RECONNAISSANCE GEOLOGY OF THE JABAL HASHAHISH QUADRANGLE, SHEET 17/41 B, KINGDOM OF SAUDI ARABIA

by

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(INTERAGENCY REPORT 395)

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 82-286

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

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U.S. Geological Survey
Jiddah, Saudi Arabia
1982

An Interagency Report prepared by the
U.S. Geological Survey
Saudi Arabian Mission
for the
Ministry of Petroleum and Mineral Resources
Kingdom of Saudi Arabia

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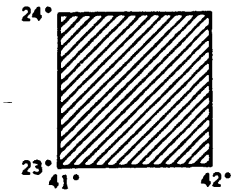
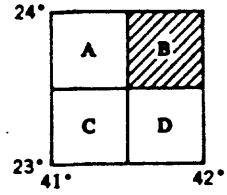


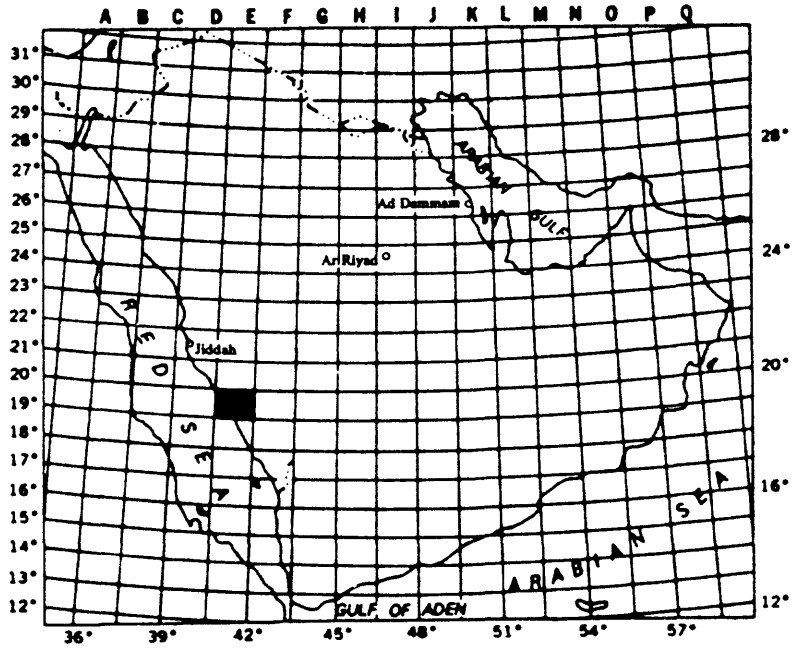
23/41

1-degree quadrangle



23/41 B

30-minute quadrangle



19E

1x1½-degree quadrangle

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ABSTRACT

The Jabal Hashahish quadrangle (sheet 17/41 B) lies between lat 17°30' and 18°00' N. and long 41°30' and 42°00' E. and encompasses an area of 2,950 km^2, of which only about 600 km^2 is land; the remainder is covered by the Red Sea. The geologic formations exposed in the quadrangle include Precambrian layered and intrusive rocks, Tertiary gabbro dikes, Quaternary basaltic lavas and pyroclastic rocks, and Quaternary surficial deposits.

The Precambrian rocks include layered sedimentary and volcanic rocks that have been assigned to the Baish, Bahah, and Ablah groups. These rocks have been folded, metamorphosed, and invaded by intrusions. They are cut by Miocene gabbro dikes that were intruded during the initial stages of the opening of the Red Sea rift. The Quaternary rocks also include basalt that was extruded during a continuation of that opening, after the uplift that formed the escarpment that parallels the eastern shore of the Red Sea, but before the Holocene erosional cycle. Coastal, pediment, and alluvial, and eolian deposits of various kinds are also of Quaternary age.

The economic potential of the quadrangle lies essentially in the agricultural value of its flood-plain deposits, though these are not so widely used as those in Wadi Hali and Wadi Yiba, which are located in the Manjamah quadrangle. The coral reefs possibly could provide raw materials for use in a cement industry, if any such industry were ever required in this area.

INTRODUCTION

The Jabal Hashahish quadrangle (sheet 17/41 B) lies between lat 17°30' and 18°00' N. and long 41°30' and 42°00' E. (fig. 1). It encompasses an area of 2,950 km^2, of which only about 600 km^2 is land; the remainder is covered by the Red Sea. The quadrangle is about 460 km southeast of Jiddah and 140 km northwest of Jizan. The coastal road from Jizan passes Jabal ar Rahabah on the way to Al Qahmah along the southern edge of the Wadi Dhahaban quadrangle; a road branches from this near Hisn al Awadi, in the east-central

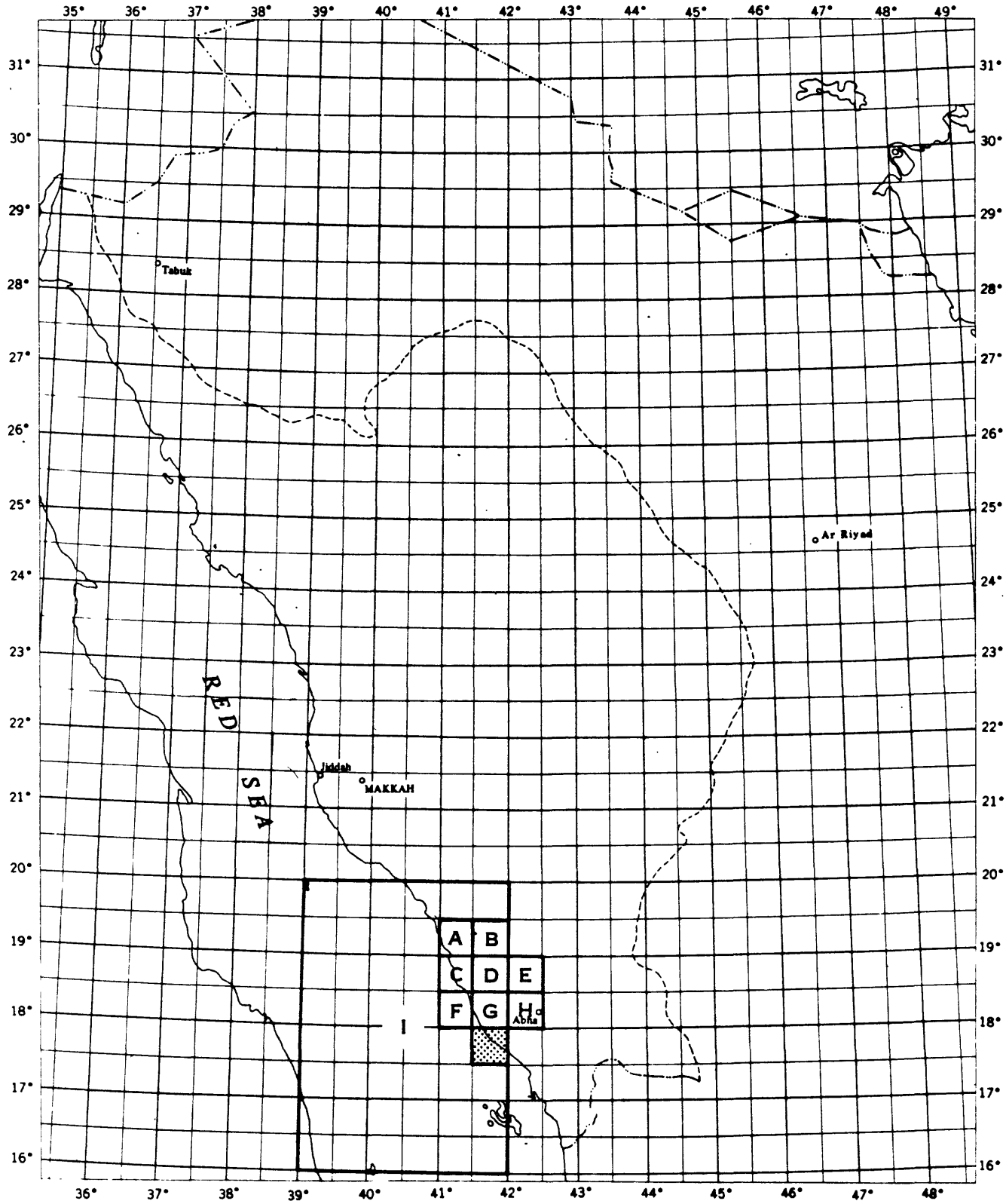

Figure 1.–Index map of western Saudi Arabia showing the location of the Jabal Hashahish quadrangle (shaded) and other quadrangles cited in this report: A, Al Qunfudhah (Hadley, 1975a); B, Wadi Yiba (Bayley, 1972); C, Manjamah (Hadley, 1984a); D, Wadi Hali (Hadley, 1975b); E, Jabal 'Aya (Prinz, 1975); F, Wadi Amq (Hadley, 1984b); G, Wadi Dhahaban (Hadley, 1984c); H, Jabal Sawdah (Ratte and Andreasen, 1974); I, Tihamat ash Sham (Brown and Jackson, 1958).

part of the Jabal Hashahish quadrangle, and follows Wadi Nahb, then continues toward Mukaylah.

The broad geologic features of the area are shown on the 1:500,000-scale map of the Tihamat ash Sham quadrangle (Brown and Jackson, 1958). The area and its surroundings are shown on the 1:2,000,000-scale map of the Arabian Peninsula (U.S. Geological Survey and Arabian American Oil Company, 1963). More detailed work and mineral-resource studies were started in 1970 and have included work on the following nearby quadrangles: Wadi Yiba, 19/41 D (Bayley, 1972); Jabal Sawdah, 18/42 C (Ratte and Andreasen, 1974); Al Qunfudhah, 19/41 C (Hadley, 1975a); Wadi Hali, 18/41 B (Hadley, 1975b); and Jabal 'Aya, 18/42 A (Prinz, 1975).

Fieldwork was done by the author in the Jabal Hashahish, Manjamah, 18/41 A (1982a), Wadi Amq, 18/41 C (1982b), Wadi Dhahaban, 18/41 D (1982c) quadrangles between mid-December 1973 and late March 1974; he was assisted in the field and office by Ghanim Jeri Alharbi, Yacob Essa Takrony, Murshid Abdo Ahmad, and Saud Muslih Ashaybani; logistic, drafting, and laboratory support were provided by the Directorate General of Mineral Resources.

All the work on the Jabal Hashahish quadrangle was done under an agreement between the Saudi Arabian Ministry of Petroleum and Mineral Resources and the U.S. Geological Survey.

PRECAMBRIAN ROCKS

Layered rocks

The Precambrian layered rocks of the Jabal Hashahish quadrangle are assigned to the Baish, Bahah, and Ablah groups. Those assigned to the Baish group include mafic to intermediate volcanic rocks, sedimentary rocks, and some chert; those assigned to the Bahah and Ablah groups are all of sedimentary origin. The rocks have been intruded by syntectonic and posttectonic granodiorite to granite intrusions and have been strongly affected by faults with north- to north-northwest trends. These faults are parallel with the Miocene gabbro dikes, the escarpment at the edge of the mountainous hinterland of the Arabian Shield, and the trend of the Red Sea rift.

The layered rocks have been regionally metamorphosed to greenschist facies and contact metamorphosed to amphibolite facies by the granodiorite to granite intrusions, which are

themselves gneissose in some places near their margins. Despite this metamorphism, the original character of the rocks can generally be determined.

Baish group

The Baish group (Schmidt and others, 1973) includes the oldest rocks in the quadrangle and is represented in the Jabal Hashahish quadrangle by moderately to strongly schistose basalt, andesite, related volcaniclastic rocks, graywacke, slate, argillite, and chert, which crop out over a small area between rocks of the Bahah group and a granodiorite to quartz monzonite intrusion in the northeastern part of the quadrangle. The lava flows include green to dark-green rocks, commonly amygdaloidal and porphyritic, with phenocrysts 0.2 to 2 cm long in a fine-grained chloritic groundmass; most of the amygdules are filled with chlorite, but some contain calcite, quartz, and (or) epidote. The volcaniclastic rocks include several kinds of tuffs and agglomerates, are gray, green, red, or tan, and are fine to medium grained except for the agglomerates, in which the clasts are as much as 30 cm in diameter. Most of the bedding in these rocks and sedimentary structures in the graywacke, slate, and argillite has been obliterated by shearing. The tuffs are commonly spotted or mottled where this shearing has affected feldspar fragments and lapilli or where they contain limonitic siderite rhombs.

Bahah group

In a small area west of the Baish group, outcrops of graywacke, siltstone, and argillite have been assigned to the Bahah group (Schmidt and others, 1973); lavas and tuffs that are associated with these rocks to the north appear to be missing in the Jabal Hashahish quadrangle.

Ablah group

The most abundant Precambrian rocks in the Jabal Hashahish quadrangle include schistose siltstone, graywacke, quartzite, and conglomerate assigned to the Ablah group. Similar and more highly metamorphosed rocks that belong to the same structural unit in nearby quadrangles have been assigned to the Hali group (Ratte and Andreasen, 1974; Prinz, 1975), but the balance of recent opinion is that these rocks represent different metamorphic facies of stratigraphically equivalent rocks that have all been assigned to the Ablah group by Schmidt and others (1973) and by Hadley (1975b). The nonconglomeratic rocks in the unit are fine to medium grained, tan and gray, and contain abundant biotite and sericite; bedding and other sedimentary structures are poorly preserved. The conglomerate is poorly sorted and contains clasts as much as 30 cm in diameter composed mainly

of metavolcanic, metasedimentary, and lesser amounts of metaplutonic rocks.

Intrusive rocks

Granodiorite to quartz monzonite

A granodiorite to quartz monzonite pluton that occupies about 60 km^2 in the southeastern corner of the adjoining Wadi Dhahaban quadrangle extends southward about 3 km into the Jabal Hashahish quadrangle. The rocks of the pluton are light gray, medium grained, leucocratic, and strongly gneissose near the margins of the intrusion. The Baish group country rocks have been strongly metamorphosed and foliated by emplacement of the granodiorite to quartz monzonite pluton. The pluton was intruded probably during syntectonic deformation of the Ablah group.

Quartz monzonite

Quartz monzonite forms a small outcrop 4 km northeast of Jabal Hashahish in the north-central part of the quadrangle; it probably represents a large intrusion that is otherwise covered by alluvium and sand. The rock is light orange, medium grained, and equigranular; it is strongly weathered and consequently very friable. Quartz, microcline, and plagioclase in roughly equal proportions make up about 90 percent of the rock, the remainder being biotite, opaque minerals, sphene, apatite, and epidote.

Granite

An irregularly shaped granite intrusion along the eastern side of Wadi Nahb, in the northeastern part of the Jabal Hashahish quadrangle, has been weathered and eroded so that only a few isolated inselbergs rise from a plain covered with granitic detritus. The granite is friable, medium grained, leucocratic, and equigranular to hypidiomorphic-granular.

TERTIARY ROCKS

Gabbro dikes

One Miocene gabbro dike crosses the northeastern corner of the quadrangle, several penetrate about 2 km from the Wadi Dhahaban quadrangle to the north, and a short but wide branching dike cuts the granite just described. These dikes are part of a system that has yielded potassium-argon (K/Ar) whole-rock dates ranging from 19 to 27 million years (m.y.) ago, averaging 22 m.y. (Brown, 1972; Blank, 1978). They were intruded toward the close of the initial opening of the Red Sea rift. The dikes are composed of clinopyroxene and plagioclase with accessory magnetite, chlorite, and apatite,

and have gabbroic to ophitic textures; hornblende is common to abundant in some of them. Sheeted dikes exposed just south of the quadrangle area have been formed by intrusion in at least three pulses.

QUATERNARY ROCKS AND DEPOSITS

Volcanic rocks

Basalt flows surround cinder cones such as Jabal Hashahish and cover more than 60 percent of the land area of the quadrangle (fig. 2). Survival of easily eroded volcanic features such as these cinder cones, relationships with underlying alluvium and weathered bedrock, radiometric age determinations of 0.5 m.y. or less (Ghent and others, 1979), and superposition of successive flows show that the eruptions occurred periodically during Quaternary time. Basaltic volcanism is known to have continued into historic times in the Al Madinah area in the northern part of the Shield. The basalt flows are therefore interpreted as having resulted from the continuation of the opening of the Red Sea rift after intrusion of the Miocene gabbro dikes. The composition of the flow rocks (alkali olivine basalt) and pressure-temperature calculations based on the composition of inclusions suggest that the flows were derived from partial melting of the upper mantle (Ghent and others, 1979).

The surfaces of the basalt fields are composed of angular blocks of lava as much as 40 cm in diameter. The flow rocks beneath are vesicular, columnar basalt. No detailed stratigraphic succession of flows has been worked out but, in general, the dark flows overlie older flows of lighter color. In places, the flow rocks overlie loosely consolidated tephra, and both are underlain in places by Precambrian rocks that are weathered and stained with hematite to a depth of as much as 30 cm; in other places, the basalt and tephra overlie alluvium.

Many large cinder cones rise above the general level of the basalt fields, and one cone forms an island about 3 km west of the coastline. Some of the cones are well preserved, with a complete, enclosed, bowl-shaped central vent, but most are partly eroded, in some instances to the extent that the vent or vents have been breached or completely obliterated. Most of the cones have a single vent, but composite cones may have as many as six overlapping or separate vents. A cone in the northwestern part of the quadrangle is composed entirely of stratified cinders in 2- to 4-m thick massive beds and finer grained, laminated beds that are 0.5 to 1 m thick. The cinders are red, reddish orange, gray, brown, and black, and enclose a few volcanic bombs and pieces of ropy lava. A cone with several breached vents near the southern margin of the

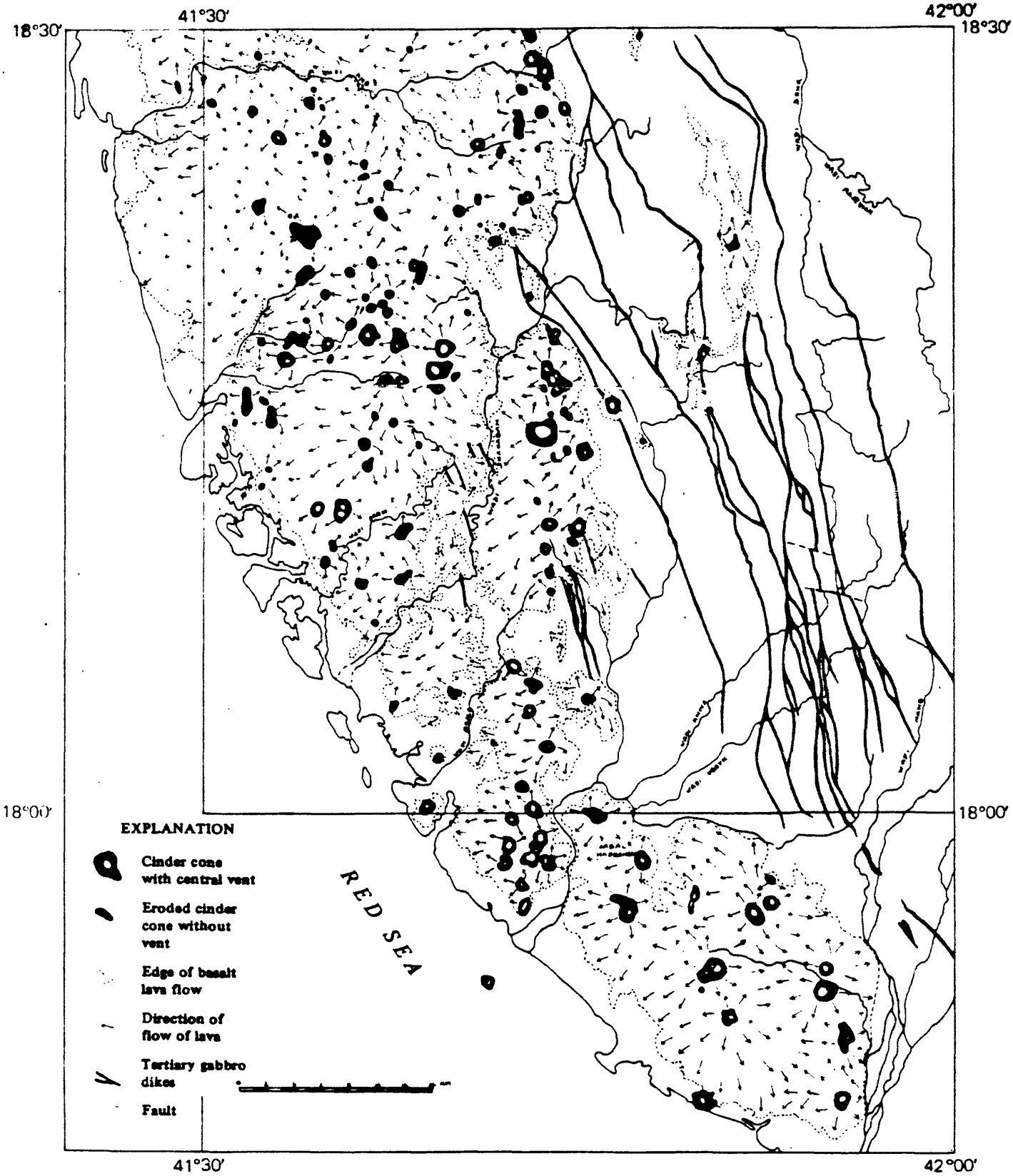

Figure 2.– Generalized map of the Wadi Dhahaban quadrangle and adjoining areas showing Tertiary dikes and Quaternary volcanic features.

volcanic field consists of reddish-gray, pumiceous cinder andwelded tuff, which contains abundant lithic fragments, some of which appear to be red granophyre and may be products of differentiation at depth.

The basalt is unaltered and contains, in order of decreasing abundance, twinned labradiorite laths, clinopyroxene, olivine, magnetite, iddingsite, and apatite; some of its very abundant vesicles are partly filled with white calcite. Euhedral olivine and augite xenocrysts as much as 3 cm long are embedded in the basalt or have been weathered out and strewn over the flows. Abundant fragments of harzburgite, websterite, and gabbro as much as 4 cm in diameter occur on the slopes of some of the cinder cones. Both the xenocrysts and these blocks are considered to represent material derived from the mantle or lower crust (Ghent and others, 1979).

The tephra occur as black, flat-lying, well-stratifed layers with beds 2 to 25 cm thick; similar material on the cinder cones is dark red. The beds are graded and consist of ejecta ranging up to 3 mm in diameter.

Surficial deposits

Shallow bank and coral reef deposits

Shallow bank and coral reef deposits are present along the coast and around the offshore volcanic island. The reef deposits, which are still forming, consist of cemented accumulations of the skeletons and shells of many kinds of coral, gastropods, brachiopods, and pelecypods. The bank deposits are a mixture of calcareous and terrigenous muds, the latter dominating those along the coastal margin.

Pediment and plains deposits

Pediments and derived deposits cover extensive areas around the basalt fields and in the valley of Wadi Nahb. They consist of boulder- and cobble-sized material on the steep flanks of outcrops, and of gravel, sand, and silt washed from the coarse material into flat areas below the steep slopes. These abundant deposits have resulted from the rapid erosion caused by disturbance of the balance of coastal-plain drainage by the eruption of great thicknesses of basaltic rocks.

Alluvial sand and gravel deposits

Sand and gravel deposits form the floors of all the main wadis and their tributaries and consist of tan to brown, subangular to well-rounded, unstratified to well-stratified material that is commonly crossbedded and fills channels.

Wadi flood-plain deposits

Extensive flood-plain deposits have formed along the major wadis, and consist of tan silt with subordinate amounts of fine-grained sand and clay; these deposits are as much as 4 m thick and are generally unstratified. New material is deposited during periods of intermittent flooding in the low-energy environments of high ground within the wadis and marginal to the main channels.

Sabkhah deposits

The sabkhah deposits are present along the coast, between the edges of the basalt outcrops and the shallow bank and coral reef deposits of the shoreline. They are flats composed of brown and white saline silt with partly indurated crusts 1 to 3 cm thick.

Eolian sand deposits

Eolian sand deposits form dune fields that are present along the coast and between the basalt and the shoreline deposits. They consist of fine- to medium-grained tan sand that forms dunes as much as 7 m high, separated from each other by wind-deflated barren ground.

ECONOMIC GEOLOGY

The economic potential of the Jabal Hashahish quadrangle lies essentially in the agricultural value of its flood-plain deposits along Wadi Nahb in the southeastern part, and Wadi Najla in the northern part of the quadrangle. These plains benefit from the frequent rainfall in the escarpment province and the refreshment of their soils with the products of the weathering and erosion of the Precambrian rocks and possibly also derivatives from the Quaternary volcanic rocks. However, agricultural activities are less intense in this quadrangle than along Wadi Hali and Wadi Yiba in the Manjamah quadrangle. The coral reefs could provide raw material for use in a cement industry if any such industry were ever required in this area.

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