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NATURAL RESOURCES PROGRAM

SPACE APPLICATIONS PROGRAMS

TECHNICAL LETTER NASA-43

U.S. Geological Survey
Department of the Interior

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

Technical Letter
NASA-43
August 1966

Dr. Peter C. Badgley
Chief, Natural Resources Program
Office of Space Science and Applications
Code SAR, NASA Headquarters
Washington, D.C. 20546

Dear Peter:

Transmitted herewith are 2 copies of:

TECHNICAL LETTER NASA-43

GEOLOGICAL UTILIZATION OF GEMINI COLOR PHOTOGRAPH OF

DUBA AREA, SAUDI ARABIA*

by

Robert F. Johnson**

and

Jules A. MacKallor***

Sincerely yours,

William A. Fischer
Research Coordinator
Earth Orbiter Program

*Work performed under NASA Contract No. R-09-020-015
**U. S. Geological Survey, Jidda, Saudi Arabia
***U. S. Geological Survey, Washington, D. C.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TECHNICAL LETTER NASA-43

GEOLOGICAL UTILIZATION OF GEMINI COLOR PHOTOGRAPH OF DUEA AREA, SAUDI ARABIA*

by

Robert F. Johnson**

and

Jules A. MacKallor***

August 1966

These data are preliminary and should
not be quoted without permission

Prepared by the Geological Survey
for the National Aeronautics and
Space Administration (NASA)

*Work performed under NASA Contract No. R-09-020-015
**U.S. Geological Survey, Jidda, Saudi Arabia
***U.S. Geological Survey, Washington, D. C.

Photo copies of illustrations are available for viewing at the following places:

Author(s); Discipline Coordinators; NASA Data Bank (Houston); Remote Sensing Evaluation and Coordination Staff (RESECS) and the U.S. Geological Survey Libraries (Denver, Menlo, Washington).

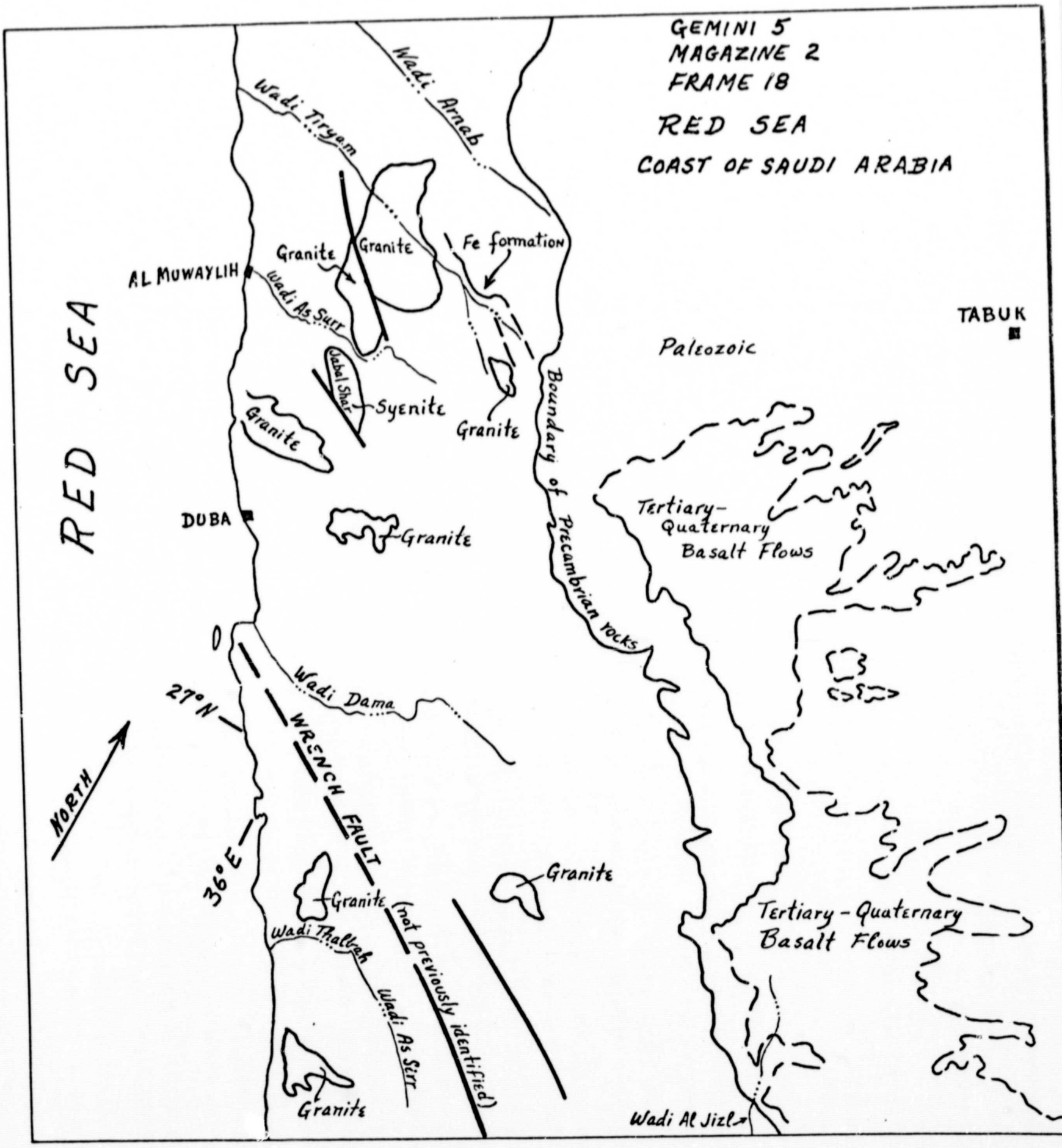
GEMINI 5
MAGAZINE 2
FRAME 18
RED SEA
COAST OF SAUDI ARABIA
RED SEA
Wadi Tiryam
Wadi Arnab
AL MUWAYLIH
Granite
Granite
Fe formation
Wadi As Surr
Jabal Shar
Syenite
Granite
Granite
TABUK
Paleozoic
Boundary of Precambrian rocks
Tertiary-Quaternary Basalt Flows
DUBA
Granite
Wadi Dama
27°N
WRENCH FAULT (not previously identified)
NORTH
36°E
Granite
Granite
Wadi Thalbah
Wadi As Sirr
Granite
Tertiary-Quaternary Basalt Flows
Wadi Al Jizl

Figure 1.

Figure 2

GEOLOGIC UTILIZATION OF GEMINI COLOR PHOTOGRAPH OF DUBA AREA, SAUDI ARABIA

by

Robert F. Johnson

and

Jules A. MacKallor

INTRODUCTION

The primary purpose of this Technical Letter is to report the discovery of an important geological feature by use of Gemini photography. In a letter of February 21, 1966, to George L. Schoechle, Assistant Branch Chief, Foreign Geology, Glen F. Brown, Chief of the U. S. Geological - Saudi Arabian Mission said, "one significant early result was Johnson's recognition of a large wrench fault we hadn't previously spotted."

An overlay prepared by R. F. Johnson in Saudi Arabia shows major faults, numerous geological contacts, and geographic features and forms the backbone of this report. MacKallor added background information about the photography and put the material in the format of a technical letter.

Background

The Branch of Foreign Geology of the U. S. Geological Survey has cooperative projects in many countries, and USGS personnel are sent color enlargements (approximately 8 inches by 8 inches) of appropriate Gemini photographs to be studied for their potential interest and usefulness in their own fields of geologic investigation. Thus, experienced geologists with the first hand knowledge of specific foreign areas are able to evaluate the usefulness of space photographs for a variety of geological problems.

The Branch of Foreign Geology has conducted geologic and hydrologic studies in Saudi Arabia in cooperation with the Ministry of Petroleum and Mineral Resources since 1950. Currently, a team of 22 U. S. Geological Survey specialists are conducting a 6 year minerals survey of the Precambrian Arabian Shield (200,000 sq. mi.) financed entirely by the Government of Saudi Arabia. In addition to published reports, the Survey team has access to photo mosaics and unpublished reports from a number of sources not normally available. As previously stated, Johnson's recognition of a large wrench fault is a valid discovery, perhaps the first, resulting from use of a Gemini photograph.

Evaluation

The nearly vertical picture was taken over Saudi Arabia by Cooper and Conrad from the Gemini V space ship on August 27, 1965, at 07:10 GMT from an altitude of more than 100 miles. A hand-held Hasselblad camera with a Zeiss planar 80 mm focal length lens was used with 70 mm Ektachrome film, ASA No. 64.

This single photograph covers about 115 miles (190 kilometers) of the Red Sea coast of the Arabian Peninsula and a total land area of 10,000 sq. miles. It is 90 miles (150 kilometers) from Duba on the coast to Tabuk near the northeastern corner of the photograph. In figure 1, the average of the scale measured along the coast is 1:900,000, and the scale as measured from Duba to Tabuk the scale is 1:1,000,000.

A black and white copy of the color photograph is included with this report. On the color photograph the boundary between the Precambrian "basement" and the younger rocks is plainly visible. Large areas of volcanic flows and of intrusive rocks can be readily delineated. The alignment of numerous wadis (intermittent stream channels) approximately parallel to the faults shown on the overlay indicates a northwest-trending structural component throughout the entire area of Precambrian rocks exposed on the photograph.

This Gemini picture illustrates the value of photographs from space, at least for arid regions. Delineating the rocks into gross units, Johnson did for this area, can save much time and expense in planning geologic projects such as reconnaissance for minerals, including petroleum. Areas containing favorable rock-types and structures can be selected for detailed investigations. The synoptic view obtained from a single space photograph will be an aid in understanding and solving the structural relations of broad regions. This particular photograph is of special interest to scientists engaged in studies of the Red Sea area and the Rift Valleys of Africa and their relation to the theory of continental drift.