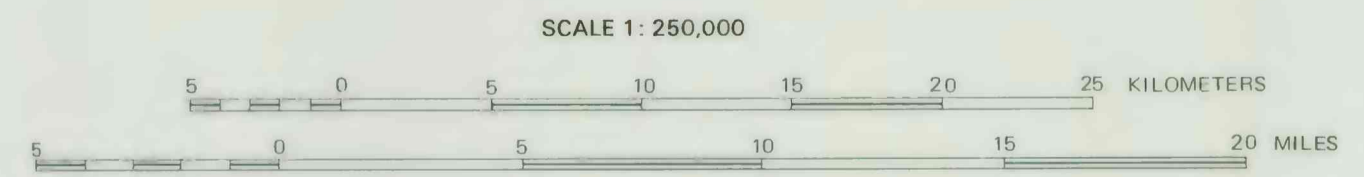


Original surveys supervised by B.R.G.M.  
1:250,000 assembly by the Riofines Geological Mission, 1980.  
For survey details see Airborne Magnetometer and Scintillation Counter  
Survey Reports of 1961-1962, 1965-1966, 1966-1967.

**LEGEND**

CONTOUR INTERVAL	20 GAMMAS
500 GAMMA CONTOUR	
100 GAMMA CONTOUR	
20 GAMMA CONTOUR	
MAGNETIC LOW	
RADIOMETRIC CONTOUR	
FIDUCIAL POINTS	
FLIGHT LINES	



Magnetic interpretation on a Universal Transverse Mercator projection. Geology is mosaicked to a UTM grid but geologic base adapted from lithologic maps prepared by the Riofines Geological Mission are on Lambert Conformal projection.

Geologic base from Riofines Geological Mission (1979). Geologic Explanation adapted from Riofines Geological Mission (1979).

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

**EXPLANATION**

**MAGNETIC INTERPRETATION**

- Boundary between rock units of different magnetic properties or of differing magnetic patterns. Dashed where location is uncertain. Dotted where boundary is buried beneath nonmagnetic rocks. Code letters (described below), where present, indicate which side is the more magnetic rock unit.
- M** Magnetic rock unit, lithology uncertain
- R** Magnetic rock unit possessing reverse remanent magnetization
- G,GR** Magnetic rock unit probably granitic in composition. Subscript "R" where rock unit possesses reverse remanent magnetization
- B** Magnetic rock unit probably mafic in composition
- Z,ZR** Zone of magnetic anomalies. Subscript "R" if more than half of the anomalies in the zone are magnetic lows that appear to be caused by rocks with reverse remanent magnetization
- 60** Approximate dip of magnetic boundary as estimated by comparison with a set of calculated models
- d/** Linear magnetic anomaly probably caused by a dike

**LAYERED ROCKS 1**

Include virtually unmetamorphosed to moderately metamorphosed (greenschist to lower amphibolite facies) and deformed rocks, with original volcanic and sedimentary character preserved.

**PREDOMINANTLY VOLCANIC ROCKS:** proximal volcanic sequences with flow rocks, volcaniclastic rocks, and minor sedimentary rocks of clastic and chemogenic origin.

- Undifferentiated mafic to felsic volcanic rock
- Predominantly andesitic volcanic rock
- Undifferentiated felsic volcanic rock (dacite to rhyolite)
- Predominantly rhyolitic rock
- Predominantly subaerial volcanic rock of felsic composition including tuff, breccia, agglomerate, ignimbrite, and so forth; in some areas has significant sedimentary component (tuffite, sandstone, siltstone). Grades into distal volcanic sequences
- Agglomerate and breccia
- Volcaniclastic conglomerate
- Extrusive-intrusive complex, mainly of dioritic composition including fine-grained diorite and andesite with some gabbro and sedimentary rock
- Extrusive-intrusive complex of ultramafic to mafic composition (so-called 'Ophiolite Complex') including gabbro, basalt, and serpentinite with subordinate greenstone, pyroxenite, and metasedimentary rocks. In most areas all strongly deformed

**MIXED VOLCANIC-SEDIMENTARY ROCKS:** distal volcanic sequences with flow rocks and volcaniclastic rocks interbedded with sedimentary rocks of clastic and chemogenic origin (siltstone, sandstone, conglomerate, chert, marble)

- Mixed volcanic-sedimentary rocks including andesite and rhyolite flow and pyroclastic rock, siltstone, chert, and conglomerate
- Interbeds of dacitic volcanic rock (flow rock and tuff) in sedimentary sequences
- Mixed volcanic-sedimentary rocks including siliceous vitric tuff, tuffaceous graywacke, and siltstone (in some places present as chlorite-sericite schist)

**PREDOMINANTLY SEDIMENTARY ROCKS**

In some areas include minor volcanic interbeds.

- Clastic rocks, mainly medium to fine-grained sandstone (impure arenite to graywacke) with some siltstone (chlorite-sericite schist) and conglomerate. Locally include volcanic interbeds
- Clastic rocks, mainly siltstone (argillite, pelitic schist, chlorite-sericite schist) and fine-grained sandstone (graywacke). Locally contain calcareous siltstone and sandstone, marble, and some volcanic interbeds
- Calcareous siltstone (argillite) and/or some marble and calcareous sandstone
- Clastic rocks, mainly coarse-grained lithic (volcaniclastic) sandstone with some conglomerate and argillite
- Clastic rocks, mainly graphitic siltstone, sericite-chlorite schist; locally include sericitic marble and conglomerate
- Undifferentiated, unmetamorphosed sedimentary rocks, including polymict conglomerate, sandstone, siltstone, variegated shale, and cherty limestone, with some andesite and rhyolite
- Limestone and marble, including black marble and gray dolomitic marble; locally include chert and commonly intraformational and extraformational (poly)mic conglomerate. Stromatolites reported from Jabal Damkh and Jabal al Badr areas
- Polymict conglomerate

**LAYERED ROCKS 2**

Include moderately to strongly metamorphosed and deformed rocks, the original volcanic and sedimentary character of which has been blurred or destroyed.

- Biotite schist, mainly in zones of contact metamorphism
- Amphibolite, mainly of volcanic derivation
- Heterogeneous paragneisses, including hornblende-biotite schist, amphibole gneiss, feldspathic amphibolite (metamorphosed andesite), metarhyolite, leucocratic quartzofeldspathic gneiss (metamorphosed rhyolite), chlorite-sericite-biotite and calc-schist (metamorphosed graywacke), quartzite, marble, and calc-silicate gneiss (metamorphosed impure dolomitic marble or marl)
- Biotite-hornblende-garnet gneiss, amphibolite, and biotite-hornblende schist (inferred to be mainly metamorphosed mafic volcanic rocks)
- Migmatite zones

**PLUTONIC ROCKS**

- Posttectonic alkalic granite (perthitic orthoclase-albite-sodic amphibole, and accessory biotite)
- Late to posttectonic calc-alkalic granite (two feldspar-hornblende-biotite) and granodiorite; locally alkalic. Accompanied by gabbro and diorite. Circa 556±23 to 518±12 Ma; postdates Murdama group. Typically has contact aureoles
- Microgranite ring dike (calc-alkalic biotite granite) grading to porphyritic rhyolite. Circa 571±22 Ma
- Graphitic (micro) granite porphyry; includes graphic granite and granophyre. Mainly calc-alkalic, in places soda-alkaline. Considered to be pre-Murdama group
- Heterogeneous granitic rocks including trondhjemite, granodiorite, and calc-alkalic granite. Commonly contain biotite and hornblende. Commonly linedated with inclusions of gabbro, diorite, and metamorphic rocks. Syn- to posttectonic with respect to the Huleiyah group; typically pre-Murdama group. One date of 590±12 Ma
- Biotite granite with numerous xenoliths of biotite schist and ultramafic rocks. Possibly equivalent to heterogeneous megacrystic granodiorite
- Granodiorite
- Heterogeneous syntectonic megacrystic granodiorite: ranges from quartz diorite to calc-alkalic granite. Typically linedated, schistose, or gneissic; commonly migmatitic with inclusions of country rock
- Undifferentiated, partly linedated, locally gneissic granitic rocks, including biotite-amphibole granite, trondhjemite, granodiorite, and diorite, with some inclusions of biotite gneiss. Age uncertain; possibly represent mobilized basement rocks
- Diorite to quartz diorite
- Foliated, metadiorite to quartz diorite with inclusions of country rock
- Gabbro
- Ultramafic rocks, largely serpentinite with some peridotite, pyroxenite, and gabbro. Associated with talc schist and marble (ultramafic rocks with carbonate)

**MINERALIZATION**

Major or dominant commodity	Host environment (shown under commodity symbol)
iron sulfides	VF Volcanic felsic
gold	VI Volcanic intermediate
copper	Va Volcanic mafic
	Vap Proximal volcanic/clastic
zinc	If Intrusive acid
lead	Ii Intrusive intermediate
	im Intrusive basic
silver	Iu Intrusive ultramafic
iron oxides	Scs Sedimentary clastic
tungsten	Scb Sedimentary carbonate clastic
	Scb Sedimentary carbonate
tin	M metamorphic
chromium	Sk skarn
fluorine (fluorite)	
niobium	Surface expression (shown on the left of commodity symbol)

**Types of mineralization (shown within commodity symbol)**

- disseminated
- stockwork/stringer zone/breccia fill
- shear/fracture vein filling
- stratiform-massive
- unknown

**AGE DATING**

- Whole rock Rb/Sr isochron
- Whole rock K/Ar isochron
- Rb/Sr determination on biotite

**OTHER SYMBOLS**

- Ancient working
- Ancient working, drilled
- Gossan
- Staining
- Mineralized outcrop
- Alteration zones

**SOURCES OF LITHOLOGIC DATA**

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- Riofines Geological Mission, 1979
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- Kashkary, A. A. R., 1974
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- Letalmet, J., 1979

**MAGNETIC INTERPRETATION OF THE WADI AR RAYN QUADRANGLE, SHEET 23H**

by  
**Andrew Griscom**  
1982