



Aerial photography and controlled mosaic, 1961
SCALE 1:100 000
10 KILOMETERS
10 MILES
Geology mapped during 1965

**RECONNAISSANCE GEOLOGY OF THE HMDAH QUADRANGLE, SHEET 19/43D,
KINGDOM OF SAUDI ARABIA**

By
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EXPLANATION

PLUTONIC AND HYBRIDAL INTRUSIVE ROCKS, NONLAYERED METAMORPHIC ROCKS

LAYERED SEDIMENTARY, PYROCLASTIC, AND METAMORPHIC ROCKS

QUATERNARY

TERTIARY(?)

CAMBRIAN-ORDOVICIAN

PRECAMBRIAN AND CAMBRIAN(?)

CONTACT - Dashed where approximately located or inferred; dotted where concealed

FAULT - Dashed where approximately located or inferred; dotted where concealed

STRIKE AND PLUNGE OF MINOR FOLD AXIS

STRIKE OF VERTICAL BEDDING

STRIKE AND DIP OF FOLIATION

STRIKE OF VERTICAL FOLIATION

STRIKE AND DIP OF FOLIATION AND PLUNGE OF LINEATION - Marked by oriented biotite (b), quartz (q), chlorite (c), or hornblende (h); pencil structure (ps)

STRIKE OF VERTICAL FOLIATION AND PLUNGE OF LINEATION - Marked by pencil structure (ps)

GENERALIZED STRIKE AND DIP OF CRUMPLED FOLIATION

STRIKE AND DIP OF PRIMARY FLOW BANDING

STRIKE OF VERTICAL PRIMARY FLOW BANDING

STRIKE AND DIP OF CATACLASTIC FOLIATION

STRIKE AND DIP OF CATACLASTIC FOLIATION AND PLUNGE OF LINEATION - Marked by oriented biotite (b) and quartz (q)

STRIKE OF VERTICAL CATACLASTIC FOLIATION AND PLUNGE OF LINEATION - Marked by oriented biotite (b)

DIKE - Lithology not determined

ISOLATED OUTCROP OF MARBLE

LINEAMENT FROM AERIAL PHOTOGRAPHS - Prominent lineament not checked on ground; may be dikes, foliation, joints, bedding, or faults, or in the gabbro-norite intrusive complex, igneous outcrops

PLUTONIC AND HYBRIDAL INTRUSIVE ROCKS, NONLAYERED METAMORPHIC ROCKS

Td
Diabase plug
Dark gray to nearly black plug of unaltered diabase; intrusive into serpentinite

OCw
Wajid Sandstone
Reddish-brown, yellow, tan, and white crossbedded sandstones, limonite and hematite-cemented layers and concretions, thin conglomerate and clay lenses, locally overlies saprolite

Id
Andesite and other dark dikes
Dark andesite, andesite porphyry, and other dark dikes, including lamprophyre; intrusive into rhyolite dikes

Rd
Rhyolite dike
Brown to reddish-brown, fractured and unhealed, generally in swarms

qp
Quartz porphyry
Pink to red, commonly brown-stained; locally muscovite-bearing; forms small masses or dikes

gp
Granite, spilitic, felsitic, and pegmatitic dikes, quartz veins
White, pink, or red granite dikes (g) in swarms, generally associated with or grading into felsite dikes (f) which are locally garnetiferous and magnetite-bearing; granite and felsite dikes undivided (gf); white spilitic dikes (sp); felsite and pegmatite dikes undivided (fp); quartz veins (q)

rgp
Pink granite porphyry
Dikes and small plugs of pink granite porphyry; contains rare brown spots possibly derived from grains of allanite

qm **qmp**
Quartz monzonite and quartz monzonitic porphyry
Gray, medium to fine-grained, equigranular biotite-quartz monzonite (qm) as thin dikes and sills intruded by dikes of fine-grained, brown-weathering, red granite and felsite; plug of gray, fine-grained, massive quartz-monzonite porphyry (qmp)

sp **spg** **spa**
Biotite granite
White, light-gray, and pink to red, massive to locally flow-banded peralitic biotite granite (sp) and porphyritic biotite granite (spg), generally in homogeneous sub-circular plutons; locally small plugs of this granite are strongly zoned with coarse-grained diastatic core (spa)

gb **gba** **di** **d** **da** **an**
Gabbro, diorite, diabase, dacite porphyry, and andesite dikes
Gray, dark-gray, dark-green, dark-brown, and nearly black, fine to coarse-grained dikes of gabbro (gb), gabbro with selvages of anorthosite (gba), diorite and diorite porphyry (di), diabase (d), dacite porphyry (da), and andesite (an)

px **pxb**
Pyroxenite and bronzite dikes
Dark green to nearly black, medium to coarse-grained pyroxenite dikes (px), locally altered to poor quality soapstone at contacts with intrusive biotite granite; pyroxenite and dark brown hornblende bronzite dikes undivided (pxb)

gln
Layered gabbro and norite complex
Dark-gray, dark-green, dark-brown, and nearly black layered intrusive complex; rocks are massive and give a distinctive resonant note when struck by hammer

dgb **gb** **gba**
Diorite, gabbro, and anorthosite
Gray, dark-gray, and dark-green, medium-grained, locally coarse-grained, massive to locally gneissic diorite and gabbro undivided (dgb) in intrusive complexes; dark green to nearly black gabbro (gb); and gabbro and anorthosite (gba)

gr
Granite
Light gray to pink or red calc-alkalic biotite granite, medium-grained, inequigranular to porphyritic; may include some biotite granite of the peralitic magma series

gg **gpg**
Biotite granite gneiss and biotite-hornblende granodiorite gneiss
Light gray to gray, fine to medium-grained, massive to strongly foliated nonmetamorphosed, biotite granite gneiss (gg) and biotite-hornblende granodiorite gneiss (gpg); common inclusions and veins of meta-andesite, hornblende schist, and biotite schist

sp **hsp**
Serpentinite
Dark green to brownish green serpentinite (sp); hornblende schist partly replaced by or completely intruded by serpentinite (hsp)

md **ad** **am**
Diorite, microdiorite, and amphibolite
Dark microdiorite, diorite, and gabbro, mainly biotite diorite, quartz-poor porphyroblastic gneiss (md); dioritic rocks completely mixed with meta-andesite (ad); gabbroic rocks metamorphosed to amphibolite (am)

sc **a** **cs** **bs** **lg**
csa **cs** **hs** **gm**
Meta-andesite and metagraywacke, chlorite schist, chlorite sericite schist, hornblende schist, biotite schist, layered gneiss, and marble
Interbedded meta-andesite and metagraywacke (a) including nearly nonmetamorphosed to lightly metamorphosed andesite, andesite lithic tuff, andesite agglomerate, graywacke siltstone and sandstone, limestone and dolomite (m); meta-andesite and serpentinite undivided (sa); sericite-chlorite schist (sc) formed from andesite and graywacke; chlorite schist (cs) formed from andesite; chlorite-sericite schist (csa) formed from andesite and graywacke with andesite dominant; hornblende schist (hs) generally equivalent to chlorite schist; hornblende-biotite schist (hbs); biotite schist and biotite gneiss (bs); undivided, interbedded hornblende schist, hornblende gneiss, biotite schist, and biotite gneiss (lg); marble (m)

SELECTED ELEMENTS IN RECONNAISSANCE SAMPLES

Showing sample numbers and results of spectrographic analyses of wadi sand

COPPER, ZINC, AND MOLYBDENUM

Location of samples with 20 ppm (parts per million) or less copper; also, less than 100 ppm zinc and 2 ppm or less molybdenum, unless otherwise indicated

Location of sample with 30 to 50 ppm copper; also, less than 100 ppm zinc and 2 ppm or less molybdenum unless otherwise indicated

Location of sample with 70-100 ppm copper; also, less than 100 ppm zinc and 2 ppm or less molybdenum unless otherwise indicated; Cu = threshold

Location of sample with 150 ppm copper; also, less than 100 ppm zinc and 2 ppm or less molybdenum; Cu = anomalous copper

ZINC

Threshold 100 ppm zinc; located by adjacent copper symbol

Anomalous 150-200 ppm zinc; located by adjacent copper symbol

MOLYBDENUM

Threshold molybdenum, 3-5 ppm; located by adjacent copper symbol

Anomalous molybdenum, 7 ppm; located by adjacent copper symbol

OTHER ELEMENTS

Ag, silver; B, boron; Ba, barium; Br, beryllium; Cr, chromium; Co, cobalt; Ga, gallium; La, lanthanum; Mn, manganese; Nb, niobium; Ni, nickel; Pb, lead; Sc, scandium; Sn, tin; Sr, strontium; Ti, titanium; V, vanadium; Y, yttrium; Zr, zirconium; located by adjacent copper symbol. In ppm, parts per million.

Other anomalous elements and values

Other threshold elements and values

Threshold element in detrital magnetite by chemical analysis: 100 Cu, 700 Zn, and 30-50 Mo; anomalous elements: 150, 225 Cu, 1000, 2000 Zn, and 70 Mo

Scheelite and/or powellite

Present in wadi sand (superimposed on symbol for copper)

MINERAL RESOURCES

METALLIC MINERAL DEPOSITS

Riah
Ancient mine or prospect

Gold mines: Riah, El Hlamiya north, El Hlamiya south, Jabal Ibn Hassan, Jabal Ibn Hassan extension. Gold prospect: Wadi Al Mushel. Zinc, copper, and silver mine: Ash Sha'ib

INDUSTRIAL MINERALS AND ROCKS

Quartz
A
Asbestiform minerals

Limestone and marble
Chemical analysis given in table 14 for sample number with asterisk

MINERALS OF LITTLE OR NO ECONOMIC IMPORTANCE

Allanite (Aln), clear calcite (Ca), graphite (Gt), limonite (ld), magnetite (Mg), muscovite (Ms), moscovite (Mo), pyrite (pyr), talc (Tc), gossan (gss)