10

III

E7.5 10.2 4 6
CR 142539

COMISION DE ESTUDIOS DEL TERRITORIO NACIONAL

ERTS-I

"Made available under NASA sponsorship
In the interest of early and wide dissemination of Earth Resources Survey
Program information and without liability
for any use made thereof."

N75-21768
(E75-10246) TO MAKE A LAND USE INVENTORY AND ITS CHANGE WITH TIME AND DEVELOPMENT. TO INVESTIGATE HOW THIS AREA IN THE SEMI-ARID CLIMATE IS DEVELOPING, AND THE ECOLOGICAL (Consejo de Recursos Naturales no G3/43 00246
Unclas

1631G

RECEIVED
FEB 25 1975
SIS/902.6

OFICINA DE PERCEPCION REMOTA

estudios especiales

TYPE III REPORT. FINAL. TEST SITE SR-9631/7. CETENAL.
Principal Investigator Ing. Carlos Acosta Del Campo.
MEXICO CITY. SEPTEMBER 1974.

SECRETARIA DE LA PRESIDENCIA

SECRETARIA DE LA PRESIDENCIA

COMISION DE ESTUDIOS DEL TERRITORIO NACIONAL

ORIGINAL PHOTOGRAPHY
COLOR ILLUSTRATIONS

Original photography may be purchased from:
EROS Data Center
10th ... Avenue
Sioux Falls, SD 57198

DEPARTAMENTO DE ESTUDIOS ESPECIALES

OFICINA DE PERCEPCION REMOTA

Type III Report on Test Site MMC No. 631-07. NASA's SR. No. 9631/7.

Ing. Carlos Acosta Del Campo

Mexico City, October 1974.

SR No. 9631/7

To Make a Land Use Inventory and Its change - with Time and to Map Urban and Transporta-- tion Development, to Investigate How this Area in the Semi-Arid Climate is Developing, and - the Ecological Impact with the Construction of Several Government Projects in Central Mexi co.

Ing. Carlos Acosta Del Campo

CETENAL-Comisión de Estudios del Territorio Nacional.

San Antonio Abad No. 124

México, 8.D.F. México

October 1974.

Type III Report for Period May-September 1974.

CONEE-Comisión Nacional del Espacio Exterior.

Eugenia No. 197 10° piso

México 12, D.F. México

1. SR No. 9631/7	2. Type of Report III-Final
3. Recipients Catalog. No.	
4. Title. To Make a Land Use Inventory and Its Change with Time and To Map Urban and Transportation Development. To Investigate How this Area in the Semi-Arid Climate is Developing, - and the Ecological Impact with the Construction of Several Government Projects in Central Mexico.	5. Report Date. October 1974.
	6. Period covered. May - September 1974.
7. Principal Investigator. Ing. Carlos Acosta Del Campo.	8. No. of Pages 17
9. Name and Address of Principal Investigators Organization. CETENAL. San Antonio Abad No. 124 México 8, D.F. México.	10. Principal Investiga. Rept. No. N/A
	11. GSFC Technical Monitor. George Ensor. Code 430
12. Sponsoring Agency Name and Address. CONEE. Eugenia No. 197 10°piso, México 12, D.F. México.	13. Key Words. N/A
14. Supplementary Notes. N/A	

15. Abstract.

This investigation was conducted to make a land use inventory together with the mapping of lineaments, geomorphic features and lithologic units - in Central Mexico. The information retrieved by visual interpretation --- from ERTS-1 imagery was compared with the already compiled in CETE— NAL's thematic charts. As a result long lineaments and large geomorphic features detected on ERTS's imagery surpasses the information contained in the charts. On the contrary the information on land resources and litho logic units derived from the images was inferior to the data supplied in -- the charts.

P R E F A C E

Objetives: To make a land use inventory, together with the mapping of li---neaments, fault systems intersection, and lithologic units.

Scope of Activity: Visual interpretation of one ERTS-1 image, four bands — and of one off-set press copy of a NASA's false color composite, each one-of different date. Two months working time.

Significant analyses, findings and techniques: Comparison between ERTS-1-image scale 1:1,000,000 and CETENAL's charts scale 1:50,000 in irrigated land surface determination in one selected spot gave the following results: Surface on CETENAL's charts 129,900 Has. and arbitrarily we gave 100%-to this value. Surface on image 122,400 Has., 94.5% of the first value.

It is necessary to use all four bands to have optimum results on the inter--pretation. The PI made use of photointerpretation techniques only, mostly-monoscopically.

Conclusions: Long lineaments and large geomorphic features detected on --ERTS's imagery surpasses the information already compiled on CETE----NAL's charts. On the contrary the partial land use inventory results fall --below those who can be obtained by data extracted from CETENAL's thema tic charts. The same is said for the mapping of lithologic units and in gene ral about land resources in which CETENAL's charts information is far su perior.

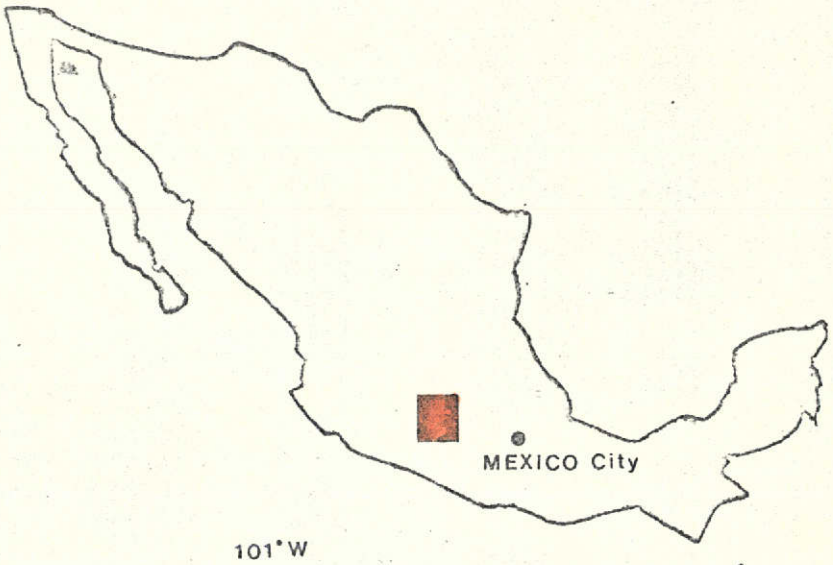
Recomendations: To overcome the 94.5% results on partial land use inventory carried on the images it is recomended to employ computer compati--ble tapes to extract the maximum available information on earth resources contained in multispectral scanner data by automatic extraction informa--tion techniques.

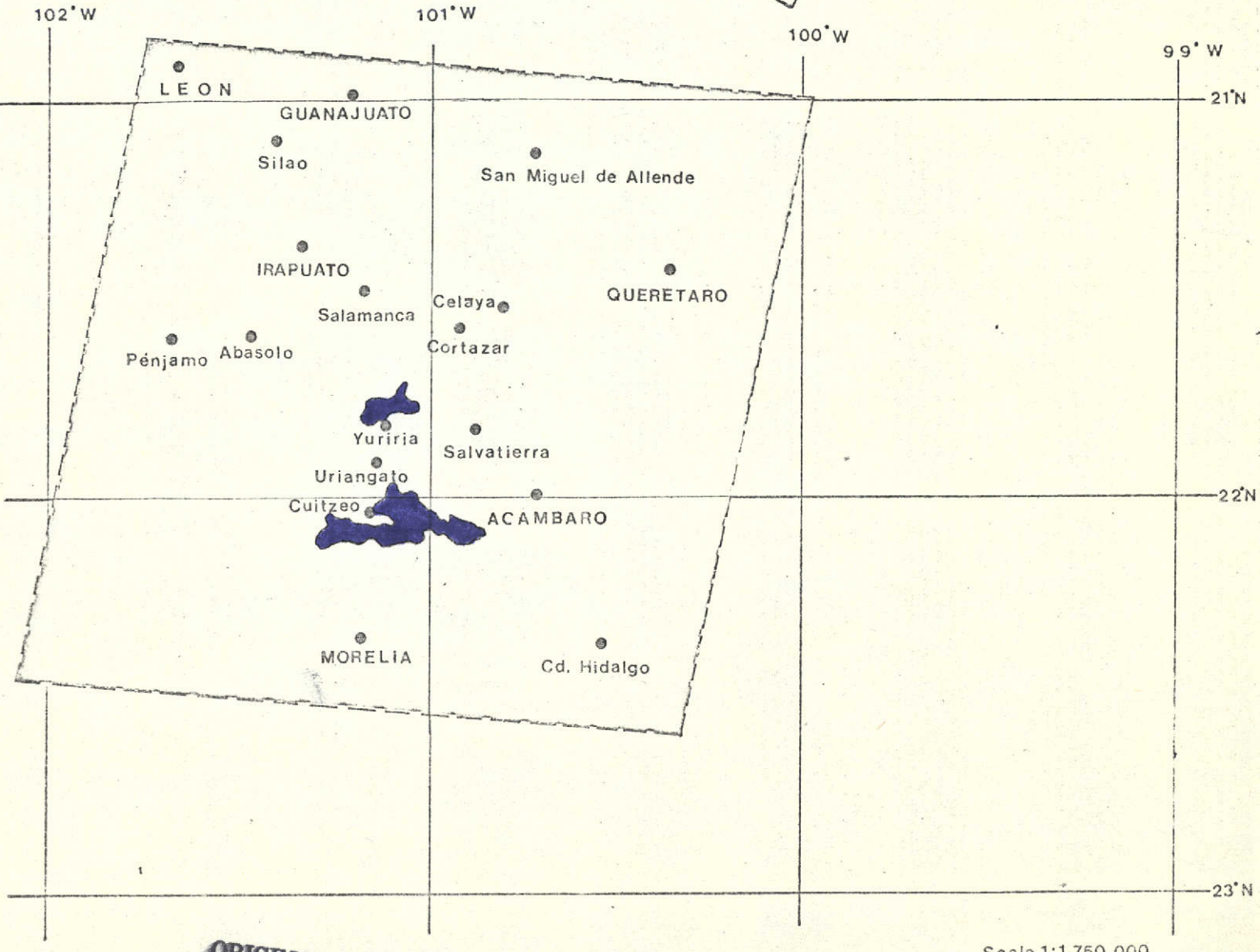
TABLE OF CONTENTS

LOCATION SKETCH
TEST SITE SR-9631/7

E

E-1255-16402
04 April 1973





Scale 1:1 750 000

ORIGINAL PAGE IS
OF POOR QUALITY

F O R E W O R D

The title of this investigation is COMPREHENSIVE STUDY OF LEON-QUERETARO AREA, and as such was indicated in the proposal forwarded to -- NASA on August 19, 1971, entitled "To Make a Land Use Inventory and Its Change with Time and to Map Urban and Transportation Development, to — Investigate How this Area in the Semi-Arid Climate is Developing, and the Ecologic Impact with the Construction of Several Government Projects in - Central Mexico", number SR-9631/7, Principal Investigator Ing. Jorge F. Vaca of the Comisión de Estudios del Territorio Nacional, CETENAL.

Due to several causes Ing. Vaca, formerly PI, was unable to work in this - investigation and this circunstances involved its two co-investigators.

In May 1974 instead of Ing. Vaca, Ing. Carlos Acosta Del Campo was ---- appointed PI of the above mentioned Test Site MMC # 631-07 by the authorities of CETENAL, without any co-investigator. CETENAL (Comisión de -- Estudios del Territorio Nacional), a branch of the Secretary of the Presi-- dency, is the Mexican Government agency in charge of producing the cartography: topographic, geologic, soils distribution, actual land use and po-- tential land use charts covering the National Territory, all of them at the - scale 1:50,000, plus a climatic chart at the scale of 1:500,000. This information is being used by federal agencies for planning the economic and social development of the country and also by private people in general.

After a preliminary examination of the ERTS-1 images, and taking into ac

count the resolution and working scales of such images, it is not posible -- to detect minor changes in urban and transport development. Besides, due to economic contraction during the last two years in Mexico, there are not- new developments and not government projects with ecological impact in -- this central area of Mexico. Then, this investigation was conducted only under the point of view to make a partial land use inventory, together with the mapping of lineaments, fault systems intersection, and lithologic units.

No ground-truth or field tests were conducted at this time because of CETENAL's charts information availability.

The information retrieved from ERTS-1 imagery as a result of this investigation was compared with the one already compiled in the test site by CE-- TENAL.

The degree of percent error, savings in time, personnel and money, and -- the compatibility between both types will determine the use of ERTS imagery to update CETENAL topographic and actual land use charts. Moreover, there is a project to use ERTS images to produce thematic maps of all the ---- country, scales 1:1,000,000, 1:2,000,000, 1:4,000,000.

A C K N O W L E D G E M E N T S

About the interpretation and drawings on the overlays, part time was devo_ ted by Juan Martín Galindo García and Jesús Rubén Montaño Fuentes, un-- dergraduates students of Petroleum Engineer and Geologist Engineer res-- pectively. To them my deep appreciation.

The off-set press copy of NASA's false color composite provided in this -- report was a courtesy of IPESA CONSULTORES, México, D.F.

CONEE's color enhancement facilities were a great help in the interpreta- tion period. I remain grateful to CONEE.

Last, but not least, NASA's ERTS images on test site SR-9631/7 provided the raw material to carry on the investigation. I send my warmest thanks - to NASA.

WORKING DATA

This investigation was carried on ERTS-1 images, date 04 april 1973, ID - E-1255-16402, MSS bands 4, 5, 6 and 7, black and white transparencies, -- scale 1:1,000,000; center of image coordinates N 20° 19' Lat, W 101° 04' - Long; Sun elevation 56°, Sun azimuth 110°; 10 h 40' 20" local time. Also - was used an off-set press copy of one NASA's false color composite, date 22 January 1973, ID E-1183-16394, MSS bands 4 yellow, 5 magenta and 7 - cyan; paper print, scale 1:1,000,000; center of image coordinates N 20° -- 25' Lat, W 100° 49' Long; Sun elevation 38°, Sun azimuth 138°; 10 h 39' -- 40" local time. All images are of good quality and 99.5% cloud free.

The PI (Principal Investigator) made full use of photointerpretation techniques, mostly monoscopically. No automatized digital interpretation was -- attempted at this time.

Five overlays were obtained all of them adjusted to the area covered by the E-1255-16402 black and white material, and they are: 1) Cities Location -- overlay; 2) Water Bodies (lakes, dams) and Irrigated Agricultural Lands; — 3) Forests; 4) Lithologic Units, Geomorphic Features, Lineaments and --- Fault Systems overlay; 5) Hydrologic overlay.

The areas of irrigated lands and forests were obtained with a planimeter, - but discrimination between crop species and types of vegetation and forests was not attempted.

The first step in the interpretation process was an analysis of original material, negatives and diapositives in 70 mm film format. Then the negatives were blow up at the scale of 1:1,000,000, diapositives. The false color composite in paper print is at the scale 1:1,000,000, and it shows around 90% of the scenery displayed in the black and white material because of different date and orbit of the satellite pass.

In the preliminary interpretation, the products were five transparent overlays to the 1:1,000,000 diapositives, as stated before. Then, the second step consisted in the usage of CONEE's facilities (Comisión Nacional del Espacio Exterior, National Comision of Outer Space, México) which consisted in a Datacolor System Model 702-12 who features a desk console including a light box to illuminate the 1:1,000,000 transparencies black and white; a monochrome television camera to convert the transmited light to an electrical video signal; an analyzer that separates the shades of gray or voltage levels in the video signal into 12 colors and encodes the levels into color television signals; and a color television monitor for reproduction of the transparency in the original black and white or in the color analysis.

Thus, the above said facilities were employed to color enhance the images and this facilitated enormously the final interpretation.

After that, a revision of the overlays were attempted using enlargements of band 7 on glossy paper prints black and white, scales 1:500,000 and 1:250,000. At the last scale the scan lines became visible.

At last, the overlays were inked, titled, reproduced and inserted in this -- report.

Bands 4,5 and 7 of the MSS, image E-1255-16402 scale 1:1,000,000, black & withe glossy prints, are supplied.

Also is provided an off-set press copy of the NASA's false color composite E-1183-16394, bands 4,5 and 7,which was the composite image utilized in - this investigation.

An annex presents the thematic charts of CETENAL, corresponding to the zone located in Overlay No. 1, CORTAZAR sheets, for comparison purposes.

A brief description of the characteristics detected and annotated on the --- overlays follw.

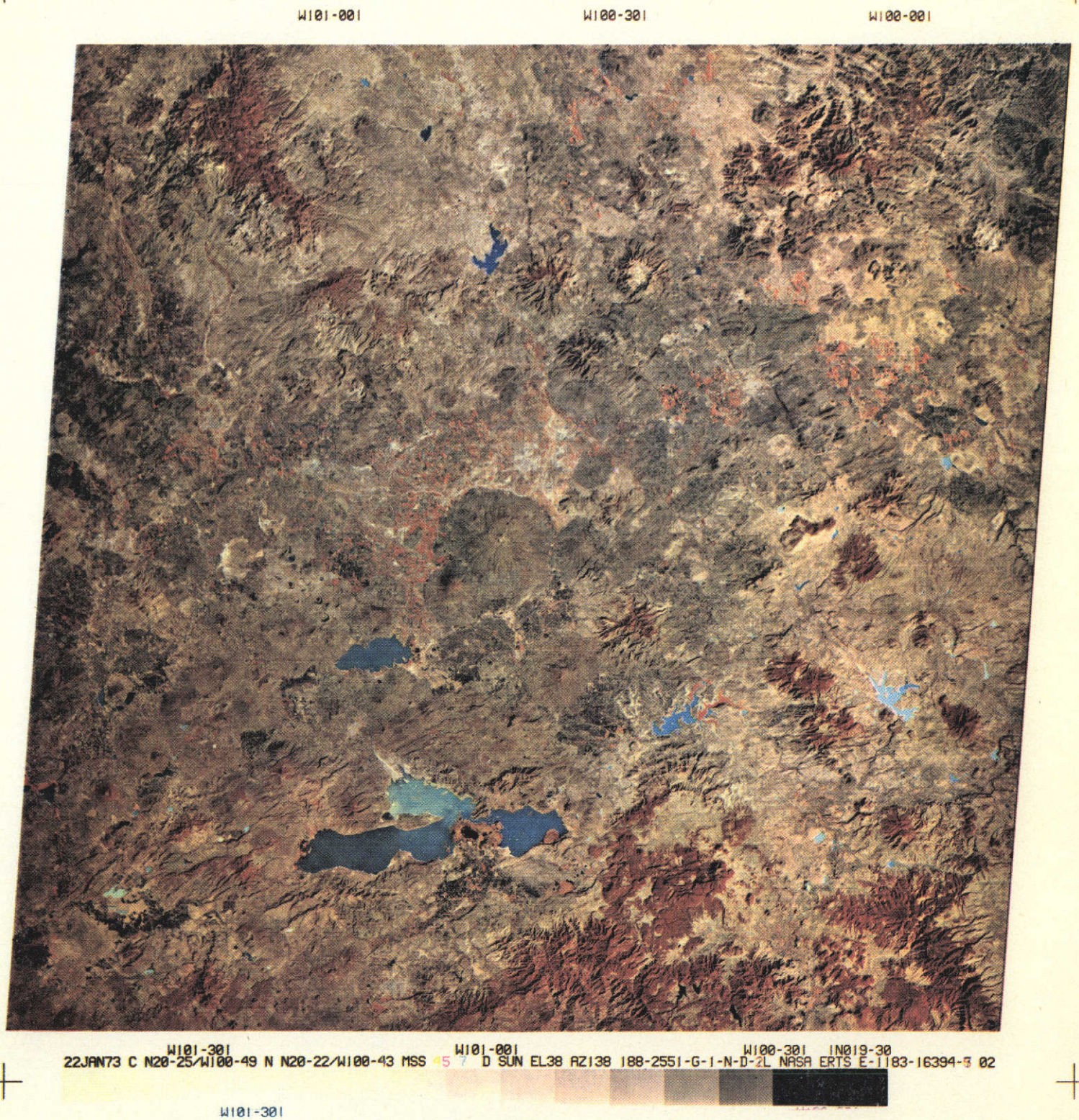


Imagen tomada por el satélite ERTS-1, el día 22 de enero de 1973. Pertenece a la Hoja Ciudad de México del Plan Nacional Hidráulico.

ERTS-1 image, January 22, 1973, off-set false color composite reproduction.

It belongs to Mexico City sheet, Hidraulic National Plan.

O V E R L A Y No. 1

Cities Location

Band 5

Scale of the image 1:1,000,000 black and white transparency.

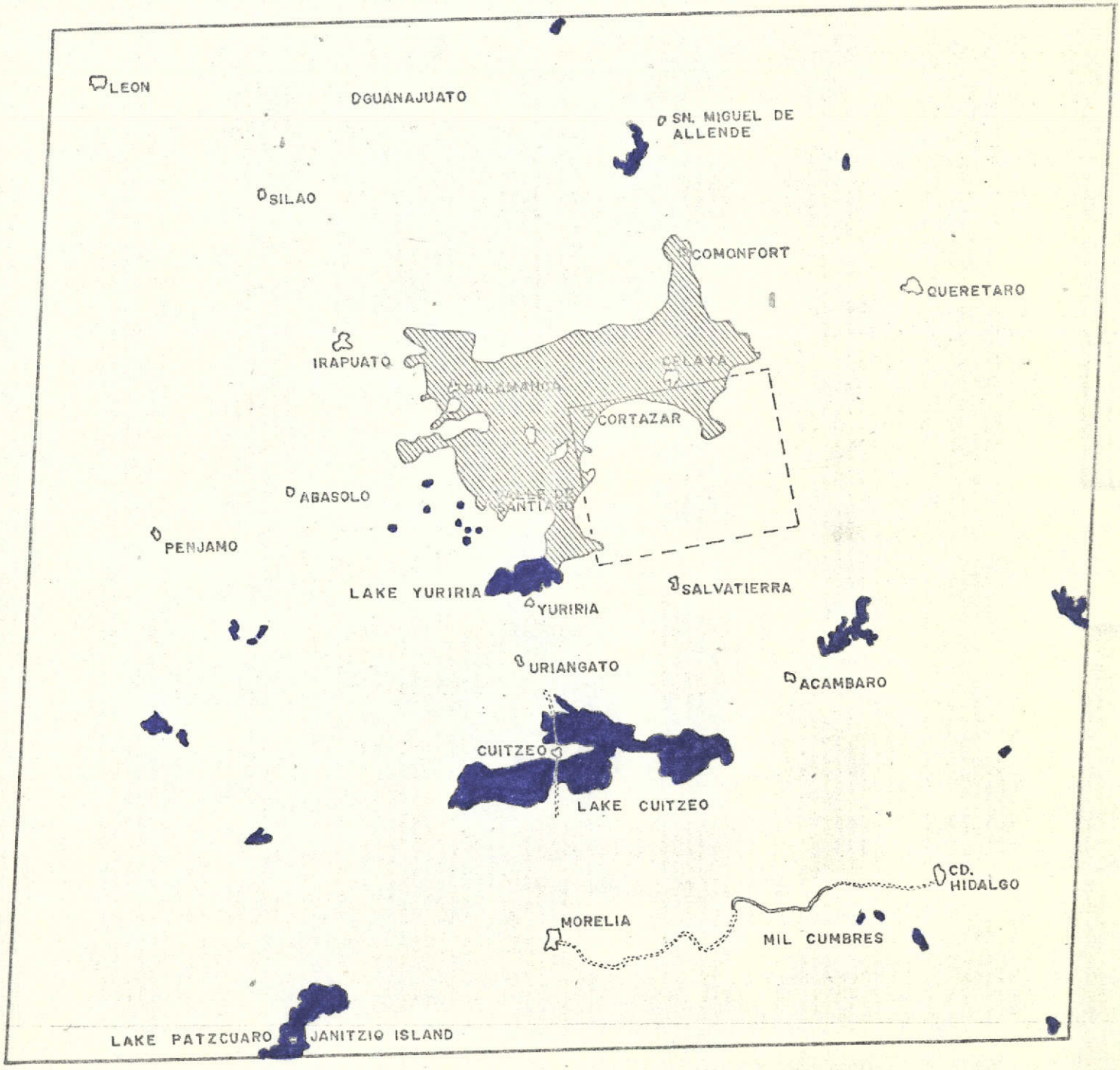
The resolution of the imagery in band five was so good that this band was - used to locate cities with population between 20,000 and 80,000 individuals. Small cities could be detected and plotted with the aid of dividers and a --- map at the scale 1:1,750.000.

Railroads and roads were rarely detectable, but the highway at Mil Cum-- bres range is visible along 15 kilometers in the highest and forested por-- tion of the road.

Also, because of its linearity and gray tone separation on the water-body - at both sides of the road which crosses the Lake of Cuitzeo, a length of 9 - kilometers of the highway between Morelia and Salamanca cities is clearly visible in this image.

Results: In general, at this scale the cultural features with very few excep tions could not be observed, but small cities could be readily found if their map positions were known, but this is not the case of railroads and roads - which could not be observed even with the assistance of maps, except in -- the circumstances stated above.

ORIGINAL PAGE IS
OF POOR QUALITY



OVERLAY No.1
CITIES LOCATION
E-1255-16402-4 04/APRIL/73

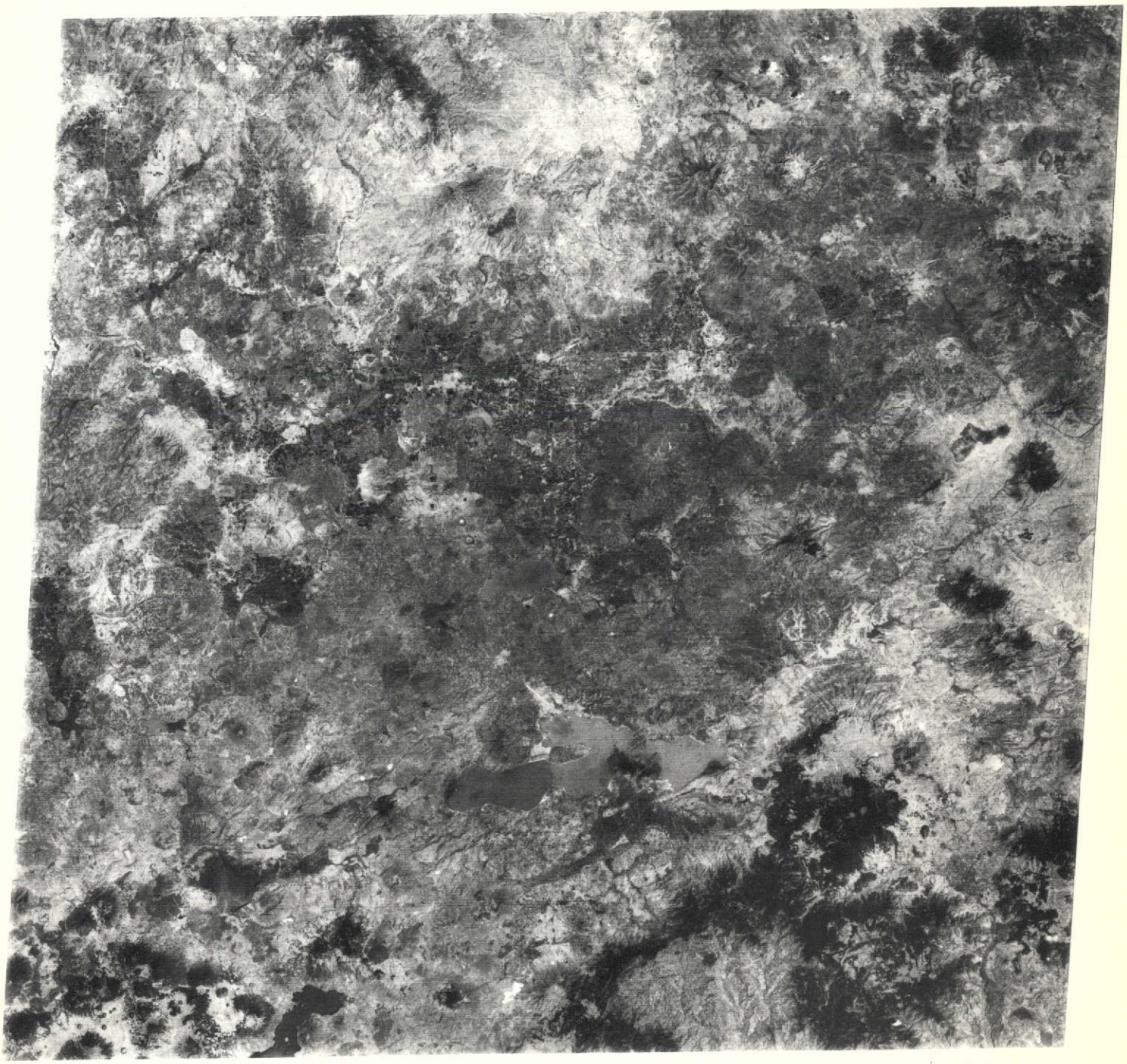
SURFACE DISPLAYED ON CETENAL'S SHEETS DETERMINED WITH A PLANIMETER

CETENAL'S SHEET CORTAZAR

HIGHWAY

SCALE
1:1000 000 Aprox.

W101-301 W101-001 W100-301



04APR73 C N20-19/W101-04 N N20-17/W100-58 MSS 5 D SUN EL56 AZ110 188-3555-G-1-N-D-2L NASA ERTS E-1255-16402-5 02

W102-00 W101-301 W101-001

O V E R L A Y No. 2

Water Bodies and Irrigated Agricultural Lands.

Band 4

Scale 1:1, 000, 000 black and white transparency.

To identify and delineate water-bodies, lakes and dam reservoirs, band -- four was selected because of its better definition in this aspect.

In all other bands not only the water-bodies showed deeper gray tones, also a deep black colored recent basalt flows north of Lake Patzcuaro ----- appears like a lake-body but in band four they could be identified correctly.

The white spot at the middle of Lake Patzcuaro is Janitzio island. In Lake Cuitzeo, at the road who crosses the water-body, the deep gray tone at the west is the reflectance combination of deeper bottom (5-9 foot) plus aquatic vegetation; the light gray tone at the east shows silted condition, lesser -- depth (3 feet) and lack of aquatic vegetation.

North of Lake Yuriria (really a reservoir made during colonial times, XVI Century) it could be seen not less than seven small crater-lakes. This row of young volcanoes along fault lines are of basaltic composition, and they - exhibit cinder and prismatic lava walls inside the craters.

The main current is the Lerma river, but only one of its canyons at the -- east and its winding course at the west border of the image are clearly discernible. The Tepuxtepec and Solís dams are located along its course.

The main water-bodies were superimposed on all overlays for easy location purposes.

Band 7

To detect and delineate zones of irrigated agricultural lands band seven -- was selected due to its better resolution.

At the scale already mentioned, it is not possible to discriminate between - old and abandoned agricultural lands and recent ones. Also in the black and white transparency you can not tell which portions of the zones are already watered and which not. To elucidate this, next time we are going to have - large scales on false color composites.

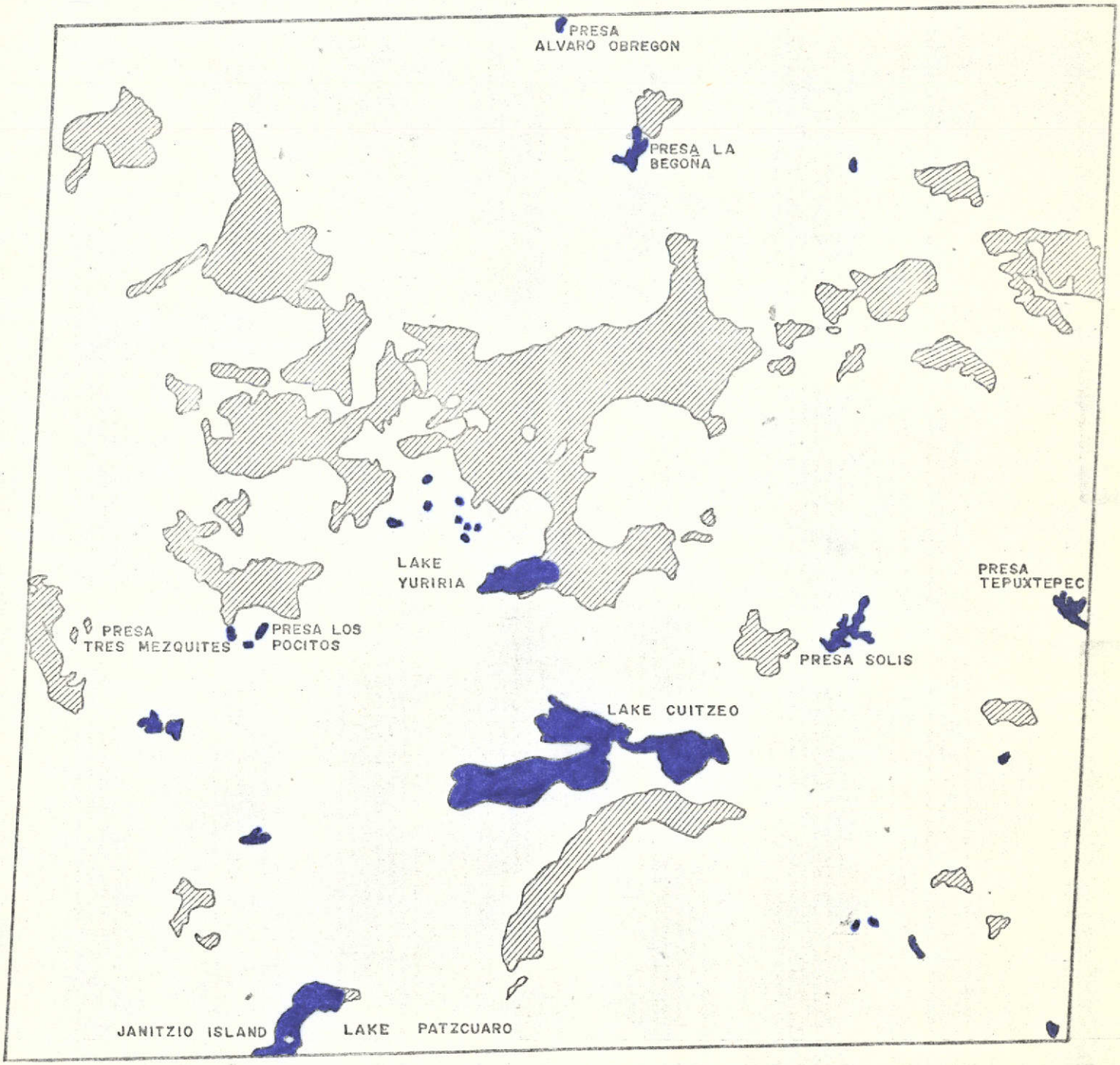
Nevertheless, in one of the plotted zones on the overlay a planimeter was - run and a total irrigated agricultural land surface was obtained. This spot - at the north of Yuriria Lake was selected to compare its surface against the data obtained from CETENAL's charts. See location on overlay No. 1.

Surface deployed on ERTS image = 122,400 Has.

Surface displayed on CETENAL's charts = 129,900 Has.

If we suppose arbitrarily that the surface on CETENAL's charts is one hundred percent correct, then ERTS-1 surface determination is 94.5% of that - obtained from the charts.

ORIGINAL PAGE IS
OF POOR QUALITY



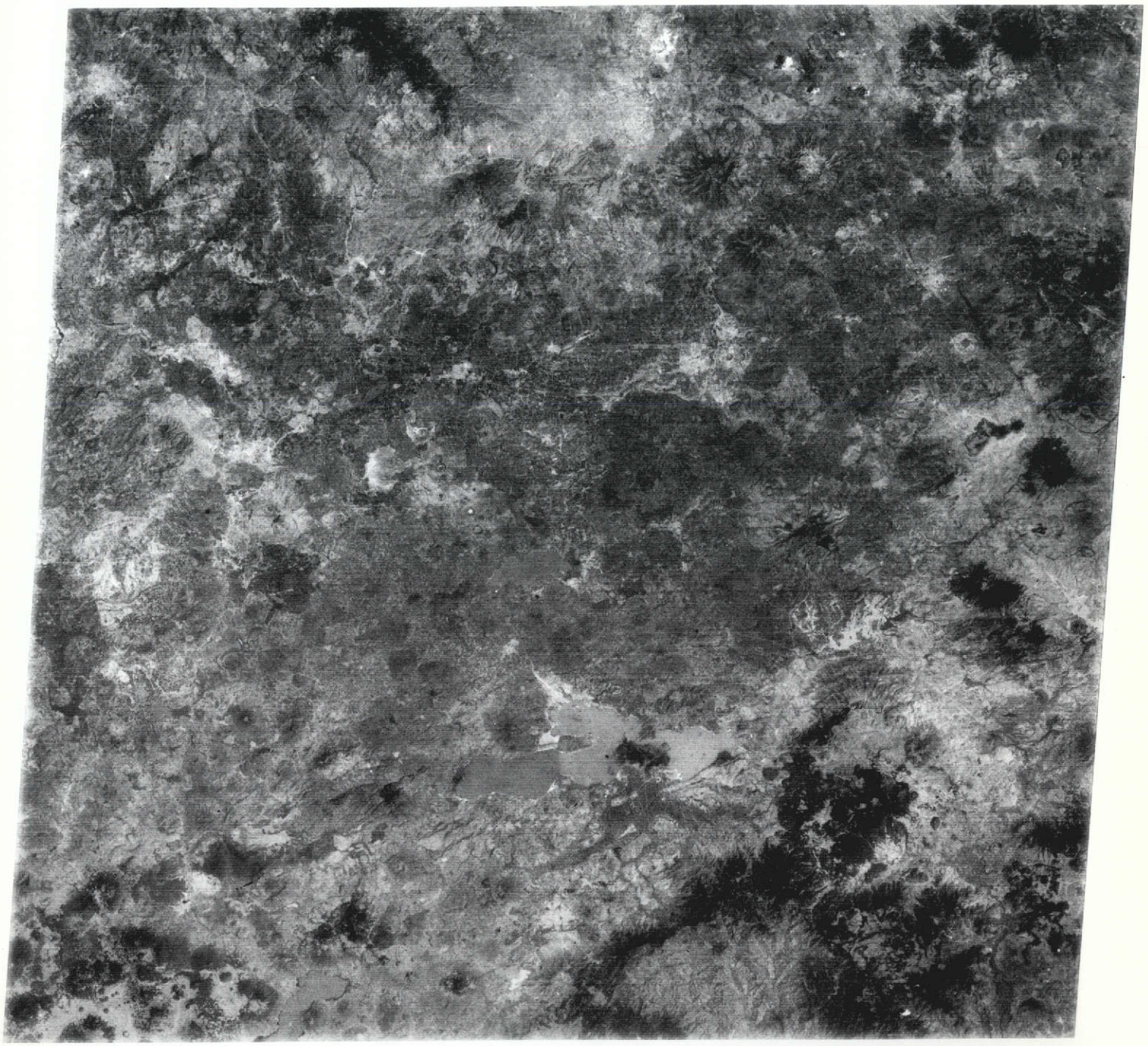
OVERLAY No. 2
WATER BODIES AND IRRIGATED AGRICULTURAL LANDS
E-1255-16402-7 04/APRIL/73

IRRIGATED AGRICULTURAL LANDS

WATER BODIES

SCALE
1:1 000 000 Aprox.

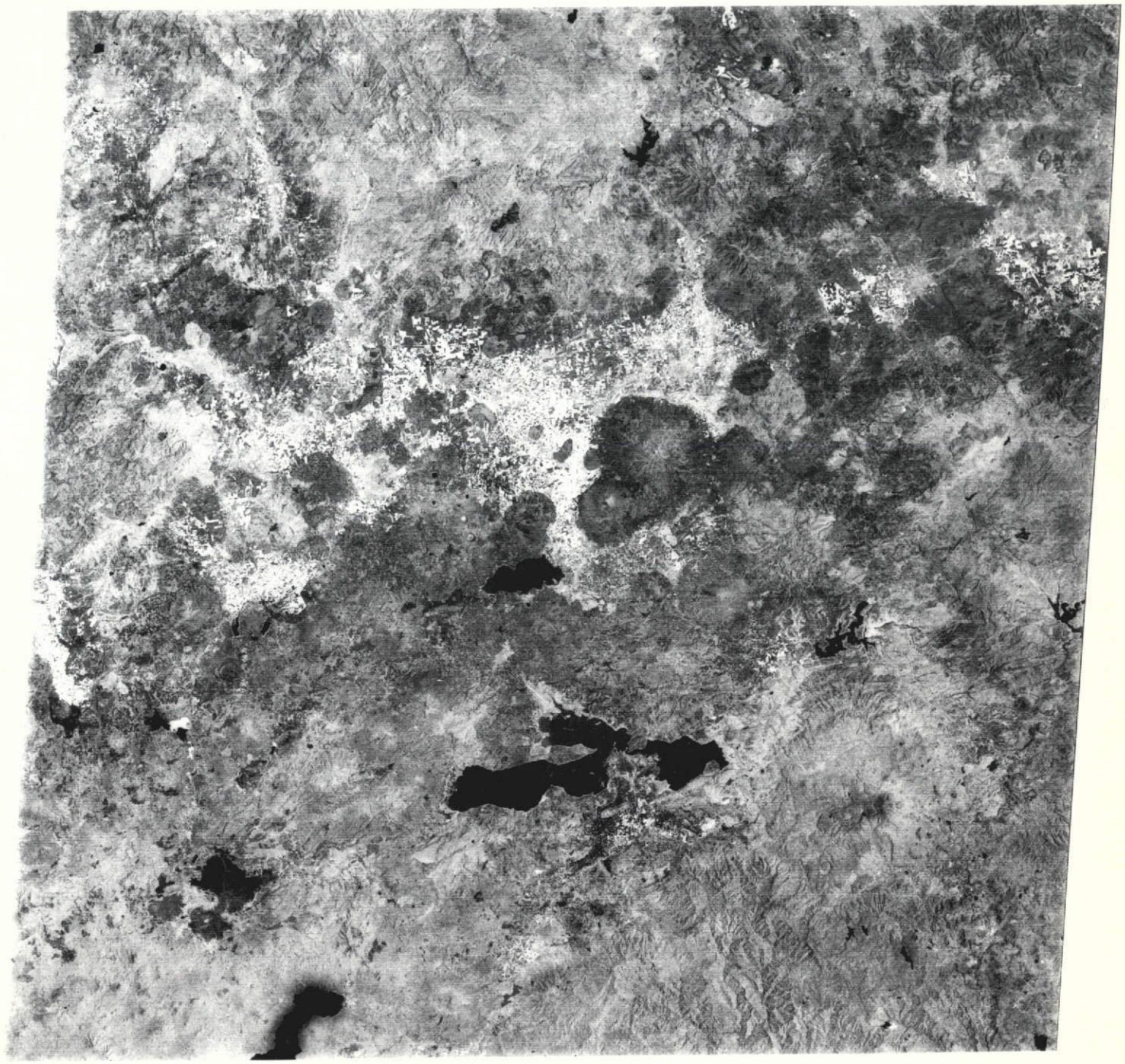
W101-301 W101-001



W101-301 N019-30 W101-00 W100-301
04APR73 C N20-19/W101-04 N N20-17/W100-58 MSS 4 D SUN EL56 AZ110 188-3555-G-1-N-D-2L NASA ERTS E-1255-16402-4 02

W102-00 W101-301 W101-001

W101-301 W101-001 W100-301



W101-301 N019-30 W101-00 W100-301
04APR73 C N20-19/W101-04 N N20-17/W100-58 MSS 7 D SUN EL56 AZ110 188-3555-G-1-N-D-1L NASA ERTS E-1255-16402-7 02

W102-00 W101-301 W101-001

O V E R L A Y No.3

Forests

Band 5

Band five was used to trace the contour of the forest complexes. Most of the forest dwells over soils formed by the weathering of andesitic flows and tuffs.

The forest complexes traced comprise primary pine family trees and secondary oak family trees.

No discrimination between such forest associations was attempted.

Also the plotting of natural and cultivated grass, wild scrub and bush, was not attempted in this time because of the small scale used.

OVERLAY No.3
FORESTS

E-1255-16402-5 04/APRIL/73

FORESTS

SCALE
1:1000 000 Aprox.

ORIGINAL PAGE IS
OF POOR QUALITY

O V E R L A Y No. 4

Lithologic Units, Geomorphic Features, Lineaments and Fault Systems.

Band 7

Band seven was elected because natural vegetation and forests does not --- show in deep gray tones which shadows most of the land features, as happened in the other bands. Also shows better the geomorphologic aspects.

Lithologic Unites

Several lithologic units were delineated on this image. They are distinguished because of gray tone variation and broad drainage pattern. Such general lithologic units are as follows:

a) Alluvium plus volcanic tuffs.

b) Lava flows, mostly basaltic in character.

c) Marine sedimentary rocks.

Geomorphic Features

There are several geomorphic characteristics easily recognized in the --- image. They are:

d) Lava mesas, mostly basaltic but some rhyolitic, some of them are ---- ignimbrites. No distinction between them was attempted.

e) Small young crater-lakes of basaltic cinder and lava composition, along fault lines.

f) Shield basaltic volcanoes with a small cinder cone at the top.

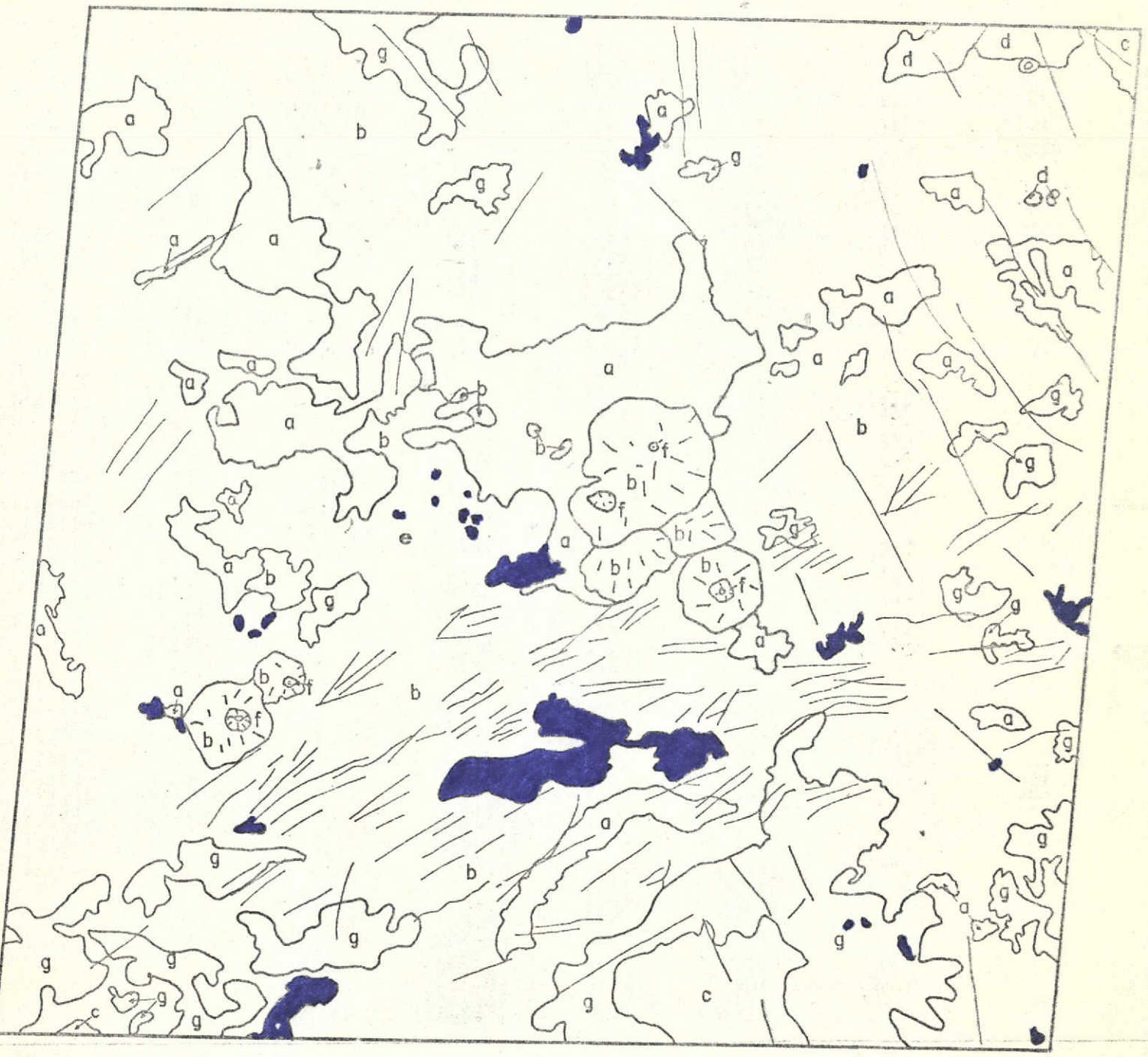
g) Andesitic mountains.

Lineaments and Fault Systems

Some of the long lineaments are deep seated faults which reach the upper -- mantle, and their intersections can be favorable places to look for econo--- mic mineralization if the host rock, the geologic age, the orogeny and the - petrographic and petrologic characteristics are adequate.

Such long lineaments are shown in this overlay, must of them falling in 3 - sets of fault systems: W-E trend, corresponding to the so called neo-volca nic axis; N-E trend, N 70° E average; and N-W trend, N 27°W average bea- ring.

ORIGINAL PAGE IS
OF POOR QUALITY



OVERLAY No. 4

LITHOLOGIC UNITS, GEOMORPHIC FEATURES, LINEAMENTS AND FAULT SYSTEMS

E-1255-16402-7 04/APRIL/73

LEGEND: See pages 12, 13

SCALE
1:1 000 000 Aprox.

O V E R L A Y No. 5

Hydrologic Features

Band five was used to plot the broad drainage pattern.

Because of scale and resolution the marine sedimentary rocks outcrops -- shows coarse dendritic pattern.

Andesitic outcrops shows an angulate pattern, because of fracture and faulting control.

Basalt flows shows no visible drainage pattern because of its youth.

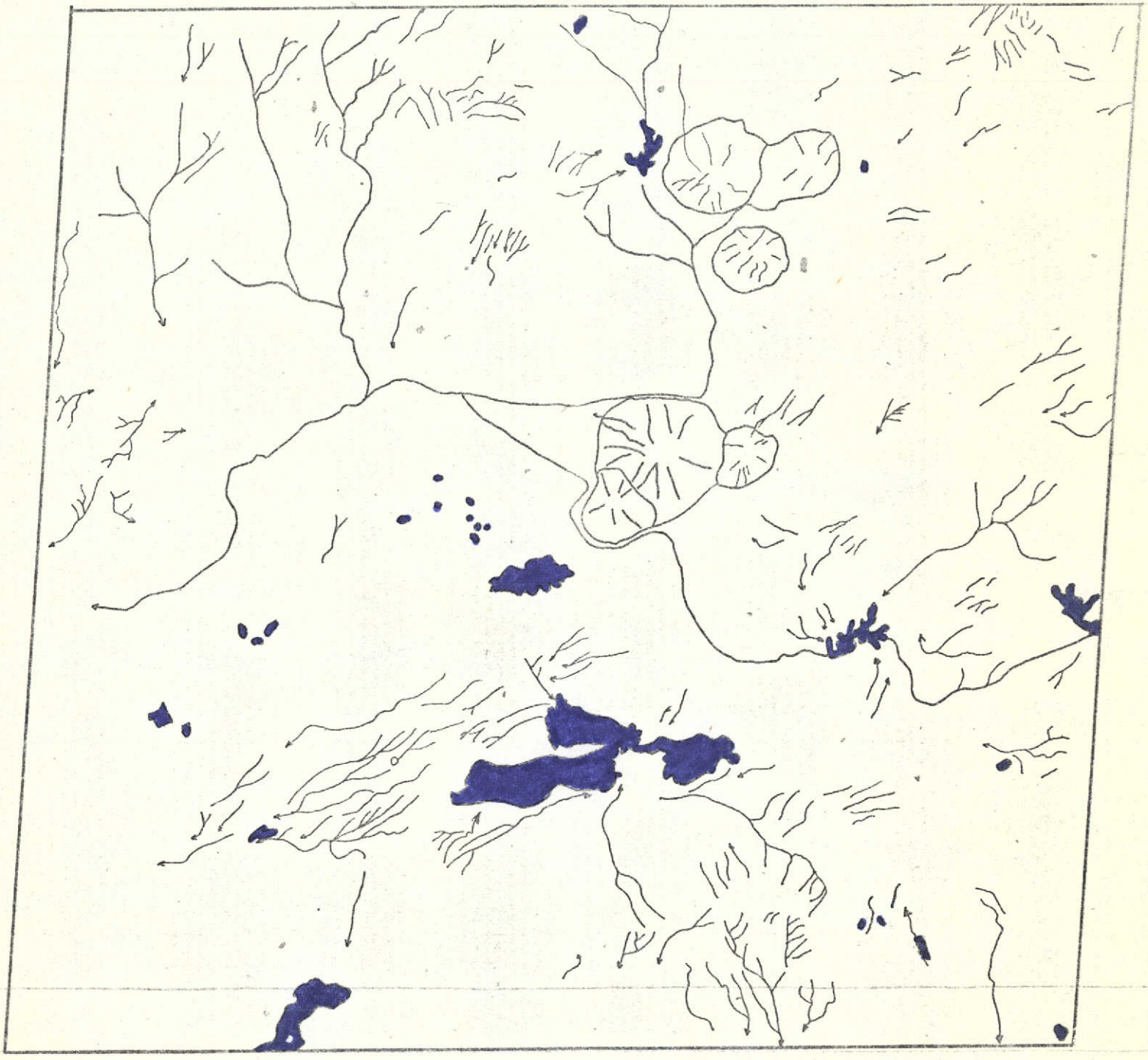
Basaltic tuffs presents a coarse trellis drainage pattern.

Alluvium shows in part visible drainage but not in the coarser sand and -- gravel portions because of high porosity and permeability.

The zone at the north-east corner, which shows one of the marine sedimen-- tary lithologic units, drains to the Gulf of Mexico. All other areas drains to the Pacific Ocean.

There are several closed basins with no visible stream outlets, mainly ---- around the lakes water-bodies.

ORIGINAL PAGE IS
OF POOR QUALITY



OVERLAY No.5
HIDROLOGIC FEATURES
E-1255-16402-5 04/APRIL/73

RIVERS

CREEKS

SCALE
1:1 000 000 Aprox.

CONCLUSIONS

ERTS images, because of its inherent sinoptical view, were useful to distinguish several lithologic units, broad geomorphologic features, a great array of lineaments and to define and confirm three main fault systems. Then, it was established a major lithologic, geomorphic and structural relationship on the central part of the country, covered by the images corresponding to the test site MMC No. 631-07, León-Querétaro. In the long lineament detection topic, ERTS images were superior to CETENAL's geologic charts information, not so in the information about land resources and lithologic units in which CETENAL's charts were far superior.

A comparison of a partial land use inventory between an ERTS image scale 1:1,000,000 and an actual land use CETENAL's chart scale 1:50,000, gave the following results over one selected spot:

Superface deployed on CETENAL's chart = 129,900 Has.

Arbitrarily we gave 100% to this last value.

Surface displayed on ERTS image = 122,400 Has.,94.5% of CETENAL's charts figure..

RECOMENDATIONS

To improve the 94.5% results on partial land use inventory using the ERTS images it is highly recomended to employ computer compatible tapes to extract the maximum available information on earth resources contained in them by automatic extraction information techniques.

A N N E X

Climatic chart, 14Q-III Querétaro, Scale 1:500,000

(Carta de Climas)

United States of Mexico chart, up-date already published charts. One side - topographic chart, the other thematic charts.

(Carta de la República. Avance de trabajos al 30 de junio de 1974. Un lado muestra el estado de las cartas topográficas; el otro el de las cartas temáticas).

CORTAZAR F-14-C-74 charts. Scale 1:50,000.

Topographic chart. Contour interval: 10 m.

(Carta Topográfica)

Geologic chart.

(Carta Geológica)

Actual land use chart.

(Carta Uso del Suelo)

Soils distribution chart.

(Carta Edafológica)

Potential land use chart.

(Carta Uso Potencial)

Page intentionally left blank