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RECONNAISSANCE INVESTIGATIONS OF ANCIENT GOLD MINES IN THE SOUTHERN PART OF THE WADI BIDAH DISTRICT, JABAL IBRAHIM AND AL AQIQ QUADRANGLES, KINGDOM OF SAUDI ARABIA

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CONTENTS

ILLUSTRATIONS

TABLES

RECONNAISSANCE INVESTIGATIONS OF ANCIENT GOLD MINES IN THE SOUTHERN PART OF THE WADI BIDAH DISTRICT, JABAL IBRAHIM AND AL AQIQ QUADRANGLES, KINGDOM OF SAUDI ARABIA

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ABSTRACT

Ancient gold mines in the southern part of the Wadi Bidah district, Kingdom of Saudi Arabia, are located either within lenses of ferruginous chert or in large felsic intrusions of Precambrian age. All are associated with quartz veins, stringers, and stockworks. Samples from both types of deposits have low silver and base-metal contents; samples from deposits within ferruginous chert have anomalous arsenic contents.

None of the deposits are large enough to be considered as prime exploration targets at this time. Analytical results from the Bani Sar deposit, which is located within felsic plutonic rocks, are encouraging, but additional surface investigations are needed to define the size and extent of the mineralized zone. Deposits associated with ferruginous chert are also of exploration interest. Anomalous gold contents and other evidence of mineralization were found along a considerable exposure of the metasedimentary unit that contains the chert lenses.

INTRODUCTION

Although the Wadi Bidah district, located in the southwestern part of the Precambrian Arabian Shield, is known mainly for massive sulfide deposits (Kiilsgaard and others, 1978), it also contains numerous ancient gold mines. This study covers only those gold deposits that are in the southern part of the district and east of Wadi Bidah, hereafter known as the study area (fig. 1). This area includes ancient mines in the southeastern part of the Jabal Ibrahim quadrangle (sheet 20/41 C) and in the southwestern part of the adjacent Al Aqiq quadrangle (sheet 20/41 D). Two types of ancient mines are in the area, those along quartz veins in diorite to granodiorite intrusive rocks and those confined to lenses of ferruginous chert within a major metasedimentary unit.

The ancient mines are in rough terrain, and access is by poor tracks leading from the Al Bahah to Al Aqiq road or from the Al Bahah to At Taif macadam highway, and then by foot for

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[1]/U.S. Geological Survey, Denver, Colorado

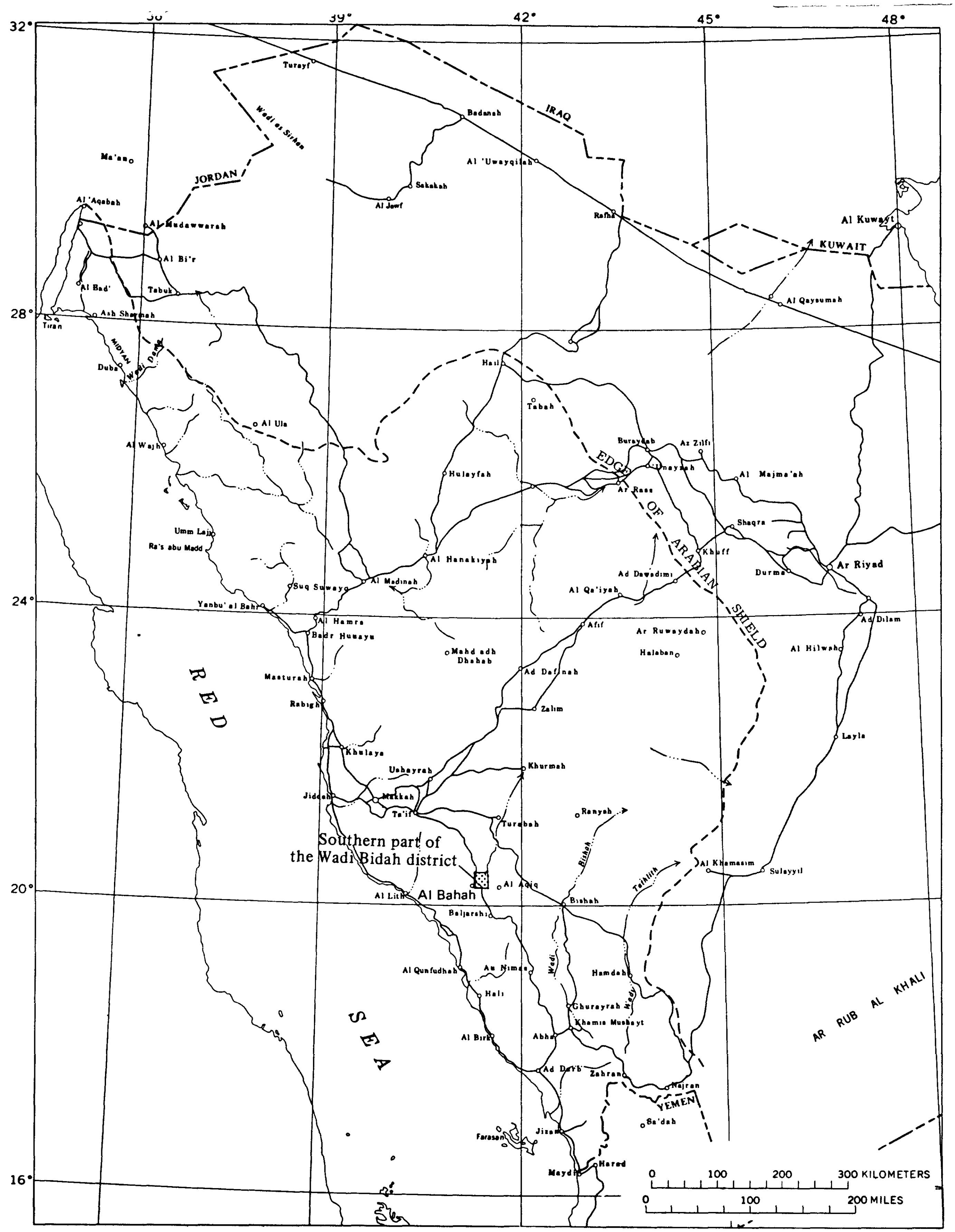


Figure 1.–Index map of western Saudi Arabia showing the location of the study area in the southern part of the Wadi Bidah district.

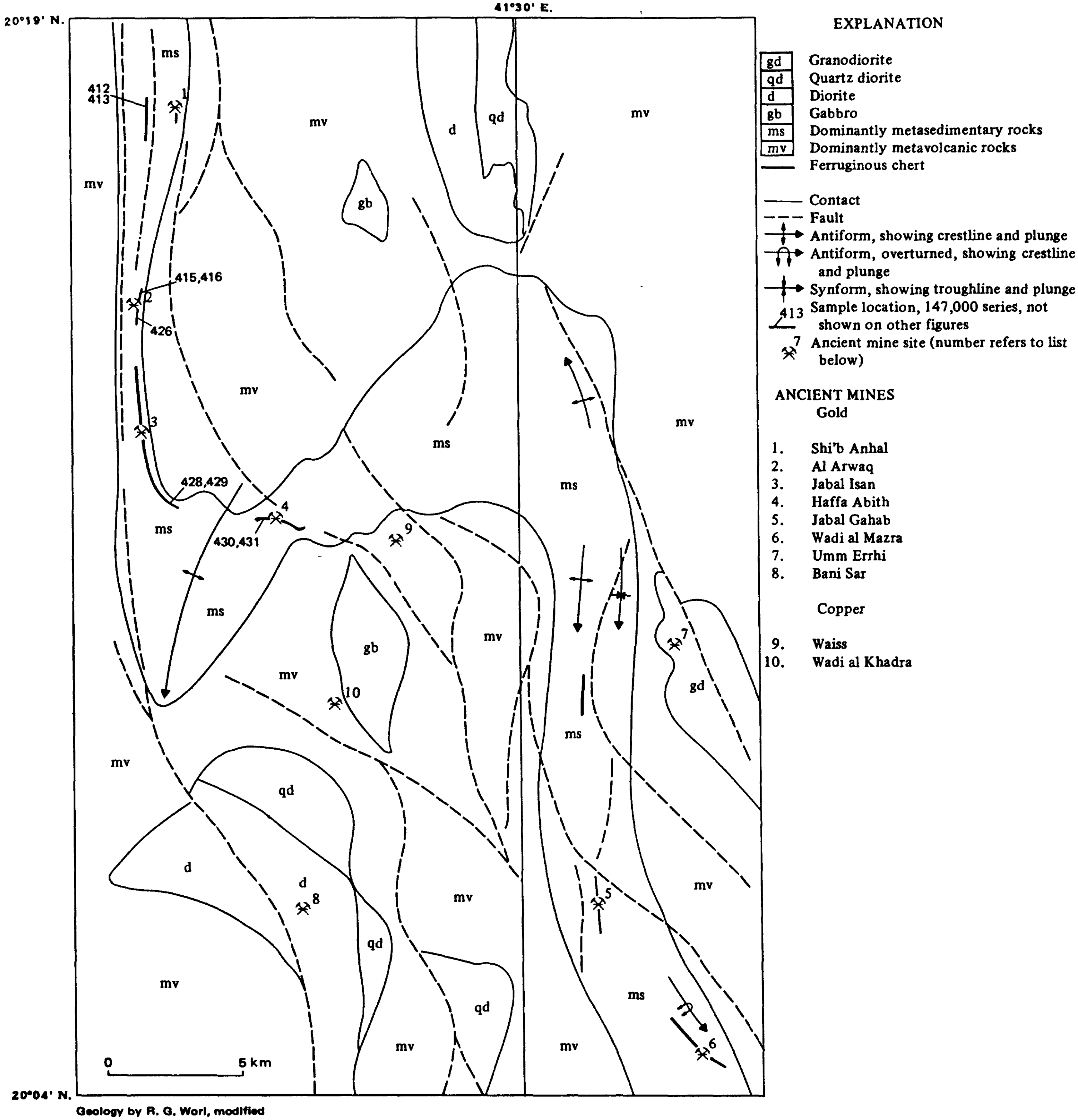
distances of as much as 5 km. The Bani Sar (fig. 2, site 8) and Wadi al Mazra (fig. 2, site 6) mines are the only two that can be reached directly by vehicle.

The Jabal Ibrahim and Al Aqiq quadrangles were mapped by Greenwood (1975a, 1975 b), during which time I sampled the Shi'b Anhal, Al Arwaq, and Jabal Isan ancient mine areas (fig. 2, sites 1, 2, and 3). A small area of approximately 9 km^2 just south and west of the Haffa Abith ancient mine (fig 2, site 4) was mapped and studied by Kiilsgaard (1981). The Bani Sar ancient mine (fig. 2, site 8) was sampled extensively by Larkin, and the Umm Errhi ancient mine (fig. 2, site 7) was visited by Shanti and Schaffner (Goldsmith, 1971). None of these three deposits were previously mapped, and the others shown on figure 2 are new discoveries.

The sites were mapped and sampled (fig. 2) during 10 days in April 1980. Two ancient mines in intrusive rocks were studied: Bani Sar (site 8) and Umm Errhi (site 7). Six ancient mines in ferruginous chert were mapped and sampled: Shi'b Anhal (site 1), Al Arwaq (site 2), Jabal Isan (site 3), Haffa Abith (site 4), Jabal Gahab (site 5), and Wadi al Mazra (site 6). In addition, several zones of ferruginous chert were sampled. Geologic plane-table maps were prepared for Shi'b Anhal, Haffa Abith, and part of the Bani Sar ancient mines. Pace and traverse maps for workings at Al Arwaq, Jabal Isan, and Wadi al Mazra were prepared. The locations of two ancient copper mines are also shown on figure 2: Wadi al Khadra (site 10) and Waiss (site 9). These are discussed elsewhere (Flanigan and others, 1982; R. G. Worl and J. C. Wynn, unpublished data, 1982).

SAMPLING PLAN

Three types of samples were collected for geochemical analysis: dump samples, channel samples, and rock-chip samples along traverses. All analyses were performed by the Directorate General of Mineral Resources-U.S. Geological Survey laboratory in Jiddah under the guidance of K. J. Curry. All samples were analyzed for gold and silver using semiquantitative spectrography and atomic absorption. Samples analyzed for gold by atomic absorption were prepared by digesting a 10-g sample split, first in HCl, then in HNO_3; adding HBr and Methyl Iso Butyl Ketone (M.I.B.K.) to the washed and centrifuged solution; washing the resultant organic layer in a weak HCl-HBr-H_2O solution to remove interfering elements; and then collecting the organic layer in a test tube sealed with a polyethylene stopper (K. J. Curry, written commun., 1978). Results of all analyses are recorded in the U.S. Geological Survey Rock Analysis Storage System (RASS) computerized data base, Jiddah, Saudi Arabia.



Geology by R. G. Worl, modified from Greenwood (1975 a,b).

Figure 2.–Geology and ancient mines in the southern part of the Wadi Bidah district.

Dump samples each consisted of approximately 3 kg of rock chips, 1 to 5 cm in diameter, collected from ancient waste dumps. Each sample was a composite collected from the top 20 cm of material at several locations on the dump. Channel samples were collected across or along altered, veined, and mineralized zones. Each sample consisted of 1 to 3 kg of chips, 2 to 5 cm in diameter, collected along a continuous strip of outcrop. The channel length was variable and is included along with the sample description in table 2. Traverse samples each consisted of 2 to 3 kg of chips, 2 to 5 m in diameter, collected along a 25-m-long traverse line. A continuous series of samples was collected along the traverse line.

Gold and silver contents for dump and channel samples are listed in tables 1 and 2, respectively. Analyses of traverse samples are summarized in the discussion of individual mines, and those samples containing detectable gold (more than 0.5 g/t) are shown on the individual mine-site maps (figs. 3-8). Copper, lead, and zinc contents were low for all samples, usually less than 100 ppm. Arsenic contents for all types of samples from the Shi'b Anhal, Al Arwaq, Jabal Isan, and Haffa Abith mine sites were as much as 3,000 ppm. Samples from the other areas contained no arsenic. Gold and silver contents are reported in grams per metric ton (g/t).

GEOLOGIC SETTING

The Wadi Bidah district is in a Precambrian greenstone belt that is composed of a metabasalt-graywacke-chert assemblage. Greenwood (1975a) assigned these rocks to the Baish and Bahah groups. The belt is intruded by elongate, north-trending lenses and stocks of gabbro to quartz monzonite. Numerous mafic and felsic dikes, mostly andesite and aplite, cut the layered rocks. All rocks are foliated, and the greenstones are slightly to strongly schistose. The schistosity trends north and dips steeply, similar to the general attitude of layered rocks throughout the southern part of the Arabian Shield.

Layered rocks in the study area include dominantly metasedimentary or dominantly metavolcanic units. The metasedimentary unit is sheared and locally mylonitized where it crops out along Wadi Bidah. In the central part of the study area, the layered rocks are characterized by broad, open to very complex folding. The outline of the metasedimentary unit defines a broad kink in the north trend of the greenstone belt (fig. 2).

Table 1.--*Gold and silver contents of dump samples*
[Results in grams per metric ton. Site number refers to fig. 2]

Sample number	Ancient mine	Gold	Silver
160000	Wadi al Mazra (site 6)	0.12	1.7
160001	Wadi al Mazra (site 6)	.12	1.5
160002	Wadi al Mazra (site 6)	.12	1.6
160003	Wadi al Mazra (site 6)	.12	1.5
160008	Umm Errhi (site 7)	<.05	<0.05
160012	Umm Errhi (site 7)	.42	<.5
160013	Umm Errhi (site 7)	.64	<.5
160020	Haffa Abith (site 4)	1.96	1.7
160021	Haffa Abith (site 4)	.40	1.4
160022	Haffa Abith (site 4)	1.24	1.3
160093	Bani Sar (site 8)	13.8	2.0
160094	Bani Sar (site 8)	1.52	1.1
160095	Bani Sar (site 8)	5.42	2.0
160096	Bani Sar (site 8)	3.24	1.3
160097	Bani Sar (site 8)	.08	.9

Table 2.--*Gold and silver contents and sample descriptions of channel samples* [Results in grams per metric ton. Sample location number refers to figure number]

Sample number	Sample location	Width (meters)	Sample description	Gold	Silver
147396	5	0.7	Hematitic chert	<0.05	1.0
147397	5	4.0	Hematitic chert	.08	.5
147398	5	2.5	Chert with abundant hematite	2.6	<.5
147399	5	2.0	Quartz vein in small working	.08	.5
147400	4	.5	Iron-stained quartz in workings	.08	<.5
147401	4	1.0	Across end of deep workings	.08	<.5
147402	4	.5	Quartz, iron-stained	1.56	.8
147403	4	.5	Quartz, iron-stained, in workings	1.04	.5
147404	4	.5	Quartz, iron-stained, in workings	.08	1.1
147405	4	2.5	Quartz, white, limonitic	.16	<.5
147406	4	1.5	Quartz in end of workings	.08	.6
147407	4	1.5	Quartz in end of workings	8.80	1.1
147408	4	.5	Quartz	5.40	1.8
147409	4	2.0	Quartz	1.72	1.2
147410	5	1.0	Shattered quartz	.12	<.5
147412	2	1.0	Quartz stringers, veinlets	.08	<.5
147413	2	2.0	Quartz stringers, veinlets	.08	<.5
147414	3	1.5	Selvage of white quartz	1.24	1.9
147415	2	3.0	Quartz stringers in hematitic chert	.08	1.1
147416	2	4.0	Quartz stringers in hematitic chert	<.05	.8
147417	4	2.0	Quartz, limonitic	1.04	1.1
147418	4	2.0	Abundant limonite in workings	<.05	.8
147419	4	1.0	Shear zone in workings	1.04	1.0
147420	4	2.0	Limonitic shear in workings	.12	1.0
147421	4	1.5	Across end of deep workings	3.30	<.5
147422	4	1.0	Limonitic quartz in workings	4.02	3.8
147423	4	1.0	Limonitic quartz in workings	.40	1.1
147424	4	2.0	Quartz, white, in workings	.20	.7
147425	4	2.0	Quartz, white, in workings	.40	1.4
147426	2	1.0	Chert formation with quartz	<.05	.5
147427	5	3.0	Chert formation with quartz	<.05	.5
147428	2	4.0	Chert formation with quartz on edge	<.05	<.5
147429	2	5.0	Chert formation with quartz	<.05	.6
147430	2	2.0	Limonitic quartz stringers at top of small workings	<.05	.9
147431	2	1.0	Limonitic iron formation	.05	1.0
160009		1.0	Chlorite-bearing quartz	.08	<.5
160010		1.0	Quartz	15.6	1.2
160011		1.0	Quartz	3.2	<.5
160044	5	1.0	Sheared zone with MnO stringers	.08	2.6
160047	5	1.0	Sheared zone with MnO stringers	.16	2.1

Layered rocks include coarse, blocky, and vesicular metabasalt, breccia, pyroclastic rocks, tuff to agglomerate, graywacke, arkosic graywacke, water-sorted tuff, calcareous and cherty tuff, dolomitic marble, ashy marble, carbonaceous graywacke, chert, phyllite and schist, and lenses of ferruginous chert. All rocks are composed of varying amounts of plagioclase, chlorite, epidote, quartz, and sericite, with locally abundant amphibole (probably actinolite), pyrite, hematite, magnetite, and carbonaceous material.

Many of the ancient gold mines described in this report lie within a single, dominantly metasedimentary stratigraphic unit (fig. 2). To the east and north of this unit, most rocks are massive or thickly bedded pyroclastic volcanic rocks. To the west and south, the rocks include pyroclastic volcanic rocks and volcanic-derived graywacke. Rocks within the dominantly metasedimentary unit include fine-grained carbonaceous phyllite, carbonaceous sericite schist, quartz-sericite schist, thinly bedded marble, ferruginous-calcareous sandstone, calcareous lapilli tuff, waterlaid tuff, green quartzite, and graywacke with lenses of ferruginous chert.

The ferruginous chert lenses are scattered through the length of this unit but are largest and best exposed near the Al Arwaq and Jabal Isan ancient mines (fig. 2). The chert is composed of chalcedonic quartz, quartz, and magnetite or hematite, with locally abundant pyroclasts and minor chlorite. It is well to poorly bedded and in lenses of all sizes. There is considerable lithologic variation in the chert along strike, with zones of banded iron formation, zones of abundant pyroclastic and clastic material, and zones of bedded quartzite. Contacts with other rock types grade across zones as much as 1 m wide.

The dominantly metasedimentary unit continues to the north through the massive sulfide lens-bearing zones at Rabathan into the Wadi Shuqub quadrangle (Green and Gonzalez, 1980). Ferruginous chert diminishes to the north, and the calcareous rocks and carbonaceous material are not exposed near the northern boundaries of the two quadrangles.

Intrusive rocks in the study area include gabbro, anorthositic gabbro, hornblende diorite, quartz diorite, and granodiorite. All are foliated and metamorphosed to greenschist facies in varying degrees, with the granodiorite being the least affected. Numerous mafic and felsic dikes, most commonly massive andesite and aplite, cut all types of rocks.

DESCRIPTIONS OF ANCIENT MINES

Two types of ancient mines are discussed in this report. The first type is associated with quartz stringers and pods located within or next to lenses of ferruginous chert. The second type is found along quartz-vein systems in felsic intrusive rocks.

Deposits associated with ferruginous chert

Shi'b Anhal

The Shi'b Anhal ancient gold mine (figs. 2, 3 lat 20°17'26" N., long 41°25'06" E.) is the northernmost mine discussed in this report. The country rocks are a sequence of carbonaceous schist and phyllite, ferruginous-calcareous sandstone with ferruginous chert lenses, dolomitic marble, finely bedded waterlaid tuff, and graywacke. The rocks are strongly foliated and trend north and dip steeply. They are also locally strongly sheared along this trend. The latest fractures generally trend east.

The ancient workings are inclines and shafts in and along quartz-stringer zones, where these zones cut ferruginous chert lenses. The inclines and shafts are partially filled, but some are still open to a depth of several meters.

Six chip samples taken previously from the walls of the ancient workings (Greenwood, 1975a) averaged 5.4 g/t gold and 1.4 g/t silver. The gold contents ranged from 0.17 to 8.70 g/t. One channel sample (147414) of a selvage of white quartz in the walls of one of the workings contained 1.24 g/t gold and 1.9 g/t silver (table 2). Twenty-four traverse samples (160641 to 160664) were collected across the zone (fig. 3); four contained detectable gold. Two of these samples were collected across ancient workings, whereas the other two were collected away from the workings.

Al Arwaq

Al Arwaq workings (fig. 2, lat 20°14'52" N., long 41°24'33" E.) are in a large lens of ferruginous chert within a carbonaceous schist that also contains lenses of marble, graywacke, and massive tuff. The workings are located within a small area and consist of a series of pits and shafts with minor underground adits. There are also several small, shallow pits at scattered locations throughout the lens.

The gold contents of 20 grab samples from the ancient mines collected previously (Greenwood, 1975a) ranged from 0.1 to 4.10 g/t (average 1.0 g/t). The silver contents ranged from 0.5 to 1.5 g/t (average 1.0 g/t). Eleven channel

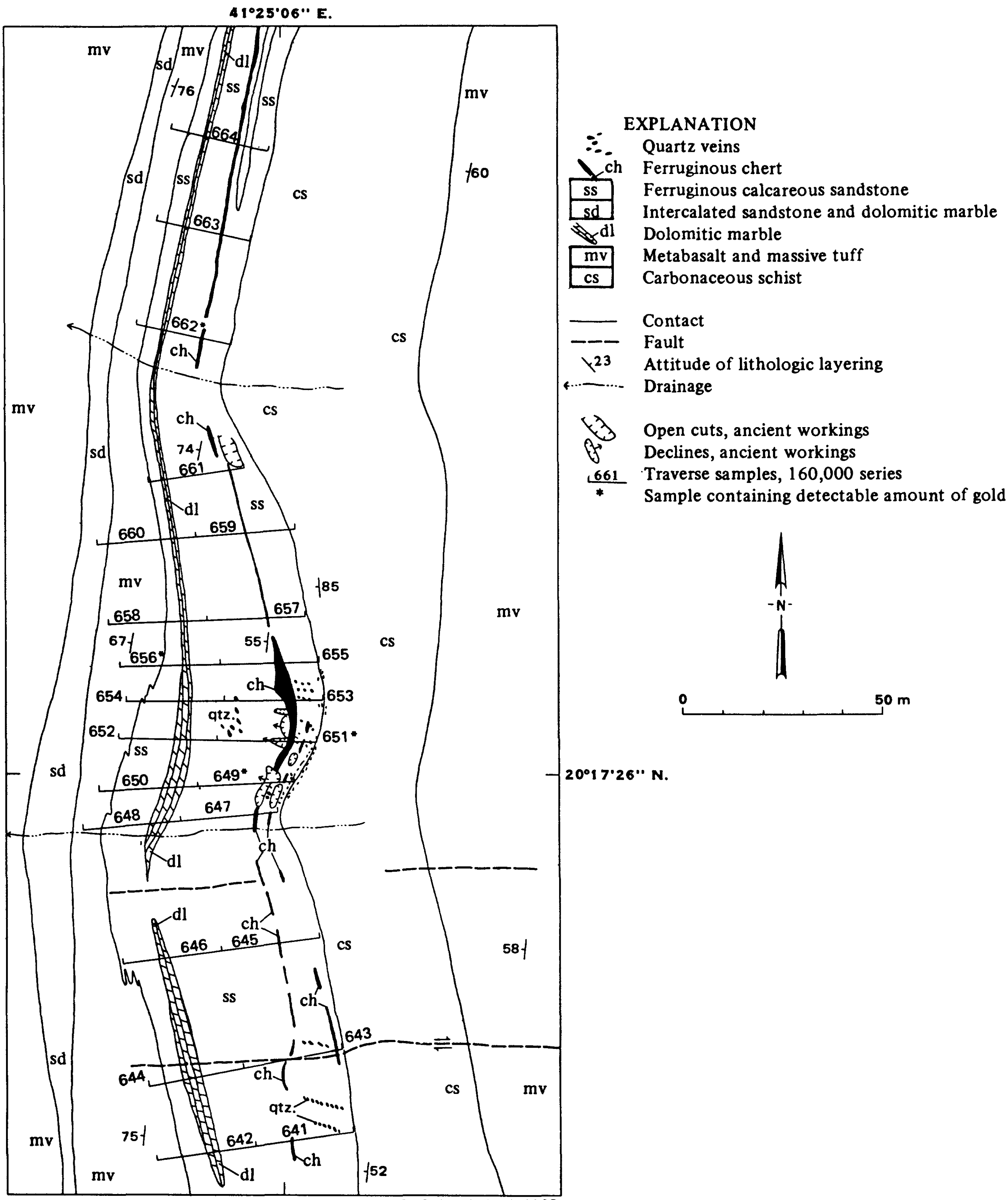


Figure 3.--Geology of the Shi'b Anhal ancient mine area.

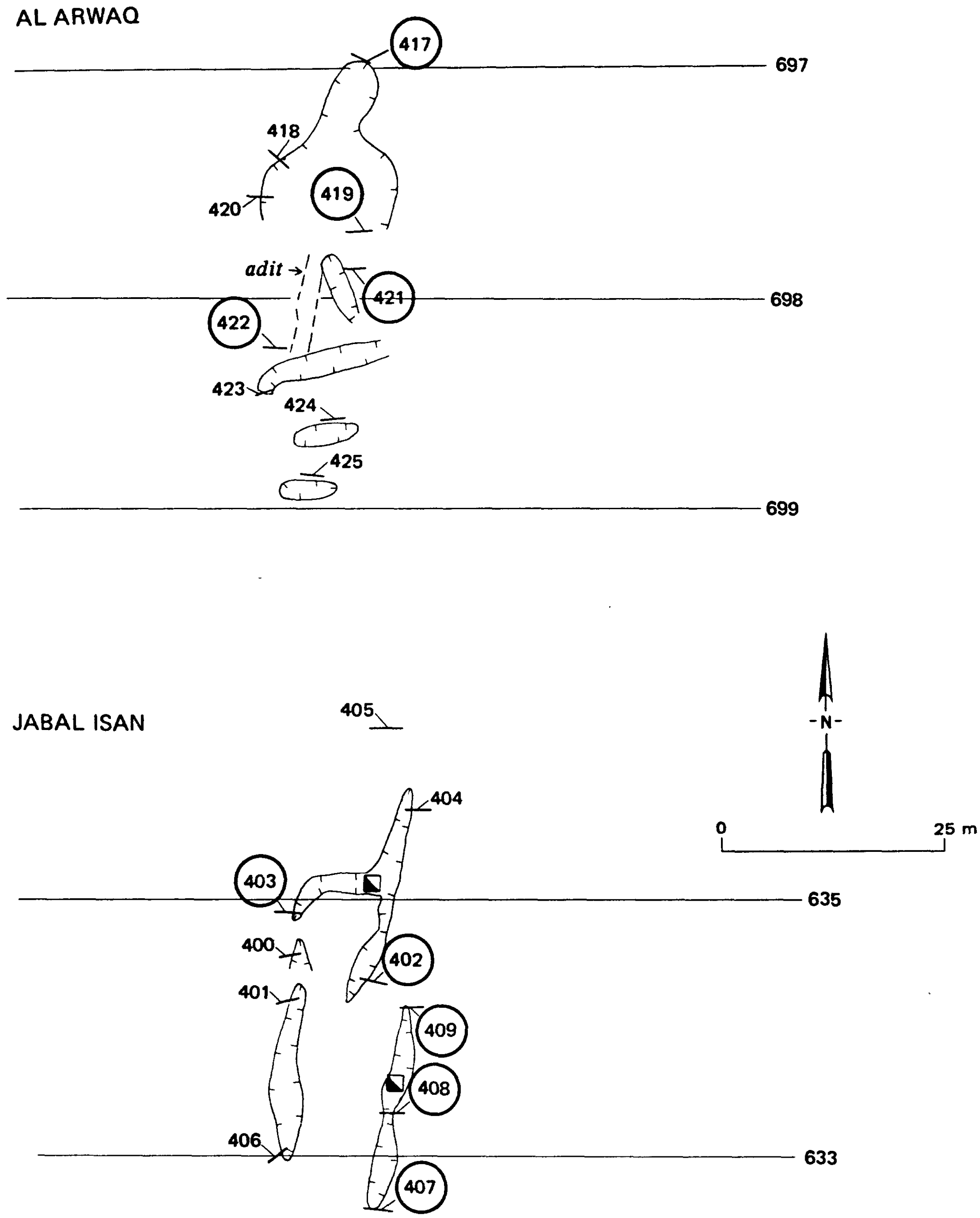
samples from this study (147415 to 147426) were collected near the ancient workings. Sample descriptions and analytical results are listed in table 2, and locations are shown on figure 4. The samples contained as much as 4.02 g/t (average 1.0 g/t), and as much as 3.8 g/t silver (average 1.2 g/t). Ten traverse samples (180691 to 180700) were collected near the ancient workings. The traverses are across the chert lens and were 25 m in length and spaced from 10 to 50 m apart. Half of the samples contained trace amounts of gold (less than 1 g/t). Of these samples, only one was near the ancient mine.

Jabal Isan

The Jabal Isan ancient workings (fig. 2, lat 20°12'51" N., long 41°24'39" E.) are along quartz pods and stringers within a ferruginous chert lens (fig. 5). This lens is one of the largest in the study area and is from 10 to 40 m wide. Enclosing rocks are carbonaceous phyllite and schist, buff to pale-green massive tuff, green quartzite, bedded tuff, lapilli tuff, calcareous tuff, quartz-sericite schist, marble, and graywacke. The ferruginous chert lens pinches out north and south, and locally it thins considerably through intercalation with the metasedimentary and metavolcanic units.

The ancient workings consist of a series of small pits and shafts as much as 15 m deep in a zone of shattered, sheared, and bleached ferruginous chert; quartz veinlets and pods along cross fractures are common (fig. 5).

Twenty previously collected grab samples from dumps, pits, and outcrops at the ancient mine sites are listed in Greenwood (1975a). The gold contents of these samples ranged from 0.1 to 53.5 g/t (average 5.4 g/t) and the silver contents ranged from 0.4 to 4.0 g/t (average 1.6 g/t). Seventeen channel samples were collected in and around the Jabal Isan ancient workings for this study (147396 to 147410). Sample descriptions and gold and silver contents are listed in table 2, and sample locations are shown on figure 4. Gold contents ranged from nil to 8.80 g/t (average 1.30 g/t), and silver contents ranged from nil to 2.6 g/t (average 0.87 g/t). Six of the samples contained more than 1 g/t gold; five of these are from the ancient workings. Thirty-four composite chip samples were collected from 17 traverses across the chert lens for a total length of 750 m. Each traverse consisted of two samples, one across the chert lens and extending into enclosing rock on the west and the other extending 25 m into enclosing rock on the east. Eleven of the samples contained detectable gold (0.08 to 1.0 g/t). Six of these were samples across the chert lens; of these, two were in the vicinity of ancient mines. The other five samples with detectable gold, including the sample with the highest gold content, were from the enclosing rock.



EXPLANATION

— 635	Traverse samples, 160,000 series
— 406	Sample location, 147,000 series
(409)	Sample containing more than 1 g/t gold
	Open cuts, ancient workings
	Shafts, ancient workings

Figure 4.–Sketch map of some workings at Al Arwaq and Jabal Isan ancient mines showing sample locations.

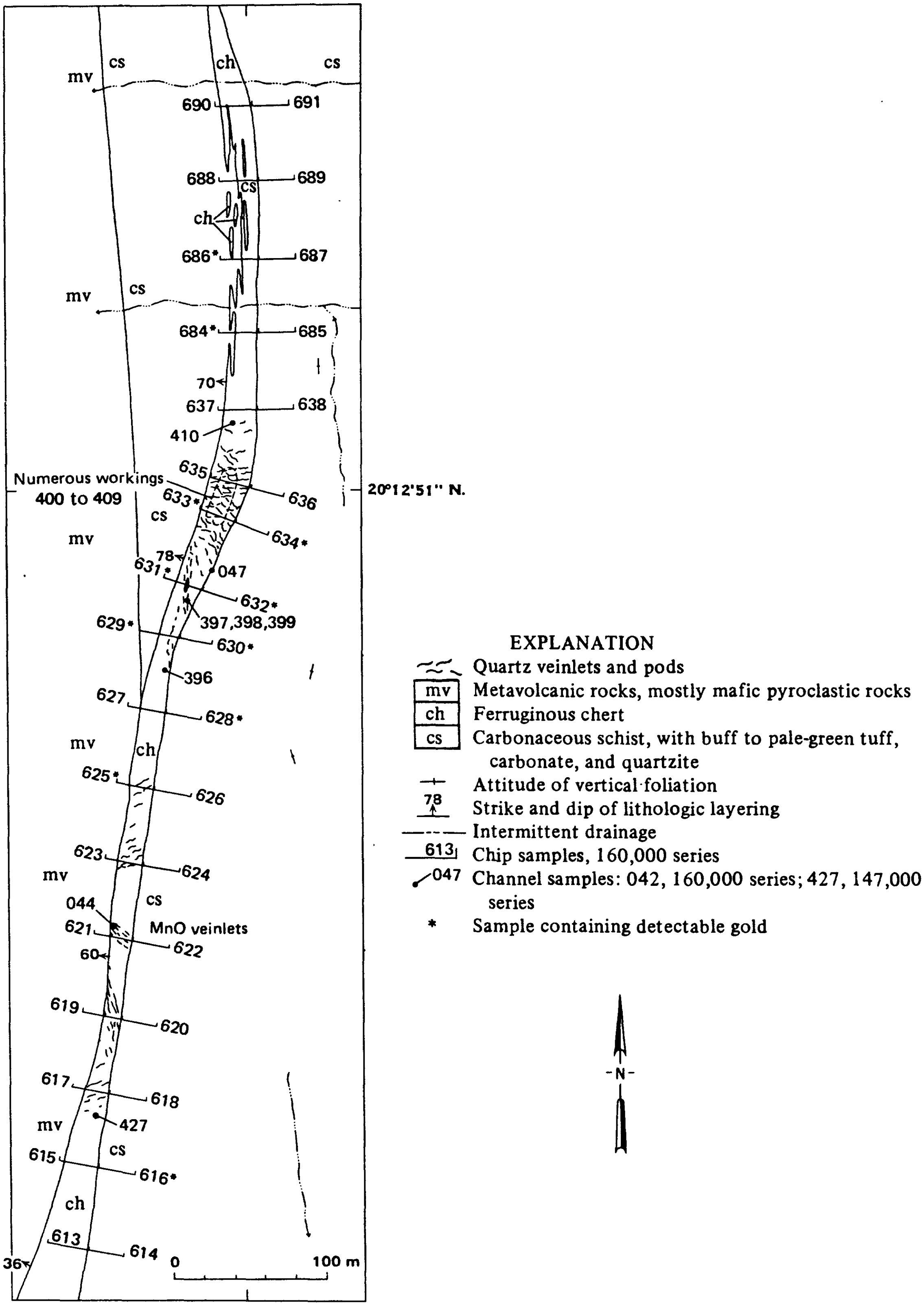


Figure 5.–Geology of the Jabal Isan ancient mine area.

Haffa Abith

The Haffa Abith workings (fig. 2, lat 20°12'08" N., long 41°26'44" E.) are in a folded sequence of ferruginous chert, carbonaceous schist, carbonate-bearing tuff, dolomitic marble, metabasalt, and graywacke (fig. 6). The ferruginous chert unit includes intercalated quartzite and graywacke and contains zones with abundant clastic and pyroclastic material.

The ancient workings consist of a nearly continuous series of open cuts and declines that extend more than 120 m down a steep hillside. Many of the open cuts are more than 2 m deep, and some of the inclines are more than 10 m deep. The workings are in a zone of fractures and quartz veins and veinlets with attendant carbonate alteration that trends N. 18° W. within the ferruginous chert unit. The waste dumps are large and contain abundant quartz. To the north are several shallow prospect pits and small lenses of ferruginous chert. This ancient mine has not been previously described in the literature and was discovered in May 1979 by Wais K. Assa.

The gold contents of nine samples of vein material collected by Kiilsgaard (1981) range from 0.09 to 3.51 g/t. Three dump samples collected for this study (160020, 160021, and 160022) contained 1.96, 0.40, and 1.24 g/t gold and 1.7, 1.4, and 1.3 g/t silver, respectively. Two channel samples (147430 and 147431) collected from the walls of the workings contained no detectable gold and 1.0 g/t silver. Only three of thirty-eight traverse samples (160523 to 160560) contained traces of gold (less than 1 g/t).

Jabal Gahab

The Jabal Gahab ancient mine workings (fig. 2, lat 20°06'49" N., long 41°31'02" E.) consist of several very small, shallow trenches scattered along a distance of approximately 1 km. The workings are along the edge of a large pod of ferruginous chert and along quartz veinlets within the chert. The pod is in contact with metabasalt, volcaniclastic rocks, and graywacke to the east and carbonaceous schist to the west. Four traverse samples (160515 to 160518) contained no detectable gold.

Wadi al Mazra

Wadi al Mazra ancient mine (fig. 2, lat 20°04'43" N., long 41°32'30" E.) consists of a series of small pits and inclines scattered along a distance of approximately 1 km. The southernmost workings are illustrated in figure 7. Country rocks are sheared greenschists, mostly metabasalt,

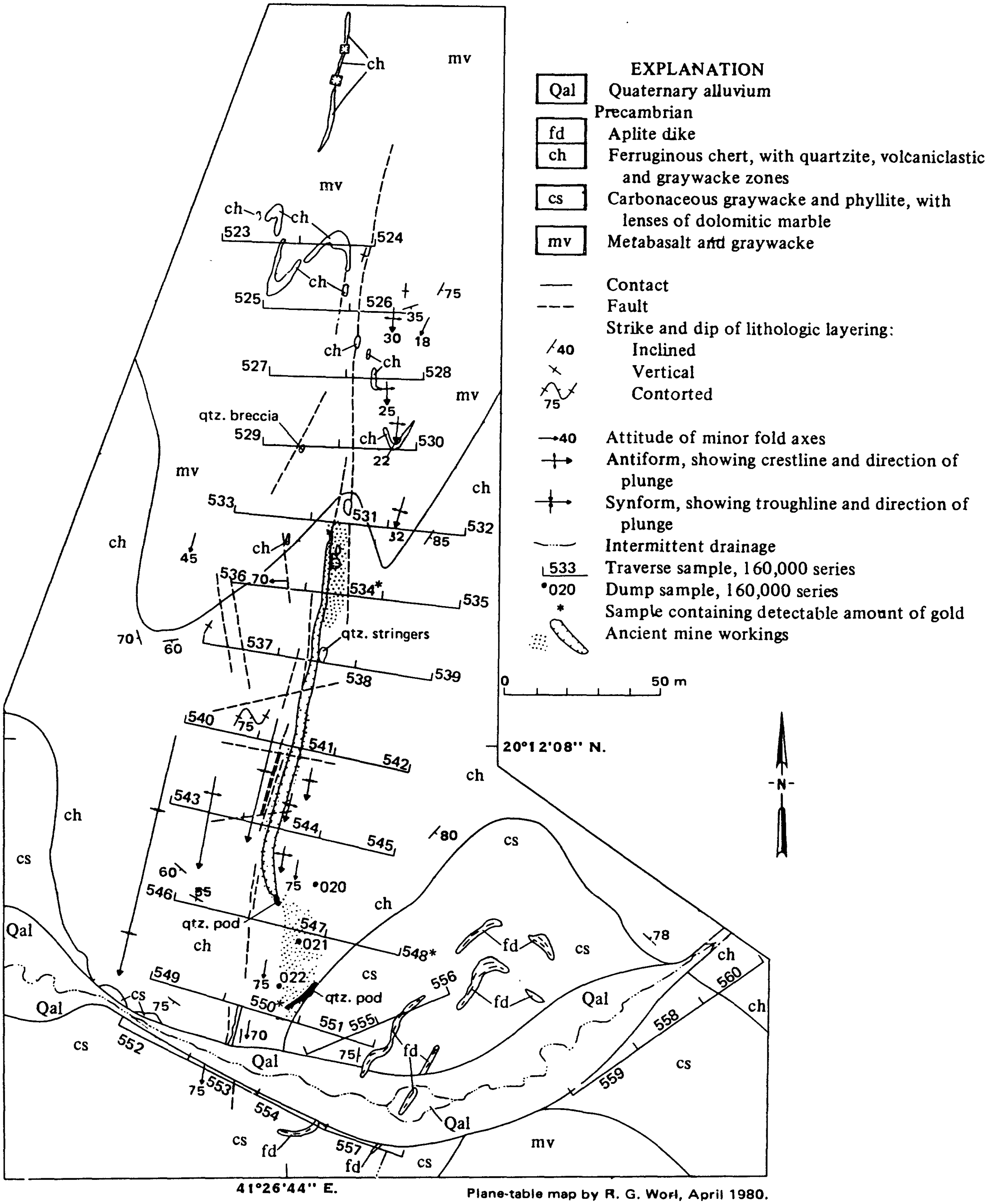


Figure 6.–Geology of the Haffa Abith ancient mine area.

graywacke, and carbonaceous graywacke. All workings are in or along lenses of ferruginous chert and follow fractures and dark quartz stringers. Dump samples 160000 to 160003 contained trace amounts of gold (less than 1 g/t). Six traverse samples (160509 to 160514) contained less than 0.06 g/t gold.

Deposits within felsic intrusive rocks

Bani Sar

The Bani Sar ancient gold mine (fig. 2, lat 20°06'47" N., long 41°26'39" E.) consists of numerous open cuts, pits, and shafts for a distance of 2,500 m along a system of quartz veins. The larger workings are shown in figure 8.

Country rock is a narrow diorite intrusion that is 15 km long and elongate north. The rocks are schistose, locally sheared along a general north trend, and metamorphosed to greenschist facies. A series of mafic and felsic dikes cuts the intrusion. Most of the older, mafic dikes are massive andesite. The felsic dikes are granodiorite and granite, with northeast-trending granite dikes being the youngest.

The mineralized zone is along a quartz-vein system that trends 335° and follows older mafic dikes (fig. 8). The system consists of two parallel quartz veins that are from 1 to 5 m apart. A zone of alteration and quartz veins is located between the two veins. The ancient workings consist of a series of open cuts and deep shafts and inclines in and beside the quartz veins. Most mineralized rocks seem to be in the selvage zone of the quartz pods.

Larkin (Goldsmith, 1971) collected 60 channel samples across the mineralized zone. Their gold contents ranged from nil to 22 g/t (average 2 g/t). The gold contents of dump samples collected for the present study ranged from 0.08 to 13.8 g/t (average 4.8 g/t). Silver contents ranged from 1 to 2 g/t. Twenty traverse samples (160921 to 160940) were collected across the zone (fig. 8), and fourteen contained detectable amounts of gold. Three contained more than 2 g/t gold, and one sample (160938) contained 11.4 g/t gold. These are all very significant values, if one considers that the samples were from 25-m-long traverses.

Umm Errhi

The Umm Errhi ancient workings (fig. 2, lat 20°10'11" N., long 41°32'04" E.) are in a granodiorite intrusion that is 6 km long and generally elongate north. The granodiorite is sheared and metamorphosed to the greenschist facies. Numerous quartz-porphyry dikes and red aplite dikes cut the granodiorite.

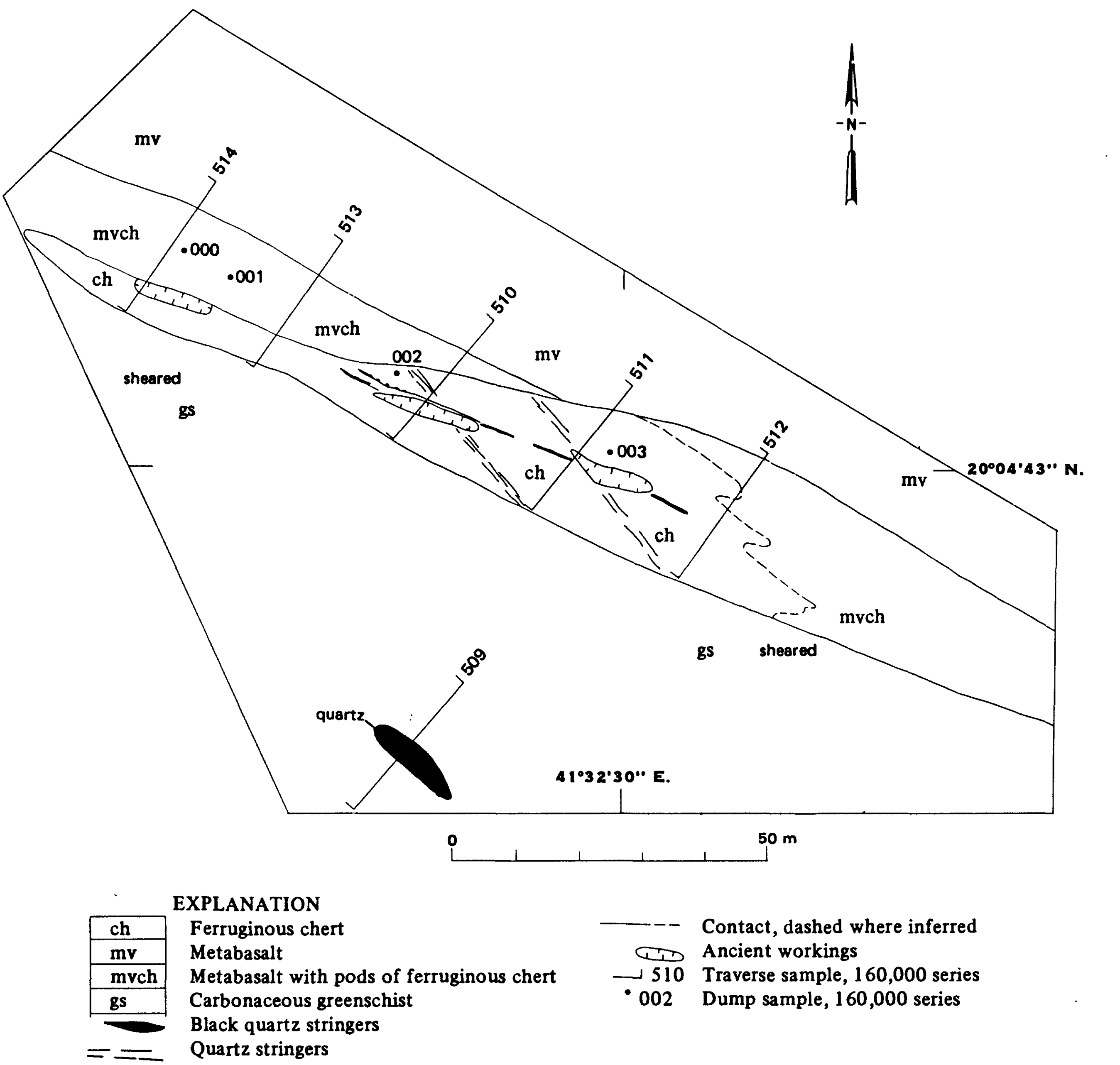


Figure 7.–Geology of the Wadi al Mazra ancient mine area.

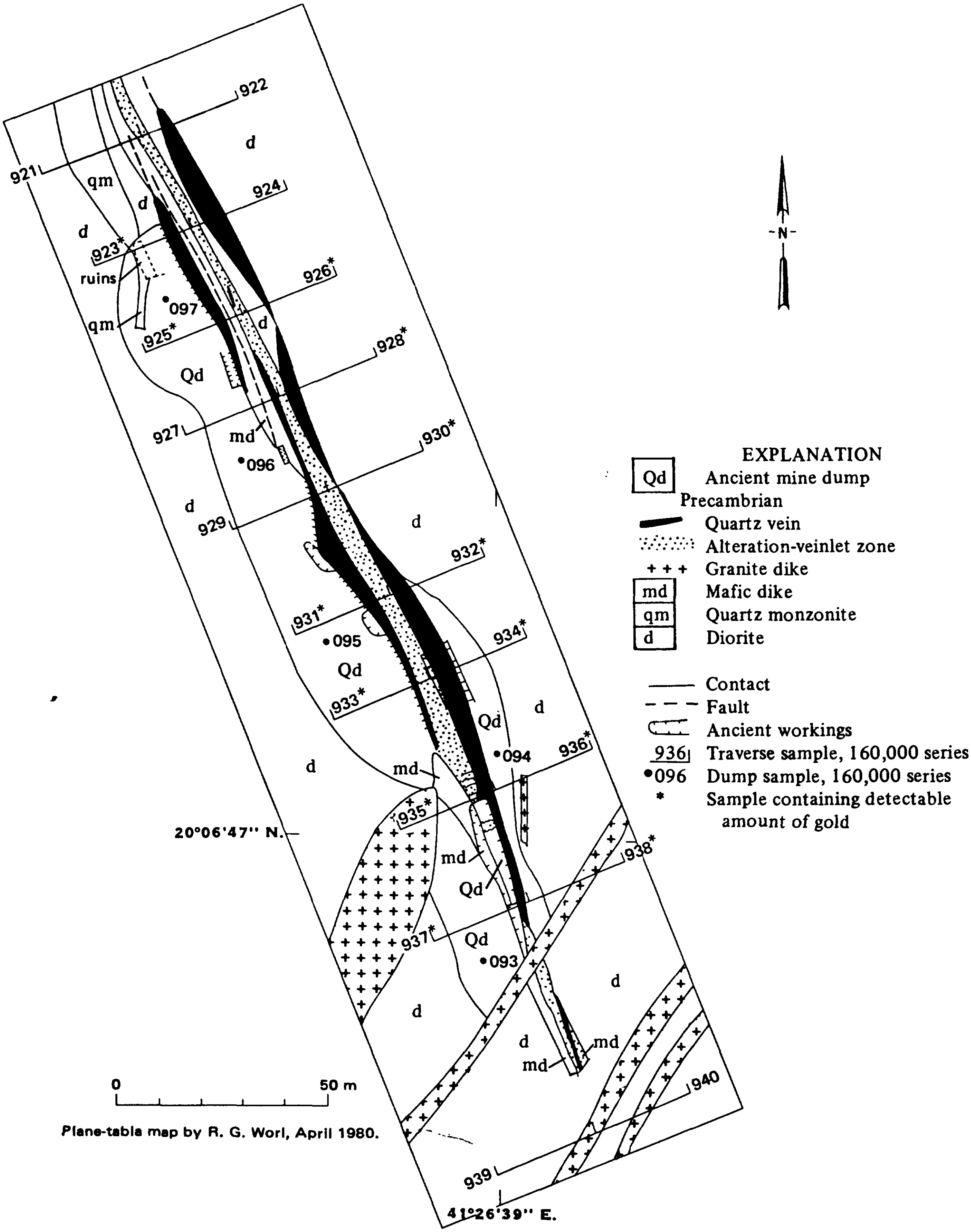


Figure 8.–Geology of the Bani Sar ancient mine area.

The ancient workings consist of shallow pits and trenches along two parallel quartz veins that are approximately 50 m apart. The veins are from 20 to 70 cm wide and approximately 60 m long, and they are slickensided along the edges. Most of the quartz is milky white, with pods and stringers of chlorite and irregularly shaped vugs. There are minor malachite stains on some of the quartz.

Three dump samples (160008, 160012, and 160013) contained nil, 0.42, and 0.64 g/t gold and nil silver. Three channel samples (160009, 160010, and 160011) were collected and consisted entirely of quartz; two contained significant amounts of gold, 3.2 and 15.6 g/t. The silver contents of the channel samples were 1 g/t or less. Two of four traverse samples (160519 to 160522) contained trace amounts of gold (less than 1.0 g/t).

CONCLUSIONS

The ancient gold mines in the southern Wadi Bidah district study area are in two geologic environments. Most are in or next to lenses of ferruginous chert; two are within large felsic intrusions. All are associated with quartz. Those in the ferruginous chert are along stringers and veinlets of quartz that cut the chert lenses at various angles. The deposits in the felsic intrusive rocks are along quartz veins that mostly trend north. Silver and base-metal contents were low in samples from both types of deposits; arsenic contents were anomalous in some samples from deposits associated with ferruginous chert. All these deposits have the characteristics of quartz-vein gold deposits related to greenstone belts that formed in response to greenschist metamorphism.

The deposits associated with ferruginous chert lenses are of interest because of the large area of exposure of the metasedimentary unit that bears the lenses. None of the known and sampled ancient mines are large enough to be of economic interest. However, reasonable amounts of gold were detected in dump samples and channel samples taken from the ancient workings, and trace amounts of gold were detected in the ferruginous chert and enclosing metasedimentary rocks.

The gold contents were high in samples from the Bani Sar deposit, which is in a felsic-plutonic environment, and the area has some potential. However, fieldwork to date is not sufficient to define the extent of the structure containing the quartz veins or the nature of the mineralization along the quartz veins.

The nature and distribution of the ancient gold mines and the gold contents in the ferruginous chert suggest that the gold was remobilized from a local source within the metasedimentary unit. Such a source bed could potentially be a very large, low-grade gold deposit, and more exploration in this area is warranted.

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