and consist of over 10,000 feet of quartzite, limestone, and shale of Cambrian, Ordovician, and Silurian age. The Roberts Mountains Formation crops out in the southern and northwestern parts of the window. Strata above the thrust consist of chert and quartzite of Ordovician and Devonian age. The strata in the window are unmetamorphosed and no granitic rocks crop out in the window. The quartz monzonite of the Austin pluton lies 3 miles south of the southern limit of the window, and granitic rocks also crop out in a small area about 3 miles north of the northern limit of the window and in a small area about 7 miles east of the eastern limit of the window. Except for a quicksilver prospect (Bailey and Phoenix, 1944, p. 113), no metallic mineral deposits have been reported.

TOIYABE RANGE SOUTH OF AUSTIN

Lower plate strata ranging in age from Cambrian to Devonian are extensively exposed in the Toiyabe Range south of Austin (fig. 3). These strata have been intruded by several plutons, the largest of which contains the rich silver veins of the Reese River district at Austin.

Three thrust plates are recognized in the Toiyabe Range south of Austin. The lower and middle plates are separated by the Kingston Canyon thrust, a fault at present recognized only in this part of the Toiyabe Range; the middle and upper plates are separated by the Roberts Mountains thrust, which is of regional extent. The strata in the lower two plates lithologically resemble each other more than they resemble the strata of the upper plate, but they are not entirely the same. The most conspicuous difference is in strata of Middle Cambrian to Early Ordovician age, which are mostly black phyllite and argillaceous limestone in the lower plate and mostly light-gray limestone in the middle plate. The juxtaposition of these unlike facies suggests that considerable lateral transport has occurred along the Kingston Canyon thrust. Strata above the Roberts Mountains thrust in the Toiyabe Range consist of western assemblage black chert, shale, and quartzite assigned to the Valmy Formation of Ordovician age.

The Silurian Roberts Mountains Formation is recognized in both the lower and middle plates in the Toiyabe Range. The most extensive outcrops are: (1) about 8 miles south of Austin on the west side of the range, (2) in a 5-mile-long northwest-trending belt extending from Kingston Canyon on the southeast to the west side of the range on the northwest, and (3) about 1 to 2 miles south of the mouth of Kingston Canyon on the east side of the range.

Five mining districts are located in the Toiyabe Range from Austin on the north to the vicinity of the Lander-Nye County line on the south. The largest of these is the Reese River silver district at Austin, which has a recorded production of over $18 million. In the Birch Creek district along the east side of the range about 9 miles southeast of Austin, deposits of gold, silver, and lead occur in granitic rocks along the southern margin of the Austin pluton and in flanking metamorphosed lower Paleozoic strata. Beryllium, tungsten, arsenic, and molybdenum are also known from this district (table 1). The Big Creek district is in the western half of the range from 7 to 12 miles southwest of Austin. Here antimony deposits occur in the dark shale and chert above the Roberts Mountains thrust, in the carbonate strata below the thrust, and in a silicified fault breccia along the thrust. In the Kingston district in the eastern part of the range about 20 miles south of Austin, gold and silver have been produced from veins in lower Paleozoic rocks. The Washington district, which is mostly in Nye County, has produced silver and lead ores from veins cutting lower Paleozoic rocks. Some of these deposits occur close to the Aiken Creek and Vindicator plutons (fig. 3). In addition, uranium has been mined from deposits in both intrusive rocks and metamorphosed Lower Cambrian sedimentary rocks along the southern edge of the Austin pluton on the west side of the range 3 miles south of Austin (Davis, 1954; Sharp and Hetland, 1954; Thurlow, 1956; Nye, 1958).

PETES CANYON WINDOW

The Petes Canyon window in the Roberts Mountains thrust is in the Toquima Range about 20 miles southeast of Austin (fig. 4). This window covers about 20 square miles and exposes Ordovician and Silurian carbonate strata; the Roberts Mountains Formation is the most widely exposed formation in the lower plate and occurs directly below the thrust. Upper plate strata consist of shale, quartzite, and chert of the Vinini Formation. No granitic intrusive rocks occur in the window, but granitic rocks crop out about 5 miles southwest of the southern part of the window, and a small outcrop of granitic rock is about 4 miles northwest of the northwestern part of the window. No metallic mineral deposits have been reported from the window, although tungsten has been mined in tactite adjacent to the previously mentioned small exposure of granitic rock northwest of the window.

SUGGESTIONS FOR PROSPECTING

Since the discovery of the rich silver veins at Austin in 1862, southern Lander County has attracted the attention of prospectors. The numerous mines and prospects in the region attest to the thorough search for surface outcrops of readily recognizable mineral-bearing veins and lodes. The possibility of finding a large mineral deposit by using the same methods as previous prospectors seems remote, and the search for metals in the region should be focused on new prospecting techniques and deep exploration by drilling.

Deposits of fine-grained gold similar to those recently found at Carlin and Cortez, however, may have gone undetected in southern Lander County, in spite of extensive earlier prospecting, because exposures of such deposits show little, if any, metallic minerals detectable to the naked eye and the gold is not easily recognizable using ordinary prospecting methods. Exploration for obscure deposits of this type requires extensive sampling and abundant chemical data. The development of rapid and inexpensive methods for determining trace amounts of gold, silver, and mercury (Lakin and Nakagawa, 1965; Huffman and others, 1967; Ward and others, 1963; Vaughn, 1967) has provided the tools for conducting this type of prospecting economically.

As outlined here, several areas in southern Lander County have a structural and stratigraphic setting similar to the areas where gold has been found at Carlin and Cortez; that is, carbonate rocks, including the Roberts Mountains Formation, are exposed below the Roberts Mountains thrust. The areas considered favorable for prospecting in southern Lander County include the Ravenswood window in the Shoshone Range northwest of Austin, the Callaghan window in the Toiyabe Range north of Austin, the Petes Canyon window in the Toquima Range southeast of Austin, and extensive exposures of lower plate rocks in the Toiyabe Range south of Austin.

Prospecting in the region could also be undertaken by drilling. The most likely possibility of finding hidden deposits seems to be by drilling through upper plate siliceous and volcanic rocks that contain ore deposits into lower plate carbonate rocks that are more favorable hosts for ore deposits; small deposits in upper plate rocks could indicate larger deposits at depth. Within the region, deposits occur in upper plate rocks in the Skookum district, 7 miles northwest of Austin, and along the north side of the Austin pluton, 4 miles north of Austin within the Reese River district; in the latter area, however, some supposed upper plate rocks may instead by assignable to the Cambrian Gold Hill Formation in the lower plate. These areas seem favorable for deposits at depth, but no information is available about the depth to the lower plate carbonate rocks. A further possibility for drilling is along the west flank of the granitic pluton in the Ravenswood window northwest of Austin (fig. 2), where carbonate rocks could occur adjacent to granitic rocks under a presumably thin cover of Tertiary and Quaternary sedimentary rocks.

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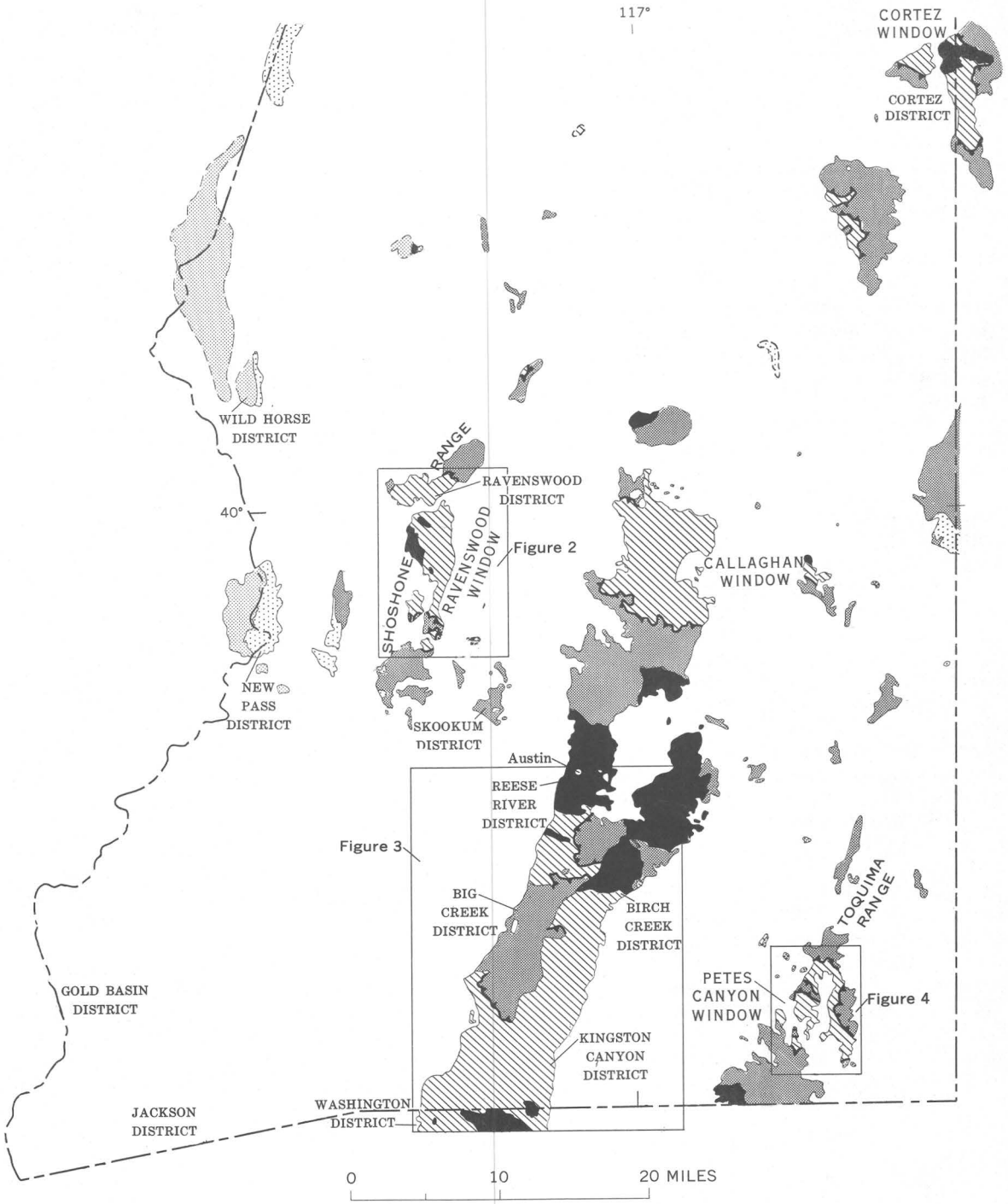
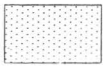


Figure 1.—Pre-Tertiary rocks, mining districts, and sources of information in southern Lander County.

EXPLANATION

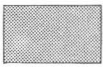
Jurassic granitic rocks

Triassic rocks



Pennsylvanian and Permian rocks

ROCKS ABOVE ROBERTS MOUNTAINS THRUST



Cambrian to Devonian siliceous and volcanic assemblage

ROCKS BELOW ROBERTS MOUNTAINS THRUST

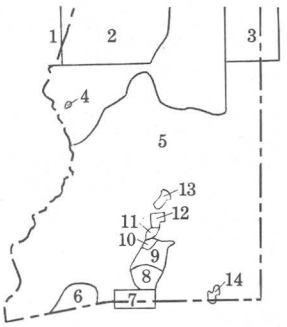
Cambrian to Devonian carbonate and transitional assemblage

Contact

Dashed where approximately located

Roberts Mountains thrust

Sawteeth on upper plate. Elsewhere, contact between siliceous and volcanic rocks and carbonate and transitional assemblage rocks is a high angle fault (not shown on this map)



SOURCES OF INFORMATION USED IN FIGURES 1–4 AND IN U.S. GEOLOGICAL SURVEY OPEN-FILE MAPS OF SOUTHERN LANDER COUNTY, NEVADA

1. Muller, Ferguson, and Roberts (1951).
2. Ferguson, Muller, and Roberts (1951).
3. Gilluly and Masursky (1965).
4. Dane and Ross (1942).
5. Geologic mapping by J. H. Stewart and E. H. McKee in 1966 and 1967.
6. Geologic mapping by E. H. McKee in 1967, based in part on work by H. F. Bonham.
7. Modified from Means (1962).
8. Geologic mapping by J. H. Stewart in 1967, based in part on work by D. B. MacLachlan.
9. Modified from Washburn (1966b).
10. Modified from Hansen (1960).
11. Modified from Lowell (1958).
12. Modified from Nye (1958).
13. Modified from Ross (1953).
14. Mapping by E. H. McKee in 1967, based in part on work by Kay and Crawford (1964).

U.S. GEOLOGICAL SURVEY OPEN-FILE MAPS IN SOUTHERN LANDER COUNTY, NEVADA

(see references cited for description)

1. Stewart and McKee (1968b).
2. Stewart and McKee (1968).
3. McKee (1968a).
4. McKee (1968b).
5. Stewart and McKee (1968a).

Figure 1.—Continued.

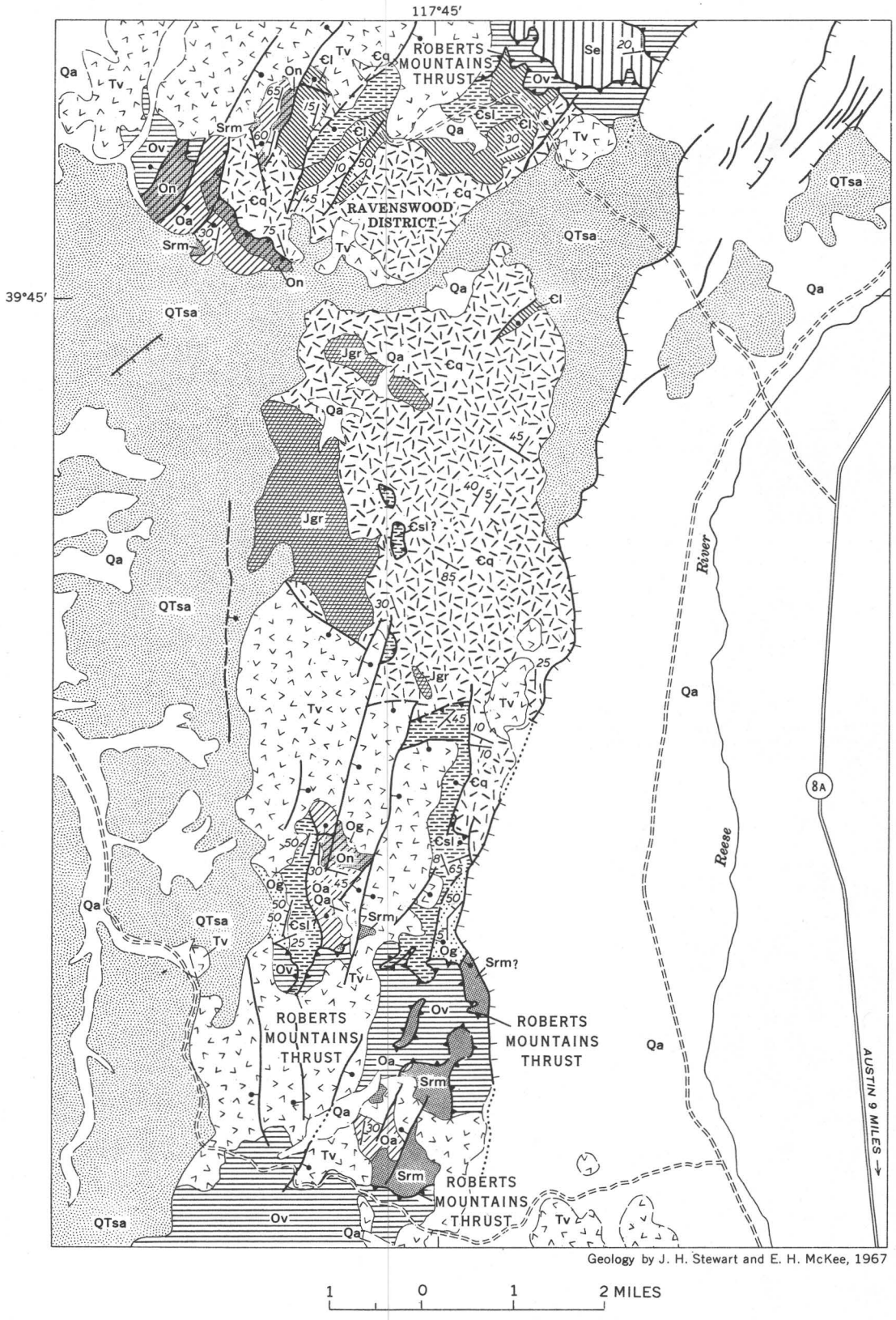


Figure 2.—Geologic map of the Ravenswood window, Shoshone Range.

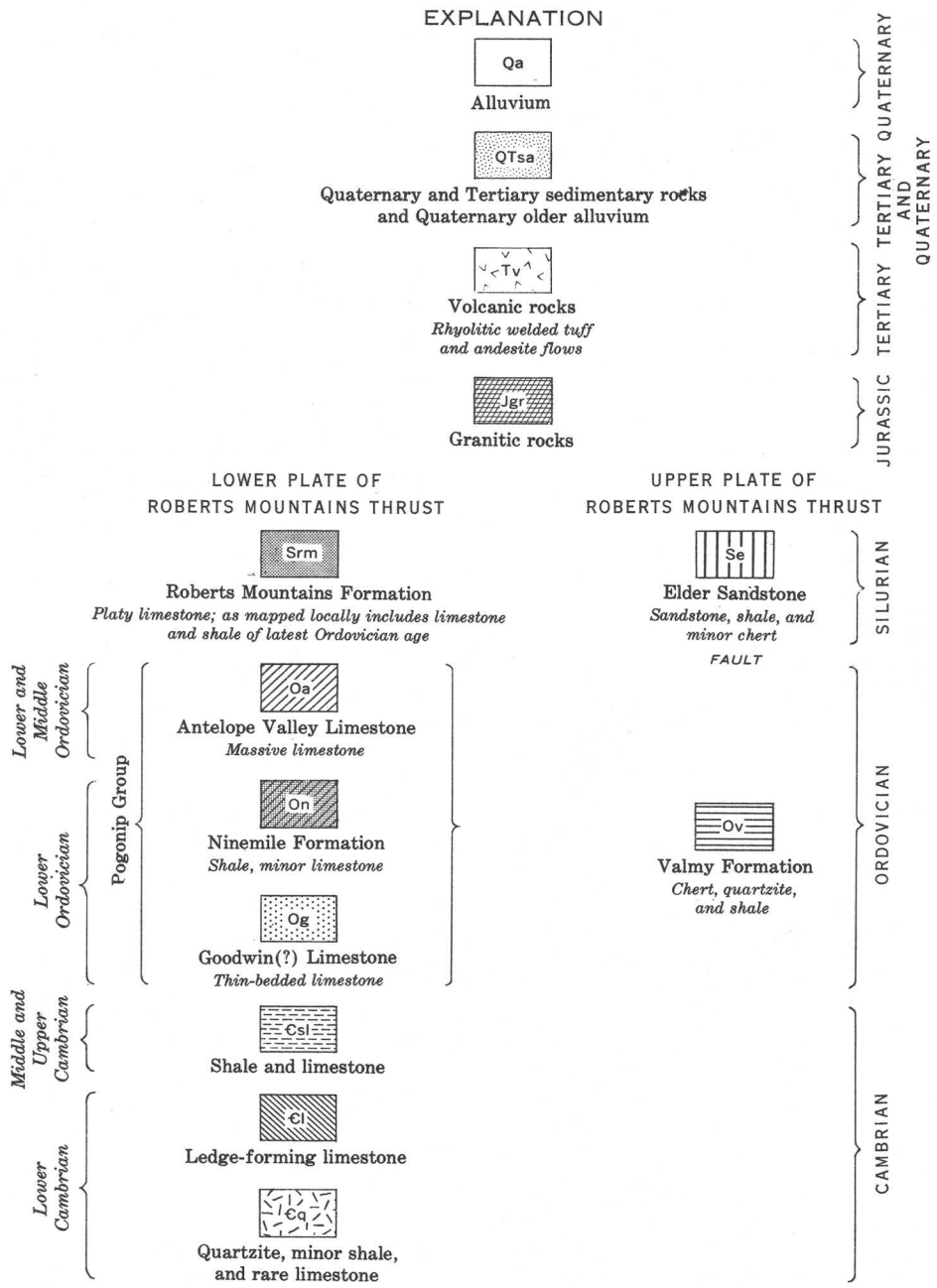


Figure 2.—Continued.

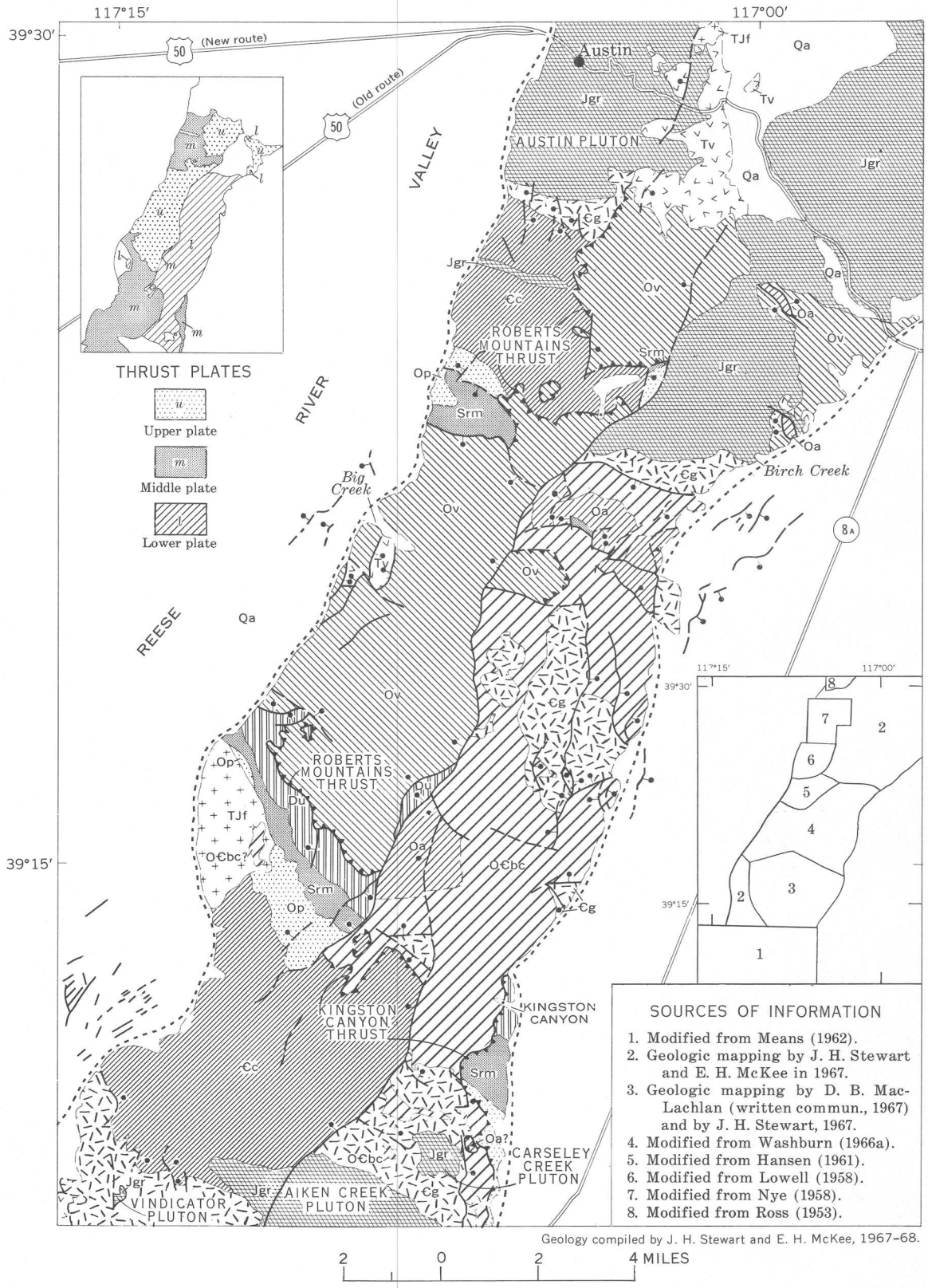


Figure 3.—Geologic map of the Toiyabe Range south of Austin.

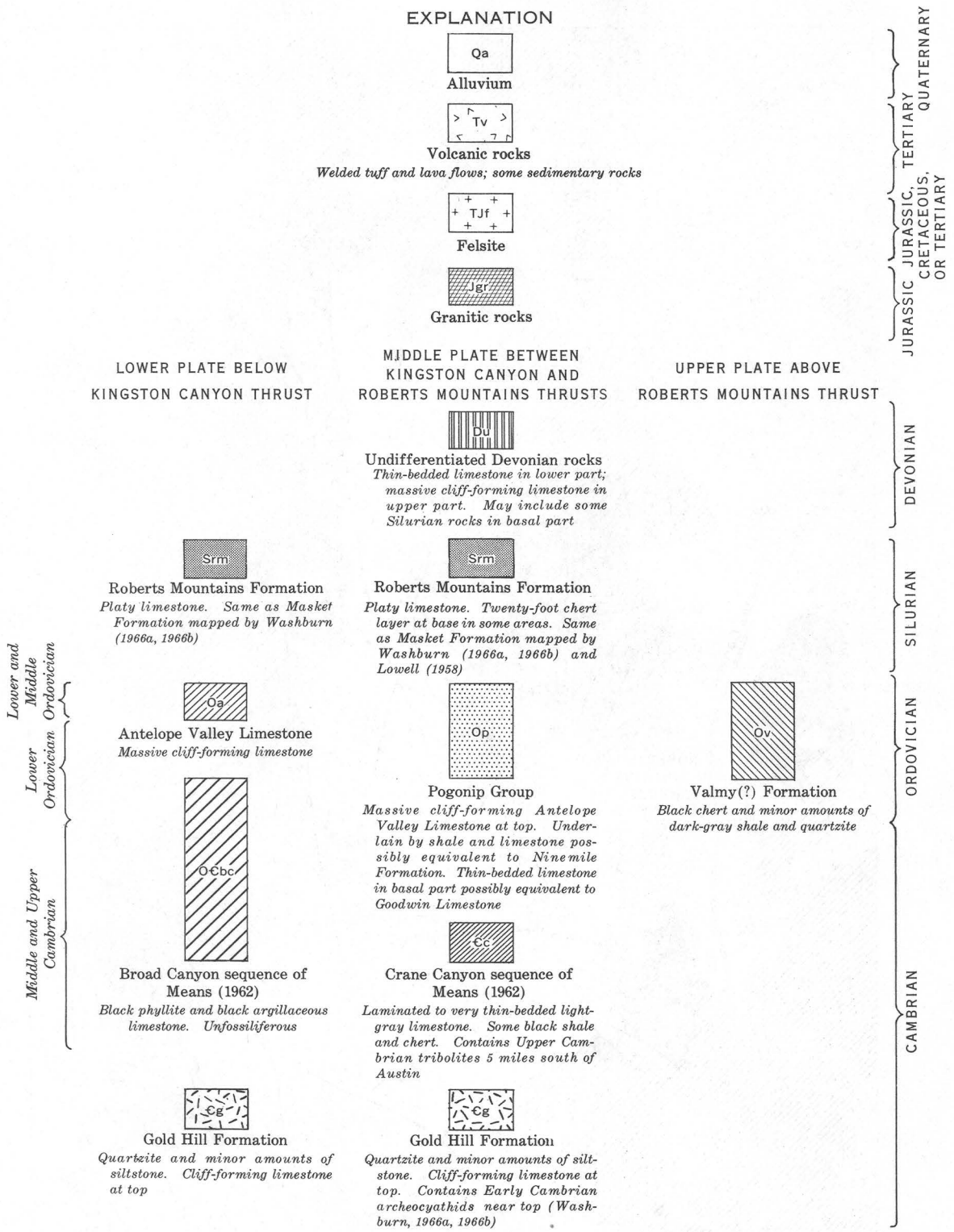


Figure 3.—Continued.

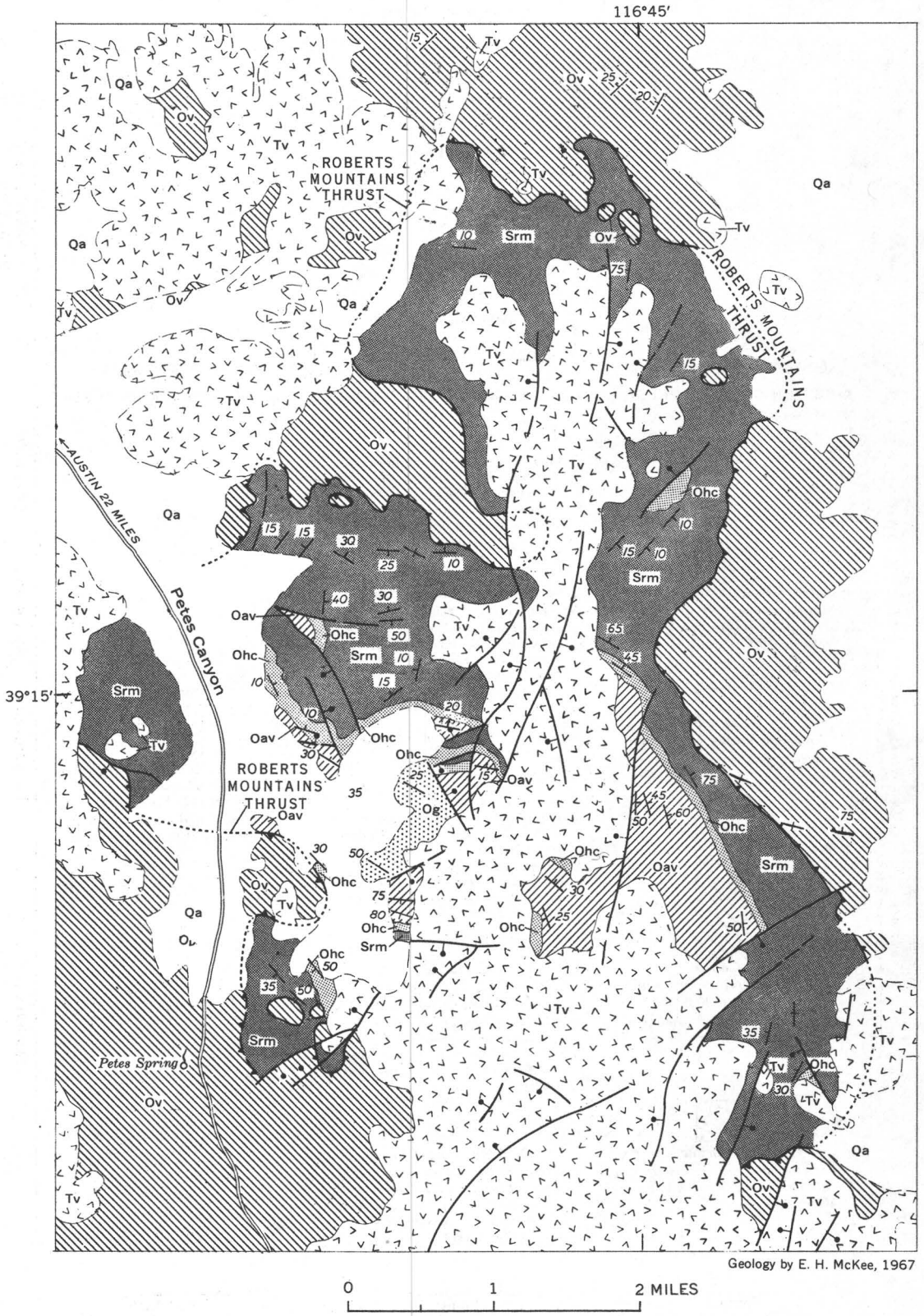


Figure 4.—Geologic map of Petes Canyon window in northern Toquima Range.

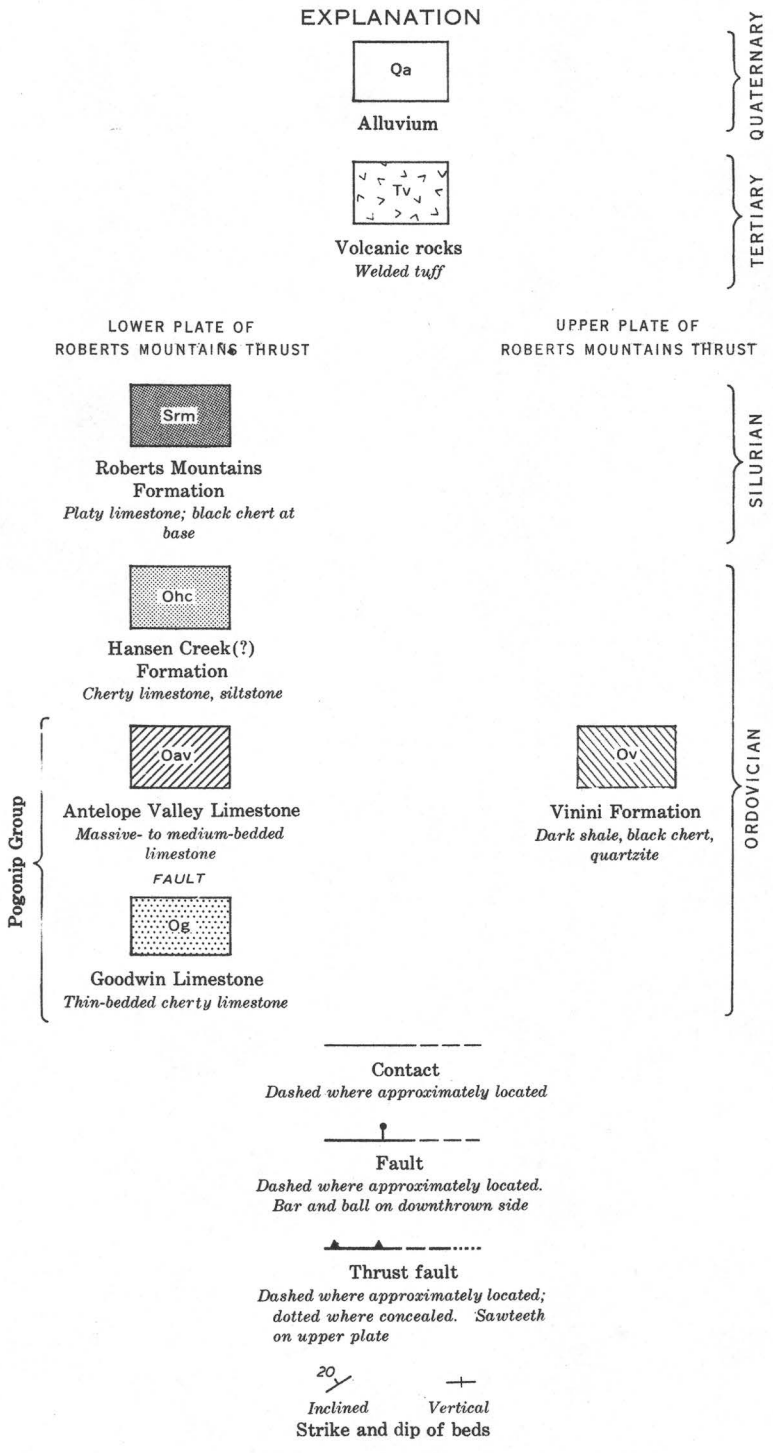


Figure 4.—Continued.

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