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EXPLORATION TARGETS IN NORTH-CENTRAL NEVADA

by

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Few areas in the United States offer exploration targets like those in north-central Nevada. Here, a unique combination of geologic features permits us to make fair guesses as to where extensions of known districts may be found, and where we may look for new ones.

Most of the major mineral districts in Nevada were discovered by prospectors who picked up ore on the surface. The ore bodies we are now seeking are concealed under volcanic rocks, alluvium, and thrust plates. These ore bodies can be found by careful study of the complex factors that controlled the migration of ore-bearing solutions and formation of the ore bodies.

First, a summary of the regional geology will be helpful in understanding the lithologic and structural control of the ore bodies. During the early Paleozoic, Nevada lay within the Cordilleran geosyncline (Roberts, Hotz, Gilluly, and Ferguson, 1958); deposition of carbonate rocks in the shallow marine waters in eastern Nevada took place contemporaneously with deposition of a Western (siliceous) assemblage of shales, chert, and accompanying basic volcanics in deeper offshore waters in western Nevada. Transitional rocks, mostly shale, chert, and shaly limestone, separate the other facies. Deposition continued from Cambrian to late Devonian without any serious breaks, but in late Devonian, uplift in the west was accompanied by folding and the movement of great thrust plates eastward on the Roberts Mountains thrust fault; these plates reached beyond a line connecting Eureka, Elko, and Mountain City. We call this disturbance the Antler orogeny. Subsequently, deformation during the late Pennsylvanian in north-central Nevada resulted in local uplifts, causing doming. Subsequent erosion of these domed areas entirely removed upper-plate rocks in places, thus exposing lower-plate rocks in windows; the result was a broad area of klippes and windows between the line of emergence of the thrust on the west, and the zone of the thrust toe on the east (fig. 1). In Eureka County and adjacent Lander County, the alinement of windows (fig. 2) indicates that belts of doming follow northwest trends. Two of the belts, one on the southwest (Eureka to Battle Mountain), and the other on the northeast (Railroad district to Lynn) are indicated on the map. These trends do not parallel any known trends in the Paleozoic. They may be inherited from Precambrian structural trends.

Except for these local Pennsylvanian uplifts, sedimentation continued in north-central Nevada until late Permian, when uplift again prevailed in the west. The seas returned in early Mesozoic, but at the end of Jurassic local vulcanism brought marine deposition to an end. In the late Cretaceous, continental sedimentation in central Nevada heralded the basin and range structures of today.

The major base metal mining districts in north-central Nevada are localized in carbonate rocks near intrusive bodies. The major gold deposits are along thrust breccias. Formation of ore deposits requires that three factors, genetic, structural, and lithologic, be met. By genetic is meant the source of ore-bearing fluids which may be from igneous bodies or from depth. Major structural breaks permit solutions to migrate from depth, and minor breaks exert local controls in distribution of ore deposits in districts. Lastly, we need a host rock that can be replaced; limestone and dolomite are the most likely hosts. In eastern Nevada the principal ore bodies found so far have been localized in the lowest carbonate unit in the section, usually the oldest Cambrian dolomite (fig. 3, Eldorado Dolomite at Eureka). Presumably, this is because the Precambrian rocks that form the basement in Nevada are siliceous rocks such as schist, gneiss, quartzite, and granite; after the ore solutions passed through some thickness of these rocks, they were in equilibrium with them. Then, when the solutions hit the carbonate rocks--generally dolomite--equilibrium was disturbed and reaction took place. The Combined Metals Limestone at Pioche also contains ore bodies that are examples of this kind of lithologic control.

Earlier I mentioned that a unique combination of circumstances permits us to explore areas in north-central Nevada with more confidence than in other places. The three major factors that control the ore deposits, genetic, structural, and lithologic, all occur together in and around the windows. Figure 2 shows that many of the windows contain intrusive bodies; preliminary data indicate that the productive intrusives are late Cretaceous or early Tertiary in age. These came in much later than the initial doming, but appear to have accentuated the doming during the introduction of the magma. Aeromagnetic maps of the region show that the regional geology is reflected also in the geophysical picture (fig. 5). The northwest trend is readily apparent; it shows in general alinement of granitic bodies which are the broad highs scattered across the map, and in the sharp northwest anomaly that is caused by basic intrusives--mostly dike feeders to the late Tertiary flows. Thus we have evidence for long term deformation along the northwest belts, first in Precambrian, then during the Paleozoic, Late Mesozoic, early Tertiary, and late Tertiary.

On figure 5 I have also plotted the major mining districts; you will note a close relationship between the broad highs that represent granitic bodies and the districts. This relationship is so close that it is immediately apparent that some of the other broad anomalies, those that do not have associated mining districts, ought to be looked at carefully. Some of these anomalies are in or near windows, but others are not. The principal objective in exploration in this area is to find the thrust fault and underlying carbonate rocks where they may be domed up and therefore be within reach of shallow exploration methods. The intrusives come in zones of deformation, such as the domes, and being mostly magnetic, can be detected by airborne magnetometers. Moreover, the metals come up with the intrusives, so the contacts are good places to look. Field work should start with a geochemical program; if one finds a leakage of metals into zones now at the surface, that is the place to begin initial exploration. A detailed geophysical program should be integrated with the geochemical program; then finally, a drilling program could follow if all seems favorable. Because the minerals in most of the districts are zoned, possible lateral and vertical zoning should be taken into account.

With this background, I will now discuss some of the mining districts in north-central Nevada, and will make some suggestions for further exploratory work.

The Eureka district is largely underlain by carbonate facies rocks; possibly the Roberts Mountains thrust once covered the district, but has now been eroded. At Eureka Nolan (1962) has worked out a detailed picture of the stratigraphic and structural control of the ore bodies. Figure 3 is a map of the highly productive area around Ruby Hill; much of the early-day production here was from the base of the Eldorado, the first dolomite in the section, which here is in fault contact with the underlying Prospect Mountain Quartzite. Section A-A' trends northeast-southwest across the map (fig. 3). The stratigraphic position of the major ore bodies is shown diagrammatically in the lower part of the Eldorado. In a longitudinal section the ore bodies are shown more like they really occur, as discontinuous pipes and lenses (fig. 4). In the Eureka district, deep exploration in the Hamburg Dolomite south of Ruby Hill and in the covered areas to the north seems promising: objective, the Eldorado Dolomite below.

In the Cortez district (fig. 6) most of the ore bodies are in the Hamburg Dolomite, just below the Eureka Quartzite (Masursky, oral communication, 1963), associated with thin porphyry dikes. The ore bodies spread out along bedding, and were impressive in size and grade, yielding some $20 million. No one knows how far it is to the base of the Eldorado in this area, but it is suggested that this could be a zone of potential exploration.

West of the frontal fault that borders the range, the carbonate rocks have been downfaulted; in recent years Erickson, Masursky, Marranzino, and Uteana (1961) of the Geological Survey have sampled geochemical anomalies in these rocks and in some of the upper plate rocks. It would be most interesting to know what lies below these anomalies in the thrust zone and in the carbonate units. Possibly ore bodies lie deep, but a little "wildcatting" may be worth while.

At the Buckhorn mine (figs. 1, 5, 9) gold production from north-trending fault zones in andesite or basalt has been substantial (Vanderburg, 1938). Further deep exploration in this area seems warranted.

At Mount Hope, 15 miles southeast of Cortez, about 10 million pounds of zinc ore have been mined from Permian limestone along an alaskite contact (fig. 7, Matson, 1946). Apparently the possible sites for ore have been pretty well drilled out in the explored block and the potential for additional ore in the limestone is not great, but as you can see from the map, lower-plate Devonian rocks are present a mile to the west and may well be present at reasonable depths in the vicinity of the mine. The upper-plate thickness is not known, but as the thrust is apparently flat in this area, the plate may be thin.

The Roberts district, 8 miles south of Cortez (figs. 1, 5, 11) has yielded a small production from a tactite body near a small intrusive body (Vanderburg, 1938). Geochemical sampling of nearby areas along the Roberts Mountains thrust and intrusive contacts may be worth while.

The Shoshone Range contains three districts, Bullion (Gold Acres-Tenabo), Hilltop, and Lewis. The principal ore body at Gold Acres was in the thrust zone in the Gold Acres window (fig. 8) (Keith Ketner, oral communication, 1962). This ore body has been largely mined out, though some carbonaceous ore remains; careful geochemical and geophysical work to the northwest may yield clues to undiscovered ore bodies. The Tenabo district to the north is partly in the window and partly in the upper-plate rocks. Sampling of the upper-plate rocks northwest of the window is suggested; if preliminary work is favorable, this is another place to unlimber the drill, and determine the distance to the lower plate. At Hilltop (fig. 5) a number of small veins have been explored in siliceous facies and intrusive rocks. No carbonate rocks are exposed here, but the carbonates below may be within reach. At Lewis, silver veins in siliceous rocks have yielded significant production; again, some deep probing is indicated--target, the lower-plate carbonate rocks. (See also Vanderburg, 1939).

In Battle Mountain (Roberts, 1951) the copper-gold ore bodies are partly in late Paleozoic rocks, partly in underlying siliceous rocks, and partly in intrusive quartz monzonite. As the mining districts in Battle Mountain are 12 - 15 miles northwest of the last window, the thrust plate may be fairly thick. Nevertheless, the plate should be probed in both the Copper Canyon and Copper basin areas (figs. 1, 5). The leakage through the plate amounts to $13 million in base and precious metals; much more may have been trapped below by reactions with carbonate rocks and along thrust breccia.

That covers all I wish to say about the southwestern belt; now we will turn briefly to the northeastern one, which is most interesting now because the Newmont Company is actively carrying on exploration there. The northeast belt is noted especially for its gold deposits in the Lynn and Maggie Creek districts. The Lynn area has been recently mapped by the Geological Survey in reconnaissance fashion and by John Roen (1961) in detail (fig. 10). I have generalized Roen's map, showing the carbonate rocks, siliceous rocks, and volcanic and granitic rocks. The significant feature, however, is the structural control of ore by the Roberts Mountains thrust fault. Newmont's exploration has been carried on principally along the northeastern contact of the thrust with the underlying carbonate rocks. I presume that metallization was localized in sheared rocks within the thrust zone.

At the Carlin window, the Newmont Company is also carrying on exploration of the upper-plate rocks and the thrust zone. Small-scale silver, copper, and barite production in the past was encouragement for this exploratory work. Recent reports in the mining journals indicate that work in these two areas has yielded large tonnages of low-grade gold ore.

In the Reese River district Ross (1953) has mapped gold-silver veins in the northern part of the district in Yankee Blade Canyon. These veins are in siliceous facies rocks in the upper plate of the Roberts Mountains thrust; a few miles east, in the southern part of Grass Valley, limestone of the carbonate facies crops out. This indicates that carbonate rocks underlie the veins in Yankee Fork Canyon; the depth is unknown, but may be less than 1,000 feet. Surface geochemical sampling in this area is suggested.

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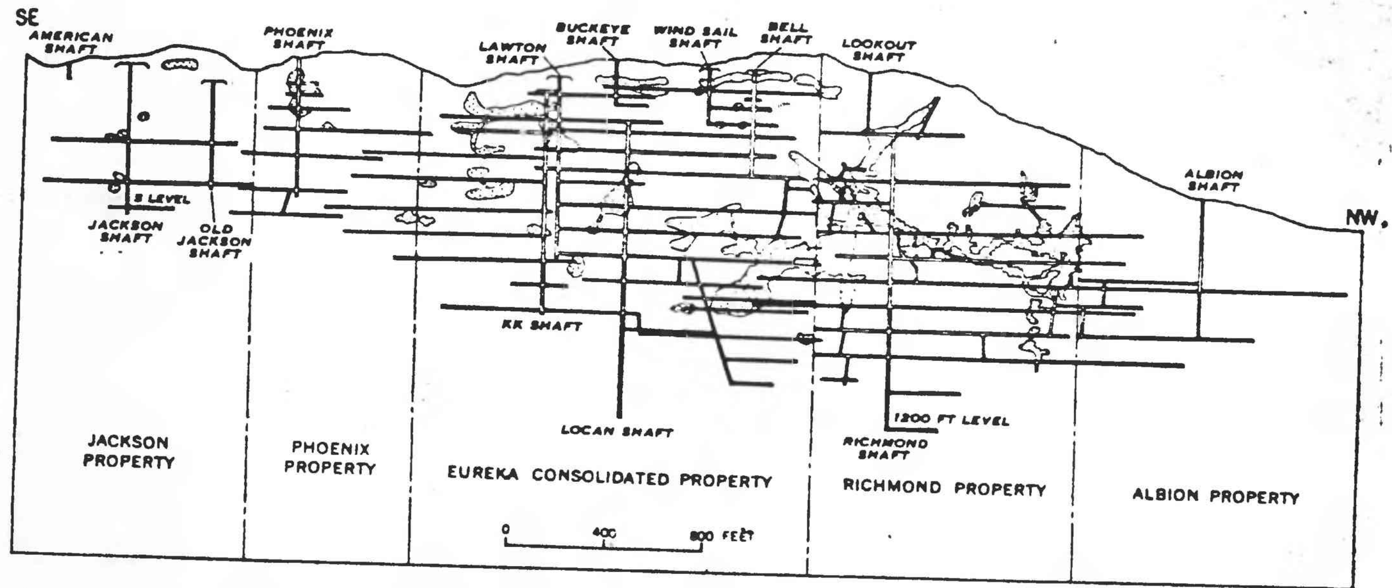

Adapted from J. S. Curtis, 1884, pl. 3

Figure 4. Longitudinal section along the Ruby Hill fault zone, Eureka district, Nevada.

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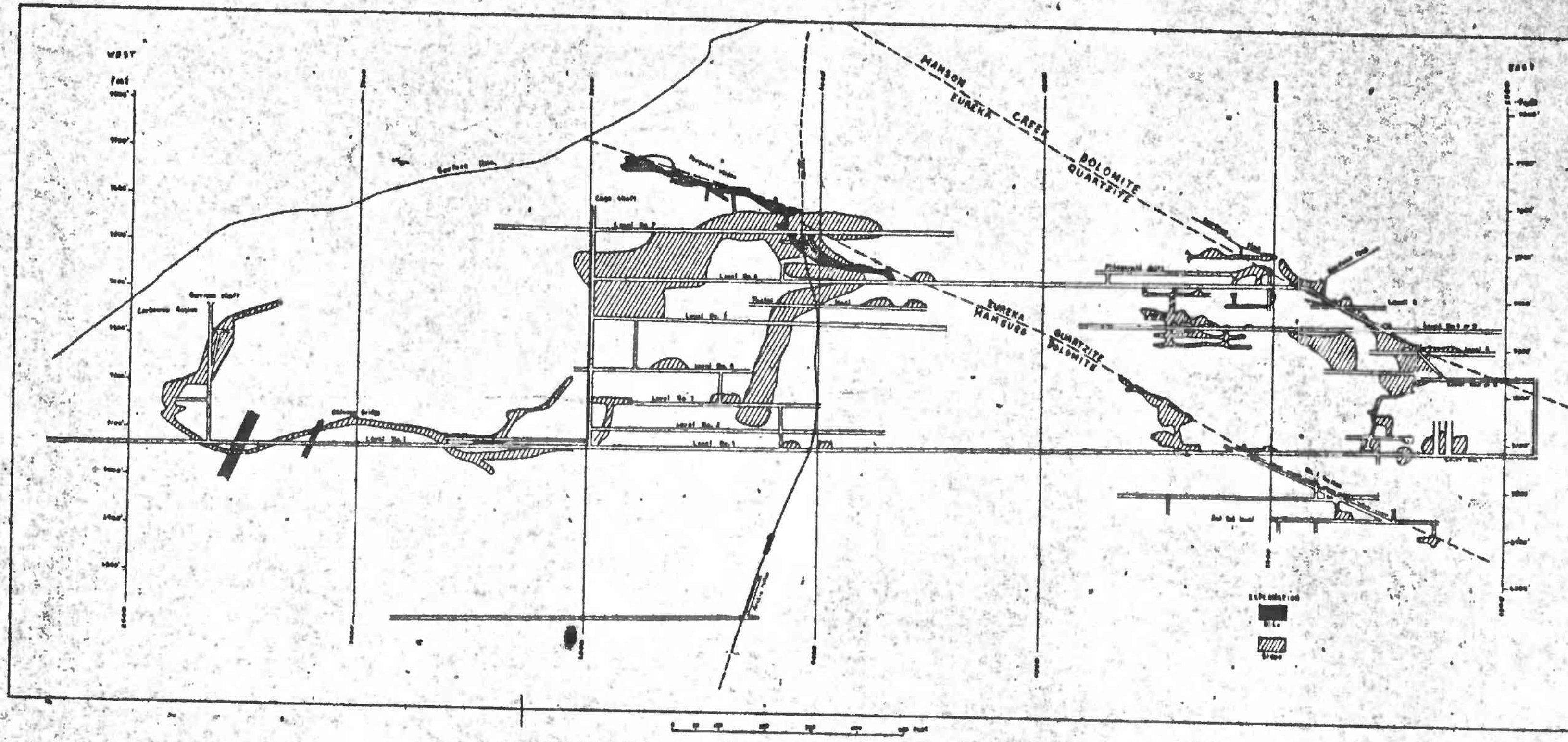

FIGURE 6 - COMPOSITE SECTION OF THE MINES OF THE CORTEZ METAL COMPANY

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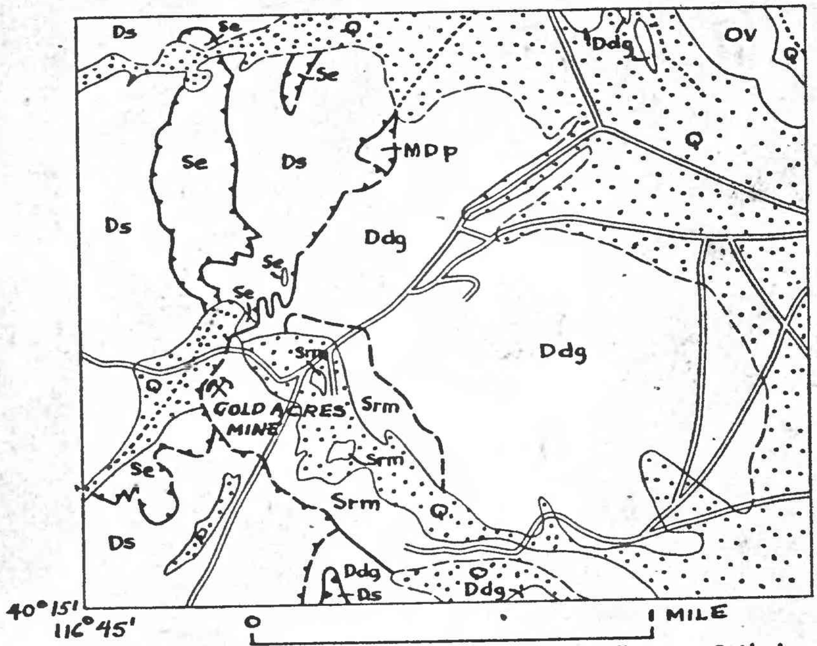

Modified after James Gilluly, written communication, 1954

EXPLANATION

Q — Alluvium

Siliceous facies	Carbonate facies
Ds — Slaven Formation	MDp — Pilot Formation
Se — Elder Formation	Ddg — Devils Gate Formation
Ov — Valmy Formation	Srm — Roberts Mountains Formation

Contact — Fault — Thrust fault

Figure 8. Geologic map of the Gold Acres-Tenabo district, Nevada.

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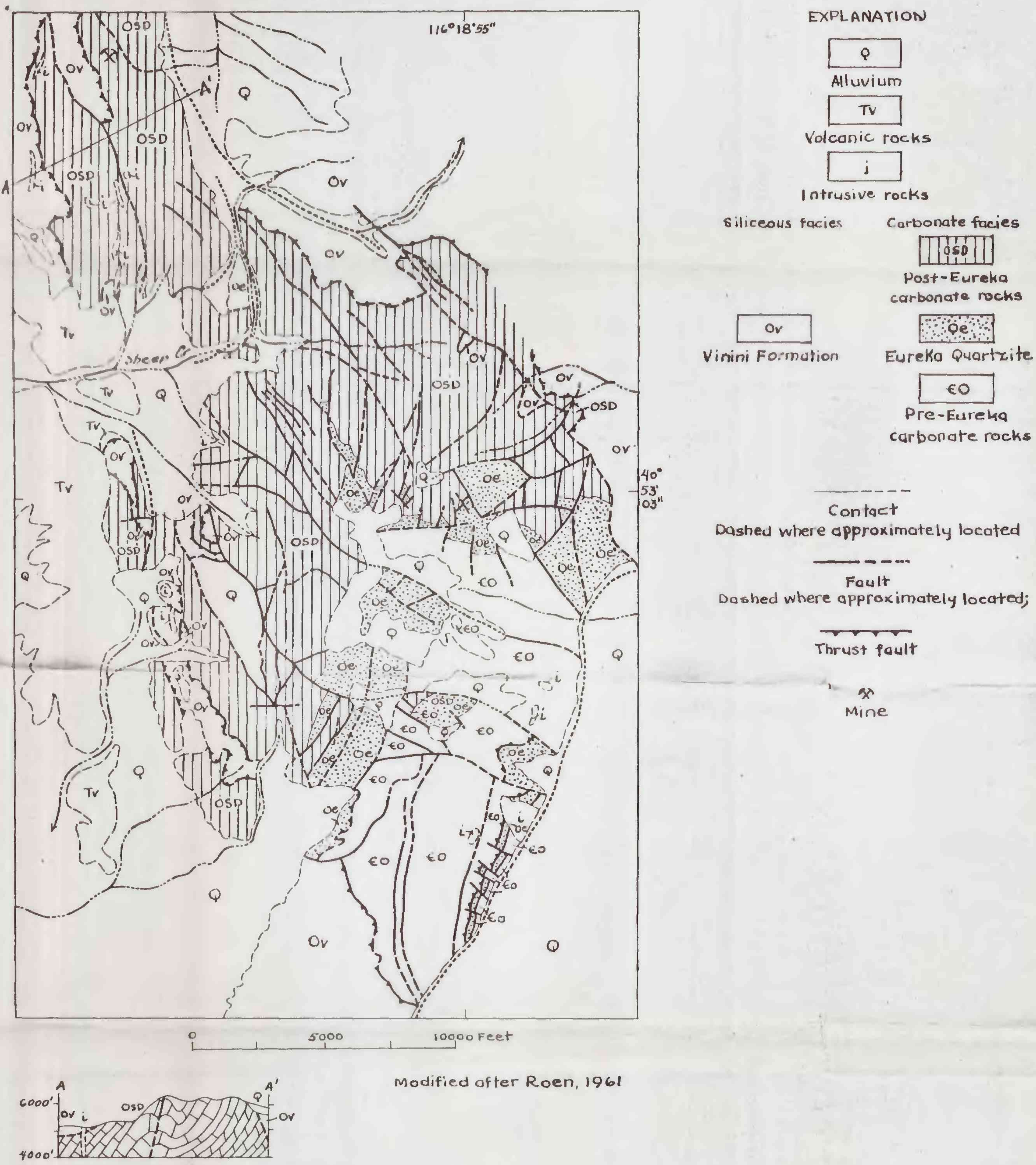

Figure 10. Geologic map of the Lynn district, Nevada.

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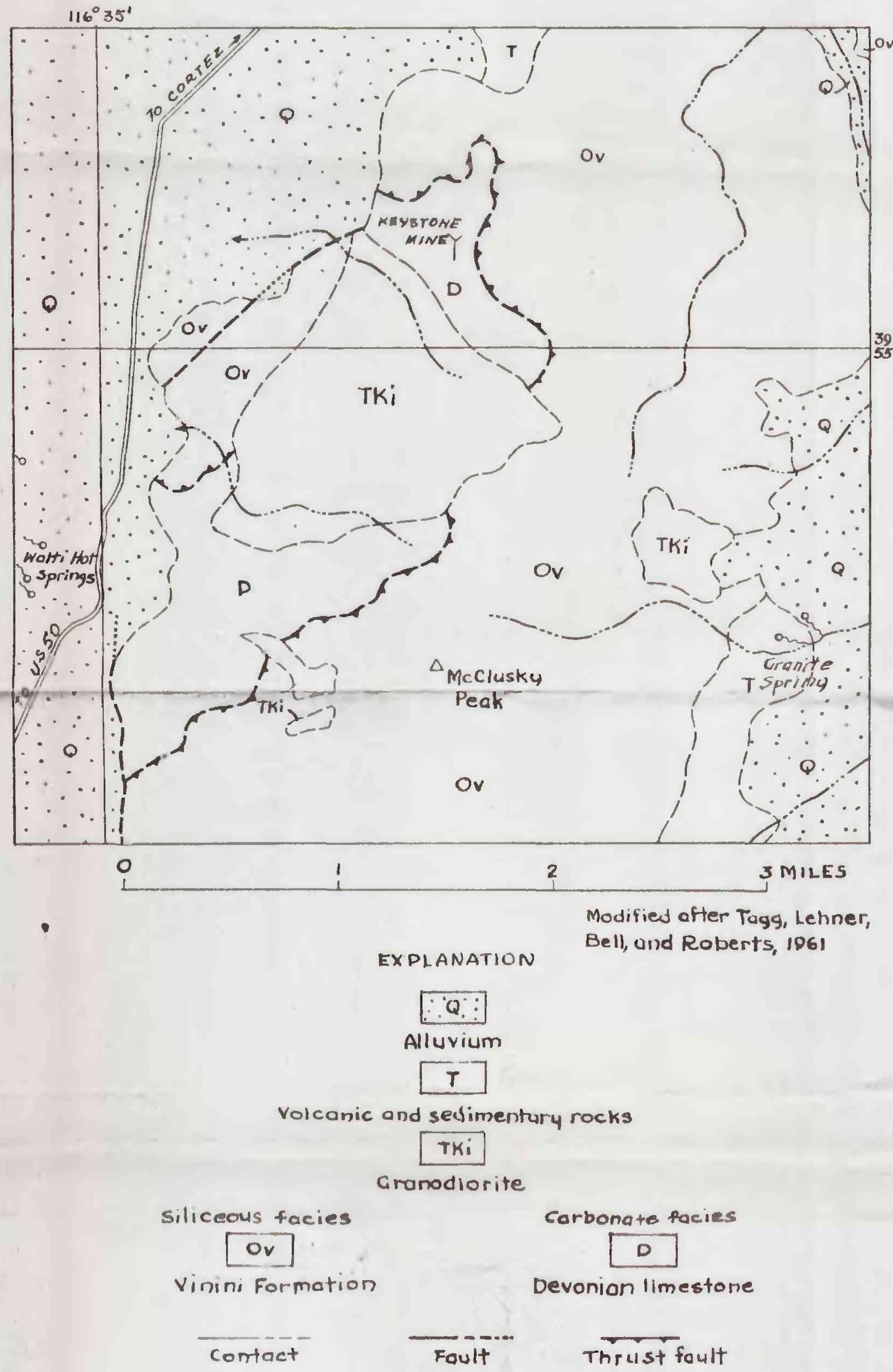

Figure 11. Geologic map of the Roberts district, Nevada.

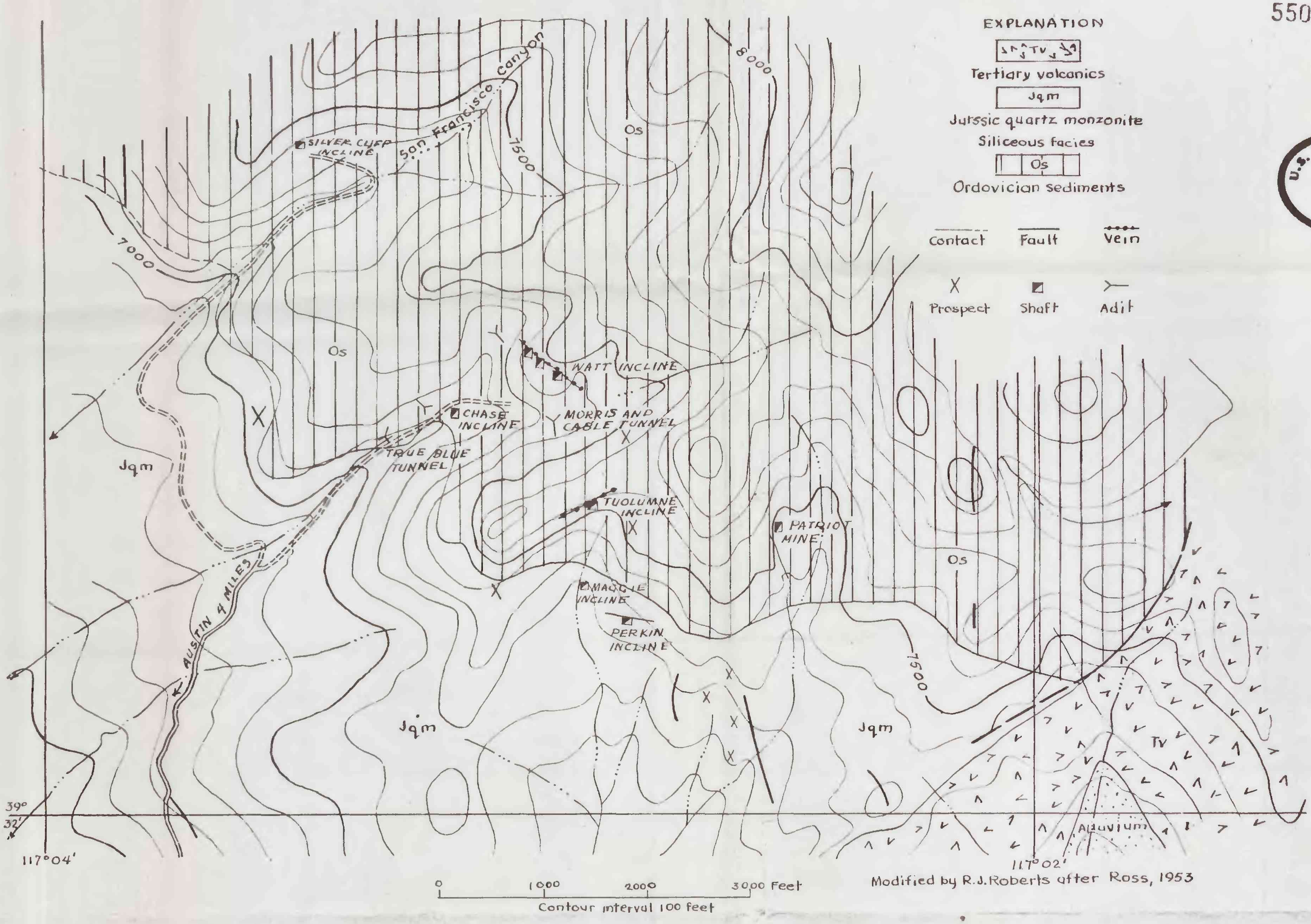

Figure 12. Geologic map of the northern part of the Reese River district, Nevada.

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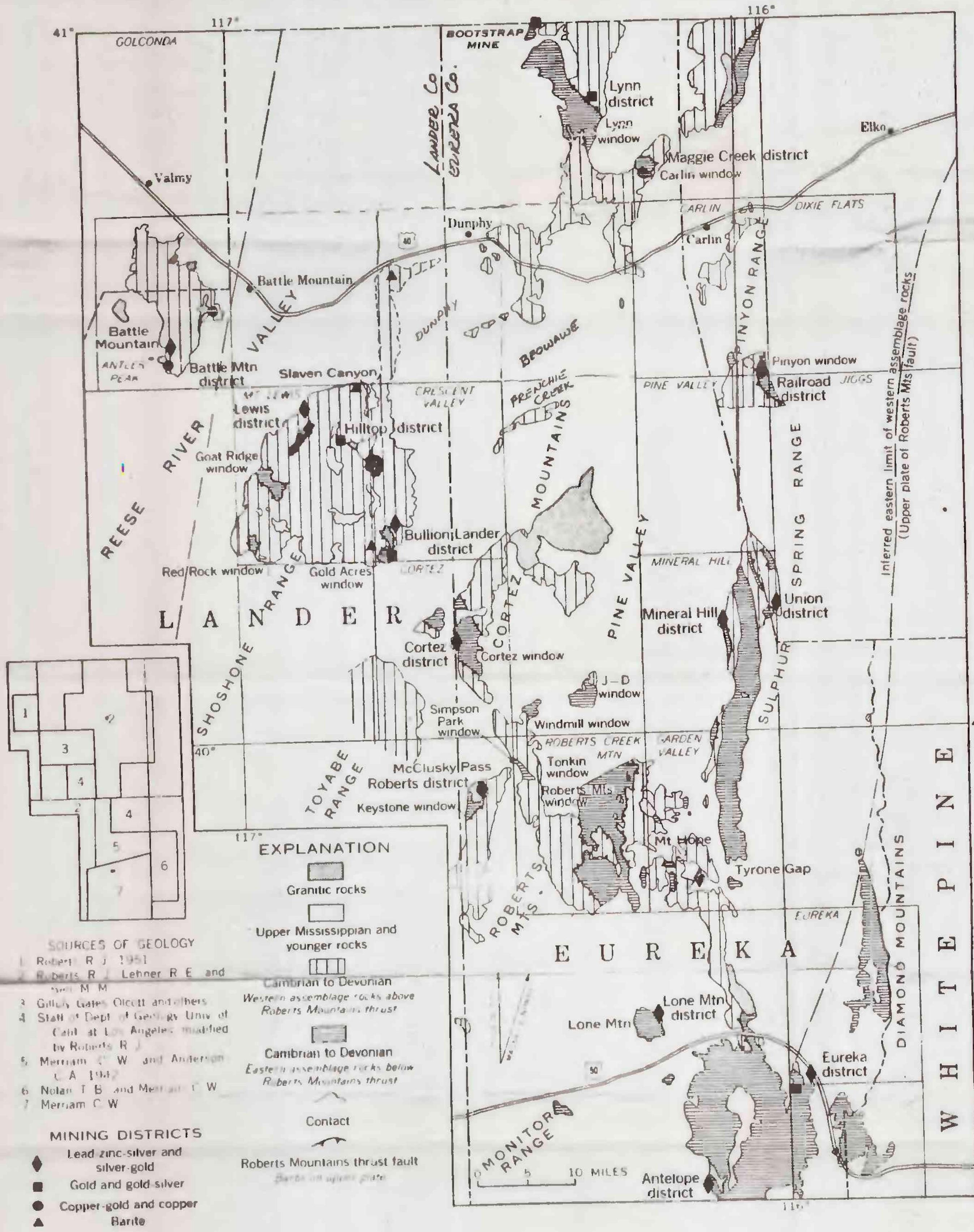

Figure 2. Map showing northwest alinement of windows between Eureka and Battle Mountain, Nevada.

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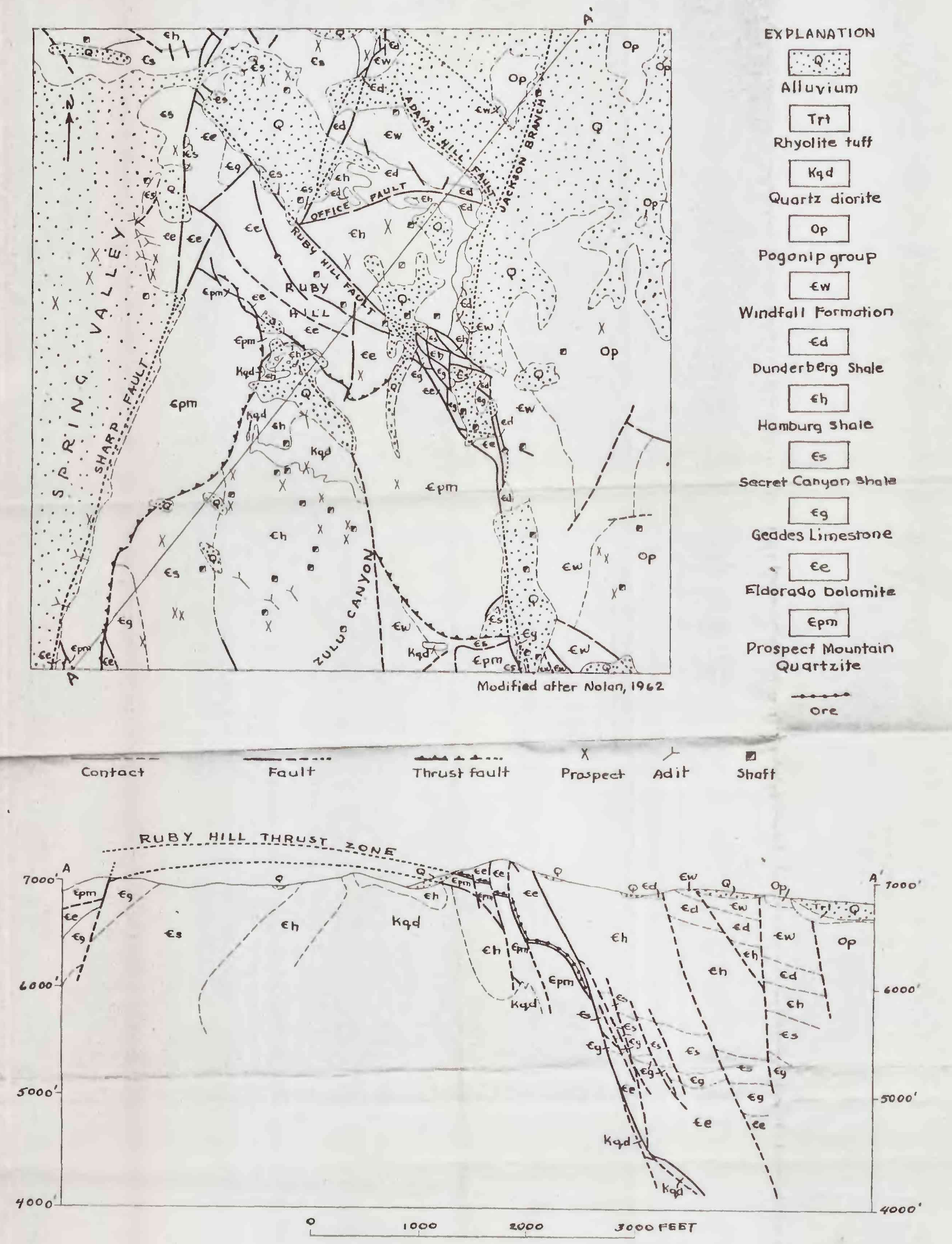

Figure 3. Geologic map and section of part of the Eureka district, Nevada.

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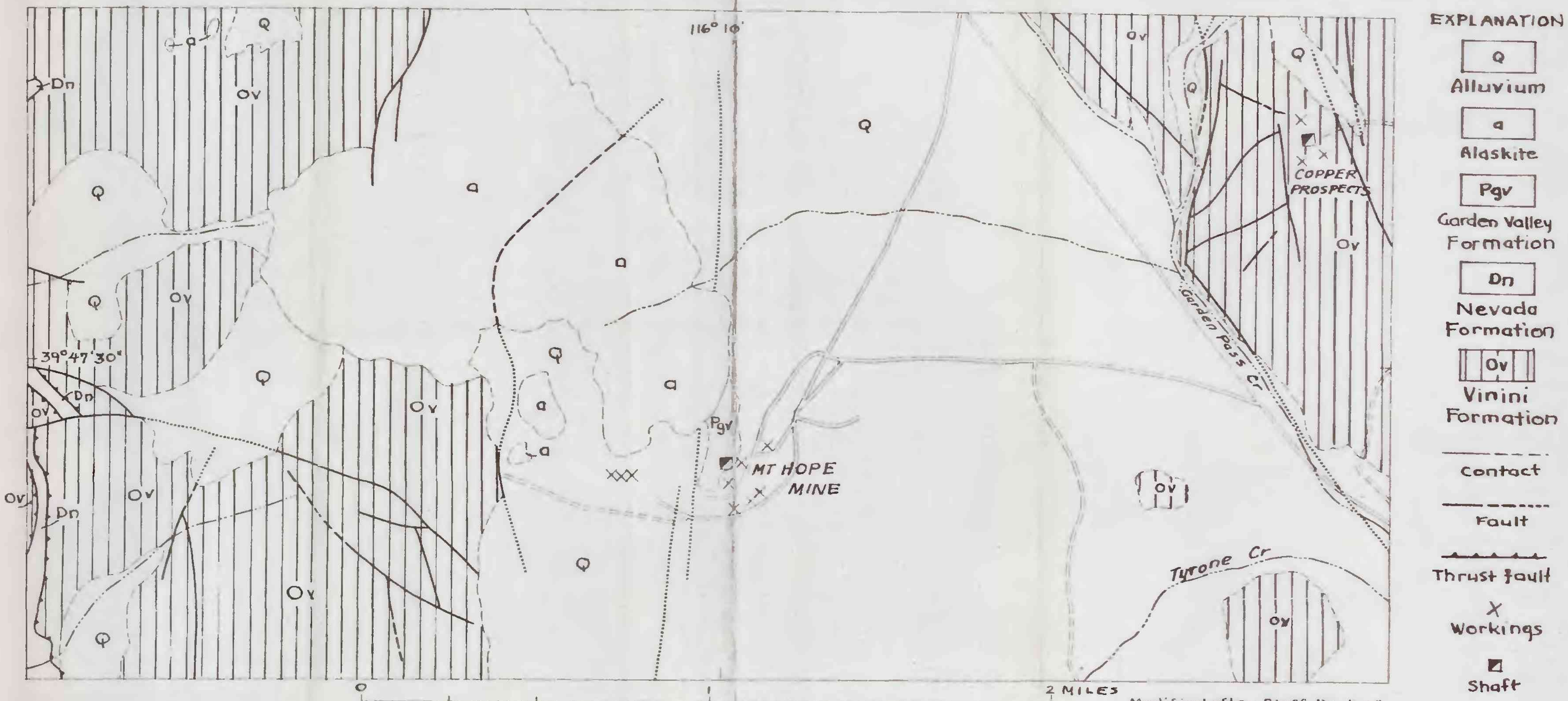

Figure 7. Geologic map of the Mt. Hope district, Nevada.

Modified after Staff, Dept. of Geol., Univ. of Calif. at Los Angeles.
Written communication, 1950

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Figure 9. MAP OF THE BUCKHORN MINING DISTRICT, EUREKA COUNTY, NEVADA