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Preliminary studies of gold deposits and rock geochemistry in the Shiaila area, Jabal As Silsilah quadrangle, Kingdom of Saudi Arabia

by

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by

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ABSTRACT

Gold-quartz veins, widely spaced over an area of 6 by 8 km, are thin and lenticular, and contain moderate to high amounts of gold. The veins, possibly cogenetic with granites of the nearby Jabal Silsilah ring complex, are in a structurally and geologically complex area where the Raha fault zone probably dips south beneath the area, and where Najd faults cross the mineral zone. Felsic dikes from the ring complex cross the Shiaila area, and in many places, structurally controlled gold-quartz deposition. Granitic cupolas and related gold-quartz deposition may exist at depth.

Rock chip sampling in the area denotes a higher than average content of arsenic and antimony in listwaenite of the Raha fault, as well as chromium and nickel in felsic dikes and gold-quartz veins.

INTRODUCTION

The Shiaila area (MODS 1383) measures 6 by 8 km, and is at approximately long 26°13'30" N. lat 42°41'30" E. about 5 km north of the Jabal as Silsilah granite ring complex (figs. 1 and 2 (p 12)). The area was chosen for further study because of a geological setting that includes scattered ancient workings on gold-quartz veins adjacent to the major, regional Raha fault zone (du Bray, 1983).

Previous workers include Mytton (1970) who sampled dumps and briefly described several of the ancient workings, and du Bray (1983) who mapped the geology of the Jabal as Silsilah quadrangle, including the Shiaila area, at 1:100,000-scale and noted the presence of numerous ancient workings. Also, Flanigan and Zablocki (1984) established a geophysical traverse across the Raha fault zone in the study area.

Present investigations, begun by Smith during the field season 1401/1402, included reconnaissance dump sampling at ancient mine sites and rock chip sampling along the Raha fault. Samater, assisted by Waiss Issa Assumali and Ali Dualeh, sampled dumps and located ancient workings on enlarged aerial photographs of the area during the field season 1402/03. In 1404 Smith sampled dumps of ancient workings in greater detail, mapped the geology of the area at a scale of 1:20,000, collected numerous rock chip samples, and directed trenching across several ancient workings. Waiss Issa Assumali operated the backhoe in performing the trenching operations.

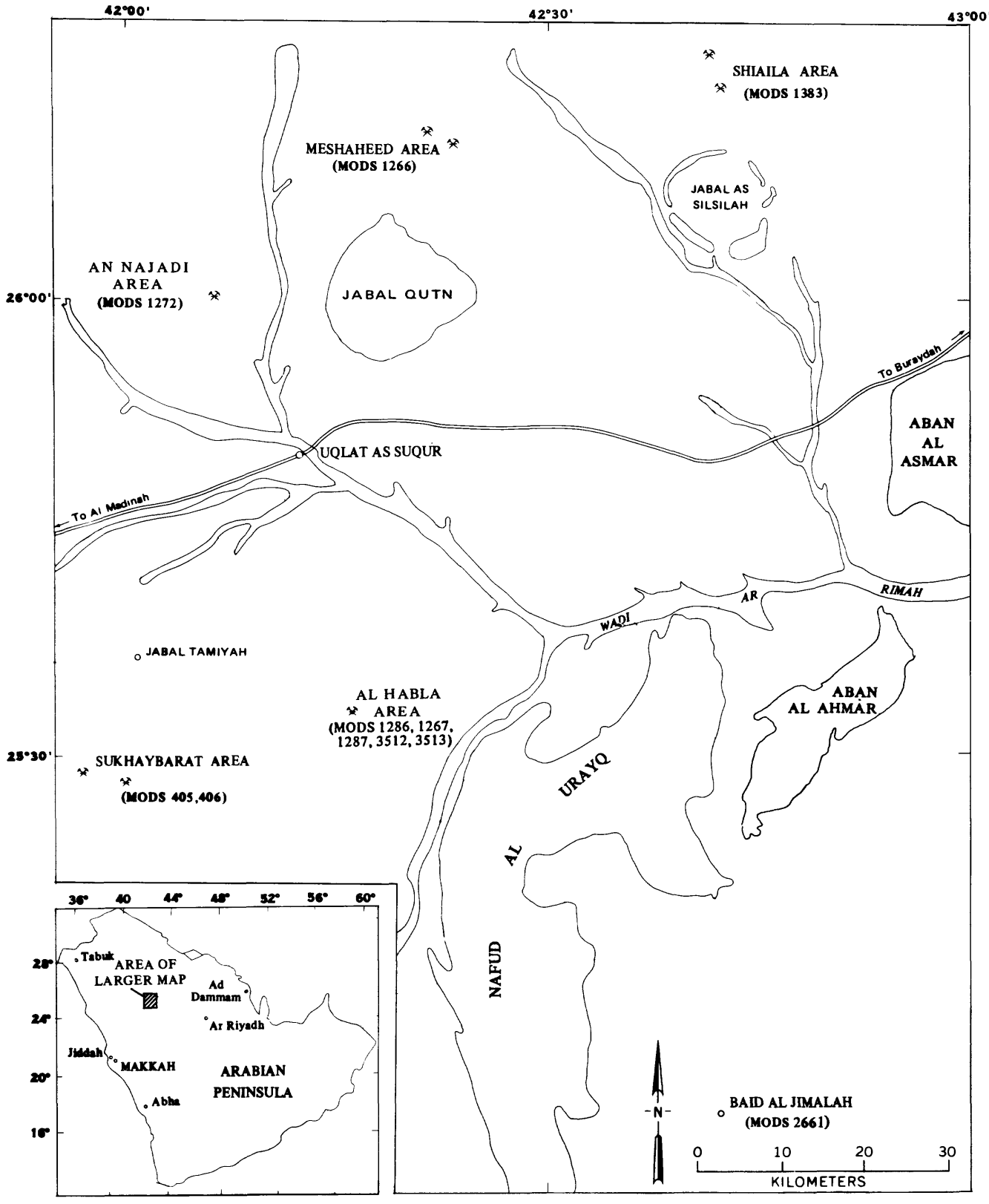

Figure 1.--*Locations of Shiaila and surrounding mineral localities. Numbers in parentheses are identifiers used for these mineral localities in the Mineral Occurrence Documentation System (MODS) of the Deputy Ministry for Mineral Resources.*

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GEOLOGY

Most of the Shiaila area is underlain by metasedimentary rocks mapped by du Bray (1983) as Maraghan lithic graywacke, a member of the Murdama group (plate 1). These rocks are dark gray-brown and layering is not evident in most places. Much of the rock is an immature sandstone with lesser graywacke composed of fragmented quartz, volcanic rock, and feldspar. At one locality in the center of the area a conglomerate composed mainly of chert cobbles is no more than 5 m thick and is interlayered with graywacke (plate 1).

The northern margin of the study area is marked by a westerly-trending, low ridge composed mainly of dolomitic rocks that are enclosed within the Raha fault zone (plate 1). These rocks weather to light brown and in places are cut by quartz stockworks and veins (not shown on plate 1). On the west end of the carbonate rock near its southern contact with Maraghan graywacke is a large area of mostly light gray jasperoid. Other smaller areas of jasperoid are on and near the eastern end of the carbonate outcrop. This rock is brecciated and cut by white quartz veinlets. The carbonate rocks, hereafter called listwaenite, are intruded by a small stock of gabbro on their eastern end, and the listwaenite locally contains small serpentinite pods. The listwaenite, derived by carbonate metasomatism of serpentinite, bears disseminated chrome spinels, and in many places is slightly stained by a green secondary nickel mineral (garnierite ?). Disseminated pyrite is common in many places. The listwaenite is intruded by aplite at one locality.

Graywacke and sandstone, much the same as those described previously, are in fault contact with the listwaenite on its north side (plate 1). Du Bray (1983) has mapped these metasediments as belonging to the Qarnayn lithic graywacke, also a member of the Murdama group. He also has mapped metasedimentary rocks in the northeastern part of the quadrangle as part of the same unit. These rocks are in contact with another branch of the Raha fault zone and they extend north and east of the fault. Similar rocks are in contact south and west of the fault, but du Bray has mapped these rocks as Maraghan lithic graywacke and classified them as younger. He bases his mapping on differences in erosional characteristics, coloration on Landsat false-color imagery, and the high frequency aeromagnetic pattern (BRGM, 1967) for rocks north of the fault system, in contrast to a pattern of uniform magnetic intensity for those to the south.

The authors, however, were unable to contribute significant data concerning the relative age of metasediments in contact with listwaenite on the north side. The rocks are poorly exposed in the area, but appear to be similar to metasediments to the south. Furthermore, there is no significant difference in aeromagnetic patterns over

metasedimentary rocks north or south of the listwaenite, and all rocks show a uniform magnetic intensity, unlike the pattern over Qarnayn graywacke as described above. On the other hand, Flanigan and Zablocki (1984) conducted audio-magnetotelluric (AMT) and telluric-electric measurements along a traverse that crossed metasedimentary rocks on both sides of the fault zone (plate 1). Their findings were that rocks on the north side are more resistive, probably indicating a higher degree of metamorphism, and perhaps greater age than those metasediments on the south side of the fault zone. With these considerations in mind, the authors will follow du Bray and designate metasediments on the north side of the Raha fault zone in the Shiaila area as Qarnayn lithic graywacke.

The Maraghan graywacke is cut by medium-grained, reddish- brown-weathering felsic dikes that are mainly composed of relatively long, slender hornblende laths, alkali feldspar, and moderate quartz. Magnetite as well as pyrite are common constituents. The dikes trend north across the map area (plate 1) and are probably cogenetic with the granite ring complex at Jabal as Silsilah. The mineral constituents of the dikes are similar to rocks on the north side of the ring complex, as described by du Bray (*in press*). Northerly trending aplite dikes also cut the Maraghan graywacke in the study area; they also are very likely genetically related to rocks in the Silsilah ring complex. They are cream to whitish, and in places contain disseminated pyrite.

The primary structural feature of the Shiaila area is the west-trending Raha fault zone marked by listwaenite. Du Bray (1983) terms the Raha fault as a major structural discontinuity. According to du Bray the Raha fault at Shiaila is a branch of the main fault trend, and on his geologic map of the Jabal as Silsilah quadrangle shows the Shiaila segment of the Raha fault joining with the principal west-trending segment that passes about 6 km north. Williams (1983) has mapped the fault as continuing west in the west-adjoining Samirah quadrangle. Cole (in press) has mapped the similar Ata fault system in the Al Abanat and Uqlat as Suqur quadrangles about 50 km southwest of Shiaila. The authors agree that these faults are major crustal discontinuities, most probably active since the formation of the Arabian Shield. Both fault systems are delineated by zones of serpentinite, listwaenite, and jasperoid, and markedly resemble rocks along the Nabitah (Stoeser and others, 1984) and Al Amar (Thekair, 1976) fault systems.

The attitude of the Raha fault zone at Shiaila is not readily apparent, but faint layering in the listwaenite suggests that the fault dips south from 22 to 45 degrees. If this suggestion is correct, then younger Maraghan graywacke may have thrusted north over the older Qarnayn graywacke, but direct evidence concerning the relative movement of the north and south fault blocks was not found in the area. Indirect evidence that the Raha fault zone dips south was located in the south part of the map area where a hydrothermally altered aplite dike contains clots of chromium-bearing mica; also, felsic dikes in the area generally have a high chromium content, as do some of the gold-quartz veins (table 4). Since rocks within the fault zone are known to have a high chromium content, perhaps hydrothermal solutions passed through chromium-bearing rocks of the fault, took the metal into solution, and later deposited chromium after rising through secondary, connecting vertical faults.

The Shiaila area is probably affected by a regional fault related to the Najd fault system (fig. 2, plate 1). The aeromagnetic map of the Jabal as Silsilah quadrangle (BRGM, 1967) shows a well-defined, linear anomaly striking about N. 75° W. at the east edge of the quadrangle. The anomaly terminates east of the Shiaila area, but the fault probably continues to the west since the linear aeromagnetic pattern may have resulted only from the presence of magnetite-bearing dikes intruded into the fault. Faults of this trend probably extend into the study area since several ancient workings on quartz

veins are aligned in the same direction. The projection of the main fault trend crosses the extreme southern part of the map area (plate 1). Normally, Najd faults are left-lateral strike-slip faults with estimated horizontal displacement as much as 240 km (Moore and Al-Shanti, 1979; Brown, 1972).

The west end of the listwaenite outcrop in the Raha fault is terminated by a north-striking right-lateral shear (plate 1). A related and perhaps subsidiary shear strikes northeast and probably cuts the listwaenite with only minor horizontal displacement. The north-trending shear zone is vertical and the northeast trending shear dips 70^{o} southeast. Evidence of intense shearing with great displacement was observed along both shear zones where boudins of listwaenite are found in sheared graywacke as far as 2 km from the listwaenite outcrop (plate 1). The presence of listwaenite boudins in shears south of the listwaenite lens, and especially in the northeast-striking shear as shown on plate 1, would also seem to indicate a south-dipping Raha fault zone. Aplite dikes have intruded both shear zones. At one locality in the northeast-striking shear a boudin of listwaenite interrupts the continuity of an aplite dike; apparently, shearing and much vertical displacement have occurred since dike intrusion. The listwaenite has been sheared and dragged north at its western terminus. From this point north and west, rocks are covered by a flat, alluvial plain; consequently, the amount of northerly displacement of the western shear block is not known. Also, no evidence was found concerning the relative vertical displacement of the east and west blocks.

Away from faults and shears, the Maraghan graywacke in the map area is gently tilted south, and folding of the metasediments was not noted.

ECONOMIC GEOLOGY

Several geologic features of the Shiaila area were noted during reconnaissance studies in early parts of the investigation:

1. Gold-bearing quartz veins, worked by ancient miners, are scattered over a wide area in metasedimentary rocks.

2. The gold-bearing quartz veins are adjacent to the Raha fault; a regional tectonic fault. The same relationship is found in other parts of the Arabian Shield where gold and other metals are spatially associated with major faults of the same character (Worl, 1979; Boyle and others, 1984; Stoeser and others, 1984).

3. Listwaenites associated with the Raha fault contain quartz stockworks, jasperoids, late quartz veins, and minor gold-quartz veins. In some areas disseminated pyrite is a common accessory mineral in quartz.

4. The diorite-granodiorite association with gold-quartz veins common to the general area probably does not prevail at Shiaila. Instead, aplite dikes and medium-grained felsic dikes at Shiaila probably evolved from the granite ring complex at Jabal as Silsilah. Gold-quartz veins are associated with some of the dikes.

Present investigations were performed in order to study certain aspects of the geological relationships outlined above, as well as assess the gold potential of the area.

ANCIENT MINE WORKINGS ON GOLD-QUARTZ VEINS

Most ancient workings are linear and extend along quartz veins in metasediments, but many were probably dug for prospecting purposes since they are only small pits (plate 1). The workings are linear and together they comprise more than 2 km. Quartz veins worked by ancients are not currently visible, and only veins encountered by trenching were exposed, since all of the workings are nearly filled with mining debris or wind blown sand. Judging from the quartz on dumps and the arrangement of the workings the veins are probably lenticular and less than 1 m thick. An ancient village consisting of stone ruins, numerous broken grinding wheels, and quartz mill tailings covers an area of about 100 m by 500 m in the southeast corner of the map area. Other smaller ruins are in the northeast corner (plate 1).

Quartz, or quartz with calcite, on many of the dumps is white and appears to lack sulfides of any type. In places, veins of this type are moderately stained by manganese oxides and contain small clots of chlorite. Streaks of potassium feldspar in quartz was noted on dumps in both the northwest and northeast parts of the map area. Many ancient workings contain very sparse quartz on dumps. Some of the larger dumps in the southeast and south-central part of the area display mostly iron-stained quartz. Minor gray quartz was observed in dumps and in some of the sorting piles. Stibnite in quartz was found in two dumps, but apparently the metal is not important in the Shiaila area. Evidence of base metals was not seen during the investigation.

Wall rock alteration is apparent in some of the larger dumps, but others contain relatively unaltered rocks. Hydrothermally altered metasedimentary rocks display iron oxides after pyrite, and are kaolinized and friable.

Dumps were sampled by collecting quartz along their entire length. Wall rocks were also sampled, especially where they are hydrothermally altered and/or contain quartz stringers. Sample locations are shown on plate 1. All dump samples were assayed for gold and silver by the atomic absorption method. This method was also used in assaying for copper, zinc, lead, arsenic, molybdenum, cobalt, and antimony for nine dump samples in the 213000 sample number series. All samples were assayed by standard spectrographic analyses for 31 elements.

Twenty-eight ancient workings or groups of workings are numbered on plate 1. Fourteen trenches made during this study are also numbered and shown. Table 1 gives brief descriptions of samples and workings. Atomic absorption analytical data for gold and silver, and spectrographic analyses of samples containing notable values in other elements are listed in table 1.

Forty-three quartz samples collected from dumps have gold and silver contents ranging from 0 to 280 parts per million (ppm) and 0 to 11.5 ppm silver, respectively (table 1). Discounting two samples that contain more than 100 ppm gold, the average gold and silver contents of 41 quartz samples are 6.8 and 0.7 ppm, respectively; the gold/silver ratio is 9.7. Table 1 lists two samples (213042 and 213140) on which repeat gold assays were performed. Duplicate results were not found in either sample, which probably indicates that the quartz in these samples contains relatively large gold particles. Arsenic is present in many of the quartz samples, but only in amounts as much as 700 ppm. Although stibnite was sighted on two dumps during our examination, antimony is sparse in quartz samples with a high of only 400 ppm. A few samples contain as much as 1500 ppm chromium.

Ten samples of hydrothermally altered wall rock collected from dumps have gold and silver contents ranging from 0 to 19.3 ppm and 0 to 1.9 ppm, respectively (table 1). One sample contains 19.3 ppm gold, but the remainder of the samples are much lower in gold content. Discounting the sample with an unusually high gold content, the average for the remaining nine samples is 0.77 ppm gold and 0.53 ppm silver. Wall rock samples are relatively rich in arsenic and contain as much as 2000 ppm of the element, but base metals and antimony are present in minor amounts, or are absent.

TRENCHING

Fourteen trenches were dug across ancient workings (plate 1), but most of these were unsuccessful in intersecting quartz veins in place. In most places the miners had worked the veins deeper than the 3.3-m depth capability of our backhoe. Because of this problem, trenches were placed at the ends of workings in several places (plate 1), but quartz veins were not encountered in most of these trenches. Sample results are given in table 2. The following is a brief description of the geology in each of the trenches:

T-1 - Working No. 25 - The trench bottomed in unaltered metasediments. Debris-filled ancient workings about 50 cm wide indicate that the bottom of the ancient workings was not reached. One 1-cm-thick quartz stringer was encountered. No samples were collected.

T-2, T-3, T-4, and T-5 - Working No. 23 - None of the trenches reached the bottom of the working. Trenches T-2 and T-3 encountered kaolinized and iron oxide-impregnated metasediments extending about 1 m from the walls of the working. One quartz veinlet 2 cm thick was found.

T-6 and T-7 - Working No. 22 - Trench T-6 did not reach the bottom of the working. The bottom of the trench revealed a debris-filled working about 50 cm wide. Rocks in the walls of the working are not hydrothermally altered. Trench T-7 was placed on the projection of the working, a few meters from the north end, but no vein or hydrothermal alteration was encountered. Samples were not collected in either trench.

T-8 - Working No. 13 - This trench was placed near the southeast end of the working. Only unaltered metasedimentary rock was cut. No samples were collected.

T-9 - Working No. 11 - A 20-cm-thick quartz vein was found in the wall of the working. The trench did not reach the bottom of the working.

T-10 - Working No. 10 - This trench found a 30-cm-thick quartz vein adjacent to an aplite dike at one end of the working.

T-11 - Working No. 9 - One 20-cm-thick quartz vein was found in hydrothermally altered walls of the working. The bottom of the working was not reached.

T-12 - Working No. 8 - The trench was cut across the south end of the working where it encountered five thin quartz stringers in a 1.5-m-wide zone.

T-13 - Working No. 28 - This trench is near the north end of the working in kaolinized listwaenite. The trench cut two workings spaced 3.0 m apart, but did not reach bottom of either working. No veins were cut.

Table 1.--Analytical data for dump sampling in the Shiaila area.

[Values in parts per million. Leaders indicate none detected. Tr indicates trace amounts detected]

Ancient Working number	Sample number	Description	Atomic absorption analyses		Spectrographic analyses
			Au	Ag	Notable elements
1	213045	Pit 5 m long. Quartz with K-spar, MnO, chlorite.	9.0	0.1	
2	213042	Workings 100 m long. Quartz white, brecciated.	92.3	2.8	
3	213062	Three pits, largest 12 m long. Quartz, white with abundand MnO.	16.0	0.6	
4	213091	Small pit on white quartz.	0.8	-	
	213092	As above.	0.6	-	
5	213069	Small pit, qtz, white with sparse FeO.	4.4	0.2	
6	213072	As above.	5.8	0.3	
7	147776	Small pit, quartz white.	14.4	0.5	
8	200511	Working 50 m long. Quartz, FeO stained.	118.5	11.5	
9	200512	Four workings along 450 m zone. Quartz, FeO stained.	0.3	Tr	
9	200513	Quartz, as above.	10.5	1.3	
9	200514	Quartz, as above.	1.6	0.7	Cr-1000
9	200515	Quartz, as above.	11.7	1.3	
9	200516	Quartz, as above.	1.0	2.5	As-700, Cr-1500
9	200517	Quartz, as above.	44.0	5.2	
9	200518	Quartz, as above.	10.7	1.2	
9	200519	Quartz, as above.	7.4	0.7	Cr-1000
10	213011	Pit with dumps of aplite containing qtz stringers.	0.4	-	
11	200522	Working 20 m long. Quartz with moderate FeO.	0.4	-	
12	200523	As above. 9.5 1.9			
13	200524	Working 50 m long. Quartz with moderate FeO.	3.2	0.5	
14	200526	Working 20 m long. Quartz, some gray. Abundant FeO.	5.6	0.7	As-300
15	200525	Working 20 m long. Quartz, white.	2.2	Tr	
16	200509	Working 50 m long. Quartz sparse on dumps.	3.1	1.2	
17	213143	Working 10 m long. Aplite and graywacke with quartz.	1.0	0.4	Sb-500
18	147766	Small pit on contact with aplite dike. Minor quartz.	-	0.5	As-500
	147777	Same pit as above. Aplite.	-	Tr	

Table 1.--continued

Ancient Working number	Sample number	Description	Atomic absorption analyses Au	Ag	Spectrographic analyses Notable elements
19	213139	Two semi-parallel pits, 15 m long. Quartz, white.	1.0	-	
20	213140	Working 20 m long. Quartz white. Aplite on dumps.	222.0	6.7	
		Repeat gold assay	280.0		
		Repeat gold assay	280.0		
20	213141	Small pit. Aplite with quartz stringers. Chrome mica in aplite.	0.8	0.3	Cr-1000
20	213142	Working 25 m long. Quartz, sparse on dump.	9.8	1.1	
20	200508	As above.	9.0	2.5	
21	213138	Series small workings 120 m long.	0.4	Tr	
22	147844	Series workings 190 m long. Quartz from sorting pile.	2.1	Tr	
22	147845	Altered wall rock.	19.3	1.9	As-1000
22	147846	Quartz, white, with moderate FeO stain.	10.4	1.5	As-200
23	147764	Wall rock, altered.	1.0	1.7	As-700
24	147763	As above.	0.1	0.7	As-500
25	147759	Working 45 m long. Wall rock, altered.	0.9	0.8	As-2000
25	147760	Quartz, white with moderate FeO. From sorting pile.	9.4	1.4	
25	147761	Wall rock, altered.	0.2	0.5	
25	147762	Quartz, white, from sorting pile.	0.1	Tr	
26	213137	Working 60 m long. Quartz, banded, hematitic.	-	0.2	As-650
27	213106	Working 30 m. Quartz, white, no sulfides.	-	-	
28	147748	Working 155 m long. Quartz, white, mod. FeO stain.	3.7	Tr	As-300
28	147749	Quartz, as above.	0.1	Tr	As-300
28	147750	As above.	0.2	Tr	As-300
28	147751	Wall rock, altered.	1.1	Tr	As-300
28	147752	As above.	1.1	0.6	As-200
28	147753	As above.	1.7	0.5	As-200
28	147754	Quartz, white, sorting pile.	0.4	Tr	As-200
28	147756	As above.	0.1	Tr	As-200
28	147757	Wall rock, altered.	0.9	Tr	

T-14 - Working No. 28 - This trench was placed a few meters from the south end of the working. No vein or rock alteration was encountered.

A sample from a 30-cm-thick quartz vein cut by trench T-10 assayed 44.0 ppm gold and repeat assays were 38.0 and 52.0 ppm gold (table 2); otherwise, the metal is present in minor amounts in samples of thin quartz stringers or hydrothermally altered metasediments. Arsenic in four samples from four trenches in the hydrothermally altered walls of Working No. 23 is in the range 230-3750 ppm, but samples of wall rock from trenches across other workings are low in accessory elements.

Table 2.--Atomic absorption analytical data for trench sampling in the Shiaila area.

[Values in parts per million. Leaders indicate none detected. Tr indicates trace amounts detected]

Trench number	Sample number	Description	Au	Ag	Notable elements
2	213006	Altered graywacke, abundant hematite.	0.1	-	As-2500, Zn-510
3	213007	Altered graywacke with one, 1-cm-thick quartz veinlet.	0.1	-	As-3750
4	213008	Graywacke, fresh.	0.2	-	As-230
5	213009	Graywacke, altered.	0.1	-	As-400
9	213010	Quartz, white, 20 cm thick.	1.3	-	
10	213012	Aplite with quartz stringers.	0.9	-	
10	213013	Qtz, 30 cm, white.	44.0	0.4	
		Repeat gold assay.	38.0		
		Repeat gold assay.	52.0		
11	213014	Quartz, white, 20 cm.	0.3	Tr	
12	213015	Five quartz stringers in 1.5-m-wide zone.	0.2	Tr	
13	213016	Carbonate wall rock.	0.2	-	
13	213017	As above, intensely kaolinized.	0.4	Tr	
13	213018	Graywacke, abundant hematite.	1.8	Tr	
13	213019	Carbonate rock, kaolinized.	0.3	Tr	
14	213020	Graywacke, fresh.	Tr	-	

STRUCTURAL CONTROL AND GENESIS OF GOLD-QUARTZ VEINS

Regional structural events in the Silsilah-Shiaila area may have occurred in the following sequence (figs. 2 and 3): 1) northerly-directed thrust faulting along the Raha fault trend; 2) left-lateral faulting along Najd fault trends; 3) intrusion of metagabbro into a Najd fault that cuts the southwest rim of the Silsilah complex. This fault is based as well on a distinct linear aeromagnetic anomaly (BRGM, 1967) that crosses the west-adjoining Samirah quadrangle, and terminates a few kilometers west of the Silsilah ring complex, where according to aerial photographic studies, it joins a more northerly-striking fault trace that cuts the southwest part of the ring complex; 4) intrusion of alkaline dacite into the north part of the ring complex; 5) intrusion of the main body of the Silsilah alkaline granite. Najd faults and perhaps the Raha fault acted as partial controls; 6) shearing and displacement of rocks along a north-northeast trend that cuts the Raha fault; 7) intrusion of the Fawwarah alkali-feldspar granite, where again, Najd faulting acted as a control; (8 intrusion of felsic dikes and aplite dikes into faults and shears in Maraghan lithic graywacke.

Upon cessation of magmatic activity a related hydrothermal system deposited gold in fracture-filling quartz veins, mostly in Maraghan lithic graywacke (fig. 3). At working No.'s 5, 6, 7, 8, and 9 gold-quartz veins were deposited adjacent to felsic dikes, and at working No's 10, 17 and 18 the veins are adjacent to aplite dikes (felsic dike rocks were found on mine dumps at working No. 9 and an aplite dike was cut in a trench at working No. 10). In places the dikes themselves are shattered and veined with quartz. Aplite dikes and gold-quartz veins are found in the north-northeast-striking shear zone, the youngest of major faults or shears in the Shiaila area (plate 1). The tin-greisen mineralization associated with the Fawwarrah alkali granite (figs 2 and 3) is post Hadhir aplite (du Bray, in press), but the relationship of the Hadhir aplite with aplite dikes in the Shiaila area (plate 1) is not known. In addition to tin and tungsten, the greisens are enriched in lead, zinc, and bismuth, unlike the gold-quartz veins at Shiaila.

The Fawwarah granite, youngest of the intrusive granite complex at Jabal as Silsilah (du Bray, 1984), has been dated at 587 $\pm$ 7 Ma using the U/Pb zircon dating method (J. S. Stacey, written communication). In nearby areas, such as Meshaheed, An Najadi, Sukhaybarat, and Al Khaymah (fig. 1; Smith and Samater, 1984a; Smith and others, 1984a; Boyle and Howes, 1983, Smith and Samater, 1984b) gold deposition is associated with diorite, or granodiorite plutons or dikes. These intrusive rocks are similar to numerous plutons in the northern Shield and are thought to be part of the Idah suite (Cole, 1984); chronologically dated at 620 to 615 Ma (Cole and Hedge, 1985). Gold-quartz veins at Al Habla are associated with a granite porphyry (Cole, in Smith and others, 1984b). This particular granite has not been dated by geochronologic methods. Cole believes that although the granite is similar in many respects to those at Fawwarah (du Bray, 1983), Baid al Jimalah, (Cole and others, 1981), Jabal Qutn (Stuckless and others, in press; 1984; Williams, 1984), and Jabal Minyah (Moore, 1984), the Al Habla granite is less evolved and is not enriched in tin and fluorine as are the above-named granites. As a result, he places the Al Habla granite in the Idah suite, but with reservations because of compositional differences.

Gold-quartz deposition at Shiaila is thought to have been controlled by two major influences; 1) serpentinization and subsequent carbonatization of mafic rocks in the Raha fault zone where silica and gold were leached from the mafic rocks, and mobilized and deposited in a more concentrated form in adjacent rocks; 2) later magmatic-hydrothermal activity by granitic magmas that penetrated the Raha fault zone, Najd faults, and enclosing metasediments (figure 3). The magma acted as the driving force to create heat cells whereby circulating meteoric water in advance of the

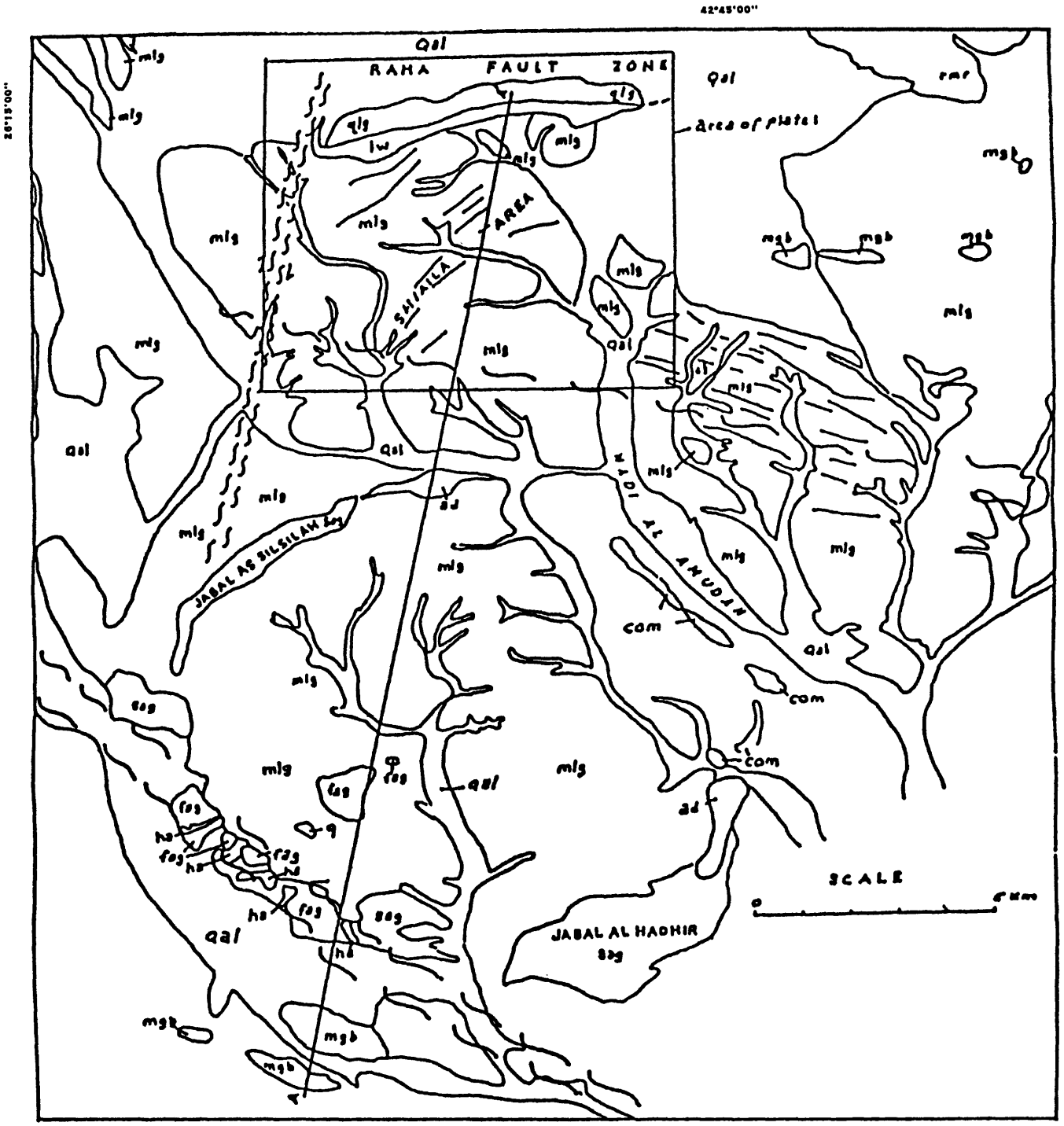

Figure 2.--*Geology of the Silsilah-Shiaila area. Modified after E. A. du Bray (1983, 1984).*

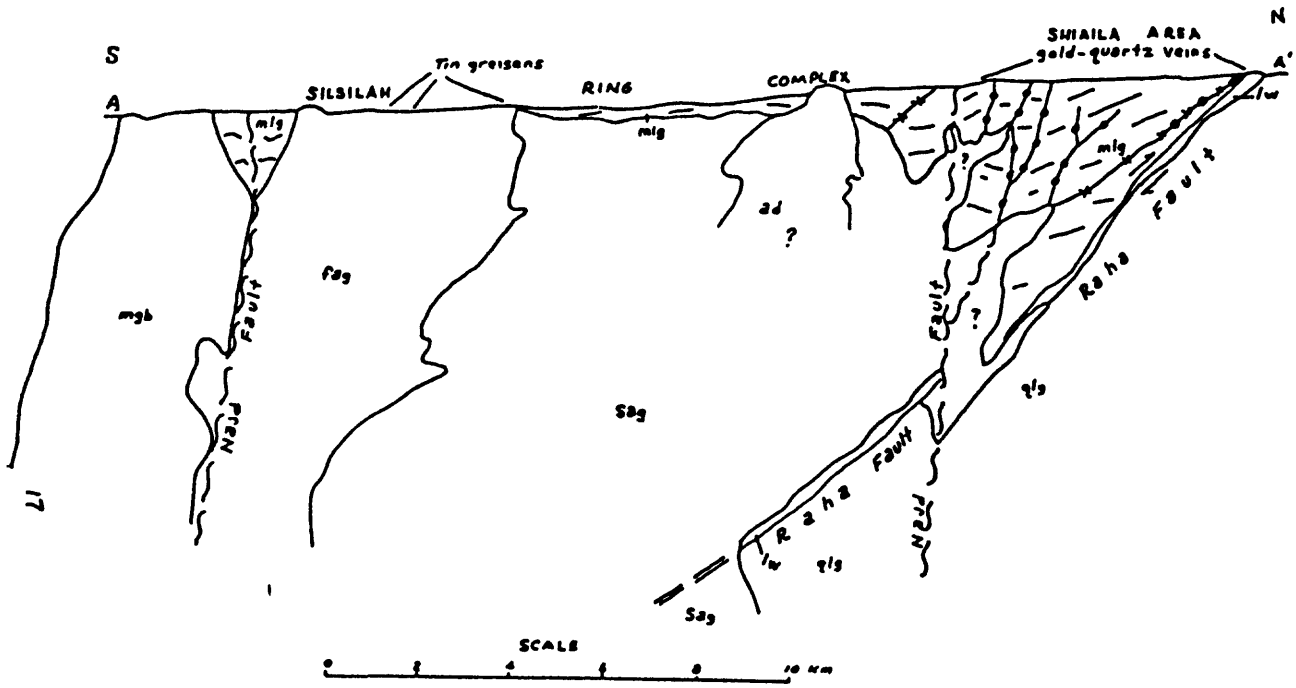

Figure 3.--*Geologic cross section of the Silsilah-Shiaila area based on a south-dipping Raha fault zone.*

EXPLANATION OF MAP UNITS
[FIGURES 2 AND 3]

SEDIMENTARY DEPOSITS

Qal ALLUVIUM--Undifferentiated surficial deposits

INTRUSIVE ROCKS

DIKES--Aplite, white to cream, and medium-grained felsic

fag FAWWARAH ALKALI-FELDSPAR GRANITE--Fine- to medium-grained, equigranular alkali-feldspar granite; contains biotite, muscovite, and topaz

ha HADIR APLITE--Fine grained, inequigranular, quartz poor

sag SILSILAH ALKALI GRANITE--Fine grained, inequigranular Na-bearing silicates compose 5 percent of this rock

com COMENDITE--Pale reddish-brown, porphyritic

ad ALKALINE DACITE--Dark gray, fine grained

? INTRUSIVE COMPLEX OF ALKALINE TO PERALKALINE COMPOSITION

mgb METAGABBRO--Fine grained, altered

METAVOLCANIC ROCKS

rmr RAHA METARHYOLITE--Brick-red-weathering metarhyolite porphyry

METASEDIMENTARY ROCKS

mlg MARAGHAN LITHIC GRAYWACKE--Weathers gray-brown

lw LISTWAENITE (carbonate-silicate rocks)--Derived from alteration of mafic-ultramafic rocks in the Raha fault zone

qlg QARNAYN LITHIC GRAYWACKE--Weathers gray-brown

SYMBOLS

CONTACT

MAJOR FAULT, OR SHEAR--Najd faults, or younger

STRIKE AND DIP OF BEDDING

QUARTZ VEIN

q QUARTZ MASS

magma leached gold from enclosing rocks to be redeposited in the form of gold-quartz veins in near-surface zones of lesser temperature and pressure. Some of the gold may have been an original constituent of the metasediments, and perhaps this is true of most areas intruded by Idah suite diorite-granodiorites. Thus the magmas themselves would not be the source of the gold, but instead acted only as concentrators of the metal.

GEOCHEMISTRY

Numerous rock chip samples were collected in the Shiaila area (plate 1) for the purpose of obtaining geochemical profiles for the various types of rock and vein material including listwaenite, jasperoid, quartz veins in listwaenite (not shown on plate 1), and dikes. In early parts of the investigation atomic absorption analytical methods were used for gold, silver, copper, lead, and zinc in addition to semi-quantitative spectrographic methods for these and 26 other elements. These samples are included in the 147000 and 200000 sample series (table 4, plate 1). Later in the investigation, for samples in the 213000 series, atomic absorption analytical methods were used for the analyses of gold, silver, copper, lead, zinc, arsenic, antimony, molybdenum, cobalt, and nickel; and spectrographic methods were employed for for the analyses of these and 21 other elements.

Table 3 lists geometric means of the ten elements for the various rock and vein categories as outlined above. Included also, for comparison purposes, are geometric means for the same elements contained in seventeen gold-quartz vein-type samples. Progressive metasomatic alteration of mafic-ultramafic rocks in major, tectonic faults such as the Raha fault probably proceed in the following sequence: mafic-ultramafic rock-serpentinite-listwaenite-jasperoid-quartz veins. Thus, silica is removed from large volumes of rock and deposited in the form of jasperoid and quartz veins. Under such conditions it is possible that gold and other metals may have been leached and deposited in the same manner. Consequently, jasperoid and quartz veins in listwaenite were sampled to test their metal content and compare with listwaenite. Table 3 shows that nickel, probably as an original constituent in mafic-ultramafic rocks, is largely retained in the listwaenite with jasperoid and quartz veins in listwaenite containing much less of the metal. The geometric mean for arsenic in listwaenite is 138.9 ppm, whereas those for jasperoids and quartz veins are 37.4 ppm and amounts too low for calculation, respectively. Plate 1 and table 4 show that arsenic is distributed erratically within the listwaenite in amounts as much as 2500 ppm. The geometric mean for antimony in listwaenite is 23.9 ppm and both jasperoid and quartz veins contain amounts of the metal too low for calculation. Antimony is also distributed erratically within the listwaenite in amounts as much as 970 ppm (plate 1, table 4). Thus, it appears that the listwaenite is slightly enriched in both arsenic and antimony, whereas, the jasperoids and quartz veins are poor in the metals. The listwaenite is also very slightly enriched in gold and silver when compared to all other categories except gold-quartz veins.

Geometric means of 37.0 and 37.7 ppm for nickel and cobalt, respectively, in felsic dikes are high when compared to an average of 1 ppm for granite worldwide (Levinson, 1980), otherwise, the relative abundance of other elements in the dikes is not especially significant. The geometric means of 3.0 ppm for gold and 0.5 ppm for silver are higher in gold-quartz veins than those for any other group, but that of arsenic in gold-quartz veins (99.7 ppm) is lower than the geometric mean of the element in listwenite (138.9 ppm). Gold-quartz veins have a geometric mean of 34.6 ppm for antimony; greater than any other category.

Spectrographic analytical data show that 18 rock chip samples of listwaenite assayed in the range 10-30 ppm tin (table 4). Most of these samples are concentrated in the western sheared part of the listwaenite lens (plate 1). Levinson (1980) gives an average of 1 ppm tin for mafic rocks worlwide, and since the listwaenites are believed to have derived from mafic rocks, the samples are thought to be anomalous in tin content.

Spectrographic analytical data for chromium (table 4) indicate that listwaenite contains generally high chromium in amounts as much as 3000 ppm. Some felsic dike samples contain as much as 2000 ppm chromium, and although statistical methods were not employed on chromium data, it is believed that average chromium content of the dikes is much higher than the average of 4 ppm for granites worldwide (Levinson, 1980). Some gold-quartz veins worked by ancient miners contain as much as 1500 ppm chromium, which is also high when considering the general composition of the veins and the types of enclosing wall rocks.

Table 3.--Geometric means of ten elements for various rock types and veins in the Shiaila area using atomic absorption analytical data.

[Leaders indicate quantities too low to perform calculation. Values in parts per million]

	Listwaenite	Jasperoid	Quartz veins in listwaenite	Dikes	Gold-quartz veins
No. of samples	68	19	10	12	17
Au	0.02	-	-	-	3.0
Co	35.5	9.3	7.7	37.0	6.1
Ni	216.7	15.8	26.8	37.7	12.5
Ag	0.01	-	-	-	0.5
As	138.9	37.4	-	-	99.7
Cu	14.6	10.3	5.0	17.9	5.5
Mo	5.4	7.6	6.6	5.4	6.1
Pb	2.8	8.3	2.0	6.3	7.6
Sb	23.9	-	-	-	34.6
Zn	33.3	21.8	4.8	48.9	10.3

Table 4.--Atomic absorption and spectrographic analyses for all sampling in the Shiaila area.

[Values for Fe, Mg, Ca, and Ti in percent. All other elements in parts per million. AA=analysis by atomic absorption. S=analysis by spectometry. AZ=sample digestion by A to Z methods and analysis by atomic absorption. G=greater than value shown. N=not detected at value shown. L=detected, but at less than value shown.]

PRINTOUT FOR SPEC/AA

SAMPLE	S-FE	S-MG	S-CA	S-TI	S-MN	S-AS	S-B	S-BA	S-BE	S-BI
147734	0.5000	10.0000G	5.0000	0.0020L	700.0000	1000.0000	10.0000L	20.0000L	1.0000N	10.0000N
147735	5.0000	10.0000	5.0000	0.5000	1500.0000	200.0000N	30.0000	100.0000	1.0000N	10.0000N
147736	3.0000	10.0000G	5.0000	0.0020L	500.0000	300.0000	10.0000L	30.0000	1.0000N	10.0000N
147737	3.0000	10.0000G	3.0000	0.0150	700.0000	200.0000N	10.0000L	20.0000	1.0000N	10.0000N
147738	3.0000	10.0000G	10.0000	0.0150	1500.0000	200.0000N	10.0000L	30.0000	1.0000N	10.0000N
147739	5.0000	10.0000G	20.0000	0.0020	700.0000	200.0000L	10.0000L	500.0000	1.0000L	10.0000N
147740	3.0000	10.0000G	5.0000	0.0020L	500.0000	200.0000L	10.0000L	20.0000	1.0000L	10.0000N
147741	5.0000	10.0000G	3.0000	0.0020L	700.0000	200.0000L	10.0000L	20.0000L	1.0000L	10.0000N
147742	3.0000	10.0000G	5.0000	0.0100	700.0000	200.0000L	10.0000L	20.0000L	1.0000N	10.0000N
147743	5.0000	10.0000G	5.0000	0.0300	700.0000	200.0000	10.0000L	30.0000	1.0000N	10.0000N
147744	15.0000	0.2000	0.3000	0.0500	10.0000	200.0000N	10.0000	30.0000	1.0000N	10.0000N
147745	3.0000	10.0000G	7.0000	0.0300	700.0000	300.0000	10.0000L	20.0000	1.0000N	10.0000N
147746	2.0000	10.0000G	7.0000	0.0100	700.0000	300.0000	10.0000	70.0000	1.0000N	10.0000N
147747	3.0000	10.0000G	7.0000	0.0070	700.0000	200.0000N	10.0000L	20.0000	1.0000N	10.0000N
147748	0.2000	0.1000	0.0700	0.0070	10.0000	300.0000	15.0000	20.0000	1.0000N	10.0000N
147749	0.5000	0.0700	0.0700	0.0150	20.0000	300.0000	20.0000	30.0000	1.0000N	10.0000N
147750	0.3000	0.0300	0.0700	0.0030	15.0000	300.0000	10.0000	20.0000N	1.0000N	10.0000N
147751	2.0000	0.5000	0.7000	0.1000	100.0000	300.0000	70.0000	300.0000	1.0000	10.0000N
147752	3.0000	1.5000	2.0000	0.1500	500.0000	200.0000	70.0000	300.0000	2.0000	10.0000N
147753	3.0000	0.7000	0.7000	0.3000	150.0000	200.0000	100.0000	300.0000	2.0000	10.0000N
147754	0.5000	0.0700	1.0000	0.0150	30.0000	200.0000	15.0000	20.0000	1.0000N	10.0000N
147755	0.7000	0.1000	0.7000	0.0200	70.0000	300.0000	10.0000	30.0000	1.0000N	10.0000N
147756	1.0000	0.1500	0.1000	0.0700	70.0000	200.0000	70.0000	200.0000	1.0000	10.0000N
147757	0.7000	0.5000	5.0000	0.1000	300.0000	200.0000N	30.0000	200.0000	2.0000	10.0000N
147759	5.0000	2.0000	10.0000	0.7000	1500.0000	2000.0000	50.0000	700.0000	1.0000L	10.0000N
147760	1.0000	0.5000	5.0000	0.0500	500.0000	200.0000L	10.0000	150.0000	1.0000N	10.0000N
147761	5.0000	3.0000	3.0000	1.0000	500.0000	200.0000N	30.0000	700.0000	1.0000L	10.0000N
147762	0.5000	0.0300	0.7000	0.0200	70.0000	200.0000N	20.0000	30.0000	1.0000N	10.0000N
147763	5.0000	3.0000	7.0000	0.7000	1500.0000	500.0000	70.0000	700.0000	1.0000	10.0000N
147764	3.0000	1.5000	20.0000G	0.3000	1500.0000	700.0000	50.0000	500.0000	1.0000L	10.0000N
147766	3.0000	3.0000	5.0000	0.7000	700.0000	500.0000	200.0000	700.0000	5.0000	10.0000N
147767	1.5000	0.3000	3.0000	0.0500	300.0000	200.0000N	150.0000	700.0000	2.0000	10.0000N
147772	5.0000	10.0000G	20.0000G	0.0050	1000.0000	500.0000	10.0000L	100.0000	1.0000N	10.0000N
147773	3.0000	10.0000G	5.0000	0.0020L	500.0000	200.0000	10.0000L	20.0000	1.0000N	10.0000N
147813	3.0000	10.0000	20.0000	0.0100	500.0000	200.0000N	10.0000L	20.0000N	1.0000N	10.0000N
147814	3.0000	10.0000	10.0000	0.2000	1000.0000	200.0000N	15.0000	300.0000	1.0000N	10.0000N
147815	3.0000	10.0000G	20.0000G	0.0100	2000.0000	200.0000N	10.0000L	20.0000	1.0000N	10.0000N
147816	3.0000	10.0000G	20.0000G	0.0020L	700.0000	200.0000N	10.0000L	20.0000L	1.0000N	10.0000N
147817	5.0000	10.0000	20.0000G	0.0700	500.0000	200.0000N	10.0000L	150.0000	1.0000N	10.0000N
147818	3.0000	10.0000G	20.0000	0.0030	500.0000	200.0000N	10.0000L	30.0000	1.0000N	10.0000N
147819	2.0000	10.0000	5.0000	0.0020L	200.0000	200.0000N	10.0000L	30.0000	1.0000N	10.0000N
147844	0.7000	0.1500	1.0000	0.0150	100.0000	200.0000N	15.0000	20.0000	1.0000N	10.0000N
147845	3.0000	1.5000	1.5000	0.7000	500.0000	1000.0000	30.0000	500.0000	1.0000L	10.0000N
147846	0.5000	0.1000	0.2000	0.0100	70.0000	200.0000	15.0000	20.0000	1.0000N	10.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-CD	S-CO	S-CR	S-LA	S-MO	S-NB	S-NI	S-SB	S-SC	S-SN
147734	20.0000N	7.0000	300.0000	20.0000N	5.0000N	20.0000N	200.0000	100.0000N	5.0000L	10.0000N
147735	20.0000N	30.0000	300.0000	20.0000N	20.0000	20.0000N	70.0000	100.0000N	30.0000	10.0000N
147736	20.0000N	50.0000	1500.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000	10.0000N
147737	20.0000N	70.0000	2000.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147738	20.0000N	70.0000	3000.0000	20.0000N	5.0000N	20.0000N	500.0000	100.0000N	5.0000	10.0000N
147739	20.0000N	50.0000	3000.0000	20.0000L	5.0000N	20.0000N	700.0000	100.0000N	5.0000	10.0000N
147740	20.0000N	30.0000	1500.0000	20.0000L	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147741	20.0000N	50.0000	5000.0000	20.0000L	5.0000N	20.0000N	500.0000	100.0000N	5.0000L	10.0000N
147742	20.0000N	50.0000	2000.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147743	20.0000N	70.0000	1500.0000	20.0000N	5.0000N	20.0000N	1000.0000	100.0000N	5.0000	10.0000N
147744	20.0000N	5.0000N	200.0000	20.0000N	5.0000N	20.0000N	30.0000	100.0000N	5.0000	10.0000
147745	20.0000N	50.0000	2000.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000	10.0000N
147746	20.0000N	30.0000	700.0000	20.0000N	5.0000N	20.0000N	300.0000	100.0000N	5.0000	10.0000N
147747	20.0000N	50.0000	1500.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147748	20.0000N	5.0000N	150.0000	20.0000N	15.0000	20.0000N	15.0000	100.0000N	5.0000N	10.0000N
147749	20.0000N	5.0000N	300.0000	20.0000N	5.0000L	20.0000N	10.0000	100.0000N	5.0000N	10.0000N
147750	20.0000N	5.0000N	200.0000	20.0000N	5.0000L	20.0000N	20.0000	100.0000N	5.0000N	10.0000N
147751	20.0000N	5.0000	150.0000	20.0000N	5.0000N	20.0000N	30.0000	100.0000N	5.0000	10.0000N
147752	20.0000N	10.0000	150.0000	20.0000N	5.0000N	20.0000N	50.0000	100.0000N	10.0000	10.0000N
147753	20.0000N	7.0000	150.0000	20.0000N	5.0000N	20.0000N	30.0000	100.0000N	7.0000	10.0000N
147754	20.0000N	5.0000N	300.0000	20.0000N	7.0000	20.0000N	15.0000	100.0000N	5.0000N	10.0000N
147755	20.0000N	5.0000L	300.0000	20.0000N	5.0000L	20.0000N	20.0000	100.0000N	5.0000N	10.0000N
147756	20.0000N	5.0000N	70.0000	20.0000N	5.0000N	20.0000N	7.0000	100.0000N	5.0000N	10.0000N
147757	20.0000N	5.0000L	500.0000	20.0000L	5.0000N	20.0000N	10.0000	100.0000N	5.0000L	10.0000N
147759	20.0000N	20.0000	500.0000	20.0000L	5.0000L	20.0000N	30.0000	100.0000N	30.0000	10.0000N
147760	20.0000N	5.0000L	700.0000	20.0000L	5.0000L	20.0000N	15.0000	100.0000N	5.0000N	10.0000N
147761	20.0000N	7.0000	300.0000	20.0000L	5.0000N	20.0000N	20.0000	100.0000N	20.0000	10.0000N
147762	20.0000N	5.0000L	500.0000	20.0000L	15.0000	20.0000N	10.0000	100.0000N	5.0000N	10.0000N
147763	20.0000N	20.0000	150.0000	20.0000L	5.0000N	20.0000N	30.0000	100.0000N	30.0000	10.0000N
147764	20.0000N	10.0000	200.0000	20.0000L	15.0000	20.0000N	15.0000	100.0000N	15.0000	10.0000N
147766	20.0000N	7.0000	300.0000	20.0000L	5.0000L	20.0000N	50.0000	100.0000N	20.0000	10.0000N
147767	20.0000N	5.0000L	150.0000	20.0000L	5.0000N	20.0000N	10.0000	100.0000N	5.0000N	10.0000N
147772	20.0000N	50.0000	2000.0000	20.0000L	5.0000N	20.0000N	1000.0000	100.0000N	5.0000	10.0000N
147773	20.0000N	30.0000	3000.0000	20.0000L	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147813	20.0000N	50.0000	1500.0000	20.0000N	7.0000	20.0000N	1000.0000	100.0000N	5.0000L	10.0000N
147814	20.0000N	15.0000	500.0000	20.0000N	5.0000N	20.0000N	50.0000	100.0000N	20.0000	10.0000N
147815	20.0000N	50.0000	3000.0000	20.0000N	15.0000	20.0000N	500.0000	100.0000N	5.0000L	10.0000N
147816	20.0000N	50.0000	3000.0000	20.0000N	5.0000N	20.0000N	1500.0000	100.0000N	5.0000L	10.0000N
147817	20.0000N	50.0000	3000.0000	20.0000N	5.0000N	20.0000N	1000.0000	100.0000N	7.0000	10.0000N
147818	20.0000N	50.0000	2000.0000	20.0000N	10.0000	20.0000N	1000.0000	100.0000N	5.0000	10.0000N
147819	20.0000N	20.0000	1500.0000	20.0000N	5.0000N	20.0000N	700.0000	100.0000N	5.0000L	10.0000N
147844	20.0000N	5.0000N	300.0000	20.0000N	15.0000	20.0000L	15.0000	100.0000N	5.0000N	10.0000N
147845	20.0000N	7.0000	300.0000	20.0000N	5.0000N	20.0000L	20.0000	100.0000N	15.0000	10.0000N
147846	20.0000N	5.0000N	150.0000	20.0000N	7.0000	20.0000L	20.0000	100.0000N	5.0000N	10.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-SR	S-V	S-W	S-Y	S-ZR	AA-CU-P	AA-PB-P	AA-ZN-P	AA-AU-T	AA-AG-T
147734	150.0000	10.0000	50.0000N	10.0000N	10.0000N	10.0000	20.0000	10.0000	0.0500N	0.8000
147735	200.0000	300.0000	50.0000N	15.0000	70.0000	55.0000	20.0000	65.0000	0.0500N	0.5000L
147736	150.0000	20.0000	50.0000N	10.0000N	10.0000N	10.0000	10.0000	10.0000	0.0500N	1.1000
147737	150.0000	30.0000	50.0000N	10.0000N	10.0000N	25.0000	5.0000	10.0000	0.0500L	0.8000
147738	500.0000	30.0000	50.0000N	10.0000N	10.0000N	10.0000	15.0000	10.0000	0.0500N	3.2000
147739	300.0000	15.0000	50.0000N	10.0000L	10.0000N	15.0000	10.0000	20.0000	0.0500L	2.0000
147740	100.0000	20.0000	50.0000N	10.0000L	10.0000N	15.0000	20.0000	25.0000	0.0500L	1.9000
147741	100.0000	30.0000	50.0000N	10.0000L	10.0000N	35.0000	20.0000	30.0000	0.0500L	1.8000
147742	300.0000	20.0000	50.0000N	10.0000N	10.0000N	5.0000	5.0000	15.0000	0.0500N	1.0000
147743	200.0000	30.0000	50.0000N	10.0000N	10.0000N	10.0000	35.0000	15.0000	0.0500N	0.8000
147744	100.0000N	200.0000	50.0000N	10.0000L	10.0000L	75.0000	55.0000	30.0000	0.0500N	1.5000
147745	300.0000	30.0000	50.0000N	10.0000N	10.0000N	25.0000	30.0000	25.0000	0.0500N	0.8000
147746	500.0000	30.0000	50.0000N	10.0000N	10.0000N	10.0000	20.0000	15.0000	0.0500N	0.5000
147747	500.0000	50.0000	50.0000N	10.0000N	10.0000N	60.0000	60.0000	40.0000	0.0500N	1.3000
147748	100.0000N	20.0000	50.0000N	10.0000N	10.0000N	5.0000N	10.0000N	5.0000N	3.7200	0.5000L
147749	100.0000N	20.0000	50.0000N	10.0000N	10.0000L	5.0000	10.0000	5.0000	0.1200	0.5000N
147750	100.0000N	20.0000	50.0000N	10.0000N	10.0000N	5.0000N	10.0000N	5.0000	0.1900	0.5000N
147751	200.0000	70.0000	50.0000N	10.0000	70.0000	15.0000	20.0000	30.0000	1.1000	0.5000L
147752	200.0000	100.0000	50.0000N	15.0000	70.0000	30.0000	25.0000	70.0000	1.0700	0.6000
147753	300.0000	100.0000	50.0000N	10.0000	200.0000	25.0000	20.0000	70.0000	1.6800	0.5000
147754	100.0000N	20.0000	50.0000N	10.0000L	10.0000L	5.0000N	10.0000N	10.0000	0.3700	0.5000L
147755	100.0000N	20.0000	50.0000N	10.0000L	10.0000L	10.0000	15.0000	10.0000	0.3000	0.5000L
147756	200.0000	30.0000	50.0000N	10.0000L	150.0000	10.0000	15.0000	25.0000	0.1000	0.5000L
147757	150.0000	70.0000	50.0000N	10.0000N	30.0000	5.0000	25.0000	5.0000	0.8600	0.5000L
147759	300.0000	300.0000	50.0000N	20.0000	200.0000	45.0000	50.0000	70.0000	0.9100	0.8000
147760	100.0000N	50.0000	50.0000N	10.0000N	10.0000N	5.0000	35.0000	5.0000	9.4300	1.4000
147761	300.0000	200.0000	50.0000N	20.0000	200.0000	45.0000	25.0000	55.0000	0.1900	0.5000
147762	100.0000N	20.0000	50.0000N	10.0000L	10.0000N	5.0000N	5.0000	10.0000	0.0900	0.5000N
147763	200.0000	200.0000	50.0000N	30.0000	200.0000	70.0000	45.0000	85.0000	0.1300	0.7000
147764	100.0000	200.0000	50.0000N	30.0000	100.0000	30.0000	60.0000	55.0000	1.0300	1.7000
147766	150.0000	200.0000	50.0000N	20.0000	200.0000	30.0000	35.0000	70.0000	0.0500L	0.5000
147767	150.0000	30.0000	50.0000N	10.0000L	100.0000	5.0000	25.0000	200.0000	0.0500L	0.5000L
147772	300.0000	20.0000	50.0000N	10.0000L	10.0000N	15.0000	30.0000	20.0000	0.0500L	0.7000
147773	100.0000	20.0000	50.0000N	10.0000L	10.0000N	15.0000	25.0000	20.0000	0.0500L	0.8000
147813	150.0000	15.0000	50.0000N	10.0000N	10.0000N	35.0000	15.0000	20.0000	0.0500L	0.9000
147814	300.0000	100.0000	50.0000N	10.0000L	10.0000L	50.0000	20.0000	50.0000	0.0500L	1.1000
147815	150.0000	50.0000	50.0000N	10.0000L	10.0000N	15.0000	15.0000	25.0000	0.0500L	1.1000
147816	150.0000	15.0000	50.0000N	10.0000N	10.0000N	10.0000	15.0000	10.0000	0.0500N	0.9000
147817	300.0000	70.0000	50.0000N	10.0000L	10.0000L	130.0000	20.0000	25.0000	0.0500L	0.8000
147818	200.0000	30.0000	50.0000N	10.0000L	10.0000N	15.0000	10.0000	15.0000	0.0500L	0.5000
147819	200.0000	15.0000	50.0000N	10.0000L	10.0000N	15.0000	10.0000	15.0000	0.0500L	0.5000
147844	100.0000N	15.0000	50.0000N	10.0000N	10.0000L	5.0000	10.0000N	10.0000	2.0900	0.5000L
147845	200.0000	200.0000	50.0000N	15.0000	150.0000	40.0000	5.0000	40.0000	19.2600	1.9000
147846	100.0000N	20.0000	50.0000N	10.0000N	10.0000N	5.0000	10.0000	5.0000	10.4500	1.5000

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-FE	S-MG	S-CA	S-TI	S-MN	S-AS	S-B	S-BA	S-BE	S-BI
200508	1.0000	0.3000	1.5000	0.0700	500.0000	200.0000N	70.0000	100.0000	1.0000L	10.0000N
200509	0.5000	0.1500	3.0000	0.0200	300.0000	200.0000N	1500.0000	50.0000	1.0000	10.0000N
200510	0.7000	0.3000	0.5000	0.0300	500.0000	200.0000N	30.0000	150.0000	1.0000L	10.0000N
200511	0.7000	0.1000	0.7000	0.0500	300.0000	200.0000N	15.0000	70.0000	1.0000N	10.0000N
200512	1.5000	0.1500	5.0000	0.0300	1000.0000	200.0000N	20.0000	200.0000	1.0000N	10.0000N
200513	1.0000	0.2000	3.0000	0.0300	700.0000	200.0000N	15.0000	150.0000	1.0000N	10.0000N
200514	5.0000	1.5000	15.0000	0.1500	3000.0000	200.0000N	30.0000	500.0000	1.0000	10.0000N
200515	0.7000	0.1000	1.0000	0.0150	500.0000	200.0000N	10.0000L	100.0000	1.0000N	10.0000N
200516	5.0000	3.0000	15.0000	0.3000	2000.0000	700.0000	20.0000	500.0000	1.0000	10.0000N
200517	0.7000	0.2000	0.3000	0.0200	200.0000	200.0000N	15.0000	150.0000	1.0000N	10.0000N
200518	0.7000	0.1000	1.5000	0.0150	300.0000	200.0000N	15.0000	150.0000	1.0000N	10.0000N
200519	3.0000	2.0000	15.0000	0.2000	3000.0000	200.0000N	20.0000	500.0000	1.0000L	10.0000N
200520	1.0000	0.7000	10.0000	0.1000	500.0000	200.0000N	15.0000	100.0000	1.0000N	10.0000N
200521	0.7000	0.2000	5.0000	0.0300	300.0000	200.0000N	20.0000	70.0000	1.0000N	10.0000N
200522	0.5000	0.1500	5.0000	0.0300	500.0000	200.0000N	50.0000	150.0000	1.0000N	10.0000N
200523	0.5000	0.2000	0.5000	0.0200	200.0000	200.0000N	15.0000	100.0000	1.0000N	10.0000N
200524	1.0000	0.2000	1.5000	0.0500	300.0000	200.0000N	20.0000	150.0000	1.0000N	10.0000N
200525	0.7000	0.5000	3.0000	0.0700	700.0000	200.0000L	15.0000	150.0000	1.0000N	10.0000N
200526	0.7000	0.1500	7.0000	0.0300	700.0000	300.0000	10.0000	50.0000	1.0000N	10.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB
200508	20.0000N	5.0000L	200.0000	20.0000	20.0000N	5.0000L	20.0000N	10.0000	10.0000N	100.0000N
200509	20.0000N	5.0000N	200.0000	15.0000	20.0000N	5.0000L	20.0000N	7.0000	10.0000N	100.0000N
200510	20.0000N	5.0000L	500.0000	5.0000L	20.0000N	5.0000L	20.0000N	10.0000	10.0000N	100.0000N
200511	20.0000N	5.0000L	300.0000	15.0000	20.0000N	5.0000L	20.0000N	10.0000	20.0000	100.0000N
200512	20.0000N	5.0000L	500.0000	10.0000	20.0000N	5.0000L	20.0000N	20.0000	10.0000N	100.0000N
200513	20.0000N	5.0000L	300.0000	7.0000	20.0000N	5.0000L	20.0000N	20.0000	10.0000N	100.0000N
200514	20.0000N	20.0000	1000.0000	15.0000	20.0000N	5.0000L	20.0000N	150.0000	10.0000L	100.0000N
200515	20.0000N	5.0000N	300.0000	7.0000	20.0000N	5.0000L	20.0000N	10.0000	10.0000N	100.0000N
200516	20.0000N	30.0000	1500.0000	20.0000	20.0000N	5.0000N	20.0000N	150.0000	10.0000L	100.0000N
200517	20.0000N	5.0000N	300.0000	7.0000	20.0000N	5.0000L	20.0000N	20.0000	10.0000N	100.0000N
200518	20.0000N	5.0000N	300.0000	5.0000L	20.0000N	10.0000	20.0000N	20.0000	10.0000N	100.0000N
200519	20.0000N	20.0000	1000.0000	10.0000	20.0000N	5.0000N	20.0000N	100.0000	15.0000	100.0000N
200520	20.0000N	5.0000N	300.0000	15.0000	20.0000N	5.0000N	20.0000N	15.0000	10.0000L	100.0000N
200521	20.0000N	5.0000N	200.0000	5.0000L	20.0000N	5.0000L	20.0000N	10.0000	10.0000N	100.0000N
200522	20.0000N	5.0000N	200.0000	15.0000	20.0000N	5.0000L	20.0000N	7.0000	10.0000N	100.0000N
200523	20.0000N	5.0000N	300.0000	30.0000	20.0000N	5.0000L	20.0000N	10.0000	70.0000	100.0000N
200524	20.0000N	5.0000L	500.0000	7.0000	20.0000N	15.0000	20.0000N	30.0000	10.0000L	100.0000N
200525	20.0000N	5.0000L	300.0000	10.0000	20.0000N	5.0000N	20.0000N	10.0000	10.0000L	100.0000N
200526	20.0000N	5.0000N	500.0000	10.0000	20.0000N	7.0000	20.0000N	15.0000	10.0000L	100.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	AA-AU-P	AA-AG-P
200508	5.0000L	10.0000N	100.0000L	50.0000	50.0000N	10.0000L	200.0000N	30.0000	9.0400	2.5000
200509	5.0000N	10.0000N	100.0000	20.0000	50.0000N	10.0000L	200.0000N	10.0000L	3.0600	1.2000
200510	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	10.0000L	200.0000N	50.0000	0.4600	1.2000
200511	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	15.0000	200.0000N	15.0000	118.4700	11.9000
200512	5.0000L	10.0000N	100.0000N	70.0000	50.0000N	10.0000L	200.0000N	10.0000N	0.2600	0.5000L
200513	5.0000L	10.0000N	100.0000N	50.0000	50.0000N	10.0000L	200.0000N	10.0000N	10.4700	1.3000
200514	15.0000	10.0000N	100.0000	150.0000	50.0000N	15.0000	200.0000N	30.0000	1.5700	0.7000
200515	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000L	200.0000N	10.0000L	11.7300	1.3000
200516	20.0000	10.0000N	100.0000	200.0000	50.0000N	20.0000	200.0000N	70.0000	1.0200	2.5000
200517	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	10.0000L	200.0000N	10.0000N	44.0000	5.2000
200518	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	10.0000L	200.0000N	10.0000N	10.7300	1.2000
200519	20.0000	10.0000N	100.0000	150.0000	50.0000N	15.0000	200.0000N	30.0000	7.3600	0.7000
200520	7.0000	10.0000N	500.0000	50.0000	50.0000N	10.0000L	200.0000N	20.0000	9.4400	1.0000
200521	5.0000L	10.0000N	200.0000	30.0000	50.0000N	10.0000L	200.0000N	20.0000	3.6700	0.5000L
200522	5.0000N	10.0000N	100.0000	30.0000	50.0000N	10.0000L	200.0000N	15.0000	0.3900	0.5000N
200523	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	10.0000L	200.0000N	10.0000N	9.4700	1.9000
200524	5.0000L	10.0000N	100.0000N	50.0000	50.0000N	10.0000L	200.0000N	10.0000	3.1700	0.5000
200525	5.0000L	10.0000N	100.0000N	50.0000	50.0000N	10.0000L	200.0000N	30.0000	2.2500	0.5000L
200526	5.0000L	10.0000N	300.0000	20.0000	50.0000N	10.0000L	200.0000N	15.0000	5.5900	0.7000

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-FE	S-MG	S-CA	S-TI	S-MN	S-B	S-BA	S-BE	S-BI	S-CD
213000	0.7000	0.2000	2.0000	0.0500	200.0000	20.0000	100.0000	1.0000N	10.0000N	20.0000N
213001	0.7000	0.2000	2.0000	0.0200	300.0000	20.0000	150.0000	1.0000N	10.0000N	20.0000N
213006	5.0000	2.0000	10.0000	0.1500	1500.0000	20.0000	700.0000	1.0000N	10.0000N	20.0000N
213007	3.0000	1.0000	5.0000	0.2000	1000.0000	30.0000	700.0000	1.0000N	10.0000N	20.0000N
213008	5.0000	2.0000	10.0000	0.2000	700.0000	30.0000	500.0000	1.0000N	10.0000N	20.0000N
213009	2.0000	1.0000	10.0000	0.1500	700.0000	30.0000	50.0000	1.0000N	10.0000N	20.0000N
213010	0.5000	0.0700	0.5000	0.0150	100.0000	20.0000	150.0000	1.0000N	10.0000N	20.0000N
213011	1.0000	0.0500	0.2000	0.0300	100.0000	20.0000	700.0000	1.0000N	10.0000N	20.0000N
213012	1.0000	0.2000	0.7000	0.0500	300.0000	100.0000	500.0000	1.0000N	10.0000N	20.0000N
213013	1.0000	0.1000	0.5000	0.0200	500.0000	10.0000	500.0000	1.0000N	10.0000N	20.0000N
213014	2.0000	0.3000	0.2000	0.2000	200.0000	10.0000	300.0000	1.0000N	10.0000N	20.0000N
213015	5.0000	0.7000	1.0000	0.2000	300.0000	20.0000	500.0000	1.0000N	10.0000N	20.0000N
213016	0.7000	0.2000	1.5000	0.0200	100.0000	70.0000	500.0000	2.0000	10.0000N	20.0000N
213017	0.7000	0.2000	1.0000	0.0500	100.0000	100.0000	700.0000	2.0000	10.0000N	20.0000N
213018	5.0000	0.7000	5.0000	0.2000	700.0000	70.0000	700.0000	2.0000	10.0000N	20.0000N
213019	0.7000	0.2000	0.7000	0.0300	70.0000	100.0000	500.0000	2.0000	10.0000N	20.0000N
213020	5.0000	5.0000	1.0000	0.2000	300.0000	50.0000	500.0000	2.0000	10.0000N	20.0000N
213021	3.0000	10.0000	10.0000	0.0300	1500.0000	10.0000	500.0000	1.0000L	10.0000N	20.0000N
213022	5.0000	10.0000	7.0000	0.2000	1000.0000	20.0000	500.0000	1.0000L	10.0000N	20.0000N
213023	7.0000	0.5000	5.0000	0.0200	1000.0000	10.0000	300.0000	1.0000L	10.0000N	20.0000N
213024	5.0000	7.0000	7.0000	0.1500	1000.0000	10.0000L	500.0000	1.0000L	10.0000N	20.0000N
213025	7.0000	7.0000	3.0000	1.0000	1000.0000	15.0000	700.0000	1.0000L	10.0000N	20.0000N
213026	7.0000	5.0000	7.0000	0.1000	1500.0000	50.0000	200.0000	1.0000L	10.0000N	20.0000N
213027	5.0000	10.0000	10.0000	0.0200	1500.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213028	5.0000	7.0000	5.0000	0.2000	1000.0000	100.0000	200.0000	1.0000L	10.0000N	20.0000N
213029	5.0000	7.0000	1.0000	0.2000	700.0000	10.0000	700.0000	1.0000L	10.0000N	20.0000N
213030	5.0000	5.0000	1.0000	0.2000	700.0000	10.0000L	1000.0000	1.0000L	10.0000N	20.0000N
213031	5.0000	10.0000	20.0000	0.0100	1000.0000	10.0000L	700.0000	1.0000L	10.0000N	20.0000N
213032	5.0000	1.0000	1.0000	0.0700	1000.0000	10.0000	700.0000	1.0000L	10.0000N	20.0000N
213033	5.0000	5.0000	3.0000	0.2000	700.0000	10.0000	1000.0000	1.0000L	10.0000N	20.0000N
213034	5.0000	5.0000	5.0000	0.2000	1000.0000	10.0000	1000.0000	1.0000L	10.0000N	20.0000N
213035	7.0000	10.0000	10.0000	0.2000	1500.0000	10.0000L	300.0000	1.0000L	10.0000N	20.0000N
213036	5.0000	0.5000	2.0000	0.1000	1000.0000	10.0000L	700.0000	1.0000L	10.0000N	20.0000N
213037	5.0000	5.0000	5.0000	0.2000	1000.0000	20.0000	200.0000	1.0000L	10.0000N	20.0000N
213038	5.0000	5.0000	5.0000	0.2000	1000.0000	10.0000L	1500.0000	1.0000L	10.0000N	20.0000N
213039	5.0000	7.0000	7.0000	1.0000	1000.0000	10.0000L	300.0000	1.0000	10.0000N	20.0000N
213040	5.0000	5.0000	5.0000	0.2000	1000.0000	30.0000	500.0000	1.0000L	10.0000N	20.0000N
213041	2.0000	5.0000	10.0000	0.1000	1500.0000	30.0000	200.0000	1.0000L	10.0000N	20.0000N
213042	1.0000	0.2000	1.0000	0.0500	500.0000	20.0000	70.0000	1.0000L	10.0000N	20.0000N
213043	1.0000	0.7000	0.7000	0.0700	200.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213044	2.0000	5.0000	5.0000	0.0500	1000.0000	10.0000	300.0000	1.0000L	10.0000N	20.0000N
213045	0.7000	0.2000	0.5000	0.0500	300.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213046	0.7000	0.2000	0.5000	0.0200	100.0000	50.0000	1000.0000	1.0000L	10.0000N	20.0000N
213047	0.5000	0.1000	0.1000	0.0100	150.0000	50.0000	300.0000	1.0000L	10.0000N	20.0000N
213048	0.7000	0.1000	0.2000	0.0200	100.0000	50.0000	700.0000	1.0000L	10.0000N	20.0000N
213049	0.5000	0.0700	0.7000	0.0100	100.0000	10.0000	500.0000	1.0000L	10.0000N	20.0000N
213050	0.7000	0.1500	1.0000	0.0500	100.0000	30.0000	700.0000	1.0000L	10.0000N	20.0000N
213051	0.5000	0.2000	1.5000	0.0300	200.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213052	5.0000	5.0000	7.0000	0.2000	700.0000	50.0000	300.0000	1.0000L	10.0000N	20.0000N
213053	5.0000	7.0000	5.0000	0.0020L	500.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-CR	S-LA	S-NB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZR
213000	500.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213001	500.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213006	1000.0000	20.0000N	20.0000N	20.0000	10.0000N	200.0000	150.0000	50.0000N	10.0000	30.0000
213007	200.0000	20.0000	20.0000N	10.0000	10.0000N	200.0000	150.0000	50.0000N	15.0000	100.0000
213008	200.0000	20.0000	20.0000N	10.0000	10.0000N	200.0000	150.0000	50.0000N	15.0000	150.0000
213009	100.0000	20.0000N	20.0000N	5.0000	10.0000N	500.0000	100.0000	50.0000N	10.0000	50.0000
213010	200.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	30.0000	50.0000N	10.0000N	10.0000N
213011	300.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000	30.0000	50.0000N	10.0000N	50.0000
213012	300.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000	30.0000	50.0000N	10.0000N	100.0000
213013	300.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213014	200.0000	20.0000N	20.0000N	5.0000	10.0000N	150.0000	150.0000	50.0000N	10.0000L	70.0000
213015	700.0000	20.0000N	20.0000N	10.0000	10.0000N	200.0000	150.0000	50.0000N	10.0000	200.0000
213016	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	10.0000	50.0000N	10.0000N	100.0000
213017	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	10.0000	50.0000N	10.0000N	100.0000
213018	700.0000	30.0000	20.0000N	10.0000	10.0000N	150.0000	200.0000	50.0000N	20.0000	150.0000
213019	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	10.0000	50.0000N	10.0000N	100.0000
213020	150.0000	20.0000	20.0000N	15.0000	10.0000N	100.0000	150.0000	50.0000N	15.0000	150.0000
213021	150.0000	20.0000	20.0000N	5.0000N	15.0000	500.0000	10.0000	50.0000N	10.0000N	50.0000
213022	1500.0000	20.0000	20.0000N	10.0000	30.0000	700.0000	70.0000	50.0000N	10.0000	50.0000
213023	1500.0000	20.0000	20.0000N	5.0000	10.0000	200.0000	50.0000	50.0000N	10.0000N	10.0000
213024	1500.0000	20.0000	20.0000N	5.0000N	10.0000N	200.0000	100.0000	50.0000N	10.0000N	30.0000
213025	200.0000	20.0000	20.0000N	50.0000	10.0000N	500.0000	200.0000	50.0000N	20.0000	200.0000
213026	150.0000	20.0000L	20.0000N	70.0000	10.0000N	700.0000	200.0000	50.0000N	10.0000N	20.0000
213027	70.0000	20.0000	20.0000N	5.0000N	10.0000N	500.0000	20.0000	50.0000N	10.0000N	10.0000
213028	150.0000	20.0000	20.0000N	20.0000	10.0000N	500.0000	150.0000	50.0000N	10.0000	100.0000
213029	100.0000	20.0000	20.0000N	10.0000	10.0000N	500.0000	150.0000	50.0000N	20.0000	200.0000
213030	200.0000	30.0000	20.0000N	10.0000	30.0000	500.0000	50.0000	50.0000N	20.0000	200.0000
213031	3000.0000	30.0000	20.0000N	5.0000	10.0000N	200.0000	70.0000	50.0000N	10.0000N	10.0000
213032	200.0000	30.0000	20.0000N	10.0000	10.0000	100.0000	10.0000	50.0000N	20.0000	100.0000
213033	1000.0000	30.0000	20.0000N	15.0000	10.0000N	500.0000	100.0000	50.0000N	10.0000	50.0000
213034	1000.0000	20.0000	20.0000N	20.0000	10.0000N	500.0000	150.0000	50.0000N	20.0000	150.0000
213035	150.0000	20.0000	20.0000N	50.0000	10.0000N	100.0000	200.0000	50.0000N	20.0000	50.0000
213036	200.0000	20.0000	20.0000N	10.0000	10.0000N	200.0000	15.0000	50.0000N	20.0000	100.0000
213037	700.0000	20.0000	20.0000N	30.0000	10.0000N	700.0000	150.0000	50.0000N	20.0000	50.0000
213038	150.0000	20.0000	20.0000N	20.0000	10.0000N	200.0000	150.0000	50.0000N	30.0000	200.0000
213039	150.0000	30.0000	20.0000N	15.0000	10.0000N	300.0000	150.0000	50.0000N	30.0000	200.0000
213040	150.0000	20.0000	20.0000N	10.0000	10.0000N	300.0000	100.0000	50.0000N	10.0000	100.0000
213041	30.0000	20.0000N	20.0000N	5.0000	10.0000N	500.0000	30.0000	50.0000N	10.0000	70.0000
213042	300.0000	20.0000N	20.0000N	5.0000L	10.0000N	100.0000	30.0000	50.0000N	10.0000N	20.0000
213043	300.0000	20.0000	20.0000N	5.0000L	10.0000N	200.0000	20.0000	50.0000N	10.0000	200.0000
213044	1000.0000	20.0000N	20.0000N	5.0000	15.0000	500.0000	50.0000	50.0000N	10.0000N	20.0000
213045	150.0000	20.0000N	20.0000N	5.0000L	10.0000L	100.0000	30.0000	50.0000N	10.0000N	20.0000
213046	200.0000	20.0000	20.0000N	5.0000N	10.0000L	200.0000	20.0000	50.0000N	10.0000N	70.0000
213047	200.0000	20.0000N	20.0000N	5.0000N	10.0000L	100.0000N	10.0000	50.0000N	10.0000N	20.0000
213048	200.0000	20.0000N	20.0000N	5.0000N	10.0000L	200.0000	10.0000	50.0000N	10.0000N	50.0000
213049	200.0000	20.0000N	20.0000N	5.0000N	10.0000L	200.0000	15.0000	50.0000N	10.0000N	20.0000
213050	200.0000	20.0000N	20.0000N	5.0000N	10.0000L	200.0000	10.0000	50.0000N	10.0000N	50.0000
213051	500.0000	20.0000N	20.0000N	5.0000N	10.0000L	100.0000N	20.0000	50.0000N	10.0000N	10.0000
213052	1000.0000	20.0000N	20.0000N	10.0000	15.0000	200.0000	50.0000	50.0000N	20.0000	50.0000
213053	3000.0000	20.0000N	20.0000N	5.0000L	30.0000	300.0000	20.0000	50.0000N	10.0000N	10.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

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SAMPLE	AA-AU-P	AA-CO-P	AA-NI-P	AZ-AG	AZ-AS	AZ-CU	AZ-MO	AZ-PB	AZ-SB	AZ-ZN
213000	0.0500N	5.0000L	35.0000	0.1000L	10.0000L	5.0000	5.0000L	1.0000L	5.0000	5.0000
213001	0.0500N	10.0000	50.0000	0.1000L	10.0000	6.0000	5.0000L	1.0000	5.0000L	6.0000
213006	0.0800	30.0000	70.0000	0.1000L	2500.0000	16.0000	5.0000L	7.0000	6.0000	150.0000
213007	0.1000	10.0000	20.0000	0.1000L	3750.0000	29.0000	5.0000L	13.0000	8.0000	55.0000
213008	24.0000	15.0000	20.0000	0.1000L	230.0000	29.0000	5.0000L	7.0000	6.0000	58.0000
213009	0.1400	10.0000	10.0000	0.1000L	400.0000	26.0000	7.0000	12.0000	6.0000	19.0000
213010	1.2800	5.0000N	5.0000L	0.1000L	10.0000L	4.0000	5.0000L	12.0000	5.0000L	5.0000
213011	0.4000	5.0000L	10.0000	0.1000L	60.0000	7.0000	5.0000L	10.0000	5.0000L	26.0000
213012	0.8800	5.0000L	5.0000L	0.1000L	10.0000L	5.0000	5.0000L	9.0000	5.0000L	26.0000
213013	0.4400	5.0000L	10.0000	0.4000	10.0000L	5.0000	5.0000	3.0000	5.0000L	2.0000
213014	0.3000	5.0000L	10.0000	0.1000L	30.0000	8.0000	5.0000L	2.0000	5.0000L	26.0000
213015	0.1600	10.0000	15.0000	0.1000L	90.0000	29.0000	5.0000L	7.0000	5.0000L	42.0000
213016	0.1800	5.0000N	10.0000	0.1000L	10.0000L	1.0000	5.0000L	2.0000	5.0000L	4.0000
213017	0.4200	5.0000N	10.0000	0.1000N	15.0000	3.0000	5.0000L	2.0000	5.0000L	8.0000
213018	1.8000	15.0000	50.0000	0.1000L	1100.0000	45.0000	5.0000L	4.0000	7.0000	66.0000
213019	0.3000	5.0000N	5.0000L	0.1000L	15.0000	2.0000	5.0000N	4.0000	5.0000L	5.0000
213020	0.0500L	10.0000	20.0000	0.1000N	100.0000	83.0000	5.0000L	6.0000	5.0000	83.0000
213021	0.0500N	5.0000N	5.0000L	0.1000L	10.0000L	3.0000	5.0000L	2.0000	5.0000L	14.0000
213022	0.0500L	30.0000	400.0000	0.1000L	500.0000	22.0000	5.0000L	5.0000	15.0000	50.0000
213023	0.3600	45.0000	450.0000	0.1500	2500.0000	340.0000	7.0000	18.0000	29.0000	135.0000
213024	0.0500L	40.0000	450.0000	0.1000L	110.0000	6.0000	5.0000L	10.0000	6.0000	68.0000
213025	0.0500N	35.0000	55.0000	0.1000N	10.0000L	3.0000	5.0000L	1.0000	5.0000L	73.0000
213026	0.0500N	40.0000	30.0000	0.1000N	10.0000L	180.0000	5.0000L	4.0000	5.0000L	41.0000
213027	0.0500N	5.0000N	5.0000L	0.1000N	10.0000L	2.0000	5.0000L	2.0000	5.0000L	4.0000
213028	0.0500N	15.0000	40.0000	0.1000N	10.0000L	84.0000	5.0000L	2.0000	5.0000L	54.0000
213029	0.0500N	10.0000	25.0000	0.1000L	50.0000	65.0000	5.0000L	15.0000	8.0000	78.0000
213030	0.0500N	5.0000L	15.0000	0.1000N	10.0000L	13.0000	5.0000L	6.0000	5.0000L	48.0000
213031	0.2600	55.0000	1250.0000	0.1000N	10.0000L	11.0000	5.0000L	3.0000	12.0000	19.0000
213032	0.0500N	5.0000L	10.0000	0.1000N	10.0000L	21.0000	5.0000L	1.0000L	5.0000L	59.0000
213033	0.0500N	35.0000	230.0000	0.1000N	10.0000	70.0000	5.0000L	10.0000	5.0000L	96.0000
213034	0.0500N	30.0000	140.0000	0.1000L	10.0000L	56.0000	5.0000L	12.0000	5.0000L	92.0000
213035	0.0500N	50.0000	70.0000	0.1000N	10.0000N	160.0000	5.0000L	3.0000	5.0000L	31.0000
213036	0.0500N	5.0000L	10.0000	0.1000N	10.0000N	16.0000	5.0000L	2.0000	5.0000L	62.0000
213037	0.0500N	55.0000	180.0000	0.1000N	10.0000N	54.0000	5.0000L	3.0000	5.0000L	110.0000
213038	0.0500N	20.0000	50.0000	0.1000L	10.0000N	53.0000	5.0000N	10.0000	5.0000L	86.0000
213039	0.0500N	20.0000	25.0000	0.1000N	10.0000N	60.0000	5.0000N	2.0000	5.0000L	90.0000
213040	0.0500N	15.0000	50.0000	0.1000L	10.0000N	32.0000	5.0000N	4.0000	5.0000L	74.0000
213041	0.0500N	5.0000L	5.0000L	0.1000L	10.0000N	5.0000	5.0000N	2.0000	5.0000L	38.0000
213042	92.3000	5.0000L	30.0000	2.8200	10.0000N	7.0000	5.0000	5.0000	5.0000L	18.0000
213043	0.0500N	5.0000L	20.0000	0.1000L	10.0000N	9.0000	5.0000L	10.0000	8.0000	20.0000
213044	0.0500N	35.0000	550.0000	0.1000L	400.0000	21.0000	5.0000L	4.0000	23.0000	35.0000
213045	9.0000	5.0000L	15.0000	0.1500	10.0000L	3.0000	5.0000L	2.0000	5.0000L	11.0000
213046	0.0500N	5.0000N	10.0000	0.1000L	10.0000N	4.0000	5.0000L	32.0000	5.0000L	45.0000
213047	0.0500N	5.0000L	10.0000	0.1000L	10.0000N	5.0000	6.0000	4.0000	5.0000L	12.0000
213048	0.0500N	5.0000N	10.0000	0.1000N	10.0000N	8.0000	5.0000L	9.0000	5.0000L	30.0000
213049	0.8000	5.0000N	10.0000	0.1000L	10.0000N	6.0000	5.0000	6.0000	5.0000L	14.0000
213050	0.0500N	5.0000N	10.0000	0.1000L	10.0000L	6.0000	5.0000L	7.0000	5.0000L	17.0000
213051	0.0500N	5.0000L	55.0000	0.1000L	50.0000	5.0000	5.0000L	1.0000	5.0000L	6.0000
213052	0.0500N	45.0000	5.0000L	0.1000L	200.0000	95.0000	5.0000L	5.0000	6.0000	62.0000
213053	0.0500N	55.0000	1000.0000	0.1000L	20.0000	11.0000	5.0000L	1.0000L	60.0000	38.0000

Table 4.--Atomic absorption and spectrographic analyses--Continued

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SAMPLE	S-FE	S-MG	S-CA	S-TI	S-MN	S-B	S-BA	S-BE	S-BI	S-CD
213054	5.0000	7.0000	5.0000	0.0020L	500.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213055	5.0000	5.0000	5.0000	0.0020L	500.0000	10.0000L	20.0000	1.0000L	10.0000N	20.0000N
213056	5.0000	5.0000	10.0000	0.0020L	500.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213057	5.0000	7.0000	5.0000	0.0020L	500.0000	10.0000L	70.0000	1.0000L	10.0000N	20.0000N
213058	5.0000	7.0000	5.0000	0.0020L	500.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213059	5.0000	7.0000	5.0000	0.0050	700.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213060	2.0000	5.0000	10.0000	0.0020	1000.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213061	2.0000	7.0000	7.0000	0.0020L	500.0000	10.0000L	70.0000	1.0000L	10.0000N	20.0000N
213062	0.5000	0.1500	1.0000	0.0300	500.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213063	1.5000	0.7000	1.0000	0.1000	500.0000	10.0000	500.0000	1.0000L	10.0000N	20.0000N
213064	1.0000	0.2000	1.0000	0.0500	300.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213065	1.0000	0.2000	1.0000	0.0200	300.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213066	0.5000	0.2000	0.5000	0.0500	100.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213067	1.0000	0.2000	0.5000	0.0500	150.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213068	0.5000	0.0200L	0.7000	0.0030	200.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213069	0.0500L	0.0200L	0.1000	0.0050	150.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213070	0.0500L	0.0200L	0.1000	0.0020	100.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213071	5.0000	0.0200	1.0000	0.0200	200.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213072	0.5000	0.0200	0.1000	0.0100	150.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213073	5.0000	2.0000	2.0000	0.2000	500.0000	30.0000	700.0000	1.0000L	10.0000N	20.0000N
213074	5.0000	2.0000	2.0000	0.2000	700.0000	30.0000	300.0000	1.0000L	10.0000N	20.0000N
213075	5.0000	5.0000	5.0000	0.0020L	700.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213076	2.0000	3.0000	2.0000	0.0200	500.0000	10.0000	700.0000	1.0000L	10.0000N	20.0000N
213077	0.5000	0.1000	0.5000	0.0100	100.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213078	5.0000	0.2000	7.0000	0.2000	700.0000	30.0000	700.0000	1.0000L	10.0000N	20.0000N
213079	5.0000	1.5000	5.0000	0.2000	700.0000	50.0000	700.0000	1.0000L	10.0000N	20.0000N
213080	5.0000	7.0000	5.0000	0.2000	200.0000	10.0000	700.0000	1.0000L	10.0000N	20.0000N
213081	2.0000	5.0000	20.0000	0.0200	300.0000	10.0000L	150.0000	1.0000L	10.0000N	20.0000N
213082	5.0000	2.0000	2.0000	0.5000	700.0000	10.0000	700.0000	1.0000L	10.0000N	20.0000N
213083	5.0000	10.0000	15.0000	0.0020L	700.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213084	2.0000	7.0000	5.0000	0.0020L	500.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213085	7.0000	5.0000	5.0000	0.5000	1000.0000	20.0000	200.0000	1.0000L	10.0000N	20.0000N
213086	2.0000	7.0000	7.0000	0.0100	700.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213087	2.0000	10.0000	5.0000	0.0020L	200.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213088	2.0000	10.0000	5.0000	0.0020L	300.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213089	2.0000	10.0000	5.0000	0.0020L	500.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213090	10.0000	1.0000	5.0000	0.0500	500.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213091	0.5000	0.0200L	0.2000	0.0020L	150.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213092	1.0000	0.1000	2.0000	0.0500	500.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213093	0.5000	0.0200L	0.2000	0.0020	200.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213094	0.5000	0.1000	0.2000	0.0700	150.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213095	1.0000	1.0000	0.2000	0.0700	150.0000	10.0000	300.0000	1.0000L	10.0000N	20.0000N
213096	0.5000	0.2000	0.2000	0.0500	100.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213097	0.5000	0.2000	1.0000	0.0500	200.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213098	0.5000	0.1000	1.0000	0.0500	200.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213099	0.5000	0.2000	1.0000	0.0500	200.0000	10.0000	200.0000	1.0000L	10.0000N	20.0000N
213100	1.0000	0.3000	0.5000	0.0500	150.0000	10.0000	500.0000	1.0000L	10.0000N	20.0000N
213101	1.0000	0.5000	0.2000	0.0500	70.0000	10.0000	500.0000	1.0000L	10.0000N	20.0000N
213102	5.0000	5.0000	5.0000	0.2000	700.0000	20.0000	500.0000	1.0000L	10.0000N	20.0000N
213103	2.0000	0.3000	5.0000	0.2000	700.0000	30.0000	300.0000	1.0000L	10.0000N	20.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

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SAMPLE	S-CR	S-LA	S-NB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZR
213054	2000.0000	20.0000N	20.0000N	5.0000L	20.0000	300.0000	15.0000	50.0000N	10.0000N	10.0000N
213055	1000.0000	20.0000N	20.0000N	5.0000	15.0000	300.0000	15.0000	50.0000N	10.0000N	10.0000N
213056	2000.0000	20.0000N	20.0000N	5.0000	20.0000	200.0000	20.0000	50.0000N	10.0000N	10.0000N
213057	1000.0000	20.0000N	20.0000N	5.0000	15.0000	300.0000	15.0000	50.0000N	10.0000N	10.0000N
213058	2000.0000	20.0000N	20.0000N	5.0000	20.0000	300.0000	15.0000	50.0000N	10.0000N	10.0000N
213059	2000.0000	20.0000N	20.0000N	20.0000	20.0000	300.0000	100.0000	50.0000N	10.0000N	10.0000N
213060	2000.0000	20.0000N	20.0000N	5.0000L	10.0000	700.0000	10.0000	50.0000N	10.0000N	10.0000N
213061	1500.0000	20.0000N	20.0000N	5.0000	10.0000	300.0000	10.0000	50.0000N	10.0000N	10.0000N
213062	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000	15.0000	50.0000N	10.0000N	15.0000
213063	150.0000	20.0000	20.0000N	5.0000	10.0000N	200.0000	20.0000	50.0000N	20.0000	200.0000
213064	200.0000	20.0000L	20.0000N	5.0000L	10.0000N	150.0000	15.0000	50.0000N	10.0000	100.0000
213065	100.0000	20.0000N	20.0000N	5.0000L	10.0000N	100.0000	10.0000	50.0000N	10.0000	70.0000
213066	150.0000	20.0000N	20.0000N	5.0000L	10.0000N	150.0000	10.0000	50.0000N	20.0000	200.0000
213067	200.0000	20.0000N	20.0000N	5.0000L	10.0000N	150.0000	10.0000	50.0000N	20.0000	150.0000
213068	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000L	10.0000N
213069	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000L	10.0000N
213070	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N
213071	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	100.0000	50.0000N	10.0000N	500.0000
213072	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000	10.0000N
213073	1000.0000	20.0000N	20.0000N	20.0000	10.0000N	200.0000	100.0000	50.0000N	15.0000	50.0000
213074	500.0000	20.0000N	20.0000N	20.0000	10.0000N	300.0000	100.0000	50.0000N	10.0000N	50.0000
213075	2000.0000	20.0000N	20.0000N	5.0000L	20.0000	300.0000	15.0000	50.0000N	10.0000N	10.0000N
213076	1000.0000	20.0000N	20.0000N	5.0000L	10.0000	200.0000	30.0000	50.0000N	10.0000N	10.0000L
213077	200.0000	20.0000N	20.0000N	5.0000L	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213078	200.0000	20.0000	20.0000N	15.0000	10.0000N	500.0000	100.0000	50.0000N	20.0000	200.0000
213079	1000.0000	20.0000	20.0000N	15.0000	10.0000N	300.0000	100.0000	50.0000N	10.0000	70.0000
213080	1000.0000	20.0000	20.0000N	20.0000	10.0000N	500.0000	150.0000	50.0000N	10.0000	70.0000
213081	1500.0000	20.0000L	20.0000N	5.0000N	10.0000N	300.0000	100.0000	50.0000N	10.0000L	20.0000
213082	30.0000	50.0000	30.0000	10.0000	10.0000N	500.0000	100.0000	50.0000N	30.0000	300.0000
213083	2000.0000	20.0000N	20.0000N	5.0000L	10.0000N	500.0000	15.0000	50.0000N	10.0000N	10.0000N
213084	1000.0000	20.0000N	20.0000N	10.0000	10.0000N	500.0000	15.0000	50.0000N	10.0000N	10.0000N
213085	100.0000	20.0000	20.0000N	30.0000	10.0000N	500.0000	200.0000	50.0000N	30.0000	100.0000
213086	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	20.0000	50.0000N	10.0000N	10.0000N
213087	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	300.0000	20.0000	50.0000N	10.0000N	10.0000N
213088	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	15.0000	50.0000N	10.0000N	10.0000N
213089	1000.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	15.0000	50.0000N	10.0000N	10.0000N
213090	150.0000	20.0000	20.0000N	5.0000N	10.0000N	150.0000	70.0000	50.0000N	10.0000N	30.0000
213091	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	15.0000	50.0000N	10.0000N	10.0000N
213092	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213093	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N
213094	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	150.0000	15.0000	50.0000N	20.0000	200.0000
213095	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	20.0000	50.0000N	20.0000	200.0000
213096	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	15.0000	50.0000N	20.0000	200.0000
213097	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	15.0000	50.0000N	20.0000	100.0000
213098	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	150.0000	15.0000	50.0000N	10.0000	100.0000
213099	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	150.0000	15.0000	50.0000N	10.0000	100.0000
213100	200.0000	30.0000	20.0000N	5.0000L	10.0000N	200.0000	20.0000	50.0000N	20.0000	100.0000
213101	200.0000	30.0000	20.0000N	5.0000L	10.0000N	200.0000	20.0000	50.0000N	20.0000	100.0000
213102	500.0000	20.0000	20.0000N	50.0000	10.0000N	200.0000	200.0000	50.0000N	15.0000	70.0000
213103	100.0000	20.0000N	20.0000N	7.0000	10.0000N	300.0000	150.0000	50.0000N	15.0000	100.0000

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	AA-AU-P	AA-CO-P	AA-NI-P	AZ-AG	AZ-AS	AZ-CU	AZ-MO	AZ-PB	AZ-SB	AZ-ZN
213054	0.0500L	65.0000	700.0000	0.1000L	150.0000	23.0000	5.0000L	1.0000L	8.0000	32.0000
213055	0.0500N	55.0000	1100.0000	0.1000L	90.0000	7.0000	5.0000L	1.0000L	45.0000	28.0000
213056	0.0500N	50.0000	850.0000	0.1000L	10.0000N	12.0000	5.0000L	4.0000	19.0000	49.0000
213057	0.0500N	60.0000	1200.0000	0.2000	10.0000N	11.0000	5.0000L	1.0000	5.0000L	29.0000
213058	0.0500N	55.0000	1200.0000	0.1000L	10.0000N	23.0000	5.0000L	1.0000	5.0000L	28.0000
213059	0.0500N	55.0000	400.0000	0.1100	10.0000N	14.0000	5.0000L	1.0000L	5.0000L	36.0000
213060	0.0500N	40.0000	800.0000	0.1000N	600.0000	12.0000	5.0000L	1.0000L	60.0000	35.0000
213061	0.0500N	45.0000	750.0000	0.1000L	20.0000	17.0000	5.0000L	1.0000L	9.0000	36.0000
213062	16.0000	5.0000N	15.0000	0.5600	10.0000N	6.0000	5.0000	1.0000L	5.0000L	9.0000
213063	0.0500N	5.0000L	20.0000	0.1000L	10.0000N	12.0000	5.0000	11.0000	5.0000L	40.0000
213064	0.0500L	5.0000N	10.0000	0.1000L	10.0000N	9.0000	6.0000	6.0000	5.0000N	16.0000
213065	0.0500L	5.0000L	10.0000	0.1000L	10.0000N	6.0000	5.0000L	3.0000	5.0000L	13.0000
213066	0.0500L	5.0000N	15.0000	0.1000L	10.0000N	6.0000	5.0000L	6.0000	5.0000L	13.0000
213067	0.0500L	5.0000N	10.0000	0.1000L	10.0000N	9.0000	5.0000	8.0000	5.0000L	20.0000
213068	0.0500L	5.0000L	15.0000	0.1000L	10.0000N	5.0000	7.0000	1.0000N	5.0000L	5.0000
213069	4.4000	5.0000N	10.0000	0.1900	10.0000N	3.0000	6.0000	30.0000	25.0000	33.0000
213070	0.0500L	5.0000L	10.0000	0.1000N	10.0000L	3.0000	5.0000L	1.0000L	5.0000L	2.0000
213071	0.0500L	5.0000N	10.0000	0.1000N	10.0000	9.0000	5.0000L	1.0000N	5.0000L	5.0000
213072	5.8000	5.0000N	10.0000	0.3100	140.0000	4.0000	6.0000	13.0000	5.0000L	3.0000
213073	0.0500L	40.0000	135.0000	0.1000L	10.0000N	62.0000	5.0000N	1.0000	7.0000	86.0000
213074	0.0500N	25.0000	35.0000	0.1000L	10.0000N	70.0000	5.0000N	13.0000	5.0000L	71.0000
213075	0.0500L	50.0000	1000.0000	0.1000N	400.0000	9.0000	5.0000N	1.0000L	85.0000	33.0000
213076	0.0500L	30.0000	550.0000	0.1000N	80.0000	7.0000	5.0000L	2.0000	24.0000	17.0000
213077	0.0500N	5.0000L	20.0000	0.1000N	10.0000N	7.0000	5.0000	1.0000L	5.0000L	9.0000
213078	0.5600	10.0000	20.0000	0.1500	10.0000N	16.0000	5.0000N	5.0000	5.0000L	44.0000
213079	0.0500L	40.0000	300.0000	0.1300	100.0000	53.0000	5.0000N	4.0000	47.0000	82.0000
213080	0.0500L	35.0000	170.0000	0.1000L	10.0000N	49.0000	5.0000N	8.0000	5.0000L	84.0000
213081	0.0600	40.0000	700.0000	0.1000L	10.0000N	10.0000	5.0000N	2.0000	5.0000L	12.0000
213082	0.0500N	20.0000	5.0000N	0.1000L	10.0000N	13.0000	5.0000L	8.0000	5.0000L	200.0000
213083	0.0500L	60.0000	1400.0000	0.1000L	10.0000N	5.0000	5.0000L	1.0000N	5.0000L	22.0000
213084	0.0500L	30.0000	450.0000	0.1000L	240.0000	4.0000	5.0000L	1.0000N	36.0000	42.0000
213085	0.0500L	50.0000	55.0000	0.1000L	10.0000N	117.0000	5.0000N	1.0000L	5.0000L	116.0000
213086	0.0500L	40.0000	500.0000	0.1000N	10.0000N	3.0000	5.0000L	1.0000L	5.0000L	31.0000
213087	0.0500L	60.0000	1100.0000	0.1000L	160.0000	27.0000	5.0000L	1.0000N	26.0000	34.0000
213088	0.0500L	60.0000	1400.0000	0.1000L	250.0000	7.0000	5.0000L	1.0000N	29.0000	21.0000
213089	0.0500L	60.0000	1350.0000	0.1000L	400.0000	8.0000	5.0000L	1.0000N	50.0000	36.0000
213090	0.0500L	20.0000	75.0000	0.1000L	35.0000	48.0000	80.0000	60.0000	5.0000L	32.0000
213091	0.0800	5.0000L	15.0000	0.1000N	10.0000	4.0000	6.0000	1.0000N	5.0000L	3.0000
213092	0.0600	10.0000	40.0000	0.1000N	35.0000	4.0000	5.0000	2.0000	5.0000L	11.0000
213093	0.0500L	5.0000N	15.0000	0.1000N	10.0000N	3.0000	5.0000	3.0000	5.0000L	2.0000
213094	0.0800	5.0000N	10.0000	0.1000N	10.0000N	13.0000	5.0000L	7.0000	5.0000L	21.0000
213095	0.0500N	5.0000N	10.0000	0.1000N	10.0000N	11.0000	5.0000	9.0000	5.0000L	53.0000
213096	0.0500N	5.0000N	15.0000	0.1000L	10.0000N	13.0000	5.0000	6.0000	5.0000L	20.0000
213097	0.0500L	5.0000N	30.0000	0.1000L	10.0000N	5.0000	5.0000L	7.0000	5.0000L	22.0000
213098	0.0500L	5.0000N	20.0000	0.1000L	10.0000N	5.0000	5.0000L	5.0000	5.0000L	15.0000
213099	0.0500L	5.0000N	20.0000	0.1000L	10.0000N	6.0000	5.0000L	5.0000	5.0000L	23.0000
213100	0.0500N	5.0000	25.0000	0.1000N	10.0000L	7.0000	5.0000L	10.0000	5.0000L	22.0000
213101	0.0500N	5.0000	10.0000	0.1000N	10.0000L	5.0000	6.0000	8.0000	5.0000L	22.0000
213102	0.0500N	40.0000	95.0000	0.1000N	100.0000	60.0000	5.0000L	3.0000	7.0000	82.0000
213103	0.0500L	15.0000	15.0000	0.1000N	50.0000	25.0000	5.0000L	5.0000	5.0000	56.0000

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-FE	S-MG	S-CA	S-TI	S-MN	S-B	S-BA	S-BE	S-BI	S-CD
213104	2.0000	5.0000	1.5000	0.1000	500.0000	20.0000	200.0000	1.0000L	10.0000N	20.0000N
213105	5.0000	5.0000	1.0000	0.2000	500.0000	30.0000	700.0000	1.0000L	10.0000N	20.0000N
213106	0.5000	0.2000	0.5000	0.0200	100.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213107	2.0000	5.0000	1.0000	0.0500	700.0000	30.0000	150.0000	1.0000L	10.0000N	20.0000N
213108	1.0000	10.0000	5.0000	0.0020L	500.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213109	2.0000	2.0000	20.0000	0.0020L	500.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213110	0.5000	0.5000	10.0000	0.0200	500.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213111	0.5000	0.5000	1.5000	0.0020L	200.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213112	2.0000	0.2000	5.0000	0.1000	700.0000	30.0000	500.0000	1.0000L	10.0000N	20.0000N
213113	2.0000	7.0000	10.0000	0.0020N	500.0000	10.0000L	150.0000	1.0000L	10.0000N	20.0000N
213114	0.7000	0.3000	1.0000	0.0150	500.0000	10.0000	300.0000	1.0000L	10.0000N	20.0000N
213115	1.0000	0.7000	1.5000	0.0200	200.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213116	2.0000	7.0000	5.0000	0.0020	1000.0000	10.0000N	70.0000	1.0000L	10.0000N	20.0000N
213117	5.0000	0.2000	1.5000	0.0500	150.0000	10.0000	150.0000	1.0000L	10.0000N	20.0000N
213118	5.0000	5.0000	5.0000	0.2000	700.0000	20.0000	100.0000	1.0000L	10.0000N	20.0000N
213119	1.0000	5.0000	5.0000	0.0020L	500.0000	10.0000	20.0000N	1.0000L	10.0000N	20.0000N
213120	3.0000	10.0000	5.0000	0.0200	500.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213121	1.5000	10.0000	5.0000	0.0100	500.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213122	0.5000	5.0000	5.0000	0.0020L	200.0000	20.0000	300.0000	1.0000L	10.0000N	20.0000N
213123	2.0000	5.0000	5.0000	0.0020L	500.0000	10.0000L	70.0000	1.0000L	10.0000N	20.0000N
213124	1.5000	7.0000	5.0000	0.0200	200.0000	10.0000L	150.0000	1.0000L	10.0000N	20.0000N
213125	1.0000	5.0000	2.0000	0.0200	200.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213126	5.0000	5.0000	0.5000	0.2000	300.0000	30.0000	300.0000	1.0000L	10.0000N	20.0000N
213127	5.0000	7.0000	5.0000	0.0200	700.0000	10.0000N	50.0000	1.0000L	10.0000N	20.0000N
213128	0.5000	1.5000	1.0000	0.0030	200.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213129	2.0000	5.0000	5.0000	0.0200	700.0000	10.0000	100.0000	1.0000L	10.0000N	20.0000N
213130	2.0000	1.0000	10.0000	0.0020L	200.0000	10.0000L	50.0000	1.0000L	10.0000N	20.0000N
213131	5.0000	7.0000	3.0000	0.2000	1000.0000	20.0000	200.0000	1.0000L	10.0000N	20.0000N
213132	0.5000	0.2000	0.7000	0.0100	200.0000	10.0000	50.0000	1.0000L	10.0000N	20.0000N
213133	3.0000	7.0000	5.0000	0.0020	300.0000	10.0000	20.0000	1.0000L	10.0000N	20.0000N
213134	2.0000	7.0000	1.0000	0.0020L	300.0000	10.0000L	20.0000N	1.0000L	10.0000N	20.0000N
213135	5.0000	5.0000	5.0000	0.2000	1000.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213136	5.0000	5.0000	5.0000	0.3000	1000.0000	10.0000	300.0000	1.0000L	10.0000N	20.0000N
213137	0.5000	0.0200L	0.1000	0.0100	100.0000	10.0000	20.0000N	1.0000L	10.0000N	20.0000N
213138	0.5000	0.0200L	0.7000	0.0200	150.0000	10.0000	70.0000	1.0000L	10.0000N	20.0000N
213139	0.5000	0.0200L	0.1000	0.0030	100.0000	20.0000	100.0000	1.0000L	10.0000N	20.0000N
213140	0.5000	0.0200	0.1000	0.0100	100.0000	20.0000	70.0000	1.0000L	10.0000N	20.0000N
213141	0.5000	0.5000	0.1000	0.2000	100.0000	200.0000	200.0000	1.0000	10.0000N	20.0000N
213142	0.5000	0.2000	0.1000	0.0500	100.0000	50.0000	100.0000	1.0000L	10.0000N	20.0000N
213143	2.0000	0.5000	0.1000	0.1000	200.0000	70.0000	200.0000	1.0000L	10.0000N	20.0000N
213144	1.0000	0.7000	10.0000	0.0500	200.0000	2000.0000G	200.0000	3.0000	10.0000N	20.0000N
213145	5.0000	1.5000	7.0000	0.2000	700.0000	50.0000	500.0000	1.0000L	10.0000N	20.0000N
213146	1.0000	0.1000	1.0000	0.0200	200.0000	10.0000L	100.0000	1.0000L	10.0000N	20.0000N
213147	5.0000	2.0000	2.0000	0.1000	500.0000	30.0000	500.0000	1.0000L	10.0000N	20.0000N
213148	0.5000	0.0200L	0.1000	0.0020L	100.0000	10.0000	20.0000N	1.0000L	10.0000N	20.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	S-CR	S-LA	S-NB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZR
213104	200.0000	20.0000	20.0000N	10.0000	10.0000N	300.0000	100.0000	50.0000N	15.0000	150.0000
213105	150.0000	20.0000	20.0000N	20.0000	10.0000N	500.0000	150.0000	50.0000N	10.0000	150.0000
213106	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213107	150.0000	20.0000N	20.0000N	15.0000	10.0000N	200.0000	70.0000	50.0000N	10.0000N	20.0000
213108	1000.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	10.0000	50.0000N	10.0000N	10.0000N
213109	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	50.0000	50.0000N	10.0000N	10.0000N
213110	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	10.0000	50.0000N	10.0000N	10.0000N
213111	200.0000	20.0000N	20.0000N	10.0000	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N
213112	100.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	50.0000	50.0000N	20.0000	150.0000
213113	1000.0000	20.0000N	20.0000N	5.0000N	10.0000N	150.0000	10.0000	50.0000N	10.0000N	10.0000N
213114	200.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	15.0000	50.0000N	10.0000	10.0000N
213115	500.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	15.0000	50.0000N	10.0000N	10.0000N
213116	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	10.0000	50.0000N	10.0000N	10.0000N
213117	150.0000	20.0000	20.0000N	5.0000	10.0000N	700.0000	100.0000	50.0000N	10.0000	50.0000
213118	500.0000	20.0000	20.0000N	20.0000	10.0000N	100.0000N	100.0000	50.0000N	20.0000	50.0000
213119	200.0000	20.0000N	20.0000N	5.0000	10.0000N	100.0000	10.0000	50.0000N	10.0000N	10.0000N
213120	150.0000	20.0000N	20.0000N	20.0000	10.0000N	100.0000N	50.0000	50.0000N	10.0000N	10.0000N
213121	500.0000	20.0000N	20.0000N	5.0000N	10.0000N	500.0000	10.0000	50.0000N	10.0000N	10.0000N
213122	50.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	10.0000L	50.0000N	10.0000N	10.0000N
213123	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000	70.0000	50.0000N	10.0000N	10.0000N
213124	100.0000	20.0000N	20.0000N	10.0000	10.0000N	200.0000	50.0000	50.0000N	10.0000N	10.0000N
213125	1000.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N
213126	200.0000	20.0000N	20.0000N	10.0000	10.0000N	300.0000	100.0000	50.0000N	20.0000	150.0000
213127	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	300.0000	50.0000	50.0000N	10.0000N	10.0000N
213128	300.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000	10.0000	50.0000N	10.0000N	10.0000N
213129	1000.0000	20.0000N	20.0000N	10.0000	10.0000N	100.0000	30.0000	50.0000N	10.0000N	10.0000N
213130	2000.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213131	1500.0000	20.0000N	20.0000N	15.0000	10.0000N	200.0000	100.0000	50.0000N	10.0000	70.0000
213132	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	15.0000	50.0000N	10.0000N	10.0000N
213133	1000.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	20.0000	50.0000N	10.0000N	10.0000N
213134	1000.0000	20.0000N	20.0000N	5.0000L	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N
213135	100.0000	20.0000	20.0000N	20.0000	10.0000N	100.0000N	100.0000	50.0000N	20.0000	50.0000
213136	200.0000	20.0000	20.0000N	30.0000	10.0000N	200.0000	150.0000	50.0000N	30.0000	150.0000
213137	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213138	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	20.0000	50.0000N	10.0000N	10.0000N
213139	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	150.0000	50.0000N	10.0000N	10.0000N
213140	200.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	150.0000	50.0000N	10.0000N	10.0000N
213141	1000.0000	20.0000N	20.0000N	7.0000	10.0000N	100.0000N	200.0000	50.0000N	15.0000	70.0000
213142	200.0000	20.0000N	20.0000N	5.0000L	10.0000N	100.0000N	50.0000	50.0000N	10.0000L	20.0000
213143	200.0000	20.0000	20.0000N	5.0000	10.0000N	100.0000N	100.0000	50.0000N	10.0000L	150.0000
213144	150.0000	20.0000N	20.0000N	5.0000L	10.0000N	200.0000	50.0000	50.0000N	10.0000L	70.0000
213145	300.0000	20.0000N	20.0000N	20.0000	10.0000N	500.0000	100.0000	50.0000N	10.0000	70.0000
213146	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	200.0000	30.0000	50.0000N	10.0000N	10.0000L
213147	500.0000	20.0000N	20.0000N	20.0000	10.0000N	200.0000	100.0000	50.0000N	10.0000	50.0000
213148	150.0000	20.0000N	20.0000N	5.0000N	10.0000N	100.0000N	10.0000	50.0000N	10.0000N	10.0000N

Table 4.--Atomic absorption and spectrographic analyses--Continued

PRINTOUT FOR SPEC/AA

SAMPLE	AA-AU-P	AA-CO-P	AA-NI-P	AZ-AG	AZ-AS	AZ-CU	AZ-MO	AZ-PB	AZ-SB	AZ-ZN
213104	0.0500N	30.0000	125.0000	0.1000N	10.0000L	29.0000	5.0000L	5.0000	5.0000L	76.0000
213105	0.0500N	25.0000	55.0000	0.1000N	10.0000L	38.0000	5.0000L	6.0000	5.0000L	78.0000
213106	5.8000	15.0000	20.0000	0.2000	75.0000	4.0000	8.0000	5.0000	5.0000L	6.0000
213107	0.0500N	80.0000	245.0000	0.1000	10.0000L	45.0000	5.0000L	4.0000	5.0000L	77.0000
213108	0.0500N	60.0000	800.0000	0.1000N	75.0000	5.0000	5.0000L	1.0000	10.0000	35.0000
213109	0.0500N	95.0000	1350.0000	0.1000N	10.0000L	5.0000	5.0000L	1.0000L	5.0000L	14.0000
213110	0.0500N	5.0000	30.0000	0.1000N	10.0000L	2.0000	5.0000L	5.0000	5.0000L	7.0000
213111	0.0500N	5.0000	25.0000	0.1000N	10.0000L	19.0000	5.0000	2.0000	5.0000L	5.0000
213112	0.1400	15.0000	20.0000	0.1000N	160.0000	6.0000	5.0000L	7.0000	5.0000L	43.0000
213113	0.1000	85.0000	1300.0000	0.1000N	10.0000L	7.0000	5.0000L	2.0000	5.0000L	22.0000
213114	0.0500N	15.0000	25.0000	0.1000N	10.0000L	13.0000	5.0000	3.0000	5.0000L	10.0000
213115	0.0500N	15.0000	70.0000	0.1000N	10.0000L	5.0000	10.0000	1.0000	5.0000L	6.0000
213116	0.7000	45.0000	500.0000	0.1000N	10.0000L	3.0000	5.0000L	3.0000	5.0000L	40.0000
213117	0.0500L	15.0000	20.0000	0.2000	150.0000	45.0000	6.0000	23.0000	5.0000L	17.0000
213118	0.0500N	60.0000	125.0000	0.1000N	10.0000L	106.0000	5.0000L	2.0000	5.0000L	50.0000
213119	0.0500N	25.0000	85.0000	0.1000N	10.0000L	8.0000	5.0000L	1.0000	5.0000L	8.0000
213120	0.0500N	40.0000	60.0000	0.1000L	10.0000L	3.0000	5.0000L	1.0000	5.0000L	24.0000
213121	0.0500N	20.0000	270.0000	0.1000N	10.0000L	3.0000	5.0000L	1.0000	5.0000L	7.0000
213122	0.0500N	5.0000L	25.0000	0.1000L	25.0000	9.0000	5.0000L	4.0000	970.0000	10.0000
213123	0.0500N	55.0000	1000.0000	0.1000N	1000.0000	6.0000	5.0000	2.0000	71.0000	22.0000
213124	0.0500N	10.0000	45.0000	0.1000N	10.0000L	18.0000	5.0000L	2.0000	17.0000	17.0000
213125	0.0500N	10.0000	245.0000	0.1000N	10.0000L	8.0000	5.0000L	1.0000	12.0000	12.0000
213126	0.0500N	15.0000	45.0000	0.1000N	10.0000L	43.0000	5.0000L	11.0000	5.0000L	80.0000
213127	0.0500N	80.0000	950.0000	0.1000N	10.0000L	27.0000	5.0000L	2.0000	5.0000L	36.0000
213128	0.0500N	5.0000L	30.0000	0.1000N	10.0000L	4.0000	9.0000	3.0000	5.0000L	4.0000
213129	0.0500N	35.0000	335.0000	0.1000N	160.0000	4.0000	5.0000	4.0000	28.0000	46.0000
213130	0.0500N	10.0000	170.0000	0.1000N	20.0000	7.0000	5.0000L	1.0000	10.0000	15.0000
213131	0.0500N	50.0000	160.0000	0.1000N	10.0000L	44.0000	5.0000L	12.0000	5.0000L	83.0000
213132	0.0500N	5.0000	40.0000	0.1000N	10.0000L	5.0000	7.0000	1.0000	5.0000L	6.0000
213133	0.0500N	50.0000	950.0000	0.1000N	1000.0000	7.0000	5.0000L	1.0000	97.0000	23.0000
213134	0.0500N	75.0000	1500.0000	0.1000N	1300.0000	2.0000	5.0000L	1.0000L	5.0000L	23.0000
213135	0.0500N	45.0000	50.0000	0.1000L	10.0000L	41.0000	5.0000L	2.0000	290.0000	92.0000
213136	0.0500N	50.0000	70.0000	0.1000N	10.0000L	40.0000	5.0000L	1.0000	5.0000	71.0000
213137	0.0500N	10.0000	5.0000	0.2000	650.0000	3.0000	5.0000	16.0000	5.0000L	19.0000
213138	0.2800	5.0000	15.0000	0.1000L	120.0000	4.0000	10.0000	6.0000	5.0000L	8.0000
213139	1.0000	5.0000	5.0000	0.1000N	10.0000L	4.0000	6.0000	1.0000	8.0000	3.0000
213140	222.0000	5.0000	10.0000	6.7000	10.0000L	5.0000	10.0000	8.0000	18.0000	23.0000
213141	0.7600	5.0000	20.0000	0.3000	10.0000L	31.0000	5.0000L	14.0000	5.0000L	38.0000
213142	9.8000	5.0000	15.0000	1.1000	120.0000	10.0000	5.0000	9.0000	5.0000L	27.0000
213143	1.0000	5.0000	10.0000	0.4000	100.0000	39.0000	6.0000	18.0000	400.0000	39.0000
213144	0.0800	10.0000	5.0000	0.1000N	10.0000L	8.0000	5.0000L	4.0000	40.0000	23.0000
213145	0.0600	30.0000	60.0000	0.5000	50.0000	12.0000	5.0000L	4.0000	5.0000	69.0000
213146	1.4000	5.0000	15.0000	0.4000	10.0000L	3.0000	5.0000	14.0000	5.0000L	13.0000
213147	0.0600	45.0000	135.0000	0.1000N	120.0000	46.0000	5.0000L	4.0000	5.0000	80.0000
213148	0.0500N	5.0000	10.0000	0.1000N	10.0000L	3.0000	6.0000	1.0000L	5.0000L	4.0000

CONCLUSIONS AND RECOMMENDATIONS

Dump sampling of quartz vein material in the Shiaila area gave an average of 6.8 gold and very low silver. The veins are widely spaced and are thought to be short, lenticular, and less than 1 m thick. Pyrite is the principal accessory mineral, but in places, relatively pyrite-free quartz assays as much as 280 ppm gold. Assay values are not repeated in some of the samples with high gold assays, indicating that the gold is probably free and in large particles in quartz.

The geological environment of the Shiaila area is complex, with major faults including the Raha, and probably Najd-type faults transecting the area. The intrusion of the nearby Silsilah granite ring complex and subsequent gold deposition by a related hydrothermal system was probably controlled, at least partially, by the faults, and fault junctures. In such case, perhaps large areas of metasedimentary rocks were hydrothermally altered; perhaps around the margins of granite cupolas at depth (fig. 3). It is therefore recommended that geophysical surveys be made in the Shiaila area to test for this possibility. Gravity surveys would be appropriate geophysical methods to locate buried cupolas, and audio-magnetotelluric and electric-telluric methods could locate altered zones. Flanigan and Zablocki (1985) report that hydrothermally altered Maraghan lithic graywacke was probably detected by electric-telluric measurements immediately south of the geophysical traverse in the Shiaila area (plate 1). Wadi alluvium and drifted sand cover much of the area immediately south of the map area and extend to the Silsilah ring complex. The geophysical surveys should cover all of this zone as well. Later drilling should be employed to test any geophysical anomalies, perhaps in conjunction with testing some of the larger vein systems.

Numerous samples of listwaenite, jasperoid, and quartz veins in the Raha fault zone indicate moderate enrichment of the listwaenite in arsenic and antimony although gold values are uniformly low. The listwaenite is also slightly enriched in tin locally, especially on its western, sheared end. These conditions would seem to imply that rocks in the Raha fault zone have been affected by hydrothermal systems associated with both gold and tin deposition; factors to keep in mind while studying the area.

DATA STORAGE

Petrographic descriptions, sample locations, thin sections, and results of chemical analyses are stored in Data File USGS-DF-05-4, (Smith and Samater, 1985) in the Jeddah office of the U. S. Geological Survey Saudi Arabian Mission.

Data on mineral occurrences in the Shiaila area have been updated and entered for the following MODS numbers:

1383	Shiaila	Au	Updated	2/85

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