U.S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY, PREPARED FOR

MINISTRY OF PETROLEUM AND MINERAL RESOURCES
DEPUTY MINISTRY FOR MINERAL RESOURCES

KINGDOM OF SAUDI ARABIA

OPEN-FILE REPORT USGS-OF 85-578
SHEET 1

Aerial photography 1956 and controlled mosaic 1959 Aero Service Corp., Photogrammetric Engineers Philadelphia 20, Pennsylvania, U. S. A.

This report has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

Geology mapped in May 1983.

TRUE NORTH

SCALE 1 : 100 000

2 0 2 4 6 8 10 KILOMETERS

2 0 2 4 6 8 10 MILES

DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

CORRELATION OF MAP UNITS

INTRUSIVE ROCKS	SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS	
	Qsb, Qu	QUATERNARY
	QTv, QTb	TERTIARY
	Tr	TERTIARY
	UNCONFORMITY	
	Es	CAMBRIAN
	UNCONFORMITY	
	sk	Shammar group
	UNCONFORMITY	
qp	zs, zrt, zr, zrd, zdat, zda	Zarghat formation; Shammar group; PROTEROZOIC
di, ag, bg, bhg, hbg, da, qd	UNCONFORMITY	
	hs, hma, hat, ha	Hulayfah group

DESCRIPTION OF ROCK UNITS

INTRUSIVE ROCKS

APLITE, PEGMATITE, SILICIC DIKES--White, fine- to coarse-grained, granitic to silicic dikes. Intrude all other plutonic rocks

qp QUARTZ PORPHYRY--Similar to alkali-feldspar granite described below but is characterized by distinctive blue-white quartz phenocrysts contained in a cryptocrystalline felsic matrix

di QUARTZ DIABASE--Medium-gray, fine- to medium-grained rock, composed of plagioclase laths, quartz, ophitic hornblende, subophitic augite, reddish-brown biotite, sphene, and magnetite. Alteration minerals include sparse chlorite, epidote, and calcite

ag ALKALI-FELDSPAR GRANITE--Pink to light-gray, and white, coarse-grained, hypidiomorphic granular granite. Composed predominantly of perthite and quartz. Accessory minerals include biotite, sphene, magnetite, apatite, and rare zircon. Intrudes rocks of the Zarghat formation of the Shammar group

bg BIOTITE GRANITE--Similar to biotite-hornblende granite except that biotite is the dominant mafic mineral

bhg BIOTITE-HORNBLENDE GRANITE--Similar to hornblende granite described below except that biotite and hornblende occur in approximately equal amounts

hbg HORNBLENDE GRANITE--Medium- to light-gray, fine- to medium-grained hornblende granite; hypidiomorphic to allotriomorphic granular; commonly strongly porphyritic. Composed of potassium feldspar, plagioclase, quartz, and hornblende. Biotite, magnetite, sphene, and zircon are accessory minerals. Alteration minerals include calcite, epidote, and chlorite

da DACITE--Dark- to medium-gray dacite; porphyritic. Contains large eroded phenocrysts of potassium feldspar and minor plagioclase in a cryptocrystalline feldspar matrix. Accessory minerals include primary epidote, piedmontite, allanite, and magnetite. Intruded by biotite granite and biotite-hornblende granite dikes

qd QUARTZ DIORITE--Light-gray, fine- to medium-grained quartz diorite. Composed of plagioclase, quartz, and minor potassium feldspar. Accessory minerals include hornblende and augite. Alteration minerals include uralitic hornblende, epidote, chlorite, and sericite, all indicating greenschist facies metamorphism

SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS

Qsb SABKHA DEPOSITS--White, salt-saturated mud, silt, and fine sand

Qu SURFICIAL DEPOSITS, UNDIVIDED--Thin pediment gravels, eolian sand, and alluvial sand, gravel, and cobble deposits derived from the surrounding outcrops.

QTv BASALTIC VENTS--Reddish-gray, dark-gray, and black cinder cones and vents. Composed predominantly of scoria, cinders, and bombs

QTb BASALT--Dark to medium-gray and black, aa and pahoehoe flows. Ranges in composition from hawaiite to alkali-olivine basalt. Older flows contain 5-10 percent olivine while younger flows contain 10-20 percent olivine. Numbers denote decreasing relative age of flows, QTb_1 being the oldest

Tr RHYOLITE--Pale-greenish-yellow, nonwelded ash-flow and ash-fall tuff and conglomerate. Contains large, fluffy, non-collapsed pumice fragments and numerous lithic fragments of rhyolite and andesite. Shatter cracks filled with quartz and evidence of partial reworking suggesting subaqueous deposition

Es SIQ SANDSTONE--Dark-red, reddish-brown and buff, friable, medium-grained to coarsely conglomeratic, cross-bedded, silica and calcite cemented, quartz sandstone. Sparse quartz pebbles are white, gray, and brown, well-rounded and polished. This thick, flat-lying sandstone is the basal Cambrian-age member of the widespread Saq Sandstone that covers the northern part of the Arabian Shield

SHAMMAR GROUP

sk KUARA FORMATION--Rounded, coarse gravel to small cobbles. Composed predominantly of rhyolite and granitoid rocks, but also contains cobbles of plutonic rocks and thus probably correlates with similar deposits in the Jabal al Usayfir, Khaybar, and Nuqrah quadrangles (Fairer, 1984; Dhellemmes and Delfour, 1980; Delfour, 1977)

ZARGHAT FROMATION:

zs Sedimentary rocks--Conglomerate, tuffaceous sandstone and siltstone, and feldspathic greywacke

zrt Rhyolite tuff--Welded and nonwelded ash-fall and ash-flow tuffs, lithic tuff, and tuff breccia. Composed of alkali-feldspar, quartz, and small to very sparse amounts of plagioclase. Secondary minerals include hematite, chlorite, epidote, calcite, and sericite. Cristobalite and tridymite are present in spherulites and pumice of some of the ash-flow tuffs. Eutaxitic and flow-banded textures are commonly well-developed in the tuffs. Lithic fragments include andesite, basalt, granitoid rocks, and angular fragments of rhyolite

zr Rhyolite--Similar composition to rhyolite tuffs. Contains large, blue-white, euhedral quartz phenocrysts. Probably emplaced as sills

zrd Rhyodacite--Similar in composition to dacites described below but contain more alkali-feldspar and less plagioclase. Transitional to rhyolites described above and dacites described below

zdat Dacite tuff--Welded and nonwelded, ash-fall and ash-flow tuffs and tuff breccia. Similar in composition to dacite described below

zda Dacite--Composed of plagioclase, quartz, and sparse alkali-feldspar phenocrysts in a cryptocrystalline matrix of plagioclase, quartz, and sparse alkali-feldspar microlaths. Augite and sphene are common accessory minerals. Alteration minerals include epidote, calcite, and chlorite.

HULAYFAH GROUP

hs SEDIMENTARY ROCKS--Greywacke, phyllite, conglomerate, slate, quartzite, and black marble

hma MARBLE--Red, white, grey, and buff, fine- to coarse-grained, thin- to thick-bedded, silicic marble. Commonly contains veins and pods of calcite and quartz

hat ANDESITE TUFF--Fragmental tuff. Similar to andesite described below

ha ANDESITE--Dark-gray to black, fine-grained rock. Contains phenocrysts of plagioclase, sparse alkali-feldspar, quartz, and hornblende in a fine-grained felsic matrix. Magnetite and sphene are accessory minerals. Alteration minerals include calcite, epidote, chlorite, and uralitic hornblende

SYMBOLS

- CONTACT
- FAULT--Showing relative horizontal movement where known; dotted where concealed
- SYNCLINE--Showing trace of trough plane and direction of plunge
- 26 ATTITUDE OF BEDS--Inclined, showing dip
- VOLCANIC CONE
- SPRING
- LINEATIONS OBSERVED ON LANDSAT IMAGES

INTRODUCTION

LOCATION AND ACCESS

The Ash Shamila quadrangle, sheet 26/40 A, is centred 168 km southwest of Ha'il, in north-central Saudi Arabia, and is bounded by lat 26°30' and 27°00' N. and long 40°00' and 40°30' E. Access is by way of the Al Madinah - Ha'il paved highway to Hulayfah or Gazzalah, thence by unimproved road to Zarghat, located a few km from the eastern margin and the southeast corner of the quadrangle. Desert tracks lead from Zarghat to the remainder of the area, but a large part of the quadrangle is underlain by the Tertiary and Quaternary Harrat Ithnayn; access over this terrain by vehicle is difficult.

The area has low relief, marked only by Paleozoic sandstone remnants, volcanic cones in the harrat, and Jabal Bushra. Drainage on the harrat trends generally northerly, but rainfall is low. The climate is typical of inland Saudi Arabia, with summer day temperatures reaching 45 - 50°C., and with cold nights. Temperatures can reach 0°C. in winter. Vegetation is sparse.

The area is sparsely populated, and permanent water is available from wells at Ash Shamila.

PREVIOUS AND PRESENT WORK

The Ash Shamila quadrangle was first mapped by Brown and others (1963) as part of the Northeastern Hijaz quadrangle (scale 1:500,000), and the eastern part was included in the reconnaissance map of the Hulayfdah - Zarghat area by Bowden (1982). Quadrangles to the north, east, and south are being mapped at a scale of 1:100,000 by the U. S. Geological Survey Saudi Arabian Mission. The author mapped in reconnaissance at a scale of 1:100,000 during May, 1983.

ACKNOWLEDGMENTS

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GEOLOGIC SETTING

The formation of the rocks and structure of the Arabian Shield during the Proterozoic is the result of a large west-directed, convergent event that spanned over 600 million years, and ended about 550 Ma. During this time a large ocean basin, located to the east of the African craton, was consumed along a series of island arcs. About 680 Ma, a continental mass impinging from the east collided with the Arabian Shield, forming the Nabitah orogenic belt along suture zones marked by ultramafic rocks. To the west was the African craton. Continued compression caused the formation of acidic plutonic rocks and the eruption of rhyolitic volcanic rocks. Near the end of the Proterozoic, the Arabian Shield failed under compression along the Najd sinistral shear-fault system. Coarse, blanketlike, sandstones of the Siq member of the Cambrian Saq Sandstone covered all of the Proterozoic rocks until they were partially stripped by erosion, than covered by Tertiary to Quaternary basalt flow sand cinder cones.

PROTEROZOIC SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS

The Proterozoic layered rock units of the quadrangle can be divided into two main assemblages: 1) the Hulayfah group (780-680 Ma), which are mafic to intermediate volcanic rocks and some sedimentary rocks which formed in the island-arc environment; and 2) the Shammar group (630-570 Ma), which are intermediate to rhyolitic volcanic rocks and arkosic sediments that are intracratonic in character.

HULAYFAH GROUP

The oldest rocks in the quadrangle belong to the Hulayfah group, an assemblage of andesite flows and tuffs, overlain by and interfingered with andesite, greywacke, and marble. These rocks were formed as part of the Hulayfah island arc (Stoeser and others, 1984). Deposition in the arc ceased with the onset of its collision with an eastern continental plate about 680-630 Ma, during which period the rocks of the Nabitah orogenic belt were formed.

SHAMMAR GROUP

The Shammar group is represented in the quadrangle only by rocks of the Zarghat and Kuara formations.

Zarghat formation

Remobilized crustal rocks were injected as diorite and granite plutons (described below), and erupted as dacite to rhyolite ash-fall and ash-flow tuffs and agglomerates of the Zarghat formation from 630 to 600 Ma.

The base of the Zarghat formation overlies the Hulayfah group rocks unconformably, and consists of a thin basal conglomerate that is similar to the Kuara formation.

Kuara formation

The Kuara formation consists primarily of rounded coarse to small cobbles composed of rhyolite and granitoid rocks. The unit also contains cobbles of plutonic rocks and therefore probably correlates with similar but thicker deposits that have been named the Kuara formation in the Jabal al Usayfir (Fairer, 1985), Khaybar (Dhelemmes and Delfour, 1980), and Nuqrah (Delfour, 1977) quadrangles.

PROTEROZOIC INTRUSIVE ROCKS

Quartz diorite, dacite, hornblende granite with variations to biotite-hornblende granite and biotite granite, and gabbro mapped in adjacent quadrangles, intrudethe Hulayfah rocks at various stages.

The Shammar group was succeeded by intrusions of alkali-feldspar granite and elsewhere also by gabbro, probably toward the end of Shammar deposition.

PALEOZOIC ROCKS

Coarse, blanket-like, sandstone rocks of the Siq member of the Cambrian Saq Sandstone covered all of the Proterozoic rocks, until they were partially stripped by erosion and covered by Tertiary and Quaternary basalt vents and flows.

Four separate flows of Tertiary to Quaternary basalt are recognised on the basis of field relationships, and by color variation on Landsat imagery.

SURFICIAL DEPOSITS

Salt-saturated sabkhah deposits occur adjacent to the Tertiary-Quaternary basalt flow margins.

Other surficial deposits include thin pediment deposits, eolian sand, and alluvial sand, gravel, and cobble deposits derived from the surrounding outcrops.

STRUCTURE

The structures of the Ash Shamila quadrangle were predominantly caused by the Najd-age shearing and faulting during the late Proterozoic by a maximum compressive stress aligned approximately east-northeast. As a result, tension fractures, commonly filled with quartz, strike about N. 70° - 80° E., and sinistral shear faults strike N. 65°-75° W. These fault directions are exhibited in all of the late Proterozoic granitoid plutons and eruptive rocks emplaced prior to the Najd event. These Najd-age structures have been overprinted on a preexisting set of structures that were the result of the collision of a plate from the east that caused north- northwest-trending, west-directed, subduction-related, thrust faults and associated suture zones. As a result of the Najd-age shear faults, these occurrences of ultramafic rocks have been offset into an en echelon sinistral pattern (J. M. O'Neill, unpub. data, 1984). Folds associated with the collision event tend to be asymmetrical, having shallower east dips than west dips, and north-northeast axial traces shallowly plunging to the south.

ECONOMIC GEOLOGY

No mineral deposits of economic importance are known, but the alkali-feldspar granite located near the northeast corner of the quadrangle contains anomalous quantities of tin and warrants further study.

DATA STORAGE

Petrographic descriptions, sample locations, thin sections, and results of chemical analyses are stored in Data File USGS-DF-03-118 in the Jiddah office of the U.S. Geological Survey Saudi Arabian Mission.

No Mineral Occurrence Documentation System (MODS) localities were established.

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RECONNAISSANCE GEOLOGIC MAP OF THE ASH SHAMILA QUADRANGLE, SHEET 26/40 A, KINGDOM OF SAUDI ARABIA

by
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