A Study of the Heavy Minerals From Topaz Mountain, Juab County, Utah

by

Richard C. Guimond

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Approved by Douglas Pride

TABLE OF CONTENTS

TABLES AND FIGURES

ABSTRACT

Rock specimens and bulk sediment samples were collected from Topaz Valley, on the southern flank of Topaz Mountain. Both types of samples were examined macroscopically and microscopically. Heavy minerals within the sediment mainly include topaz and specular hematite, with subordinate bixbyite, magnetite, fluorite, and pseudobrookite. The topaz and hematite percentages were significantly different for the four size distributions studied. The topaz content decreases as the grain size decreases. Conversely the hematite content progressively increases as the grain size decreases. Topaz, hematite (only as inclusions), bixbyite, pseudobrookite, and quartz were found in the rock cavities. Contrarily only quartz and feldspar were found as significant percentages in thin section, although topaz, hematite, and pseudobrookite also were found in thin section. The presence of topaz (a fluorine-bearing mineral) at Topaz Mountain, and of fluorite at nearby Spor Mountain, suggest that the region may be an attractive target for molybdenum exploration.

INTRODUCTION

The Thomas Mountain Range, located in central-western Utah, lies about 150 miles southwest of Salt Lake City. The range is composed of Paleozoic sedimentary rocks, Tertiary volcanics, and Quaternary alluvium. Topaz Mountain, located in the southeastern part of the range, is composed almost completely of silver-gray rhyolite and volcanic glass. The rhyolite is pock-marked and weathered by the rain and wind, but is still very hard. From the southeast Topaz Mountain seems to be surrounded by flat land, although the Thomas Range extends northward for some distance from the mountain. The climate of the vicinity is dry and the weather generally is clear, with temperatures ranging to 100^{o} F. and more in the summer. The mountain consists of several rugged ledges, giving it a step-like appearance. Juniper and mountain mahogany grow throughout the area, but the vegetation in Topaz Valley is almost entirely sagebrush. The valleys of the vicinity contain fragmented and weathered rhyolite, and the minerals found within the rhyolite, including topaz.

For the past 50 years, Topaz Mountain has been known as an excellent collecting site for topaz crystals. The majority of the crystals are clear, and are found in the dry stream beds that lead to the mountain. All of the topaz crystals are a brilliant amber color if found before they are bleached by the sun. Varieties can be found with varying degrees of amber tint. The amber topaz crystals are found in unexposed vugs of the rhyolite. Twinned and doubly terminated crystals often can be found.

PURPOSE

The purpose of the present investigation was to study the heavy mineral component of sediment samples from Topaz Valley. A secondary objective was to characterize the rhyolite source rocks for sediment in the valley by thin section studies.

SAMPLE COLLECTION

Four sediment samples were taken within Topaz Valley, as shown in Figure 1. The samples were taken from the vorth, south, east, and west sides of the valley. Both rock and sediment samples were taken at each location. Five of the rock samples were chosen for thin section study.

LABORATORY PREPERATION

The bulk sediment samples were sieved using mesh sizes of 2000, 991, 495, 250, and 124 microns. The finest sediment was collected in the pan. These size fractions are characterized respectively as A, B, C, D, E, and F; and they correspond with Wentworth scale subdivisions between gravel, very coarse sand (A), coarse sand (B), medium sand (C), fine sand (D), very fine sand (E), and finally that material finer than very fine sand that was caught in the pan (F).

Following sieving, the heavy mineral fraction was separated from the light by floatation using bromoform ($CHBr_3$, specific gravity 2.85). This was done for the samples smaller than coarse sand (991 microns). The apparatus used is shown in Figure 2. The float samples were poured into the container and the heavy minerals were released into filter paper through the opening at the bottom of the container. The bromoform was filtered through the paper leaving the grains which then were washed with acetone to remove excess bromoform. A portion of the heavy mineral grains were mounted in epoxy in preparation for microscopic examination. The cleansing procedure was repeated for the light minerals. The breakdown of the heavy and light mineral content is shown in Tables 1, 2, and 3.

Five hand samples, exhibiting the most characteristic features seen in the area, features such as flow structure and texture, were chosen for thin section study. Chips small enough for mounting, were polished to mirror finish on one side and attached with epoxy to a glass slide. Next, the chip was ground down to approximately 30 microns thickness and covered with a cover slip. The results from the thin section study are recorded in the write up of this report.

Samples with sediment larger than 991 microns were examined with a binocular microscope and found to be nearly all fine rock matrix, topaz, and some quartz. Some of the rock fragments larger than 991 microns contain inclusions of a dark mineral, tentatively identified as hematite.

RESULTS

Sediment Studies

The light minerals consist dominantly of fine rock matrix, quartz, and some topaz that did not sink in the lipuid separation. At times the quartz was difficult to distinguish from the topaz. Inclusions of hematite were found in some of the topaz, during the course of the hand specimen studies (Figure 10).

The heavy minerals consist of hematite, topaz, bixbyite, and magnetite, with traces of pseudobrookite, fluorite, and green volcanic glass. Identifications were based on binocular and petrographic examinations (including index oils), and by comparison with a published account of the geology of the Topaz Mountain area (Staatz and Carr, 1964).

The hematite (Fe_2O_3) was found as silvery metallic hexagonal plates and occured in all size distributions. It was concentrated especially in the finer grain sizes (see Table 4). The data from the heavy mineral studies do not correlate well with the sieve size data. The major difference is the percentages of hematite and topaz in the samples. This difference might be explained by the fact that hematite is much more brittle than the topaz and during the mechanical sieving those crystals were fragmented into smaller sizes. The plates of hematite quite often were twinned, and in most instances were broken. The fragmentation made a clear distinction between hematite and bixbyite difficult. Hematite plates commonly were found as inclusions within larger topaz crystals. Hematite was <u>not</u> found above 991 microns, except as inclusions in topaz (see Figure 3 for example of hematite plates).

Topaz ($Al_2SiO_4(F,OH)_2$) is found in vugs in the rock matrix as well as single crystals in stream beds, throughout the area. Most of the crystals found are singly terminated, although doubly terminated crystals do occur in the area (Figures 4 and 10). Some of the topaz crystals are opaque, consisting of topaz poikolitically enclosing rhyolite. Microscopic topaz is found mainly as cleavage fragments. Most of the topaz examined was clear, with only an occasional amber-tinted grain being found. Topaz fragments were found in all sieve sizes although it is most common in the larger grain sizes (see Table 4).

Bixbyite ($(Mn,Fe)_2O_3$) was not found in thin section, but was found in all sediment size fractions of diameter less than 991 microns. It was found as fragments of small black cubes, and more rarely as tetragonal trisoctahedrons. Quite often, bixbyite was found "perched" on crystals of topaz; and it is known to occur in the same manner on crystals of garnet, beryl, and quartz (Staatz and Carr, 1964).

A very small number of grains of pseudobrookite ($Fe_2O_3 \cdot TiO_2$) were found in the grain mounts. Macroscopically, one crystal fragment with a diameter about one-eighth inch was found at sample locality number 4 (Figure 1). Pseudobrookite occurs in the Topaz Mountain area as submetallic acicular crystals forming radiating clusters (Staatz and Carr, 1964).

Magnetite (Fe_3O_4) occurs as black granular masses having no distinct shape, and it is present in all the size fractions less than 991 microns in diameter. Fluorite (CaF_2), and the green volcanic glass were found only as small fragments and make up a very small percentage of the grains sampled (together comprising only about 2.5 percent of the total). Approximately 8.5 percent of the total grains counted were of unidentifiable material (Table 4).

Slight differences exist in the percentages of topaz and hematite from the four sites sampled (Table 4). As seen in this table, there is a consistant decrease in the amount of topaz as the grain size decreases (C through F). Conversely, the hematite content progressively increases from C to F. The contents of the other minerals remain fairly constant throughout the range of sizes below 991 microns.

Hand specimen study reveals a variety of crystal occurrences as well as excellent examples of flow textures. The flow texture, and a destinctive gray color to the rhyolite, can be seen in Figure 5. Figure 6 contains characteristic vugs ½-inch and smaller in size, containing amber topaz crystals of the type found in rock throughout the area. This figure also shows crystals of pseudobrookite. Figure 7 contains quartz of the type found in the area; and Figure 8 contains and excellent example of amber-colored topaz crystals. The largest crystal in this figure is about 1 inch long. The last two figures examined (9 and 4) are of topaz crystals poikolitically enclosing rhyolite martix; and clear ("bleached") topaz typical of the area.

Thin Section Studies

Slide 1 - color patchy, ranging from light-gray to brown; crystals of feldspar and quartz in a fine-grained groundmass (some devitrification of groundmass indicated). Crystals range from 5 to 10 millimeters in diameter, and are euhedral to subhedral. Feldspar is primarily sanadine with minor plagioclase. Quartz occurs as well defined crystals with some fragmented grains (like the sanadine).

quartz	- 12%
sanadine	- 7%
plagioclase	- ½%
hematite	- ½%
groundmass	- 80%

Slide 2 - light gray to brown in color; groundmass exhibits excellent flow structure; groundmass dominantly feldspar and quartz. Large crystals (topaz, sanadine, plagioclase, and quartz) are 5 to 10 millimeters in diameter and are euhedral to subhedral. Some of glass is embayed by quartz crystals. Noted that some quartz crystals exhibit reaction rings. Sanadine occurs as polycrystalline patches on parts of the slide. (See Figures 11 and 12).

quartz	- 10%
sanadine	- 12%
topaz	- 2%
hematite	- 1%
groundmass	- 75%

Slide 3 - light-gray to brown color; crystals (quartz, sanadine, plagioclase and topaz) are 5 to 10 millimeters in diameter, and are nearly all euhedral. Groundmass exhibits obvious devitrification. Brown patches apparently are carbonate which is to fine-grained to identify. Some of the quartz crystals show embayment of the glass. One grain on this slide was tentatively identified as pseudobrookite.

quartz	- 7%	
sanadine	- 4%	
plagioclase	- 2%	
topaz	- 1%	
hematite	- 1%	
groundmass	- 85%	(25% are the brown patches)

Slide 4 - slide is light gray to brown in color. Crystals (quartz, sanadine and hematite) are 1 to 10 millimeters in diameter and range from euhedral to subhedral in shape. The fine-grained groundmass is made up of feldspar and quartz and exhibits flow structure. Polycrystalline masses of feldspar are noted. Noted some quartz crystals showing over-growths.

quartz	- 13%
sanadine	- 5%
hematite	- 1%
plagioclase	- 1%
groundmass	- 80%

Slide 5 - light gray to brown in color; crystals of quartz, sanadine and topaz are 5 to 10 millimeters in diameter; groundmass is very fine-grained quartz and sanadine. Some patches of larger grains exist and the quartz crystals seem to be much more distinctive in shape than in previous slides. Some mineralization in a fracture running the length of the section was tentatively identified as very fine-grained quartz.

quartz	- 12%
sanadine	- 5%
topaz	- 2%
hematite	- ½%
plagioclase	- ½%
groundmass	- 80%

DISCUSSION

Fluorine is present at Topaz Mountain mainly through the presence of topaz, although some fluorite is present. At Spor Mountain, located immediately to the west of Topaz Mountain, fluorine is present as abundant fluorite. The occurrences of these minerals indicate that the region is anomalous with respect to fluorine. Thes may be significant in light of the fact that fluorine apparently is important as an ore-carrier in the genesis porphyry-type molybdenum deposits (Lamarre and Hodder, 1978). Anomalous fluorine (as fluorite) is present at Urad-Henderson Deposits, Colorado (Wallace, MacKenzie, Blair, and Muncaster, 1978); Climax, Colorado (Wallace, et al, 1968); Redwell Basin, Colorado (Sharp, 1978); and at Questa, New Mexico (Carpenter, 1968). The Topaz Mountain-Spor Mountain region also may contain anomalous molybdenum and related mineralization.

Table 1

DISTRIBUTION OF HEAVY AND LIGHT MINERALS*

Sample Numbers	Total Weight	Weight of Heavy Minerals	% of Heavy Minerals	Weight of Light Minerals	% of Light Minerals
1-C	12.46	.10	.8	12.36	99.2
1-D	14.99	.21	1.4	14.78	98.6
1-E	2.41	.23	9.5	2.18	90.5
1-F	6.28	.33	5.25	5.95	94.75
2-C	26.45	.33	1.2	26.12	98.8
2-D	22.91	.37	1.6	22.54	98.4
2-E	5.11	.17	3.3	4.94	96.7
2-F	4.44	.05	1.13	4.39	98.87
3-C	16.27	.22	1.35	16.05	98.65
3-D	17.22	.30	1.7	16.92	98.3
3-E	1.87	.06	3.2	1.81	96.8
3-F	7.53	.07	.93	7.46	99.07
4-C	11.21	.19	1.7	11.02	98.3
4-D	6.35	.24	3.78	6.11	96.22
4-E	.75	.05	6.67	.70	93.3
4-F	1.41	.11	7.8	1.30	92.2

* Weight is in grams

Table 2

WEIGHT DISTRIBUTION OF HEAVY AND LIGHT MINERAL CONTENT

PER COLLECTION SITE FOR SAMPLES C, D, E, AND F*

Sample Numbers	Total Weight of C, D, E, and F	Weight of Heavy Minerals	% of Heavy Minerals	Weight of Light Minerals	% of Light Minerals
1	36.14	.87	2.41	35.27	97.59
2	58.91	.92	1.56	57.99	98.44
3	42.89	.65	1.52	42.24	98.48
4	19.72	.59	2.99	19.13	97.01

* Weights are in grams

Table 3

WEIGHT DISTRIBUTION OF HEAVY AND LIGHT MINERAL CONTENT

PER SIZE CATEGORY C THROUGH F*

Letter	Total Weight	Weight of Heavy Minerals	% of Heavy Minerals	Weight of Light Minerals	% of Light Minerals
C	66.39	.84	1.27	65.55	98.73
D	61.47	1.12	1.82	60.35	98.18
E	10.14	.51	5.03	9.63	94.97
F	19.66	.56	2.85	19.10	97.15

* Weights are in grams

Table 4

DISTRIBUTION OF HEAVY MINERALS IN THE DIFFERENT

SIEVE SIZE CATAGORIES (C, D, E, F)

Mineral	Number of Grains in Sieve Size C	Percentage of Total	1-C	%	4-C	%
Topaz	71	52.6	30	54.5	41	51.2
Hematite	31	23.0	10	18.2	21	26.2
Bixbyite	12	8.89	6	10.9	6	7.5
Pseudo-brookite	1	.74	0	- -	1	1.2
Magnetite	4	2.96	2	3.6	2	2.2
Fluorite	1	.74	1	1.8	0	- -
Green Glass	1	.74	0	- -	1	1.2
Unknown	14	10.4	6	10.9	8	10.0
Totals	135		55		80	

Continued on next page.

Table 4 cont.

Mineral	Number of Grains in Sieve Size D	Percentage of Total	Catagories 1-D	%	3-D	%
Topaz	69	39.4	37	40.2	32	38.6
Hematite	51	29.1	27	29.3	24	28.9
Bixbyite	26	14.9	15	16.3	11	13.3
Pseudo-brookite	2	1.14	0	- -	2	2.4
Magnetite	9	5.14	2	2.2	7	8.4
Fluorite	2	1.14	1	1.1	1	1.2
Green Glass	1	.57	0	- -	1	1.2
Unknown	15	8.6	10	10.9	5	6.0
Totals	175		92		83	

Continued on next page.

Table 4 cont.

Mineral	Number of Grains in Sieve Size E	Percentage of Total	Catagories 2-E	%	3-E	%
Topaz	48	29.8	20	26.3	28	32.9
Hematite	66	41.0	32	42.1	34	40.0
Bixbyite	15	9.3	6	7.9	9	10.6
Pseudo-brookite	3	1.9	2	2.6	1	1.2
Magnetite	14	8.7	9	11.8	5	5.9
Fluorite	0	- -	0	- -	0	- -
Green Glass	1	.62	1	1.3	0	- -
Unknown	14	8.7	6	7.9	8	9.4
Totals	161		76		85	

Continued on next page.

Table 4 cont.

Mineral	Number of Grains in Sieve Size F	Percentage of Total	Catagories 2-F	%	4-F	%
Topaz	50	19.5	21	18.9	29	20.0
Hematite	112	43.8	42	37.8	70	48.3
Bixbyite	41	16.0	21	18.9	20	13.8
Pseudo-brookite	7	2.73	2	1.8	5	3.5
Magnetite	15	5.86	7	6.3	8	5.5
Fluorite	2	.78	2	1.8	0	- -
Green Glass	10	3.9	5	4.5	5	3.4
Unknown	19	7.42	11	9.9	8	5.5
Totals	256		111		145	

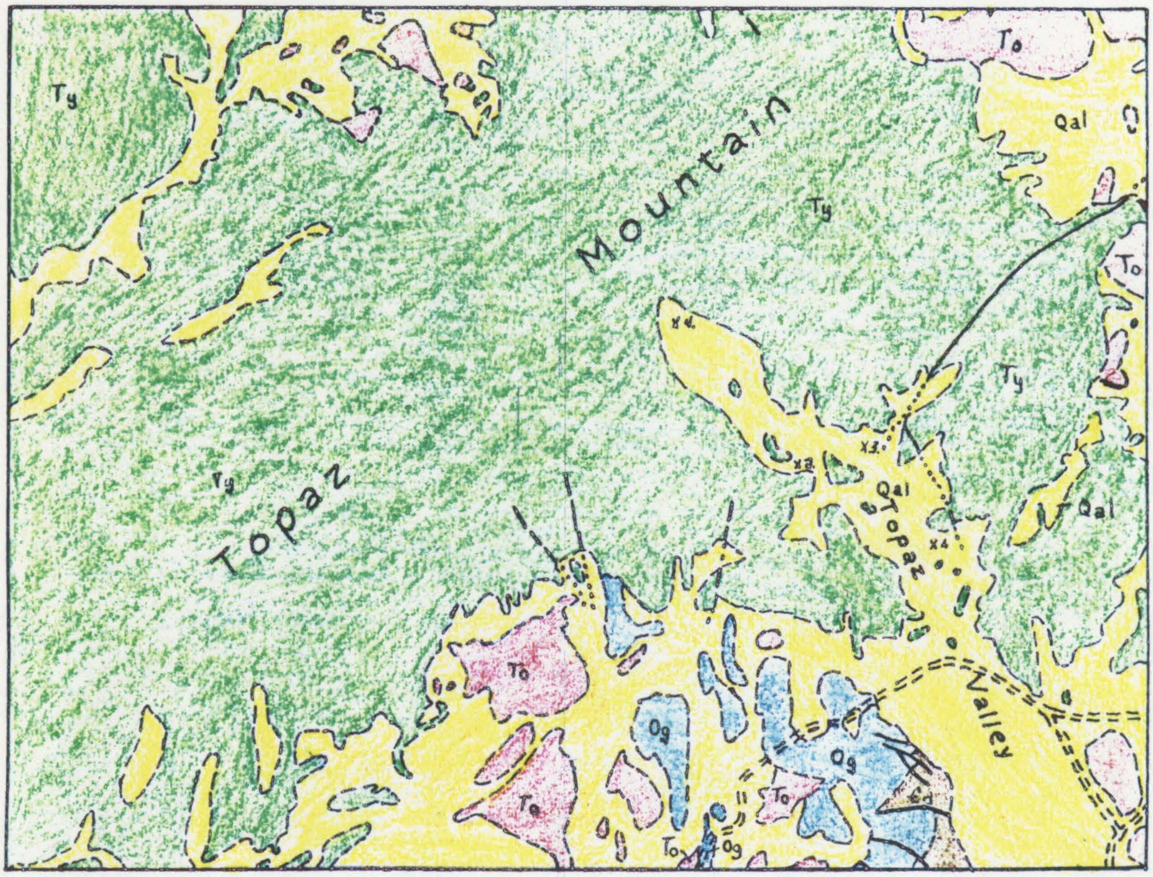
Continued on next page.

Table 4 cont.

TOTALS

Mineral	Total Number of Grains	Percentage of Total
Topaz	238	32.7
Hematite	260	35.8
Bixbyite	94	12.9
Pseudobrookite	13	1.79
Magnetite	42	5.78
Fluorite	5	.69
Green Glass	13	1.79
Unknown	62	8.53
Total Number of Grains Counted	727	

Figure I



GEOLOGIC MAP OF TOPAZ MOUNTAIN, JUAB COUNTY, UTAH

EXPLANATION

QUATERNARY { Qal — Alluvium

TERTIARY { Ty — Younger Volcanics; To — Older Volcanics

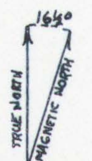
ORDOVICIAN { Og — Garden City formation (limestone)

CAMBRIAN { €d — Dugway Ridge dolomite

SCALE 1:31 680

1 — ½ — 0 — 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL



APPROXIMATE MEAN DECLINATION, 1963

LOCATION

Fault
Dashed where approximately located; dotted where concealed

X 1.
Collection Site

Figure 2

Apparatus Used for Heavy Mineral Seperation

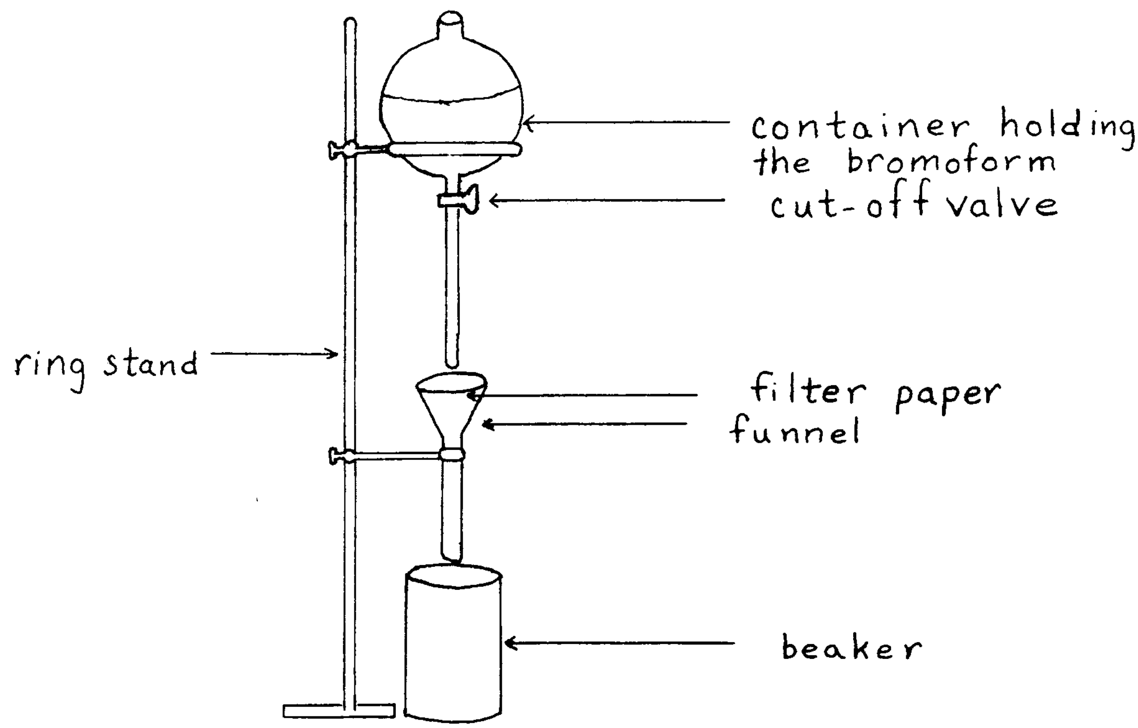
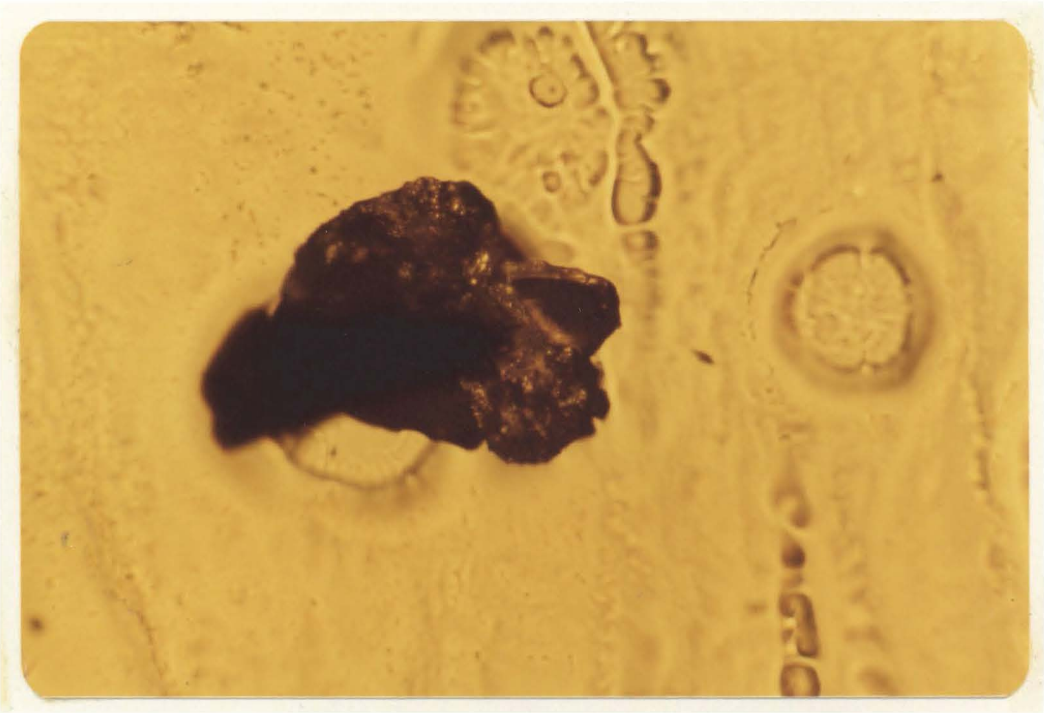


Figure 3



Photomicrograph of hematite. Note plate on right of grain. Reflected light, 40X. From sediment sample 1-C.

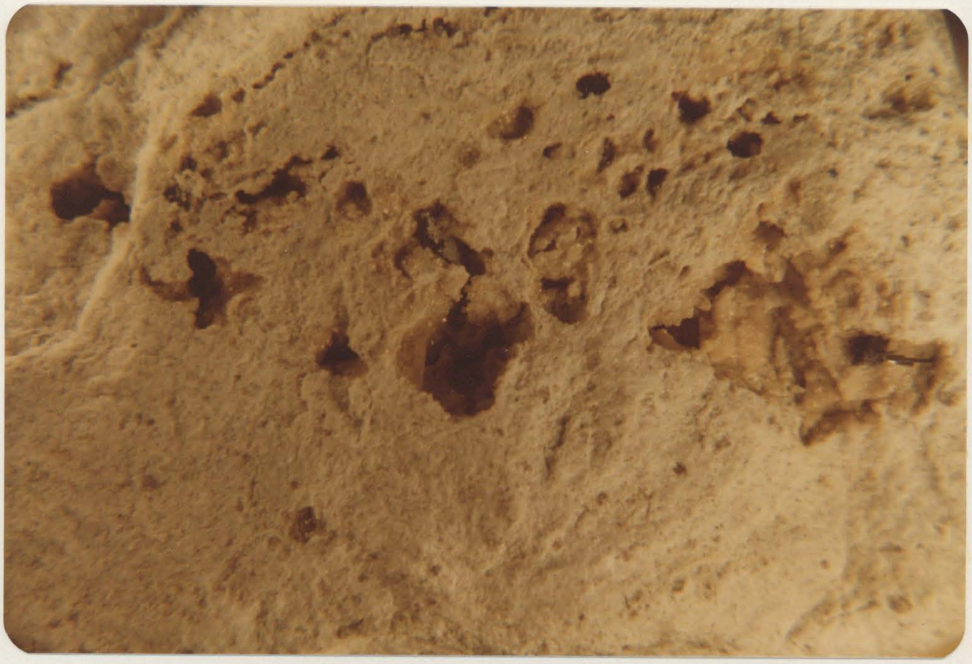
Figure 4

Photograph of "bleached" topaz and pseudobrookite (center). Note doubly terminated topaz crystal (½ inch in length) at top and the matrix found on the topaz crystals.

Figure 5

Photograph of rhyolite from the area (length of 2 inches). Note flow structure.

Figure 6



Photograph of vugs in rhyolite (center vug $\frac{1}{2}$ inch in diameter). Note amber topaz sprinkled throughout the vugs and the pseudobrookite to the far right.

Figure 7

Photograph of quartz on rhyolite typical of the area. Specimen is 2 inches in length.

Figure 8

Photograph of amber topaz ($1\frac{1}{4}$ inches in length). Note matrix on the ends of the large crystal.

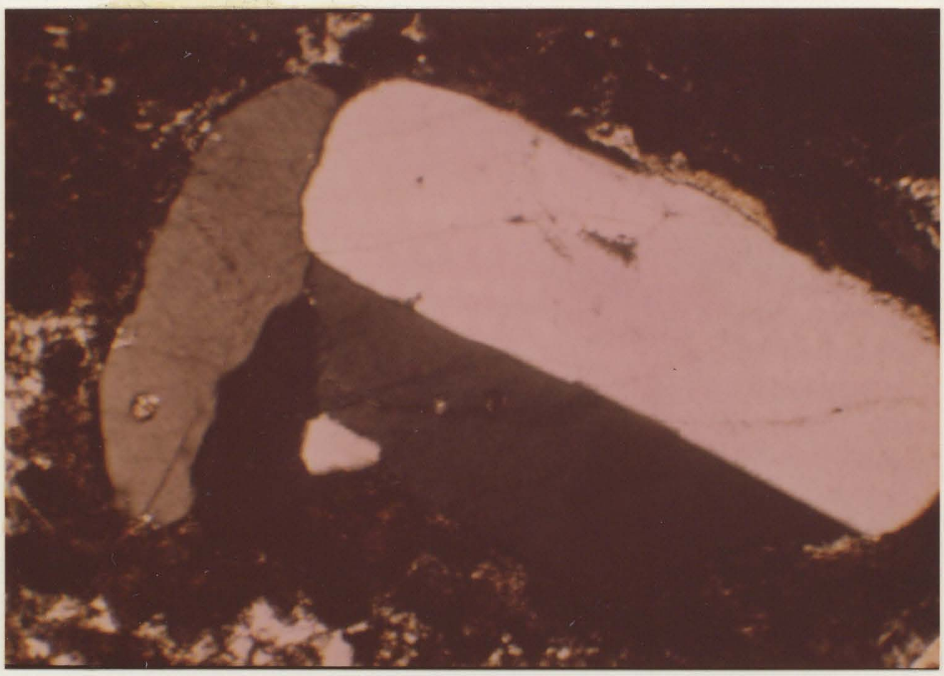
Figure 9

Photograph of topaz enclosing rhyolite matrix ($\frac{1}{2}$ inch in length).

Figure 10

Photograph of topaz with hematite inclusions (1 inch in length). Note double termination.

Figure 11



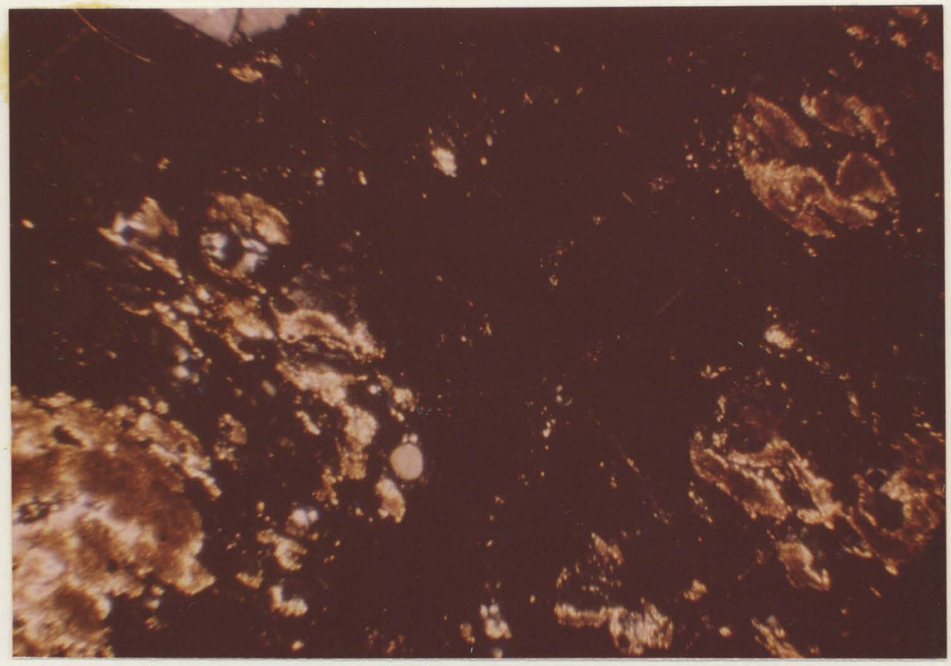
Photomicrograph of sanadine. Crossed nicols, 40X.

From slide 2.

Figure 12

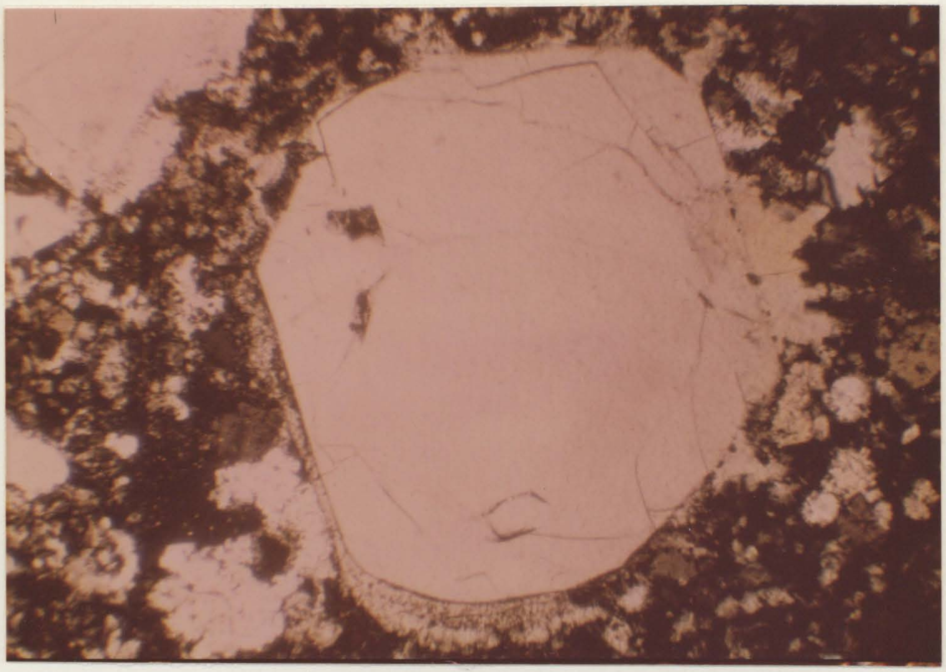
Photomicrograph of plagioclase. Crossed nicols, 40X.
From slide 2.

Figure 13



Photomicrograph of glassy texture seen in slide 3.
Crossed nicols, 40X.

Figure 14



Photomicrograph of quartz from slide 4. Crossed nicols, 40X.

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