UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOCHEMISTRY OF DRY STREAM SEDIMENT AND BEDROCK SAMPLES, TURBINELLA-GAMBEL OAK INSTANT STUDY AREA, MOHAVE COUNTY, ARIZONA

By

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Geochemistry of Dry Stream Sediment and Bedrock Samples, Turbinella-Gambel Oak Instant Study Area, Mohave County, Arizona

The Turbinella-Gambel Oak instant study area is east of the Virgin Mountains in northern Mohave County, Arizona. Relatively flat-lying Permian Kaibab Limestone and Triassic Moenkopi Formation sedimentary strata and Tertiary basalt comprise the exposed bedrock in the area. Summary reports on the geology and on the mineral resource appraisal of the area appear in Throckmorton (1980), and Throckmorton and Hamm (1980).

Dry stream and bedrock samples were collected to augment field observations for the mineral resource determination. These samples were analyzed by the U.S.G.S. six-step semiquantitative spectrographic method and by wet chemical methods (cold acid extraction of heavy metals and copper); results of the analyses appear in Table 1. Sample locations appear on the geologic map, Figure 1. An insufficient number of samples were taken to allow for a meaningful statistical treatment of the analytical data. Thus, in the following discussion, anomalous values are those that are qualitatively, abnormally higher than the majority of the sample values for the same element.

Anomalous values of some elements occur in several stream sediment samples, but considering the magnitude of the anomalous values, the presence of the same elements in unmineralized country rock, and the distribution of the samples containing the anomalous values, it appears that the anomalous values do not indicate the presence of unexposed ore bodies.

Some samples contain anomalously large amounts of barium (Ba) - 2,000 to 7,000 ppm - and strontium (Sr) - 2,000 to more than 10,000 ppm. Ba and Sr were probably derived from Kaibab and Moenkopi evaporite and clastic units, in which the Ba and Sr may have occurred in gypsum, as minor cationic substitute for calcium, or in minerals such as barite or celestite. The one gypsum sample analyzed does not have high values of Sr (300 ppm) or Ba, (not detected), but a silty gypsum does have moderate Sr content (700 ppm). Veizer (1979), however, reported average values of Sr in evaporite rocks: in Paleozoic gypsum deposits - 687 ppm (4 samples from Spitzbergen); in anhydrite - 2040 ppm (34 samples from Germany). In addition, Cadigan (1972) reported the presence of barite in Moenkopi Formation clastic rocks, and a limonitic siltstone analyzed in the present study contains 3000 ppm of Ba, and 1500 ppm of Sr. It thus appears probable that Sr and Ba occur in moderate amounts in country rock, and are concentrated in sediment derived from the country rock.

Zirconium (Zr) occurs in anomalous amounts in several stream sediment samples, and is present in one Moenkopi Formation siltstone sample in relatively large amounts. Cadigan (1972) reported the presence of zircon in Moenkopi Formation rocks. Since zircon is highly resistant to weathering, it is probably concentrated in stream sediments derived from Moenkopi rocks.

Table 1. -- Analyses of samples from the Turbinella-Gambel Oak instant study area, Arizona.

(Samples include: 1-- clay- and silt-size stream sediment particles; 2-- heavy particles separated from stream sediment sized between .19 mm and 2.36 mm; 3-- bedrock samples: 5B limestone conglomerate; 6B silty limestone; 19A gypsum; 19B silty gypsum; 20A limonitic siltstone, 20B friable red siltstone; 20C limestone; 101A limestone; 102B dolomite; 105B sandy dolomite. Results are to be identified with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.12, etc., but are reported arbitrarily as midpoints of these brackets, 1., 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc. The precision of a reported value is approximately plus or minus one bracket of 68 percent, or two brackets at 95 percent confidence. Symbols used are: 1--G, greater than 10 percent, or greater than value shown, 2--W, not detected at limit of detection; 3--L, detected, but below limit of determination. Elements looked for but not found are: Au, Cd, Sb, Sn, W, Th. The limits of detection for bedrock and silt-clay samples are (in units as reported below): Fe, .05; Mg, .02; Ca, .05; Ti, .002; Mn, 10; Ag, 200; Au, 10; B, 10; Ba, 20; Be, 1; Bi, 10; Cd, 20; Co, 5; Cr, 10; Cu, 5; Ca, 20; Mo, 5; Nb, 20; Ni, 5; Pb, 10; Sb, 100; Sc, 5; Sn, 10; Sr, 100; Th, 100; V, 10; W, 50; Y, 10; Zn, 200; Zr, 10. The limits of detection for heavy mineral separates are: (in units as reported below): Fe, .1; Mg, .05; Ca, .1; Ti, .005; Mn, 20; Ag, 1; As, 500; Au, 20; B, 20; Ba, 50; Be, 2; Be, 2; Bi, 20; Cd, 50; Co, 10; Cr, 20; Cu, 10; La, 50; Mo, 10; Nb, 50; Ni, 10; Pb, 20; Sb, 200; Sc, 10; Sw, 20; Sr, 200; Th, 200; V, 20; W, 100; Y, 20; Zn, 500; Zr, 20.)

Semiquantitative Spectrographic Analyses

Sample No.	(percent) Fe	Mg	Ca	Ti	(ppm) Mn	Ag	As	B	Ba	Be	Bi	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr
BEDROCK SAMPLES																									
5B	.2	.3	15	.03	200	N	N	15	200	L	N	N	30	L	L	N	N	N	N	L	150	15	10	N	70
6B	1	.2	20	.015	700	N	N	L	300	N	N	15	150	L	L	N	N	30	N	L	150	20	L	N	20
19A	N	.05	15	.003	10	N	N	N	N	N	N	N	N	L	L	N	N	N	N	N	300	L	N	N	N
19B	.3	1.5	10	.07	50	N	N	15	L	L	N	N	15	N	20	N	N	N	N	L	700	15	N	N	L
20A	15	.3	1.5	.3	30	N	700	30	3000	1	N	15	70	15	30	15	L	20	L	L	1500	50	15	N	500
20B	2	1.5	7	.3	300	N	N	20	700	1.5	N	10	70	30	30	L	N	15	15	7	200	50	50	N	300
20C	.15	.7	G20	.015	70	N	N	N	N	N	N	N	30	N	L	N	N	N	N	N	200	10	10	10	10
101A	.1	3	G20	.015	15	N	N	10	N	N	N	N	20	L	L	N	N	L	L	N	200	15	20	N	L
102B	.3	10	15	.015	70	N	N	15	N	N	N	N	150	5	20	N	N	5	L	L	100	15	30	N	70
105B	3	5	7	3	1000	N	N	30	700	2	N	20	70	50	30	N	L	30	15	10	150	70	20	N	150

Sample No.	Semiquantitative Spectrographic Analyses (percent) Fe	Mg	Ca	Ti	(ppm) Mn	Ag	As	B	Ba	Be	Bi	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr	Colorimetric Analyses cx Hm	cx Cu
STREAM SEDIMENTS, SILT AND CLAY																											
2L	1.5	3	7	.3	300	N	N	15	300	1	N	10	100	15	20	N	N	20	30	7	300	70	30	N	150	3	1
3L	1.5	3	7	.3	300	N	N	20	500	1	N	7	70	15	30	N	N	15	15	7	200	30	30	N	200	5	3
4L	3	3	7	.3	300	N	N	20	300	1	N	15	150	20	30	N	L	30	15	7	300	70	30	N	300	5	3
5L	1.5	1.5	7	.3	300	N	N	15	300	L	N	7	70	15	20	N	N	15	15	5	200	30	30	N	300	5	1
6L	3	3	7	.3	700	N	N	15	500	1.5	N	30	150	30	30	N	L	30	15	10	150	70	30	N	300	5	3
7L	3	3	7	.3	700	N	N	20	300	1	N	30	150	30	20	N	L	30	15	7	200	100	20	N	200	5	1
8L	3	1.5	1.5	.3	700	N	N	15	700	1.5	N	30	150	30	50	N	L	50	15	10	150	100	30	N	300	3	3
9L	3	1.5	2	.5	700	N	N	20	500	2	N	30	150	30	30	N	L	70	15	10	300	70	30	N	300	5	3
10L	3	3	7	.3	700	N	N	20	700	1.5	N	30	200	30	30	N	L	70	15	15	200	100	30	N	300	5	5
11L	3	1.5	3	.3	500	N	N	20	500	1	N	30	150	20	30	N	L	70	15	7	150	70	30	N	500	5	1
12L	3	1.5	1.5	.3	500	N	N	20	700	1.5	N	30	150	30	30	N	L	70	15	10	150	100	30	N	500	3	3
13L	2	3	7	.3	500	N	N	30	300	1	N	10	70	15	20	N	N	20	15	7	200	70	30	N	150	5	1
14L	3	3	7	.3	700	N	N	30	300	1.5	N	15	70	30	30	N	N	30	15	10	150	70	30	N	150	5	3
15L	3	1.5	3	.3	700	L	N	20	500	2	N	20	100	30	30	N	N	30	15	7	150	70	30	N	200	3	3
16L	1.5	.3	.3	.3	500	N	N	10	300	1	L	15	70	20	L	N	N	20	15	5	L	70	15	N	150	1	5
17L	3	3	1.5	.7	700	N	N	15	700	1	N	30	700	50	30	N	L	15	15	10	100	100	30	N	300	5	3
18L	3	3	7	.3	500	N	N	15	500	1	N	20	150	30	30	N	L	30	30	7	150	70	30	N	150	5	3
100L	3	3	5	.7	700	N	N	15	500	1.5	N	30	300	30	30	N	L	70	15	10	150	70	30	N	300	3	1
101L	3	3	7	.3	700	N	N	20	300	1	N	15	150	20	20	N	N	50	15	7	150	50	30	N	200	3	1
102L	2	3	7	.3	500	N	N	15	300	1	N	15	150	15	30	N	N	30	15	7	150	30	20	N	200	5	1
103L	1.5	3	7	.3	700	N	N	30	300	1.5	N	15	150	20	30	N	N	30	15	7	150	30	30	N	300	7	3
104L	3	3	7	.3	700	N	N	20	500	1.5	N	30	150	20	30	N	N	30	15	7	200	70	30	N	150	5	3
105L	3	1.5	2	.5	700	N	N	15	700	1.5	N	30	150	30	30	N	L	50	15	7	150	70	30	N	300	5	3
106L	3	3	7	.3	700	N	N	15	700	1	N	30	150	30	30	N	L	50	15	10	150	70	30	N	200	5	3
107L	1.5	1.5	7	.3	500	L	N	20	500	1	N	10	100	15	30	N	L	20	20	7	150	50	30	N	300	L(1)	3

Sample No.	Semiquantitative Spectrographic Analyses (percent)				(ppm)																			
	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Bi	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr
HEAVY PARTICLE SEPARATE, MAGNETIC FRACTION																									
2Hm	15	7	3	.7	1500	N	N	L	700	L	N	50	1500	100	70	10	L	300	50	30	500	150	30	N	150
3Hm	30	10	3	1	3000	N	N	20	700	L	N	150	3000	150	L	20	L	700	70	30	700	300	30	L	100
4Hm	15	7	3	1	3000	N	N	L	1000	L	N	150	2000	700	L	N	L	300	70	30	300	300	20	L	150
5Hm	3	7	1.5	.7	3000	N	500	20	1000	2	N	150	3000	500	70	50	N	700	150	15	L	300	30	700	150
6Hm	15	7	5	1.5	1500	N	N	L	1000	L	N	70	700	70	5	N	50	300	N	30	700	150	20	N	200
7Hm	15	10	7	1	2000	N	N	L	1500	L	N	100	1500	100	70	N	50	300	L	30	700	200	30	N	150
8Hm	15	7	3	1	2000	N	N	L	700	L	N	100	1500	100	50	N	L	300	L	30	500	150	30	N	150
9Hm	15	7	3	1	2000	N	N	L	700	L	N	150	2000	150	50	N	L	300	L	30	300	300	20	N	150
10Hm	7	7	3	.7	1500	N	N	L	700	L	N	70	1500	70	50	N	L	300	N	20	300	150	20	N	150
11Hm	15	7	3	1.5	2000	N	N	L	700	L	N	100	1500	100	50	N	L	300	L	20	300	300	20	N	150
12Hm	15	7	3	1	2000	N	N	L	700	L	N	150	1500	150	50	N	L	300	20	30	300	300	30	N	100
13Hm	15	7	3	1	3000	N	N	L	700	L	N	100	1500	70	50	N	L	700	20	30	700	200	30	N	700
14Hm	15	7	3	.7	1500	N	N	L	700	2	N	70	1500	70	70	N	50	300	30	30	700	150	30	N	200
15Hm	15	10	3	1	1500	N	N	L	700	L	N	150	1500	100	50	N	L	500	20	30	300	200	20	N	150
16Hm	15	10	.3	.3	1500	N	N	L	300	L	N	150	3000	70	50	N	N	700	30	10	N	150	L	N	200
17Hm	15	15	3	.7	1500	N	N	L	700	L	N	150	3000	50	50	N	L	700	L	20	300	150	20	N	150
18Hm	15	7	3	.7	1500	N	N	L	700	L	N	100	1500	150	50	N	L	300	L	30	500	150	20	N	150
100Hm	15	7	3	1	1500	N	N	L	700	L	N	70	1500	70	L	N	L	300	L	20	700	150	20	N	150
101Hm	15	7	5	1.5	1500	N	N	L	700	2	N	70	1500	70	L	N	L	300	L	30	700	150	20	N	300
102Hm	15	7	3	.7	2000	N	N	L	700	L	N	70	1500	70	50	N	L	300	30	20	300	150	20	N	150
103Hm	15	10	3	1.5	3000	N	N	L	700	L	N	150	2000	100	50	N	50	500	30	30	700	200	20	N	300
104Hm	15	7	3	1.5	3000	N	N	L	1000	L	N	70	1500	100	70	N	70	300	L	30	700	200	30	N	200
105Hm	15	10	3	1.5	2000	N	N	L	700	L	N	100	1500	150	50	N	L	300	20	30	300	200	30	N	150
106Hm	7	5	2	.7	700	N	N	N	200	N	N	50	700	50	N	N	N	200	N	15	200	150	L	N	300
107Hm	15	7	3	1.5	1500	N	N	L	700	3	N	70	1000	100	70	N	50	300	30	20	500	200	30	L	700

Sample No.	Semiquantitative Spectrographic Analyses (percent) Fe	Mg	Ca	Ti	(ppm) Mn	Ag	As	B	Ba	Be	Bi	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr
HEAVY PARTICLE SEPARATE, NON-MAGNETIC FRACTION																									
2H	15	7	3	.15	700	N	N	20	300	L	N	100	1500	100	50	20	N	700	150	10	200	150	50	L	500
3H	15	7	1.5	.2	1000	N	N	20	7000	L	N	70	700	200	70	30	N	700	150	L	G10000	150	70	N	700
4H	15	7	1	.3	1500	N	N	20	1500	L	N	150	1500	100	50	10	N	500	70	15	2000	150	20	N	300
5H	15	5	1.5	.15	700	N	N	50	700	L	N	70	700	300	70	30	N	700	150	L	200	150	50	L	2000
6H	15	10	3	.7	1500	N	N	L	700	L	N	100	1500	100	50	10	L	500	50	20	500	150	30	N	150
7H	10	15	3	.3	1000	N	N	L	700	N	N	100	1500	50	L	N	L	500	20	20	700	100	L	N	150
8H	10	15	1.5	.3	1500	N	N	L	500	N	N	150	1500	70	L	L	L	700	30	20	200	150	20	N	500
9H	15	15	.7	.3	1500	N	N	L	1500	N	N	150	3000	30	50	N	N	700	L	15	L	100	30	N	700
10H	15	15	2	.3	1500	N	N	L	1500	L	N	150	2000	50	L	N	N	700	30	20	300	100	30	N	1500
11H	15	15	1.5	.7	1500	N	N	70	300	L	N	150	1500	70	150	N	L	1500	30	20	L	150	70	N	G2000
12H	15	15	.3	.15	1500	N	N	L	200	L	N	150	1500	20	50	N	N	700	L	10	L	70	20	N	200
13H	15	7	1.5	.3	3000	N	N	150	7000	L	N	70	1500	300	50	50	N	1000	150	15	G10000	150	100	N	G2000
14H	15	10	3	.15	1500	N	N	L	2000	L	N	150	1500	1000	70	20	N	700	150	15	1000	150	30	N	150
15H	20	15	1	.5	1500	N	N	30	1500	L	N	150	3000	100	100	N	L	2000	30	15	L	150	70	N	G2000
16H	15	15	.15	.2	1500	N	N	L	300	L	N	150	3000	30	50	L	N	700	30	10	N	150	20	N	300
17H	15	15	1.5	.3	1500	N	N	L	200	L	N	150	3000	20	50	N	N	700	N	20	N	150	L	N	70
18H	15	7	3	.3	1500	N	N	L	1500	L	N	70	1500	150	L	10	N	700	100	20	300	150	20	N	200
100H	15	7	1.5	.3	1500	N	N	L	700	L	N	150	2000	50	50	N	N	700	30	15	200	150	L	N	150
101H	15	7	2	.3	1500	N	N	L	500	L	N	70	1000	70	50	L	N	500	70	15	200	100	20	N	700
102H	15	10	3	.3	1500	N	N	20	100	L	N	100	2000	150	50	15	N	700	100	30	200	150	30	N	500
103H	15	10	3	.3	1500	N	N	L	300	L	N	150	1500	70	50	15	N	1000	100	30	L	150	50	N	1500
104H	15	10	1.5	.3	1500	N	N	L	700	L	N	150	1500	100	50	10	N	700	150	10	L	150	L	N	150
105H	15	10	2	.5	1500	N	N	20	2000	L	N	150	2000	70	50	10	N	700	70	30	200	150	30	N	1000
106H	15	7	3	.5	1500	N	N	L	500	L	N	100	1000	70	50	N	N	500	30	20	300	150	20	N	300
107H	15	5	10	.7	1500	N	N	150	300	3	N	50	700	100	200	10	N	700	150	15	300	150	200	N	G2000

In several stream sediment samples, anomalous values of nickel (Ni) - 2,000 ppm - and and chromium (Cr) - 3,000 ppm - appear to be the result of residual concentration of minerals composed of these elements in sediment derived from weathering basalt. Results of a spectrographic analysis of a basalt (Locality 2764) are: Ni - 200 ppm, and Cr - 700 ppm. The high values of Cr and Ni in most of the stream sediment samples also reflect partial deviation of the sediment from basaltic rock.

Anomalous values of arsenic (As), copper (Cu), and zinc (Zn) are unaccounted for, but are insignificant. The values are low on an absolute scale, and the anomalous sediments are isolated, and not supported by adjacent anomalies.

In summary, geochemical sampling and analysis has detected relatively large or anomalous amounts of some elements in stream sediment samples; however, in most instances these high values are accountable by considering the geologic setting of the area. The remaining high values are insufficiently high to be geologically significant. The results indicate that in the study area, there are no economically significant mineral deposits that are detectable by the geochemical methods employed.

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