DEPARTMENT OF THE INTERIOR
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Geology and Mineralization at the Umm Shat Sharq A Gold Prospect, Ishmas Gold District, Kingdom of Saudi Arabia

by

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GEOLOGY AND MINERALIZATION AT THE UMM SHAT SHARQ A GOLD PROSPECT, ISHMAS GOLD DISTRICT, KINGDOM OF SAUDI ARABIA

By

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ABSTRACT

The Umm Shat Sharq A ancient mine is located approximately 60 km east southeast of Ranyah city and 3 km east southeast of Jabal al Hadad. The mine workings, which define the extent of the prospect, are located in the north-central part of the Ishmas gold district 2 km west of the Nabitah fault zone. The ancient mine consists of a low-lying mound of mine spoil 215 m long and 30 m wide. Core and percussion drilling (390.3 m total length drilled) were conducted in five drill holes located immediately west of the mine site.

A 3-10-m-thick vein zone (main vein zone) was intercepted in 3 drill holes, whereas two overlapping zones, 3 and 5 m thick, were intercepted in the southernmost hole drilled. The strike (approximately S. 200° W.; dip = 25-35° W.) of the vein zone appears to parallel the trend of the ancient workings. The veins occur at a lithologic boundary that separates fine-grained quartz monzodiorite from medium-grained quartz monzodiorite.

The weighted-average concentrations of gold and silver for 33 core samples containing gold concentrations higher than the threshold value (60 ppb) are 247 ppb and 0.24 ppm, respectively, over a total summed intercept length of 40.04 m. The largest gold intercept (345 ppb over 7.15 m) was encountered in the main vein zone in drill hole 5; a 2,772 ppb Au intercept from a combined 1.0-m-length of channel samples was obtained from a trench (White and Doebrich, 1988). The largest gold concentration (1,100 ppb) present in a drill-core sample was obtained from a 1.5 m length of drill core containing indications of the presence of a fault. In the main vein zone, gold-silver ratios vary from 1.17 at 70 m depth (drill hole 5) to 2.52 (maximum) in trench samples. These ratios appear to decrease from the surface downward along the dip slope of the main vein zone structure; this observation is consistent with a supergene gold-enrichment model.

Primary gold deposition is associated with sericite + pyrite + arsenopyrite alteration envelopes on quartz veins; however, gold concentrations in barren white veins are well below the threshold concentration. Gold enrichment, on the other

hand, occurred either in fault zones or adjacent to thick quartz veins and is associated with limonite + hematite found primarily in argillized rocks. Limonite + hematite stringers increase in numeric density in argillized country rocks adjacent to these veins; this argillic alteration is superimposed upon sericitic alteration. Thick, continuous quartz veins deflect propagating fractures along their margins or nucleate fractures at these margins. These observations indicate the role played by acidic supergene solutions that descended along porous and permeable fracture zones proximal to thick veins or along fault structures that intercept these zones.

INTRODUCTION

LOCATION AND PHYSIOGRAPHY

Umm Shat Sharq A ancient mine (MODS 01460) is located at lat 20° 58'30" N. and long 43° 21'22" E., approximately 60 km east-southeast of Ranyah, the principal city in the region. Jabal al Hadad, located 3 km west-northwest of the workings, has a police station, store, and gas station. The mine site is accessible by four-wheel-drive vehicle on desert tracks.

Umm Shat Sharq A ancient mine is located in the north-central part of the Ishmas gold district (Figure 1), approximately 2 km west of a north-trending range of hills near the westernmost part of the Nabitah fault zone (Figure 2). The ancient workings consist of a low-lying mound of mine spoil 215 m long and 30 m wide. This is one of many small ancient mines identified as the Umm Shat group of mines by White and Doebrich (1988). This group of mines consists of a semicircular arrangement of workings within which are two clusters of mines: Umm Shat Gharb to the west and Umm Shat Sharq to the east.

Umm Shat Sharq A (this study) is the northeasternmost mine in a group of ancient mines. The Umm Shat Sharq A ancient mine workings are near the eastern edge of a flat pediplane consisting of alluvium, wadi sediments, and flat, poorly exposed outcrops. In the vicinity of the mine, quartz lag typically covers portions of the erosional surface.

PREVIOUS INVESTIGATIONS

The Umm Shat Gharb group of mines was first located and described by Schaffner (undated report). Gonzales (1974) examined and sampled the mine dumps at Umm Shat Gharb. Boyle and Atkinson (1982) determined that the area surrounding the Umm Shat groups of mines had no placer-gold resource potential. White and Doebrich (1988) defined the nature of gold occurrences in the Umm Shat Gharb and Umm Shat Sharq groups of mines. Ground geophysical surveys (EM GENIE, magnetic, and VLF) were conducted by Last and others (1988) at Umm

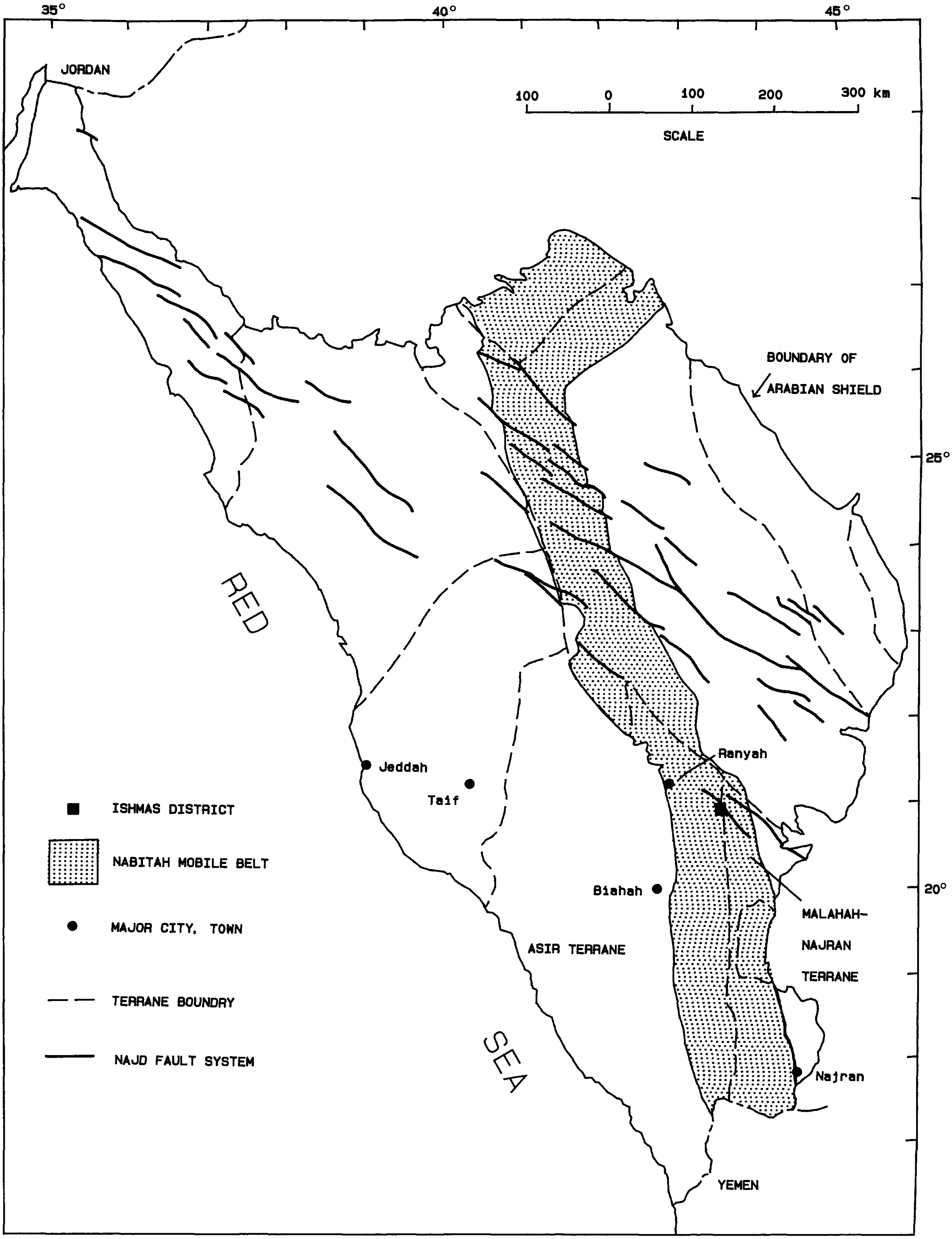

FIGURE 1.--Generalized tectonic map of the Arabian Shield showing the location of the Ishmas gold district, Nabitah mobile belt, and Najd fault system (modified after Johnson and Vranas, 1984; Stoeser and Camp, 1985; Johnson and others, 1987; and Doebrich and White, 1989).

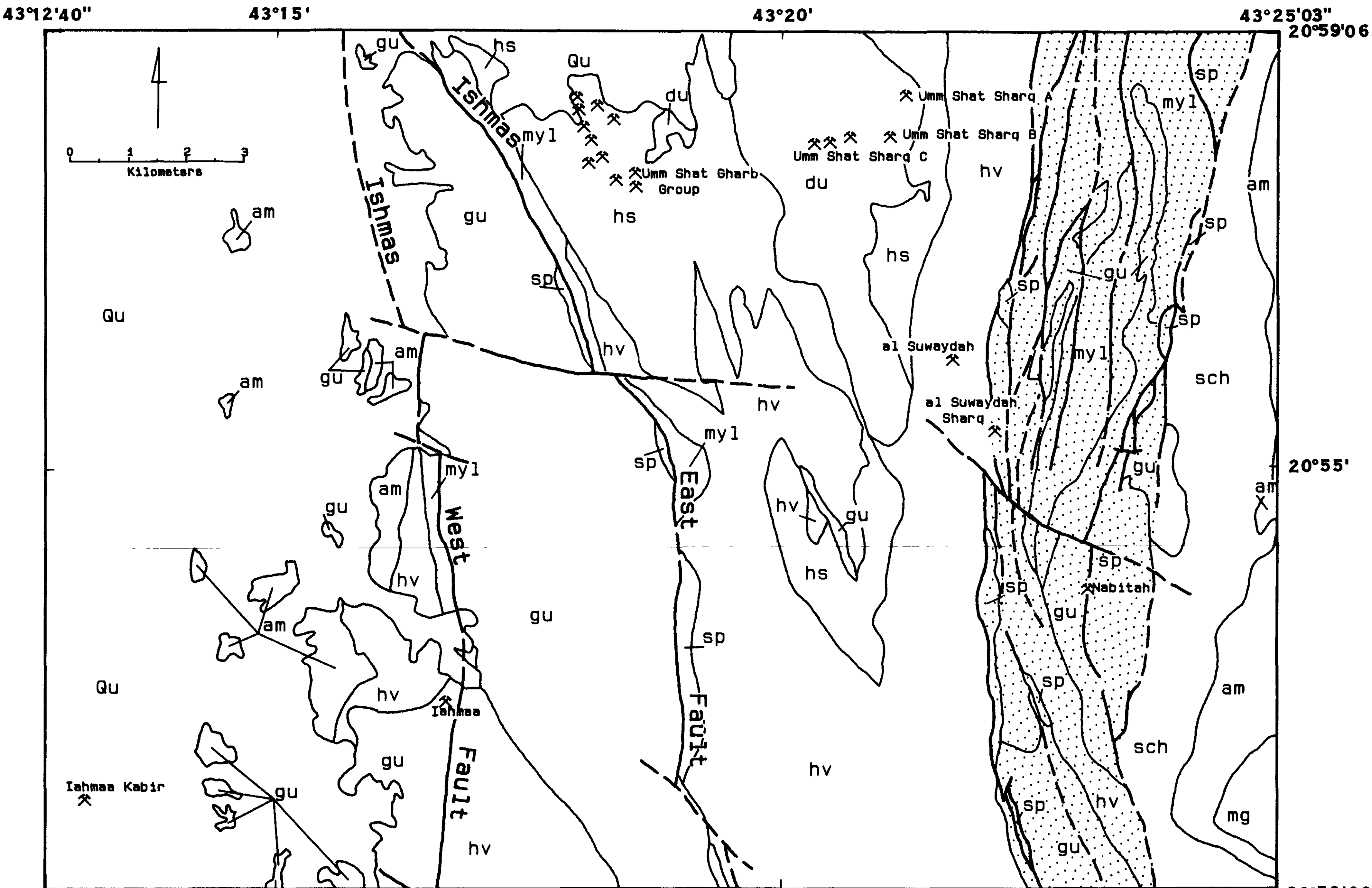

FIGURE 2.--Generalized geologic map of the Ishmas gold district showing the location of Umm Shat Sharq and Ishmas Kabir ancient mines (modified after Doebrich and White, 1989).

EXPLANATION

Qu Undivided Quaternary cover

sp Serpentinite

myl Mylonite

sch Schist-cataclastic microbreccia, mylonite, chert, marble, basalt, mylonite gneisses, and schist

am Undivided amphibolite

mg Monzogranite

du Undivided intrusive rocks of intermediate composition: tonalite, dacite porphyry, and quartz monzodiorite

gu Undivided mafic intrusive rocks: gabbro, diabase, and minor diorite

hs Undivided volcanic wacke, sandstone, marble, chert, carbonate, and minor basalt

hv Undivided basalt, andesite, and dacite; intercalated tuff breccia, crystal-lithic lapilli tuff, ash-fall and ash-flow tuff, laminated to thin-bedded ash-fall and water-lain tuff


FAULT--Dashed where approximate


NABITAH FAULT ZONE--Faults dashed where approximate

ISHMAS KABIR ⚒ ANCIENT MINE SITE

(Modified from Doebrich and White, 1989)

Shat Gharb and Umm Shat Sharq C. Doebrich and White (1989) established the geologic setting for the Umm Shat groups of mines.

White and Doebrich (1988) trenched and sampled Umm Shat Sharq A. The results of trench mapping and geochemical investigation indicated the presence of a 4.7 g/t Au, 1-m-thick gold-bearing structure (defined by a 55-cm-thick quartz vein bounded at the footwall by a mineralized fault breccia and 40-cm-thick zone of argillization). Both the shallow (26° W.) dip of the structure and the reported gold grade justified exploration drilling at this site.

PRESENT INVESTIGATION

Four diamond-bit drill holes, each bearing approximately 125° azimuth and inclined at -60°, initially were drilled at Umm Shat Sharq A. The fourth hole drilled was abandoned after the loss of a downhole hammer and bit that could not be retrieved. Subsequently, a fifth hole was drilled (-90° inclination) in order to expedite the completion of prospect drilling. Drill-hole-collar sites and traces are shown in Figure 3. All holes were drilled along three sections; one hole each was drilled in the southernmost and northernmost sections, whereas three holes were drilled in the central section.

A multipurpose Atlas Copco mobile drill (B 53) was utilized in the prospect drilling. Core drilling was conducted solely in drill holes 1 and 2. A combination of percussion and core drilling methods were used in drill holes 3 and 5; only percussion drilling was used in drill hole 4. Drilling activity commenced on November 24, 1988, and was completed on January 5, 1989. A total of 390.3 m was drilled in five holes. PQ-, HQ-, and NQ-sized bits were utilized during core drilling.

METHODS

Drill core was laid out, measured, split with a diamond saw, sampled, and logged. Cuttings obtained from percussion drilling were sampled, mixed and split, and logged with a binocular microscope. Core-sample intervals were determined by lithologic breaks and were not to exceed 1 m in length in any mineralized interval. Core-sample sizes were 1.5-2.0 m in unmineralized country rock. All percussion samples were collected in canvas bags at 1.5-m intervals.

Samples were submitted for assaying to the chemistry laboratory of the Directorate General for Mineral Resources (DGMR) under the direction of A. Hakim (DGMR) and J. Curry of the U.S. Geological Survey (USGS). Gold assays in Appendix 1 are listed for standard atomic absorption (in ppm) and graphite furnace (in ppb) methods of analysis.

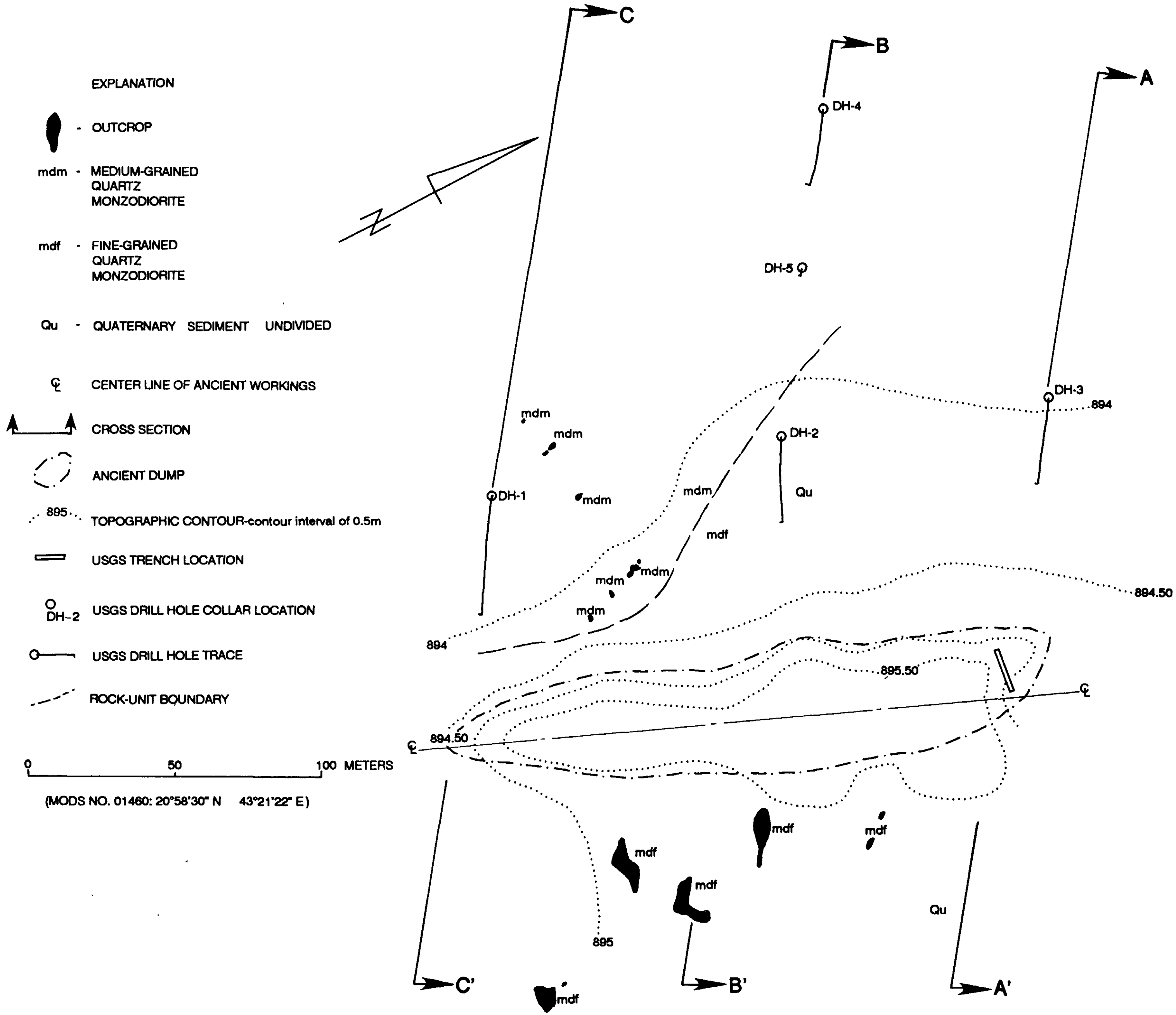

FIGURE 3.--Outcrop map of Umm Shat Sharq A ancient gold mine showing ancient workings, trench location, drill-hole projections, and drill-hole collar locations. Cross sections A-A', B-B', and C-C' contain drill holes 3, 2-5-4, and 1, respectively. Surrounding plain covered by undivided Quaternary alluvium.

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GEOLOGIC SETTING

The Ishmas gold district, as defined in White and Doebrich (1988) and Doebrich and White (1989), is located approximately 15 km southwest of the truncation of the Nabitah mobile belt (Schmidt, 1981; Stoeser and others, 1984; Stoeser and Camp, 1984 and 1985; Figure 1) by the southern boundary faults of the northwest-trending Najd fault zone (Gonzales, 1974; Worl, 1978). This district constitutes the northernmost part of the central Jabal Ishmas - Wadi Tathlith gold belt delineated by Worl (1979). The north-trending Nabitah fault zone, which transects the eastern part of the district (Figure 2), separates the Asir terrane to the west from the Malahah-Najran terrane to the east (Johnson and Vranas, 1984; Smith and others, 1984; Johnson and others, 1987). The Malahah-Najran terrane was included in the Afif terrane by Stoeser and Camp (1984, 1985).

Approximately 30 percent of the exposures in the Ishmas gold district mapped (1:25,000 scale) by Doebrich and White (1989) consist of plutonic igneous rocks that intrude precratonic Halaban-group rocks evolved between 785 and 746 Ma (Smith and others, 1984). Basalt, tuff, ferruginous chert, marble, schist, cataclastic schist, and mylonitic schist (sch) comprise a north-trending belt adjacent to the eastern margins of the Nabitah fault zone (Figure 2). In the northcentral part of the district, north-trending precratonic layered rocks include metamorphosed volcanic wacke, tuffaceous sandstone, marble, chert, ferruginous carbonate rocks, and minor basalt units (hs). Undivided basalt, andesite, dacite flows, and tuff (hv) areally bound the sedimentary and minor basalt units (hs) to the east, south, and southwest. Doebrich and White (1989) documented an east to west calc-alkaline evolutionary trend from older tholeiitic rocks to younger dacitic rocks.

Pretectonic fault-bounded gabbro and coeval fine-grained diabase (gu) intrude the easternmost volcanic rocks in the Nabitah fault zone. A large layered-gabbro lopolith (gu) crops out in the western part of the district and predates the Nabitah compressional orogeny proposed by Stoeser and others (1984) to have occurred between 680 and 640 Ma in the southern part of the Nabitah mobile belt. A monzogranite stock (mg) in the southeastern part of the district also predates the orogeny. In the north-central part of the district, the emplacement of tonalite, dacite porphyry, and quartz monzodiorite stocks (undivided intrusive rocks of intermediate composition, du, Figure 2) postdates the Nabitah orogeny. The Umm Shat group of ancient mines is included within the boundaries of a quartz monzodiorite stock (du) described by Doebrich and White (1989).

North-trending mylonite units crop out extensively in the district and are spatially associated with the Nabitah, Ishmas East, and Ishmas West fault zones (myl; Figure 2). The high strain rates typifying mylonite formation are ascribed to Nabitah orogenesis by Doebrich and White (1989) and Walker and others (1989). Locally, mylonitized serpentinite (sp) is thought to have been diapirically injected upward into the crust along these fault zones during the Nabitah orogeny (Doebrich and White, 1989).

PROSPECT GEOLOGY

LITHOLOGY

The Umm Shat Sharq group of mines is hosted by a quartz monzodiorite stock, the youngest of three intrusions of intermediate composition (du) that include the following rock types: tonalite (oldest), quartz diorite, and quartz monzodiorite (Doebrich and White, 1989). A breccia dike, interpreted to be a Najd-age structure by Doebrich and White (1989), cuts the quartz monzodiorite stock, a pre-Najd intrusion. A modal composition of 12-17 percent quartz, 18-29 percent potassium feldspar, 44-48 percent plagioclase, and 10-22 percent mafic minerals typifies the lithology of the quartz monzodiorite stock (Doebrich and White, 1989).

The Umm Shat Sharq A ancient mine workings are situated at the boundary between two texturally distinct units of the quartz monzodiorite stock. Outcrops located immediately east of the mine spoil (Figure 3) consist of fine-grained (≤ 1.0 mm grain size) quartz monzodiorite. Outcrops on the western side of the workings consist of medium-grained (≤ 3 mm grain size) quartz monzodiorite containing clots (5-8 mm in diameter) of amphibole and biotite grains. Texturally, these rocks are hypidiomorphic.

Medium-grained and fine-grained rock-unit contact relationships could not be precisely determined on the surface due to poor outcrop exposure. However, a transitional boundary (1-2 cm thick) between these two units was observed in drill hole 1 at a down-hole depth of 66.4 m (Figure 4). Since no cut-off features of veins or grains were identified, the contact is not intrusive, but it is an internal boundary separating two lithologic units within the quartz-monzodiorite stock. The definition of the boundary between both rock units in the cross section (B-B') containing drill holes 2 and 5 (Figure 4) was based upon the assumption that the rock-unit boundary orientations are nearly equivalent in this cross section and the one containing drill hole 1 (C-C'); the contact must be steeply inclined (> 70°) to the southwest. The rock-unit boundary defined by outcrop exposures and cross sections is shown on the prospect map (Figure 3).

Conceivably, the fine-grained quartz monzodiorite represents a border unit extending approximately 0.3 km eastward from the mine workings to the quartz monzodiorite intrusive contact (Figure 2). However, it is possible that the quartz monzodiorite intrusion mapped by Doebrich and White (1989) is, in fact, a poorly exposed composite body consisting of smaller, perhaps nested intrusions.

VEINS AND ALTERATION

Primary gold mineralization in Umm Shat Sharq ancient A mine drill core is spatially associated with quartz veins and related sericite + pyrite + arsenopyrite alteration envelopes. Massive, milky-white quartz veins as thick as 55 cm (drill hole 5) are cut by later clear quartz veins as thick as 5 mm. Hematite + limonite + rhombohedral-carbonate-group minerals coat fractures that cut quartz veins and are usually parallel to quartz-vein boundaries. Volumetrically significant sulfide occurrences in thicker veins (> 5 mm thick) are rare, whereas pyrite and arsenopyrite are common in veins less than 3 mm thick. One occurrence of molybdenite was observed in a 2-mm-thick quartz vein in drill hole 1. Quartz-vein distribution, thickness, and attitudes are plotted on the cross sections shown in Figure 5. Crustified vein textures were not observed in drill core, trench exposures, or mine spoil.

Quartz crystals line vugs widely distributed throughout thick quartz veins. Typically, larger cavities are ovoid-to-flat, less than 3 mm across, and 5 mm long; smaller vugs have equidimensional shapes <3 mm in diameter. Early milky-white quartz veins and late clear-quartz veins are vug laden, and some vugs are filled with rhombohedral-carbonate-group minerals and minor hematite-limonite. One purple-fluorite-filled, quartz-crystal-lined vug was noted during core logging of drill hole 2 at 18 m down-hole depth.

Quartz veins are enveloped by highly sericitized quartz monzodiorite country rock. This alteration feature typically contains ≤ 3 percent by volume pyrite and ≤

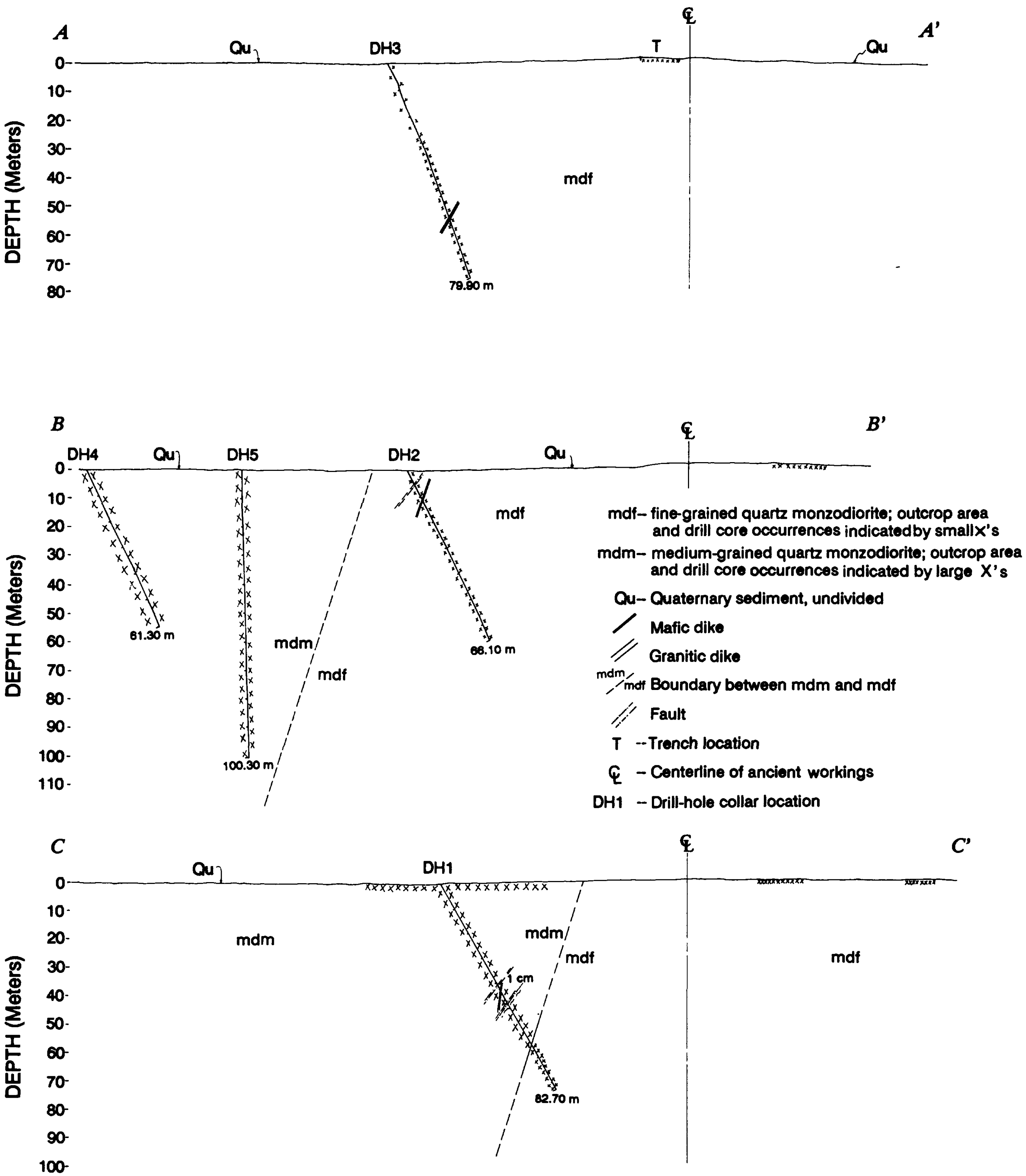


FIGURE 4.--Geologic cross sections (locations on Figure 3) A-A', B-B', and C-C' containing drill holes 3, 4-5-2, and 1, respectively.

0.5 percent by volume arsenopyrite. Although discrete grains of these phases were commonly observed, several instances of arsenopyrite surrounding pyrite were noted; pyrite may be slightly earlier than the incipient formation of arsenopyrite. Chlorite after biotite and hornblende was commonly observed near extensively developed sericitic alteration-envelope margins.

Sericite + pyrite + arsenopyrite ± chlorite alteration of the country rock is extensively developed in a zone containing thick quartz veins (main vein zone). This zone, shown on the cross sections in figures 5, 6, and 7, was mined on the surface by the ancients; the mine spoil at Umm Shat Sharq A represents the disturbance of this zone by ancient mining. The cumulative thickness of quartz veins in the drill hole 5 main vein zone is approximately 0.8 m; the cumulative thickness of sericite-altered country rock is approximately 9.0 m. The thickness of this main vein zone varies from 3 m (minimum, drill hole 2) to 10 m (maximum, drill hole 5), thereby indicating variability in the main vein zone thickness (figures 5, 6, and 7, Section B-B'). The thickness of this zone in the cross section containing drill hole 3 (figures 5, 6, and 7, Section A-A'), the northernmost hole, is approximately 10 m. Two separate zones, each 8 m and 3 m thick, were encountered in drill hole 1 (figures 5, 6, and 7, Section C-C'), thereby indicating the presence of two overlapping zones of veining, alteration, and mineralization.

Several 5-10-cm-thick mylonite zones were noted adjacent to quartz veins (> 1 cm thick) in drill holes 1 and 2. This zone consists of deformed quartz monzodiorite that contains boudined and tightly folded veins less than 1 cm thick. Mylonite units and deformed quartz veins are not as widespread and extensively developed at Umm Shat Sharq A as at the Ishmas Kabir ancient mine (Walker and others, 1989).

Limonite + hematite ± carbonate stringers less than 2.0 mm thick typically are found in thick quartz veins (> 0.1 m thick) and associated alteration envelopes encountered in the main vein zone. These stringers increase in numeric frequency toward thick quartz vein margins in quartz monzodiorite; stringer densities are very high (> 10 per cm) in quartz monzodiorite country rock adjacent to these vein margins. Limonite + hematite ± carbonate stringers have either planar or very irregular geometries. Where their geometry is irregular, iron-oxide-filled stringers define the extent of crackle breccia in country rock next to thick quartz-vein margins. Planar stringers in quartz monzodiorite commonly are parallel to these vein margins.

Limonite and hematite are most commonly found as fracture fillings (stringers). It is estimated that less than a third of these oxides are pseudomorphous after pyrite and arsenopyrite; limonite- and hematite-bearing stringers are found proximal to these iron-oxide pseudomorphs. The distribution of all types of limonite and hematite (> 0.5 percent by volume in drill core) is shown on the cross sections in Figure 6.

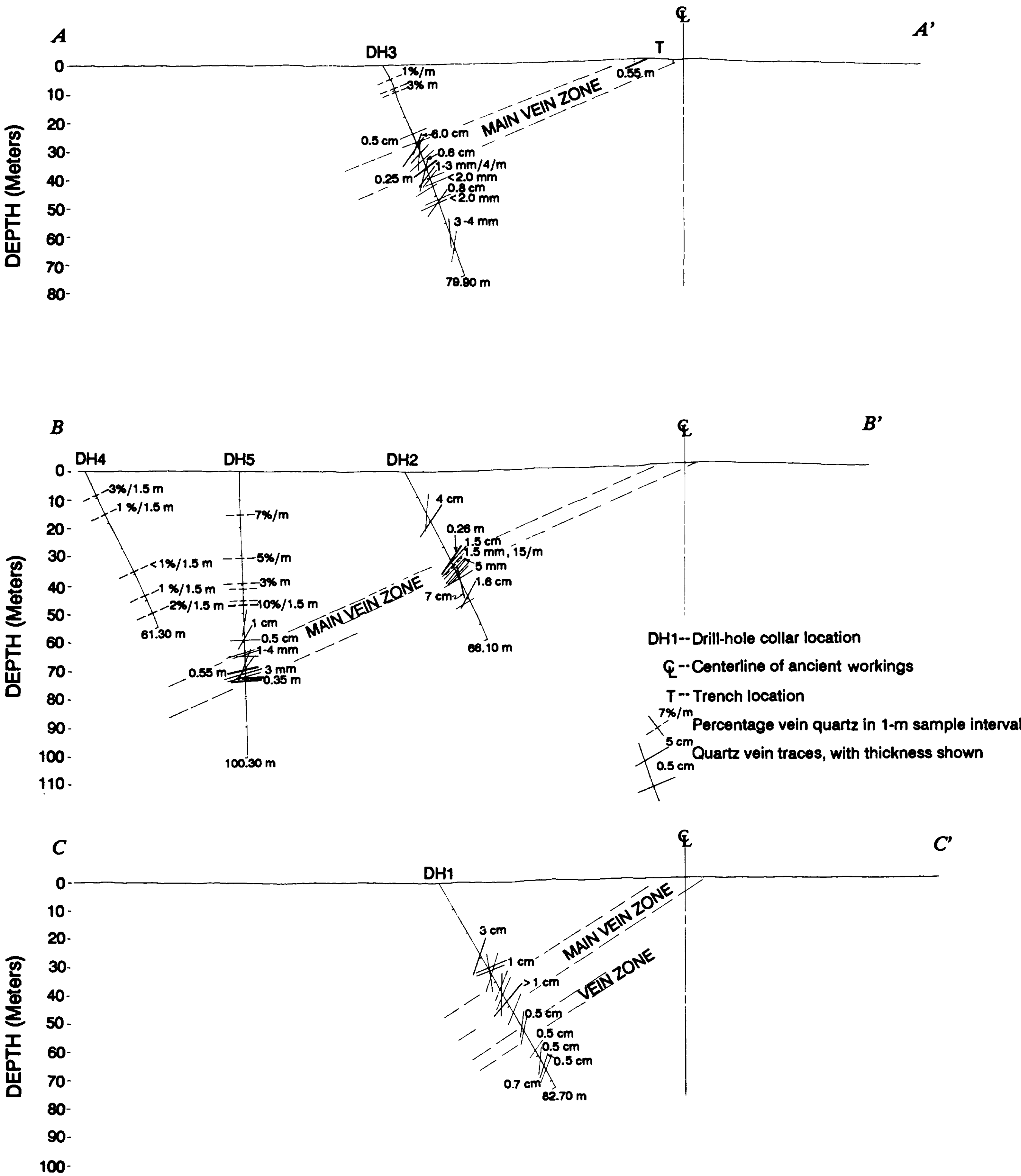


FIGURE 5.--Geologic cross sections (locations on Figure 3) A-A', B-B', and C-C' containing drill holes 3, 4-5-2, and 1, respectively. Quartz veins and vein thicknesses plotted on drill-hole traces. Veins without thicknesses shown are < 2 mm thick. Main vein zone is shown projected from ancient workings; a lower vein zone is shown in C-C'. Percent-per-meter designations represent percentage of vein quartz per 1 m sample interval (percussion drilling cuttings).

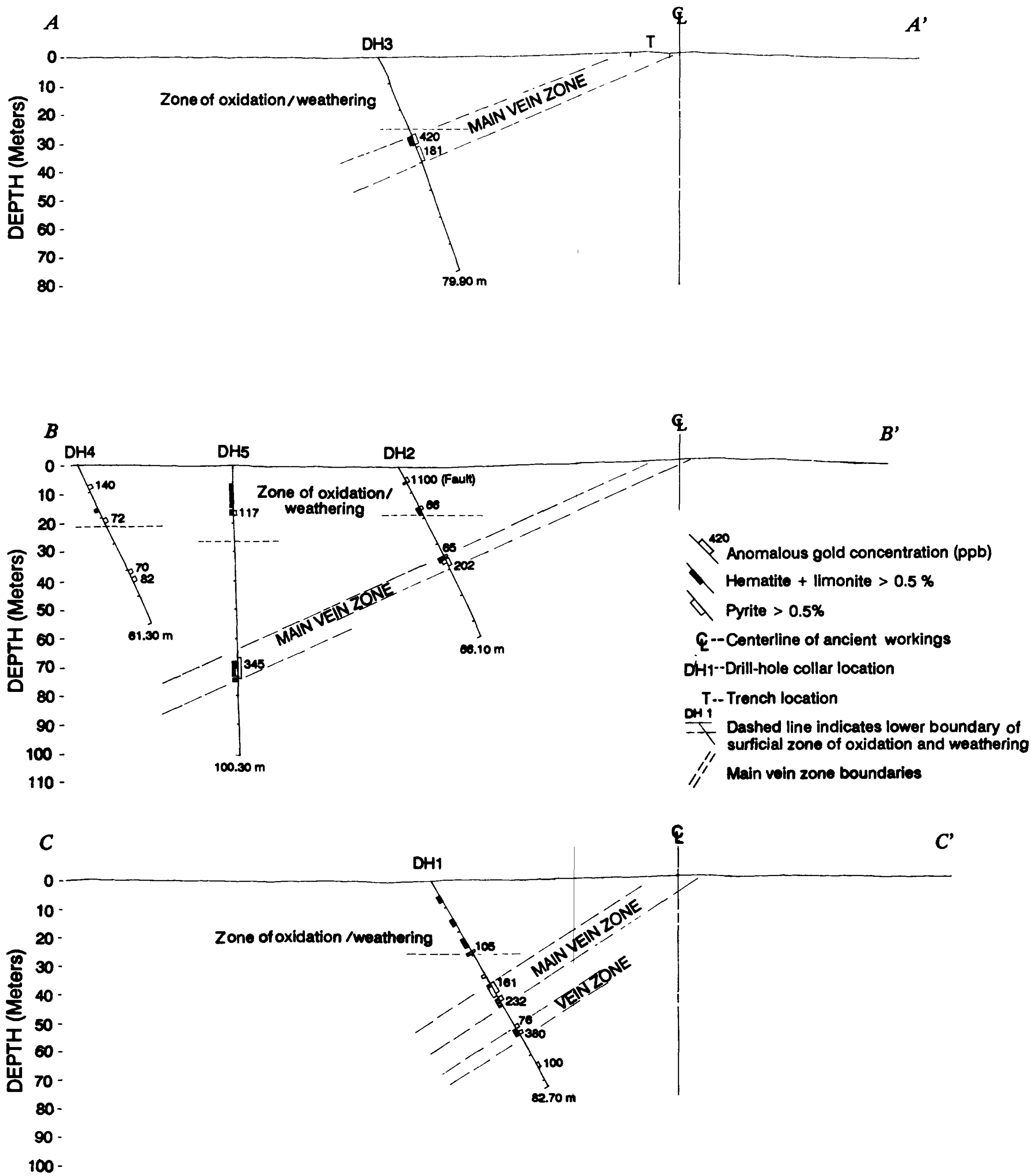


FIGURE 6.--Geologic cross sections (locations on Figure 3) A-A', B-B', C-C' containing drill holes 3, 4-5-2, and 1, respectively. The main vein zone is shown projected from the ancient workings; a lower vein zone is shown in C-C'.

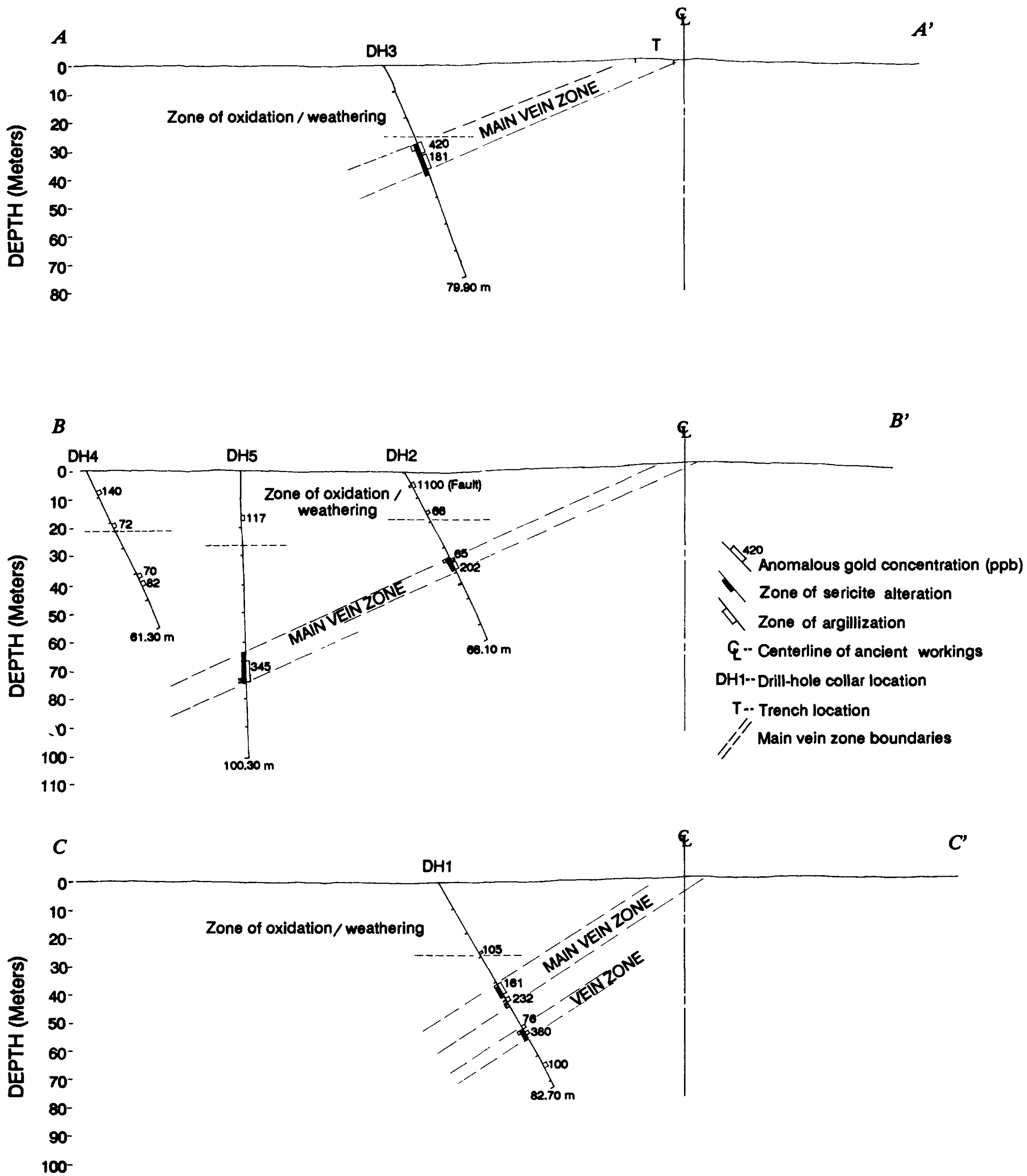


FIGURE 7.--Geologic cross sections (locations on Figure 3) A-A', B-B', C-C' containing drill holes 3, 4-5-2, and 1, respectively. Main vein zone shown projected from ancient workings; a lower vein zone is shown in C-C'.

Limonite and hematite stringers are found in, but are not limited to, zones of argillization superimposed on sericitic alteration that formed earlier. Argillized country rock was observed adjacent to quartz veins in drill core. Limonite + hematite ± carbonate stringer density is highest within these zones of argillization. Secondary gold enrichment may be spatially associated with these stringers and argillization (see DISCUSSION).

In a single trench cut across the Umm Shat Sharq A ancient mine workings, White and Doebrich (1988) determined that a 55-cm-thick quartz vein bounded by a 5-cm-wide fault breccia and 40-cm-wide zone of argillized gouge at the vein footwall hosted gold mineralization. This vein structure strikes S. 211° W. and dips 26° NW. The general trend of the ancient workings and associated spoil is N. 18° E. (S. 198° W.).

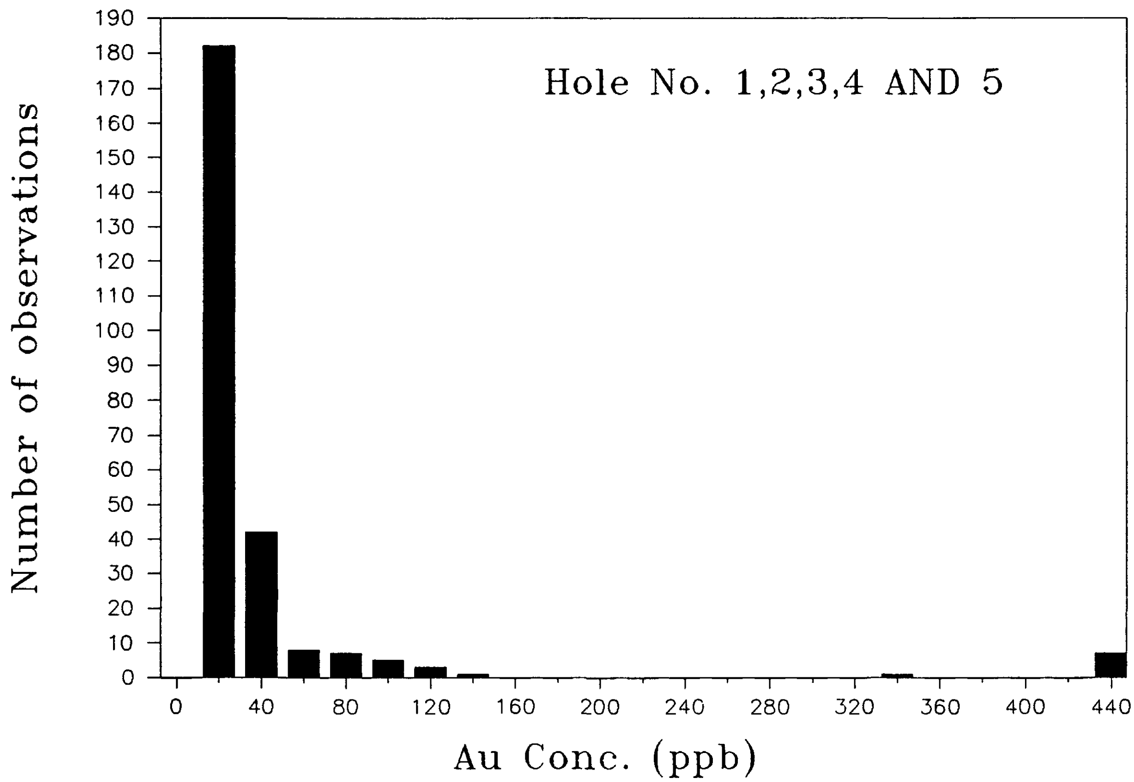
FAULTS

Faults containing fault breccia and gouge were intercepted in drill holes 1 and 2 (Figure 4). Fault detritus observed in core fragments is poorly cemented. Limonite coats fragments and forms partly slickensided surfaces. Sixty-five-degree angles were measured between slickenside surfaces and the drill-core axis and also fault-breccia-coated surfaces and the drill-core axis in two faults encountered in drill hole 1. Identification and cross correlation of fault structures between drill holes is, at best, difficult because of the finely pulverized nature of cuttings obtained by percussion drilling in the upper parts of drill holes 3 and 5, and in the entirety of drill hole 4.

White and Doebrich (1988) observed 5-cm-thick fault breccia at the footwall of a 55-cm-thick quartz vein in a trench cutting the main vein zone in the northern part of the ancient workings. A crackle breccia (whose clasts are defined by highly irregular and intersecting stringers filled with carbonate + limonite + hematite) was observed at the hanging wall of a 55-cm-thick quartz vein encountered in drill hole 5; this cross section is located midway between the ends of the mine dumps. No expression of this disrupted zone was recognized either in the drill hole 2 or the main vein zone in drill hole 3.

GEOCHEMICAL RESULTS

Normal and logarithmic histograms of gold concentrations in 269 drill-core samples are shown in Figure 8. Based upon the distribution of these data, a threshold value of 60 ppb Au was chosen to define gold mineralization patterns; the locations of these gold intercepts is shown on cross sections in figures 6 and 7. Gold concentration per sample versus depth in all drill holes is presented in Figure 9. Anomalous gold concentrations are associated with sericite + sulfides and argillization + limonite + hematite.



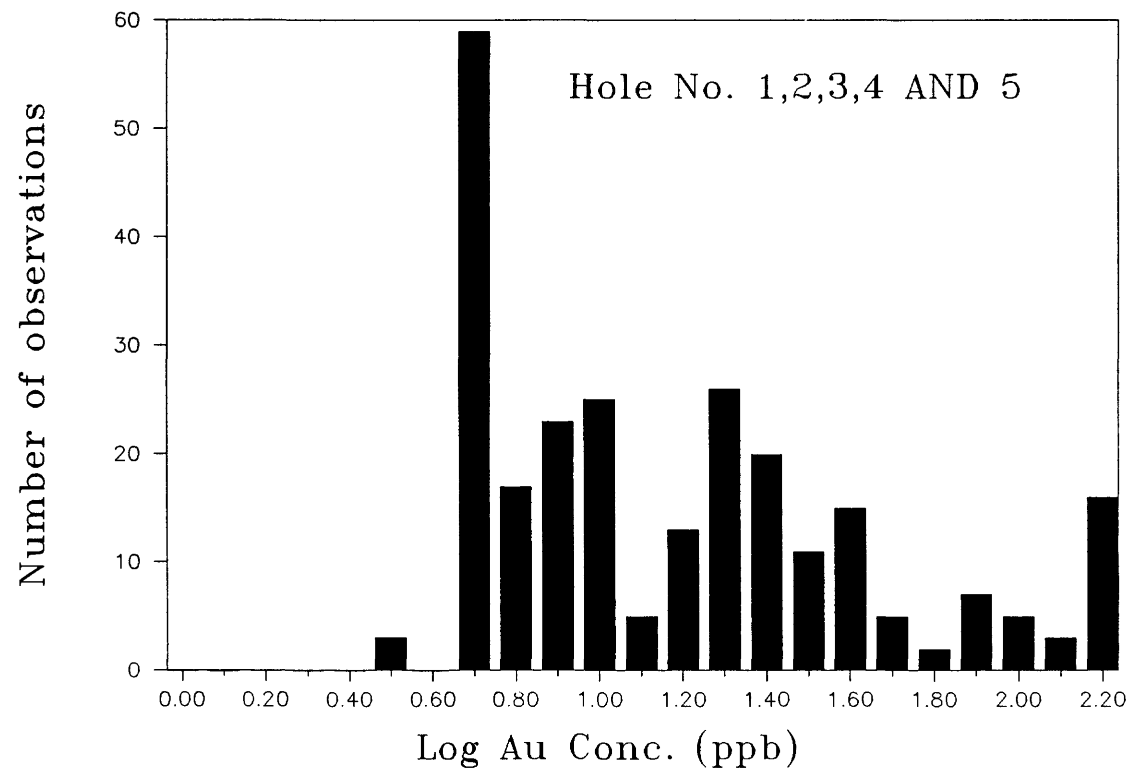
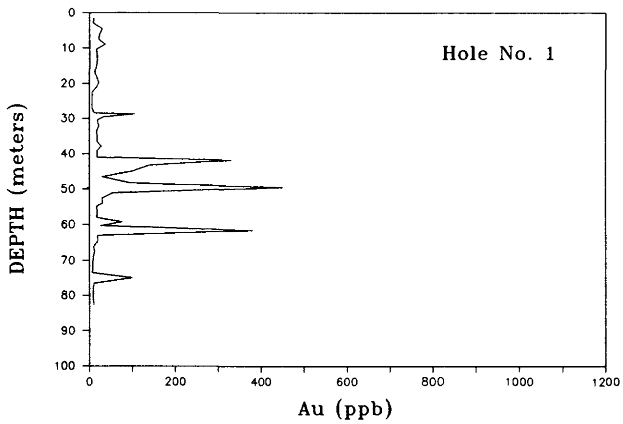
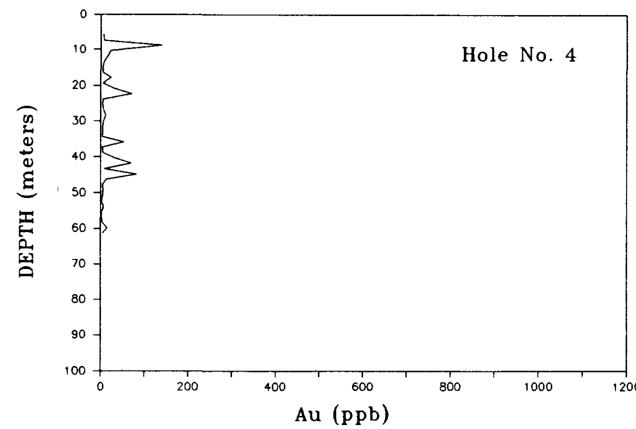
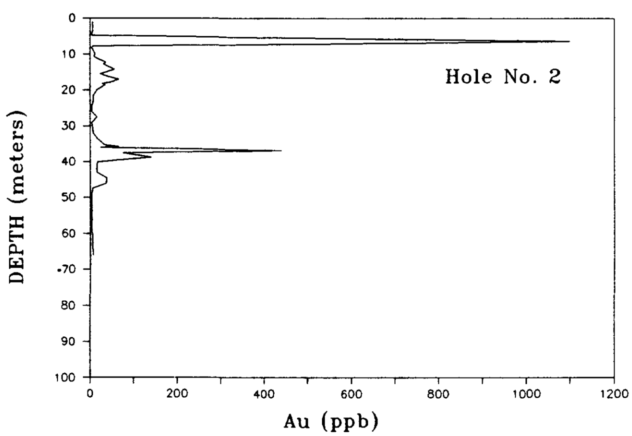
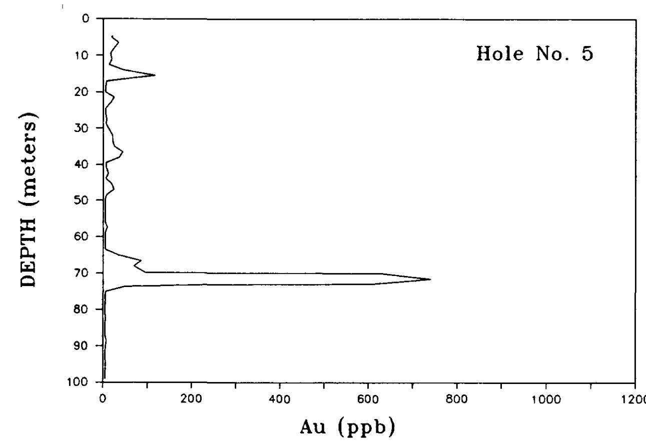


FIGURE 8.--Histograms of gold concentration (ppb) and log of gold concentration (ppb) for 269 drill-core samples. Gaps between bars separate class intervals and are not representative of population characteristics.









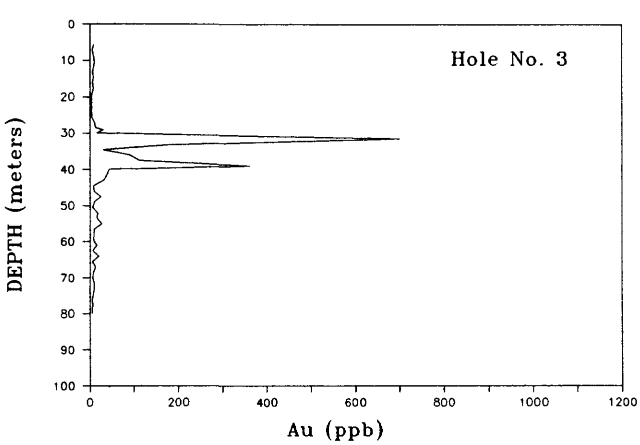


FIGURE 9.--Depth versus gold concentration (ppb) diagrams for drill holes 1, 2, 3, 4, and 5.

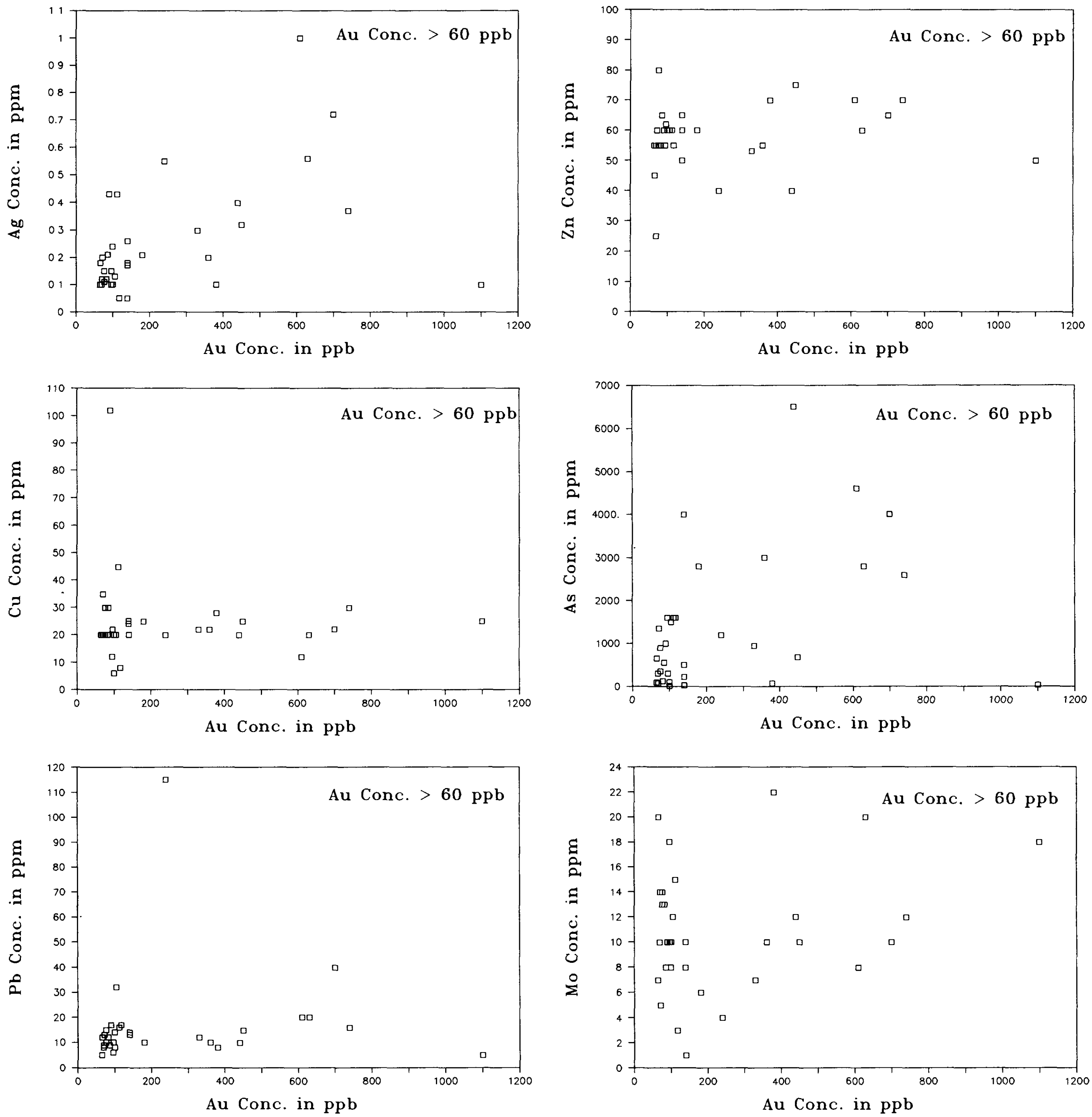


FIGURE 10.--Variation diagrams of silver, copper, lead, zinc, arsenic, and molybdenum concentration versus gold concentration (samples contain >60 ppb Au).

Table 1 lists silver, copper, lead, zinc, arsenic, bismuth, antimony, molybdenum and gold concentrations for samples with gold concentrations higher than 60 ppb. Thirty-three samples (12 percent of the total sample population) assayed above this threshold limit. These samples define 18 gold intercepts that (along with below-gold-threshold samples) are listed for each drill hole in Appendix 2. The largest gold concentration in one sample was 1,100 ppb within a sample interval of 1.5 m in a core sample containing a fault zone intersection (drill hole 2). The second largest gold concentration assayed in one sample was 740 ppb from a 1.3-m-long core sample containing sericite + pyrite (+arsenopyrite) and argillic alteration with associated limonite + hematite stringers (drill hole 5). The highest silver concentrations reported in Table 1 for samples containing > 60 ppb Au are 1) 1.00 ppm over a 0.25 m sample interval (drill hole 5) and 2) 0.72 ppm over a 1.50-m sample interval (drill hole 3). Arithmetic average concentrations of lead, arsenic, and silver in those samples containing > 60 ppb Au are signigicantly higher (by inspection) than average concentrations of the same elements in the total sample population. The average concentrations of copper, zinc, bismuth, antimony, and molybdenum appear to be comparable between the total sample population and the > 60 ppb Au populations. A complete listing of assay results is presented in Appendix 1.

Samples that exceed threshold gold concentrations are plotted on variation diagrams of silver, copper, lead, zinc, and arsenic versus gold content in Figure 10. These diagrams indicate that only silver and arsenic appear to increase as gold increases. A similar functional relationship between lead and gold is suspect.

The weighted-average concentrations ($\Sigma XY/\Sigma Y$, where X = concentration and Y = sample length) of gold and silver for 33 samples each containing > 60 ppb Au are 247 ppb and 0.24 ppm, respectively, over a total intercept length (ΣY) of 40.04 m. The largest gold intercept defined by the threshold gold concentration was 345 ppb within a sample interval of 7.15 m in drill hole 5; this intercept changes to 609 ppb Au within a sample interval of 3.60 m if a 150 ppb Au threshold concentration is utilized instead. The gold-silver ratio of these 33 samples is 1.03, based upon weighted average. Similarly, the gold-silver ratio of the entire population of 269 samples is 0.39; therefore, the gold-silver ratio increases in the anomalous > 60 ppb gold population relative to the total sample population.

The relationship between gold occurrence in quartz veins and quartz vein alteration zones is readily apparent in Table 2, which presents geochemical and mineralogical concentration data for quartz veins and alteration envelopes in the main vein zone intercepted by drill hole 2. Gold concentrations are higher in highly sericitized and argillized alteration zones (samples -389 and -391) than in less-altered rocks. Zones of argillization 5 and 3 cm thick, superimposed on earlier sericite + sulfide alteration (in samples -389 and -391) bound the sulfide-barren, 0.30-m-thick, massive white-quartz vein represented by sample -390. Similarly, gold concentration increases in a highly sericitized (+pyrite) zone containing quartz

TABLE 1.--Geochemical results for drill-core samples containing > 60 ppb Au. MIN. = minimum concentration, MAX. = maximum concentration, AVG. = arithmetic mean concentration of element, STD. = one standard deviation, NO. = samples analysed.

	RASS NO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
	*******	****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Hole # 1	241321	0.32	0.13	20	32	60	1500	0	3	12	0.11	105
	241332	0.80	0.30	22	12	53	950	0	4	7	0.33	330
	241333	1.50	0.18	20	13	65	500	0	2	8	0.15	140
	241334	1.70	0.24	20	14	60	100	0	2	8	0.11	100
	241336	1.85	0.15	22	10	62	300	0	3	10	0.10	96
	241337	1.15	0.32	25	15	75	675	0	4	10	0.45	450
	241344	1.22	0.15	30	10	80	350	0	3	14	0.08	76
	241346	1.30	0.10	28	8	70	70	0	3	22	0.39	380
	241355	1.50	0.10	6	8	60	15	0	2	10	0.12	100
Hole # 2	241364	1.50	0.10	25	5	50	35	0	3	18	1.30	1100
	241374	0.85	0.18	20	12	45	650	0	3	20	0.07	66
	241389	0.45	0.10	20	5	55	90	0	3	7	0.07	65
	241391	0.75	0.40	20	10	40	6500	0	2	12	0.45	440
	241392	0.80	0.11	20	15	55	900	0	2	13	0.08	76
	241393	1.25	0.17	25	14	50	220	0	2	8	0.15	140
Hole # 3	241417	1.50	0.72	22	40	65	4000	0	2	10	0.70	700
	241418	1.75	0.21	25	10	60	2800	0	3	6	0.18	180
	241420	1.50	0.43	102	17	60	1000	0	4	10	0.10	90
	241421	1.50	0.43	45	16	60	1600	0	5	15	0.11	112
	241422	1.50	0.20	22	10	55	3000	0	3	10	0.34	360
	241423	0.70	0.26	24	13	60	4000	0	3	10	0.13	140
Hole # 4	241467	1.50	0.05	20	13	50	25	0	1	1	0.13	140
	241476	1.50	0.20	20	13	60	1350	0	2	5	0.08	72
	241489	1.50	0.12	20	9	55	70	0	2	14	0.07	70
	241491	1.50	0.12	20	12	55	120	0	2	13	0.09	82
Hole # 5	241511	1.50	0.05	8	17	55	1600	0	0	3	0.12	117
	241545	1.50	0.21	30	9	65	550	0	0	8	0.07	86
	241546	1.85	0.10	35	8	25	300	0	0	10	0.10	69
	241547	0.20	0.10	12	6	55	1600	0	0	18	0.10	95
	241548	1.50	0.56	20	20	60	2800	0	0	20	0.50	630
	241549	1.30	0.37	30	16	70	2600	0	0	12	0.60	740
	241550	0.25	1.00	12	20	70	4600	0	0	8	0.65	610
	241551	0.55	0.55	20	115	40	1200	0	0	4	0.20	240
		MIN.	0.05	6.00	5.00	25.00	15.00	0.00	0.00	1.00	0.07	65.00
		MAX.	1.00	102.00	115.00	80.00	6500.00	0.00	5.00	22.00	1.30	1100.00
		AVG.	0.25	24.55	16.58	57.58	1396.06	0.00	2.06	10.79	0.25	248.39
		STD.	0.21	15.43	18.72	10.42	1559.57	0.00	1.39	4.87	0.26	249.89
		NO.	33	33	33	33	33	33	33	33	33	33

STATISTICAL DATA FROM DRILL HOLE NO. 1,2,3,4 AND 5 - ALL SAMPLES

	Ag	Cu	Pb	Zn	As	Bi	Sb	Mo	Au (ppm)	Au (ppb)
MIN.	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	3.00
MAX.	1.00	102.00	115.00	100.00	6500.00	4.00	7.00	500.00	1.30	1100.00
AVG.	0.11	24.81	8.61	55.25	262.39	0.01	1.51	12.82	0.04	42.46
STD.	0.10	11.27	8.49	8.38	745.05	0.24	1.41	31.08	0.12	117.05
NO.	269	269	266	269	269	269	269	269	269	269

TABLE 2.--Main vein zone geochemical characteristics in drill hole 2. RASS numbers=241387 through 241394. Thickness=sample length; Hem. + Lim. (%)=volume percent of hematite, limonite; pyr.(%)=volume percent pyrite; Ap=volume percent arsenopyrite; Tr=trace; quartz monzodiorite=Qmd; quartz-sericite-pyrite alteration=QSP (volume percent); and argillic alteration=arg (volume percent).

Unit	RASS	Thickness (meters)	Au (ppb)	Ag (ppm)	As (ppm)	Pb (ppm)	Cu (ppm)	Zn (ppm)	Mo (ppm)	Hem.+ Lim. (%)	Pyr. (%)
Qmd(unaltered)	-387	1.5	17	0.1	30	4	22	45	10	0	0
Qmd(15%QSP)	-388	1.70	33	0	700	5	25	50	4	0.1	0.2
Qmd(40%QSP +30%arg;5cm arg.zone against qtz.vein,below)	-389	0.45	65	0.1	90	5	20	55	7	1.0	Tr
Quartz vein	-390	0.30	24	0.1	160	1	5	5	3	0.2	0
Qmd(QSP+arg= 70%)+qtz.veins (<3cm thick); 20cm arg.zone against qtz. vein,above	-391	0.75	440	0.4	6500	10	20	40	45	2.0	1.0 +0.1Ap
Qmd(40%QSP)	-392	0.80	76	0.11	900	15	20	55	8	0.3	1.0 +Tr Ap
Qmd(80%QSP)+ qtz.veins	-393	1.25	140	0.17	220	14	25	50	15	0.2	2.0
Qmd(5%QSP)	-394	1.30	17	0.10	70	5	25	50	2	0.1	Tr

veins (sample -393; Table 2). Therefore, these alteration zones are typified by higher concentrations of gold, limonite, hematite, pyrite, arsenopyrite, silver, arsenic, lead, and possibly molybdenum than are found in quartz veins.

Comparable relationships between main vein zone quartz veins and alteration envelopes in drill hole 2 (Table 2) are also found in drill hole 5 (Table 3). Of note in drill hole 5 is the presence of a 0.45-m-thick zone of argillization (samples -549 and -550) in the hanging wall above a 55-cm-thick quartz vein (sample -551); a 0.1-m-thick argillization zone (sample -552) is present in the vein footwall. This argillization appears to be superimposed on sericite + pyrite + arsenopyrite that formed earlier. Samples -549 and -550 contain greater amounts of limonite and hematite than other samples (except -543) from the sequence shown in Table 3; gold, silver, arsenic, and lead concentrations are among the highest of all samples analysed. The noteworthy occurrence of hematite + limonite ± carbonate stringers in the 55-cm-thick quartz vein (sample -551) coincides with a moderately higher concentration of gold in the vein compared to relatively unaltered country rocks (samples -542 and -553).

TABLE 3.--Main vein zone geochemical characteristics in drill hole 5. RASS numbers=241542 through 241553. Thickness=sample length; Hem. + Lim. (%)=volume percent of hematite, limonite; pyr.(%)=volume percent pyrite; Ap=volume percent arsenopyrite; Tr=trace; quartz monzodiorite=Qmd; quartz-sericite-pyrite alteration=QSP; and argillic alteration=arg (presented as total volume percent). 0.45-m- and 0.1-m-thick argillic alteration zones are superimposed over sericitic alteration and bound a 0.55-m-thick quartz vein.

Unit	RASS	Thickness (meters)	Au (ppb)	Ag (ppm)	As (ppm)	Pb (ppm)	Cu (ppm)	Zn (ppm)	Mo (ppm)	Hem.+ Lim. (%)	Pyr. (%)
Qmd(2%QSP)	-542	1.50	4	0.1	0	6	24	60	16	0	Tr
Qmd(40%QSP)	-543	1.50	4	0.22	600	8	24	65	7	3.0	1.0
Qmd(15%QSP)	-544	1.50	34	0.10	500	7	24	60	15	0.1	0.2
Qmd(30%QSP)	-545	1.50	86	0.21	550	9	30	65	8	0.3	1.0
Qmd(20%QSP+ 5%arg);lim. +hem.stringers w/ arg.	-546	1.85	69	0.10	300	8	35	25	10	1.0	0.3
Quartz vein w/ 2cm arg.zone in vein hangingwall	-547	0.20	95	0.10	1600	6	12	55	18	1.0	Tr
Qmd(100%QSP) +deformed Qtz.veins	-548	1.50	630	0.56	2800	20	20	60	20	1.0	3.0 +0.5%Ap
Qmd(80%QSP+ 10%arg);0.2m arg.at bottom of interval	-549	1.30	740	0.37	2600	16	30	70	12	2.0	1.0
Qmd(arg.zone +QSP & qtz. veins)	-550	0.25	610	1.0	4600	20	12	70	8	7.0	0
Quartz vein	-551	0.55	240	0.55	1200	115	20	40	4	0.5	0
Qmd;0.1m arq+ QSP zone against qtz vein,0.2m QSP zone below arg. zone,rest of interval fresh	-552	1.35	49	0.10	900	8	30	65	20	0.25	0.2
Qmd(unaltered)	-553	1.50	6	0.10	10	6	30	60	6	0	0

White and Doebrich (1988) report gold-assay data from three trench samples that include the following data from the main vein zone: 1) 4,000 ppb Au, 2 ppm Ag from a 55-cm-thick quartz vein; 2) 10,000 ppb Au, < 1 ppm Ag from a 5-cm-thick calcite-cemented fault breccia; and 3) 180 ppb Au, < 1 ppm Ag from a 40-cm-thick argillized gouge zone. The fault breccia and argillized zone are immediately adjacent to the footwall part of the quartz vein; a sericitic zone in quartz monzodiorite (biotite monzodiorite; White and Doebrich, 1988) is present below the argillized gouge zone. This sequence is similar to that encountered below the 55-cm-thick quartz vein in drill hole 5.

The **weighted-average** gold concentration for the three trench samples mentioned above is 2,772 ppb (White and Doebrich, 1988, report a **sample average** = 4.7 g/t for this trench intercept). A maximum weighted-average silver concentration (assuming < 1 ppm = 1 ppm) is 1.55 ppm Ag; a minimum weighted-average silver concentration (assuming < 1 ppm = 0 ppm) is 1.10 ppm Ag. Therefore, gold-silver ratios for maximum and minimum possible silver averages are 1.79 and 2.52, respectively. These ratios are greater than the gold-silver ratio (1.03) calculated for 33 drill-core samples containing greater than 60 ppb Au.

The weighted-average gold concentration for the main vein zone (encountered in drill hole 5) gold intercept (> 150 ppb Au), which appears to correlate with the vein zone in the trench, is 609 ppb within a 3.60-m length of core sample; the average silver concentration for this same interval is 0.52 ppm. Therefore, the gold-silver ratio for this interval is 1.17. Clearly, the gold-silver ratio determined from trench samples collected across this vein is greater than the ratio calculated for core samples from a depth of 70 m below surface in drill hole 5. Gold-silver ratios at Umm Shat Sharq A ancient mine appear to decrease from the surface downward along the dip slope of the main vein structure.

DISCUSSION

ORIGIN OF QUARTZ VEINS

The Umm Shat Sharq A ancient mine is situated at what appears to be the internal intrusive boundary between a fine-grained border (?) unit and an internal unit of a quartz monzodiorite intrusion. The mine is located (at surface) approximately 0.3 km west of the quartz monzodiorite intrusive contact mapped by Doebrich and White (1989). Assuming that the steep dip (70° W.) of the border unit-internal unit boundary mimics the attitude of the quartz monzodiorite intrusive contact, the Umm Shat Sharq A vein system is located nearly 0.3 km from the stock intrusive contact. These vein structures may be entirely confined within the intrusive boundaries of the quartz monzodiorite intrusion. If the quartz vein structures are present solely within the confines of the quartz monzodiorite stock, then vein-quartz-forming hydrothermal solutions must have originated within the stock intrusive boundaries. No evidence was found that would indicate that the vein system is a through-going, fault-filling feature.

Umm Shat Sharq A main vein zone contains anomalous concentrations of arsenic that denote the occurrence of arsenopyrite in sericite-alteration zones and in quartz veins less than 3 mm thick. Of the trace and minor elements analysed in the drill core by atomic absorption spectroscopy, arsenic ($\leq$ 6,500 ppb) and gold ($\leq$ 740 ppb) increase the most dramatically from country rocks into vein and alteration zones. Generally, as gold increases, arsenic increases; this observation also typifies the main vein zone at Ishmas Kabir (Walker and others, 1989). These elevated arsenic concentrations may characterize veins that crystallized from solutions having, at least in part, magmatic-hydrothermal components.

Thick quartz veins (> 0.1 m) at Umm Shat Sharq A contain quartz-crystal-lined cavities (vugs) that, in some instances, are filled with rhombohedral-carbonate-group minerals. Many of these vugs also occur in clear quartz veins (< 3 mm thick) and along later fractures found within early thick, milky-white quartz veins; a significant portion of the vug population postdates early white-quartz vein formation. The presence of quartz-crystal-lined vugs in some quartz veins indicates that vein quartz could maintain open space under low lithostatic pressure conditions existing since vein formation.

Mineralization Model

Gold enrichment is thought to have occurred when acidic solutions dissolved (possibly from sulfides) and concentrated gold in 1) limonite + hematite-coated stringers in argillized country rock adjacent to quartz veins and 2) in fault and shear zones containing limonite. The presence of argillized zones adjacent to faults and thick quartz veins is *a priori* evidence that acidic hydrothermal solutions destabilized feldspar and also early-formed sericite, pyrite, and arsenopyrite. Limonite and hematite formed pseudomorphs after pyrite and (presumably) arsenopyrite in argillized hanging wall and footwall country rocks proximal to quartz veins. However, limonite + hematite in fracture fillings locally exceeds (by volume) limonite + hematite in pseudomorphs after sulfides. Limonite + hematite stringers may impart significant concentrations of gold to otherwise barren quartz veins.

The anomalous occurrence of secondary gold in drill core is well below the present day zone of complete sulfide oxidation/zone of weathering (Figure 7) at the Umm Shat Sharq A prospect. Gold concentrations and gold-silver ratios that increase upward along the dip slope of a thick vein structure are proposed to be the characteristic signature of acidic, descending hydrous solutions that may have had a supergene origin. These solutions confined by and passed through permeable zones adjacent to thick quartz veins, possibly from near-surface into hypogene environments. If thicker quartz-vein systems in the Ishmas gold district have a greater strike-and-dip extent (see also White and Doebrich, 1988; Walker and others, 1989) than thinner vein systems, the former would have been more likely to intersect near-surface environments that may have originated the secondary mineralizing solutions. Additionally, thicker quartz-vein structures in the Ishmas gold district could characterize more extensively developed secondary-gold enriched systems than thinner veins of similar mineralogy; therefore, to ancient miners, the economic viability of the Umm Shat Sharq A gold prospect could have been partly a function of vein extent and geometry.

Pertinent information obtained from drill-core samples (this study) indicate that thick quartz veins themselves concentrated later fractures. A post-quartz-vein fracturing event increased rock porosity and permeability proximal to thick quartz veins either prior to or during the passage of acidic hydrothermal solutions through these fractures. Therefore, the increase in iron-oxide-filled fracture density near thick, early-formed quartz veins is attributable to 1) the deflection of fractures into quartz-vein structures, 2) the propagation of fractures along quartz-vein boundaries, and 3) the nucleation of fractures at quartz-vein boundaries.

Acidic (supergene) solutions are thought to have descended throughout fractures adjacent to thicker quartz veins. Primary-gold-bearing sericite + pyrite + arsenopyrite alteration envelopes are extensively developed adjacent to these veins. Hence, more primary gold was available for dissolution by hydrous solutions; faults having different orientations than vein structures may have intercepted these hydraulic flow patterns. A concomitant deposition of anomalously high concentrations of primary gold (> 60 ppb) and quartz in thick veins is not indicated by the results obtained in this prospect assessment.

Deformation Model and Age of Veins

White and Doebrich (1988) classified the veins of the Ishmas gold district into two categories: Nabitah-age and post-Nabitah-age veins. Walker and others (1989) related the occurrence of mylonite schist proximal to veins at Ishmas Kabir to post-vein orogeny; veins and associated alteration at Ishmas Kabir were grouped under the earlier Nabitah-age category of veins. Doebrich and White (1989) determined that the quartz monzodiorite stock that hosts Umm Shat Sharq A was formed after the Nabitah orogeny. Therefore, the lack of widespread mylonite in the Umm Shat Sharq A main vein zone may be indicative of a post-Nabitah-age (post-orogeny) vein-formation event. That is, the limited mylonite occurrences at Umm Shat Sharq suggest that 1) stresses carried by quartz veins and 2) strain rates imparted to country rocks were not as great as those that formed more volumetrically extensive mylonite in quartz diorite. Instead, quartz monzodiorite adjacent to thick quartz veins at Umm Shat Sharq A was subjected to brittle deformation and fractured, as evidenced by the presence of breccias and iron-oxide-coated stringers in the country rocks.

Grade and Tonnage

On the basis of present drilling results, the Umm Shat Sharq A gold prospect is judged to be subeconomic, and so no further presentation of grade-and-tonnage calculations will appear in this report.

SUMMARY

Core drilling defined the extent of anomalous subeconomic concentrations of gold at the Umm Shat Sharq A ancient mine prospect. The maximum gold concentrations encountered in drill core were 1,100 ppb (1.5 m core sample) and 740 ppb Au (1.3 m core sample) in fault (6 m depth) and vein-alteration zones (72 m depth), respectively. Silver concentrations in samples defined by gold intercepts are ≤ 1.0 ppm Ag. The weighted average concentration of gold and silver for 33 core samples (> 60 ppb Au threshold concentration) is 247 ppb and 0.24 ppm, respectively, over a total summed length of 40.04 m. The largest gold intercept, 345 ppb (7.15 m) was encountered in a 10-m-thick main vein zone in drill hole 5; a 2,772 ppb Au intercept (1.0 m) was obtained from trench samples collected across this vein zone by White and Doebrich (1988). Gold-silver ratios vary within the main vein zone from 1.17 (> 150 ppb gold threshold concentration) at 72 m depth (drill hole 5) to 2.52 (maximum) in the main vein zone trench samples.

Utilizing a gold threshold concentration of 60 ppb clearly defines primary gold intercepts in sericite + pyrite + arsenopyrite alteration zones that envelop quartz veins; gold concentrations in thick, massive white quartz veins intersected by drilling is insignificant. Secondary gold may be defined by limonite and hematite associated with argillization found in fault and vein zones. Vein zone agrillized rocks are specifically characterized by an increase in the number of limonite + hematite-coated stringers (< 2 mm thick) adjacent to these thick, post-Nabitah-age quartz veins.

Thick quartz veins (for example, > 0.1m) may have a greater strike and dip extent than thinner (< 0.1 m) quartz veins in the Umm Shat Sharq A main vein zone (3-10 m thick). The fundamental significance of this lies in the fact that porous and permeable fracture zones associated with these veins are more likely to 1) intercept acidic hydrothermal solutions responsible for gold enrichment and 2) allow descent of hydrous solutions through large volumes of primary gold-bearing sericite + sulfide (pyrite + arsenopyrite) zones. Increasing gold grades and gold-silver ratios up the dip slope of these structures may be indicative of supergene solutions that descended through these porous and permeable zones from an oxidized-weathered zone into hypogene environments.

Thick post-Nabitah-age quartz veins at Umm Shat Sharq A ancient mine influenced the later formation of fracture zones responsible for gold mineralization. It is proposed that these fractures were nucleated and propagated along these vein boundaries either before or during the introduction of acidic supergene solutions. Mylonite was formed locally in quartz monzodiorite country rocks at thick quartz-vein margins, but this feature of ductile-type deformation is much less prevalent than in earlier Nabitah-age vein systems, such as those found at Ishmas Kabir ancient mine. Umm Shat Sharq A thick quartz veins transmitted stresses of smaller magnitude than stresses that mylonitized Ishmas Kabir Nabitah-age quartz veins.

RECOMMENDATION

It is recommended that no further gold-resource assessment work be conducted at the Umm Shat Sharq A ancient mine at this time.

DATA STORAGE

Data File

All field and laboratory data for this report, including field notes, core-log sheets, and geochemical analytical results, are stored in Data File USGS-DF-10-1 in the Jeddah office of the U.S. Geological Survey Saudi Arabian Mission.

Mineral Occurrence Documentation System

Updated information was added to the Mineral Occurrence Documentation System (MODS) for the Umm Shat Sharq A gold prospect, MODS 01460. No new MODS files were established.

REFERENCES CITED

Boyle, D.McK., and Atkinson, B.G., 1982, Assessment of the placer-gold potential of the Arabian Shield: Results of reconnaissance investigations: Riofinex Geological Mission Open-File Report RF-OF-02-26, 60 p.

Doebrich, J.L., and White, W.H., 1989, Geology of the Ishmas gold district, Kingdom of Saudi Arabia: Saudi Arabian Deputy Ministry for Mineral Resources Technical Record USGS-TR-08-1, 40 p. U.S. Geological Survey Open-File Report (in press)

Gonzales, L., 1974, Geology of the Jabal Ishmas quadrangle, with a section on aeromagnetic studies by V.J. Flanigan: U.S. Geological Survey Saudi Arabian Project Report 186, 34 p. U.S. Geological Survey Open-File Report 75-181.

Johnson, P.R., and Vranas, G.J., 1984, The origin and development of late Proterozoic rocks of the Arabian Shield, an analysis of terranes and mineral environments: Riofinex Geological Mission Open-File Report RF-OF-04-32, 96 p.

Johnson, P.R., Scheibner, E., and Smith, E.A., 1987, Basement fragments, accreted tectonostratigraphic terranes, and overlap sequences: elements in the tectonic evolution of the Arabian shield: in Terrane Accretion and Orogenic Belts, American Geophysical Union Geodynamics Series, volume 19, pp. 323-343.

Last, B.J., Oskoui, R.M., and Basahel, M., 1988, Ground geophysical surveys at gold prospects in the Jabal Ishmas area (21/43C, 20/43A): Saudi Arabian Directorate General of Mineral Resources Open-File Report DGMR-OF-05-50, 54 p.

Schmidt, D.L., 1981, Geology of the Jabal Al Qarah quadrangle, Sheet 20/43C, Kingdom of Saudi Arabia: U.S. Geological Survey Saudi Arabian Mission Miscellaneous Document 31 (Interagency Report 367), 52p. Saudi Arabian Deputy Ministry for Mineral Resources Map Series (in press)

Schaffner, D.F., undated, Ishmas (ancient gold workings): Saudi Arabian Mining Syndicate (SAMS) Record 3/211/4066, 4 p.

Smith, E.A., Barnes, D.P., Johnson, P.R., Bognar, B., Garfield, L., and Scheibner, E., 1984, A review of the geology, mineralization, and mineral resource potential of the Kingdom of Saudi Arabia: Saudi Arabian Deputy Ministry for Mineral Resources Open-File Report RF-OF-05-1, volume II, 380 p.

Stoeser, D.B., Stacey, J.S., Greenwood, W.R., and Fischer, L.B., 1984, U/Pb zircon geochronology of the southern part of the Nabitah mobile belt and Pan-African continental collision in the Saudi Arabian Shield: Saudi Arabian Deputy Ministry for Mineral Resources Technical Record USGS-TR-04-5, 57 p. U.S. Geological Survey Open-File Report 85-239.

Stoeser, D.B. and Camp, V.E., 1984, Pan-African microplate accretion of the Arabian Shield, Saudi Arabian Deputy Ministry for Mineral Resources Technical Record USGS-TR-04-17, 26 p. Contributions to Mineralogy and Petrology (in press)

_________ and Camp, V.E., 1985, Pan-African microplate accretion of the Arabian Shield: Geological Society of America Bulletin, volume 96, pp. 817-826.

Walker, B.M., Talib, M.Ben, Komi, M.El, Hussain, M.A., 1989, Geology, mineralization, and drilling results at the Ishmas Kabir gold prospect, Kingdom of Saudi Arabia, Saudi Arabian Directorate General of Mineral Resources Open File Report OF-09-11, (in prep).

White, W.H., and Doebrich, J.L., 1988, Gold deposits of the Ishmas district, Kingdom of Saudi Arabia: Saudi Arabian Deputy Ministry for Mineral Resources Technical Record USGS-TR-08-1, 73 p. U.S. Geological Survey Open-File Report (in press)

Worl, R.G., 1978, Gold deposits associated with the Jabal Ishmas-Wadi Tathlith fault zone, Kingdom of Saudi Arabia: U.S. Geological Survey Saudi Arabian Project Report 249, 23 p. Saudi Arabian Directorate General of Mineral Resources Bulletin (in press)

_________ 1979, The Jabal Ishmas-Wadi Tathlith gold belt, Kingdom of Saudi Arabia: U.S. Geological Survey Saudi Arabian Project Report 264, 108 p. U.S. Geological Survey Open-File Report 79-1519.

APPENDIX 1

Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 1

Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 2

Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 3

Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 4

Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 5

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 1

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241301	0.95	1.40	0.45	0.10	32	8	100	10	0	0	20	0.01	10
241302	1.40	3.00	1.60	0.10	25	5	60	15	0	0	5	0.01	9
241303	3.00	4.50	1.50	0.10	26	7	60	25	0	0	5	0.03	30
241304	4.50	6.00	1.50	0.10	22	9	55	45	0	0	10	0.03	24
241305	6.00	7.50	1.50	0.10	25	8	65	25	0	0	4	0.03	21
241306	7.50	9.00	1.50	0.10	25	6	55	35	0	0	4	0.03	36
241307	9.00	10.50	1.50	0.10	22	7	60	45	0	0	10	0.01	15
241308	10.50	12.00	1.50	0.10	25	7	60	35	0	0	7	0.02	18
241309	12.00	13.50	1.50	0.10	25	10	60	100	0	0	10	0.02	18
241310	13.50	15.00	1.50	0.10	20	8	60	75	0	0	10	0.02	16
241311	15.00	16.50	1.50	0.10	18	15	62	70	0	0	6	0.02	13
241312	16.50	17.19	0.69	0.15	18	10	65	65	0	0	10	0.01	14
241313	17.19	18.56	1.37	0.10	22	7	60	40	0	0	4	0.02	19
241314	18.56	19.84	1.28	0.10	20	7	55	15	0	0	6	0.03	22
241315	19.84	21.00	1.16	0.11	20	10	60	90	0	0	10	0.02	17
241316	21.00	22.50	1.50	0.10	20	7	55	15	0	0	7	0.01	7
241317	22.50	24.00	1.50	0.10	20	8	60	15	0	0	15	0.01	7
241318	24.00	25.50	1.50	0.10	45	10	55	16	0	0	12	0.01	7
241319	25.50	27.00	1.50	0.10	24	7	60	20	0	0	20	0.01	7
241320	27.00	28.40	1.40	0.10	24	10	60	40	0	2	10	0.01	12
241321	28.40	28.72	0.32	0.13	20	32	60	1500	0	3	12	0.11	105
241322	28.72	29.50	0.78	0.11	30	10	65	350	0	1	500	0.03	34
241323	29.50	30.35	0.85	0.10	22	10	65	80	0	1	10	0.02	19
241324	30.35	32.00	1.65	0.10	24	10	62	50	0	1	12	0.03	22
241325	32.00	33.50	1.50	0.10	20	7	62	20	0	3	10	0.03	17
241326	33.50	35.00	1.50	0.10	25	8	60	35	0	3	12	0.03	18
241327	35.00	36.50	1.50	0.10	20	6	50	25	0	2	5	0.03	18
241328	36.50	37.85	1.35	0.10	16	10	60	75	0	2	5	0.04	27
241329	37.85	39.15	1.30	0.10	16	8	55	25	0	2	10	0.03	18
241330	39.15	40.65	1.50	0.10	20	8	55	25	0	2	10	0.03	18
241331	40.65	41.00	0.35	0.14	20	7	56	35	0	3	10	0.03	18
241332	41.00	41.80	0.80	0.30	22	12	53	950	0	4	7	0.33	330
241333	41.80	43.30	1.50	0.18	20	13	65	500	0	2	8	0.15	140
241334	43.30	45.00	1.70	0.24	20	14	60	100	0	2	8	0.11	100
241335	45.00	46.50	1.50	0.10	16	10	62	125	0	2	5	0.03	29
241336	46.50	48.35	1.85	0.15	22	10	62	300	0	3	10	0.10	96
241337	48.35	49.50	1.15	0.32	25	15	75	675	0	4	10	0.45	450
241338	49.50	51.00	1.50	0.10	32	10	60	150	0	2	8	0.06	54
241339	51.00	52.50	1.50	0.10	30	10	65	25	0	2	15	0.03	29
241340	52.50	54.00	1.50	0.10	22	10	60	25	0	2	10	0.03	30
241341	54.00	54.80	0.80	0.10	22	9	45	15	0	3	1	0.02	17
241342	54.80	56.30	1.50	0.10	25	7	60	20	0	2	40	0.02	18
241343	56.30	58.00	1.70	0.10	25	7	60	20	0	3	26	0.02	17
241344	58.00	59.22	1.22	0.15	30	10	80	350	0	3	14	0.08	76
241345	59.22	60.20	0.98	0.17	25	8	65	150	0	2	28	0.03	26
241346	60.20	61.50	1.30	0.10	28	8	70	70	0	3	22	0.39	380
241347	61.50	63.00	1.50	0.10	40	10	70	25	0	2	32	0.02	19
241348	63.00	64.59	1.59	0.10	28	10	65	25	0	2	70	0.01	20
241349	64.59	66.00	1.41	0.10	25	10	60	25	0	2	15	0.01	10
241350	66.00	67.50	1.50	0.10	15	15	65	45	4	2	20	0.01	12
241351	67.50	69.00	1.50	0.10	12	12	55	25	0	3	15	0.01	9
241352	69.00	70.50	1.50	0.10	45	12	60	25	0	3	15	0.01	8
241353	70.50	72.00	1.50	0.10	10	10	60	25	0	2	16	0.01	8
241354	72.00	73.50	1.50	0.10	6	10	65	20	0	4	20	0.01	7

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 1--(continued)

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241355	73.50	75.00	1.50	0.10	6	8	60	15	0	2	10	0.12	100
241356	75.00	76.50	1.50	0.10	5	6	55	20	0	2	3	0.01	10
241357	76.50	78.00	1.50	0.10	8	7	55	20	0	3	3	0.01	9
241358	78.00	79.50	1.50	0.10	15	7	55	20	0	4	10	0.01	9
241359	79.50	81.00	1.50	0.10	12	8	60	20	0	3	3	0.01	9
241360	81.00	82.70	1.70	0.10	10	6	50	20	0	2	13	0.01	10
		TOTAL	81.75										
			Min	0.10	5.00	5.00	45.00	10.00	0.00	0.00	1.00	0.01	7.00
			Max	0.32	45.00	32.00	100.00	1500.00	4.00	4.00	500.00	0.45	450.00
			Avg	0.12	21.87	9.43	60.90	113.68	0.07	1.67	20.63	0.05	43.76
			Std	0.04	7.90	3.72	7.54	243.88	0.51	1.30	63.27	0.09	85.02

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 2

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241361	0.00	0.97	0.97	0.10	25	5	65	30	3	4	0.01	5
241362	0.97	3.40	2.43	0.10	40	6	50	35	2	12	0.01	5
241363	3.40	4.80	1.40	0.10	30	4	50	30	3	11	0.00	4
241364	4.80	6.30	1.50	0.10	25	5	50	35	3	18	1.30	1100
241365	6.30	7.80	1.50	0.10	25	3	50	35	3	17	0.01	7
241366	7.80	8.23	0.43	0.00	30	4	50	30	2	17	0.00	4
241367	8.23	9.73	1.50	0.10	35	3	50	30	2	13	0.01	10
241368	9.73	10.80	1.07	0.13	30	4	50	40	3	5	0.01	9
241369	10.80	12.25	1.45	0.11	30	9	50	230	2	3	0.04	36
241370	12.25	12.75	0.50	0.10	30	10	50	240	2	5	0.03	31
241371	12.75	14.25	1.50	0.00	30	5	50	45	2	8	0.06	56
241372	14.25	15.50	1.25	0.00	30	5	50	40	2	9	0.03	23
241373	15.50	16.15	0.65	0.10	20	5	45	90	2	6	0.04	39
241374	16.15	17.00	0.85	0.18	20	12	45	650	3	20	0.07	66
241375	17.00	17.85	0.85	0.10	30	7	55	210	3	15	0.05	46
241376	17.85	18.20	0.35	0.16	20	7	50	260	2	10	0.03	28
241377	18.20	18.50	0.30	0.00	40	5	50	55	1	12	0.04	34
241378	18.50	20.00	1.50	0.00	30	3	45	30	3	10	0.02	15
241379	20.00	21.50	1.50	0.00	25	4	50	40	3	9	0.01	7
241380	21.50	23.00	1.50	0.00	15	4	50	40	2	9	0.01	7
241381	23.00	24.50	1.50	0.00	25	5	50	35	3	20	0.01	4
241382	24.50	26.00	1.50	0.00	20	3	50	20	3	17	0.01	4
241383	26.00	27.50	1.50	0.00	25	4	50	30	2	4	0.02	16
241384	27.50	29.00	1.50	0.00	25	4	50	30	3	12	0.01	4
241385	29.00	30.50	1.50	0.00	25	5	50	30	3	4	0.01	6
241386	30.50	32.00	1.50	0.00	30	4	50	30	3	15	0.01	7
241387	32.00	33.50	1.50	0.10	22	4	45	30	2	10	0.02	17
241388	33.50	35.20	1.70	0.00	25	5	50	700	2	4	0.04	33
241389	35.20	35.65	0.45	0.10	20	5	55	90	3	7	0.07	65
241390	35.65	35.90	0.25	0.10	5	1	5	160	0	4	0.03	24
241391	35.90	36.65	0.75	0.40	20	10	40	6500	2	12	0.45	440
241392	36.65	37.45	0.80	0.11	20	15	55	900	2	13	0.08	76
241393	37.45	38.70	1.25	0.17	25	14	50	220	2	8	0.15	140
241394	38.70	40.00	1.30	0.10	25	5	50	70	2	9	0.02	17
241395	40.00	41.50	1.50	0.10	30	5	50	40	2	18	0.02	15
241396	41.50	43.00	1.50	0.10	20	5	50	70	2	13	0.03	16
241397	43.00	44.50	1.50	0.10	20	3	45	30	2	14	0.04	38
241398	44.50	46.00	1.50	0.10	25	4	50	80	2	5	0.04	37
241399	46.00	47.50	1.50	0.10	25	3	50	20	0	1	0.00	5
241400	47.50	49.00	1.50	0.13	75	7	55	50	0	1	0.00	4
241401	49.00	50.50	1.50	0.10	40	5	50	25	0	2	0.00	4
241402	50.50	52.00	1.50	0.10	40	5	50	15	0	1	0.00	4
241403	52.00	53.50	1.50	0.10	25	3	45	15	0	0	0.00	4
241404	53.50	55.00	1.50	0.10	45	5	45	20	0	1	0.00	4
241405	55.00	56.50	1.50	0.10	20	3	45	20	0	0	0.00	4
241406	56.50	58.00	1.50	0.10	25	2	45	15	0	0	0.00	4
241407	58.00	59.50	1.50	0.10	20	3	45	10	0	1	0.00	4
241408	59.50	61.00	1.50	0.10	40	4	50	20	0	2	0.00	6
241409	61.00	62.50	1.50	0.10	20	5	45	20	0	1	0.00	5
241410	62.50	64.00	1.50	0.00	20	5	50	20	0	2	0.00	5
241411	64.00	65.50	1.50	0.00	25	5	45	20	0	2	0.00	7
241412	65.50	66.10	0.60	0.00	25	4	50	20	0	2	0.00	7

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 2--(continued)

RASS NO.	FROM	TO	INT. {m}	Ag {ppm}	Cu {ppm}	Pb {ppm}	Zn {ppm}	As {ppm}	Sb {ppm}	Mo {ppm}	Au {ppm}	Au {ppb}
			Min	0.00	5.00	1.00	5.00	10.00	0.00	0.00	0.00	4.00
			Max	0.40	75.00	15.00	65.00	6500.00	3.00	20.00	1.30	1100.00
			Avg	0.08	27.15	5.19	48.46	222.12	1.69	8.04	0.05	49.19
			Std	0.07	9.80	2.70	7.11	896.26	1.17	5.94	0.19	159.94

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 3.

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241451	4.95	5.65	0.70	0.10	35	0	60	70	0	3	8	0.01	9
241452	5.65	7.15	1.50	0.10	40	0	60	20	0	3	30	0.00	5
241453	7.15	8.65	1.50	0.10	20	0	55	25	0	3	3	0.01	8
241454	8.65	10.15	1.50	0.10	20	0	60	40	0	2	5	0.01	10
241455	10.15	11.65	1.50	0.10	20	0	60	30	0	3	4	0.01	9
241456	11.65	13.15	1.50	0.10	30	0	50	30	0	3	30	0.01	6
241457	13.15	14.65	1.50	0.10	37	0	55	25	0	3	8	0.01	8
241458	14.65	16.15	1.50	0.10	40	8	50	30	0	6	6	0.01	6
241459	16.15	17.65	1.50	0.10	50	0	50	20	0	6	2	0.01	8
241460	17.65	19.15	1.50	0.10	27	9	50	40	0	5	3	0.00	4
241461	19.15	20.65	1.50	0.10	30	2	50	20	0	5	17	0.00	4
241462	20.65	22.15	1.50	0.10	20	10	50	20	0	7	3	0.00	4
241463	22.15	23.65	1.50	0.10	20	7	50	55	0	4	3	0.00	4
241464	23.65	25.50	1.85	0.10	30	6	45	20	0	6	3	0.00	4
241413	25.50	27.00	1.50	0.10	20	6	60	80	0	2	3	0.01	11
241414	27.00	28.40	1.40	0.10	15	3	50	40	0	3	5	0.01	13
241415	28.40	29.05	0.65	0.10	35	15	50	450	0	2	5	0.04	30
241416	29.05	29.90	0.85	0.10	10	5	55	80	0	2	3	0.01	15
241417	29.90	31.40	1.50	0.72	22	40	65	4000	0	2	10	0.70	700
241418	31.40	33.15	1.75	0.21	25	10	60	2800	0	3	6	0.18	180
241419	33.15	34.50	1.35	0.10	24	9	60	800	0	3	5	0.02	30
241420	34.50	36.00	1.50	0.43	102	17	60	1000	0	4	10	0.10	90
241421	36.00	37.50	1.50	0.43	45	16	60	1600	0	5	15	0.11	112
241422	37.50	39.00	1.50	0.20	22	10	55	3000	0	3	10	0.34	360
241423	39.00	39.70	0.70	0.26	24	13	60	4000	0	3	10	0.13	140
241424	39.70	39.90	0.20	0.14	7	4	8	1600	0	1	18	0.04	44
241425	39.90	41.40	1.50	0.12	30	9	60	1250	0	2	7	0.03	39
241426	41.40	42.90	1.50	0.12	24	9	60	1400	0	1	8	0.02	32
241427	42.90	44.50	1.60	0.10	12	4	55	30	0	2	17	0.00	8
241428	44.50	46.00	1.50	0.10	8	4	50	20	0	1	3	0.00	10
241429	46.00	47.50	1.50	0.10	35	7	55	500	0	2	10	0.03	25
241430	47.50	49.00	1.50	0.10	50	5	55	200	0	2	5	0.01	10
241431	49.00	50.50	1.50	0.10	8	3	50	65	0	2	3	0.00	7
241432	50.50	52.00	1.50	0.10	20	4	50	250	0	2	3	0.02	18
241433	52.00	53.50	1.50	0.10	16	3	50	30	0	2	5	0.01	16
241434	53.50	55.00	1.50	0.10	10	6	55	850	0	1	10	0.03	27
241435	55.00	56.50	1.50	0.10	20	3	50	25	0	2	10	0.01	10
241436	56.50	58.00	1.50	0.10	25	3	40	20	0	2	10	0.01	9
241437	58.00	59.50	1.50	0.10	33	2	50	10	0	2	3	0.00	8
241438	59.50	61.00	1.50	0.10	12	2	50	20	0	2	7	0.01	15
241439	61.00	62.50	1.50	0.10	35	3	45	20	0	2	9	0.00	7
241440	62.50	64.00	1.50	0.10	50	5	50	25	0	2	12	0.03	20
241441	64.00	65.50	1.50	0.10	8	2	40	15	0	2	3	0.00	6
241442	65.50	67.00	1.50	0.10	45	4	50	30	0	3	12	0.01	13
241443	67.00	68.50	1.50	0.10	35	3	50	25	0	1	8	0.00	8
241444	68.50	70.00	1.50	0.12	92	3	50	20	0	2	6	0.00	7
241445	70.00	71.50	1.50	0.10	25	2	50	20	0	2	3	0.01	10
241446	71.50	73.00	1.50	0.10	20	3	50	20	0	2	3	0.01	10
241447	73.00	74.50	1.50	0.10	18	4	50	10	0	1	7	0.00	8
241448	74.50	76.00	1.50	0.10	5	0	40	10	0	1	4	0.00	5
241449	76.00	77.50	1.50	0.10	12	2	40	15	0	1	8	0.00	7
241450	77.50	79.87	2.37	0.10	45	3	45	20	0	2	10	0.00	5

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 3--(continued).

RASS NO.	FROM	TO	INT. {m}	Ag {ppm}	Cu {ppm}	Pb {ppm}	Zn {ppm}	As {ppm}	Bi {ppm}	Sb {ppm}	Mo {ppm}	Au {ppm}	Au {ppb}
			MAX	0.72	102.00	40.00	65.00	4000.00	0.00	7.00	30.00	0.70	700.00
			MIN	0.10	5.00	0.00	8.00	10.00	0.00	1.00	2.00	0.00	4.00
			Avg	0.13	28.13	5.54	51.50	476.83	0.00	2.65	7.90	0.04	41.42
			Std	0.11	18.22	6.39	8.49	966.97	0.00	1.43	5.94	0.11	108.69

Appendix 1.–Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 4

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241465	4.95	5.80	0.85	0.05	20	15	50	20	0	2	7	0.00	7
241466	5.80	7.30	1.5	0.05	20	12	50	20	0	2	16	0.00	7
241467	7.30	8.80	1.5	0.05	20	13	50	25	0	1	1	0.13	140
241468	8.80	10.30	1.5	0.05	16	15	45	200	0	2	2	0.02	22
241469	10.30	11.80	1.5	0.05	17	16	55	100	0	1	2	0.00	16
241470	11.80	13.30	1.5	0.05	20	27	55	25	0	2	16	0.00	8
241471	13.30	14.80	1.5	0.05	20	18	55	5	0	2	7	0.00	5
241472	14.80	16.30	1.5	0.05	22	8	55	5	0	1	7	0.00	6
241473	16.30	17.80	1.5	0.05	20	18	55	270	0	1	9	0.00	24
241474	17.80	19.30	1.5	0.05	22	19	60	20	0	2	30	0.00	6
241475	19.30	20.80	1.5	0.10	20	15	60	45	0	1	11	0.00	32
241476	20.80	22.30	1.5	0.20	20	13	60	1350	0	2	5	0.08	72
241477	22.30	23.80	1.5	0.10	20	15	65	20	0	3	26	0.00	6
241478	23.80	25.30	1.5	0.10	20	17	65	5	0	2	8	0.00	5
241479	25.30	26.80	1.5	0.10	20	19	60	100	0	2	25	0.00	7
241480	26.80	28.30	1.5	0.10	20	22	60	330	0	2	20	0.00	12
241481	28.30	29.80	1.5	0.10	25	20	60	45	0	2	25	0.00	7
241482	29.80	31.30	1.5	0.10	25	17	60	15	0	3	10	0.00	5
241483	31.30	32.80	1.5	0.05	20	16	55	5	0	3	5	0.00	5
241484	32.80	34.30	1.5	0.05	20	9	55	5	0	2	3	0.00	4
241485	34.30	35.80	1.5	0.10	20	8	55	330	0	3	3	0.06	53
241486	35.80	37.30	1.5	0.05	20	7	55	15	0	3	4	0.00	4
241487	37.30	38.80	1.5	0.10	20	8	55	50	0	3	6	0.00	6
241488	38.80	40.30	1.5	0.10	20	10	60	200	0	3	3	0.05	32
241489	40.30	41.80	1.5	0.12	20	9	55	70	0	2	14	0.07	70
241490	41.80	43.30	1.5	0.05	20	15	50	10	0	4	17	0.00	8
241491	43.30	44.80	1.5	0.12	20	12	55	120	0	2	13	0.09	82
241492	44.80	46.30	1.5	0.10	20	14	55	10	0	1	9	0.00	13
241493	46.30	47.80	1.5	0.10	20	14	55	0	0	1	5	0.00	5
241494	47.80	49.30	1.5	0.11	20	12	55	0	0	1	17	0.00	6
241495	49.30	50.80	1.5	0.05	20	15	60	0	0	2	14	0.00	5
241496	50.80	52.30	1.5	0.10	20	14	60	0	0	2	15	0.00	3
241497	52.30	53.80	1.5	0.05	20	12	55	0	0	4	6	0.00	7
241498	53.80	55.30	1.5	0.05	20	10	60	0	0	2	18	0.00	3
241499	55.30	56.80	1.5	0.05	20	15	60	0	0	2	13	0.00	3
241500	56.80	58.30	1.5	0.10	16	20	70	0	0	1	5	0.00	4
241501	58.30	59.80	1.5	0.10	16	10	55	140	0	2	13	0.00	15
241502	59.80	61.30	1.5	0.10	20	8	55	0	0	2	9	0.00	5
			Min.	0.00	16.00	7.00	45.00	0.05	0.00	1.00	1.00	0.00	3.00
			Max	0.20	25.00	27.00	70.00	1350.00	0.00	4.00	30.00	0.13	140.00
			Avg.	0.08	19.97	14.13	56.71	93.56	0.00	2.05	11.03	0.01	18.95
			Std.	0.03	1.74	4.38	4.63	225.34	0.00	0.79	7.33	0.03	28.23

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 5

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241503	4.65	4.95	0.30	0.06	20	30	55	80	0	2	4	0.02	22
241504	4.95	6.45	1.50	0.04	25	10	55	50	0	0	12	0.02	18
241505	6.45	7.95	1.50	0.07	15	20	50	250	0	0	8	0.03	34
241506	7.95	9.45	1.50	0.04	15	8	55	60	0	0	7	0.03	25
241507	9.45	10.95	1.50	0.04	8	6	55	40	0	0	2	0.02	16
241508	10.95	12.45	1.50	0.04	8	8	60	190	0	0	9	0.02	20
241509	12.45	13.95	1.50	0.04	35	7	60	35	0	0	7	0.01	13
241510	13.95	15.45	1.50	0.07	25	15	60	75	0	0	8	0.04	45
241511	15.45	16.95	1.50	0.05	8	17	55	1600	0	0	3	0.12	117
241512	16.95	18.45	1.50	0.03	5	7	60	40	0	0	7	0.00	8
241513	18.45	19.95	1.50	0.06	30	7	60	10	0	0	8	0.00	6
241514	19.95	21.45	1.50	0.06	22	5	68	10	0	0	16	0.00	5
241515	21.45	22.95	1.50	0.32	25	15	60	3400	0	0	12	0.02	25
241516	22.95	24.45	1.50	0.10	30	8	60	240	0	0	8	0.02	17
241517	24.45	25.95	1.50	0.09	30	7	60	115	0	0	35	0.00	6
241518	25.95	27.45	1.50	0.07	30	6	50	90	0	0	35	0.00	6
241519	27.45	28.95	1.50	0.07	35	6	50	20	0	0	25	0.00	8
241520	28.95	30.45	1.50	0.08	45	7	50	60	0	0	18	0.00	7
241521	30.45	31.95	1.50	0.01	45	7	50	40	0	0	20	0.01	14
241522	31.95	33.45	1.50	0.08	45	7	50	45	0	0	20	0.02	21
241523	33.45	34.95	1.50	0.08	50	4	60	30	0	0	16	0.02	21
241524	34.95	36.45	1.50	0.09	40	7	60	25	0	0	10	0.03	25
241525	36.45	37.95	1.50	0.11	35	3	60	55	0	0	12	0.04	44
241526	37.95	39.45	1.50	0.12	30	7	55	30	0	0	28	0.04	36
241527	39.45	40.95	1.50	0.08	15	4	50	10	0	0	6	0.00	7
241528	40.95	42.45	1.50	0.05	25	5	55	80	0	0	10	0.00	7
241529	42.45	43.95	1.50	0.13	22	7	50	500	0	0	9	0.01	12
241530	43.95	45.45	1.50	0.06	20	5	55	45	0	0	4	0.00	6
241531	45.45	46.95	1.50	0.12	20	8	50	400	0	0	7	0.02	20
241532	46.95	48.45	1.50	0.12	15	9	56	350	0	0	8	0.02	24
241533	48.45	49.80	1.35	0.10	17	7	60	30	0	0	6	0.00	8
241534	49.80	51.50	1.70	0.10	20	8	60	10	0	0	3	0.00	4
241535	51.50	53.00	1.50	0.10	20	6	60	10	0	0	12	0.00	4
241536	53.00	54.50	1.50	0.10	25	8	60	10	0	0	5	0.00	4
241537	54.50	56.00	1.50	0.10	20	7	55	10	0	0	12	0.00	4
241538	56.00	57.50	1.50	0.10	20	7	55	12	0	0	4	0.00	4
241539	57.50	59.00	1.50	0.10	20	5	60	10	0	0	3	0.01	9
241540	59.00	60.50	1.50	0.10	20	5	60	80	0	0	10	0.00	4
241541	60.50	62.00	1.50	0.10	20	4	60	0	0	0	3	0.00	4
241542	62.00	63.50	1.50	0.10	24	6	60	0	0	0	16	0.00	4
241543	63.50	65.00	1.50	0.22	24	8	65	600	0	0	7	0.12	4
241544	65.00	66.50	1.50	0.10	24	7	60	500	0	0	15	0.04	34
241545	66.50	68.00	1.50	0.21	30	9	65	550	0	0	8	0.07	86
241546	68.00	69.85	1.85	0.10	35	8	25	300	0	0	10	0.10	69
241547	69.85	70.05	0.20	0.10	12	6	55	1600	0	0	18	0.10	95
241548	70.05	71.55	1.50	0.56	20	20	60	2800	0	0	20	0.50	630
241549	71.55	72.85	1.30	0.37	30	16	70	2600	0	0	12	0.60	740
241550	72.85	73.10	0.25	1.00	12	20	70	4600	0	0	8	0.65	610
241551	73.10	73.65	0.55	0.55	20	115	40	1200	0	0	4	0.20	240
241552	73.65	75.00	1.35	0.10	30	8	65	900	0	0	20	0.05	49
241553	75.00	76.50	1.50	0.10	30	6	60	10	0	0	6	0.00	6

Appendix 1.--Geochemical analyses of drill core samples for Umm Shat Sharq drill hole 5--(continued).

RASS NO.	FROM	TO	INT. (m)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Bi (ppm)	Sb (ppm)	Mo (ppm)	Au (ppm)	Au (ppb)
241554	76.50	78.00	1.50	0.10	30	5	65	45	0	0	20	0.00	5
241555	78.00	79.50	1.50	0.10	30	5	60	10	0	0	10	0.00	5
241556	79.50	81.00	1.50	0.10	30	7	55	0	0	0	20	0.00	4
241557	81.00	82.50	1.50	0.10	30	4	60	0	0	0	10	0.00	4
241558	82.50	84.00	1.50	0.10	30	4	60	0	0	0	20	0.00	6
241559	84.00	85.50	1.50	0.10	40	6	60	0	0	0	6	0.00	4
241560	85.50	87.00	1.50	0.10	30	5	60	0	0	0	12	0.00	4
241561	87.00	88.50	1.50	0.10	35	5	55	0	0	0	12	0.00	4
241562	88.50	90.00	1.50	0.10	35	6	60	0	0	0	30	0.00	8
241563	90.00	91.50	1.50	0.10	30	5	60	0	0	0	40	0.00	6
241564	91.50	93.00	1.50	0.10	25		60	0	0	0	30	0.00	4
241565	93.00	94.50	1.50	0.10	25		60	0	0	0	26	0.00	4
241566	94.50	96.00	1.50	0.10	22		60	0	0	0	50	0.00	5
241567	96.00	97.50	1.50	0.10	30	16	60	0	0	0	26	0.00	5
241568	97.50	99.00	1.50	0.10	30	6	60	0	0	0	30	0.00	4
241569	99.00	100.30	1.30	0.10	30	6	60	0	0	0	45	0.00	4
			Min.	0.01	5.00	3.00	25.00	0.00	0.00	0.00	2.00	0.00	4.00
			Max.	1.00	50.00	115.00	70.00	4600.00	0.00	2.00	50.00	0.65	740.00
			Avg.	0.13	25.79	9.81	57.52	356.15	0.00	0.03	14.37	0.04	49.60
			Std.	0.14	9.23	14.10	6.49	846.05	0.00	0.24	10.59	0.12	137.21

APPENDIX 2

Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 1.

Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 2.

Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 3.

Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 4.

Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 5.

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 1.

RASS NO.	FROM	TO	INT. {m}	Au {ppb}	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241301	0.95	1.40	0.45	10			
241302	1.40	3.00	1.60	9			
241303	3.00	4.50	1.50	30			
241304	4.50	6.00	1.50	24			
241305	6.00	7.50	1.50	21			
241306	7.50	9.00	1.50	36			
241307	9.00	10.50	1.50	15			
241308	10.50	12.00	1.50	18			
241309	12.00	13.50	1.50	18			
241310	13.50	15.00	1.50	16			
241311	15.00	16.50	1.50	13			
241312	16.50	17.19	0.69	14			
241313	17.19	18.56	1.37	19			
241314	18.56	19.84	1.28	22			
241315	19.84	21.00	1.16	17			
241316	21.00	22.50	1.50	7			
241317	22.50	24.00	1.50	7			
241318	24.00	25.50	1.50	7			
241319	25.50	27.00	1.50	7			
241320	27.00	28.40	1.40	12			
241321	28.40	28.72	0.32	105	33.60	105.00	0.32
241322	28.72	29.50	0.78	34			
241323	29.50	30.35	0.85	19			
241324	30.35	32.00	1.65	22			
241325	32.00	33.50	1.50	17			
241326	33.50	35.00	1.50	18			
241327	35.00	36.50	1.50	18			
241328	36.50	37.85	1.35	27			
241329	37.85	39.15	1.30	18			
241330	39.15	40.65	1.50	18			
241331	40.65	41.00	0.35	18			
241332	41.00	41.80	0.80	330	264.00	161.00	4.00
241333	41.80	43.30	1.50	140	210.00		
241334	43.30	45.00	1.70	100	170.00		
241335	45.00	46.50	1.50	29			
241336	46.50	48.35	1.85	96	177.60	231.70	3.00
241337	48.35	49.50	1.15	450	517.50		
241338	49.50	51.00	1.50	54			
241339	51.00	52.50	1.50	29			
241340	52.50	54.00	1.50	30			
241341	54.00	54.80	0.80	17			
241342	54.80	56.30	1.50	18			
241343	56.30	58.00	1.70	17			
241344	58.00	59.22	1.22	76	92.72	76.00	1.22
241345	59.22	60.20	0.98	26			
241346	60.20	61.50	1.30	380	494.00	380.00	1.30
241347	61.50	63.00	1.50	19			
241348	63.00	64.59	1.59	20			
241349	64.59	66.00	1.41	10			
241350	66.00	67.50	1.50	12			
241351	67.50	69.00	1.50	9			
241352	69.00	70.50	1.50	8			
241353	70.50	72.00	1.50	8			
241354	72.00	73.50	1.50	7			

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 1--(continued).

RASS NO.	FROM	TO	INT. {m}	Au {ppb}	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241355	73.50	75.00	1.50	100	150.00	100.00	1.50
241356	75.00	76.50	1.50	10			
241357	76.50	78.00	1.50	9			
241358	78.00	79.50	1.50	9			
241359	79.50	81.00	1.50	9			
241360	81.00	82.70	1.70	10			

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 2.

RASS NO.	FROM	TO	INT. {m}	Au {ppb}	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241361	0.00	0.97	0.97	5			
241362	0.97	3.40	2.43	5			
241363	3.40	4.80	1.40	4			
241364	4.80	6.30	1.50	1100	1650.00	1100.00	1.50
241365	6.30	7.80	1.50	7			
241366	7.80	8.23	0.43	4			
241367	8.23	9.73	1.50	10			
241368	9.73	10.80	1.07	9			
241369	10.80	12.25	1.45	36			
241370	12.25	12.75	0.50	31			
241371	12.75	14.25	1.50	56			
241372	14.25	15.50	1.25	23			
241373	15.50	16.15	0.65	39			
241374	16.15	17.00	0.85	66	56.10	66.00	0.85
241375	17.00	17.85	0.85	46			
241376	17.85	18.20	0.35	28			
241377	18.20	18.50	0.30	34			
241378	18.50	20.00	1.50	15			
241379	20.00	21.50	1.50	7			
241380	21.50	23.00	1.50	7			
241381	23.00	24.50	1.50	4			
241382	24.50	26.00	1.50	4			
241383	26.00	27.50	1.50	16			
241384	27.50	29.00	1.50	4			
241385	29.00	30.50	1.50	6			
241386	30.50	32.00	1.50	7			
241387	32.00	33.50	1.50	17			
241388	33.50	35.20	1.70	33			
241389	35.20	35.65	0.45	65	29.25	65.00	0.45
241390	35.65	35.90	0.25	24			
241391	35.90	36.65	0.75	440	330.00	202.07	2.80
241392	36.65	37.45	0.80	76	60.80		
241393	37.45	38.70	1.25	140	175.00		
241394	38.70	40.00	1.30	17			
241395	40.00	41.50	1.50	15			
241396	41.50	43.00	1.50	16			
241397	43.00	44.50	1.50	38			
241398	44.50	46.00	1.50	37			
241399	46.00	47.50	1.50	5			
241400	47.50	49.00	1.50	4			
241401	49.00	50.50	1.50	4			
241402	50.50	52.00	1.50	4			
241403	52.00	53.50	1.50	4			
241404	53.50	55.00	1.50	4			
241405	55.00	56.50	1.50	4			
241406	56.50	58.00	1.50	4			
241407	58.00	59.50	1.50	4			
241408	59.50	61.00	1.50	6			
241409	61.00	62.50	1.50	5			
241410	62.50	64.00	1.50	5			
241411	64.00	65.50	1.50	7			
241412	65.50	66.10	0.60	7			

Appendix 2.–Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 3.

RASS NO.	FROM	TO	INT. {m}	Au {ppb}	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241451	4.95	5.65	0.70	9			
241452	5.65	7.15	1.50	5			
241453	7.15	8.65	1.50	8			
241454	8.65	10.15	1.50	10			
241455	10.15	11.65	1.50	9			
241456	11.65	13.15	1.50	6			
241457	13.15	14.65	1.50	8			
241458	14.65	16.15	1.50	6			
241459	16.15	17.65	1.50	8			
241460	17.65	19.15	1.50	4			
241461	19.15	20.65	1.50	4			
241462	20.65	22.15	1.50	4			
241463	22.15	23.65	1.50	4			
241464	23.65	25.50	1.85	4			
241413	25.50	27.00	1.50	11			
241414	27.00	28.40	1.40	13			
241415	28.40	29.05	0.65	30			
241416	29.05	29.90	0.85	15			
241417	29.90	31.40	1.50	700	1050.00	420.00	4.75
241418	31.40	33.15	1.75	180	315.00		
241419	33.15	34.50	1.35	30			
241420	34.50	36.00	1.50	90	135.00	180.96	5.20
241421	36.00	37.50	1.50	112	168.00		
241422	37.50	39.00	1.50	360	540.00		
241423	39.00	39.70	0.70	140	98.00		
241424	39.70	39.90	0.20	44			
241425	39.90	41.40	1.50	39			
241426	41.40	42.90	1.50	32			
241427	42.90	44.50	1.60	8			
241428	44.50	46.00	1.50	10			
241429	46.00	47.50	1.50	25			
241430	47.50	49.00	1.50	10			
241431	49.00	50.50	1.50	7			
241432	50.50	52.00	1.50	18			
241433	52.00	53.50	1.50	16			
241434	53.50	55.00	1.50	27			
241435	55.00	56.50	1.50	10			
241436	56.50	58.00	1.50	9			
241437	58.00	59.50	1.50	8			
241438	59.50	61.00	1.50	15			
241439	61.00	62.50	1.50	7			
241440	62.50	64.00	1.50	20			
241441	64.00	65.50	1.50	6			
241442	65.50	67.00	1.50	13			
241443	67.00	68.50	1.50	8			
241444	68.50	70.00	1.50	7			
241445	70.00	71.50	1.50	10			
241446	71.50	73.00	1.50	10			
241447	73.00	74.50	1.50	8			
241448	74.50	76.00	1.50	5			
241449	76.00	77.50	1.50	7			
241450	77.50	79.87	2.37	5			

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 4.

RASS NO.	FROM	TO	INT. (m)	Au (ppb)	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241465	4.95	5.80	0.85	7			
241466	5.80	7.30	1.50	7			
241467	7.30	8.80	1.50	140	210.00	140.00	1.50
241468	8.80	10.30	1.50	22			
241469	10.30	11.80	1.50	16			
241470	11.80	13.30	1.50	8			
241471	13.30	14.80	1.50	5			
241472	14.80	16.30	1.50	6			
241473	16.30	17.80	1.50	24			
241474	17.80	19.30	1.50	6			
241475	19.30	20.80	1.50	32			
241476	20.80	22.30	1.50	72	108.00	72.00	1.50
241477	22.30	23.80	1.50	6			
241478	23.80	25.30	1.50	5			
241479	25.30	26.80	1.50	7			
241480	26.80	28.30	1.50	12			
241481	28.30	29.80	1.50	7			
241482	29.80	31.30	1.50	5			
241483	31.30	32.80	1.50	5			
241484	32.80	34.30	1.50	4			
241485	34.30	35.80	1.50	53			
241486	35.80	37.30	1.50	4			
241487	37.30	38.80	1.50	6			
241488	38.80	40.30	1.50	32			
241489	40.30	41.80	1.50	70	105.00	70.00	1.50
241490	41.80	43.30	1.50	8			
241491	43.30	44.80	1.50	82	123.00	82.00	1.50
241492	44.80	46.30	1.50	13			
241493	46.30	47.80	1.50	5			
241494	47.80	49.30	1.50	6			
241495	49.30	50.80	1.50	5			
241496	50.80	52.30	1.50	3			
241497	52.30	53.80	1.50	7			
241498	53.80	55.30	1.50	3			
241499	55.30	56.80	1.50	3			
241500	56.80	58.30	1.50	4			
241501	58.30	59.80	1.50	15			
241502	59.80	61.30	1.50	5			

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 5.

RASS NO.	FROM	TO	INT. (m)	Au (ppb)	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241503	4.65	4.95	0.30	22			
241504	4.95	6.45	1.50	18			
241505	6.45	7.95	1.50	34			
241506	7.95	9.45	1.50	25			
241507	9.45	10.95	1.50	16			
241508	10.95	12.45	1.50	20			
241509	12.45	13.95	1.50	13			
241510	13.95	15.45	1.50	45			
241511	15.45	16.95	1.50	117	175.50	117.00	1.50
241512	16.95	18.45	1.50	8			
241513	18.45	19.95	1.50	6			
241514	19.95	21.45	1.50	5			
241515	21.45	22.95	1.50	25			
241516	22.95	24.45	1.50	17			
241517	24.45	25.95	1.50	6			
241518	25.95	27.45	1.50	6			
241519	27.45	28.95	1.50	8			
241520	28.95	30.45	1.50	7			
241521	30.45	31.95	1.50	14			
241522	31.95	33.45	1.50	21			
241523	33.45	34.95	1.50	21			
241524	34.95	36.45	1.50	25			
241525	36.45	37.95	1.50	44			
241526	37.95	39.45	1.50	36			
241527	39.45	40.95	1.50	7			
241528	40.95	42.45	1.50	7			
241529	42.45	43.95	1.50	12			
241530	43.95	45.45	1.50	6			
241531	45.45	46.95	1.50	20			
241532	46.95	48.45	1.50	24			
241533	48.45	49.80	1.35	8			
241534	49.80	51.50	1.70	4			
241535	51.50	53.00	1.50	4			
241536	53.00	54.50	1.50	4			
241537	54.50	56.00	1.50	4			
241538	56.00	57.50	1.50	4			
241539	57.50	59.00	1.50	9			
241540	59.00	60.50	1.50	4			
241541	60.50	62.00	1.50	4			
241542	62.00	63.50	1.50	4			
241543	63.50	65.00	1.50	4			
241544	65.00	66.50	1.50	34			
241545	66.50	68.00	1.50	86	129.00	345.06	7.15
241546	68.00	69.85	1.85	69	127.65		
241547	69.85	70.05	0.20	95	19.00		
241548	70.05	71.55	1.50	630	945.00		
241549	71.55	72.85	1.30	740	962.00		
241550	72.85	73.10	0.25	610	152.50		
241551	73.10	73.65	0.55	240	132.00		
241552	73.65	75.00	1.35	49			
241553	75.00	76.50	1.50	6			
241554	76.50	78.00	1.50	5			
241555	78.00	79.50	1.50	5			
241556	79.50	81.00	1.50	4			

Appendix 2.--Gold assays and weighted averages for samples having gold concentrations greater than 60 ppb for Umm Shat Sharq drill hole 5--(continued).

RASS NO.	FROM	TO	INT. (m)	Au (ppb)	ASSAY * LENGTH	WEIGHTED AVERAGE	TOTAL LENGTH
241557	81.00	82.50	1.50	4			
241558	82.50	84.00	1.50	6			
241559	84.00	85.50	1.50	4			
241560	85.50	87.00	1.50	4			
241561	87.00	88.50	1.50	4			
241562	88.50	90.00	1.50	8			
241563	90.00	91.50	1.50	6			
241564	91.50	93.00	1.50	4			
241565	93.00	94.50	1.50	4			
241566	94.50	96.00	1.50	5			
241567	96.00	97.50	1.50	5			
241568	97.50	99.00	1.50	4			
241569	99.00	100.30	1.30	4			

APPENDIX 3

Drill core summary logs for Umm Shat Sharq drill hole 1.

Drill core summary logs for Umm Shat Sharq drill hole 2.

Drill core summary logs for Umm Shat Sharq drill hole 3.

Drill core summary logs for Umm Shat Sharq drill hole 4.

Drill core summary logs for Umm Shat Sharq drill hole 5.

Appendix 3.--Drill core summary logs for Umm Shat Sharq drill hole 1.

KINGDOM OF SAUDI ARABIA
Ministry of Petroleum and Mineral Resources
Directorate General of Mineral Resources

Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #1

References

Logged by: M.B. El Komi

SUMMARY LOG

- xx Medium-grained quartz monzodiorite
- xx Fine-grained quartz monzodiorite
- Sericitic alteration
- Argillization
- Fault
- 60° / 5cm — Quartz vein (thickness & angle to core axis given)
- QMD ≡ Quartz monzodiorite
- QSP ≡ Quartz-sericite-pyrite

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data

Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth	Depth	Inclination	Azimuth
80.0	-59°	119°			

Depth (m)	Core recovery: RQD	Core recovery: %
0	00	05
	16	100
	04	100
	00	100
	14	100
5	32	100
	67	100
	14	100
	00	100
	74	100
10	52	100
	38	100
	46	100
	06	100
	100	100
15	42	100
	53	100
	73	100
	00	100
	20	100
20	31	100
	89	100
	100	100
	92	100
	90	100
25	41	100
	36	
	73	
	42	
	56	
30	20	
	65	
	79	
	48	
	65	
35	52	
	02	
	14	
	00	
	00	
40	14	
	14	
	22	
	52	
	50	
45	30	
	100	
	75	100

VEIN STRUCTURE (Including water loss and cementation)

- 3cm, 47° (≤1.0mm xl-lined vugs in quartz vein).
- 1cm, 81°
- 18°
- <2.0 mm
- 30°
- <2.0mm, 45°
- <2.0mm
- 37.6–39.5m: zone of carbonate stringers, 0°–29° CA
- 35°
- 56°
- <2.0mm
- <2.0mm, 30°
- <2.0mm, 30°
- 65° CA

Columns: Quartz Veins (Intersection angle with core axis) | Alteration | Lithology

FAULTS + LITHOLOGY + ALTERATION

- No Sample
- 0–28.5m: Zone of mixed-layer silicates /oxidation.
- 0–66.4m: Medium-grained quartz monzodiorite; Feldspar ≤3.0mm; ferromagnesium mineral clots ≤8.0mm.
- 28.72–29.50: molybdenite observed in quartz veins.
- NOTE: Limonite + hematite is mostly in fractures in this hole.
- 38.2–39.0m: 10% QSP.
- 39.0–41.0m: No significant sericite; biotite → chlorite.
- 41.0–41.8m: Argillized zone. 65° CA measure on gouge-coated fault zone.
- 41.8–45.8m: 50% QSP w/ significant chloritization.
- 45.8–47.0m: Moderately fresh QMD.
- 47.0–47.3m: 60% QSP.
- 47.3–48.1m: Moderately fresh QMD.

MINERALIZATION (LH Py Mo)

1.0; 0.5; 1.0; 3.0; 0.1; 0.1 0.2; 0.1; 3.0; 0.1 1.0; 1.0

SAMPLE DATA

Length (m)	Interval (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
	.40	241301	10	.10	32	8	100	10	20
	1.60	241302	9	.10	25	5	60	15	5
	1.5	241303	30	.10	26	7	60	25	5
	1.5	241304	24	.10	22	9	55	45	10
	1.5	241305	21	.10	25	8	65	25	4
	1.5	241306	36	.10	25	6	55	35	4
	1.5	241307	15	.10	22	7	60	45	10
	1.5	241308	18	.10	25	7	60	35	7
	1.5	241309	18	.10	25	10	60	100	10
	1.5	241310	16	.10	20	8	60	75	10
	1.5	241311	13	.10	18	15	62	70	6
	.69	241312	14	.15	18	10	65	65	10
	1.37	241313	19	.10	22	7	60	40	10
	1.28	241314	22	.10	20	7	55	15	6
	1.16	241315	17	.11	20	10	60	90	10
	1.50	241316	7	.10	20	7	55	15	7
	1.50	241317	7	.10	20	8	60	15	15
	1.50	241318	7	.10	45	10	55	16	12
	1.50	241319	7	.10	24	7	60	20	20
	1.46	241320	12	.10	24	10	60	40	10
	.32	241321	105	.13	20	32	60	1500	12
	.78	241322	34	.11	30	10	60	350	500
	.85	241323	19	.10	22	10	65	80	10
	1.65	241324	22	.10	24	10	62	50	12
	1.50	241325	17	.10	20	7	62	20	10
	1.50	241326	18	.10	25	8	60	35	12
	1.50	241327	18	.10	20	6	50	25	5
	1.35	241328	27	.10	16	10	60	75	7
	1.30	241329	18	.10	16	8	55	25	10
	1.50	241330	18	.10	20	8	55	35	10
	.35	241331	18	.14	20	7	56	35	10
	.80	241332	380	.30	22	12	53	950	7
	1.30	241333	140	.18	20	13	65	500	8
	1.70	241334	160	.24	20	14	60	100	8
	1.50	241335	29	.10	16	10	62	105	7
	1.85	241336	96	.15	22	10	62	300	100

KINGDOM OF SAUDI ARABIA
Ministry of Petroleum and Mineral Resources
Directorate General of Mineral Resources

Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #1

References

Logged by: M.B. El Komi

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth	Depth	Inclination	Azimuth
80.0	-59°	119°			

Columns: CORE RECOVERY (RQD, %) | CORE BOX | STRUCTURE (including water loss and cementation) | Quartz Veins | Alteration | Lithology | FAULTS + LITHOLOGY + ALTERATION | MINERALIZATION (LH, Py, Ap) | SAMPLE DATA

Depth scale: 48, 50, 55, 60, 65, 70, 75, 80, 85

Core recovery, RQD / % (48–82.7 m): 43/100, 83/100, 83/100, 58/100, 100/100, 68/100, 79/100, 64/100, 100/100, 100/100, 90/100, 84/100, 69/100, 94/100, 98/100, 83/100, 97/100, 62/100, 78, 59, 86, 100, 74, 100, 100, 100, 82, 87, 98, 100, 88, 72, 77, 76, 70/100

Structure: 1.0mm, 70° ; 50° ; 35° ; 5.0mm, 40° ; 5.0mm, 65° ; 65° ; 5.0mm, 35° ; 7.0mm, 50°

Faults + Lithology + Alteration:

65°CA 48.1–48.4m: 80% QSP

48.4–48.8m: Argillic alteration after sericite.

48.8–49.25m: 80% QSP (Significant chlorite selvages on sericitic alteration envelopes on quartz veins.

49.25–49.50m: Fault zone; gouge-coated surface at 85°CA.

49.50–50.0m: 40% QSP.

50.0–51.0m: 5% QSP

64.6–68.3m: zone of chlorite alteration.

65°? Transition (?) boundary between medium- and fine grained quartz monzodiorite is obscured by quartz vein + alteration: 66.4m.

66.4–82.7m: Fine-grained quartz monzodiorite; feldspar grain size ≤1.0mm; no ferromag. mineral clots.

71.88–82.70m: Rock is moderately chloritized.

E.O.H. = 82.7m

Mineralization (LH, Py, Ap): 3.0, 1.0; 5.0, 1.0; 0.2, 1.0; 1.5, 1.0; 0.3; 0.1

SAMPLE DATA

Interval (m)	Sample number	Au PPb	Ag PPm	Cu PPm	Pb PPm	Zn PPm	As PPm	MO PPm
1.15	241337	410	.30	25	15	75	675	10
1.5	241338	54	.10	32	10	60	150	8
1.50	241339	29	.10	30	10	65	25	15
1.50	241340	30	.10	22	10	60	25	10
.80	241341	17	.10	22	9	45	15	1
1.50	241342	18	.10	25	7	60	20	40
1.70	241343	17	.10	25	7	60	20	26
1.22	241344	76	.15	30	10	80	390	14
.98	241345	26	.17	25	8	65	150	28
1.30	241346	380	.10	28	8	70	70	22
1.50	241347	19	.10	40	10	70	25	32
1.50	241348	20	.10	28	10	65	25	70
1.41	241349	10	.10	25	10	60	25	15
1.50	241350	12	.10	15	15	65	45	20
1.50	241351	9	.10	12	12	55	25	15
1.50	241352	8	.10	45	12	60	25	15
1.50	241353	8	.10	10	10	60	20	16
1.50	241354	7	.10	6	10	65	20	20
1.50	241355	100	.10	9	8	60	15	10
1.50	241356	10	.10	5	6	55	20	3
1.50	241357	9	.10	8	7	55	20	3
1.50	241358	9	.10	15	7	55	20	10
1.50	241359	9	.10	12	8	60	20	3
1.70	241360	10	.10	10	6	50	20	13

Appendix 3.--Drill core summary logs for Umm Shat Sharq drill hole 2.

KINGDOM OF SAUDI ARABIA
Ministry of Petroleum and Mineral Resources
Directorate General of Mineral Resources

Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #2

References

Logged by: Majed Ben Talib, R.S. Kamilli

Scale

SUMMARY LOG

- xx Medium-grained quartz monzodiorite
- xx Fine-grained quartz monzodiorite
- ∴ Sericitic alteration
- /// Argillization
- ---- Fault
- / Quartz vein (thickness & angle to core axis given), e.g. 5cm, 60°
- QMD ≡ Quartz monzodiorite
- QSP ≡ Quartz-sericite-pyrite

Date Started:
Date Completed:
Driller: ADC
Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth
5.0	-61°	119°
30.0	-61.5°	116°
66.0	-66°	112°

Pyr. ≡ Pyrite; Ap. ≡ Arsenopyrite; Tr ≡ Trace

Core recovery (RQD, %) by depth (m)

Depth (m)	RQD	%
0–1	0	90
1–2	0	30
2–3	0	65
3–4	0	85
4–5	0	84
5–6	0	100
6–7	17	90
7–8	35	86
8–9	43	100
9–10	20	80
10–11	13	93
11–12	00	88
12–13	00	100
13–14	16	100
14–15	13	100
15–16	00	100
16–17	00	100
17–18	00	100
18–19	100	100
19–20	100	100
20–21	93	100
21–22	83	100
22–23	87	100
23–24	100	100
24–25	85	100
25–26	70	100
26–27	97	100
27–28	94	100
28–29	83	86
29–30	94	100
30–31	75	
31–32	88	
32–33	65	
33–34	73	
34–35	42	
35–36	91	
36–37	51	
37–38	94	
38–39	79	
39–40	72	
40–41	100	
41–42	78	
42–43	79	
43–44	90	
44–45	88	
45–46	66	100

Vein structure

- ~17 m: 30°
- ~17.5 m: 4cm, 60°
- ~35 m: 0.25m, 60°; 1.5cm, 68°; 2-1cm, 4.0cm, 68°; ≚1.5mm, 15/m, 68°; stringers, 25/m; 5mm, 70°
- ~39.5 m: stringers, ~6/m
- ~43 m: 7.0cm, 85°; stringer, 10°
- ~45.5 m: 1mm w/ 2cm potassic fsp envelope, 28°

Faults + Lithology + Alteration

6.1–6.3m: Fault zone; Rocks uphole are argillized in grus; ~1 m downhole from this argillized zone, the rocks are relatively fresh.

0.0–18.5m: Zone of mixed layer silicates/oxidation (complete) of sulfides.

NOTE: This entire drill hole consists of fine-grained quartz monzodiorite. Feldspar is ≤1.0mm grain size; ferromagnesian minerals are NOT aggregated.

45° → Propylitized felsic dike w/ 1mm, 1% biotite; 0.1mm groundmass.

Quartz monzodiorite: hypidiomorphic-equigranular; 25% biotite, 65% feldspar, 10% quartz. Tr amphibole megacrysts?

241388: 15% QSP.

241389: 40% QSP; bottom-most 0.3 m is sericitized; 5.0 cm at very bottom of sample interval is argillized adjacent to hanging wall of quartz vein. ~30% argillization in total sample.

241390: 0.25 m-thick quartz vein cut by limonite + hematite stringers.

241391: 70% QSP + argillization. 3cm-thick highly argillized zone at footwall of quartz vein (241390). Beginning of interval. Argillization from footwall of vein 20 cm downhole of vein.

241392: 40% QSP

241393: ≤3.0mm-thick quartz vein zone; 80% QSP.

241394: 5% QSP.

Mineralization (% Pyr., Ap.)

Depth (approx. m)	Pyr.	Ap.	
15.5	0.2		
16	3.0		
17	1.0		
17.5	2.0		
33.5	0.1	0.2	Tr
34.5	1.0	0.2	Tr
35.5	2.5	1.0	0.1
36	0.3	1.0	Tr
37	0.2	2.0	
38.5	0.1	Tr	

NOTE: Limonite + hematite occurs primarily as fracture fillings (stringers) and to a lesser degree as pseudomorphs after pyrite/arsenopyrite. Argillization is associated w/ limonite + hematite occurrences. The sulfides are associated w/ sericite envelopes on quartz veins. Argillic alteration of country rock appears to be later than sericitization.

Sample data

Interval (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
0.97	241361	5	0.1	25	5	65	30	0.01
2.43	241362	5	0.1	40	6	50	35	0.01
1.40	241363	4	0.1	30	4	50	30	0
1.50	241364	1100	0.1	25	5	50	35	1.3
1.50	241365	7	0.1	25	3	50	35	0.01
1.0	241366	4	0	30	4	50	30	0
1.50	241367	10	0.1	35	3	50	30	0.1
1.07	241368	9	0.13	30	4	50	40	0.01
1.45	241369	36	0.11	30	9	50	230	0.04
0.90	241370	31	0.1	30	10	50	210	0.03
1.50	241371	56	0	30	5	50	45	0.06
1.15	241372	23	0	30	5	50	40	0.03
0.60	241373	39	0.1	20	5	45	90	0.04
0.85	241374	66	0.18	20	12	45	650	0.07
0.85	241375	46	0.1	30	7	55	210	0.05
0.35	241376	23	0.16	20	7	50	240	0.03
0.30	241377	34	0	40	5	50	55	0.04
1.50	241378	15	0	30	3	45	30	0.02
1.50	241379	7	0	25	4	50	40	0.01
1.50	241380	7	0	15	4	50	40	0.01
1.50	241381	4	0	25	5	50	35	0.01
1.50	241382	4	0	20	3	50	20	0.01
1.50	241383	16	0	25	4	50	30	0.02
1.50	241384	4	0	25	4	50	30	0.01
1.50	241385	6	0	25	5	50	30	0.01
1.50	241386	7	0	30	4	50	30	0.01
1.50	241387	17	0.1	20	4	45	30	0.02
1.70	241388	33	0	25	5	50	700	0.04
0.45	241389	65	0.1	20	5	55	90	0.57
0.30	241390	24	0.1	5	1	5	100	0.03
0.78	241391	440	0.4	20	10	40	6500	0.45
0.80	241392	76	0.11	20	15	55	900	0.08
1.25	241393	140	0.17	25	14	50	280	0.15
1.30	241394	17	0.1	25	5	50	70	0.02
1.50	241395	15	0.1	30	5	50	40	0.02
1.50	241396	16	0.1	20	5	50	70	0.03
1.50	241397	38	0.1	20	3	45	30	0.04
1.50	241398	37	0.1	25	4	50	80	0.04

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Directorate General of Mineral Resources

Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #2

References

Logged by: Majed Ben Talib

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth	Inclination	Azimuth	Depth	Inclination	Azimuth

Column headings: CORE RECOVERY (RQD, %) | CORE BOX | VEIN STRUCTURE (Including water loss and cementation) | Quartz Veins | Alteration | Lithology | FAULTS + LITHOLOGY + ALTERATION | MINERALIZATION (Lim. Hem Py. Cp.) | SAMPLE DATA

Core recovery

Depth (m)	RQD	%
45	88	100
	66	100
	98	100
	96	100
	44	100
50	38	100
	43	100
	60	100
	100	
	100	
55	83	
	85	
	100	
	87	
	95	
60	88	
	40	
	72	
	81	
	100	
65	100	100
70		

Vein structure, lithology, alteration and mineralization

Depth (m)	Vein structure	Faults + Lithology + Alteration	Mineralization
~48–49	1.6 cm, 55° w/ carbonate + chlorite	Potassic pink replacement veins ~4/m	
~51–52		Potassic pink replacement veins ~5/m	No sulfides found.
~53–54	<1 mm, 50°		
~57–58		Potassic pink replacement veins ~4/m to end of hole.	
66.1		E.O.H. = 66.1 m	

SAMPLE DATA

Interval (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
1.50	241399	5	0.1	25	3	50	20	4
1.50	241400	4	0.13	75	7	55	30	4
1.50	241401	4	0.1	40	5	50	25	14
1.50	241402	4	0.1	40	5	50	15	15
1.50	241403	4	0.1	25	3	45	15	4
1.50	241404	4	0.1	45	5	45	20	3
1.50	241405	4	0.1	20	3	45	20	3
1.50	241406	4	0.1	25	2	45	15	4
1.50	241407	4	0.1	20	3	45	10	8
1.50	241408	6	0.1	40	4	50	20	10
1.50	241409	5	0.1	20	5	45	20	8
1.50	241410	5	0	20	5	50	20	12
1.50	241411	7	0	25	5	45	20	9
1.50	241412	7	0	25	4	50	20	7

Appendix 3.--Drill core summary logs for Umm Shat Sharq drill hole 3.

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Directorate General of Mineral Resources

Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #3

References

Logged by: Majed Ben Talib

Scale

SUMMARY LOG

- XX Medium-grained quartz monzodiorite
- xx Fine-grained quartz monzodiorite
- ∴ Sericitic alteration
- /// Argillization
- Fault
- Quartz vein (thickness & angle to core axis given) — 5cm, 60°
- QMD ≡ Quartz monzodiorite
- QSP ≡ Quartz-sericite-pyrite

Date Started:
Date Completed:
Driller: ADC
Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth	Depth	Inclination	Azimuth
5.0	-61°	119°	25.0	-65°	128°
8.0	-70.5°	124°	35.0	-69°	125°
8.0	-71.5°	126°	50.0	-69°	124°
14.65	-64.5°	122°	79.0	-69°	125°
14.65	-64.5°	122°			

Core recovery (RQD / %)

Depth interval (m)	RQD	%
26-27	55	85
27-28	78	100
28-29	34	65
29-30	79	100
30-31	68	100
31-32	43	100
32-33	59	100
33-34	75	100
34-35	44	100
35-36	96	100
36-37	89	98
37-38	98	99
38-39	85	98
39-40	90	97
40-41	77	94
41-42	78	94
42-43	74	98
43-44	74	100
44-45	90	100

Vein structure (including water loss and cementation)

- ~5-6 m: 1% quartz veins
- ~7.5-9 m: 3% quartz veins
- ~12-13 m: 3% quartz veins
- 5.0mm, 89°
- ≥0.1m, 85°(?)
- 6cm, 45°
- 1cm, 55°
- ≥2mm, 25°
- 65°
- 5mm, 70°
- 6cm, 35°
- 0.25 m, 55°
- 1-3mm, ~4/m: 70°, 60°, 90°, 78°, 90°

Columns: Quartz Vein | Alteration | Lithology

Faults + Lithology + Alteration

0.0-4.9m: No sample.

Percussion drilling: 4.9-25.5m. Cuttings are sand- to flour-sized.

0.0-27.5m: zone of mixed layer silicates/complete oxidation of sulfides. (Mineralization: Lim. 2.0, Hem. 0.2)

NOTE: This drill hole consists entirely of fine-grained quartz monzodiorite. Feldspar ≤1.0mm diameter.

30.0-33.1m: Highly argillized zone (much more argillized than core uphole). Limonite + hematite-coated fractures (ie. stringers) and limonite + hematite characterize this zone. 70% argillic alteration is superimposed over 30% (remaining) QSP alteration. (Mineralization: 3.0, 3.0, 1.0)

34.0-34.1m: 0.1m-thick argillic zone. (Rest of hole contains no significant occurrences of argillic alteration). (Mineralization: 0.1, 0.3)

29.90-43.30m: QSP alteration zone; alteration envelopes are on quartz veins. This interval defines the main vein zone in this drill hole.

MINERALIZATION: Lim. | Hem. | Tr = Trace | Pyr | Asp

SAMPLE DATA

Length (m)	Sample Number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
0.70	241451	9	0.1	35	0	60	70	8
1.50	241452	5	0.1	40	0	60	20	30
1.50	241453	8	0.1	20	0	55	25	3
1.50	241454	10	0.1	20	0	20	40	5
1.50	241455	9	0.1	20	0	60	30	4
1.50	241456	6	0.1	30	0	50	30	30
1.50	241457	8	0.1	97	0	55	25	8
1.50	241458	6	0.1	40	8	50	30	6
1.50	241459	8	0.1	50	6	50	20	2
1.50	241460	4	0.1	27	9	50	40	3
1.50	241461	4	0.1	30	2	50	20	17
1.50	241462	4	0.1	20	10	50	20	3
1.50	241463	4	0.1	20	7	50	55	3
1.95	241464	4	0.1	30	6	45	20	3
1.85	241413	11	0.1	20	6	60	80	3
1.40	241414	13	0.1	15	3	50	40	5
0.45	241415	30	0.1	35	15	80	450	5
0.35	241416	15	0.1	10	5	55	80	3
1.50	241417	700	0.72	22	40	65	1000	10
1.75	241418	180	0.21	25	10	60	800	6
1.35	241419	30	0.1	21	9	60	600	5
1.50	241420	90	0.43	102	17	60	3000	10
1.50	241421	112	0.43	45	16	60	1000	15
1.50	241422	340	0.12	22	10	55	3000	10
0.70	241423	130	0.86	49	13	60	4000	10
0.20	241424	44	0.14	7	4	8	1600	18
1.35	241425	39	0.12	30	9	60	1250	7
1.50	241426	32	0.12	19	9	60	3400	8
1.60	241427	8	0.10	12	4	55	30	17

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Directorate General of Mineral Resources

Organization U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #3

References

Logged by: Majed Ben Talib

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data

Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth	Inclination	Azimuth	Depth	Inclination	Azimuth

Depth (m)	Core recovery length (m)	Core recovery %
45	92	100
	86	100
	85	100
	94	100
	100	100
50	100	100
	93	100
	90	100
	100	100
	88	100
55	100	100
	100	100
	100	100
	95	100
	96	100
60	75	100
	99	
	85	
	100	
	100	
65	100	
	85	
	100	
	100	
	90	
70	100	
	100	
	100	
	93	
	85	
75	100	
	100	
	100	
	100	
	90	100
80		

Vein structure (including water loss and cementation) / Quartz Veins / Alteration / Lithology:

- <2mm, 90°
- 80°
- <2mm, 90°
- 8mm, 55°; 85°
- 85°
- 90°
- 3-4mm, 15°
- 25°

Faults + Lithology + Alteration:

- Mafic dike
- Fresh quartz monzodiorite
- Fresh quartz monzodiorite
- E.O.H. = 79.9 m

Mineralization (Lim. Hem. Pyr. Ap.):

- No sulfides

SAMPLE DATA

Interval (m)	Sample number	Au PPb	Ag PPm	Cu PPm	Pb PPm	Zn PPm	As PPm	Mo PPm
1.50	241428	10	0.1	6	4	50	20	3
1.50	241429	25	0.1	35	7	55	500	10
1.50	241430	10	0.1	50	5	55	200	5
1.50	241431	7	0.1	8	3	50	65	3
1.50	241432	18	0.1	20	4	50	250	3
1.50	241433	16	0.1	16	3	50	30	5
1.50	241434	27	0.1	10	6	55	850	10
1.50	241435	10	0.1	20	3	50	25	10
1.50	241436	9	0.1	25	3	40	20	10
1.50	241437	8	0.1	38	2	50	10	3
1.50	241438	15	0.1	12	2	50	20	7
1.50	241439	7	0.1	35	3	45	20	9
1.50	241440	20	0.1	50	5	50	25	12
1.50	241441	6	0.1	8	2	40	15	3
1.50	241442	15	0.1	45	4	50	30	12
1.50	241443	8	0.1	35	3	50	25	8
1.50	241444	7	0.1	92	3	50	20	6
1.50	241445	10	0.1	25	2	50	20	3
1.50	241446	10	0.1	20	3	50	20	3
1.50	241447	8	0.1	18	4	50	10	7
1.50	241448	5	0.1	5	0	40	10	4
1.50	241449	7	0.1	12	2	40	15	8
2.37	241450	5	0.1	45	3	45	20	10

Appendix 3.–Drill core summary logs for Umm Shat Sharq drill hole 4.

KINGDOM OF SAUDI ARABIA
Ministry of Petroleum and Mineral Resources
Directorate General of Mineral Resources

Organization: USGS

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #4

References

Logged by: Majed Ben Talib

SUMMARY LOG

X X X Medium-grained quartz monzodiorite

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data

Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth	Depth	Inclination	Azimuth
10.0	-64°	124°			
20.0	-61°	125°			
29.8	-60°	127°			
40.8	-63°	132°			
50.0	-64°	134°			

CORE RECOVERY | CORE BOX | VEIN STRUCTURE (Including water loss and cementation) | Lithology | FAULTS LITHOLOGY + ALTERATION | MINERALIZATION Py | SAMPLE DATA

Depth scale (m): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

Vein structure:
- ~10 m: 3% Quartz veins
- ~17–18 m: 1% Quartz veins
- ~39–40 m: <1% Quartz veins

Faults, lithology + alteration:
- 0.0–4.95 m: No SAMPLE.
- NOTE: Entire drill hole percussion drilled.
- Hematite common.
- 5.0–61.3 m: Quartz monzodiorite ≤ 2.0 mm grain size.
- 0.0–23.30: zone of oxidation/weathering.

Mineralization (Py): Tr (~17 m); Tr (~33–34 m); 0.1 (~44 m)

SAMPLE DATA

Length (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
.85	241465	7	.05	20	15	50	20	7
1.5	241466	7	.05	20	12	50	20	16
1.5	241467	140	.05	20	13	50	25	1
1.5	241468	22	.05	16	15	45	200	2
1.5	241469	16	.05	17	16	55	100	2
1.5	241470	8	.05	20	27	55	25	16
1.5	241471	5	.05	20	18	55	5	7
1.5	241472	6	.05	22	8	55	5	7
1.5	241473	24	.05	20	18	55	270	9
1.5	241474	6	.05	22	19	60	20	30
1.5	241475	32	.10	20	15	60	45	11
1.5	241476	72	.20	20	13	60	130	5
1.5	241477	6	.10	20	15	65	20	26
1.5	241478	5	.10	20	17	65	5	8
1.5	241479	7	.10	20	19	60	100	25
1.5	241480	12	.10	20	22	60	330	20
1.5	241481	7	.10	25	20	60	45	25
1.5	241482	5	.10	25	17	60	15	10
1.5	241483	5	.05	20	16	55	5	5
1.5	241484	4	.05	20	9	55	5	3
1.5	241485	53	.10	20	8	55	330	3
1.5	241486	4	.05	20	7	55	15	4
1.5	241487	6	.10	20	8	55	50	6
1.5	241488	32	.10	20	10	60	200	3
1.5	241489	70	.12	20	9	55	70	14
1.5	241490	8	.05	20	15	50	10	17
1.5	241491	82	.12	20	12	55	120	13
1.5	241492	13	.10	20	14	55	10	9
1.5	241493	5	.10	20	14	55	0	5

Appendix 3.--Drill core summary logs for Umm Shat Sharq drill hole 4--(continued).

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Directorate General of Mineral Resources

Organization: U S G S

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #4

References

Logged by: Majed Ben Talib

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or: I
Depth | Inclination | Azimuth | Depth | Inclination | Azimuth

Depth	CORE RECOVERY	CORE BOX	VEIN STRUCTURE (Including water loss and cementation)	Lithology	LITHOLOGY	MINERALIZATION Py	LENGTH (m)	INTERVAL (m)	SAMPLE NUMBER	Au PPb	Ag PPm	Cu PPm	Pb PPm	Zn PPm	As PPm	Mo PPm
48			1% Quartz veins	X				1.5	241494	6	.11	20	12	55	0	17
50				X X				1.5	241495	5	.05	20	15	60	0	14
				X				1.5	241496	3	.10	20	14	60	0	15
				X X				1.5	241497	7	.05	20	12	55	0	6
55				X		Tr		1.5	241498	3	.05	20	10	60	0	18
			2% Quartz veins	X X				1.5	241499	3	.05	20	15	60	0	13
				X				1.5	241500	4	.10	16	20	70	0	5
				X X				1.5	241501	15	.10	16	10	55	40	13
60				X				1.5	241502	5	.10	20	8	55	0	9

E.O.H.=61.3m

Appendix 3.--Drill core summary logs for Umm Shat Sharq drill hole 5.

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Organization: U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM - SHAT SHARQ #5

References

Logged by: Majed Ben Talib

SUMMARY LOG

- xx Medium-grained quartz monzodiorite
- xx Fine-grained quartz monzodiorite
- ∴ Sericitic alteration
- /// Argillization
- Fault
- 5cm, 60° Quartz vein (thickness & angle to core axis given)
- QMD ≡ Quartz monzodiorite
- QSP ≡ Quartz-sericite-pyrite

Scale

Date Started:
Date Completed:
Driller: ADC
Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth (m)	Inclination	Azimuth	Depth	Inclination	Azimuth
49.8	-88°	—			
100.3	-88°	—			

CORE RECOVERY (RQD, %) | CORE BOX | VEIN STRUCTURE (Including water loss and cementation) | Quartz Veins | Alteration | Lithology | FAULTS + LITHOLOGY + ALTERATION | MINERALIZATION (Tr ≡ Trace; Lim. + Hem., Py, Ap.) | SAMPLE DATA

Depth scale (m): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

Vein structure:
- ~16–17 m: 5-8% vein quartz
- ~31–32 m: 5% quartz vein
- ~39–40 m: 3% quartz vein
- ~42–43 m: 1% quartz vein

Lithology / alteration:
- 0.00–4.65m: No Sample.
- 4.65–49.80m: Percussion drilling. Cuttings are sand- to flour-sized.
- 0.0–26.0m: Zone of mixed layer silicates/complete oxidation of sulfides.

Mineralization (Lim. + Hem.): 5.0; 1.0; <1.0; ≤3.0; 1.0; 3.0; 0.1; 0.1; 0.1
Mineralization (Py): Tr; 0.1

SAMPLE DATA

Interval (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
0.30	241503	22	0.06	20	30	55	80	4
1.50	241504	38	0.04	25	10	55	50	12
1.50	241505	34	0.07	15	20	50	250	8
1.50	241506	25	0.04	15	8	55	60	7
1.50	241507	16	0.04	8	6	55	40	2
1.50	241508	20	0.04	8	8	60	190	9
1.50	241509	13	0.04	35	7	60	35	7
1.50	241510	45	0.07	25	15	60	75	8
1.50	241511	117	0.05	8	17	55	1600	3
1.50	241512	8	0.03	5	7	60	40	7
1.50	241513	6	0.06	30	7	60	10	8
1.50	241514	5	0.06	22	5	68	10	16
1.50	241515	25	0.30	25	15	60	3400	12
1.50	241516	17	0.1	30	8	60	280	8
1.50	241517	6	0.09	30	7	60	145	35
1.50	241518	6	0.07	30	6	50	90	35
1.50	241519	8	0.07	35	6	80	20	25
1.50	241520	7	0.08	43	7	50	60	48
1.50	241521	14	0.01	45	7	50	40	20
1.50	241522	21	.08	45	7	50	45	20
1.50	241523	21	.48	50	4	60	30	16
1.50	241524	25	.09	40	7	60	25	10
1.50	241525	44	.11	35	3	60	55	12
1.50	241526	36	.12	30	7	55	30	28
1.50	241527	7	0.06	15	4	50	10	6
1.50	241528	7	0.05	25	5	55	80	10
1.50	241529	12	0.13	22	7	50	500	9
1.50	241530	6	0.06	20	5	55	45	4

KINGDOM OF SAUDI ARABIA
Ministry of Petroleum and Mineral Resources
Directorate General of Mineral Resources

Organization U.S.G.S.

Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #5

References

Logged by: Majed Ben Talib

Scale

Date Started: | Hole Size: Nx - / Bx - / Ax -
Date Completed:
Driller: ADC

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)
Depth | Inclination | Azimuth | Depth | Inclination | Azimuth

Core recovery (RQD / %) | Core box | Vein structure (including water loss and cementation) | Quartz vein | Alteration | Lithology | Faults, Lithology + Alteration | Mineralization (Lim. Hem., Pyr., Ap.) | Sample data

Depth (m): 45, 50, 55, 60, 65, 70, 75, 80, 85, 90

Core recovery (RQD / %), from about 49 m downward: 15/100, 75/100, 67/100, 100/100, 91/100, 91/100, 89/100, 100/100, 100/100, 90/100, 83/100, 100/100, 100/100, 100/100, 56/100, 89/100, 84/100, 100/100, 100/100, 92/100, 91/100, 90/100, 89/100, 100/100, 41, 100, 100, 93, 100, 100, 100, 78, 100, 100, 100, 100, 100, 83, 100, 100, 100, 100, 100, 100/100

Vein structure:
- 10°
- 3-4mm, 10°
- 1cm, 30°
- 5mm, 90°
- 1-4mm, 75° / 90°
- stringers, 90°
- 5mm, 20°
- 3-4mm, 35°
- 0.2m
- 8mm, 75°
- 1cm, 30°
- 3mm, 75°
- 2-8mm 90°
- 0.35m, vug-laden quartz vein cut by hemitite + limonite stringers.

Faults, Lithology + Alteration:

The drill core in this hole consists of medium-grained quartz monzodiorite; feldspar ≤2.0mm in grain size; ≤8.0mm aggregates of ferromagnesium minerals abound. Local enrichment of potassium feldspar is common.

241542: 2% QSP

241543: 40% QSP.

241544: 15% QSP.

241545: 30% QSP.

241546: 20% QSP + 5% argillic alteration; 2cm-thick argillic zone adjacent to hangingwall of quartz vein. Hematite + limonite-coated fractures in argillic zone.

241547: 0.20 m-thick white quartz vein cut by limonite stringers. These stringers are subparallel to quartz vein boundaries.

241548: 100% QSP; qtz veins are deformed locally. Veins <1.0cm thick.

241549: 80% QSP + 10% argillization.

241550: Argillic alteration zone superimposed over QSP alteration. Quartz veins <1.0cm thick. Hematite + limonite fills fractures (>500/m). Fractures are both planar and irregular (crackle breccia?).

241551: 0.55 m-thick massive white quartz vein w/ 0.1m-thick argillic zone at vein footwall at bottom of sample interval. 0.1% hematite + limonite on fractures in quartz. ≤3.0mm diameter, crystal-lined vugs in quartz vein.

241552: 0.2m-thick QSP zone at beginning of interval.

241553: Relatively unaltered QMD.

Mineralization (Lim./Hem. | Pyr. | Ap.):

Lim./Hem.	Pyr.	Ap.
Tr	Tr	
—	—	
3.0	1.0	
0.1	0.2	
0.3	1.0	
1.0	0.3	
0.1	—	—
1.0	3.0	0.5
2.0	1.0	
0.1 / 1.0	7.0	

SAMPLE DATA

Length (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
1.50	241531	20	.12	20	8	50	400	3
1.50	241532	24	.12	15	9	56	350	8
1.30	241533	6	0.1	17	7	60	30	6
1.70	241534	4	0.1	20	8	60	10	3
1.50	241535	4	0.1	20	6	60	10	12
1.50	241536	4	0.1	25	8	60	10	5
1.50	241537	4	0.1	20	7	55	10	12
1.50	241538	4	0.1	20	7	55	12	4
1.50	241539	9	0.1	20	5	60	10	3
1.50	241540	4	0.1	20	5	60	80	10
1.50	241541	4	0.1	20	4	60	0	3
1.50	241542	4	0.1	24	6	60	0	16
1.50	241543	4	.22	24	8	65	600	7
1.50	241544	34	0.1	24	7	60	500	15
1.50	241545	86	0.04	30	9	65	550	8
1.85	241546	69	0.1	35	8	25	300	10
0.20	241547	95	0.1	12	6	55	1400	13
1.50	241548	630	.56	20	20	60	2800	20
1.30	241549	740	.37	30	16	70	2600	12
0.25	241550	610	1	12	90	70	4600	8
0.55	241551	240	.55	20	115	40	1200	4
1.35	241552	49	.1	30	8	65	900	20
1.50	241553	6	0.1	30	6	60	10	6
1.50	241554	5	.1	30	5	65	45	20
1.50	241555	5	.1	20	5	60	10	10
1.50	241556	4	0.1	30	7	55	0	20
1.60	241557	4	0.1	30	4	60	0	10
1.50	241558	6	0.1	30	4	60	0	20
1.50	241559	4	0.1	40	6	60	0	6
1.50	241560	4	0.1	30	5	60	0	12
1.50	241561	4	0.1	35	5	55	0	12
1.50	241562	8	0.1	35	6	60	0	30
1.50	241563	6	0.1	30	5	60	0	40
1.50	241564	4	0.1	25		60	0	30

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Mineral Occurrence

Drill Hole Number: UM-SHAT SHARQ #5

References

Logged by: Majed Ben Talib

Scale

Date Started:
Date Completed:
Driller: ADC

Hole Size: Nx - Bx - Ax -

Survey Data
Collar Coord: Lat. Long.
Grid Reference: Elevation:

Subsurface (Tropari or:)

Depth	Inclination	Azimuth	Depth	Inclination	Azimuth

Depth (m)	Core recovery: Length (m)	Core recovery: %	Core box	Vein structure (including water loss and cementation)	Quartz veins	Alteration	Lithology	Faults + Lithology + Alteration	Mineralization (Lim, Hem, Pyr, Ap)
93	100	100					X		
	100	100					X		
95	100	100					X		
	100	100					X		
	100	100					X		
	100	100					X		
	100	100					X		
100	30	100						E.O.H.=100.3m	

SAMPLE DATA

Length (m)	Interval (m)	Sample number	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm
	1.50	241565	4	0.1	25		60	0	26
	1.50	241566	5	0.1	22		60	0	50
	1.50	241567	5	0.1	30	16	60	0	26
	1.50	241568	4	0.1	30	6	60	0	30
	1.30	241569	4	0.1	30	6	60	0	45