

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

**Mineral investigation of the Pigeon Canyon, Snap Point, Nevershine
Mesa, and Last Chance Wilderness Study Areas (BLM),
Mohave County, Arizona**

U.S. Bureau of Mines Mineral Land Assessment
MLA 8-84
1984

By
Lane, M.E.

This open file report summarizes the results of a Bureau of Mines wilderness study and will be incorporated in a joint report with the U.S. Geological Survey. The report is preliminary and has not been edited or reviewed for conformity with the U.S. Bureau of Mines editorial standards. Work on this study was conducted by personnel from Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, CO 80225.

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MINERAL INVESTIGATION OF THE PIGEON CANYON, SNAP POINT, NEVERSHINE MESA,
AND LAST CHANCE WILDERNESS STUDY AREAS (BLM), MOHAVE COUNTY, ARIZONA

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STUDIES RELATED TO WILDERNESS
Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Pigeon Canyon (AZ-010-109), Snap Point (AZ-010-105B), Nevershine Mesa (AZ-010-105A), and Last Chance (AZ-101-111) Wilderness Study Areas (BLM), Mohave County, Arizona.

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MINERAL INVESTIGATION OF THE PIGEON CANYON, NEVERSHINE MESA, SNAP POINT, AND
LAST CHANCE WILDERNESS STUDY AREAS (BLM), MOHAVE COUNTY, ARIZONA

By Michael E. Lane, Bureau of Mines

SUMMARY

Analytical data from samples taken at breccia pipes indicate copper resources exist and uranium resources may exist within 1/4 mi of the Wilderness Study Areas. It is possible more pipes exist inside the Wilderness Study Areas and that these additional pipes may also be mineralized.

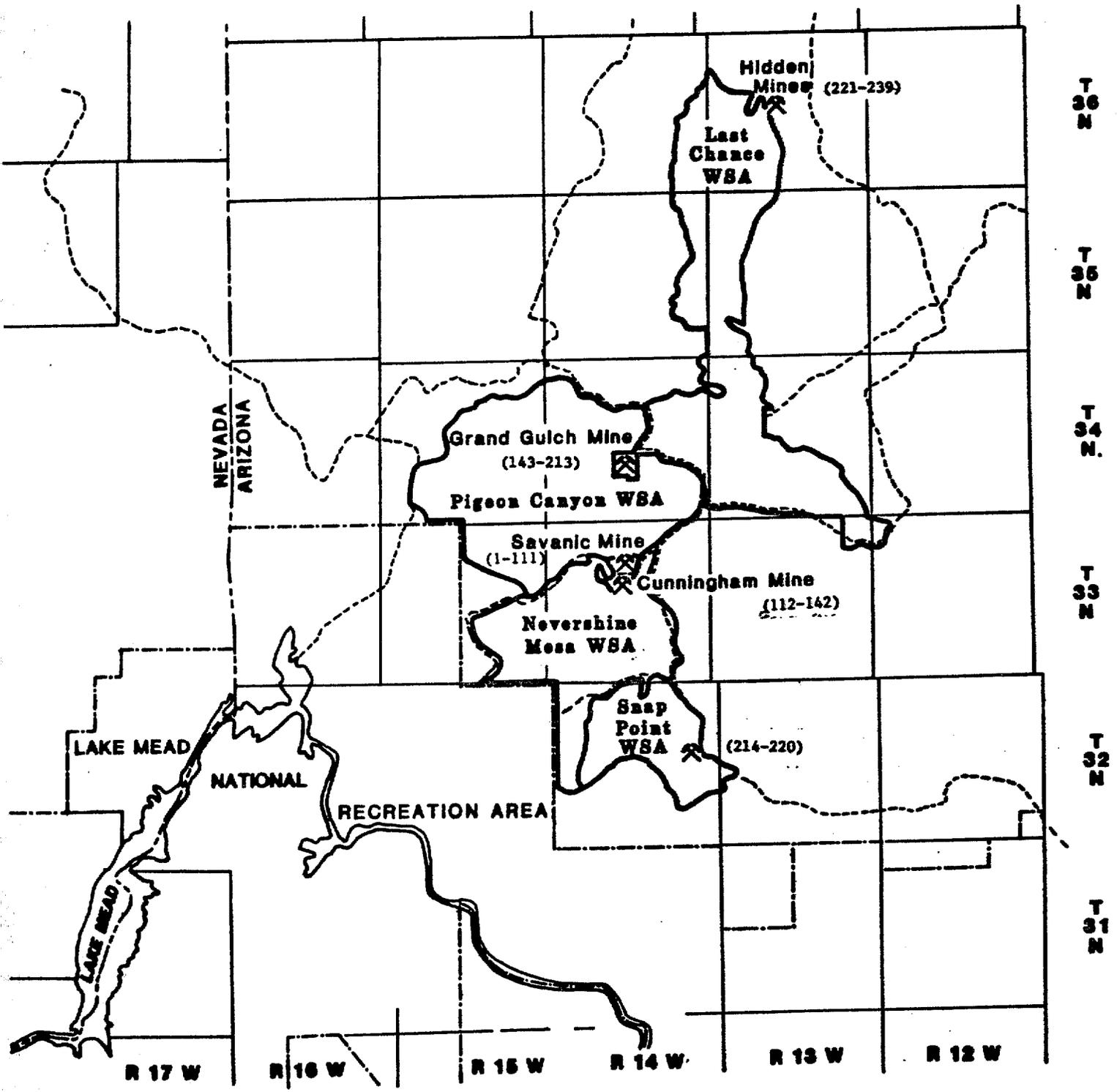
INTRODUCTION

From 1981 to 1983, the Bureau of Mines conducted a field investigation of the Pigeon Canyon, Nevershine Mesa, Snap Point, and Last Chance Wilderness Study Areas (WSA's). This study was part of a joint effort with the Geological Survey to complete a mineral survey of the WSA's.

Location, size, and geographic setting

The WSA's consist of 96,288 acres of BLM land in northwestern Mohave County, Arizona, in extreme northwest Arizona in a region known as the Arizona Strip. Acreages for the WSA's are: Pigeon Canyon, 33,348 acres; Nevershine Mesa, 19,457 acres; Snap Point, 9,500 acres; and Last Chance, 33,983 acres. Figure 1 shows the locations of the WSA's.

The WSA's lie along the Grand Wash Cliffs which consist of upper and lower cliffs separated by a broad bench. Last Chance and Snap Point WSA's mostly encompass the upper cliffs and bench while Pigeon Canyon and Nevershine Mesa WSA's are on the bench and the lower cliffs. The lower cliffs are composed of ledges of Callville Limestone (Pennsylvanian) underlain by Redwall Limestone (Mississippian). The upper cliffs are steep to gentle slopes of Supai Formation (Pennsylvanian) and overlying Hermit Shale (Permian) and ledges of Coconino Sandstone (Permian) and Toroweap Limestone (Permian). The bench is dissected by deep canyons.



EXPLANATION

-  Mine
-  Dirt road
-  Approximate WSA boundary
-  Recreation area boundary

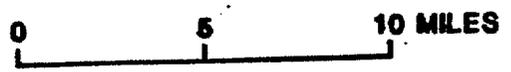


Figure 1.--Index map of the Pigeon Canyon, Nevershine Mesa, Snap Point, and Last Chance Wilderness Study Areas, Mohave County, Arizona.

Total relief in the WSA's is about 4,700 ft. The highest elevation is 6,748 ft in Last Chance WSA. The lowest elevation is about 2,000 ft at the western edge of Pigeon Canyon WSA.

Access to the WSA's is: about 85 mi south of St. George, Utah, on a dirt road through Wolf Hole to the head of either Pigeon Canyon or Hidden Canyon and then through upper Grand Wash Cliffs; or, south on I-15 from St. George about 45 mi to Riverside, Nevada, then east across Whitney Pass and Grand Wash.

Method of investigation

The Bureau of Mines conducted a search of courthouse and BLM records for information on mining claim locations and oil and gas leases. A literature search also was conducted to obtain information on mineral occurrences and mining activity in and near the WSA's. Field investigation included examination of mineralized areas, known mines, and prospects in and near the four WSA's. Mine workings were surveyed by compass-and-tape method, mapped, and sampled.

During the field investigation 239 samples were taken from mine workings. Samples were analyzed for gold and silver by fire assay and for uranium by fluorometric methods. In addition, some samples were analyzed for certain elements by atomic absorption and for 42 elements by semiquantitative spectrographic methods. Complete analyses are available for public inspection at the Bureau of Mines, Intermountain Field Operations Center, Denver Federal Center, Denver, Colorado 80225.

Acknowledgements

The Bureau of Mines appreciates information provided by 5M Mining Corporation, Hurricane, Utah, concerning the Savanic and Grand Gulch Mines and information on breccia pipes provided by Energy Fuels Exploration Company, Denver, Colorado.

Mining activity

Since 1893, copper and associated silver and lead have been mined intermittently in the vicinity of the WSA's. Mining has occurred at five localities. All, except two short adits and a trench in upper Snap Canyon (fig. 1) within the Snap Point WSA, are outside the WSA's. The Grand Gulch, Savanic, Cunningham, and Hidden Mines (fig. 1) are within 1/4 mi of the WSA's.

As of April 1983, there was no mining activity in the WSA's. However, exploration companies have shown considerable interest in uranium in several areas. Energy Fuels Exploration Company is planning to drill near the Hidden Mines just outside the Last Chance WSA. 5M Mining Corporation and Uranex are jointly planning to drill near the Savanic and Cunningham Mines near the Nevershine Mesa WSA. Both drilling projects will be for investigating possible uranium occurrences.

Several companies have located large groups of claims in and near the WSA's. Also, there are many oil and gas leases in and near the areas (pl. 1). There are no patented claims in the WSA's; however, one patented claim exists just outside the Pigeon Canyon WSA at the Grand Gulch Mine.

MINING DISTRICTS AND MINERALIZED AREAS

The WSA's are in the Bentley mining district. Mining in and near the WSA's has been limited to five mineralized areas; all but one are outside the WSA's. The four mineralized areas outside the WSA's consist of breccia pipes which have been mined for copper.

Information on mineral deposits is shown in table 1. Tables 2-6 show analytical data and sample information. Mine maps and sample localities are found in figures 2A-6D.

The mines and corresponding breccia pipes differ in size, geology, and ore minerals. Many breccia pipes throughout the Arizona Strip are known to contain uranium and copper minerals. These breccia pipes are thought to be collapse features from the dissolution of the underlying Redwall Limestone and possibly Callville and Pakoon Limestones. The collapse feature can extend into the overlying Supai Formation and Hermit Shale. The breccia pipes in the area are composed of rock fragments from overlying formations and are usually well-cemented with fine-grained sand matrix which may be siliceous or slightly calcareous. Fragments vary in size from less than an inch to room-size blocks. Because of the size of the larger blocks, it is sometimes difficult to distinguish the limits of a breccia pipe. Low temperature hypogene solutions possibly produced pyrite, chalcocite, and uraninite. Medium- to high-grade deposits were formed by supergene enrichment (Bowles, 1977).

Breccia pipes have played an important role as host for mineral deposits. Breccia pipes are important at the Orphan and Grand Gulch Mines. The Orphan Mine, on the south rim of the Grand Canyon about 1 mi northwest of Grand Canyon Village, was once Arizona's largest producer of uranium. The Orphan Mine is about 90 mi east of the Grand Gulch Mine. From 1901 to 1951, the Grand Gulch Mine produced 15,701 tons of ore containing 24,349 ounces silver and 6,651,610 pounds copper (Bureau of Mines records).

Savanic Mine

The Savanic Mine, also known as the Bronze L Mine, is in the SW1/4 sec. 9, T. 33 N., R. 14 W., about 400 ft below the rim of an unnamed side canyon of Pigeon Canyon and within 1/4 mi of the Pigeon Canyon WSA (fig. 1).

The mine has two main levels connected to the surface by both an inclined and a vertical shaft. In addition, several pits and a short adit (fig. 2A) are at the surface near the collars. The main mine (figs. 2B-2C) consists of extensive drifts, raises and stopes. Mining began before 1906 but it is not known when the deposit was discovered. Production figures for the mine were not reported.

The breccia pipe at the Savanic Mine is well defined in several locales. Within the pipe are large blocks of calcareous sandstone and/or dolomite in addition to more brecciated areas. Copper mineralization is very spotty and occurs as disseminated staining, fillings in solution cavities, and fracture fillings resembling an ore-mineral matrix of the breccia. Hematite is frequently associated with the copper minerals, especially in larger cavities wholly or partially filled by these minerals. Ore minerals are mostly bornite, chalcocite, malachite, and azurite.

The Savanic Mine has the highest degree copper mineralization of any of the breccia pipes investigated near the WSA's; however, much of the high-grade ore at the Grand Gulch Mine may have been mined. Of samples taken at the Savanic Mine (table 2) the highest copper value was 18 percent (sample 36) and highest uranium content was 19 parts per million (ppm) (sample 10). There is no known extension of the Savanic Mine breccia pipe in the adjacent WSA.

The irregular incidence of mineralization precludes calculation of reserves; although a number of the samples collected in the Savanic Mine are of potential ore grade. Thus, the Savanic Mine breccia pipe may contain copper resources.

Cunningham Mine

The Cunningham Mine, NW1/4 sec. 16, T. 33 N., R. 14 W., exposes a breccia pipe of unknown dimensions a few hundred feet north of Nevershine Mesa WSA. The mine is about 1 mi south of the Savanic Mine.

Figure 3A shows locations of surface workings and sample localities. There are two adits (fig. 3A) in which brecciation or deformation is exposed. The remainder of the workings are pits or trenches which do not reveal any definite structural boundaries. One adit (fig. 3B) shows a distinct brecciated zone in dolomite and sandstone country rock; however, this zone was not found in the adjacent adit (fig. 3C). There has been no reported production from the Cunningham Mine.

The pipe is in Callville Limestone and is composed of alternating dolomite and sandstone and highly deformed sandstone. Copper mineralization occurs as malachite crusts and specks. The extent of the breccia pipe is not known; it could not be traced into the Nevershine Mesa WSA.

Of 31 samples taken at the Cunningham Mine (table 3), ten contained copper in excess of 1 percent, the highest value being 4.2 percent. The highest uranium content was 48 ppm. Barite was found as small white pods in one adit and several pits. The highest barium content was 6.1 percent.

Grand Gulch Mine

The Grand Gulch Mine is about 1/4 mi from the Pigeon Canyon and Last Chance WSA's in the SE1/4 sec. 21, and SW1/4 sec. 22, T. 34 N., R. 14 W. (fig. 1). The mine is between the Pigeon Canyon and Last Chance WSA's and has been excluded from but is encompassed by the WSA's.

During this investigation the lower levels of the mine were not accessible. Figures 4B-G show the accessible levels of the mine that were mapped and sampled.

The mine is in a breccia pipe with abundant copper mineralization. The pipe is more or less pear-shaped and is estimated to be several hundred feet across and deep, but does not extend into the WSA. Mineralization occurs mostly along the pipe periphery. It is reported by Hill (1915) that the ore bodies are lens-like or form irregular pods and are composed of malachite, azurite, brochantite, and chalcocite. Baillieul and Zollinger (1980) state that the degree of brecciation decreases and finally dies out at about 230 ft below the surface.

It appears that most of the known high-grade ore has been mined. Exposed ore minerals are usually malachite and lesser amounts of azurite. Much of the mine is inaccessible so it is not known if this holds true for the entire mine. A few of the samples collected represent potential ore-grade material. These sampled sites are so erratically distributed that calculation of reserves is not practical. However, the breccia pipe at the Grand Gulch Mine may contain copper resources.

Of samples taken at the Grand Gulch Mine (table 4), the highest copper content was 12.2 percent (sample 169), the highest silver content was 2.4 ounces (sample 147) and the highest U_3O_8 content was 13 ppm (sample 197).

Prospects in Snap Canyon

A trench and 2 short adits in upper Snap Canyon in the NW1/4 sec. 13, T. 32 N., R. 14 W., were the only workings found within the WSA's. No visible mineralized areas were present (table 5). The trench was completely in alluvium and the adits were in alluvium at the portals and ended in what appeared to be fractured and altered Supai Formation. One adit ended in saprolite and may have been developed to collect spring water (figs. 5A and B).

Hidden Mines

The Hidden Mines are composed of 3 adits and 3 pits in the SW1/4 sec. 16, T. 36 N., R. 13 W., about 1/4 mi northeast of the Last Chance WSA. The workings, mostly in sandstone, expose a breccia pipe in a sandstone unit of the Supai Formation(?). The breccia pipe could not be traced into the WSA.

The breccia pipe is exposed in the lower adit (fig. 6B). Several readings above background radioactivity were detected using a scintillometer. These readings were possibly due to the presence of uranium in sheared or fractured sandstone. Copper mineralization in the form of malachite and azurite was found in some places as pods, crusts, or disseminated specks.

The face of the lowest adit consisted of cobble conglomerate (fig. 6B). This conglomerate, also found at the upper adit (fig. 6D), contains rounded cobbles up to 6 in. in diameter.

Of samples taken at the Hidden Mines, the highest U_3O_8 content was 37 ppm (samples 225 and 229) and the highest copper content was 4.5 percent (sample 235) (table 6).

There has been no production reported from this area.

Oil and gas

Oil and gas leases are within and near the WSA's, but there has been no drilling in the WSA's (Dan Sokal, BLM, oral commun., 1983).

CONCLUSIONS

The analytical data of the 239 samples taken indicate copper resources may exist at some of the breccia pipes investigated. Minor amounts of uranium indicate these pipes may also contain uranium resources. Barium was present at the Cunningham Mine but not in large quantities.

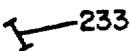
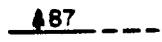
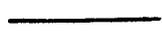
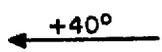
The breccia pipes at the mines are outside the WSA's. However, there is a possibility that additional breccia pipes, similar to those investigated,

may exist within the WSA's. There are over 100 breccia pipes in the Grand Canyon region which exist in the rock units present in the WSA's (Foord and others, no date). Many of these pipes have produced large amounts of copper and/or uranium ore.

REFERENCES

- Baillieul, T. A., and Zollinger, R. C., 1980, National uranium resource evaluation, Grand Canyon Quadrangle, Arizona: U.S. Department of Energy Open File Report PGI-20, 43 p.
- Bowles, C. G., 1977, Economic implications of a new hypothesis of origin of uranium- and copper-bearing breccia pipes, Grand Canyon, Arizona: U.S. Geological Survey Circular 753, p. 25-27.
- Foord, E. E., McKee, E. D., and Bowles, C. G., [no date], Status of mineral resource information for the Shivwits Plateau, Parashant, Andrus, and Whitmore Canyons and Kanab Canyon areas, Grand Canyon, Arizona: U.S. Geological Survey, unpublished report, 30 p.
- Hill, J. M., 1915, The Grand Gulch mining region, Mohave County, Arizona, in Contributions to economic geology, 1913: U.S. Geological Survey Bulletin 580, pp. 39-58.

EXPLANATION OF SYMBOLS FOR FIGURES 2A-6D

	223	VERTICAL CHIP SAMPLE LOCALITY--Showing sample number
	233	HORIZONTAL CHIP SAMPLE LOCALITY--Showing sample number
	110	DUMP SAMPLE LOCALITY--Showing sample number
	87	FAULT--Showing strike and dip; dashed where approximate
		VERTICAL FAULT--Dashed where approximate
	46	STRIKE AND DIP OF BEDS
		CONTACT
	+40°	DIRECTION AND ANGLE OF STOPE--Going up from sill level
		PILLAR
		RAISE--Extending through level
		WINZE
		RAISE--Up only
		ORE CHUTE
		
		MANWAY
		SURFACE OPENINGS--Showing sample locality number
	107	Prospect pit
	138	Trench
	221-232	Adit
	238, 239	Shaft
		INCLINED SHAFT
		SHAFT
		PORTAL OF ADIT--With open cut
		COUNTRY ROCK
		Breccia
		Sandstone
		Dolomite
		Alluvium

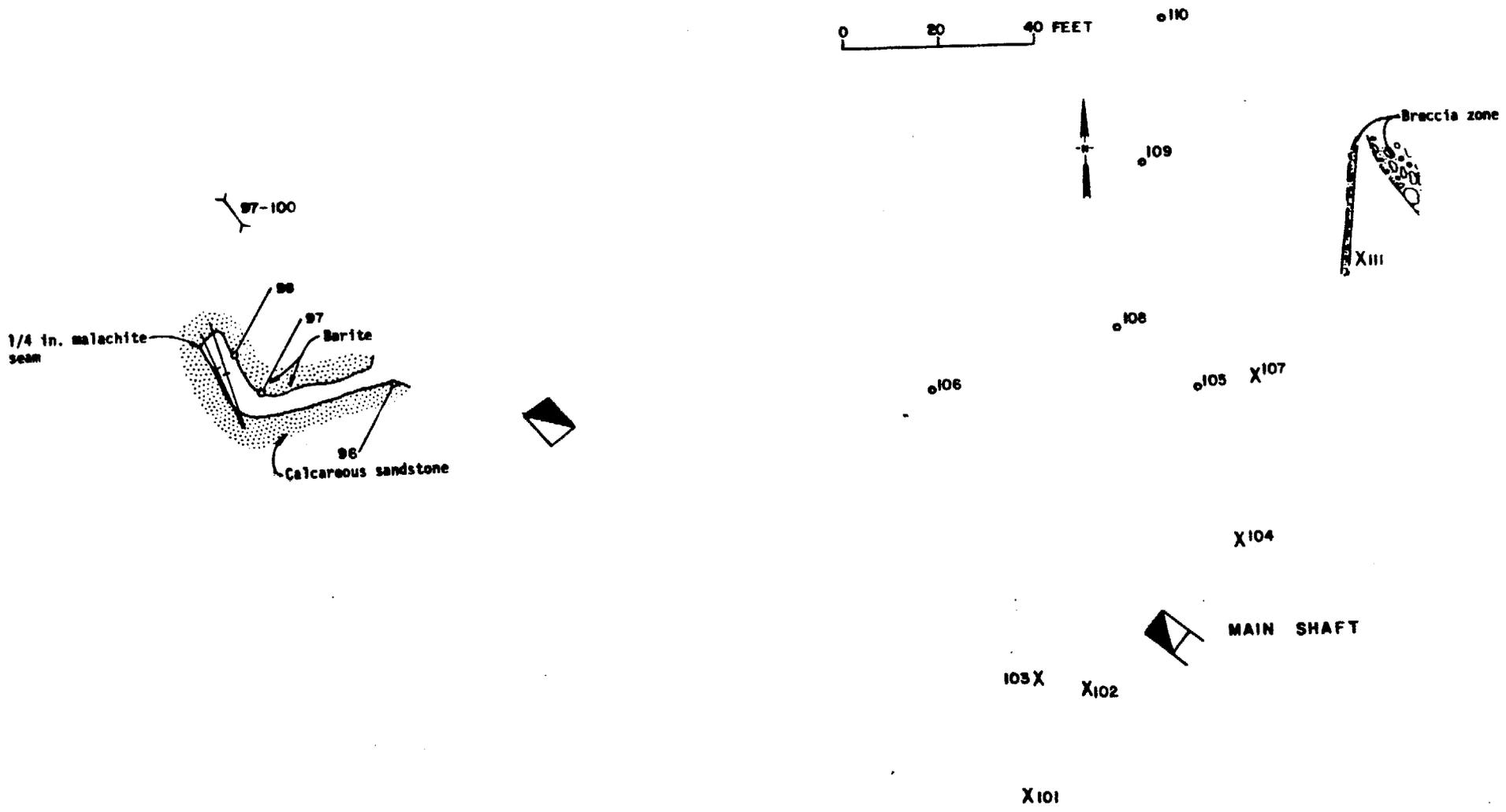


Figure 2A.--Map showing surface workings and adit at Savanic Mine and sample localities 96-111.

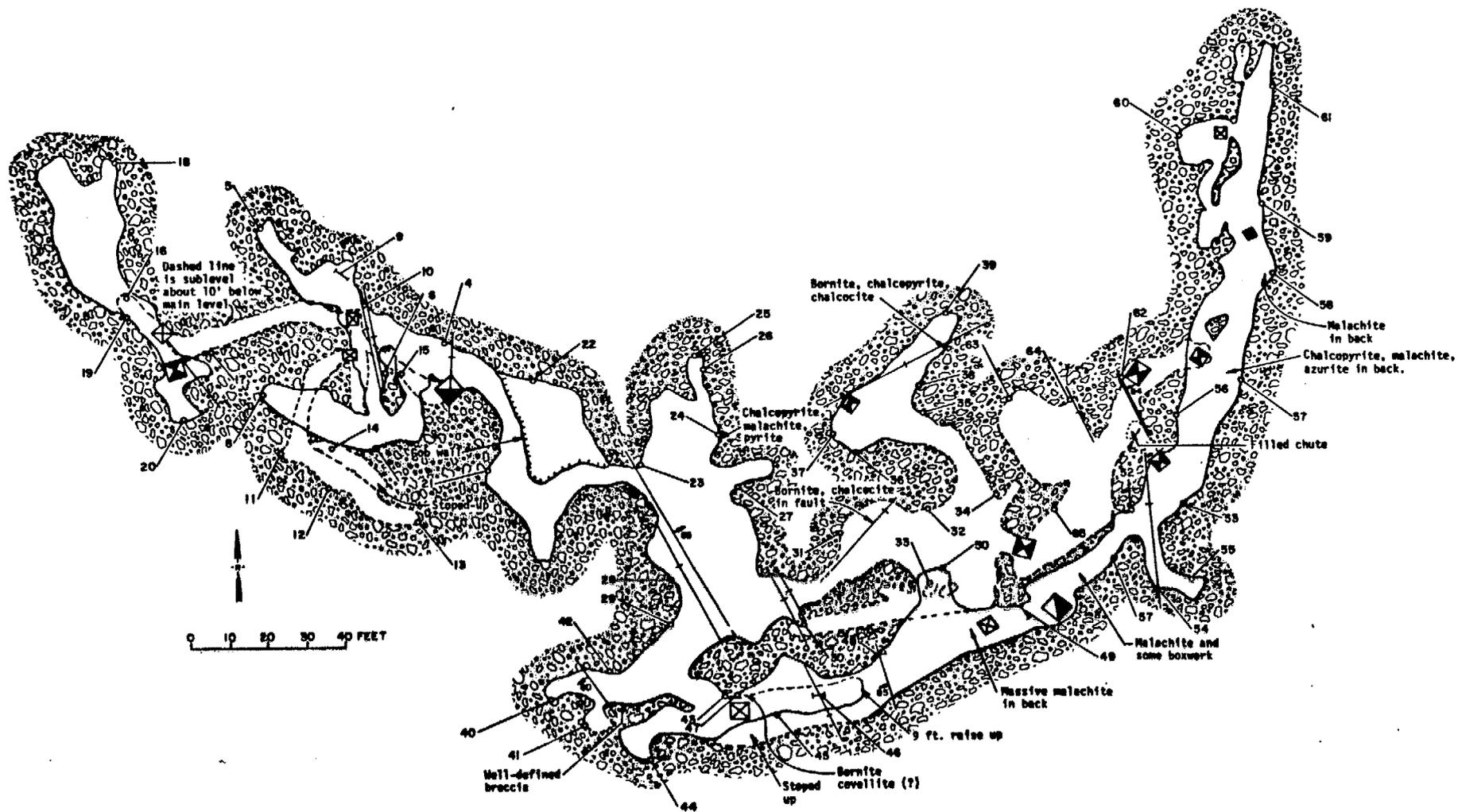


Figure 2B.--Map of 50-ft level of the Savanic Mine and sample localities 4-65.

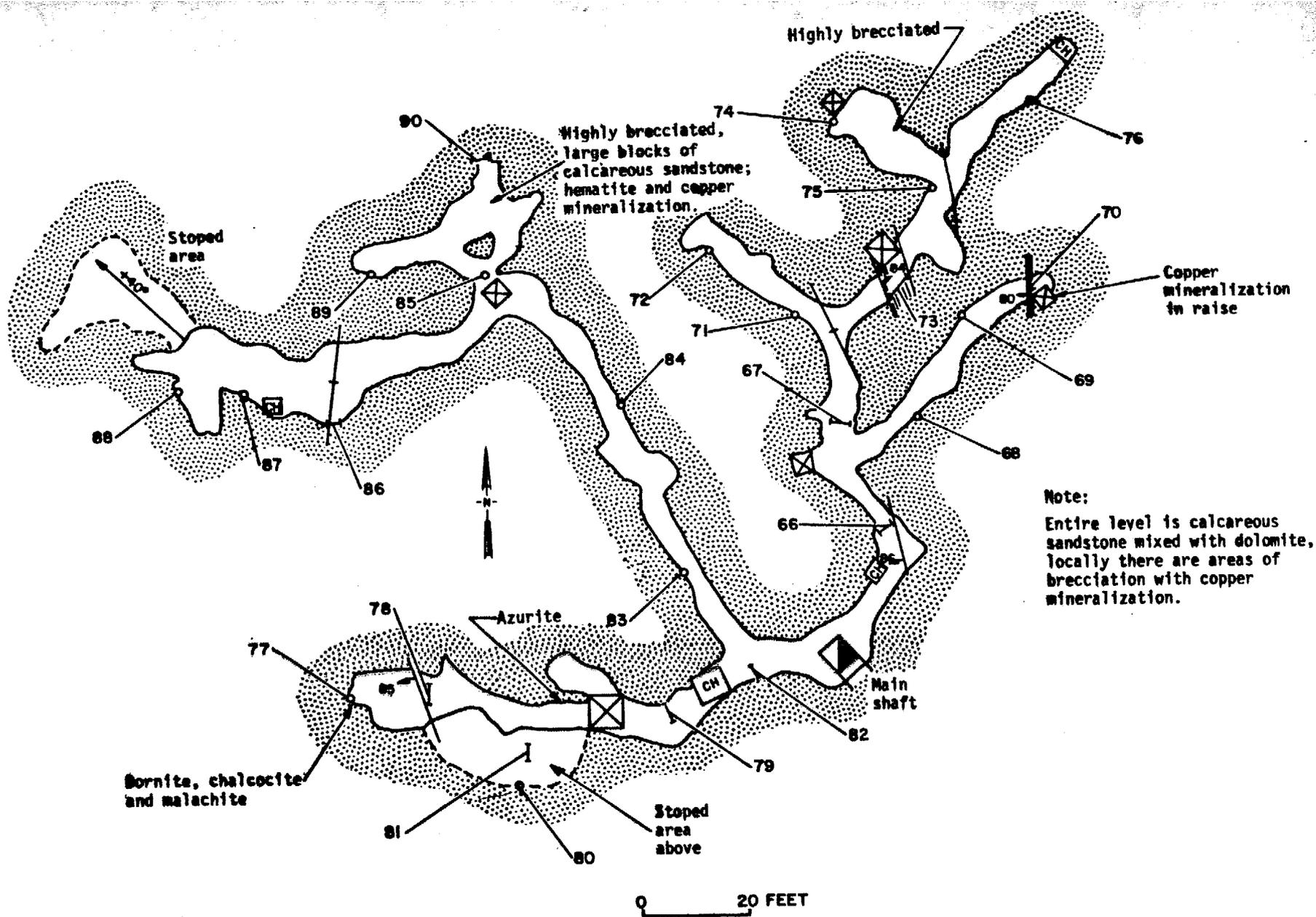


Figure 2C.--Map showing the lower level of the Savanic Mine and sample localities 66-90.

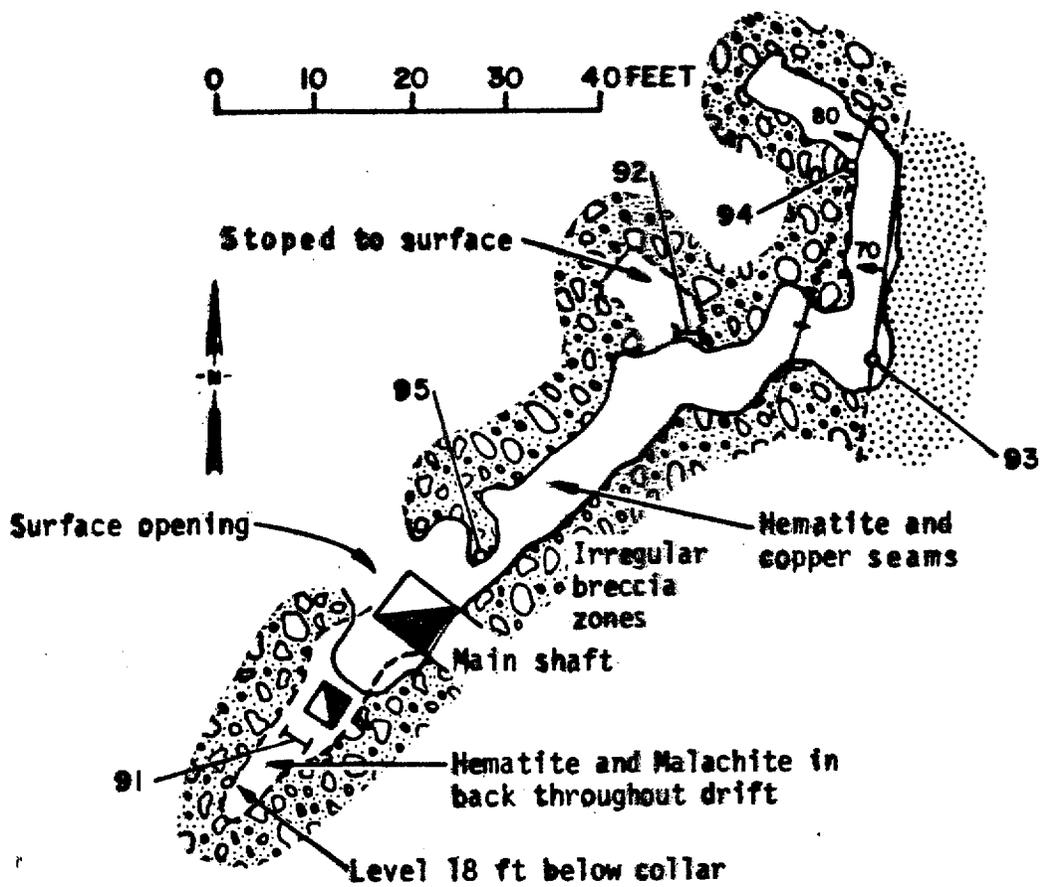


Figure 2D.--Map showing the collar level and the level 18-ft level at the Savanic Mine and sample localities 91-95.

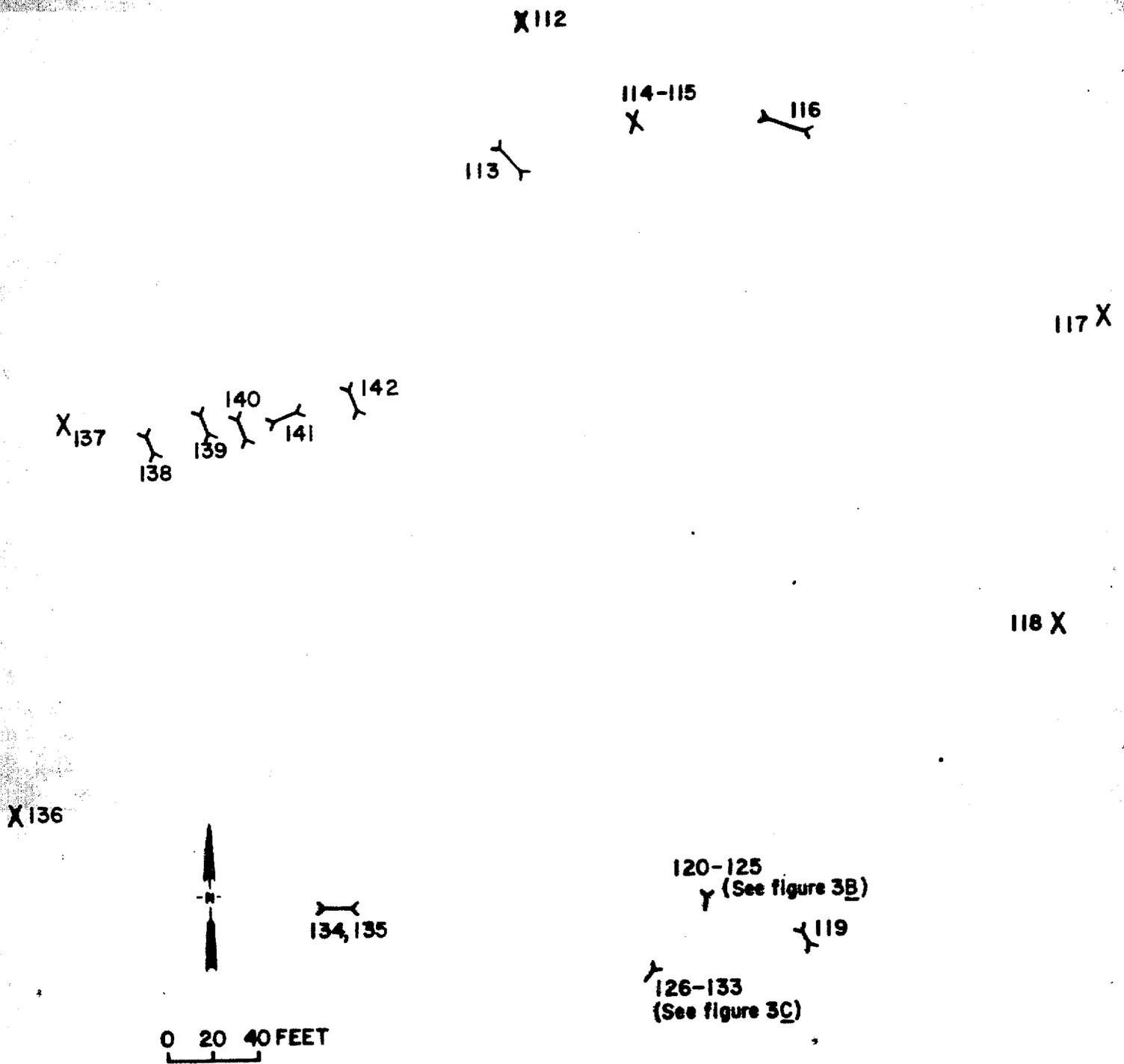


Figure 3A.--Map showing workings at the Cunningham Mine and sample localities 112-142.

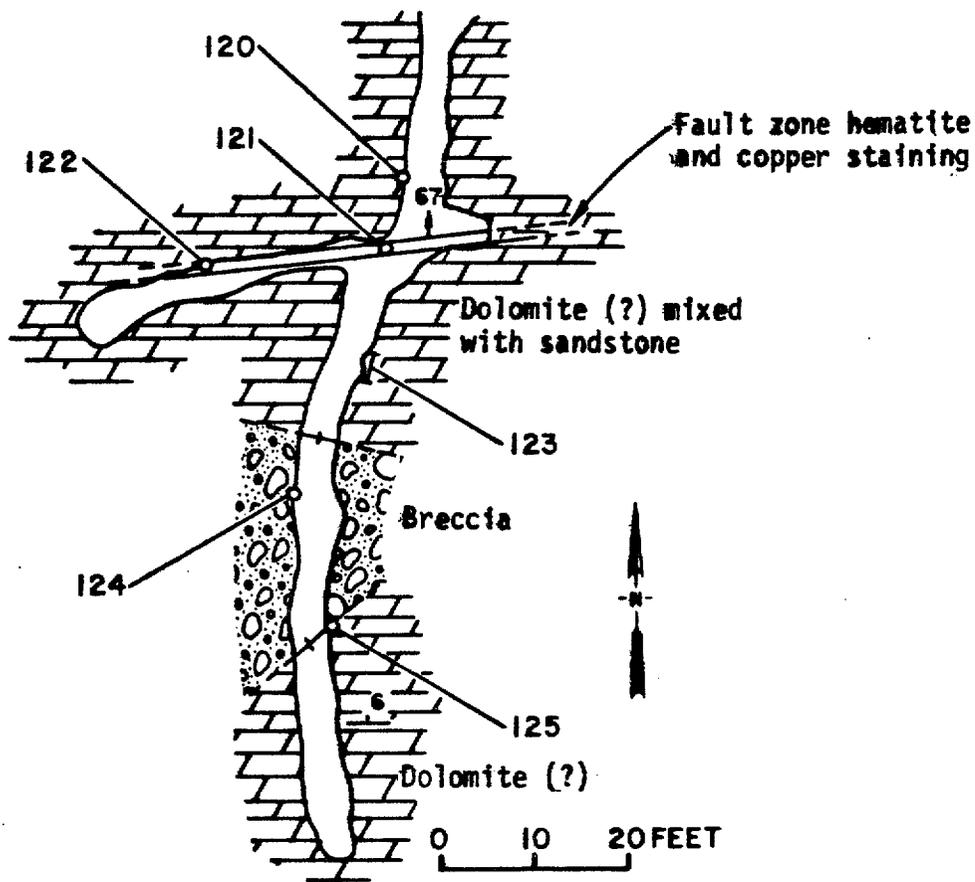


Figure 3B.--Map showing an adit at the Cunningham Mine and sample localities 120-125.

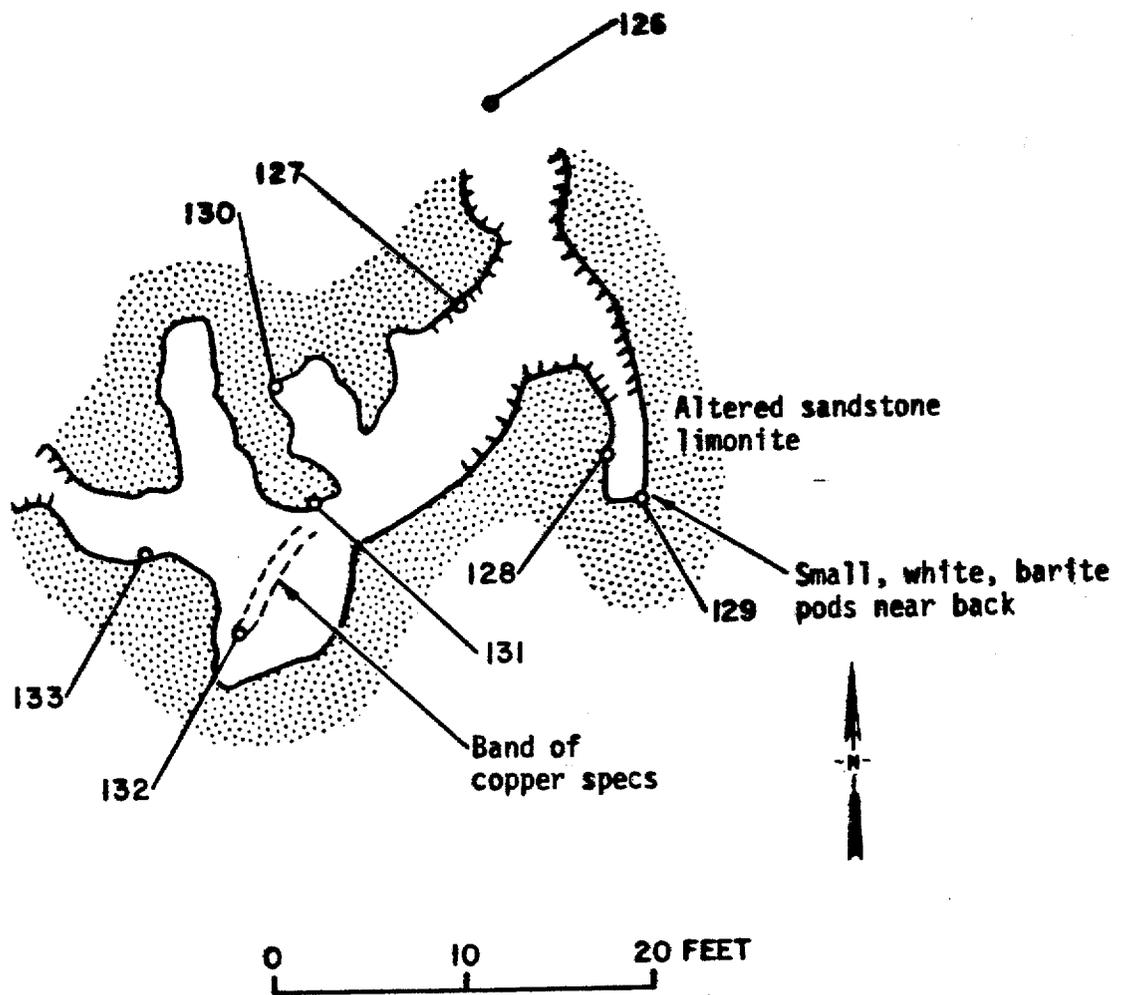
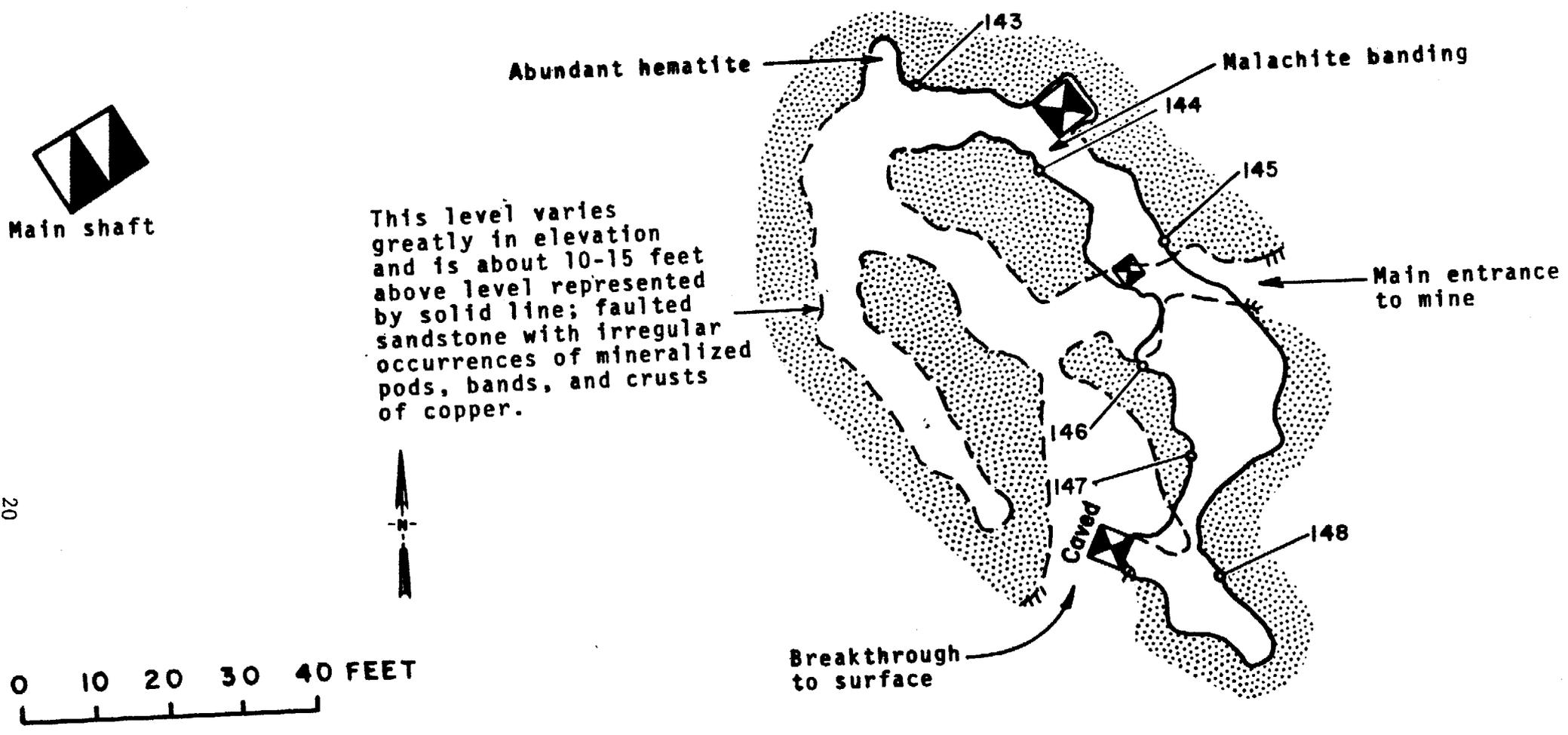


Figure 3C.--Map showing an adit at the Cunningham Mine and sample localities 126-133.



This level varies greatly in elevation and is about 10-15 feet above level represented by solid line; faulted sandstone with irregular occurrences of mineralized pods, bands, and crusts of copper.

Figure 4A.--Map showing the 65-ft level of Grand Gulch Mine and sample localities 143-148.



Main
Shaft

Entire level is
massive blocks
of sandstone
breccia

0 10 20 30 40 FEET

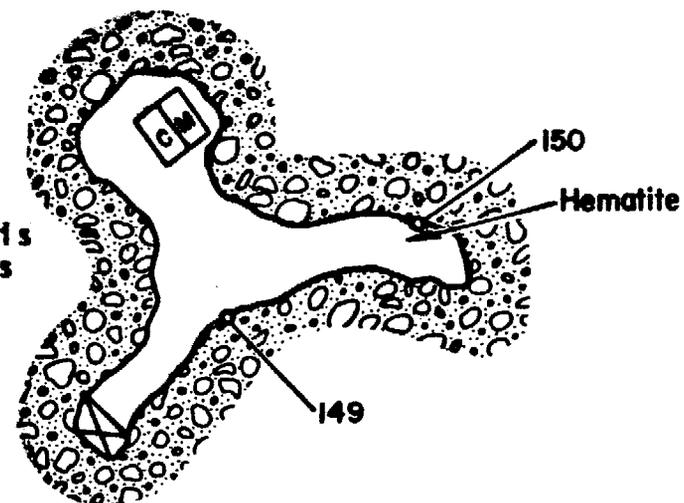


Figure 4B.--Map showing the 103-ft level of the Grand Gulch Mine and sample localities 149-150.

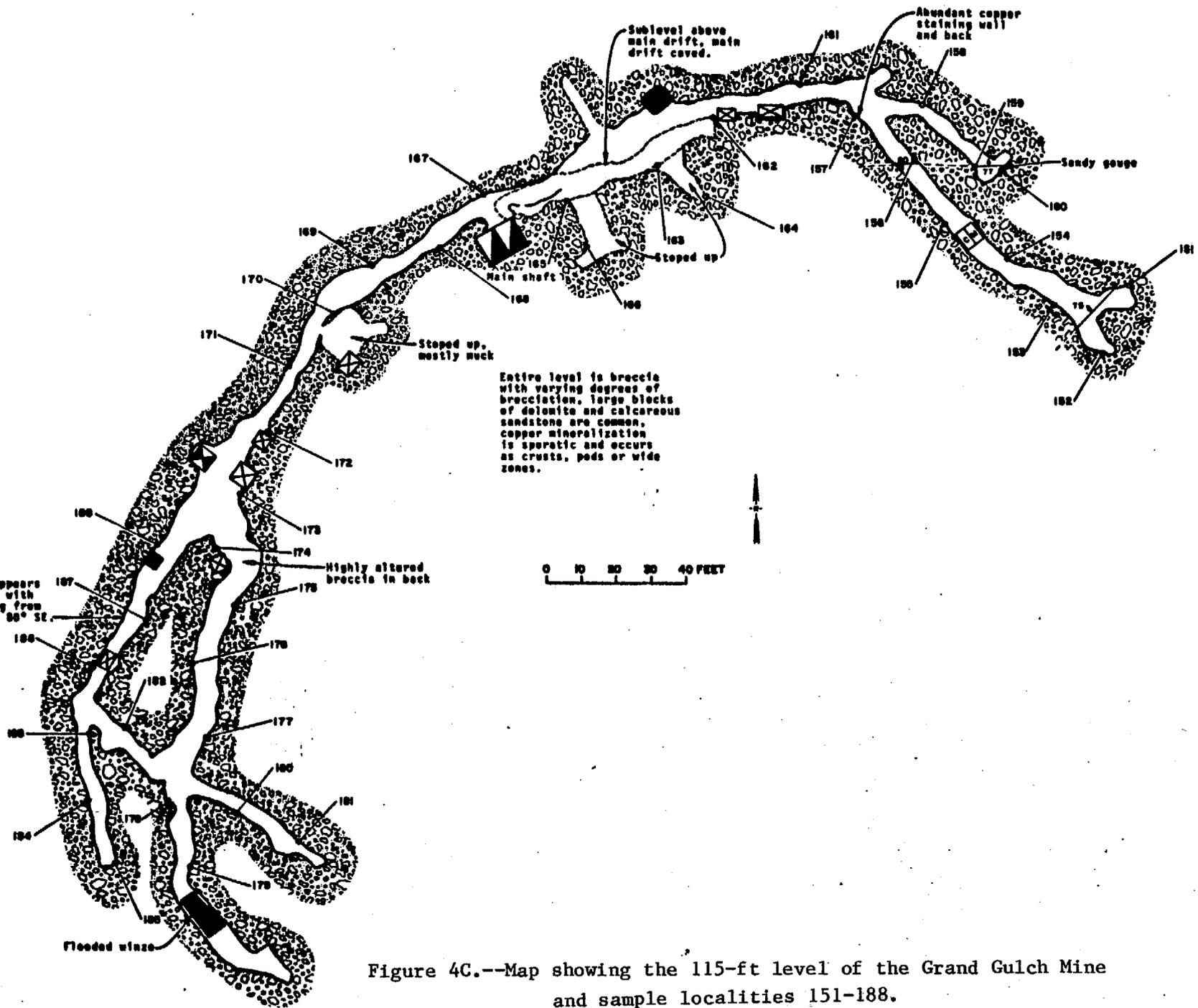


Figure 4C.--Map showing the 115-ft level of the Grand Gulch Mine and sample localities 151-188.

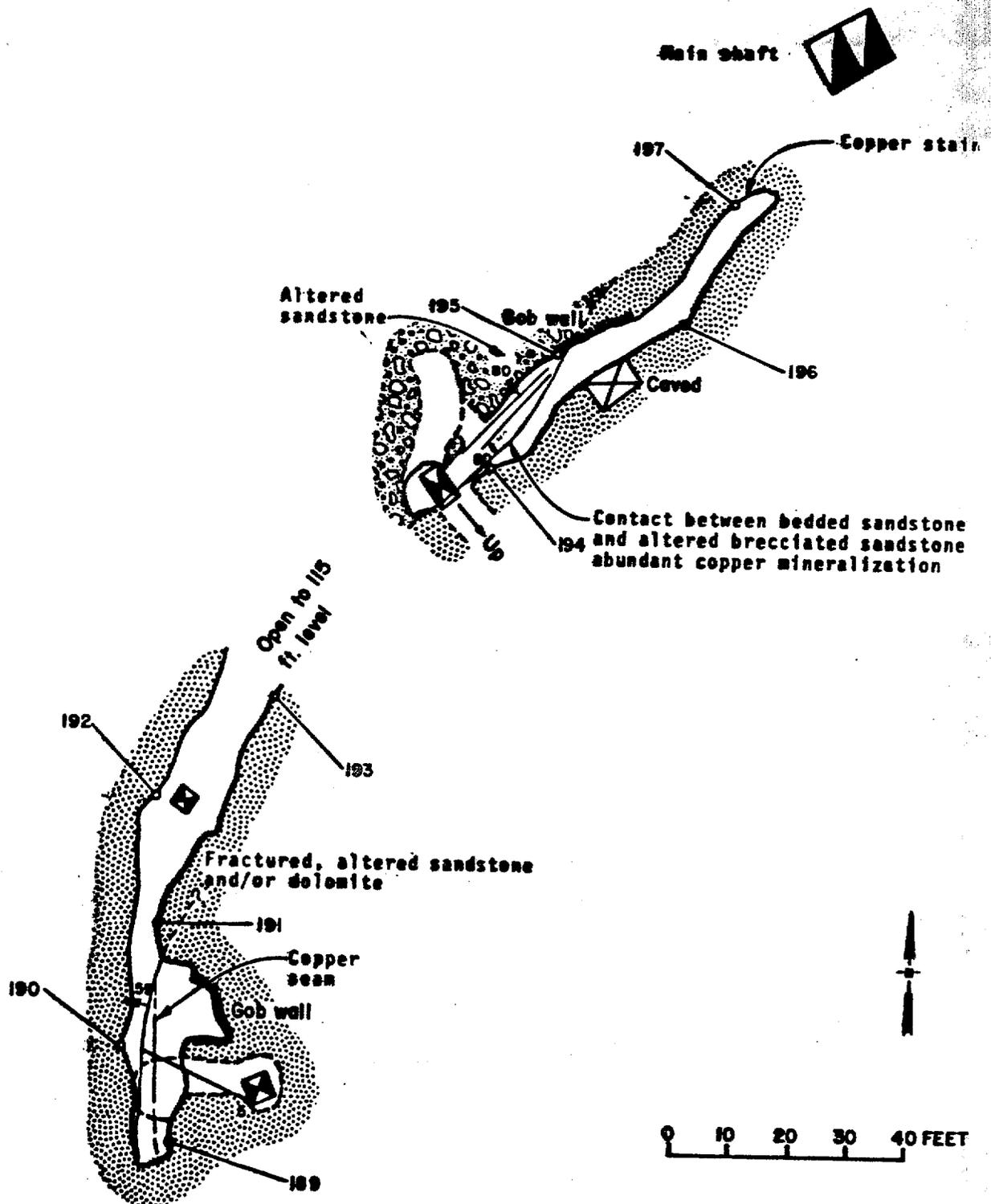


Figure 4D.--Map showing the 100-ft level of the Grand Gulch Mine and sample localities 189-196.

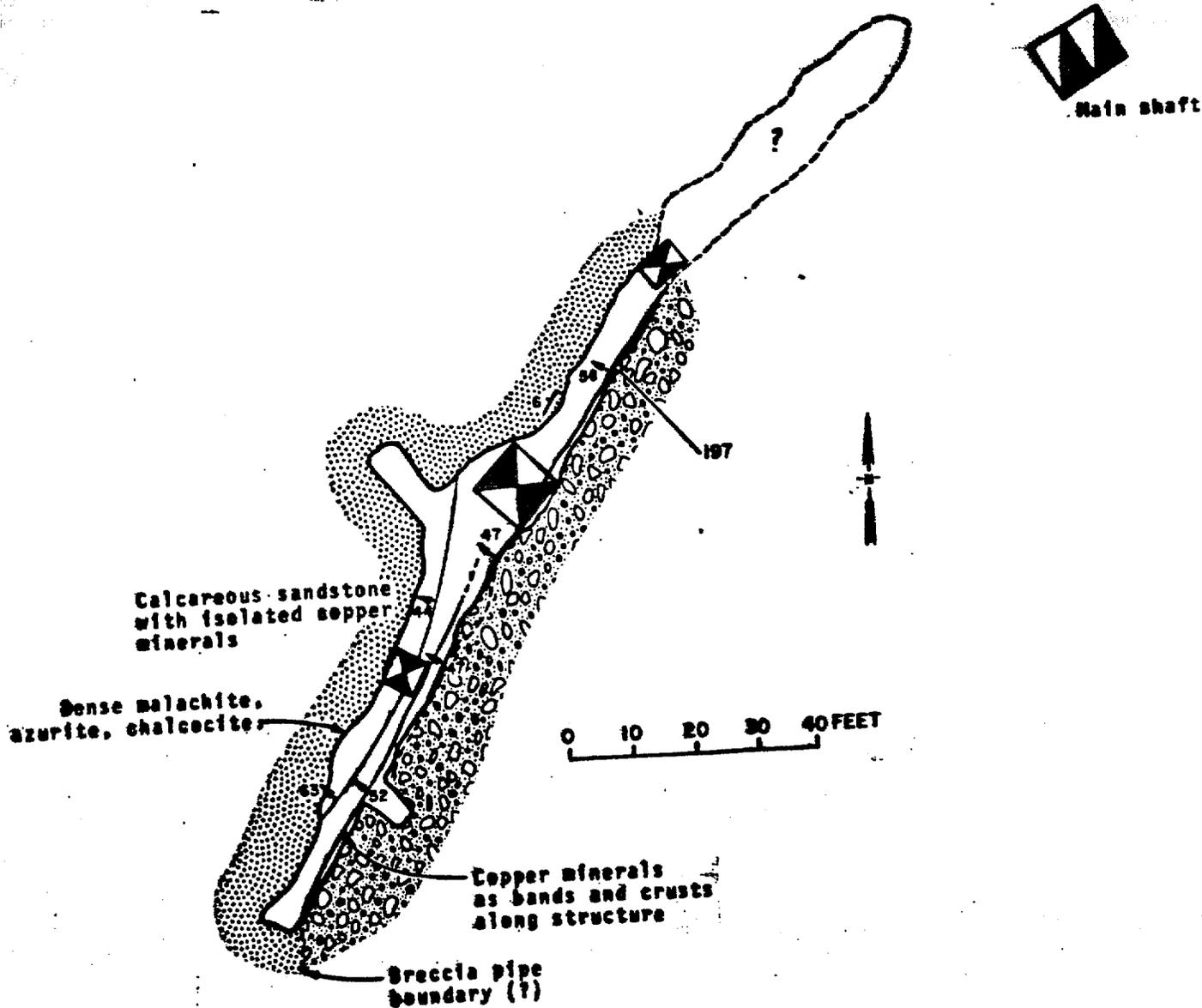


Figure 4E.--Map showing the 128-ft level of the Grand Gulch Mine and sample locality 197.

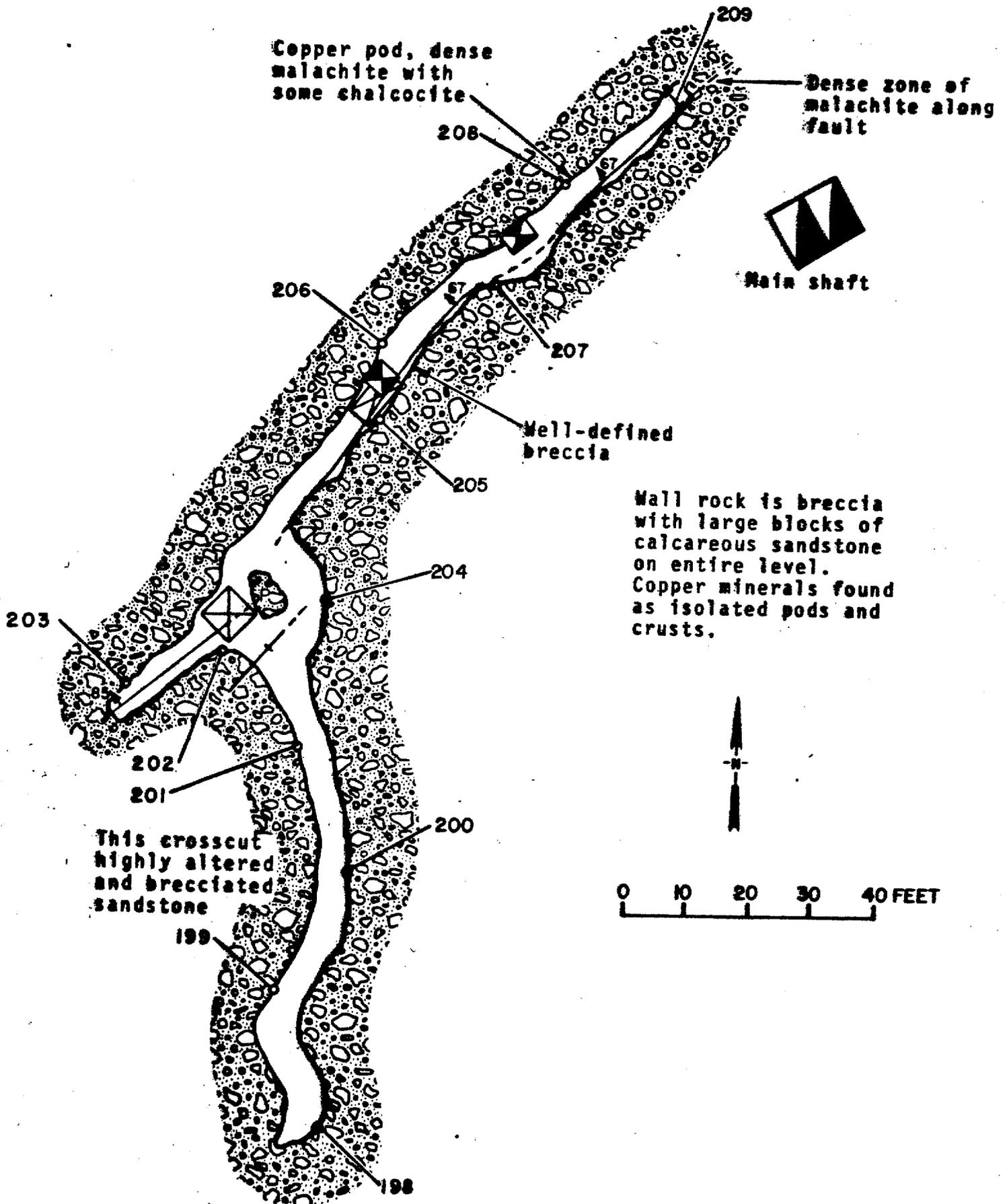
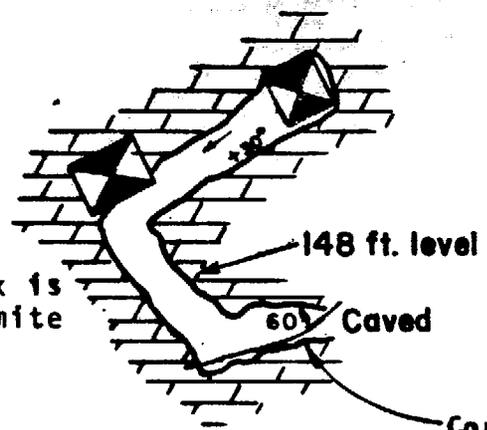


Figure 4F.--Map showing the 140-ft level of the Grand Gulch Mine and sample localities 198-209.

Country rock is
mix of dolomite
and shale



Breccia-country rock
contact indistinct

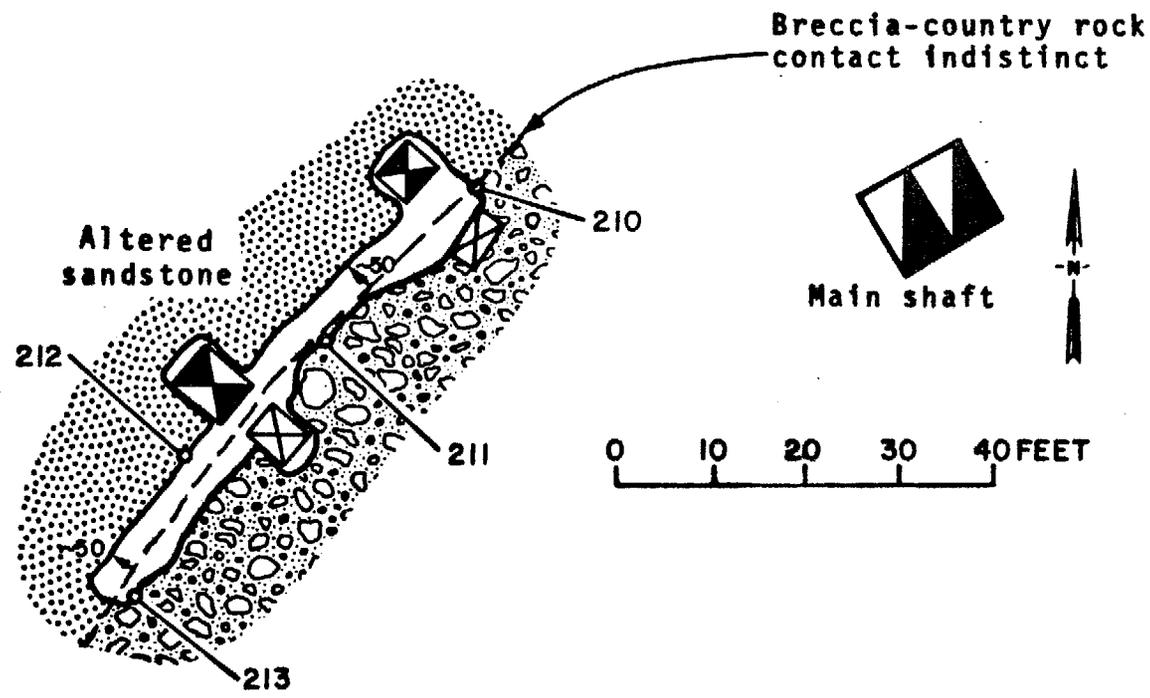


Figure 4G.--Map showing the 157-ft level of the Grand Gulch Mine and sample localities 210-213.

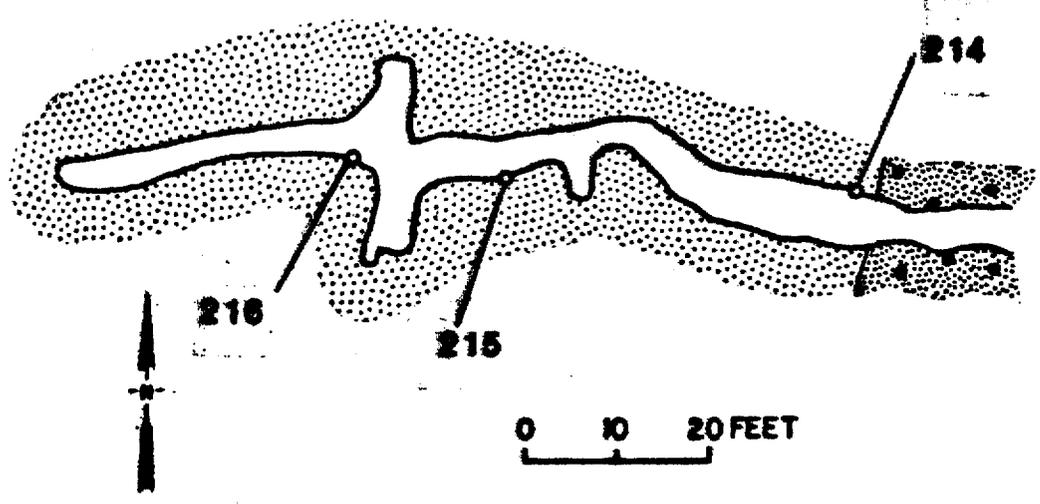


Figure 5A.--Map showing the upper adit in upper Snap Canyon and sample localities 214-216.

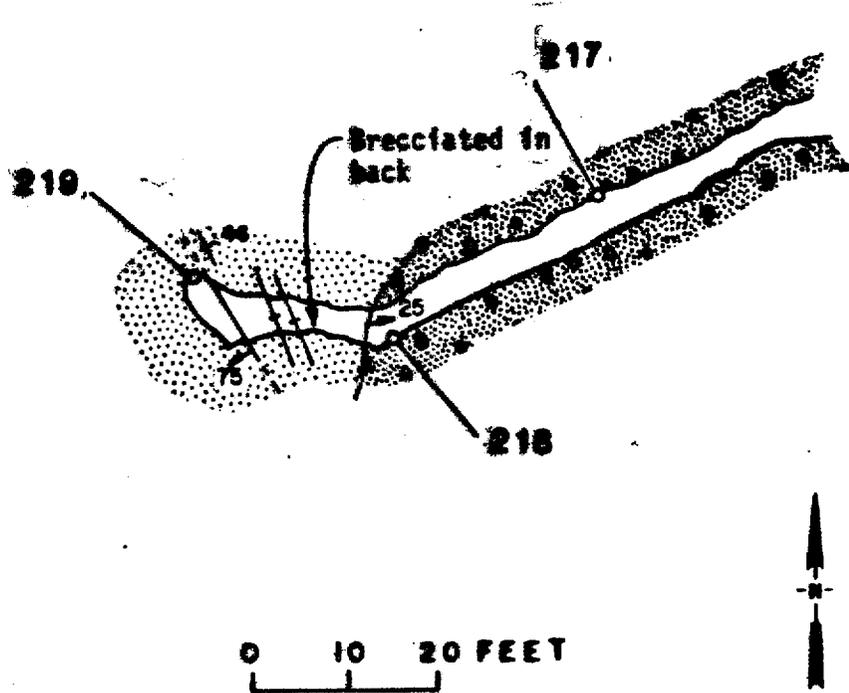


Figure 5B.--Map showing the lower adit in upper Snap Canyon and sample localities 217-219.

221-232

(SEE FIGURE 6B)

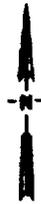
233-234

(SEE FIGURE 6C)

235-236

(SEE FIGURE 6C)

X 237



0 20 40 FEET

238-239

Figure 6A.--Map showing surface workings at Hidden Mine and sample localities 221-239.

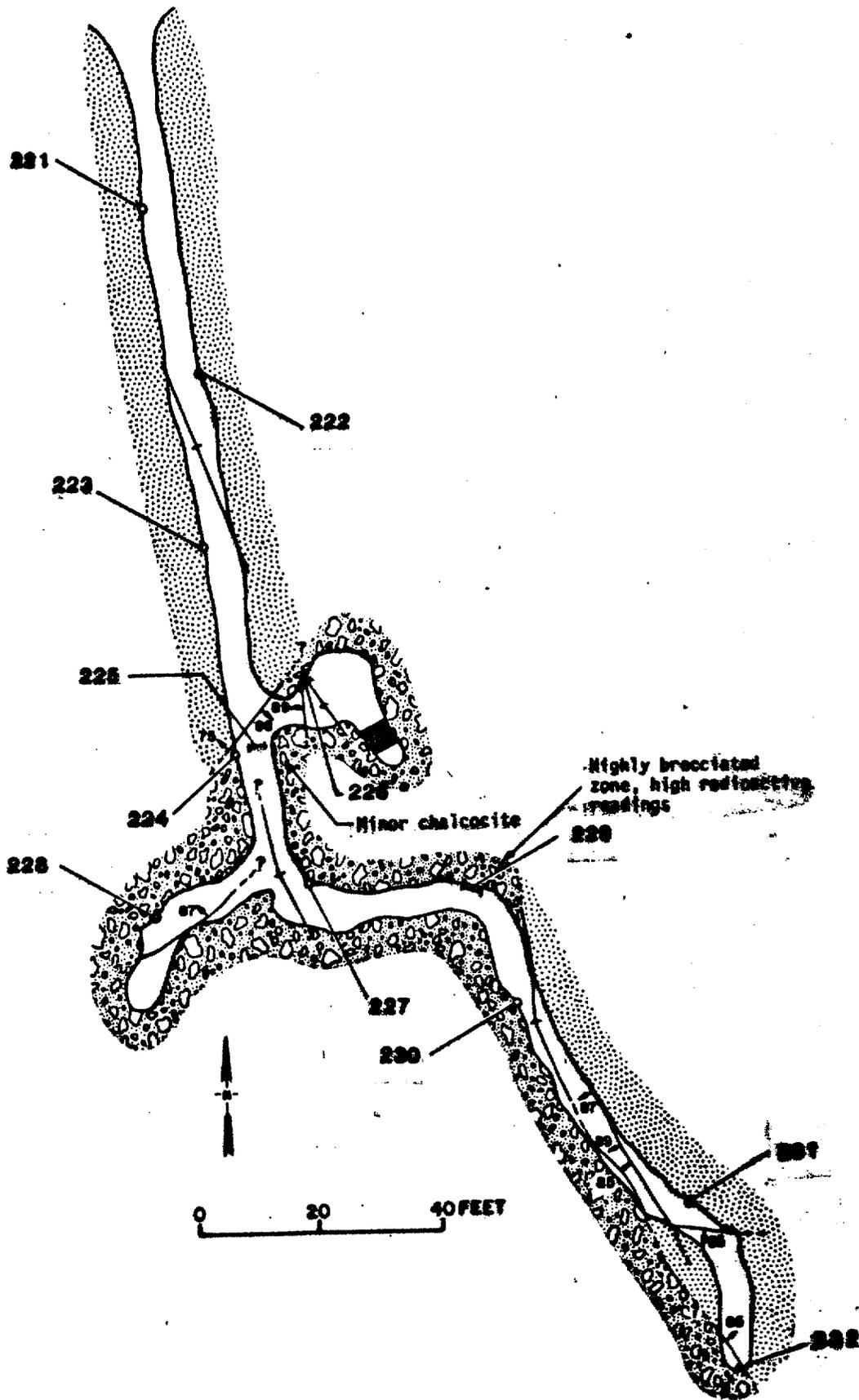


Figure 6B.--Map showing the lower adit of Hidden Mine showing sample localities 221-232.

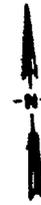
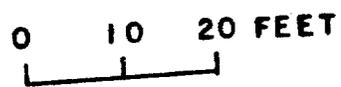
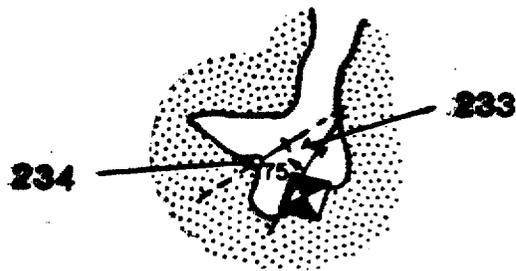


Figure 6C.--Map showing the middle adit at Hidden Mine and sample localities 233-234.

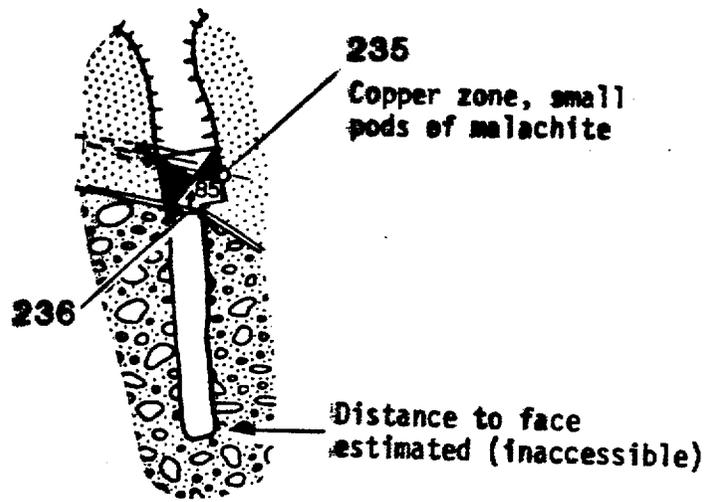


Figure 6D.--Map showing upper adit at Hidden Mine and sample localities 235-236.

Table 1.--Mineral deposits near the Pigeon Canyon, Snap Point, Nevershine Mesa, and Last Chance Wilderness Study Areas, Mohave County, Arizona

[Sample No. corresponds with sample locality shown on map. Prospects or mines labeled "inactive" have had no known production or development work since 1975; Cu, copper; U₃O₈, uranium oxide]

Sample		Location	Resource(s)	Type of deposit	Development category	Brief description
No.	Name					
1-111	Savanic Mine.	SW1/4 sec. 9, T. 33 N., R. 14 W.	Cu, U ₃ O ₈ (?)	Breccia pipe.	Mine, active, intermittent exploration activity.	Irregular mineralization in brecciated dolomite of Callville Limestone; copper minerals include malachite, chalcocite, bornite, and azurite in seams, fracture and solution cavity filling, or crusts.
112-142	Cunningham Mine.	NW1/4 sec. 16, T. 33 N., R. 14 W.	Cu, U ₃ O ₈ (?)	Breccia pipe.	Mine inactive.	Irregular copper and barite mineralization in calcareous sandstone and dolomite of Callville Limestone, locally brecciated.
143-213	Grand Gulch Mine.	SE1/4 sec. 21, SW1/4 sec. 22, T. 34 N., R. 14 W.	Cu, U ₃ O ₈ (?)	Breccia pipe.	Mine, active, intermittent exploration activity.	Various degrees of brecciation in dolomite and sandstone of Callville Limestone; malachite, azurite, and some chrysocolla(?); mine is extensive.
214-220	None	NW1/4 sec. 13, T. 32 N., R. 14 W.	None	None	Mine, inactive.	No visible mineralization; country rock of Toroweap or Supai Formation, adits mostly in alluvium or weathered country rock.
221-239	Hidden Mine.	SW1/4 sec. 16, T. 36 N., R. 13 W.	U ₃ O ₈ (?)	Breccia pipe.	Mine, inactive(?).	Minor uranium occurrence in Supai country rock; highly brecciated and altered zones, conglomerate "dike" in two adits; very little visible mineral occurrence.

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine

[Au, gold; Ag, silver; Cu, copper; Ba, barium; U₃O₈, uranium oxide; N.A., not analyzed; Tr, trace; <, less than]

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag <	Cu percent	Ba N.A.			
1	Chip	47 in.	<0.005	<0.2	3.05	N.A.	6	Silicified dolomite(?) breccia and sandstone inclusions; abundant malachite and limonite.	
2	Chip	38 in.	<.005	<.2	3.10	N.A.	7	Bedded dolomite; dendrites, iron staining, limonite, calcite, 1-in. pod of malachite.	
3	Chip	31 in.	<.005	<.2	1.90	N.A.	4	Dolomite; chalcocite and malachite in fractures, hematite staining.	
4	Chip	35 in.	<.005	<.2	2.05	N.A.	8	Brecciated dolomite; manganese, malachite limonite around breccia fragments iron-stained.	
5	Chip	46 in.	<.005	<.2	.41	N.A.	16	Do.	
6	Chip	40 in.	<.005	<.2	4.95	N.A.	12	Brecciated dolomite; malachite- and chalcocite-filled fractures, hematite staining.	
7	Chip	25 in.	<.005	<.2	1.85	N.A.	5	Same as sample no. 6 but includes calcite stringers.	
8	Chip	36 in.	<.005	<.2	2.05	N.A.	12	Silicified, brecciated dolomite; copper staining on fractures and as specks in dolomite fragments, iron-stained zone, calcite seams.	
9	Chip	47 in.	<.005	<.2	.48	N.A.	8	Iron-stained pod; minor amounts of malachite, manganese(?), limonite.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
10	Chip	18 in.	<0.005	<0.2	2.20	N.A.	19	Breccia, abundant hematite, minor copper staining, porous and vuggy, most likely solution cavity.	
11	Chip	36 in.	<.005	<.2	1.70	N.A.	8	Brecciated and bedded dolomite; malachite, chalcocite, calcite veinlets, hematite staining.	
12	Chip	41 in.	<.005	<.2	.07	N.A.	5	Bedded and brecciated dolomite; sparse malachite.	
13	Chip	48 in.	<.005	<.2	.02	N.A.	7	Limestone; hematite, no visible copper mineral.	
14	Chip	35 in.	<.005	<.2	1.85	N.A.	6	Brecciated limestone; calcite, malachite, chalcocite, and hematite stain in matrix.	
15	Chip	33 in.	<.005	<.2	.32	N.A.	10	Veinlets of calcite; malachite, chalcocite, and hematite.	
16	Chip	37 in.	<.005	<.2	1.10	N.A.	7	Dolomite; abundant malachite, manganese, minor hematite and limonite.	
17	Chip	37 in.	<.005	<.2	.02	N.A.	5	Highly fractured, iron-stained, dolomite; no visible copper minerals, manganese(?) specks.	
18	Chip	35 in.	<.005	.2	3.15	N.A.	7	Dolomite; abundant malachite, hematite, limonite, manganese, contains 0.25 pct. manganese.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
19	Chip	28 in.	<0.005	<0.2	3.70	N.A.	12	Same as sample no. 18 except it contains calcite and contains no manganese.	
20	Chip	32 in.	<.005	<.2	.17	N.A.	3	Dolomite; minor manganese and malachite.	
21	Chip	49 in.	<.005	<.2	4.25	N.A.	5	Bedded dolomite; fractures containing malachite, chalcocite, hematite stain, and calcite.	
22	Chip	35 in.	<.005	<.2	1.35	N.A.	8	Brecciated dolomite; abundant hematite, limonite, minor manganese and malachite.	
23	Chip	55 in.	<.005	<.2	4.10	N.A.	3	Brecciated dolomite; pods and fracture fillings of malachite, hematite, manganese, and chalcocite(?).	
24	Chip	60 in.	<.005	<.2	5.95	N.A.	5	Fractured and brecciated dolomite; fractures filled with malachite, chalcocite, bornite, a little azurite, hematite stain, calcite.	
25	Chip	35 in.	<.005	<.2	.10	N.A.	7	Brecciated dolomite and sandstone; abundant hematite, disseminated manganese specks.	
26	Chip	20 in.	<.005	<.2	.19	N.A.	10	Fine-grained, well sorted, brecciated sandstone; abundant manganese and limonite, manganese as banding in sandstone.	
27	Chip	51 in.	.02	<.2	2.75	N.A.	5	Dolomite; hematite and malachite in fractures.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data				U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba		
28	Chip	49 in.	<0.005	<0.2	8.80	N.A.	3	Brecciated dolomite; chalcocite(?), malachite, chalcopyrite, hematite, calcite, and manganese in fractures and as matrix.
29	Chip	46 in.	<.005	.3	1.45	N.A.	2	Dolomite; abundant malachite, hematite, limonite, manganese, minor calcite.
30	Chip	46 in.	<.005	.2	11.00	N.A.	3	Do.
31	Chip	60 in.	<.005	.4	6.25	N.A.	2	Dolomite; malachite, chalcocite, bornite, calcite as veinlets.
32	Chip	18 in.	<.005	1.0	15.30	N.A.	2	Dolomite; bornite mixed with chalcocite, malachite as veinlets and hematite stain.
33	Chip	39 in.	<.005	.2	5.65	N.A.	4	Sandy dolomite; fractures filled with malachite, hematite, and chalcocite.
34	Chip	31 in.	<.005	<.2	2.60	N.A.	3	Dolomite; veins of malachite, bornite, and chalcocite formed along fractures.
35	Chip	44 in.	<.005	<.2	3.35	N.A.	1	Sandy dolomite; fractures filled with malachite, hematite, and chalcocite.
36	Chip	14 in.	<.005	.8	18.00	N.A.	2	Brecciated dolomite; matrix of bornite, chalcocite, and malachite, hematite stain.
37	Chip	23 in.	<.005	.4	13.50	N.A.	2	Bedded dolomite; vein of calcite, bornite, chalcocite, malachite.
38	Chip	35 in.	<.005	<.2	10.70	N.A.	9	Sandy dolomite; malachite, chalcocite, bornite, and calcite veinlets in fractures.

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
39	Chip	21 in.	<0.005	<0.2	3.20	N.A.	5	Brecciated sandy dolomite; malachite, chalcocite, and calcite.	
40	Chip	48 in.	<.005	<.2	.25	N.A.	3	Brecciated dolomite; minor malachite and manganese(?).	
41	Chip	25 in.	<.005	<.2	1.75	N.A.	11	Do.	
42	Chip	20 in.	<.005	.2	2.10	N.A.	4	Sandy dolomite; malachite, chalcocite, bornite, and calcite veinlets in fractures.	
43	Chip	38 in.	<.005	<.2	.89	N.A.	2	Brecciated dolomite; pod of malachite, minor manganese.	
44	Chip	33 in.	<.005	.2	4.10	N.A.	11	Brecciated, sandy dolomite; heavy iron staining, veinlets of malachite, calcite coatings.	
45	Chip	59 in.	<.005	.4	17.35	N.A.	8	Brecciated dolomite; abundant malachite, limonite, minor amounts chalcocite, chalcopyrite.	
46	Chip	30 in.	<.005	.2	11.40	N.A.	8	Brecciated, sandy dolomite; malachite and hematite staining, calcite.	
47	Chip	11 in.	<.005	.3	6.25	N.A.	8	Vein along bedding plane in dolomite; abundant malachite, manganese(?).	
48	Chip	15 in.	<.005	.3	1.30	N.A.	3	Fault in dolomite; minor amounts of malachite, manganese, hematite.	
49	Chip	44 in.	<.005	1.0	4.30	N.A.	10	Brecciated dolomite; abundant malachite, manganese, calcite, and limonite, possibly bornite and chalcocite.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample		Assay data					Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba	U ₃ O ₈ ppm	
50	Chip	24 in.	<0.005	0.3	2.95	N.A.	5	Bedded, sandy dolomite; malachite veins, hematite staining and calcite.
51	Chip	36 in.	<.005	<.2	3.05	N.A.	11	Sandy dolomite; malachite veinlets and chalcocite(?), calcite.
52	Chip	34 in.	<.005	<.2	5.05	N.A.	6	Sandy dolomite; malachite and abundant hematite.
53	Chip	40 in.	<.005	<.2	1.90	N.A.	12	Mineralized, brecciated dolomite; altered, small lenses of hematite and malachite crystals.
54	Chip	19 in.	<.005	.3	.05	N.A.	2	Highly brecciated dolomite; clay fault gouge, no visible mineralization.
55	Chip	47 in.	.492	.5	.75	N.A.	8	Highly fractured dolomite; iron stained, disseminated and bedded copper mineralization, mostly malachite.
56	Chip	51 in.	<.005	<.2	2.45	N.A.	8	Brecciated dolomite; fracture coatings of malachite, hematite, and calcite.
57	Chip	40 in.	<.005	<.2	2.95	N.A.	10	Solution-filling of breccia; abundant hematite and manganese(?) or chalcocite, malachite as seams and specks; vuggy, hard hematite.
58	Chip	44 in.	<.005	.4	3.90	N.A.	5	Sandy dolomite; malachite veinlets and chalcocite(?), calcite.
59	Chip	39 in.	<.005	.2	1.30	N.A.	3	Dolomite; malachite along fractures.
60	Chip	26 in.	<.005	.3	11.80	N.A.	5	Brecciated dolomite; chalcocite(?), malachite, chalcopyrite, hematite, calcite, and manganese in fractures and as matrix.

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample		Assay data				U ₃ O ₈ ppm	Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba		
61	Chip	37 in.	<0.005	0.4	2.35	N.A.	18	Solution-filled breccia; hematite and manganese, calcite, malachite vuggy.
62	Chip	26 in.	<.005	<.2	.83	N.A.	1	Crushed dolomite in fault; locally vuggy, some clay gouge, abundant disseminated copper-stain specks.
63	Chip	60 in.	<.005	<.2	4.20	N.A.	<1	Fractured sandy dolomite; malachite, chalcocite, chalcopyrite, bornite, and minor azurite veins.
64	Chip	27 in.	<.005	.8	12.90	N.A.	12	Fault breccia; cemented with calcite, malachite, and chalcocite(?).
65	Chip	36 in.	<.005	<.2	6.45	N.A.	18	Dolomite breccia; pods of malachite and chalcocite(?) or manganese(?).
66	Chip	21 in.	<.005	<.2	.10	N.A.	<1	Dolomite; fault with minor copper staining.
67	Chip	39 in.	<.005	<.2	3.05	N.A.	2	Breccia pod; abundant hematite, vuggy, very few dolomite fragments, malachite.
68	Chip	36 in.	<.005	.2	.06	N.A.	<1	Sandstone overlain by dolomite; small pod of malachite.
69	Chip	32 in.	<.005	<.2	1.60	N.A.	<1	Dolomite; veinlets of malachite and hematite, calcite in fractures.

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
70	Chip	29 in.	<0.005	0.2	0.03	N.A.	<1	Vertical fractures in dolomite; slight iron staining, calcite crusts, no visible copper.	
71	Chip	33 in.	<.005	.3	4.50	N.A.	1	Dolomite; veinlets of malachite and hematite, calcite in fractures.	
72	Chip	33 in.	<.005	<.2	.77	N.A.	3	Dolomite; fractures filled with 1/4 in. veinlets of hematite and minor malachite.	
73	Chip	48 in.	<.005	<.2	.25	N.A.	1	Malachite in sheared dolomite; minor hematite staining, calcite coating.	
74	Chip	29 in.	<.005	<.2	2.20	N.A.	4	Soft, brecciated dolomite; weathered malachite and chalcocite(?), manganese and hematite along fractures.	
75	Chip	33 in.	<.005	<.2	.67	N.A.	<1	Malachite in sheared dolomite; minor hematite staining, calcite coating.	
76	Chip	32 in.	<.005	.4	.86	N.A.	2	Brecciated dolomite; calcite and hematite cement, sparse malachite.	
77	Chip	43 in.	<.005	.5	14.50	N.A.	4	Fractured sandy dolomite; malachite, chalcocite, chalcopyrite, bornite, and minor azurite veins.	
78	Chip	34 in.	<.005	.2	6.45	N.A.	4	Do.	
79	Chip	31 in.	<.005	<.2	.18	N.A.	<1	Brecciated dolomite; hematite and calcite cement, some limonite, no visible copper mineralization.	
80	Chip	34 in.	<.005	.2	2.70	N.A.	3	Dolomite; malachite, azurite, hematite, chalcocite, and bornite veinlets and pods.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
81	Chip	42 in.	<0.005	0.2	2.15	N.A.	8	Brecciated dolomite lining cavity; abundant limonite, hematite, vuggy, malachite along outer edges of cavity.	
82	Chip	32 in.	<.005	.2	6.85	N.A.	5	Dolomite breccia; impregnated with copper stain, crystalline malachite and hematite matrix.	
83	Chip	36 in.	<.005	<.2	1.60	N.A.	3	Massive, gray dolomite sparsely impregnated with malachite and hematite.	
84	Chip	34 in.	<.005	<.2	.04	N.A.	2	Gray dolomite; minor hematite.	
85	Chip	20 in.	<.005	1.2	.89	N.A.	4	Dolomitic-sandstone bed in dolomite; hematite, malachite and chalcocite(?) or manganese(?).	
86	Chip	17 in.	<.005	<.2	6.15	N.A.	<1	Fault in dolomite; malachite, hematite, and calcite.	
87	Chip	36 in.	<.005	<.2	2.15	N.A.	2	Sandy dolomite; vuggy hematite crust, malachite, chalcocite veinlets.	
88	Chip	31 in.	<.005	<.2	4.00	N.A.	1	Sandy dolomite; veinlets of manganese and hematite, coatings of calcite.	
89	Chip	33 in.	<.005	<.2	3.75	N.A.	9	Dolomite; very vuggy solution-filled cavity abundant hematite, malachite along outer edge, possibly psilomelane.	

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data				U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba		
90	Chip	42 in.	<0.005	<0.2	0.06	N.A.	8	Brecciated sandy dolomite; fractures filled with hematite and limonite, manganese stain.
91	Chip	27 in.	<.005	<.2	10.05	N.A.	6	Brecciated dolomite; malachite mixed with calcite, and hematite.
92	Chip	26 in.	<.005	<.2	1.25	N.A.	8	Brecciated sandy dolomite; hematite, malachite, manganese, and calcite.
93	Chip	15 in.	<.005	<.2	.03	N.A.	4	Fault zone, crushed dolomite; iron stained.
94	Chip	14 in.	<.005	<.2	.03	N.A.	<1	Highly fractured brown dolomite; small manganese specks, minor clay gouge.
95	Chip	26 in.	<.005	<.2	5.35	N.A.	6	Sandy dolomite; hematite, malachite, crusts of calcite and manganese.
96	Chip	11 in.	<.005	.2	1.70	<0.01	<1	Sandy dolomite; fractured, heavily iron stained, copper staining and manganese, minor amounts of barite.
97	Chip	26 in.	<.005	.4	2.20	<.01	<1	Dolomite; malachite, barite and manganese(?) veins and iron staining.
98	Chip	30 in.	<.005	<.2	.39	<.01	<1	Sandy dolomite; chalcocite, barite, and copper staining along fractures and as pods.
99	Chip	19 in.	<.005	<.2	5.10	N.A.	4	Mineralized zone; predominately hematite, calcite as irregular blebs.

Table 2.--Analytical data and description of samples 1-111 from the Savanic Mine--Continued

No.	Sample Type	Length	Assay data					U ₃ O ₈ ppm	Remarks
			Au oz/ton	Ag	Cu percent	Ba			
100	Grab	6-ft grid	Tr	0.4	1.25	<0.01	<1	Dolomite fragments; copper staining, barite(?), hematite; dump material.	
101	Chip	24 in.	Tr	.2	.50	N.A.	4	Zone of altered, unconsolidated material; deep red iron staining and limonite.	
102	Chip	30 in.	<.005	.4	2.90	N.A.	1	Brecciated sandstone and dolomite; abundant hematite, copper stain.	
103	Chip	30 in.	<.005	.2	1.30	N.A.	2	Malachite in sandy and bedded dolomite.	
104	Chip	17 in.	<.005	<.2	.02	N.A.	<1	Bedded dolomite; no visible mineralization.	
105	Grab	6-ft grid	<.005	<.2	.65	N.A.	<1	Dolomite; malachite and azurite; dump material.	
106	Grab	6-ft grid	.008	<.2	2.10	N.A.	4	Sandy dolomite with malachite and minor amounts azurite, dump material.	
107	Chip	20 in.	<.005	<.2	.45	<.01	<1	Highly fractured dolomite; abundant malachite in fractures and as crusts.	
108	Grab	6-ft grid	Tr	.4	4.05	N.A.	5	Dolomite breccia; malachite, chrysocolla, and azurite, abundant iron staining; sample of 1/3 of dump.	
109	Grab	6-ft grid	<.005	<.2	2.80	<.01	<1	Do.	
110	Grab	6-ft grid	Tr	.4	5.60	<.01	5	Do.	
111	Chip	25 in.	<.005	.2	2.50	N.A.	1	Breccia pod in dolomite, 1-in. fragments; malachite as crusts around fragments.	

Table 3.--Analytical data and description of samples 112-142 from the Cunningham Mine

[Au, gold; Ag, silver; Cu, copper; Ba, barium; U₃O₈, uranium oxide; N.A. not analyzed; Tr, trace; <, less than]

No.	Sample		Assay data					Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba	U ₃ O ₈ ppm	
112	Chip	18 in.	<0.005	<0.2	<0.01	N.A.	<1	Highly fractured sandstone; abundant iron staining.
113	Chip	14 in.	<.005	<.2	1.05	N.A.	<1	Fine-grained thin-bedded sandstone; disseminated copper blebs.
114	Chip	24 in.	<.005	<.2	2.65	N.A.	<1	Fine-grained sandstone; heavily iron-stained; isolated areas of abundant copper staining.
115	Chip	28 in.	<.005	<.2	4.20	<0.01	<1	Do.
116	Chip	30 in.	<.005	.4	2.10	N.A.	9	Thin-bedded, fractured, fine-grained sandstone; disseminated malachite and azurite.
117	Grab	4-ft grid	<.005	.2	.55	N.A.	3	Dump material of dolomite and sandstone; minor copper staining, limonite, malachite crusts.
118	Chip	29 in.	<.005	<.2	.01	6.1	N.A.	Dolomite and sandstone; barite as fracture-fillings and bladed crystals, pods up to 5 in.
119	Grab	4-ft grid	<.005	.4	.60	2.15	48	Fragments of sandstone; limonite staining, malachite coatings, some barite crystals.

Table 3.--Analytical data and description of samples 112-142 from the Cunningham Mine--Continued

No.	Sample		Assay data					U ₃ O ₈ ppm	Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba			
120	Chip	24 in.	<0.005	<0.2	0.05	0.01	<1	Fine-grained sandstone lens in dolomite; zone of disseminated pyrolusite(?).	
121	Chip	13 in.	<.005	.4	.43	<.01	4	Breccia with sandstone fragments; scattered clay pods, abundant iron staining, copper crusts.	
122	Chip	16 in.	<.005	2.0	.85	<.01	N.A.	Sandstone; abundant iron-staining, irregular copper staining.	
123	Chip	36 in.	.008	<.2	.40	<.01	<1	Shale lens in sandstone; minor malachite staining, limonite.	
124	Chip	30 in.	Tr	.2	.12	3.05	4	Sandstone and dolomite breccia; scattered 1/2-in. pods of barite in red clay-like matrix.	
125	Chip	23 in.	<.005	.8	.75	.52	45	Breccia zone in dolomite; barite as pods and stringers, scattered pea-size pods of malachite.	
126	Grab	6-ft grid	<.005	<.2	.41	1.00	7	Sandstone; malachite and azurite as coatings and small pods.	
127	Chip	26 in.	.007	.2	1.00	3.90	21	Deformed sandstone; clay gouge; limonite, minor copper staining, and barite.	

Table 3.--Analytical data and description of samples 112-142 from the Cunningham Mine--Continued

No.	Sample		Assay data					Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba	U ₃ O ₈ ppm	
128	Chip	9 in.	0.005	0.2	0.31	0.75	<1	Altered zone in sandstone; abundant limonite, no visible copper.
129	Chip	25 in.	<.005	<.2	.08	4.60	6	Gouge(?) in fined-grained sandstone; highly fractured, limonite and hematite zone, trace of copper, irregular barite.
130	Chip	30 in.	<.005	.2	.37	.01	<1	Highly altered, fine-grained sandstone; malachite blebs, iron stained.
131	Chip	8 in.	<.005	.2	1.95	<.01	26	Iron-stained sandstone; malachite and azurite, resembles solution-filled cavity.
132	Chip	22 in.	<.005	.2	1.45	.18	11	Brecciated and altered sandstone; malachite as blebs and crusts, small hematite lenses.
133	Chip	24 in.	<.005	.4	1.10	.02	2	Highly fractured sandstone; scattered pea-size pods of malachite and azurite in sandstone.
134	Chip	17 in.	<.005	.4	1.80	N.A.	<1	Fine-grained sandstone; disseminated pods of malachite and azurite.

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Table 3.--Analytical data and description of samples 112-142 from the Cunningham Mine--Continued

No.	Sample		Assay data					Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	Ba	U ₃ O ₈ ppm	
135	Chip	30 in.	<0.005	0.6	1.30	N.A.	<1	Fined-grained sandstone; azurite and malachite along fractures and as blebs.
136	Grab	6-ft grid	<.005	.2	<.01	N.A.	<1	Dump material composed of sandstone.
137	Grab	6-ft grid	<.005	.2	.01	N.A.	<1	Sandstone, no visible mineralization; dump material.
138	Chip	18 in.	<.005	.2	.01	N.A.	5	Pink sandstone.
139	Chip	36 in.	<.005	.2	.01	0.01	<1	Fine-grained sandstone.
140	Chip	30 in.	<.005	<.2	<.01	N.A.	<1	Alluvium, sandstone.
141	Chip	10 in.	<.005	.2	.01	N.A.	<1	Fractured sandstone; some manganese staining.
142	Chip	20 in.	<.005	.2	.13	N.A.	<1	Argillaceous, thin-bedded, sandstone; minor copper mineralization.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine

[Au, gold; Ag, silver; Cu, copper; U₃O₈, uranium oxide; Tr, trace; N.A., not analyzed; <, less than]

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
143	Chip	30 in.	Tr	0.2	4.60	1	White sandstone; scattered malachite pods and streaks, various degrees of iron staining.
144	Chip	43 in.	<0.005	.2	4.10	1	Sandstone; malachite occurring as vugs, small seams and specks, various degrees of iron staining with some "bleached" zones.
145	Chip	43 in.	<.005	.2	1.95	1	Fine-grained sandstone; abundant malachite blebs, upper portion of sample is white sandstone, lower portion is iron stained.
146	Chip	42 in.	<.005	.4	.42	1	Alternating dolomite and sandstone; malachite as disseminated blebs and small lenses.
147	Chip	36 in.	<.005	2.4	3.30	<1	Massive, reddish sandstone; spots and irregular streaks of malachite.
148	Chip	32 in.	<.005	<.2	6.10	4	White sandstone; scattered malachite pods and streaks, various degrees of iron staining.
149	Chip	39 in.	<.005	<.2	.05	1	Partly well-sorted sandstone and partly conglomeratic sandstone; slight limonite staining.
150	Chip	42 in.	<.005	<.2	.23	<1	Sandstone; blebs and minor malachite.
151	Chip	36 in.	<.005	<.2	.02	<1	Mixed dolomite and sandstone; clay along fractures, no visible mineralization.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
152	Chip	24 in.	<0.005	0.2	0.03	<1	Fractured dolomite; clay along seams and fractures.
153	Chip	36 in.	<.005	<.2	.36	<1	Shale in sandstone in upper portion of sample, minor malachite, lower portion is dolomite with malachite along fractures.
154	Chip	36 in.	.009	<.2	1.65	1	Mixed sandstone and dolomite; irregular copper-stained pods with limonite.
155	Chip	36 in.	<.005	<.2	2.55	<1	Sandstone; permeated by malachite, limonite staining.
156	Chip	36 in.	<.005	<.2	.05	<1	Fine-grained sandstone; clay along fractures, limonite.
157	Chip	36 in.	<.005	<.2	2.75	<1	Fine-grained sandstone; irregular pod-like zones of abundant malachite blebs.
158	Chip	36 in.	<.005	<.2	.15	<1	Red, fine-grained sandstone; heavy iron-staining along fractures.
159	Chip	36 in.	<.005	<.2	.02	<1	Massive sandstone and dolomite fine-grained, mottled.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
160	Chip	19 in.	0.005	<0.2	<0.01	<1	Fault contact of sandstone and dolomite; dolomite has solution cavities.
161	Chip	30 in.	<.005	<.2	.03	<1	Bedded sandstone and siltstone; minor copper, malachite occurs as crusts.
162	Chip	55 in.	<.005	<.2	.80	<1	Upper portion of sample is massive red sandstone, lower portion is white sandstone; no visible copper mineralization.
163	Chip	43 in.	<.005	<.2	.08	<1	Well-sorted, fine-grained sandstone; malachite and copper staining as crusts, pods, and blebs.
164	Chip	55 in.	<.005	<.2	7.40	<1	Sandstone; malachite zones throughout.
165	Chip	55 in.	<.005	.2	.85	<1	Red and white mottled sandstone; malachite crusts and irregular copper-stained pods.
166	Chip	37 in.	<.005	.2	.90	5	Massive white sandstone; malachite as irregular pea-sized pods in upper portion of sample.
167	Chip	36 in.	<.005	.2	.15	<1	Mostly limestone with small amount sandstone; fracture with minor amount malachite.
168	Chip	36 in.	<.005	<.2	.14	<1	Fine-grained sandstone; limonite on fracture surface.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
169	Chip	36 in.	<0.005	0.2	12.2	N.A.	Siltstone and clay; irregular lenses of copper staining, covered with soot from a fire.
170	Chip	36 in.	<.005	<.2	5.20	10	Sandstone covered with soot, fine-grained; permeated with copper minerals, some limonite.
171	Chip	30 in.	<.005	.4	1.30	<1	Brecciated, fossiliferous crystalline limestone; clay along fractures, minor malachite, soot covered.
172	Chip	37 in.	<.005	.2	.19	<1	Highly altered limonite or sandy dolomite; contains calcite crystals.
173	Chip	36 in.	<.005	<.2	.55	5	Breccia zone in sandstone; scattered specks of malachite.
174	Chip	30 in.	<.005	.2	.80	6	Sandstone; irregular copper-stained zones.
175	Chip	44 in.	<.005	.3	1.90	<1	Sandstone and siltstone; isolated blocks of white sandstone, seams of copper staining.
176	Chip	40 in.	<.005	<.2	3.10	<1	Breccia zone in sandstone, hard, fine-grained, blocky; scattered specks and streaks of malachite.
177	Chip	42 in.	<.005	.2	2.55	<1	Do.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
178	Chip	37 in.	<0.005	0.3	0.55	<1	Sandy dolomite, bedded; malachite specks sparse near top of sample increasing toward bottom.
179	Chip	39 in.	<.005	<.2	.06	<1	Limestone breccia, fractured and blocky; malachite as specks and streaks.
180	Chip	38 in.	<.005	.3	.01	1	Hard, dense limestone, fractured and blocky; clay along fractures.
181	Chip	41 in.	<.005	.3	.45	<1	Massive dolomite; malachite coating on fractures and as disseminated blebs.
182	Chip	45 in.	<.005	<.2	.08	<1	Brecciated dolomite; iron staining, well-cemented.
183	Chip	36 in.	<.005	.3	.14	<1	Limestone and sandy dolomite, fractured and blocky; limonite along fractures, minor specks of malachite.
184	Chip	48 in.	<.005	.4	.14	<1	Contact or fault between highly calcareous sandstone and limestone; highly altered, brecciated, minor copper.
185	Chip	42 in.	<.005	.6	.03	<1	Breccia, chert nodules, and vugs lined with calcite crystals; matrix of sandstone and claystone, limonite stain, no visible copper.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
186	Chip	52 in.	<0.005	0.7	0.40	<1	Massive limestone; altered, some calcite crystals, irregular copper staining.
187	Chip	42 in.	<.005	.4	1.75	<1	Sandstone and sandy dolomite, hard, fine-grained; malachite as specks, streaks and coatings along fractures and permeating most of the rock.
188	Chip	40 in.	<.005	.2	.03	<1	Brecciated limestone; iron staining on fractures, calcite crystals.
189	Chip	36 in.	<.005	.2	2.40	<1	Brecciated dolomite; altered, mottled, 1/2 in. seam of copper mineralization and irregular copper staining.
190	Chip	36 in.	<.005	.3	.23	<1	Sandy limestone; vuggy with some calcite crystals, minor amount of malachite specks.
191	Chip	34 in.	<.005	.6	3.60	<1	Dolomite wall rock; copper stains impregnate breccia, dolomite fragments.
192	Chip	26 in.	<.005	.3	.04	<1	Fractured, fossiliferous limestone, limonite staining.
193	Chip	28 in.	.005	.4	.05	<1	Breccia, limestone and sandstone.
194	Chip	40 in.	<.005	.7	10.2	10	Hard sandstone, fine-grained, slightly calcareous, highly fractured and blocky; zones of malachite-permeated rock.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
195	Chip	40 in.	<0.005	0.5	0.18	<1	Highly fractured sandstone, red to brown.
196	Chip	39 in.	<.005	.3	.75	<1	Red, fine-grained sandstone, possibly brecciated or altered, very few copper blebs.
197	Chip	24 in.	<.005	.3	2.90	13	Upper part of sample is sandstone; limonite, malachite coatings on fractures; lower part is breccia with sandstone and dolomite fragments; malachite zones.
198	Chip	36 in.	<.005	.6	.60	<1	Sandy limestone, dense, hard, very fine-grained.
199	Chip	36 in.	<.005	.3	.23	<1	Sandstone, very fine-grained; limonite, solution banding, scattered fragments of limestone.
200	Chip	44 in.	<.005	.2	.05	<1	Highly altered breccia, dolomite fragments, massive and hard; dendrites.
201	Chip	39 in.	<.005	.6	.19	<1	Contact of breccia and crystalline limestone; limonite stain on fractures, copper(?) staining.

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Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
202	Chip	40 in.	<0.005	0.6	0.19	<1	Highly brecciated, calcareous sandstone or dolomite(?); solution cavities or vugs, iron staining in "swirl" pattern around cavities and fragments.
203	Chip	48 in.	<.005	.4	.24	<1	Limestone and dolomite(?), fractured and mottled; no copper minerals in limestone but malachite in streaks and coatings in dolomite.
204	Chip	36 in.	<.005	.2	.29	<1	Fractured and altered limestone, sandy, fine-grained; limonite stain and minor specks of malachite.
205	Chip	48 in.	<.005	<.2	3.55	6	Breccia, sandstone matrix; locally abundant malachite, fragments of dense limestone.
206	Chip	44 in.	<.005	.4	.10	<1	Highly fractured and altered dolomite; trace of copper staining as blebs or crusts, large dolomite blocks, iron staining.
207	Chip	39 in.	<.005	<.2	3.40	10	Breccia, limestone and dolomite fragments; various degrees of copper staining with some malachite, higher copper content in upper part of sampled area.
208	Chip	60 in.	<.005	.4	1.80	3	Dolomite; local malachite and chalcocite, highly fractured with limonite stains, copper minerals coat permeate rock, vugs.

Table 4.--Analytical data and descriptions of samples 143-213 from the Grand Gulch Mine--Continued

No.	Sample		Analytical data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
209	Chip	34 in.	<0.005	0.2	0.06	<1	Dolomite, scattered vugs, highly fractured; limonite coatings, minor copper stain, small slickensides.
210	Chip	36 in.	<.005	.3	.55	<1	Breccia zone, limestone and dolomite fragments; matrix of limonite, calcite, malachite coatings.
211	Chip	35 in.	<.005	.5	1.75	<1	Breccia, limestone fragments; copper mineralization is spotty, breccia locally dense and well cemented.
212	Chip	48 in.	<.005	<.2	.06	<1	Dolomite; malachite along fractures and as replacement zones.
213	Chip	48 in.	<.005	<.2	2.15	4	Breccia zone in dolomite; malachite permeates and coats dolomite rock, limonite.

Table 5.--Analytical data and description of samples 214-220 from upper Snap Canyon

[Au, gold; Ag, silver; U₃O₈, uranium oxide; <, less than]

No.	Sample		Assay data			Remarks
	Type	Length	Au oz/ton	Ag	U ₃ O ₈ ppm	
214	Chip	42 in.	<0.005	0.1	1.6	Weathered siltstone; iron-stained.
215	Chip	48 in.	<.005	.6	.94	Weathered siltstone, sandstone, and clay.
216	Chip	65 in.	<.005	<.1	.86	Weathered siltstone.
217	Chip	44 in.	<.005	.1	3.5	Unconsolidated alluvium consisting of fragments of sandstone and siltstone (.5-10 in. diameter), plus sand and clay.
218	Chip	37 in.	<.005	<.1	1.5	Contact of unconsolidated alluvium with buff sandstone and dark brown siltstone, clay and silt matrix in alluvium, majority of fragments angular and 1 in. in diameter.
219	Chip	27 in.	<.005	.4	1.7	Buff sandstone-red siltstone contact.
220	Chip	36 in.	<.005	.1	2.6	Unconsolidated and poorly sorted alluvium, trench in hillside.

Table 6.--Analytical data and description of samples 221-239 from Hidden Mines

[Au, gold; Ag, silver; Cu, copper; U₃O₈, uranium oxide; N.A., not analyzed; <, less than]

No.	Sample		Assay data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
221	Chip	46 in.	<0.005	<0.1	N.A.	3.3	Silty sandstone; calcite along some joint surfaces, minor iron staining along joint surfaces.
222	Chip	44 in.	<.005	.1	N.A.	2.6	Buff-tan sandstone; minor iron staining along joint surfaces.
223	Chip	43 in.	<.005	.1	N.A.	2.9	Buff-tan sandstone; minor iron staining and calcite along joint surfaces.
224	Chip	44 in.	<.005	.1	N.A.	2.9	Fractured, altered sandstone, clayey gouge; abundant hematite and limonite staining.
225	Chip	36 in.	<.005	1.3	2.7	37.0	Sheared and fractured sandstone; limonite and hematite pods and staining, minor malachite and azurite staining.
226	Chip	24 in.	<.005	.4	2.4	13.0	Brecciated sandstone and siltstone; malachite, azurite, and hematite staining.
227	Chip	48 in.	<.005	.1	N.A.	3.0	Fractured buff-tan sandstone; minor iron staining.
228	Chip	29 in.	<.005	.1	.073	3.1	White to gray clayey gouge in sandstone; minor iron staining.
229	Chip	36 in.	<.005	.6	N.A.	37.0	Fractured sandstone; gouge material and hematite pod.

Table 6.--Analytical data and description of samples 221-239 from Hidden Mines--Continued

No.	Sample		Assay data				Remarks
	Type	Length	Au oz/ton	Ag	Cu percent	U ₃ O ₈ ppm	
230	Chip	34 in.	0.02	0.6	N.A.	21.0	Gouge material; pockets of hematite-limonite in fractured sandstone.
231	Chip	36 in.	<.005	.2	0.18	5.9	Fractured sandstone; minor limonite and malachite.
232	Chip	32 in.	<.005	<.1	N.A.	2.4	Alluvial material (boulders, cobbles, and sand) in contact with sandstone.
233	Chip	20 in.	<.005	.9	1.2	12.0	Gouge; hematite and limonite.
234	Chip	14 in.	<.005	.5	.04	4.1	Fault-fracture zone in sandstone; minor malachite, azurite, and limonite staining.
235	Chip	27 in.	<.005	1.2	4.5	.3	Highly altered sandstone, fractured and faulted; hematite staining, small pods of malachite disseminated throughout sample.
236	Chip	48 in.	<.005	.6	N.A.	2.2	Consolidated conglomerate, angular and rounded fragments, up to 4 in. in diameter, clay to sandy matrix.
237	Chip	38 in.	<.005	.5	.06	9.6	Fractured, altered sandstone; hematite and limonite.
238	Chip	36 in.	<.005	.6	.027	4.4	Sheared altered sandstone; abundant hematite and limonite.
239	Chip	35 in.	<.005	1.0	.029	11.0	Sheared, fractured sandstone; hematite and limonite.

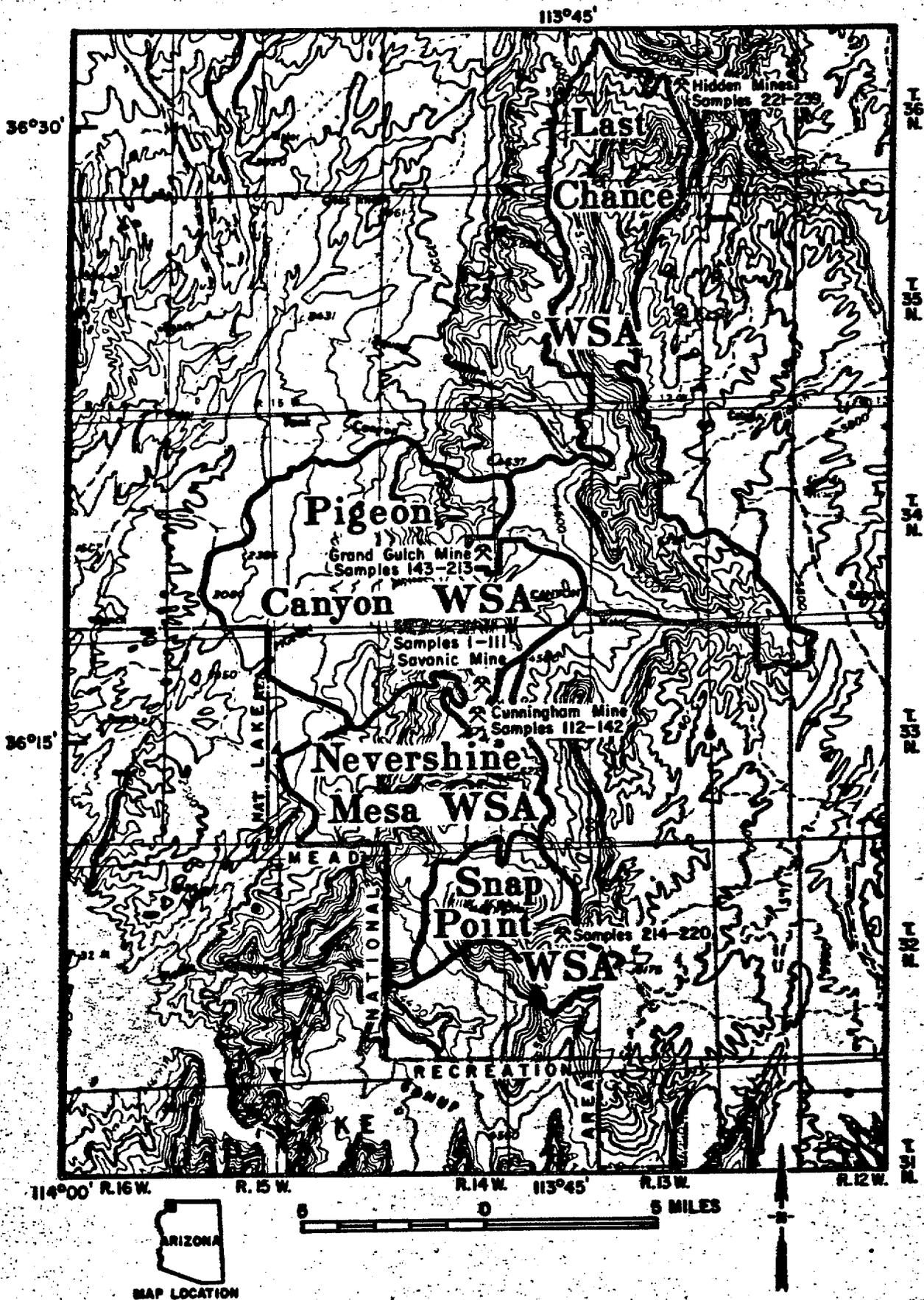


Plate 1.--Mines and prospects of the Pigeon Canyon, Nevershine Mesa, Snap Point, and Last Chance Wilderness Study Areas.