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Abstract

An area in the Cortez district, Nevada, previously established to be anomalous in arsenic, antimony, and tungsten has been found to be anomalous also in mercury and gold. Samples from narrow quartz veins, calcite veins, and shear zones in partially silicified limestone in the lower plate of the Roberts thrust fault (Cortez window) contain as much as 3.4 ounces gold per ton. The richest samples are from an outcrop, about 100 feet long, surrounded by gravels. Their economic significance is yet to be established.

INTRODUCTION

The geochemical association of arsenic, mercury, antimony, and tungsten with gold has been recognized at several low-grade open-pit mines—such as Getchell, Bootstrap, Carlin, and Gold Acres mines—in north-central Nevada (Erickson and others, 1964b; Engineering and Mining Journal, 1966). Geochemical prospecting in the Cortez district revealed anomalous amounts of arsenic, antimony, and tungsten and led to analysis of samples for mercury and gold. Development by Lakin and Nakagawa (1965) of a sensitive chemical method for rapid determination of gold in rocks and soils and by Vaughn and McCarthy (1964) of a mercury sniffer made such analysis possible in the field during geochemical prospecting.

The Carlin and Bootstrap mines in the Tuscarora Mountains, Elko and Eureka Counties, and the Gold Acres mine in the Shoshone Range, Lander County, are associated with windows in the Roberts thrust, a major structural feature of north-central Nevada along which a number of mining districts are situated (Roberts, 1960). Gold ore is chiefly in the thrust zone at Bootstrap and Gold Acres and is in and below the thrust zone at Carlin (Peter N. Lancar, Newmont's Carlin gold mine: Soc. Mining Engineers Fall Mtg. Rocky Mtn. Minerals Conf., Phoenix, Ariz., Oct. 1965). At the Getchell mine in the Osgood Mountains, Humboldt County, gold occurs in the high-angle Getchell fault zone, a zone that appears unrelated to the Roberts thrust (Hotz and Willden, 1964).

In early 1966 surface-rock and drill-hole samples collected in previous geochemical studies in the Cortez district were analyzed for gold by Nakagawa, using both chemical and atomic-absorption methods. Anomalous amounts of gold—5-14 ppm (parts per million), equivalent to 0.145-0.41 ounce per ton—were found in two surface rock samples; 2-8 ppm (0.06-0.23 oz per ton) gold was found in heavy-mineral concentrates of rotary-drill cuttings from two shallow holes drilled near the boundary of an arsenic-antimony-tungsten anomaly. These results prompted additional fieldwork in May 1966, which is reported here.

Analyses of newly collected samples showed gold concentrations as high as 3.4 ounces per ton. The samples are from narrow quartz veins, calcite veins, and shear zones in partially silicified limestone of Silurian and Devonian age in the lower plate of the Roberts thrust (Cortez window) near the Crescent fault about 4 miles north of Cortez, Nev. (fig. 1). The highest gold assays discovered in this investigation occur in samples from an outcrop, about 100 feet long, consisting of altered Devonian limestone near the east end of an arsenic-antimony-tungsten geochemical anomaly previously reported by Erickson, Masursky, Marranzino, Oda, and Janes (1964a).

The geology of the Cortez quadrangle is described by Gilluly and Masursky (1965), and the reader is referred to their report and to reports on the geochemical investigations (Erickson and others, 1961, 1964a) for a more complete discussion of the geology and geochemistry of the area.

Elwin Mosier, Howard Knight, Arthur Hubert, and Theodore Roemer, all of the U.S. Geological Survey, participated with the authors in this short but intensive field study.

RESULTS OF INVESTIGATION

For this investigation 238 rock samples were collected from 95 localities near the Crescent fault about 4 miles north of Cortez (fig. 1). Analytical results (table 1) are given only for those samples that, by at least one analytical method, contain significant amounts of gold (0.3 ppm, or 0.09 oz per ton). To check the gold values determined by colorimetric and atomic-absorption methods, 27 samples were analyzed by fire assay by C. O. Parker and Co., Denver, Colo. The results show good agreement (table 1) in view of the fact that only 1- and 2-gram samples were used in the colorimetric and atomic-absorption methods. Sample localities and localities with significant amounts of gold are shown in figure 1. Sample localities and areas of anomalous concentrations of arsenic, antimony, tungsten, and mercury are shown in figures 2, 3, 4, and 5, respectively.

The highest gold assays were found in samples from locality 722 (fig. 1), an exposure of altered limestone that, as previously mentioned, is east of the area of the strong arsenic-antimony-tungsten anomaly. The limestone, which forms a dip slope on the east side of a ridge, strikes N. 5° E., dips 65° E., and is exposed for about 100 feet along strike. The base of the slope is covered by talus. The limestone is dark orange brown in overall appearance and contains nearly vertical white calcite veins and calcite-cemented breccia zones as much as 10 inches wide that strike westward into the ridge. Quartz stringers up to 2 inches wide are parallel or subparallel to a brick-red shear zone, 8 inches wide, that strikes N. 75° W. and dips 30° SW. Samples 722 through 722-K (table 1) are selected samples from the talus; all others are from narrow veins and shear zones in the limestone. All veins, shear zones, breccia zones, and fractures sampled at this locality are gold bearing. The type of material probably constitutes less than 10 percent of the outcrop area. We have no data at present on the gold content of limestone that is not sheared, brecciated, or veined.

Dark-brownish-black jasperoid masses that crop out discontinuously on the west side of the ridge above locality 722 (fig. 1, table 1) contain much smaller but nonetheless anomalous amounts of gold. Gravel deposits cover the area between these jasperoid masses and locality 722 and may conceal gold-bearing altered rocks.

At sample localities 601, 600, 700, 701, and 702 (fig. 1), a conspicuous brick-red breccia zone, about 8 feet wide, in skarn and altered limestone strikes N. 10° W. and dips steeply east. Gold was detected only at locality 600 and in only 2 of 21 samples collected there.

At locality 606 gold occurs in a zone of dark-maroon jasperoid and breccia that contains white calcite pods and stringers. No attempt was made to trace this jasperoid zone along strike.

Preliminary mineralogic work on one sample (722-D) suggests that most of the gold occurs as very tiny disseminated specks and fine lacework in oxidized pyrite crystals. The largest fragment of gold observed in this sample is only a few microns thick but measures 200 microns in largest dimension.

The silver content of all gold-bearing samples is very low (maximum assay, 0.16 oz per ton). Spectrographic analyses show that arsenic is the most abundant metal in the gold-bearing samples; arsenic and mercury contents show a direct correlation with gold content. Small amounts of antimony and tungsten may be present; although antimony and tungsten contents do not show a direct correlation with gold content, anomalously high concentrations of antimony and tungsten commonly occur in rocks in or adjacent to areas of gold mineralization. Lead, zinc, and copper are not present in significant amounts.

An entirely different suite of metals was detected at locality 759 (fig. 1). Here, a light-gray, pink-weathering fine-grained limestone with finely disseminated oxidized pyrite crystals contains 5,000 ppm zinc, 300 ppm copper, and 20 ppm bismuth. A thin white pyritic quartz veinlet cutting the limestone contains 3,000 ppm zinc, 500 ppm copper, 300 ppm lead, 70 ppm tin, 200 ppm bismuth, and 200 ppm antimony. Gold was not detected in these samples.

Caliche-cemented gravel was sampled at 12 localities (fig. 1) in the search for possible placer accumulations of gold. Gold content was below the limit of detection (0.1 ppm) in all samples.

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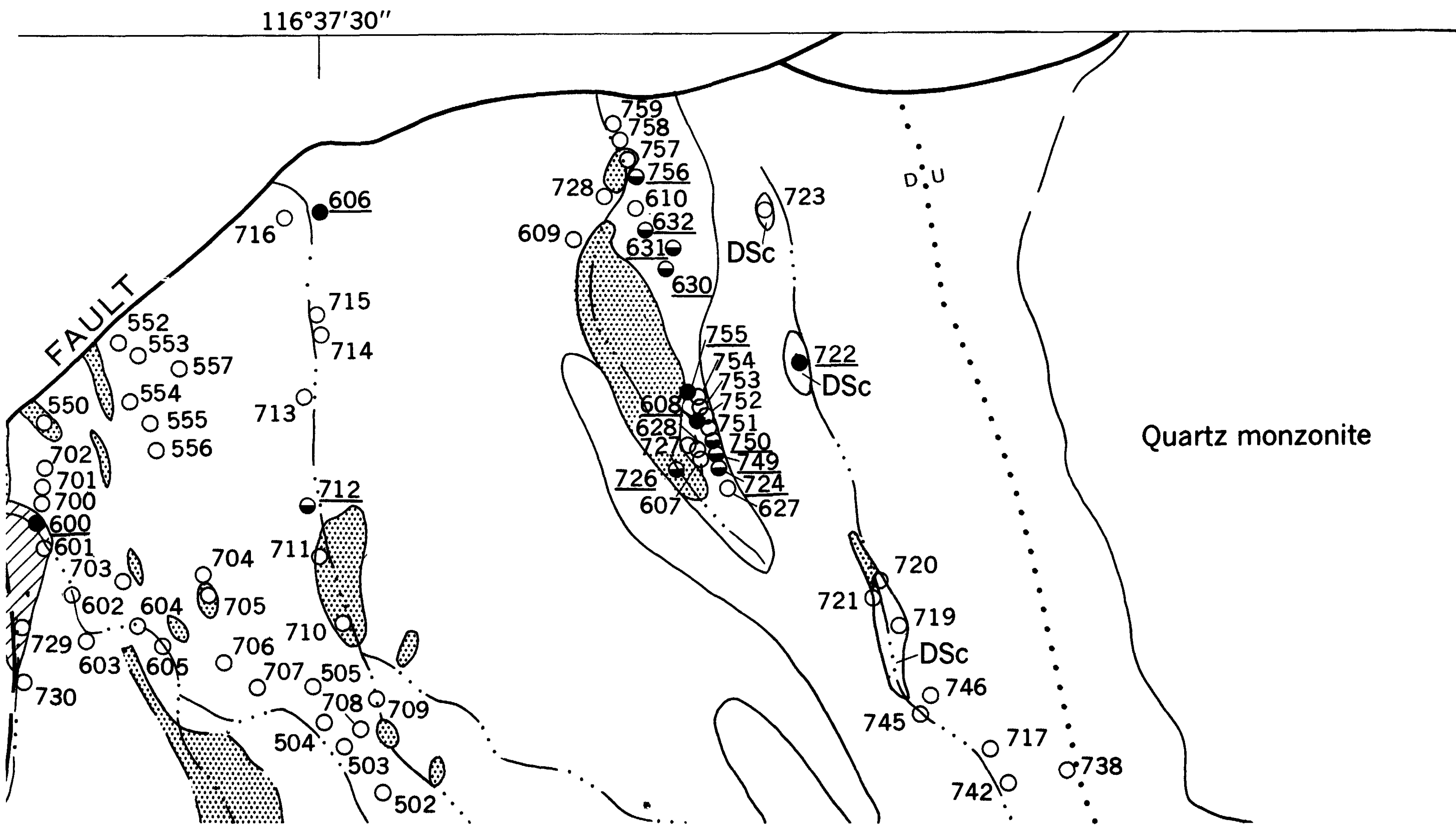
Table 1.--Analyses of rocks from the lower plate of the Roberts thrust, Cortez window, Nevada. [Spectrographic analyses by Elwin Mosier; colorimetric analyses for gold by G. H. Van Sickle; atomic-absorption analyses for gold by H. M. Nakagawa, G. H. Van Sickle, K. W. Leong, and Arthur Hubert; and for mercury by W. W. Janes and J. H. McCarthy, Jr.; fire-assay analyses by Charles O. Parker and Co. tr., trace; n.d., not determined. Sample localities shown in fig. 1. Multiple samples from one locality indicated by letter suffix.]

Locality and Sample Nos.	Description	Fire assay analyses: Ounces per ton		Fire assay analyses: Parts per million		Atomic absorption analyses in parts per million		Colorimetric analyses in parts per million	Spectrographic analyses in parts per million		
		Au	Ag	Au	Ag	Au	Hg	Au	As	Sb	W
600-C	Iron-rich material, yellow brown in prominent, nearly vertical breccia zone	0.12	tr.	4.1	tr.	8.0	1.0	10.0	7,000	1,500	300
600-E	Limestone, brick-red, leached; in breccia zone	n.d.	n.d.	n.d.	n.d.	3.5	.55	n.d.	3,000	1,000	150
606	Jasperoid, yellow brown; contains calcite pods and stringers	.18	.10	6.1	3.4	5	.15	7.5	700	300	100
606-A	Jasperoid, maroon	n.d.	n.d.	n.d.	n.d.	1	.20	n.d.	700	300	200
606-B	Jasperoid, brick-red	n.d.	n.d.	n.d.	n.d.	.5	.13	n.d.	< 500	200	300
608	Jasperoid, gray; weathers brownish black	n.d.	n.d.	n.d.	n.d.	1.5	.15	n.d.	500	< 100	< 50
630-A	Limestone breccia, brown; cemented with white calcite	n.d.	n.d.	n.d.	n.d.	.5	.13	1	< 500	< 100	< 50
631	Limestone, silicified; contains seams of white calcite and iron-rich material; weathers dark brown to black	n.d.	n.d.	n.d.	n.d.	.5	.17	.75	< 500	150	< 50
632	Do	n.d.	n.d.	n.d.	n.d.	.6	.12	.5	< 500	100	< 50
712	Limestone, red-brown, altered	n.d.	n.d.	n.d.	n.d.	.7	.24	n.d.	2,000	200	200
722	Limestone, red-brown, partially silicified. Float in talus	1.74	.08	59	2.7	47	.85	[illegible]	1,500	< 100	< 50
722-A	Limestone, red-brown, with some faint green stain, leached; contains white calcite stringers	1.96	.10	67	3.4	49	3	60	1,500	100	< 50
722-B	Limestone, red-brown; cut by 1.5-in. white quartz vein with dark-brown iron oxide ribbon in center	1.60	.10	54	3.4	54	1.7	60	3,000	< 100	50
722-C	Limestone, red-brown, leached; from fracture zone	3.40	.16	116	5.5	63	1.2	125	3,000	100	< 50
722-D	Like 722-A	2.98	.12	101	4.1	88	.90	150	2,000	150	50
722-E	Calcite vein, white; with some red-brown altered limestone	.04	.10	1.4	3.4	4.5	.38	5	500	< 100	< 50
722-F	Like 722-B	.02	.10	.7	3.4	2.3	1.6	1.5	3,000	< 100	< 50
722-G	Limestone, red-brown; veined with white calcite and pyrite	1.12	.14	38	4.8	78	1.8	52	3,000	< 100	< 50
722-H	Like 722-B	.29	tr.	9.9	tr.	11.5	2.7	10	5,000	< 100	50
722-I	Limestone, brown; partially silicified	.08	tr.	2.7	tr.	2.6	1	2	1,000	< 100	< 50
722-J	Breccia zone, red, calcite-cemented	.06	tr.	2.04	tr.	4.5	2.8	2.5	1,500	< 100	< 50
722-K	Calcite, white; veins in limestone	.12	tr.	4.1	tr.	1.25	.30	3	< 500	< 100	< 50
722-L	Shear zone, brick-red; 8 in. wide	3.1	.16	105.4	5.5	111	.85	160	2,000	< 100	< 50
722-M	Quartz vein, white; 2 in. wide; 3 ft. above 722-L	.34	.14	11.56	4.8	16.5	1	25	1,000	< 100	< 50
722-N	Jasperoid, gray; weathers black brown	.30	.12	10.2	4.1	11.0	.90	15	1,000	< 100	< 50
722-O	Quartz seam, gray and red; in Jasperoid	.90	tr.	30.6	tr.	31.	3.2	50	3,000	< 100	< 50
722-P	Limestone, gray, partially silicified; with coarsely crystalline white calcite patches	.04	tr.	1.36	tr.	.1	.01	.35	< 500	< 100	< 50
722-Q	Like 722-J; 3 in. wide	.05	.15	1.7	5.1	4	.08	5	< 500	< 100	< 50
722-R	Limestone, gray; weathers brown	.01	tr.	.34	tr.	.1	.02	.05	< 500	< 100	< 50
722-S	Breccia zone in limestone, calcite-cemented; 10 in. wide	.10	tr.	3.4	tr.	1.6	.07	2	< 500	< 100	< 50
724	Limestone, dark-gray, silicified	n.d.	n.d.	n.d.	n.d.	1	.60	.75	< 500	2,000	< 50
724-A	Limestone, dark-gray, partially silicified	n.d.	n.d.	n.d.	n.d.	.35	.03	.35	< 500	< 100	< 50
726	Like 724-A; float piece	n.d.	n.d.	n.d.	n.d.	.25	.14	.75	1,000	300	< 50
749	Jasperoid, gray-brown	n.d.	n.d.	n.d.	n.d.	.6	.08	.75	700	200	< 50
749-A	Jasperoid, brown	n.d.	n.d.	n.d.	n.d.	.8	.07	.75	1,000	100	< 50
750	Jasperoid, brown	n.d.	n.d.	n.d.	n.d.	.25	.06	.5	< 500	< 100	< 50
755	Jasperoid, brown, slightly vuggy; some coarse gray quartz	n.d.	n.d.	n.d.	n.d.	4	.06	3.5	500	< 100	< 50
756	Calcite, white, and iron-stained limestone; in shear zone	n.d.	n.d.	n.d.	n.d.	.1	.09	1	< 500	150	50



Enlargement of northeast part of map area.

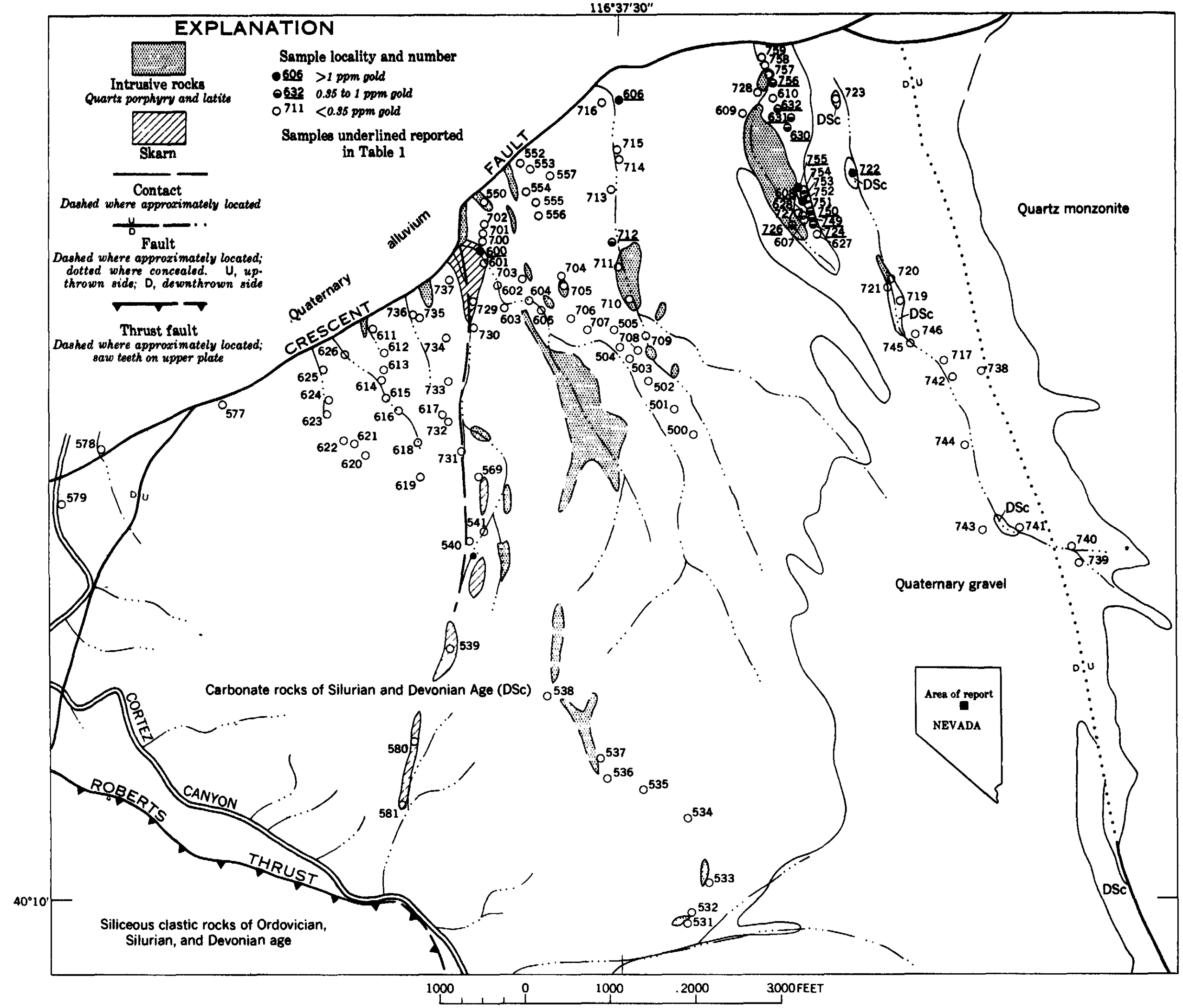


FIGURE 1.—Geochemical and geologic map of an area in the north-central part of the Cortez quadrangle, Nevada. Geology modified from Gilluly and Masursky (1965). Gold content of underlined samples shown in Table 1.

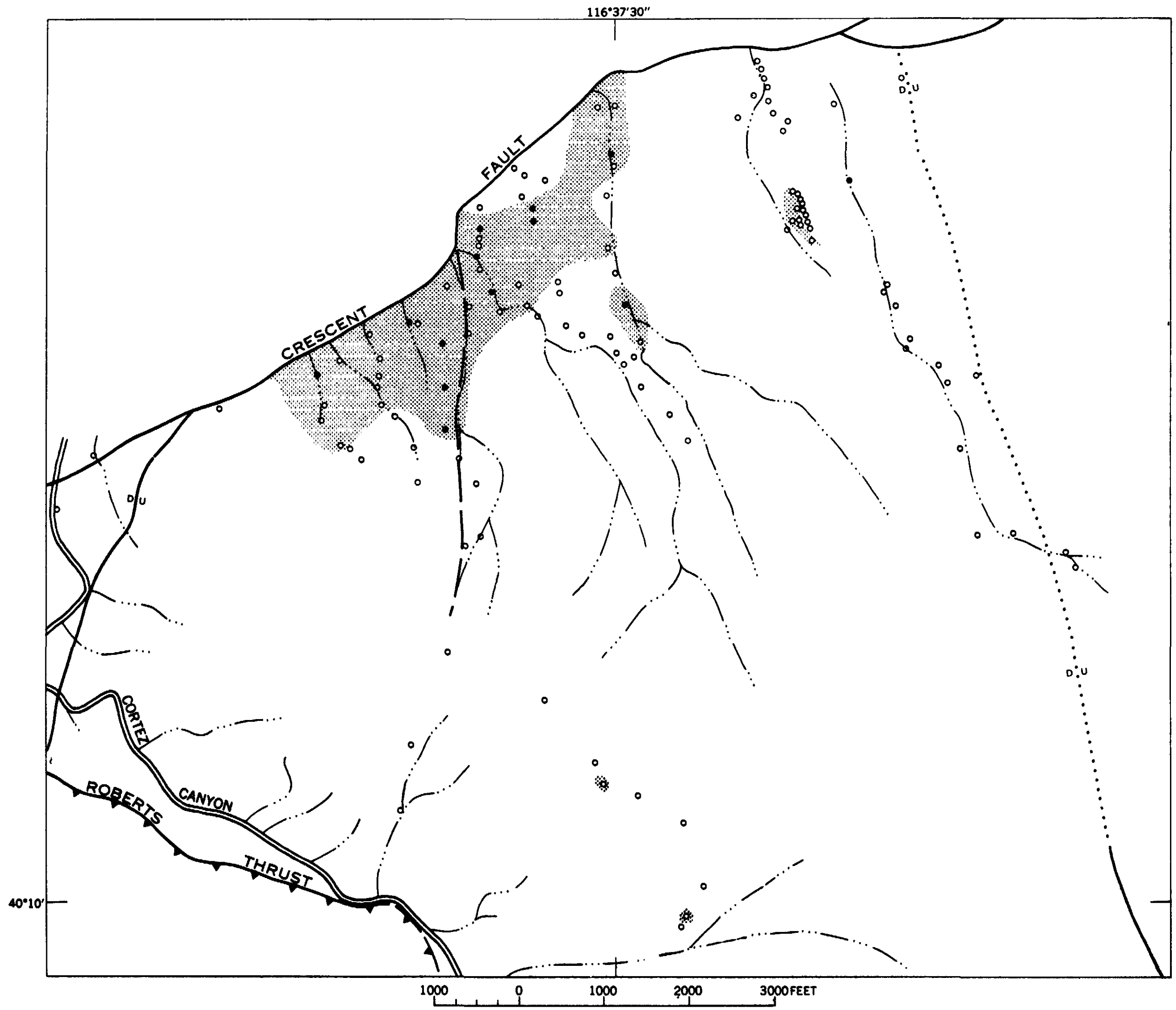


FIGURE 2.—Geochemical map showing distribution of arsenic. Samples of jasperoid, fracture fillings, and shear zones within shaded area contain at least 500 ppm. Solid circles are samples that contain at least 2,000 ppm.

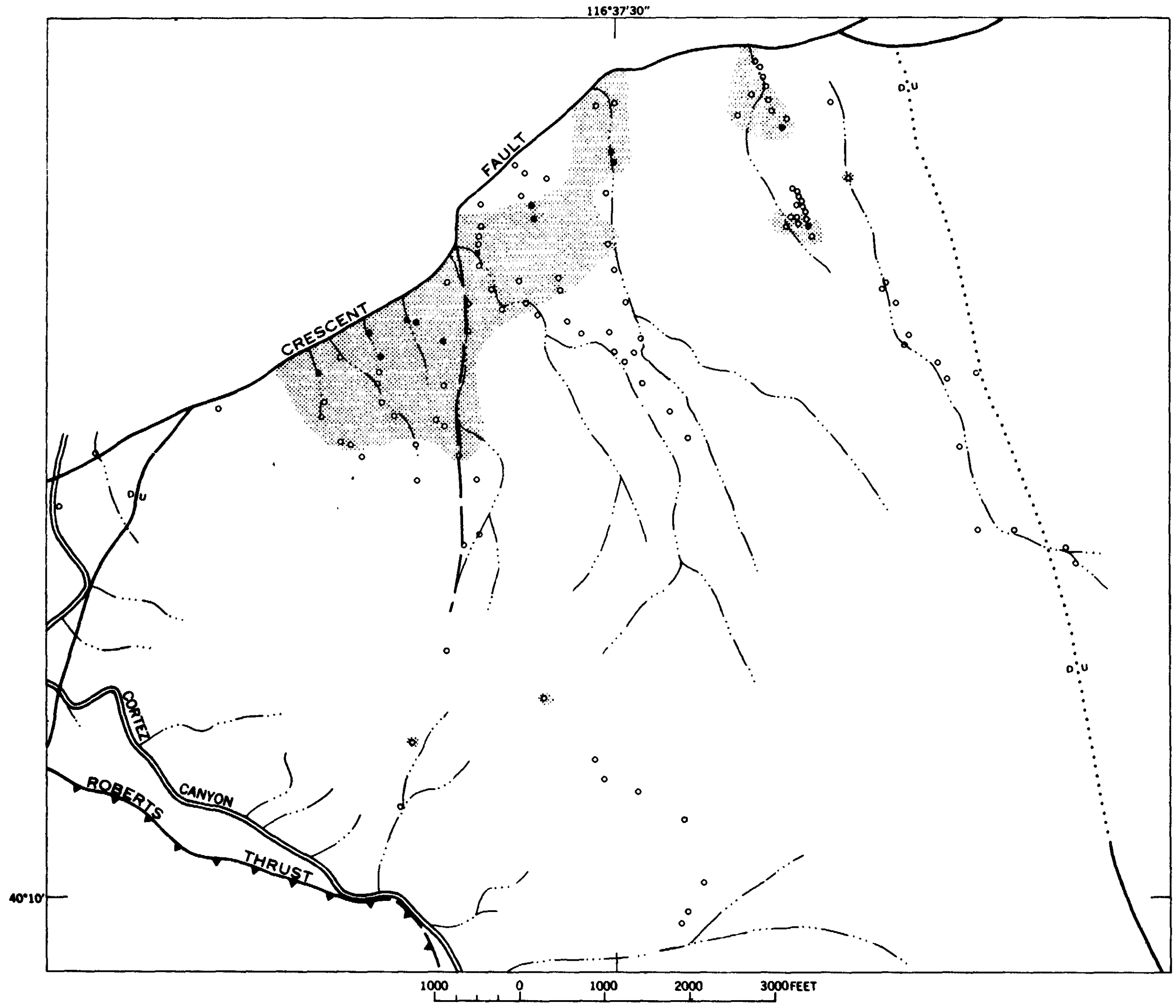


FIGURE 3.—Geochemical map showing distribution of antimony. Samples of jasperoid, fracture fillings, and shear zones within shaded area contain at least 100 ppm. Solid circles are samples that contain at least 1,000 ppm.

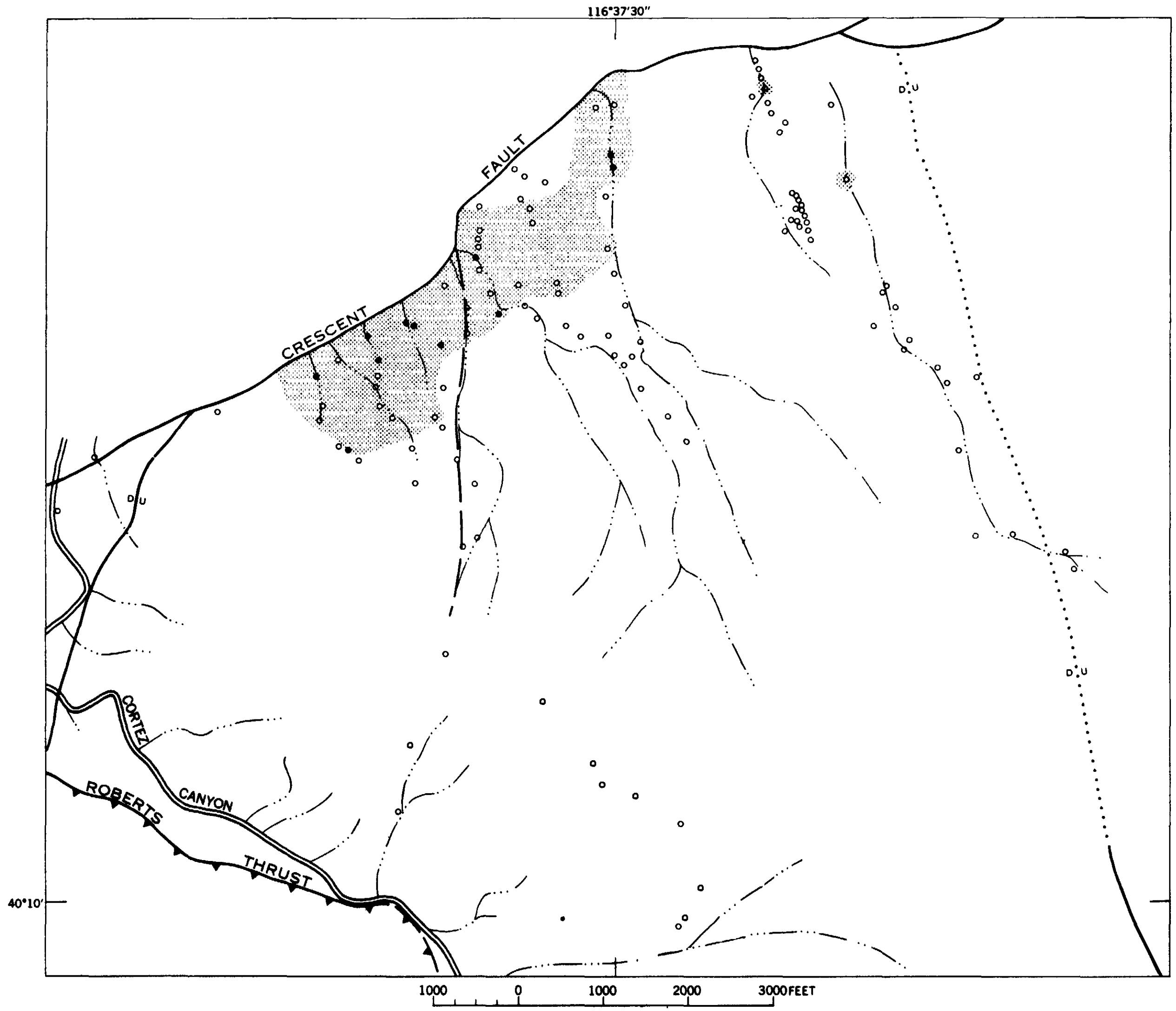


FIGURE 4.—Geochemical map showing distribution of tungsten. Samples of jasperoid, fracture fillings, and shear zones within shaded area contain at least 50 ppm. Solid circles are samples that contain at least 500 ppm.

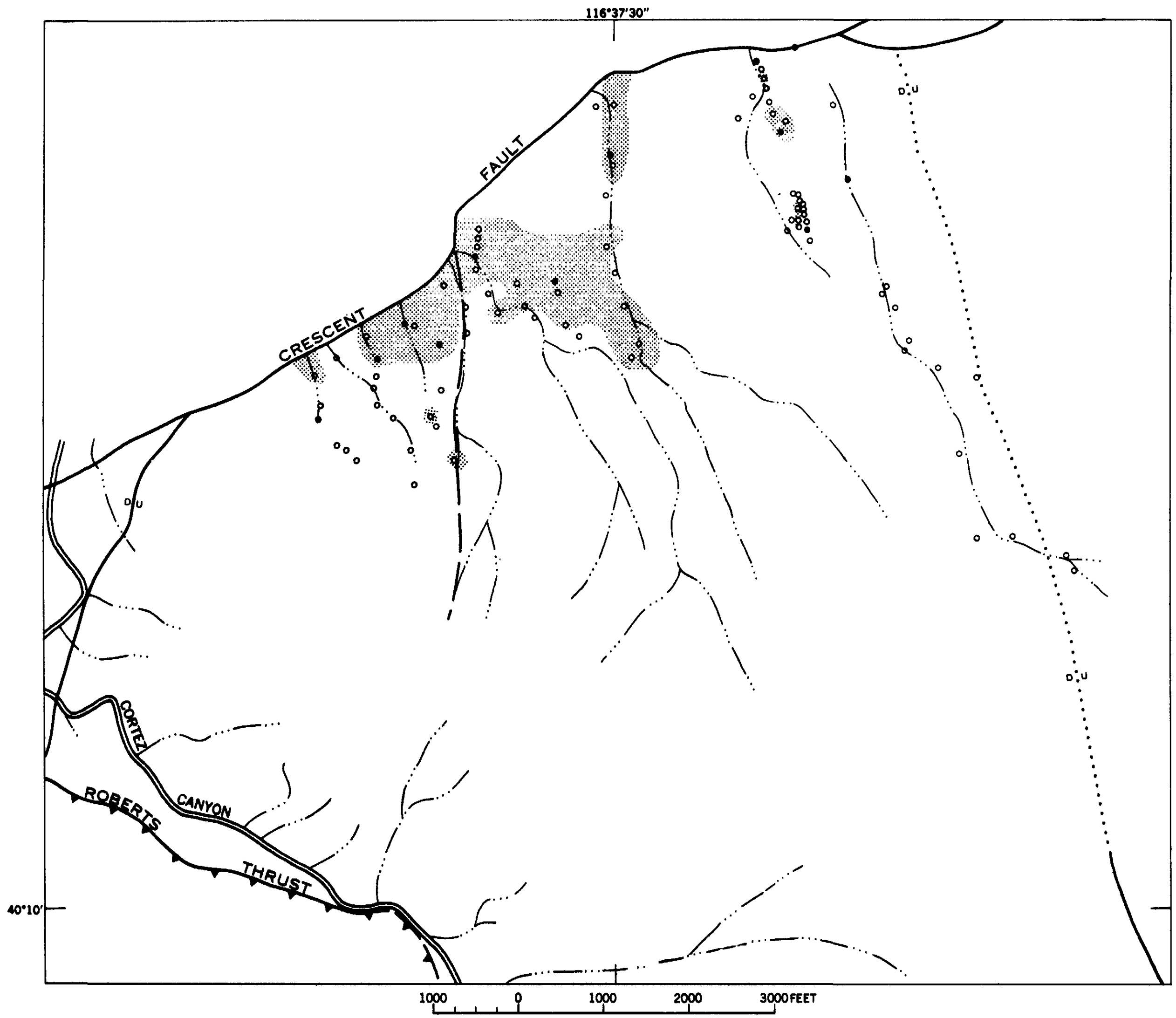


FIGURE 5.—Geochemical map showing distribution of mercury. Samples of jasperoid, fracture fillings, and shear zones within shaded area contain at least 0.1 ppm. Solid circles are samples that contain at least 0.5 ppm.

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