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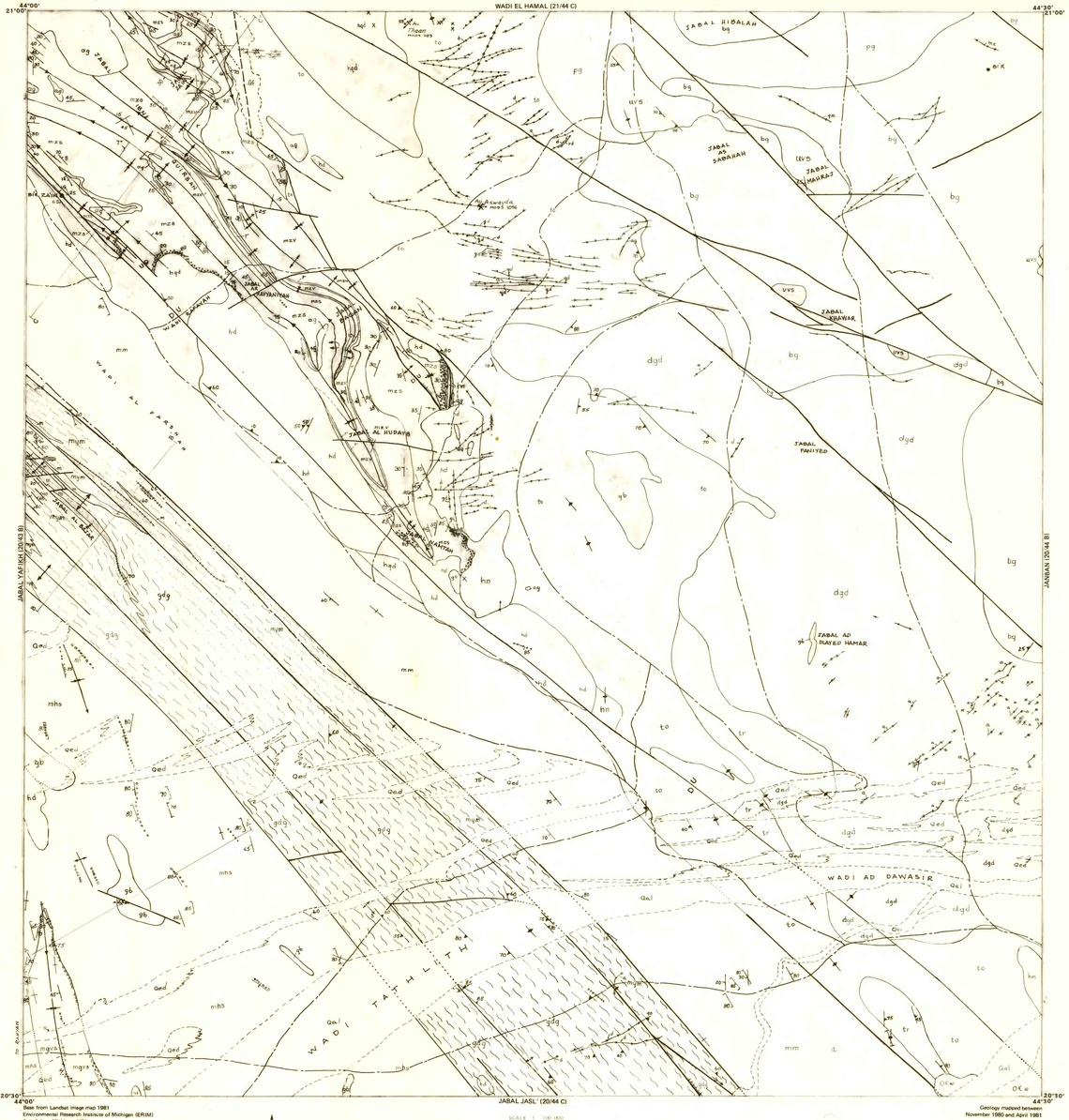
MINISTRY OF PETROLEUM AND MINERAL RESOURCES
DEPUTY MINISTRY FOR MINERAL RESOURCES

KINGDOM OF SAUDI ARABIA

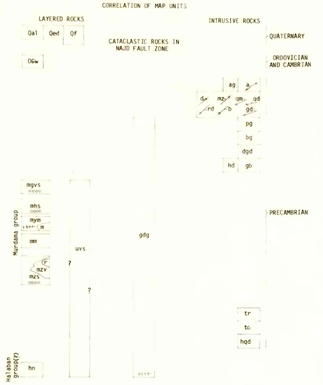
OPEN-FILE REPORT 83-639
PLATE 1



RECONNAISSANCE GEOLOGIC MAP OF THE JABAL ZAIN QUADRANGLE, SHEET 20/44 A, KINGDOM OF SAUDI ARABIA

by
Maurice R. Brock
1983

CORRELATION OF MAP UNITS



ABSTRACT

Late Precambrian rocks of the Jabal Zain quadrangle comprise two distinct terranes separated by a broad cataclastic zone that formed during latest Precambrian Najd strike-slip faulting. Only minor gold-silver prospects have been located in the quadrangle, and the potential for larger deposits is considered low.

North of the Najd fault zone, remnants of amphibolite-grade metamorphic rocks (Halabanā(?) group) and quartz diorite, tonalite, and trondhjemite are unconformably overlain by a 3- to 5-km-thick unit of conglomerate, arkose, and intermediate volcanic rocks of the Zain formation (Murdama group). The Zain appears to be conformably overlain by more intensely deformed metabasalt and immature sedimentary rock of the Masamah formation. Southwest of the Najd fault zone, the Murdama group contains immature fine-grained graywacke and minor flows (Hofoor formation) and more mature arkose and conglomerate (Al Ghabiyah formation). The Yafikh formation of calcareous sedimentary rock and marble is confined to the Najd fault zone, and its stratigraphic context in this quadrangle is unclear.

Abundant post-Murdama plutonic rocks consist of small bodies of gabbro and diorite, and an expansive compound batholith of granodiorite-granite, and discrete ovoid plutons of leucocratic granite.

Cataclastic rocks in the Najd fault zone contain variable granitoid gneiss that may have been formed from diapirically emplaced pre-Murdama plutonic basement rocks.

SUMMARY OF GEOLOGY

The quadrangle contains sedimentary and volcanic strata of the Murdama group several thousand meters thick that rest unconformably on quartz diorite basement and on isolated remnants of an older layered sequence believed to belong to the Halaban group. The lowermost few-thousand-meter-thick Murdama strata (Zain formation) is largely arkosic sandstone derived from a continental source. The arkosic sequence passes upward into a few-thousand-meter-thick sequence of basaltic volcanic rock and quartz-poor graywacke sandstone (Masamah formation). The original thickness and stratigraphic context of this basaltic unit are unknown because it is tightly folded and abuts a major fault zone. The terrane southwest of the broad fault zone, in which calcareous sediments of the Yafikh formation are confined, consists of tightly folded quartz-rich graywacke sandstone a few thousand meters thick containing a few thin layers of dacite and basalt (Hofoor formation). Source terrane for the graywacke sandstone was mostly of intermediate composition. The Al Ghabiyah formation rests unconformably on folded Hofoor formation, although it is still considered to belong to the Murdama group on the basis of lithologic similarity. The age of the Yafikh formation relative to that of adjacent Murdama rocks within the quadrangle could not be determined because contacts are not exposed or are faulted. In adjoining quadrangles (Hadley, 1976; Schmidt, in press; Kellogg, unpub. data), the authors concluded that the Yafikh is most likely the youngest unit of the Murdama.

Murdama and older rocks are folded along northwest-trending axes and are regionally metamorphosed throughout to lower greenschist facies. The quartz diorite, tonalite, and trondhjemite rocks beneath the Murdama appear to have been deformed and metamorphosed to about the same degree as the Murdama. In contrast, Halaban(?) rocks have been regionally metamorphosed to lower amphibolite facies throughout and, therefore, are considered to be the oldest rocks in the quadrangle. Relative ages of the major rock units are based in part on the degree of deformation and metamorphism and in part on comparison with more clearly constrained units of similar character and composition elsewhere in the eastern shield (Schmidt, in press; Kellogg, unpub. data). Many small bodies of hornblende diorite and gabbro have intruded Murdama rocks and, because they are generally less deformed and less altered than the units described above, they are believed to have been emplaced during the waning stages of regional deformation and greenschist-facies metamorphism.

Large volumes of posttectonic granite and granodiorite intruded the Murdama and its primitive basement following the compressional orogeny. These granitic rocks form three large plutons, which constitute most of the bedrock in the eastern half of the quadrangle. The plutons are components of a very large, compound batholith that extends far beyond the eastern and northern boundaries of the quadrangle. A thick chilled zone formed at the margin of the youngest of these three plutons during intrusion into the relatively cool tonalite host.

Subsequent deformation during the "Najd tectonic event" generated numerous northwest-trending faults with left-lateral displacement that coalesce in the Jabal Zain quadrangle into a broad zone of intense cataclasis. This 8- to 10-km-wide zone contains four parallel major faults characterized by rock gouge zones that range in thickness from a few tens of meters to more than a hundred meters. The two border faults have large vertical components of displacement as indicated by the preservation of the large block of Yafikh rocks below its expected structural position; however, the greater displacement along the zone was horizontal. Farther north along this fault zone, Brown (1972) calculated a probable left-lateral offset of approximately 125 km. Near the southern boundary of the quadrangle, metasedimentary rocks of upper amphibolite facies are typical; these include rocks mapped as Yafikh formation as well as granitic gneiss and amphibolite (probably pre-Murdama basement) that may have been diapirically during cataclasis (Schmidt, in press). Syntectonic and posttectonic granitic rocks are common in the core area of the fault zone as small plugs, sills, and dikes.

A younger and final episode of plutonic activity in this part of the shield is characterized by mafic to felsic dikes having hypabyssal texture. The rocks intruded west- and southwest-trending, antithetic fractures after Najd-age fault movement ceased, and they apparently constitute a calc-alkaline suite that ranges in composition from basalt to alkali granite. Abundant quartz was deposited within the faults and fractures at about this time, most of which appears barren, but a few small veins that contain anomalous concentrations of precious metals may be related to this period of silicification.

DESCRIPTION OF MAP UNITS

LAYERED ROCKS

Qal ALLUVIUM--Unconsolidated and slightly consolidated sand and gravel; near-surface material mixed with eolian sand, subsurface material includes partially consolidated sand and gravel

Qed DUNE SAND--Pale-tan, fine- to medium-grained, unconsolidated eolian sand, mostly quartz with few percent feldspar; forms west-trending self dunes in southern half of quadrangle; since 1951 (aerial photography) some dunes have enlarged by approximately 25 percent, and dune fronts have migrated 1 to 3 km eastward

Qf ALLUVIAL FAN--Coarse, angular rock debris; forms extensive apron of coalescing fans along western flank of Jabal Ibna Quirban; maximum thickness of deposit 30 to 40 m

OEW WAJID SANDSTONE--Reddish-brown, medium-grained arkosic sandstone and quartz-pebble conglomerate; poorly exposed in southeastern corner of quadrangle; conglomerate overlaps Precambrian basement rocks, almost all pebbles polished white quartz, matrix is red ironstone and red sandy limestone; sandstone is thin-bedded, iron-rich matrix is dark-reddish-brown

MURDAMA GROUP

mgvs AL GHABIYAH FORMATION--Greenish-gray sandstone (graywacke) with subconchoidal fracture containing well-sorted angular grains of quartz, feldspar, hornblende, biotite, pyroxene, and magnetite and a large variety of dark volcanic rock fragments in slightly metamorphosed matrix of chlorite, epidote, sericite, and opaque granules; mostly fine- to medium-grained (rarely coarse), and contains a basal boulder conglomerate (oooo) and a few thin basaltic flows. High-angle unconformity marks contact with rocks of underlying Hofoor formation, which is finer grained and contains fewer volcanic rock fragments; assigned to Murdama group in adjacent Jabal Yafikh quadrangle (Schmidt, in press)

mhs HOFOOR FORMATION--Greenish-gray to green graywacke, siltstone, and very fine to fine-grained quartzose sandstone; rare coarse sandstone beds; conglomerate layers (oooo) generally less than 10 m thick; gray dacite porphyry flow rock exposed near southeastern margin of unit; graywacke appears to be mostly thick bedded but thin lamellar beds fairly common, lamellar crossbedding also fairly common; sandstone and siltstone mostly contain very well sorted, angular grains of quartz, plagioclase, magnetite, and basaltic rock debris in a matrix of chlorite, epidote, calcite, and magnetite; quartz typically 15 to 25 percent and plagioclase 40 to 60 percent, sparse microcline in some samples; conglomerate (graywacke matrix) includes rounded cobbles of basalt, andesite, and dacite, plus angular clasts of dark, very fine grained, cherty siltstone; conglomerate also contains subordinate rounded cobbles of granite, granodiorite, and quartz diorite, and sparse white quartz pebbles. Hofoor is tightly folded and subvertical, and typically contains low-grade (greenschist) metamorphic chlorite and epidote; detrital plagioclase intensely saussuritized. Defined and correlated with Murdama group in adjacent Jabal Jasl quadrangle (Kellogg, 1982a)

mym YAFIKH FORMATION--Mostly gray, impure marble with dark-gray, calcareous pelitic schist and many thin layers of metaquartzite, metabasalt, and metadacite; thick calcite marble member (m, ++++) and thin layers of dolomite marble contain variable amounts of quartz, amphibole, biotite, and sphene; quartzite contains biotite, calcite, epidote, and magnetite; greenschist-facies actinolite schist and biotite muscovite schist in the north grade southward into higher-grade felsic paragneiss containing hornblende, biotite, garnet, and augite; amphibolite containing epidote, biotite, augite, magnetite, apatite, and sphene; and metaquartzite and calc-silicate rock containing plagioclase, calcite, hornblende, epidote, garnet, and sphene. Yafikh is intensely folded within 8- to 10-km-wide, northwest-trending Najd fault zone; schistosity and fabric of minor intercalations of granitic orthogneiss mostly concordant with compositional layering

mm MASAMAH FORMATION--Dark-gray and dark-greenish-gray interlayered mafic volcanic and immature sedimentary rock; includes basalt and andesite, and volcaniclastic flow breccia, airfall tuff, and lahar deposits; interbedded sedimentary rocks consist of locally derived quartz-bearing graywacke siltstone, sandstone, and conglomerate. Masamah is generally folded and metamorphosed to greenstone; lowermost strata include several flows of trachytoidal basalt and andesite that intertongue with arkose and dacitic and rhyolitic flows of uppermost Zain formation; intensely sheared fault zone separates Masamah from Yafikh. Masamah-type rocks included in Arfan formation of Halaban group by Schmidt (in press) and Hadley (1976) in areas north and west of Jabal Zain; Masamah tentatively assigned to Halaban group to the south by Kellogg (unpub. data), but is assigned here to Murdama group because of its relation to Zain formation

mzv ZAIN FORMATION--Mostly arkosic sedimentary rocks with volcanic flow rocks in the lower and middle parts; total estimated thickness 4,000 m to 5,000 m; lithology of lower 1,100 m very similar to Jarbuah formation to the west across Najd fault zone (Schmidt, in press); however, thickness of Zain sandstone much greater and correlation across fault zone not established; both the Zain and Jarbuah deposited on crystalline rocks and represent oldest strata of Murdama group; large volume of arkosic debris in Zain likely shed from eastern source. North and west of quadrangle, rocks considered equivalent to the Zain included in Arfan formation of Halaban group by Schmidt (in press), in Arfan and Jugluq formations of Halaban group by Hadley (1976), and middle Halaban group by Abu Rashid (1974); weak greenschist-grade metamorphism characteristic

mzs Arksic sandstone member--Mostly reddish-brown arkosic sandstone; in lowermost 300 m consists of coarse- to medium-grained arkosic sandstone containing pebble to boulder conglomerate (oooo) and a few thin flows of rhyolite to dacite; very uniform, fine-grained, thinly laminated arkosic sandstone 2,000 to 3,000 m thick overlies conglomeratic unit and contains well-sorted, very angular grains (0.1-0.2 mm) in 10 to 20 percent silty matrix; detrital grains are 15 to 30 percent quartz, 25 to 40 percent saussuritized plagioclase, 15 to 30 percent microcline, few percent each of muscovite, biotite, and magnetite, and fragments of volcanic rock; silty calcareous matrix contains mostly calcite and metamorphic epidote, chlorite, and sericite. Persistent reddish-brown color due to abundant iron oxide in matrix. Many strata display ripple marks and crossbedding fairly common in lower and upper parts; in uppermost 150 m, Zain on Jabal Ibna Quirban fine- to medium-grained, laminated arkose probably deposited in a delta and contains large-scale (0.5-5 m) amplitude crossbeds with wavelengths as much as 10 m; foreset beds dip northeasterly and suggest the delta grew in a northeastward direction

mzv Volcanic member--Intermediate and felsic volcanic flows interlayered with minor volcaniclastic debris and sandstone; lower part consists of porphyritic dacite and andesite flows a few hundred meters thick; upper part contains several-hundred-meter-thick porphyritic rhyolite to dacite and andesite interlayered with fine-grained sandstone and conglomerate; prominent marker layer (r) is 10- to 200-m-thick rhyolite ash-flow tuff. Thickness of volcanic member exceeds 1,000 m at its northwestern margin and thins southeastward to about 100 m

uvs METAVOLCANIC AND METASEDIMENTARY ROCKS--Mostly fine- to medium-grained interlayered volcanic and sedimentary rocks metamorphosed to amphibolite grade: amphibolite, hornblende and biotite quartz diorite gneiss (commonly garnetiferous), and metarhyolite porphyry as large xenolithic remnants of probable Murdama rocks in plutons

HALABAN GROUP(?)

hn NAMTAH FORMATION--Interlayered very fine grained, dark-gray metavolcanic rock (about equal amounts of basalt, andesite, and dacite) and metasedimentary rock (siltstone and limy graywacke sandstone); bedding and distinction between metasedimentary and metavolcanic rocks difficult to determine in outcrop. Namtah metamorphic mineral assemblages equivalent to amphibolite facies throughout; higher metamorphic grade suggests Namtah underwent major deformation prior to deposition of Zain formation; Namtah rocks appear sufficiently older and have compositions that justify their tentative assignment to Halaban group

INTRUSIVE ROCKS

ag ALBITE GRANITE--Pink to pale-orange, aphanitic to fine-grained, nonporphyritic alkali granite that forms sills, dikes, and small stocks in northwestern quarter of quadrangle; albite, mostly as microlaths, is only feldspar in rock as determined by X-ray diffraction analysis, argillic alteration extensive at all localities; other minerals include much cryptocrystalline quartz, few percent chloritic biotite, and trace of riebeckite; larger stock at northern boundary of quadrangle is fine grained throughout and contains numerous inclusions of metasandstone and dacite

a-g ALKALI-FELDSPAR GRANITE--Pink to red, fine-grained, porphyritic alkali granite forms several southwest-trending dikes 10 to 30 m wide and several small plugs (not mapped) in southeastern quarter of quadrangle; phenocrysts (1-3 cm) of microcline and albite-rimmed sodic oligoclase (3-5 percent of rock, locally as much as 25 percent); rapakivi and granophyric textures common; groundmass contains about equal quantities of quartz, microcline, and albite; contains 2 to 5 percent biotite; accessory cassiterite(?) is distinctive; other accessory minerals include fluorite, magnetite, apatite, zircon, sphene, and allanite

~~~ DIKE ROCKS--Mostly porphyritic, fine-grained to aphanitic including basalt, b; diorite, d; quartz diorite, qd; monzonite, mz; quartz monzonite, qm; granodiorite, gd; and rhyodacite, rd; chronology of dikes not determined but all postdate Najd faults

pg PERTHITE GRANITE--Pink to pinkish-gray, mostly coarse-grained, nonfoliated, porphyritic; hornblende predominant over biotite although dark minerals typically about 2 percent of mode; perthite prevalent feldspar phase, accompanied by sodic oligoclase and albite; few-hundred-meter-thick chill zone at western margin contains abundant perthite; intrudes As Sabahah granite

bg AS SABAHAH GRANITE--Pale-pink to light-gray, medium- to coarse-grained, locally foliated alkali-feldspar granite; coarse-grained porphyritic variety dominant; biotite generally more common than hornblende, and together they make up 1 to 5 percent of mode; generally sparse accessory minerals include sphene, zircon (concentrically zoned zircon grains are distinguishing characteristic), and interstitial fluorite. Biotite and hornblende partially altered to chlorite; nonoriented crush structure evident throughout pluton; intrudes Dawasir granodiorite and granite, and intruded by pertthite granite; unit well exposed at Jabal as Sabahah

dgd DAWASIR GRANODIORITE AND GRANITE--Pinkish-gray to light-gray, coarse- to medium-grained, locally gneissic biotite granodiorite and biotite granite; granodiorite nearly twice as abundant as granite; coarse-grained (1-2 cm), equigranular to subequigranular phases prevail over medium- to coarse-grained porphyritic phase; phenocrysts include microcline and oligoclase, many of latter rimmed with albite and microcline; granite phase completely transitional with granodiorite on outcrop and subregional scales and the two are considered coeval; granite is pinkish gray and contains nearly equal quantities of microcline and plagioclase in contrast to light-gray granodiorite; plagioclase in granite is sodic oligoclase with subordinate albite, whereas plagioclase in granodiorite contains more calcic oligoclase and appreciably less albite; intruded by As Sabahah granite

hd HORNBLENDE DIORITE--Medium- to dark-gray, fine- to medium-grained, generally massive but shear foliation conspicuous locally; typically contains about 40 percent hornblende, 60 percent calcic plagioclase, a few percent each of augite and quartz; nonoriented crush structure throughout pluton; hornblende variably altered to chlorite and epidote, plagioclase moderately saussuritized; intrudes basal units of Zain arkosic sandstone member along western flank of Jabal ar Rayyaniyah, and also intrudes tonalite and hornblende quartz diorite; hornblende diorite intruded by albite granite and commonly forms inclusions in other granitic plutons

gb GABBRO--Dark-gray, fine- to medium-grained, massive, pyroxene-plagioclase gabbro; forms many small, poorly exposed plutons mostly in southern half of quadrangle; inferred to be same general age as hornblende diorite; 50 percent pyroxene (altered to hornblende, epidote, and chlorite), 40 percent saussuritized calcic plagioclase, 5 percent fine-grained magnetite, and 1 to 2 percent apatite

tr TRONDHJEMITE--Pale-gray to pale-pink, medium- to coarse-grained, porphyritic, locally foliated leucotrondhjemite; contains a few percent hornblende and biotite, 20 to 30 percent quartz in large anhedral grains (1-1.5 cm), 40 to 50 percent plagioclase in 1.5 to 2 cm phenocrysts and subhedral groundmass grains of calcic andesine mantled with sodic oligoclase, and minor interstitial microcline; sparse accessory minerals include sphene and apatite; extensively altered to saussurite, sericite, calcite, chlorite, and epidote; intrudes tonalite in two plutons in southeastern quarter of quadrangle; and is intruded by Dawasir granodiorite and granite

to TONALITE--Moderate- to dark-greenish-gray, medium-grained, generally nonfoliated, containing about 60 percent calcic oligoclase, 20 to 30 percent quartz, 10 to 15 percent hornblende, 5 percent biotite, and minor microcline and albite; forms large, elongate body trending northwestward across quadrangle; intrudes hornblende quartz diorite and Halaban(?) layered rocks; intruded by hornblende diorite, trondhjemite, and granitic rocks along its eastern margin. Moderately to intensely deformed quartz and plagioclase grains (undulatory extinction and deformation twins), weak northtrending gneissic fabric produced by cataclasis; biotite largely converted to chlorite but hornblende unaltered. Tonalite is significantly metamorphosed in contact with granitic plutons where additional quartz and microcline present in border zone a few kilometers wide

hqd HORNBLENDE QUARTZ DIORITE--Moderate- to dark-gray, medium- to fine-grained, locally foliated quartz diorite; very similar in mineralogy and appearance to hornblende diorite but contains 5 to 10 percent quartz and intensely altered to chlorite and epidote; quartz diorite oldest plutonic rock in quadrangle and disconformably overlain by basal conglomerate of Zain formation, which in Wadi Rafayah contains abundant pebbles, cobbles, and boulders of hornblende quartz diorite; age relative to Namtah formation not certain

CATACLASTIC ROCKS IN THE NAJD FAULT ZONE

gdg GNEISSIC GRANODIORITE AND GRANITE--Pinkish-gray and light-gray orthogneiss and subordinate paragneiss; biotite granodiorite prevalent rock type; biotite granite and hornblende-biotite quartz diorite also common; minor types include trondhjemite, tonalite, diorite, amphibolite, calcitic-dolomitic marble (++++), calc-silicate rock, calcareous quartzite, and pelitic schist. Unit entirely contained in broad, northwest-trending Najd fault zone; many small granite plugs and dikes (not mapped) within this unit are nonfoliated, the high metamorphic grade of layered gneiss and schist probably produced during intense cataclasis and shearing within broad zone; orthogneiss may represent deformed older granitoid/dioritoid rock, whereas gross lithology of paragneiss suggests derivation from Murdama group (especially Yafikh formation)

ECONOMIC GEOLOGY

Prospect pits and small mines on quartz veins are in several widely distributed localities. All were examined and several were sampled for analyses. Most have no anomalous metal content. Samples from the Thaan ancient mine (MODS 1103) and nearby prospects along the north boundary of the quadrangle contain significant amounts of gold and silver (table 1; Bishop, 1982). The mine consists of an inclined shaft about 30 m deep that has a surface opening approximately 7 m wide and 25 m long. The shaft explored a 2- to 7-m-thick quartz vein, which crops out for 70 m and strikes N. 45° E. and dips 55° NW. Many small pits on small discontinuous veins occur in the area of the mine. All veins are principally quartz having a few percent gossan in fractures and pockets. Sulfide minerals are sparse in dump fragments and in exposed parts of veins. Aswayda (MODS 1096) is a small ancient mine in a similar geologic context, but Bishop (1982) reported negative results from dump samples.

A second locality that has modest gold and silver contents (table 1) is located 11 km north-northeast of the southwestern corner of the quadrangle (reported to MODS). Small veins in gabbro contain variable quantities of quartz, reddish-brown jasperoid, and brown carbonate. Ancient exploration in the mineralized area is indicated by more than a hundred closely spaced, shallow pits. Analytical data are listed in table 1.

DATA STORAGE

The sample location map for the Jabal Zain quadrangle is on file at the Jiddah office of the U.S. Geological Survey Saudi Arabian Mission under data file number USGS-OF-03-1.

The mineral locality reported to the Mineral Occurrence Documentation System (MODS) data bank will be assigned a unique 5-digit number. Inquiries regarding MODS may be made through the Office of the Technical Advisor, Saudi Arabian Deputy Ministry for Mineral Resources, Jiddah.

The work on which this report is based was performed in accordance with a work agreement between the U.S. Geological Survey and the Saudi Arabian Ministry of Petroleum and Mineral Resources.

REFERENCES CITED

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Table 1.--Analytical data for mineralized samples, Jabal Zain quadrangle (sample locations recorded in USGS-OF-03-1)

Sample Number	Au	Values in parts per million[1/] Ag	Cu	Pb	Zn	Mo	Sample Description
139351	0.61	2.4	310	680	55	10	Vein sworm in gabbro, lat 20°35' N., long 44°00' E., grab sample from quartz-jasperoid-carbonate vein, mostly consisting of limonitic jasperoid
139354	0.10	1.4	200	<10	15	0	Same location as above; grab sample of representative vein material composited from dump of many prospect pits
				THAAN ANCIENT MINE (MODS 1103) AND VICINITY			
139518a	3.82	29.8	110	130	5	0	Thaan mine; channel sample across lower 3-m interval of quartz vein above hanging wall
139518b	2.38	6.0	7500	4850	15	40	Thaan mine; select sample of Cu-stained fragments from dump surface
139518c	11.15	20.3	2150	3660	10	100	Thaan mine; select sample of gossan fragments from dump surface
139556	41.45	30.8	20	3500	20	10	Prospect 3 km NE of Thaan mine; select sample of gossan from dump; 1-2 m vein of quartz with sparse gossan
139558	13.80	5.6	40	<10	15	0	Prospect pit on quartz vein; select sample of gossan fragments from dump
578008[2/]	0.08	8.3	2500	2250	10	ND	Thaan mine; chip sample from sheared fireball with pyrite and gossan in seams
578012[2/]	1.51	1.1	32500	112	350	ND	Thaan mine; chip sample from altered diorite with Cu-stain in hanging wall

1/ Analyses by atomic-absorption, spectrophotometric, and colorimetric methods.
2/ Values from D. L. Schmidt (USGS), written commun., 1982.
ND Value not determined.

SYMBOLS

- CONTACT--Dashed where contact delineates surficial deposits; dotted where concealed
- FAULT--Dotted where concealed; arrows show direction of relative displacement; relative vertical displacement shown by U (upthrown side) and D (downthrown side)
- SHEAR ZONE
- SILICIFIED ZONE
- ANTICLINE--Showing direction of plunge
- SYNCLINE--Showing direction of plunge; dotted where concealed
- OVERTURNED ANTICLINE--Showing direction of limbs
- OVERTURNED SYNCLINE--Showing direction of limbs
- STRIKE AND DIP OF BEDS: Inclined; Vertical; Overturned
- STRIKE AND DIP OF FOLIATION: Inclined; Vertical
- STRIKE AND DIP OF CLEAVAGE: Inclined; Vertical
- BEARING AND PLUNGE OF MINOR FOLD
- WELL (BI'R)
- SMALL MINE
- PROSPECT PIT
- DIRT TRACK