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Department of Applied Earth Sciences
Stanford University
Stanford, California 94305

April 1, 1977

7.7-10147
CR-152640

Mr. J. C. Broderick
Goddar Space Flight Center
Greenbelt, Maryland, 20771

Dear Mr. Broderick

Attached is a progress report for the investigation number 28150, on behalf of Mr. Muftah M. Unis.

Please contact me if you have any questions. Your comments and suggestions are greatly appreciated and I look forword to hearing from you.

My best regards,

Sencerly,

A. A. Missallati

28150

N77-21513
(E77-10147) SIMULTANEOUS USE OF LANDSAT DIGITAL DATA WITH THAT OF GEOPHYSICAL AND GEOLOGICAL SURVEYS IN GEOMATHEMATICAL MODELLING FOR MINERAL EXPLORATION PREDICTION Progress Report, 2 Nov. 1976 - 2 Apr. 1977 G3/43
HC A02/MF A01
Unclas
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CC: Mr. Muftah M. Unis
CC: Mrs. Lisa Robok

LANDSAT TYPE 1 REPORT (April 2, 1977)

A-TITLE OF THE INVESTIGATION: Simultaneous use of LandSat digital data with that of geophysical and geological surveys in geomathematical modelling for mineral exploration prediction.

B-INVESTIGATION #: 28150

C-PRINCIPAL INVESTIGATORS:

A. A. Missallati

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D-TECHNICAL MONITOR:

J. C. Broderick

Goddard Space Flight Center
Greenbelt Maryland, 20771
Phone (301) 982-4826

E-PERIOD: November 2, 1976 to April 2, 1977

F-ACTION REQUIRED: None

Remote Sensing Laboratory
Stanford University
Stanford, California, 94305

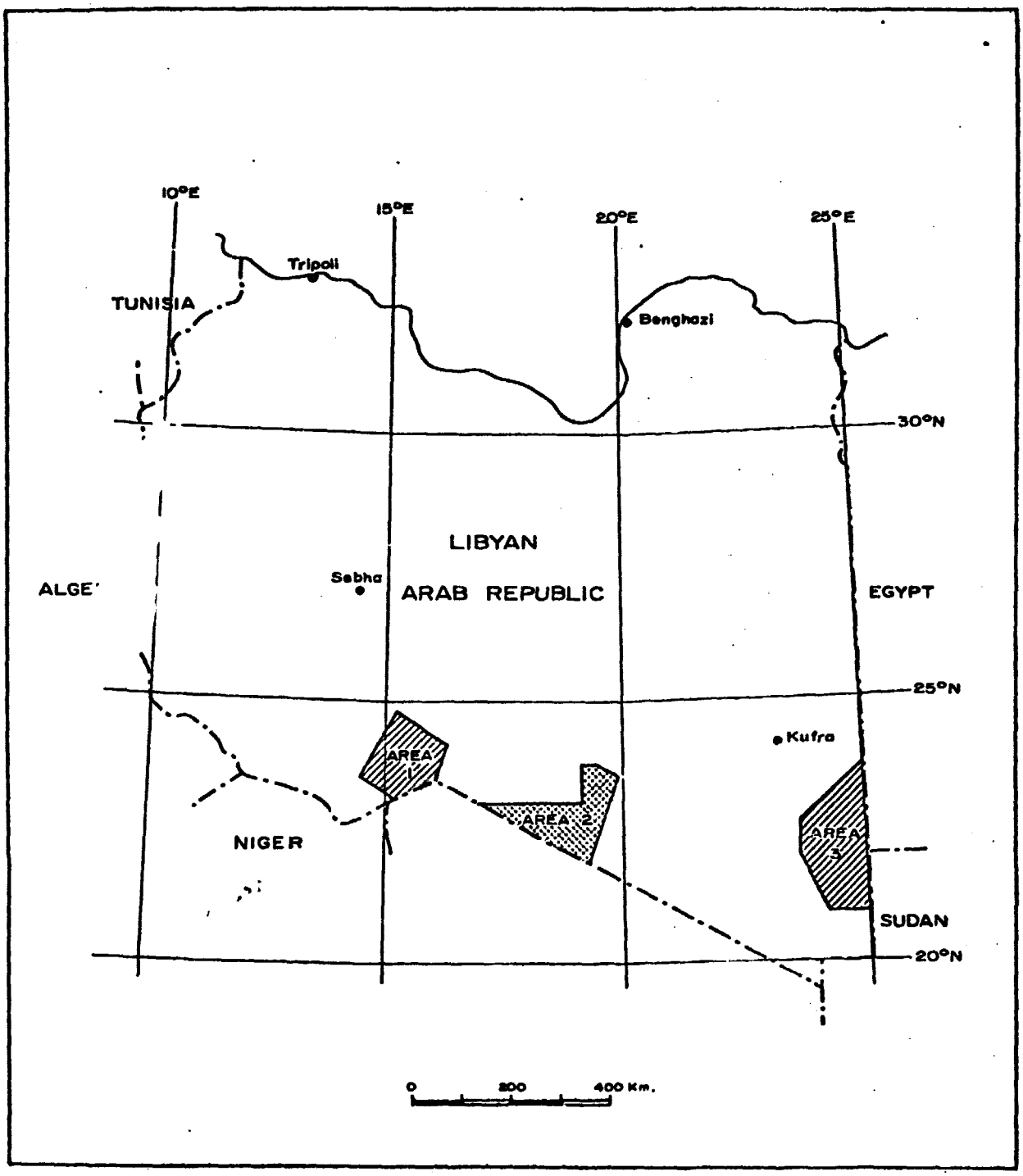
G-ABSTRACT:

A geological and mineral exploration survey progrm with particular emphasis on uranium mineralization in three areas in southern Libya (Fig. 1) was intiated by The Industrial Research Center (Department of Geological Researches and Mining) in Libya in 1974. The geological and geophysical studies in these three areas indicated the favorability of finding radioactive minerals and several anomalous zones were defined.

Area 2 (Fig. 1) has been selected as a test site for the present investigation which involves developing methods (through the application of geomathematical models) to combine and use information on regional geology, geophysics, LandSat digital data and geomathematics in computer-assisted, regional uranium resource evaluation. This investigation is now being conducted at the Stanford Remote Sensing Laboratory, School of Applied Earth Sciences.

In this investigation 43 variables, including age and type of rocks, contact relationships, structural relationships, aero-radiometric and aero-magnetic anomalies and the four LandSat-2 quantified channels (and their 6 ratios) are being used as input for the geomathematical models. One of the objectives of the study is to reveal the interrelationship among the variables and its relation to uranium occurrences. This will define which variable or variables (geological, geophysical or LandSat-2 digital data) are more significant indicators of uranium occurrences in this locality, and consequently, which may be disregarded.

LOCATION MAP



The anticipated results of this project are:

1-To locate specific target areas for uranium mineralization

2-To establish stronger criteria for the detection of radioactive mineral deposits, under differing conditions, by defining the variable or variables which are statistically more indicative of uranium occurrences. Such variables may include the selection of most-suitable MSS band imagery combinations, for the detection of radioactive minerals in these type of rocks.

3-To justify, and/or improve the derived criteria for the use of such techniques through applications in similar areas nearby and elsewhere.

H-PROBLEMS:

The delay in receiving the computer compatible tapes from EROS Data Center was the only and the main problem faced during the progress of this project.

Tapes were ordered on November 11, 1976 and were recieved on February 17, 1977, a delay of more than 3 months.

I-ACCOMPLISHMENTS:

1-SELECTION OF VARIABLES:

43 variables were selected, these include the following parameters

A-GEOLOGICAL: Include,

age and type of rocks	8 variables
contact relationships	22 variables
structural relationships	1 variable

B-GEOPHYSICAL: Include,

aero-radiometric	1 variable
aero-magnetic	1 variable

C-LANDSAT-2 DIGITAL DATA: Include,

(4)Channels	4 variables
(6)Ratios	6 variables
Total	43

2-SELECTION OF PILOT AREA:

An area 26 by 28 Km (728 sq.Km) containing all variables was selected as a pilot area.

3-CONSTRUCTION OF A GRID SYSTEM:

A grid system oriented along the LandSat azimuth was constructed. The grid lines were printed on the geophysical and geological maps (1:50.000 scale) at intervals of 500M by 450M cells (1cm by 0.9cm) representing 6 by 8 pixels to record the geological and geophysical data. The 500M by 450M cells were each subdivided further into 90 (1mm by 1mm) subcells to quantify the geological data according to pecentage covered in each cell.

J-SIGNIFICANT RESULTS:

A computer test file was created for the analysis of two rows in the pilot area. The data were organized into two groups "with" and "without" radioactivity above 1200 counts. The first 42 samples correspond to the geographic cells which are anomalous, and the rest of the samples (70) are without anomalous values.

Analysis of the output shows that all samples were properly classified.

K-PLANNING FOR NEXT PERIOD:

Assembling all data (geological, geophysical and LandSat-2 digital data) in a computer master file to make the final analysis for the pilot area.

L-PUBLISHED MATERIALS:

"Satellite Remote Sensing Seeks Radioactive Mineral Deposits"

The Stanford Earth Scientest
Vol. 5 No. 3 Winter, 1977 (enclosed)

M-RECOMMENDATIONS:

None

N-CHANGING IN STANDING ORDER FORMS:

None

O-DATA REQUEST FORMS SUBMITTED:

None

P-LANDSAT-2 IMAGES ACQUIRED OVER TEST AREA:

Type of coverage	Film source	Scene ID	CCT
LandSat-2 (MMS) Scene	B&W FCC	2492-08250	Y
LandSat-2 (MSS) Scene	B&W FCC	2492-08252	Y
LandSat-2 (MSS) Scene	B&W FCC	2564-08230	Y
LandSat-2 (MSS) Scene	B&W FCC	2564-08232	Y

S-MAILING LIST

J. C. Broderick
Goddard Space Flight Center
Greenbelt Maryland, 20771

Mr. Muftah M. Unis
Directorate of Surveys
Ministry of Planning and Scientific Affairs
P. O. Box 600
Tripoli, Libya

Lisa Robock
International Planning and Programs
Office of International Affairs
NASA Washington D. C. 20546

Chairman of the Geology Department
University of Tripoli
Tripoli, Libya

THE STANFORD EARTH SCIENTIST

Volume 5, Number 3 Winter, 1977

Satellite Remote Sensing Seeks Radioactive Mineral Deposits

Previous geological, geophysical, and geochemical studies indicated the favorability of finding radioactive mineral deposits in the Tibesti Region of southern Libya. Satellite remote sensing studies, to compare the results of these previous airborne and ground-based surveys, with the LANDSAT 2 digital data are now being carried out.

The main objective is to develop and apply methods of combining geological, geophysical, and geochemical information together with LANDSAT (as digital data matrices) to assist in locating areas of potential uranium mineralization. In combining all these information sources a geomathematical model is being used, as outlined above and developed by Dr. Alfredo Prelat, now at the Remote Sensing Laboratory, School of Earth Sciences.

In this project 43 variables, including age and type of rocks, contact relationships, structural relationships, spectrometric and magnetic anomalies, and LANDSAT-2 four quantified channels (and their ten ratios) are being used as input for the geomathematical model. One of the objectives of the study is to reveal the interrelationship among the variables and its relation to uranium occurrence. This will define which variables (geological, geophysical, or LANDSAT-2 digital data) are more significant indicators of uranium occurrence in this locality.

The anticipated results of this project are:

1. To locate target areas for uranium mineralization.
2. To establish stronger criteria for the detection of radioactive mineral deposits, under differing conditions by defining the variables which are statistically more indicative of the uranium occurrences. Such variables may include the selection of the most suitable MSS band imagery combinations, for the detection of radioactive minerals in this type of rocks.
3. To justify, and/or improve the derived criteria for the use of such techniques through applications in similar areas, nearby and elsewhere.

This project is being sponsored by a grant to Dr. A. Missillati from the University of Tripoli in Libya.

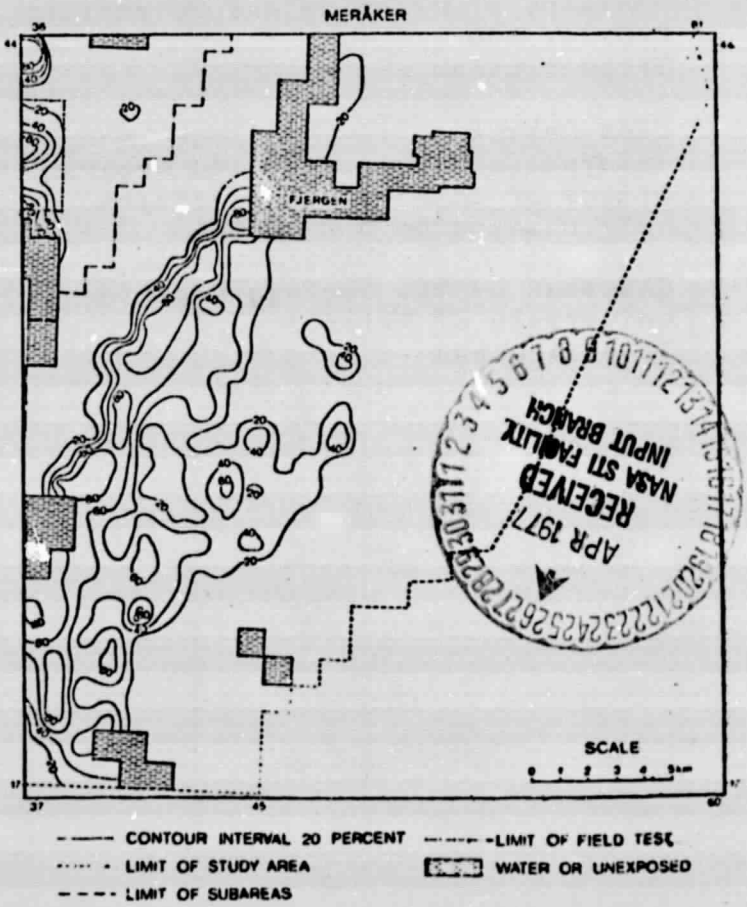
Brief Biographies of Drs. A. Prelat and A. Missillati

Dr. Alfredo Prelat: B Sc. Geology 1967, Universidad de la Plata, Argentina; M.S. Geology 1971, Stanford University, Stanford, Calif. Thesis: Application of Markov Chains to Oil Exploration; Ph.D. Geology 1974, Stanford University, Stanford, Calif. Thesis: Statistical Estimation of Oil Discovery Probabilities; Post-Doctoral 1974-76, Royal Norwegian Scientific and Industrial Research Fellowship, taken at the Norwegian Geological Survey (NGU), Trondheim, Norway; Post-Doctoral 1977, Remote Sensing Laboratory, Stanford University, Stanford, Calif.

Professional: Field Geologist 1966, United Nations, in the Andean Ranges, Argentina; Research Assistant, Computer Applications in Geology, Kansas Geological Survey, Summers 1971, 1972, 1973; Assistant Geologist, Oil Exploration, Argentina, 1968; and Research Associate 1974, Remote Sensing Laboratory, Stanford (1/74 to 7/74).

Dr. Amin Missillati: B.Sc. Geology 1965, University of Libya; M.S. Geology 1967, Columbia University, N.Y.C., N.Y.; Ph.D. Geology 1972, Stanford University, Stanford, Calif.; Post-Doctoral 1977, Remote Sensing Laboratory, Stanford University, Stanford, Calif.

Professional: Assistant Professor, 1972 to date, University of Tripoli, Libya; 1973-74, Chairman, Geology Department, University of Tripoli; 1974-76 Vice-Dean, Faculty of Science, University of Tripoli; Consultant in Industrial Scientific Research at the Industrial Research Center, the General Water Authority, the Atomic Energy Commission, and other private firms in Libya.



Mineral occurrence probability map for the Meråker mapsheet.