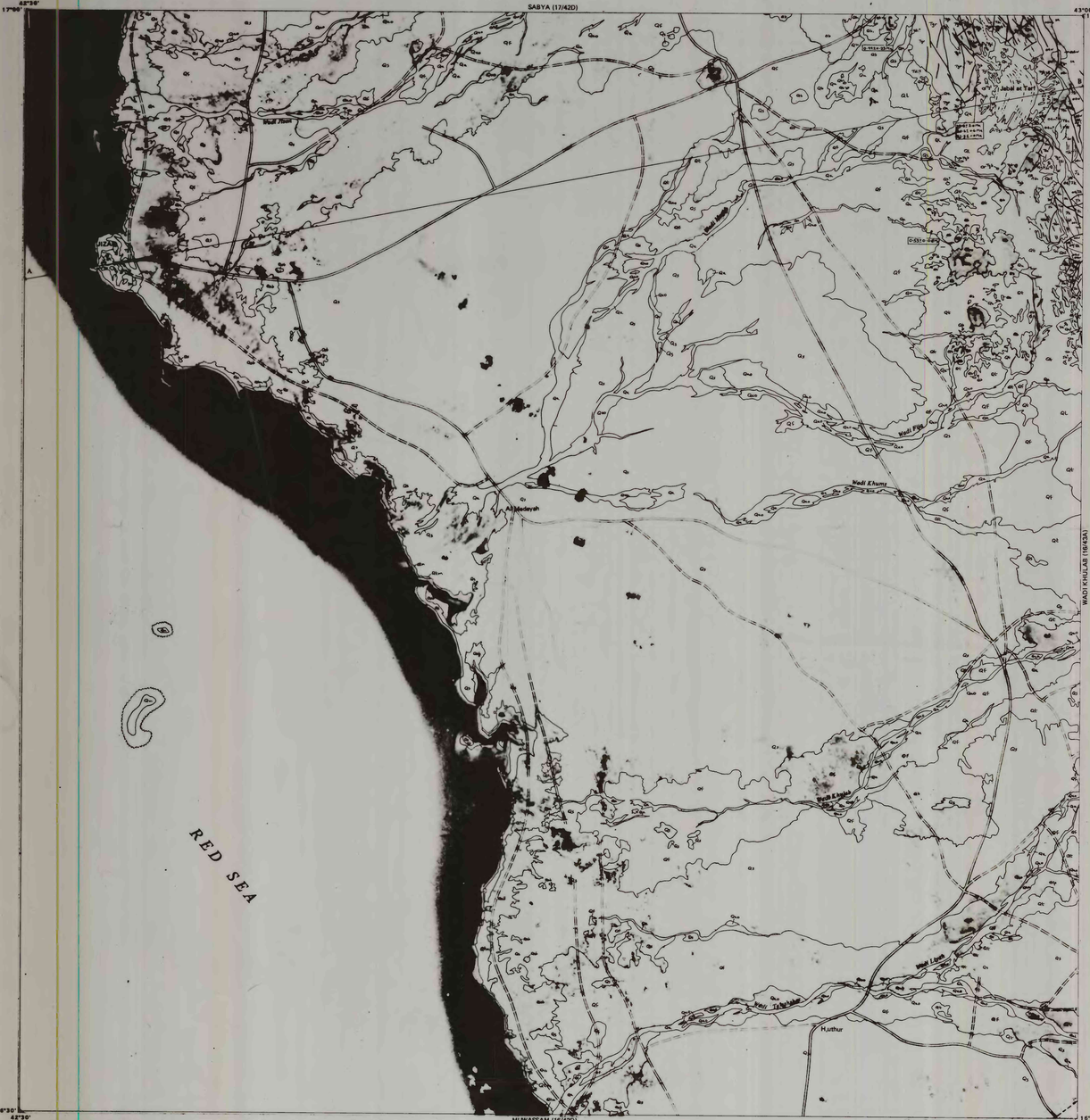
U.S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY, PREPARED FOR
MINISTRY OF PETROLEUM AND MINERAL RESOURCES
DEPUTY MINISTRY FOR MINERAL RESORCES

OPEN-FILE REPORT 85-724
PLATE 1



Aerial photography and controlled mosaic 1961-1963.
Aero Service Corporation, Philadelphia, Penn. USA.
Lambert conformal conic projection, standard parallels 17° and 35°

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

Geology mapped in 1977, 1978, and 1984
The position of the international boundary on this map is not to be taken as definitive

TRUE NORTH

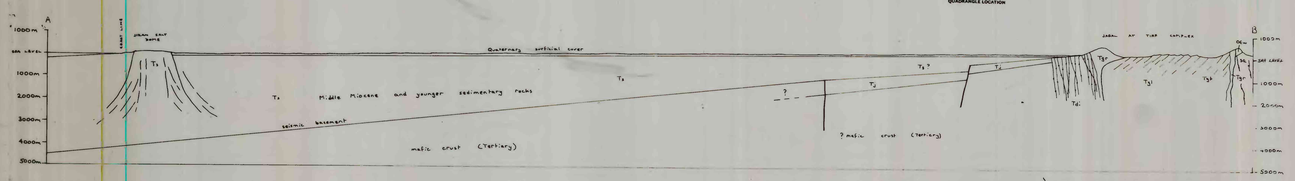
SCALE 1 : 100 000

2 0 2 4 6 8 10 KILOMETERS

2 0 2 4 6 8 10 MILES

DATUM IS MEAN SEA LEVEL

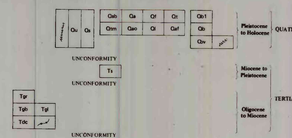
QUADRANGLE LOCATION



RECONNAISSANCE GEOLOGIC MAP OF THE JIZAN QUADRANGLE, SHEET 16/42 B, KINGDOM OF SAUDI ARABIA

By
H. Richard Blank, Jr. and Mark E. Gettings
1985

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

QUATERNARY SURFICIAL DEPOSITS

CORAL REEF--Present-day reef line shown by hachures

Qu QUATERNARY DEPOSITS UNDIVIDED--Chiefly loessic silt adjacent to Pleistocene volcanoes east of Abu Arish. The silt forms graded surfaces about 20 to 30 m above the present active drainage system

Qs EOLIAN SAND--This, most widespread surficial unit in the quadrangle, consists of beach sand, linear and barchan dunes, and extensive veneer of sand, overlying old flood plain and loessic deposits

SABKHA AND TIDAL DEPOSITS:

Qsb Sabkha deposits--Consist of supratidal accumulations of mud and clay interstratified and incrusted with minor halite and gypsum. In many cases encroached by sand and silt deposited in deltas formed by present-day streams as they approach the coast (Qtm)

Qtm Tidal deposits--Consist of mud and clay accumulations within the tidal zone; they grade laterally into sabkhas

Qa ALLUVIUM--Sand, gravel, and silt of modern active drainage system

Qao OLDER ALLUVIUM--Forms terraces within and on the flanks of active channels

Qf FLOOD-PLAIN DEPOSITS--Deposits of silt, sand and gravel, locally interspersed with boulders, between the main channels of the modern drainage system. The unit correlates north with alluvial terrace deposits of the Sabya quadrangle. It is thought to be of Pleistocene and Holocene age (Fairer, 1983)

Qf REWORKED LOESS--Deposits of reworked loessic silt and sand, forming a surface at slightly higher elevations than the flood-plain deposits, at the eastern margin of the coastal plain

Qt Qaf LOESS AND INTERSTRATIFIED SAND AND GRAVEL--These deposits (Qt) are confined to the eastern part of the quadrangle, and form graded surfaces of low relief on the alluvial terraces between the main stream channels. Much of the coarse component of the unit appears to have originated by sheet flow; upslope, the material coalesces with alluvial fans and debris from possible mudflows (Qaf)

PHANEROZOIC INTRUSIVE ROCKS

THIAMAT ASIR COMPLEX--The unit is an intrusive complex of probable mantle derivation believed by some authors to represent oceanic material emplaced in extensional structures at the boundary between the Arabian craton and the Red Sea (Coleman and others, 1979). Potassium-argon dating indicates a late Oligocene to early Miocene age (23.3±1, 23.0±2, and 20.6±0.06 Ma: Coleman and others, 1972)

Tgr Granophyre--Medium-grained leucocratic granophyric rock intrudes the sheeted dike complex and the eastern margin of the Tihamat Asir gabbro as a ring dike, and intrudes the western margin of the gabbro as a pluton partly covered by Quaternary basalt. The granophyre is of monzogranite composition and was probably derived from a parent magma similar to that of the gabbro, by fractional crystallization and/or by contamination of the magma by Precambrian continental crust

Tgb Tgl Gabbro--An arcuate body of gabbro (Tgb) and layered gabbro (Tgl), unit crops out on the northern edge of the quadrangle. Its geologic relations and chemistry indicate that it is genetically related to and contemporaneously with rocks of the sheeted dike complex (Coleman and others, 1979). The layered intrusion consists of rhythmically layered clinopyroxene olivine gabbro and clinopyroxene gabbro. The layers are as much as 1 m thick and dip between 40° and 60° to the southwest. Labradorite constitute between 46 and 74 percent of the rock, the mafic silicates include 23 to 42 percent augite and 7 to 22 percent olivine. Olivine is mostly concentrated in lower layers of the intrusion, and clinopyroxene is in the upper layers. In places, particularly in the upper part of the intrusion the layered gabbro passes into unlayered gabbro

Tdc Sheeted dike complex--The most widespread component of the Tihamat Asir complex consists of mafic and felsic dikes which crop out from the Yemen border southeast of the quadrangle to Ad Darb, over 100 km to the northwest. In the Jizan quadrangle, the dikes are particularly abundant and form a sheeted dike complex (Tdc). The complex consists of diabase, basalt, and gabbro dikes between 0.5 and 18 m thick, subordinate rhyolite and dacite dikes, and screens of mainly Tertiary volcanic country rock. Where the dikes are most abundant, the complex is composed of dike-on-dike intrusive rocks

Dike rocks--Symbolized by line ornamented with dots; consists of mafic and felsic dikes of uncertain age, but probably forming part of the Tihamat Asir complex

PHANEROZOIC LAYERED ROCKS

PLEISTOCENE TO HOLOCENE ALKALI-OLIVINE BASALT--Small volcanoes of Pleistocene to Holocene age, 100 to 150 m high, near the eastern margin of the coastal plain. Lavas have been dated by the potassium-argon method as 0.99±0.23 Ma and younger (Coleman and others, 1983)

Qb1 Qb Lava flows (Qb) and more recent lava flows (Qb_1) consist of vesicular, fine-grained, black to dark-greenish-gray alkali-olivine basalt that contains partly recrystallized inclusions of granite, amphibolite, and sandstone

Qbv Cinder cones (Qbv), mostly breached by lava, consist of crudely bedded outward-dipping agglutinated to unconsolidated basaltic lapilli, bombs, cinder, and minor flows deposited around a central vent; the unit contains inclusions of granite, amphibolite, and sandstone. On the map the crater walls are outlined by the hachured symbol

Ts SEDIMENTARY ROCKS UNASSIGNED (TERTIARY)--Includes interbedded and strongly deformed halite, gypsum, sandstone, and fine-grained sedimentary rocks that crop out in a diapiric salt dome at Jizan city on the Red Sea coast. Of probable middle to late Miocene age, the rocks are part of a widespread succession of clastic and evaporic sedimentary rocks 4-5 km thick occuring on the margins of the Red Sea

Sandstone, conglomerate, and gypsum exposed in a rift of raised coral reef off Wadi Khulab are correlated with rocks in the Jizan salt dome

At Jizan city, the salt was formerly excavated. Both the halite and gypsum potential have been assessed but no commercial exploitation has been recommended (Baltes, 1956; MidEast Industries, Ltd., 1966; Roger, 1980)

Js AMRAM FORMATION--Dolomitized limestone, calcarenite, and micrite overlain by interbedded argillaceous limestone, micrite, biosparite, biomicrite, sandy limestone, marl, and subordinate intraformational conglomerate, shale, siltstone, and sandstone. Fossils abundant, indicating a middle to late Jurassic age (Callovian to Oxfordian) for the lower part of the succession and an upper Jurassic age (Oxfordian to Kimmeridgian) for the upper part. The formation conformably overlies the Khums formation. The top of the formation is intruded by the Tihamat Asir complex. Outside the quadrangle, the formation is unconformably overlain by the Tawlah formation and the Jizan group

Jk KHUMS FORMATION--Interbedded sandstone, silty sandstone, siltstone, shale, and rare conglomerate, 20-130 m thick, overlain by massive to cross-bedded, medium- to coarse-grained sandstone as much as 290 m thick. The unit disconformably overlies the Wajid Sandstone although in most places the contact is faulted; overlain by the Amran formation. The formation probably early Jurassic in age (Anderson, 1979). Sandstone in the Khums formation consists of quartz arenite, subarkose, and immature subarkose. The detrital grains texturally more mature, and authigenic silica cement more abundant than in the Wajid Sandstone. The formation also distinguished from the Wajid Sandstone by trough-shaped cross-bedding, from a few centimeters to 0.5 m thick. The cross-sets separated by planar erosion surfaces or planar-bedded sandstone. The formation was deposited in a fluvial environment and probably derived from a northerly source

OC/Jk OCw WAJID SANDSTONE--An assemblage of medium- to coarse-grained sandstone, interbedded with Jk subordinate pebble conglomerate and iron-stained siltstone. Of probable Cambrian to Ordovician age, the sandstone was deposited in a fluvial environment on weathered and peneplained rocks of the Arabian Shield. It was derived from a southerly source. During the Tertiary, widespread gravity sliding at the basal contract produced a thin breccia horizon. The sandstone is conspicuously crossbedded, in tabular, torrential cross-sets ranging from 0.5 to 4 m in thickness. The rock is moderately to well-sorted and consists of quartz arenite, subarkose, and immature subarkose. Conglomerate is composed of vein quartz, minor schists, granite, and diabase pebbles. In places the Wajid sandstone resembles the Khums formation; where its identity is uncertain, it is symbolized OC/Jk

PROTEROZOIC GRANITOID ROCKS

gn GRANITE AND GRANODIORITE--These rocks constitute a unit of foliated to gneissic leucocratic biotite or biotite-muscovite granite and granodiorite. They contain abundant inclusions and large pendants of the Sabya formation (Blank and Gettings, 1984). The unit forms the outer part of the Shada pluton (quadrangle 16/43A) and represents a synkinematic intrusion emplaced in the Sabya formation penecontemporaneously with intrusion of the biotite granite unit

PROTEROZOIC LAYERED ROCKS

sa SABYA FORMATIONS--An assemblage of sericite-quartz schist and chlorite-sericite-quartz schist interbedded with subordinate muscovite-quartz schist, chlorite-muscovite-quartz schists, quartz-carbonate-sericite schist, greenstone, greenschist, and amphibolite-feldspar quartz schist. The formation extends south from the Sabya quadrangle (Fairer, 1983) where it represents a flyschlike succession of mainly continental derivation

EXPLANATION

CONTACT--Dashed where uncertain

TREND OF LAYERING--In layered gabbro

STRIKE AND DIP OF BEDDING

FAULT

QUARRY

HA HALITE

PAVED ROAD

DIRT TRACK

GEOCHRONOLOGIC DATA

INTERNATIONAL BOUNDARY--Approximately located

INTRODUCTION

The Jizan quadrangle, bounded by lat 16°30' and 17°00' N. and long 42°30' and 43°00' E., is one of the southernmost quadrangles of the Kingdom of Saudi Arabia. It is named after Jizan, the largest city and principal port of the region, with about 30,000 inhabitants. Other significant towns and villages include Abu Arish, Al Madayah and Karbus, all linked to Jizan and adjoining quadrangles by paved roads.

Most of the quadrangle is occupied by coastal plain bordering the Red Sea; one third is occupied by part of the Red Sea and the extreme northeast corner includes foothills of the Red Sea escarpment.

The coastal plain, as much as 40 km wide, is covered by Quaternary surficial deposits overlying a sequence of Tertiary and Quaternary sedimentary rocks as much as 5 km thick. The only relief on the plain is provided by the Jizan salt dome, elevated about 50 m above sea level at Jizan city, and by small extinct volcanoes 100 to 150 m high near Abu Arish. The coastal plain is separated from islands, tidal mud flats and shallow lagoons. The sea is shallow, less than 200 m deep, and forms part of the shelf marginal to the main axial trough of the Red Sea. The high ground in the northeast of the quadrangle is formed by Jabal at Tirf, 452 m above sea level at its summit.

PREVIOUS AND PRESENT WORK

The earliest geologic investigations in the quadrangle were by Wade (1931) and Richter-Bernburg and Schott (1954). In 1959, the area was included in the 1:500,000-scale geologic map of the Asir quadrangle (Brown and Jackson, 1959). Early geophysical studies were conducted by Compagnie Generale de Geophysique (1959), Agocs and Keller (1962), Hunting Survey Corp. Ltd. (1962) and Petromin (cited by Gillman, 1968). Gillman (1968) described the stratigraphy and subsurface structure of the quadrangle, and Brown (1972) incorporated data from the area in a tectonic map of Arabia. Studies of the Tertiary volcanic and intrusive rocks at the eastern margin of the coastal plain and discussions of their significance with respect to the opening of the Red Sea have been published by Coleman and others (1972), Blank (1977),"Coleman and others (1977), Coleman and others (1979), Gettings (1977), Kellogg and Blank (1982), Schmidt and others (1982), and Coleman and others (1983).

Important subsurface structural data is provided by the results of a deep-refraction seismic profile across western Saudi Arabia, a part of which transects the Red Sea shelf and the coastal plain just north of the quadrangle (healy and others, 1982).

Halite and gypsum resources at the Jizan salt dome have been assessed by Baltes (1956), MidEast Industries, Ltd. (1966) and Roger (1980) and the potential of the extinct volcanoes for lightweight aggregate has been considered (Roger, 1980).

The present geologic map is based on mapping of the outcropping strata in the east of the quadrangle in 1977 and 1979, photointerpretation of the Quaternary surficial deposits on the coastal plain, and a brief field reconnaissance in 1984 by consultants for the U.S. Geological Survey (Johnson and Vranas, 1984). A 1:250,000-scale map incorporating the Jizan quadrangle has recently been compiled (Blank and others, in press)

GEOLOGIC SETTING

The Jizan quadrangle spans the boundary between Proterozoic crystalline rocks of the Arabian Shield and Tertiary to Quaternary rocks of the Red Sea margin. The region is marked by a fundamental transition from crust of average continental density and thickness on the east to a very much denser, thinner, and highly dike-injected crust on the west (Healy and others, 1982). Accumulating geologic and geophysical data suggest that the transition results from attenuation of continental crust and emplacement of oceanic material during the separation of Arabia and Africa and the opening of the Red Sea, although the machanism and timing of this emplacement and the proportions of new oceanic material and continental crustal material remaining in the crust is the subject of considerable debate (Lowell and Genik, 1972; Blank, 1977; Gettings, 1977; Coleman and others, 1979; Schmidt and others, 1982; Cochran, 1983).

The crystalline shield is represented by metasedimentary schists of the Sabya formation in the extreme northeast corner of the quadrangle. These are overlain by the Cambrian to Ordovician Wajid Sandstone, Lower Jurassic Khums Formation and the Middle to Upper Jurassic Amran Formation, that crop out at the eastern margin of the coastal plain. The Phanerozoic rocks were deposited on the Arabian Shield in environments characterized by fluctuations in the position of the shore line and the depths of water in response to epeirogenic movements in the shield.

Younger rocks consist of the dike swarms and plutonic intrusions of the Tertiary Tihamat Asir complex. These rocks were probably derived from the mantle and were emplaced in extensional structures during an early phase of continental separation in the region (Coleman and others, 1979). During this early phase the crustal rocks of the region were tilted toward the proto-Red Sea resulting in the formation of east-dipping listric faults and a detachment fault or gravity slide at the base of the Wajid Sandstone (Kellogg and Blank, 1982). Following the first phase of opening of the Red Sea, a thick succession of Upper Tertiary clastic and evaporitic sedimentary rocks were deposited. They occur beneath the coastal plain, as is known from bore holes north and west of the quadrangle, and from exposures in the salt domes at Jizan and in Wadi Khulab. Other anticlinal structures beneath the coastal plain are probably also salt diapirs. Renewed continental separation in the Pleistocene resulted in formation of the volcanoes near Abu Arish. Separation continues to the present in the axis of the Red Sea. Such movement caused a volcanic eruption in 1810 AD (Simkin and others, 1981) and is the probable cause of seismicity in the region; the epicenter of an earthquake which reached 6.2 on the Richter scale was located just northeast of the quadrangle (Landry and other, 1978).

DATA STORAGE

No entries or updates have been made to the Mineral Occurrence Documentation System (MODS) data bank. Field and petrographic data in support of this map are filed in Data File USGS-DF-04-36.

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JR-703