GEOCHEMICAL SURVEY OF THE ATLANTIC CITY GOLD DISTRICT

INTRODUCTION

The Atlantic City gold district includes an area of about 20 mi² (52 km²) at the southern end of the Wind River Range in southwestern Wyoming. The district is in Fremont County about 25 miles (40 km) south of Lander and 90 miles (145 km) north-northeast of Rock Springs. The Atlantic City iron mine, an important taconite deposit that has been mined since 1962, is about 3 miles (5 km) north of the main gold district. The district has a population of several dozen people, most of whom reside in two "ghost" towns—South Pass City at the southwestern end of the district and Atlantic City in the central part. The former town of Miners Delight at the northeastern end of the district is now deserted.

Placer gold was discovered in 1842 in the region that includes the Atlantic City district (Beeler, 1904, p. 4), and placers were worked sporadically for the next 25 years. Their full development, however, was inhibited by the remoteness of the region, inadequate water supply, severe winters, and hostile Indians.

The discovery of the Carissa lode in 1867 precipitated a boom, and for a few years the district flourished. In 1869, the district had a population of 2,000 (Spencer, 1916, p. 24), but the boom was short-lived. By 1871, most of the principal veins of the district had been discovered and the area was on the decline. By 1875, all of the mines of the district were virtually idle.

Following the initial boom and decline, innumerable attempts were made to revitalize the district by reopening old mines or developing new ones. Some of the early attempts involved elaborate and costly schemes, but none was successful. A 25-mile (40-km) long series of ditches and flumes was completed in 1886 to bring water from Christina Lake to work placer deposits in the district; they were apparently used only three seasons (Spencer, 1916, p. 25). A 2800-foot (850-m) adit was started north from Rock Creek to cut a series of promising veins at depth in the NE¼ sec. 11 and SE¼ sec. 2, T. 29 N., R. 100 W.; it was abandoned before it was half completed. An elaborate but inefficient mill was constructed west of Atlantic City in 1905; the first 12,000 tons of ore processed in the mill contained $5 to $30 per ton gold but yielded only $6,000 worth of gold total (Trumbull, 1914, p. 86).

The decline of the district and the failure of efforts to revitalize it were due, in part, to free-milling ore giving way in depth to refractory sulfide ore and to the attendant milling problems. Other significant factors were poor, and at times incompetent technical management of the local operations and gross misrepresentation on the part of unscrupulous promotors, which combined to make investors wary and adequate financing difficult to obtain (Knight, 1901, p. 9).

In more recent times, numerous serious and well-considered attempts have been made to revitalize the district, but almost all have been unsuccessful. Except for about $400,000 worth of gold (11,500 oz [358 kg]) produced from operations between 1933 and 1941 (Armstrong, 1948, p. 36), very little gold has been developed or produced since the early days of the district.

Precise gold production figures for the district are difficult to obtain. Jamison (1911, p. 80) estimated the total production to be $5.86 million (280,000 oz [8,709 kg]). Spencer (1916, p. 28) considered this estimate too high and placed the total production at $1.5 million (72,500 oz [2,255 kg]). Armstrong (1948, p. 37) accepted Spencer's figure and added production during the intervening years to reach a total of $2.0 million (96,000 oz [2,675 kg]). The most recent and probably most reliable estimate places the total production of the district at 70,000 oz (2,177 kg) (Koschmann and Bergendahl, 1968, p. 263). About two-thirds to three-fourths of the gold was produced from lode deposits and the remainder from placers. The bulk of the lode production has come from four mines—the Carissa, Miners Delight, Caribou, and Garfield.

PRESENT STUDY

R. W. Bayley mapped the geology of the four quadrangles that include the Atlantic City gold district (1965a–d) and suggested that the arsenic content of soils here might be a useful indicator of concealed gold veins (Bayley and Janes, 1961). Bayley's suggestion was based on data collected along four traverses at the northeastern end of the district. The present study was undertaken to test the usefulness of this method throughout the district and to map the ore deposits and mine areas.

Field work for this study was done in the summer of 1966. Soil samples were collected along traverses crossing favorable structures and host rocks throughout the district. Geologic maps prepared by Bayley (1965a–d) were used to guide this work. Veins and mine workings were located and sampled, and bedrock in most areas showing anomalous arsenic in the soils was also sampled.

This study has shown that the arsenic content of soil is of limited use in the search for concealed gold veins. The district does, however, contain numerous "teasers", thus prospecting and exploration can be expected to continue. They will probably, however, be of a relatively small scale as they have been for the past couple of decades.

I wish to thank the residents of Atlantic City for their cooperation and hospitality and for making our stay there a pleasant one. Soil sampling was done by J. Douglass Fox and Edward R. Leydon; soil samples were analyzed in the field by Theodore A. Roemer. Their assistance is gratefully acknowledged.

TABLE 1.—*Analyses of rock samples from the Atlantic City gold district, Fremont County, Wyoming*

[All values in ppm except Ti which is in percent. Au and Hg by atomic adsorption and As by colorimetric methods; all others by semiquantitative spectrographic analysis. Looked for but not detected (lower limit of detection in ppm shown in parentheses): Cd (20), Nb (20), Sb (100), Sn (10), and W (50). Detected but in low concentrations or in only a few samples: Ag—<0.5 ppm except 5 ppm in 147 and 200, and 7 ppm in 133; Be—1 ppm or less except 2 ppm in 172 and 7 ppm in 93; Bi—7 ppm or less except 15 ppm in 203 and 1,000 ppm in 200; La—20 ppm or less except 30 ppm in 180 and 50 ppm in 201; Mo—2 ppm or less except 3 ppm in 169, 7 ppm in 147, 10 ppm in 203, and 15 ppm in 200; Sc—15 ppm or less except 30 ppm in 169; Y—10 ppm or less except 15 ppm in 109 and 201, and 20 ppm in 203; and Zn—<200 ppm except 200 ppm in 147. Analysts: G. Dounay, A. Farley, Jr., W. Ficklin, J. Friskin, B. Hansen, E. Martinez, F. Michaels, R. Miller, S. Noble, and T. Roemer]

Sample no.[1]	Au	As	Hg	Cu	Pb	Ni	Cr	Co	Mn	V	Ba	Sr	Zr	B	Ti	Remarks
Quartz veins																
2	17.5	60	0.09	<5	<10	<2	<20	<5	<10	<10	<200	<100	<20	<10	0.05	Grab sample from dump.
16	4.5	30	0.01	<5	15	<2	<20	<5	20	10	<200	500	<20	30	0.07	Calcite rich.
19	<0.1	450	0.07	20	<10	50	20	10	150	15	300	500	<20	10	0.15	Grab sample from dump.
22	<0.1	450	0.14	50	<10	30	<20	<5	10	200	<200	<100	<20	<10	0.02	Limonite rich.
23	<0.1	20	0.17	5	<10	<2	<20	10	15	<10	<200	<100	<20	<10	<.001	Very fine grained quartz.
95	0.4	250	0.16	5	<10	<2	<20	<5	50	300	500	1,500	150	20	0.5	Grab sample from dump.
100	26.0	450	0.27	5	<10	3	<20	20	50	10	<200	150	<20	<10	0.03	Do.
105	1.8	250	0.13	7	<10	10	<20	5	150	70	300	700	100	<10	0.2	Brecciated vein.
107	0.4	450	0.12	10	20	20	30	10	70	30	700	700	100	15	0.3	2½–foot vein in pillar; stoped from below.
126	0.2	250	0.15	<5	<10	2	<20	<5	50	<10	<200	<100	<20	15	0.03	Grab sample from dump.
127	10.9	300	0.13	<5	<10	2	<20	<5	30	<10	<200	<100	<20	30	0.07	Do.
128	0.2	100	0.22	<5	<10	3	<20	<5	100	<10	<200	200	<20	20	0.15	Do.
137	<0.1	<10	0.08	<5	<10	<2	<20	<5	10	70	<200	<100	<20	<10	0.005	Stringer in sample 136.
140	0.1	30	0.28	7	<10	70	150	10	300	50	500	200	70	20	0.15	Grab sample from dump; mixed quartz and mica schist.
141	0.9	600	0.22	20	<10	15	20	<5	100	70	200	<100	30	200	0.07	3–foot vein.
147	0.1	250	0.14	>20,000	<10	50	<20	20	70	50	200	<100	<20	10	0.015	Copper rich.
167	0.2	450	0.09	10	<10	5	<20	<5	500	50	700	150	150	<10	0.2	Grab sample from dump; mixed quartz and graywacke.
168	0.3	600	0.08	7	<10	10	<20	<5	200	70	700	150	150	<10	0.3	Do.
169	47.3	250	0.18	100	<10	30	100	<5	300	200	300	100	70	10	0.5	2–foot vein; mixed quartz and metagabbro.
191	0.2	10	0.05	10	<10	2	<20	10	70	<10	<100	<100	20	<10	0.03	Grab sample from center of 40–foot vein.
192	0.1	30	0.06	500	<10	50	30	10	70	20	100	<100	50	<10	0.07	2–foot vein.
196	<0.1	100	0.07	20	<10	30	70	7	200	10	200	<100	100	<10	0.3	15–foot vein; mixed quartz, graywacke, and metagabbro.
200	2.5	100	0.37	>20,000	300	10	30	<5	20	70	150	200	50	<10	0.1	1–foot vein; copper stained.
202	0.4	10	0.20	70	<10	50	<20	<5	15	<10	<100	<100	<20	<10	0.007	Thin stringers.
Limonite—rich shear zones (quartz free)																
93	2.8	1,200	0.13	100	<10	50	50	<5	300	200	300	1,500	20	20	0.3	Contact between metagabbro and mica schist.
133	32.8	250	0.16	15	30	50	150	10	200	30	700	1,000	100	15	0.3	Sheared graywacke and mica schist.
175	<0.1	80	0.10	15	<10	100	200	<5	300	50	150	<100	150	<10	0.2	10–foot shear zone.
201	<0.1	40	0.18	300	<10	<2	300	5	300	100	300	150	150	10	0.2	Brecciated graywacke and mica schist; 50 feet thick.
203	<0.1	250	0.21	300	<10	50	70	7	200	100	700	150	70	200	0.07	Highly altered graphitic schist.
Miners Delight Formation—metagraywacke, mica schist, and gneiss																
134	0.1	10	0.16	10	20	70	150	10	300	30	700	1.500	100	30	0.5	Adjacent to limonitic shear-zone sample 133.
135	<0.1	100	0.14	5	<10	30	150	10	300	70	300	200	150	10	0.15	Some limonite stain.
136	<0.1	20	0.10	5	<10	50	150	10	200	70	500	300	150	<10	0.2	Some limonite stain; host for quartz vein sample 137.
138	0.1	60	0.43	<5	10	20	100	10	300	<10	500	200	100	15	0.15	Some limonite stain.
142	<0.1	<10	0.17	<5	<10	30	150	10	300	70	500	200	70	<10	0.2	
143	0.1	60	0.14	<5	10	50	150	<5	300	70	500	150	100	<10	0.15	
144	0.1	30	0.19	5	10	50	150	<5	300	70	700	200	70	<10	0.15	
145	<0.1	10	0.18	<5	<10	50	150	<5	300	50	300	100	70	<10	0.1	
152	<0.1	80	0.19	300	20	70	150	<5	300	200	500	150	100	<10	0.2	
153	<0.1	30	0.17	70	15	50	150	<5	300	50	500	300	150	<10	0.2	
156	<0.1	20	0.12	10	20	70	150	<5	300	70	500	200	150	<10	0.2	
157	0.1	20	0.11	5	15	70	150	<5	500	70	700	200	150	<10	0.15	
160	<0.1	10	0.07	5	20	70	150	<5	300	70	500	100	150	<10	0.2	
161	<0.1	30	0.08	7	20	70	150	<5	300	70	700	100	150	10	0.2	
163	0.1	10	0.17	5	10	50	150	10	150	50	700	300	100	150	0.2	
164	<0.1	10	0.11	5	10	50	150	10	200	50	700	300	100	70	0.15	
165	0.1	30	0.08	7	<10	70	150	10	200	50	1,000	300	100	70	0.2	
166	<0.1	30	0.17	10	20	50	150	10	200	50	700	150	100	<10	0.2	
172	<0.1	60	0.09	<5	<10	50	150	<5	200	50	700	150	100	30	0.2	
180	<0.1	80	0.06	7	10	30	70	<5	300	50	700	<100	150	70	0.3	
193	<0.1	20	0.05	<5	10	70	100	7	300	30	700	300	70	<10	0.3	Host for quartz-vein sample 192.
195	<0.1	30	0.05	<5	10	150	300	7	300	50	700	300	100	30	0.3	
197	<0.1	60	0.17	10	<10	70	150	<5	200	70	500	200	150	15	0.2	
198	<0.1	30	0.20	10	<10	70	150	<5	200	70	300	200	100	<10	0.2	
199	<0.1	<10	0.13	7	<10	70	100	5	300	100	500	200	100	20	0.15	
205	<0.1	30	0.19	10	30	50	100	7	200	70	700	150	100	30	0.2	
206	<0.1	20	0.10	15	20	70	150	7	300	70	700	200	100	70	0.3	
207	0.1	10	0.10	5	10	70	150	<5	300	70	700	300	150	100	0.3	
Miners Delight Formation—graphitic schist																
109	<0.1	10	0.12	5	10	20	<20	<5	500	100	500	1,500	150	10	0.7	
174	<0.1	20	0.09	<5	<10	<2	30	5	50	15	500	<100	150	<10	0.2	Contains sparse quartz.
Metadacite porphyry																
104	<0.1	10	0.18	20	<10	150	300	<5	500	150	700	2,000	70	200	1.0	

[1] Sample locations shown on geochemical and geologic map.

GENERAL GEOLOGY

The Atlantic City gold district is underlain primarily by folded and faulted metasedimentary and metavolcanic rocks intruded by metamorphosed mafic and less abundant silicic rocks. These rocks are all Precambrian in age and are overlain unconformably by gently-dipping Cambrian sedimentary rocks and by flat-lying upper Tertiary sediments. The following geologic summary draws heavily on the work of Bayley (1965a–d and 1968).

The oldest unit in the district is the Miners Delight Formation, which consists mainly of metamorphosed sedimentary rocks—brown to dark-gray graywacke, mica schist and gneiss, and some conglomerate. Bedding is generally well developed and well preserved, and graded bedding is common. A distinctive, black graphitic schist member shown separately on the map is commonly sheared and limonitic and is the host for many gold-bearing quartz veins. The Miners Delight Formation also contains some metamorphosed mafic flows—ellipsoidal greenstone and meta-andesite. The formation is 5,000 to 10,000 feet (1,525 to 3,050 m) thick.

Several essentially conformable bodies of metadacite porphyry occur in the Miners Delight Formation. These are interpreted as sills, but the possibility that some might be flows cannot be eliminated.

Numerous sills and dikes of chloritic and hornblendic metagabbro cut the Miners Delight Formation. Metagabbro commonly preserves remnants of original igneous textures. It generally forms essentially conformable bodies in the Miners Delight Formation, but most bodies show local crosscutting relationships with the enclosing rocks. Individual sills are as much as a few hundred feet thick and some can be traced for several miles although offset by faults. Metagabbro was called amphibolite or diorite by some of the early workers in the area.

Dikes and plugs of metamorphosed leucodacite and tonalite cut metagabbro and Miners Delight Formation, and are the youngest rocks in the district to host gold-bearing veins. The Mary Ellen mine in the central part of the district is developed on a vein in a metatonalite plug.

The rocks described above are intruded by the Louis Lake batholith, a huge mass of Precambrian quartz diorite and granodiorite west and northwest of the district. Pegmatite dikes at the southwestern end of the district are related to this batholith. A few dikes of unmetamorphosed diabasic gabbro cut the batholith and other rocks.

The Precambrian rocks in the district have a general northeast to east-northeast strike and steep dip—generally within 20° of vertical. In the northern part of the district the structure is relatively simple; the progression upward in section to the north is interrupted only by local folding. To the south, the rocks are in isoclinal folds which were refolded during intrusion of the Louis Lake batholith.

The rocks are cut by steeply-dipping faults of at least two ages—one group pre-dating intrusion of the Louis Lake batholith and another that cuts the batholith. Insofar as the localization of gold veins is concerned, the most important structures are pre-batholith faults and shear zones that are parallel or subparallel with the regional northeast to east-northeast trend as defined by bedding, schistosity, and sill contacts.

The gold deposits of the Atlantic City district are undoubtedly very old—early Precambrian in age. Bayley (1968, p. 602) suggests that the source of the gold was the Louis Lake batholith which has been dated as 2.2 to 3.3 b.y. old. Lead isotope studies by Cannon and others (1966) indicate an age of 2.75 b.y. for galena in gold veins at the Mary Ellen and Snowbird mines.

GOLD-BEARING VEINS

Most of the lode gold in the district occurs in quartz veins in fracture or shear zones; some also occurs in limonite-rich shear zones containing little or no quartz. The veins are composed predominantly of white to gray to black quartz; most quartz is coarse grained, but locally it is very fine grained. At the surface, the veins contain varying amounts of limonite; at depth, pyrite and arsenopyrite. In places, particularly in the area north and east of the Duncan mine, the quartz veins show a copper stain at the surface, and Spencer (1916, p. 32) reports sparse chalcopyrite in some veins. Galena has been noted at the Mary Ellen mine (Spencer, 1916, p. 32) and at the Snowbird mine (Bayley, 1968, p. 602). Spencer (1916, p. 32) also reports finding pyrrhotite. Tourmaline accounts for the dark color of some veins, and calcite is locally abundant, particularly at the Snowbird mine. Gold is apparently associated with the sulfide minerals. The veins commonly contain slivers or horses of wall rock, and some vein material is brecciated.

Most of the veins occur within or near the borders of the graphitic schist member of the Miners Delight Formation or the metagabbro sills. Less commonly, they occur in Miners Delight graywacke and schist near the graphitic schist member or from metagabbro intrusives, as at the Shields, B & H, and W. J. Bryan mines. At the Mary Ellen mine, the principal vein is in a plug of metatonalite.

The veins generally strike northeast to east-northeast parallel or subparallel with the regional structural grain. Markedly divergent trends are noted at the Mary Ellen and Miners Delight mines where the veins make sharp, almost right-angle turns. Examples of other veins with divergent trends are at the B & H mine and in metagabbro northwest of the Gold Dollar mine adit. Except for the vein at the Mary Ellen mine, all veins are steeply dipping—most within 10° of vertical and all within 30°.

The veins are extremely variable in thickness and persistence. They range from a few inches to 50 feet (15 m) in thickness, but very thick quartz veins here are generally poor in gold. A few veins can be traced for a half-mile or so along strike, but most are not that extensive; some are simply small lenses or pods. The thickest and most persistent veins are in the graphitic schist member of the Miners Delight Formation; this member is about 100 feet (30 m) thick and is in places almost completely replaced by vein quartz. Little is known of the persistence of the veins at depth because the deepest mine, the Carissa, is only 385 feet (117 m) deep. On the lowest level of that mine, the vein has been followed for over 600 feet (183 m) (Bartlett and Runner, 1926, p. 6; Armstrong, 1948, pl. 4), suggesting that the vein continues to a somewhat greater depth.

Gold is irregularly distributed in the veins, and thus it is difficult to determine their average tenor. Knight (1901, p. 27–34) collected 13 samples of several pounds each from a number of mines in the district. Two samples were exceptionally high grade and one was low grade; the remaining ten samples contained between 0.162 and 2.16 oz/ton (5.04 and 67.2 ppm) gold and averaged 0.9 oz/ton (28 ppm). Spencer (1916, p. 32–33) concluded that the average grade ranged from 0.3 oz/ton (9 ppm) to possibly as high as 0.7 oz/ton (22 ppm). Several of the old reports make frequent mention of ore in the 0.25 to 0.4 oz/ton (8 to 12 ppm) range, and this is probably closer to the average tenor of the veins. The average of the 21 samples of vein and limonitic shear zones shown in table 1 that contain detectable gold is 0.23 oz/ton (7.2 ppm); if samples containing less than the limit of detection (0.003 oz/ton, 0.1 ppm) are also included, the average would be much lower. Comparable results were obtained by Bayley (oral commun., 1966).

The existence of large bodies of low-grade ore has been postulated in the district, but to date this idea has not been well documented. Beeler (1904, p. 13) first suggested the existence of such bodies but offered no proof. Spencer (1916, p. 31–32) reported that metadacite porphyry (quartz porphyry) in the SE¼ sec. 36, T. 30 N., R. 100 W. contains 0.1 to 0.25 oz/ton (3 to 8 ppm) gold; a sample of metadacite porphyry collected northeast of the area sampled by Spencer, however, contains less than 0.1 ppm gold (table 1, sample 104). The graphitic schist member of the Miners Delight Formation is host for many gold-quartz veins and is in many places limonite stained, but two analyzed samples of this unit also showed less than 0.1 ppm gold (table 1, samples 109 and 174). The metadacite porphyry and graphitic schist units, however, have not been adequately sampled and should be tested further to determine if they contain low-grade ore.

ARSENIC IN OVERBURDEN

Samples of overburden, generally a rocky, poorly-developed soil supporting only scrub vegetation, were collected every 100 feet (30 m) along a series of traverses crossing structures and rock units favorable for the occurrence of gold-bearing veins. A handfull of debris, generally a mixture of rock and soil, was collected from the bottom of a hole about three inches (8 cm) deep. Test samples from deeper holes gave essentially the same results, thus showing that the extra time involved in digging a deeper hole was not warranted. Insofar as possible, areas of Tertiary and Quaternary sediments, obviously transported debris, and mine waste were avoided in sampling.

Samples were screened to minus 80 mesh, and a split of the fine fraction was ground for analysis. This fraction was found to give more consistent results than if the coarse material was also included. The samples were analyzed for arsenic in a field laboratory by a colorimetric method with a lower limit of detection of 10 ppm.

About 2,400 samples of overburden were collected and analyzed. Although 364 samples contained detectable arsenic, 275 of these were at or just above the limit of detection—10 to 15 ppm; 75 samples contained 20 to 40 ppm and 14 contained 60 ppm or more. Even the low concentrations of arsenic appear, for the most part, to reflect bedrock conditions because the overwhelming majority of the samples contained no arsenic, and samples containing arsenic are found for several hundred feet along a traverse or are on strike with a known or suspected arsenic-bearing structure.

To assist in interpreting the significance of the distribution of arsenic in overburden, a rough determination of the magnitude of the dispersal of arsenic in overburden away from its source was made by sampling downslope from the toe of an arsenic-bearing mine dump (inset map). A grab sample of material from the dump contains 80 ppm arsenic, and overburden within 50 feet (15 m) of the dump contains 10 to 20 ppm. No detectable arsenic was found in overburden at the distances greater than 50 feet (15 m) downslope from the toe of the dump. These data suggest that the dispersal of arsenic is rather limited and thus the bedrock source of arsenic in overburden would be nearby, if, of course, care is taken to avoid transported debris during sampling of the overburden.

Most arsenic-bearing overburden can be related to known quartz veins or faults, or to the geologic setting in which most of the veins occur—the graphitic schist member of the Miners Delight Formation and borders of metagabbro. Arsenic-bearing overburden south of the Carissa mine, in the vicinity of the B & H mine, west of the Barr mine, and southeast of the Ground Hog mine, for example, appears to be related to quartz stringers and veins in the Miners Delight Formation. About half of the samples of overburden collected over graphitic schist contain arsenic, but there does not appear to be a correlation between intensity of alteration or veining of the schist and the occurrence of arsenic in associated overburden. Likewise, the occurrence of arsenic in overburden at or near the borders of metagabbro intrusives is also erratic. The occurrence of arsenic in overburden downslope from the postulated source is generally no more than a couple of hundred feet, a slightly greater distance than that below the sampled mine dump, but the arsenic is still rather closely tied to the source rock.

Although many veins are reflected by anomalous arsenic in overburden, in a significant number of places no arsenic occurs in overburden above intensely mineralized and veined rock. For example, metagabbro northeast of the Carissa mine and graphitic schist one-fourth to one-half mile west of the Duncan mine are riddled with quartz veins, but the overburden contains no arsenic. Also, only spotty arsenic occurs in overburden in the highly mineralized area between the Caribou and Garfield mines.

This erratic distribution of arsenic in overburden is due to the highly variable and spotty distribution of arsenic in veins and shear zones, which ranges from less than 10 ppm to 1,200 ppm (table 1), and to the limited dispersal of arsenic in overburden. Thus, if the sample of overburden happened, by chance, to be taken over an arsenic-rich part of a vein, it would probably contain arsenic, whereas a sample taken a short distance away but over an arsenic-poor section of the vein probably would show no arsenic. The interpretation of arsenic anomalies associated with veins is further complicated by the fact that there is no relationship between the gold content of a vein and its arsenic content (table 1).

In addition to the arsenic-bearing overburden associated with veins and mineralized rock, arsenic is found in overburden over large areas of Miners Delight graywacke, schist, and gneiss that are apparently barren and unmineralized or at the most contain a few scattered stringers of white quartz. Such areas occur southeast of the B & H mine, east and northeast of the Barr mine, between Atlantic City and the Caribou mine, south of the Fort Stambaugh road east of Atlantic City, at the head of Big Atlantic Gulch, and south of the graphitic schist unit near and east of the Snowbird mine.

The barren-appearing Miners Delight Formation was extensively sampled to test the possibility of the existence of large masses of gold-bearing rock and to determine the source of the arsenic in the associated overburden. Wherever possible, samples were collected from outcrops near the soil traverse, but where this was not feasible, grab samples of residual chips of bedrock were collected from the surface. About 50 samples were collected, but only eight contained detectable gold (table 1 and map) and that was at the limit of detection (0.1 ppm or 0.003 oz/ton). However, all but two samples of the suite selected for trace element analysis contained detectable arsenic in amounts ranging from 10 to 100 ppm (table 1). Thus, the arsenic in overburden from this formation appears to have been derived from low concentrations of arsenic in a large mass of rock and is not indicative of ore or mineralized material.

APPLICABILITY OF GEOCHEMICAL PROSPECTING

The arsenic content of overburden is not a good way to trace veins through covered areas or to locate concealed veins in the Atlantic City district as suggested possible by Bayley and Janes (1961). The erratic distribution of arsenic in veins coupled with the limited dispersal of arsenic in overburden results in a pattern of arsenic in overburden that is difficult to interpret. Furthermore, there is no correlation between the gold and arsenic contents of the veins, and some Miners Delight Formation barren of gold may produce anomalous arsenic in overburden derived from it. Thus the identification of a gold-bearing vein or the elimination of the possibility of the existence of such a vein in a geochemical survey cannot be made on the basis of the presence or absence of arsenic in the overburden.

No other obvious pathfinder elements in the veins in the district appear to be of possible use in geochemical prospecting for gold. Most trace elements that were analyzed for show an erratic distribution in the veins, and none of these elements is significantly concentrated in the veins in comparison with the barren host rocks (table 1). The concentration of mercury, for example, is low in both; the lead content of the Miners Delight Formation is greater than that of the veins; and the copper content of host rocks and veins is highly variable.

In the past, prospecting has been concentrated in favorable geologic settings—faults, graphitic schist, and borders of metagabbro intrusives. These still seem to be the best guides for lode gold.

GOLD IN YOUNGER SEDIMENTARY ROCKS

Flathead Sandstone.—The Flathead Sandstone of Cambrian age laps on the gold-bearing Precambrian rocks at the northeastern end of the Atlantic City district. The conglomeratic basal part of the unit attracted early prospectors, who drove several adits into the lower part of the unit about 1 mile (1.6 km) northwest of Miners Delight. Old reports contain no mention of mines in the Flathead, and so far as could be determined, little, if any, gold was produced from this unit.

The lower part of the Flathead is composed of about two-thirds conglomerate and one-third sandstone, which are reddish brown and mostly arkosic. Bedding dips gently to the northeast, an average of 10°, and most of the lower part of the unit is crossbedded with west-dipping foreset beds. Thus, the source of the debris in the Flathead was east or northeast of the gold district.

I examined and sampled about 3½ miles (5.6 km) of the basal part of the Flathead Sandstone from about 1½ miles (2.4 km) northwest to 2 miles (3.2 km) southeast of Miners Delight at the northeast end of the district. Chemical analyses showed no gold at a limit of detection of 0.1 ppm (0.003 oz/ton), nor was there any gold in several samples that were panned.

South Pass Formation.—Irregular areas of Tertiary sediments blanket the older rocks in a few places in the district and become more abundant and widespread to the south. These sediments are predominantly tuffaceous conglomerates and sandstones which are generally calcareous. Although they were referred to the White River Formation of Oligocene age by Bayley (1965a–c), Denson, Zeller, and Stephens (1965) demonstrated their late Miocene to middle Pliocene age and named them the South Pass Formation.

Fragments in the conglomerate are commonly angular and of local derivation. Many pebbles have lithologies of rocks in the gold district as well as of granite from the nearby Louis Lake batholith. The South Pass Formation was sampled within the district and for several miles to the south and southeast, but no gold was found.

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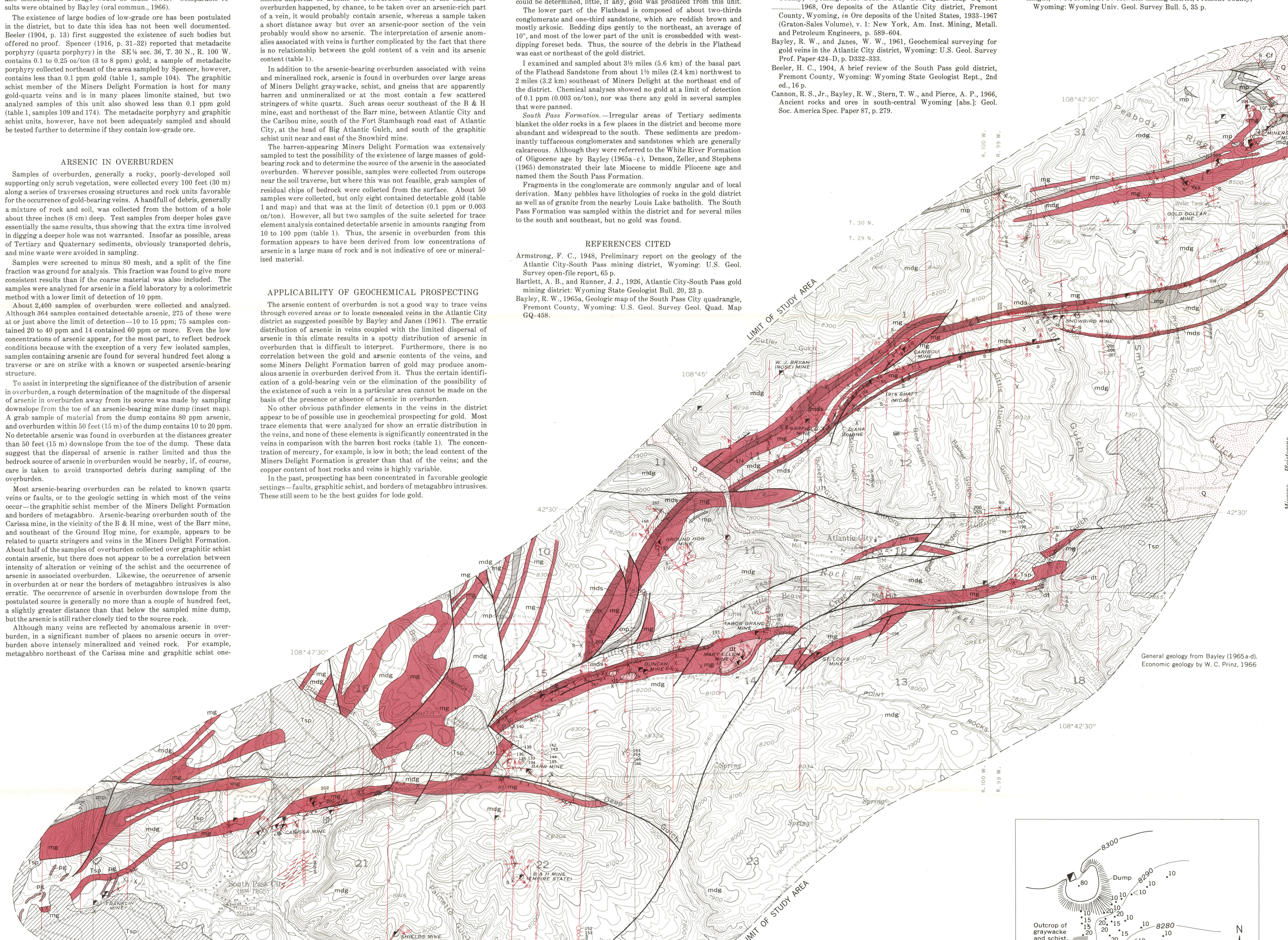
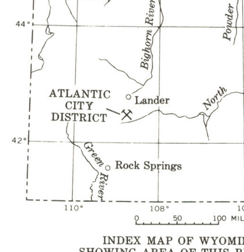


General geology from Bayley (1965a–d).
Economic geology by W. C. Prinz, 1966

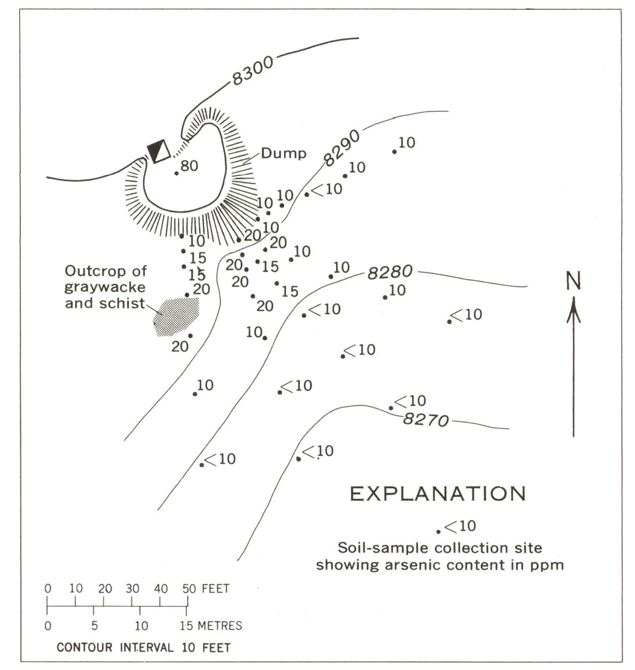
Base from U.S. Geological Survey, 1:24,000, Atlantic City, Louis Lake, South Pass City, 1953; Miners Delight, 1954

SCALE 1:20 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL



INDEX MAP OF WYOMING SHOWING AREA OF THIS REPORT



SKETCH MAP OF AREA AROUND SHALLOW SHAFT IN THE NW¼ NE¼ SEC. 5, T. 29 N., R. 99 W.

EXPLANATION

QUATERNARY (Pleistocene and Holocene)
- Q — Alluvium and glacial outwash

TERTIARY (Miocene-Pliocene)
- Tsp — South Pass Formation. *Calcareous and tuffaceous conglomerate and sandstone*

CAMBRIAN
- Cf — Flathead Sandstone. *Arkosic conglomerate and sandstone*

PRECAMBRIAN
- pg — Pegmatite
- dt — Leucodacite and tonalite. *Metamorphosed dikes and plugs*
- mg — Metagabbro. *Sills and dikes*
- mp — Metadacite porphyry. *Sills and dikes, possibly some flows*
- mdg, mds — Miners Delight Formation. mdg, *Graywacke, mica schist and gneiss, some conglomerate, ellipsoidal greenstone, and meta-andesite flows*; mds, *Graphitic schist*

Contact

Fault. *Dotted where concealed*

Vein. *Showing dip; mainly quartz but includes some limonite-rich shear zones; dotted where concealed*

Mine shaft

Test or prospect pit

Adit

Rock-sample collection site. *Mostly bedrock but includes some grab samples of residual chips of bedrock at surface along soil-sample traverses. Numbers keyed to analyzed samples in table 1; s, sample contains <0.1 ppm gold and not analyzed for other elements*

Soil-sample traverse. *Samples collected every 100 feet along traverse, analyzed for arsenic only*
- >60 ppm As
- 20 to 40 ppm As
- 10 to 15 ppm As
- <10 ppm As

MAP SHOWING GEOCHEMICAL DATA FOR THE ATLANTIC CITY GOLD DISTRICT, FREMONT COUNTY, WYOMING

By
William C. Prinz
1974

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1974

For sale by U.S. Geological Survey, Reston, Virginia 22092, price 75 cents