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Mountains Formation and partly of a distinctive sequence of alternating sandy and shaly beds. The sandy beds are brown or tan and consist of sand-size grains of carbonate and quartz. The shaly beds are gray and consist of fine-grained limestone and clay.

Beds of loosely consolidated sandstone and conglomerate of Tertiary and Quaternary age cover the lower slopes east and west of Swales Mountain. Many of the sandy beds consist partly of volcanic ash. Andesite and latite lava flows and ash beds overlie the Vinini Formation north of Swales Mountain.

INTRUSIVE ROCKS

Intrusive rocks in the Swales Mountain area consist mainly of monzonite porphyry and quartz porphyry. A stock of monzonite forms the south end of Swales Mountain in sec. 18, and a thick dike of monzonite extends from the NW $\frac{1}{4}$ sec. 16 northward through sec. 5. Most of the other intrusive rocks shown in figure 2 are quartz porphyry. The two types of rock are easily distinguished: the monzonite is rather dark and is spotted with black biotite; the quartz porphyry is light colored and is spotted with crystals of clear quartz. Geologic relations and radiometric data indicate that the intrusive rocks are of Tertiary age.

STRUCTURE

The Roberts Mountains Formation and the upper limestone unit are separated from the overlying Vinini Formation by a thrust fault. A thrust fault such as this one, which separates younger limestones from overlying older siliceous rocks, in this region is generally called the Roberts Mountains thrust fault (Roberts and others, 1958). Originally the thrust fault probably lay almost horizontally in the Swales Mountain area, but now both lower plate and upper plate rocks and the thrust fault that separates them are folded into an arch or anticline that trends north. The association of intrusive rocks with the anticline suggests that forcible emplacement of igneous rocks may have caused the anticlinal structure. The Roberts Mountains Formation and the upper limestone unit are exposed along the axis of this anticline, and they underlie the Vinini Formation at unknown depths on the flanks of the anticline.

In the course of mapping the Swales Mountain area some doubt arose as to whether limestone exposed there was actually in the lower plate of the Roberts Mountains thrust or whether it was an unusually thick body of limestone in the upper plate. Three holes drilled to clarify the structural picture indicate the limestone to be in the lower plate. These holes were designated as holes 2, 3, and 4 (figs. 1, 2, 3). Hole 2 was drilled to a depth of 2,547 feet, entirely within the Roberts Mountains Formation. Hole 3 penetrated limestone and skarn to a depth of 861 feet. Hole 4, located near Swales Creek (SE $\frac{1}{4}$ sec. 28, T. 36 N., R. 53 E.), started in Vinini Formation in the upper plate of the Roberts Mountains thrust fault, penetrated the thrust fault at a depth of 348 feet, and was extended 200 feet into limestone of the lower plate.

ROCK ALTERATION

Chert and limestone have been somewhat altered close to the borders of igneous intrusive rocks. Some chert of the Vinini Formation has been recrystallized and bleached to a quartzitelike material. Limestone along intrusive contacts has been partly converted to a mixture of garnet and pyroxene minerals called skarn or tactite. This rock is extremely dense, hard, and difficult to drill. Limestone alteration at Swales Mountain thus is different from that at the Carlin mine, where carbonate in the Roberts Mountains Formation has evidently been extensively leached, leaving a bleached, porous, soft residue of silica.

MINERALIZATION

Exposed mineralized rock is concentrated mainly at the contact of porphyry with upper plate chert on the northeast and southeast slopes of Swales Mountain (SE $\frac{1}{4}$ sec. 6; E $\frac{1}{2}$ sec. 18) and along contacts between monzonite and limestone (SE $\frac{1}{4}$ sec. 5; E $\frac{1}{2}$ sec. 8; NE $\frac{1}{4}$ sec. 17). A few samples from these areas contain as much as several tens of parts per million of gold, several hundred parts per million of silver, more than 100 parts per million of molybdenum, and thousands of parts per million of lead, zinc, and copper, but most samples are leaner. The samples whose metallic contents are shown in figures 4 to 10 were randomly selected from visibly mineralized rock

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Ketner, R. B., Evans, J. G., and Hessin, T. D., 1968, Geochemical Anomalies in the Swales Mountain Area, Elko County, Nevada: U. S. Geol. Survey Circ. 588, 13 p.

at each site. The tonnage of mineralized rock cannot be estimated, but the narrow extent of surface exposures indicates that it is small.

Nearly 300 3-inch segments taken at regular intervals from drill core were analyzed by spectographic and atomic absorption techniques. Barely detectable amounts (0.02 to 0.1 ppm) of gold were found in some samples from hole 2 between 1,080 and 1,230 feet below the surface. Silver, lead, and barium were found in the top 100 feet of hole 3 in concentrations only slightly greater than those of ordinary rock. Mercury, and molybdenum were found in slightly above-normal concentrations in hole 4 in the Vinini Formation within 50 feet of the Roberts Mountains thrust, and barium was found in above-normal concentrations in lower plate limestone within 40 feet of the thrust. The metal contents of all samples of drill core are too low to be of any immediate economic significance.

SUGGESTIONS FOR PROSPECTING

Disseminated gold deposits should be sought at Swales Mountain in the kinds of rocks that carry disseminated gold elsewhere. In the Carlin mine (Hardie, 1966) and the Cortez district (Erickson and others, 1966) gold is disseminated in the Roberts Mountains Formation. At the Gold Acres mine (Ketner, 1965) gold is disseminated in broken rock along the Roberts Mountains thrust. The presence of small gold deposits in the upper plate rocks at Swales Mountain suggests the possibility of

more extensive deposits in the Roberts Mountains Formation where it lies concealed by upper plate rocks or in the broken rock along subsurface parts of the Roberts Mountains thrust. Exploratory efforts therefore should include drilling through the upper plate in areas immediately surrounding Swales Mountain. Unfortunately there is no way of knowing how deep the thrust zone lies or how far below the thrust the Roberts Mountains Formation lies. Both could be very close to the surface without revealing their presence in any way.

Lower plate rocks intruded by igneous rocks are concealed beneath alluvium on the east flank of the mountain (secs. 4, 9). Exploration of these rocks would require drilling through the alluvium east of the area where lower plate rocks are exposed. »

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