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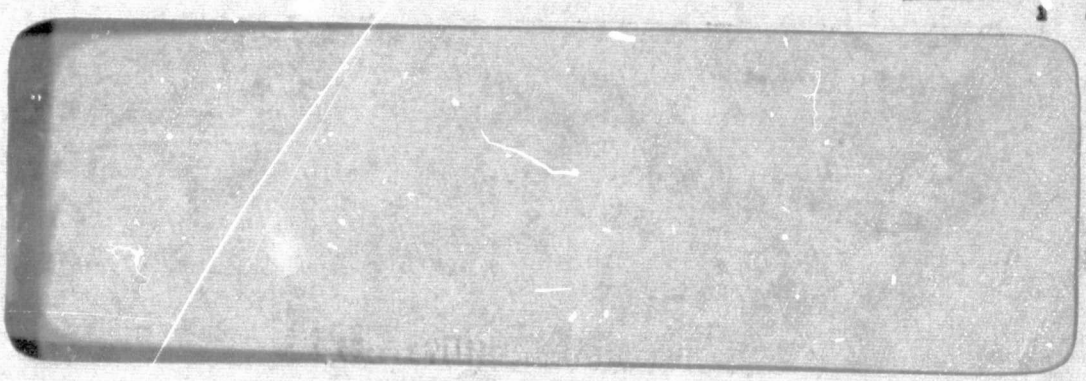
PROGRAMA DEL SATELITE DE RECURSOS NATURALES

ERTS - BOLIVIA



(E76-10357) THE 2995C EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSCR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND REGIONAL LAND USE SURVEY Quarterly Report, Nov. 1975 - Mar. 1976 (Servicio Geologico de G3/43

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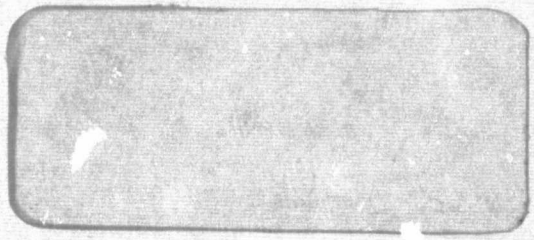

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SERVICIO GEOLOGICO DE BOLIVIA
PROGRAMA DEL SATELITE TECNOLOGICO DE RECURSOS NATURALES

CALLE FEDERICO ZUAZO 1673
ESQ. REYES ORTIZ

CASILLA DE CORREO 2729
LA PAZ – BOLIVIA

29950 EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSOR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND REGIONAL LAND USE SURVEY

QUATERLY REPORT
NOVEMBER 1975, MARCH 1976

ORIGINAL CONTAINS COLOR ILLUSTRATIONS

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1.0 INTRODUCTION

During October 1975-March 1976 period, Bolivia ERTS Program activities were aimed at finishing pending work and projects in order to start in April or May projects related to a multidisciplinary study of 38 LANDSAT images under a contract singned with Bolivia/USAID. This study will take approximately two years with the main purpose of determining new colonization areas.

At the same time a project for the National Railroad Enterprise is being planned in order to select the best route for the Grande River-Trinidad railway. SKYLAB and LANDSAT imagery will be used in the first step to plan the taking of more detailed infrared aerial photographs.

A multidisciplinary study (18 images) of the Department of Beni is also being requested. This study, at 1:250.000, is similar to those ones made for the Departments of Potosí and La Paz.

2.0 IMAGE FILES

Keeping the same nomenclature for LANDSAT imagery on Bolivia, a quantitatively map (Fig. 1) evaluating the existing imagery was prepared with appropiate codes to point out amount of cloudiness, months and years.

This map shows only those images that exists in Bolivia-ERTS Program. It must be updated with new image orders requested to EROS Data Center.

We consider 65 images are needed to cover Bolivia. There are, at the present day, 55 images with 0-20% cloudiness covering 84.6% of the country (930.000 Km^2), with a 1.8 frequency per image. Seven images with 20-30% cloudiness which means 10.7% with a 1.1 frequency per image.

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These figures indicate that from July 1972 to January 1976, Bolivia has been covered approximately four times in 42 months at different seasonal periods, letting us deduce the fact that a total coverage of Bolivia can be obtained if optimun seasonal periods are chosen for the obtaining of images within a calendar year.

3.0 IMAGE PROCESSING

70 mm negatives are being duplicated systematically and used in the reproduction of enlarged images at 1:1.000.000 and 1:250.000. We plan to start however 9.5' negatives preparation in the near future because we believe that it is possible to improve photographic resolutions using this system.

LANDSAT-1, LANDSAT-2 image processing is being done systematically, they are enlarged at 1:250.000 and 1:1.000.000 scales, color transparencias are being also prepared at a 1:1.000.000 scale.

4.0 MULTIDISCIPLINARY PROGRAM

4.1 Cartography

4.1.1 Black and White semi-controlled photomosaic.

The Military Geographic Institute has prepared within cartographic research work, a semi-controlled photomosaic at a 1:1.000.000 scale with images 1045-13570, 1368-13512, 1045-13572, 1368-13514, with a geographic names superposed on the mosaic. However, and image tone problem has appeared, which we hope can be solved with the use of new photographic material.

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The Military Geographic Institute has prepared too, a semi-controlled photomosaic at a 1:1.000.000 scale using images 2187-13554, 2187-13580, 2168-13502, 2150-13505, 2149-13444, with the purpose of making researches in order to build up later the photomosaic of the whole country.

Both works are being evaluated from the cartographic precision point of view, results that will lead us to a decision on the process of preparing the Bolivia mosaic at a 1:1.000.000 scale.

4.1.2 Color controlled photomosaics

Thanks to the USGS EROS Program cooperation, the Military Geographic Institute in coordination with the Inter American Geodetic Survey and Bolivia-ERTS Program is planning the elaboration of a color controlled photomosaic at a 1:1.000.000 scale. The following images have been chosen for this purpose: Charaña 2241-13565, Desaguadero 1010-14033, Oruro 2148-13464, Payachatas 1245-14105, Salar de Coipasa 1010-14035, Poopó Lake 2221-13460, Sucre 1008-13522, Salar de Empexa 1010-14092, Salar de Uyuni 1099-13591, Potosí 2148-13415, Colorada Lagoon 1243-14001, Tupiza 2148-13421, Salar Atacama 1243-14004, Arenal Lagoon 2148-13424. All of them presents a perfect longitudinal and transversal overlap, because they have been obtained in the same season but in different years. Thus the landscape characteristics, especially variations in water, snow and vegetation are reasonably uniform.

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4.1.3 Photomosaics without control

Because we now have a high percentage of cloud free images and because we now have adecuate working material and photographic equipment, a photomosaci without control, of the entire country, has been started on selected images at a 1:1.000.000 scale.This photomosaic will be used as a test for elaboration of future mosaics applicable to all of our multidisciplinary studies.

4.2 Geology

4.2.1 Regional Geology

4.2.1.1 Interpretation for preparing Bolivia Geological Map at a 1:1.000.000 scale.

35% of the country is covered.

4.2.1.2 Interpretation and compilation of Bolivia Geological Map at a 1:250.000 scale

28% of the country is covered.

4.2.2 Tectonics

4.2.2.1 Structural interpretation of the Bolivian Altiplano.This work is actually being reviewed.

100% of the Altiplano area has been interpreted.

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4.2.2.2 Lineament Interpretation of Bolivia. This work is being pursued using LANDSAT-2 imagery.

38% of the country is covered.

4.2.3 Mineralization

4.2.3.1 Studies related to Mineralization and lineament problems of the Cordillera Occidental section, the Altiplano and part of the Cordillera Oriental of Bolivian Andes at a 1:250.000 scale, has been completed.

Anomalous areas are actually being selected for detailed field work.

4.2.3.2 CCT Use for Iron Minerals Identification (Mutún Iron Deposit).

Image processing using the ERIM MIDAS SYSTEM has been finished. Field work and any necessary revisions will be started on May 10.

4.2.3.3 CCT Use in prospection for porphyry copper deposits.

Computer processing of all images covering the western cordillera of the Andes is being considered. Preliminary image enhancement of selected images have been processed by JPL and indicate promising results.

Aircraft overflights will aid selection of anomalous areas that should be field checked.

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4.2.3.4 CCT Use for Copper minerals in the Totora formation (Desaguadero image).

This work is in the developing stage. The CCT's have already been processed at LARS, and the information is now being evaluated.

4.2.3.5 Mineralized Belts

A new mineralized belts map at a 1:1.000.000 scale has been fineshed.

4.2.4 Geomorphology

4.2.4.1 Bolivia Geomorphology Map preparation at a 1:1.000.000 scale.

30% of the country is covered.

4.2.4.2 Bolivia Geomorphology Map preparation at a 1:250.000 scale.

30% of the country is covered.

4.2.5 Petroleum Exploration

4.2.5.1 After LANDSAT-2 images selection, images are being applied to mapping favourable areas for hydrocarbon accumulations.

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4.3 Agronomy

Revised Physiognomic Map.

Due to field verifications, 10% of the prepared maps were revised with more detailed information.

4.3.1 Physiognomic Map at a 1:1.000.000 scale.

25% of the country is covered.

4.3.2 Physiognomic Map at a 1:250.000 scale.

25% of the country is covered.

4.3.2.1 Soil Classification

Current results with CCT application in the classification of soil units are still being evaluated however, we can say that computer application combined with image visual interpretation, have enabled us to obtain more detailed information.

4.3.3 Actual land use legend revised in September 1975, is being applied to this discipline mapping.

Dr. Leonard Berry, Professor of Geography, Co-Director of Clark University, Worcester, Mass. (USA) has been in Bolivia evaluating the performed work. He found that mapping already done was sufficiently precise.

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4.3.3.2 Land Use Map

4.3.3.2.1 Actual Land Use mapping at a 1:1.000.000 scale is 26% completed.

4.3.3.2.2 Actual Land Use mapping at a 1:250.000 scale is 41% completed.

4.3.4 Ecologic Map

Agricultural Affairs Ministry has published Bolivia Ecologic Map at a 1:1.000.000 scale using LANDSAT-1 image in some areas. Unfortunately this work does not mention in detail how to apply the images to this kind of study.

4.4 General Forest Mapping

4.4.1 Legend

During October 1975-April 1976 period, several image evaluations were done on its application to forest mapping. The conclusion was that LANDSAT images are appropiate for application to mapping of different existing forests in Bolivia.

4.4.2 Forest types and Physiognomic vegetation Classification.

Twenty LANDSAT images at a 1:250,000 scale have been interpreted within this subprogram, which means about 30% of Bolivia is completed.

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4.5 Hydrology

Bolivia drainage pattern interpretation at a 1:250.000 scale now covers about 93% of the country. With this performace it is estimated that the work will be finished in the near future, as soon as images completing our coverage arrive in Bolivia.

5.0 SPECIAL PROJECTS

5.1 Patacamaya-Tambo Quemado Road

Geology, Geomorphology and Hydrology disciplines are being applied to a preliminary study for the selection of the Patacamaya-Tambo Quemado Road route. LANDSAT imagery is providing us a knowledge of the area which enable us to select the final route that this road must have.

5.2 Remote Sensing Project in Demography and Actual Land Use

Work done in this project is in accordance to the program planned with USAID. Due to its positive preliminary we plan to use CCT's of three LANDSAT images to develop research related to the Santa Cruz agricultural inventory.

5.3 Multitemporal image application is being studied to detect landscape changes that have occured in some Altiplano zones and their relation to the La Paz-Oruro railroad.

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5.4 Data Collection Platforms (DCP)

Due to experience obtained to date, a project will be developed to demostrate DCP's use in Bolivia. Necessary negotiations with NOAA and USGS were started for this purpose. A LANDSAT/GOES convertible platform is expected to arrive in Bolivia before July 1976.

5.5. Low land multidisciplinary mapping

Study of 38 LANDSAT images will be undertaken under an special contract with USAID and the National Colonisation Institute, to determine appropiate zones for new agriculture. The selected zones will be studied later in detail using conventional working methods.

6.0 PROBLEMS

6.1 Lack of images

A better Cochabamba image is needed to provide total coverage of Bolivia. It could have been obtained last August 1975 due to the excellent weather conditions. August 1976 is recommended for this coverage.

6.2 Obtention of INPE Images

6.2.1 The "Instituto Nacional de Pesquisas Espaciais" (INPE) from Brasil, have send the images detailed below.

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Date	N°	Cloudiness	Bands
3-26-76	175344 - 133656	80%	4-5-6-7
4-22-76	175369 - 131912	40%	4-5-6-7
4-22-76	175342 - 132601	30%	4-5-6-7
4-22-76	175362 - 133547	50%	4-5-6-7
4-22-76	175361 - 133007	20%	4-5-6-7
4-22-76	175361 - 132942	60%	4-5-6-7
4-22-76	175359 - 131847	80%	4-6-5-7
4-22-76	175359 - 131757	60%	4-5-6-7
4-22-76	175359 - 131822	80%	4-5-6-7

6.2.2 Images requested to INPE on 26-3-76

N°	Cloudiness	Bands
73205 - 134022	09%	4 - 5 - 6 - 7
73205 - 134047	09%	4 - 5 - 6 - 7
73189 - 135150	09%	4 - 5 - 6 - 7

6.3 Request for the Software-Larsys 3.1

If we do not get a reply from NASA soon regarding our request for the Software Larsys 3.1, we may not be able to make the research applied to Santa Cruz agriculture inventory.

7.0 CONCLUSIONS

We think that all original planned work will be accomplished in a timely fashion.

FOLDOUT FRAME 1

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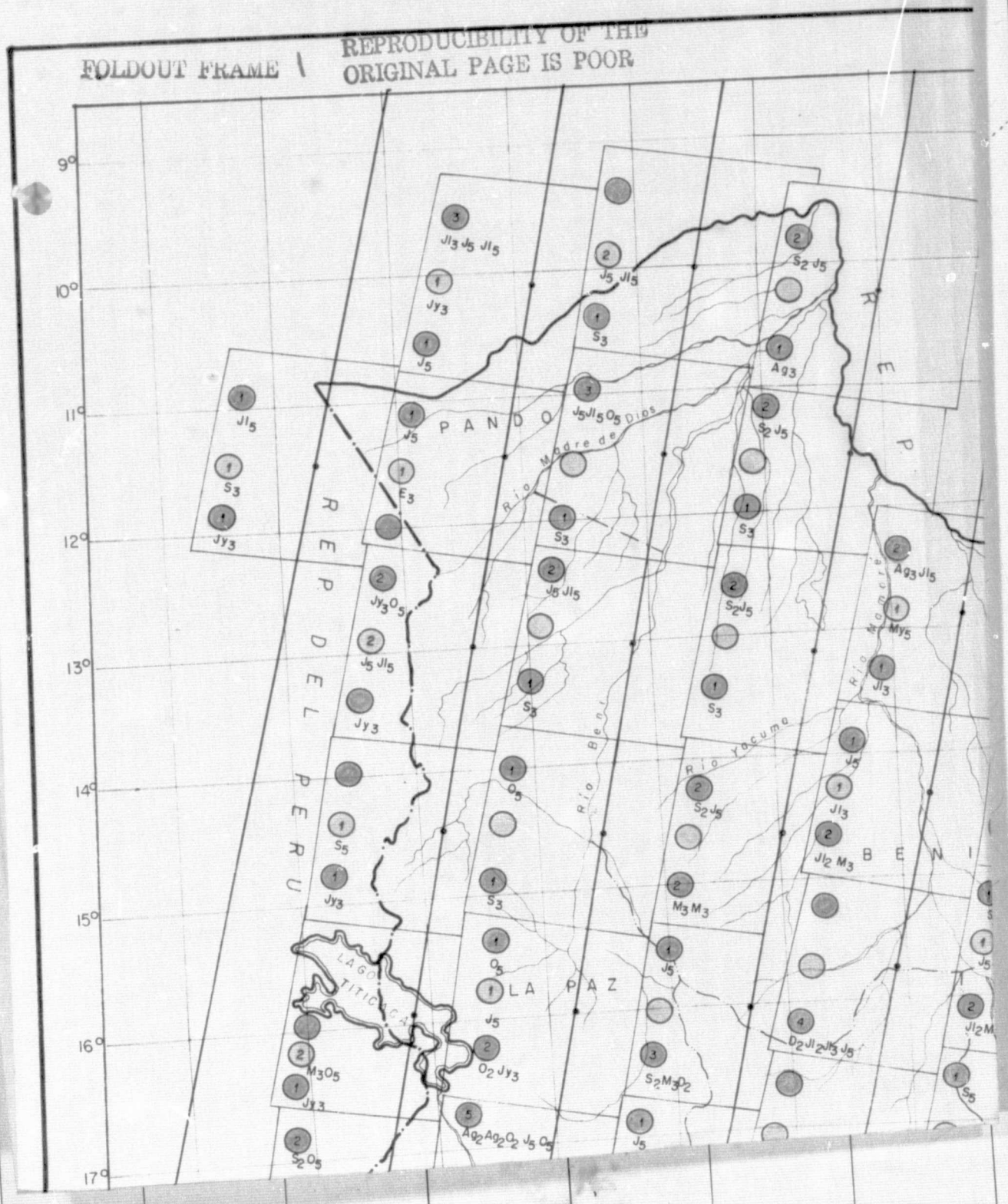


FOLDOUT FRAME 2

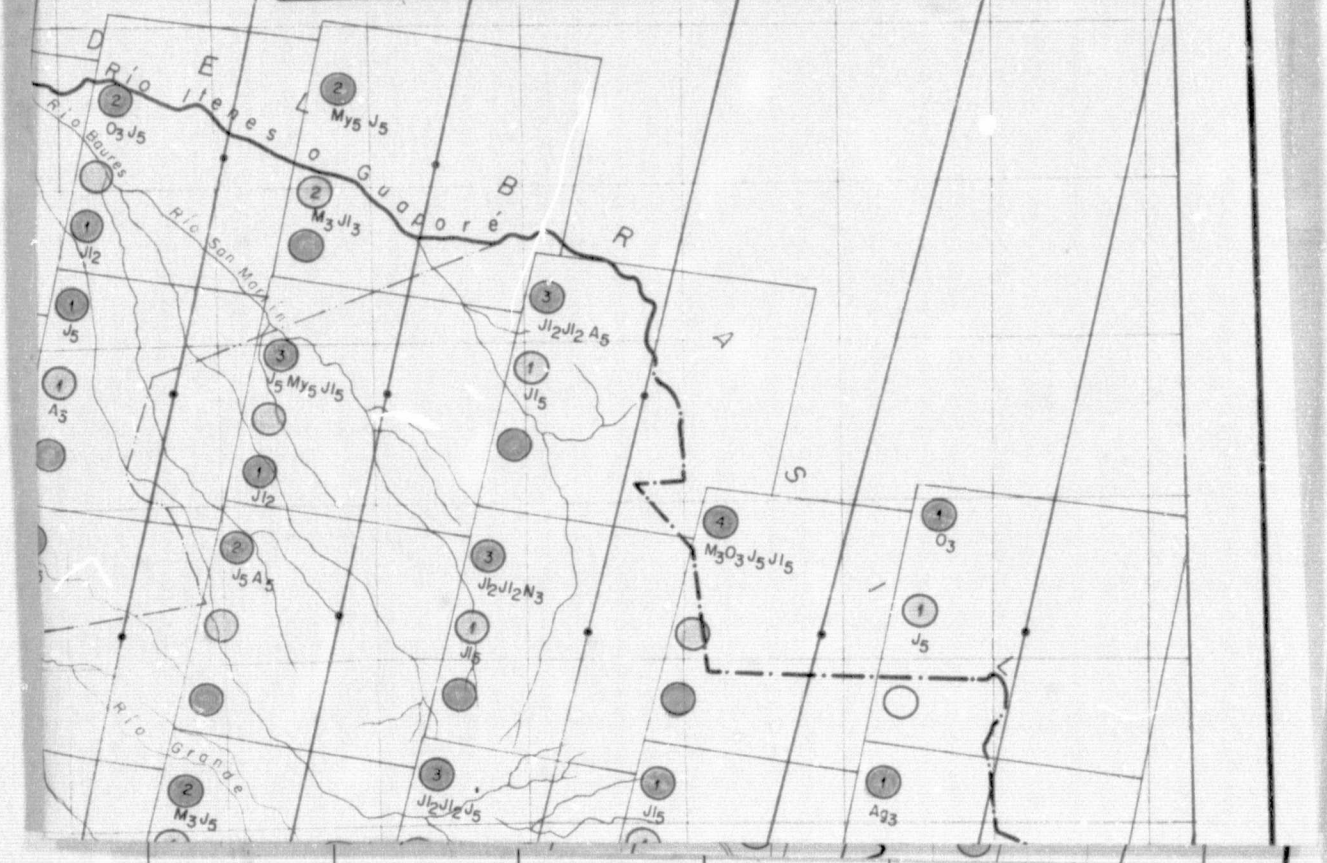
REPUBLICA DE BOLIVIA

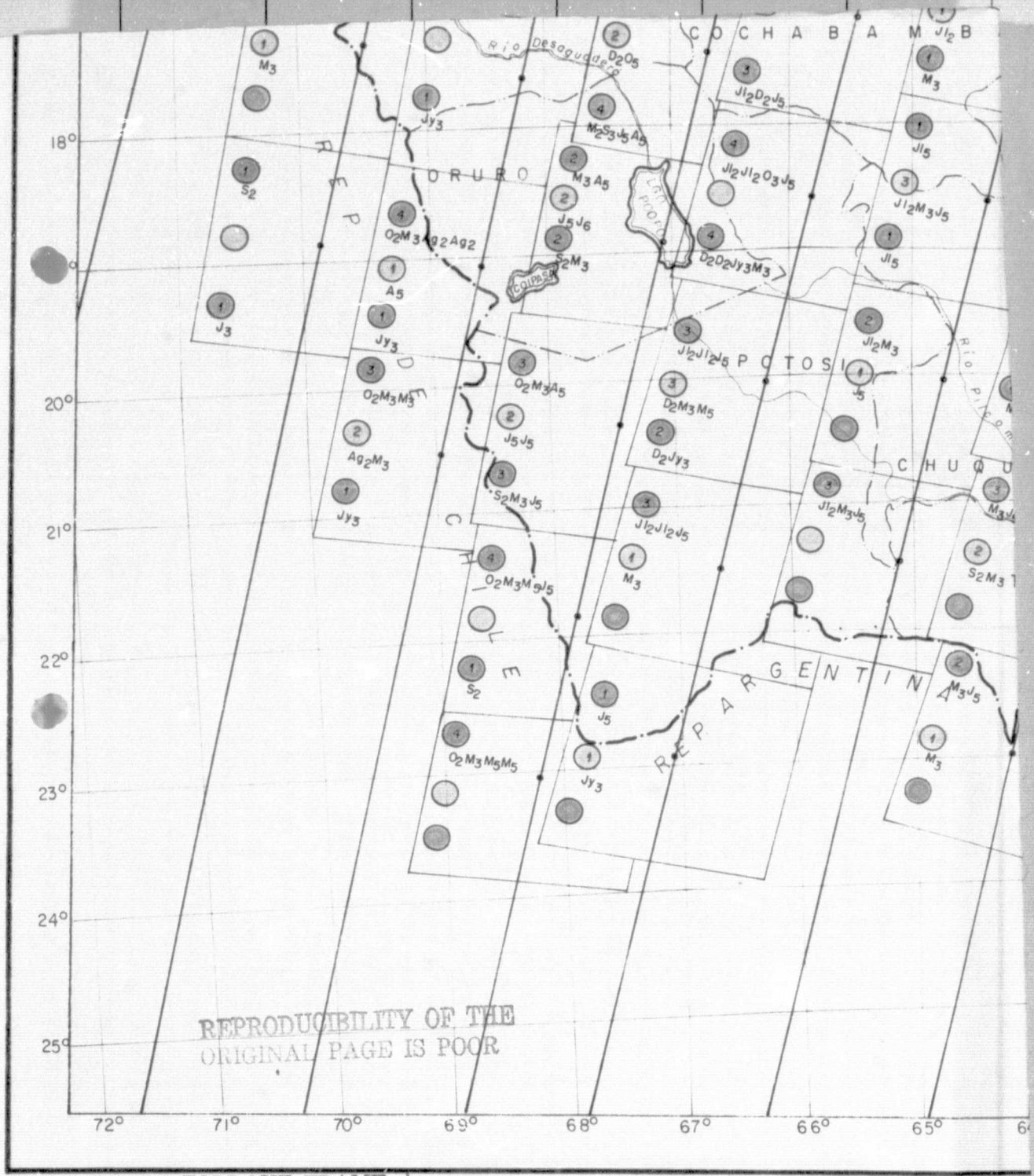
PROGRAMA DEL SATELITE TECNOLOGICO DE RECURSOS NATURALES

NOMENCLATURA DE IMAGENES LANDSAT 1-2

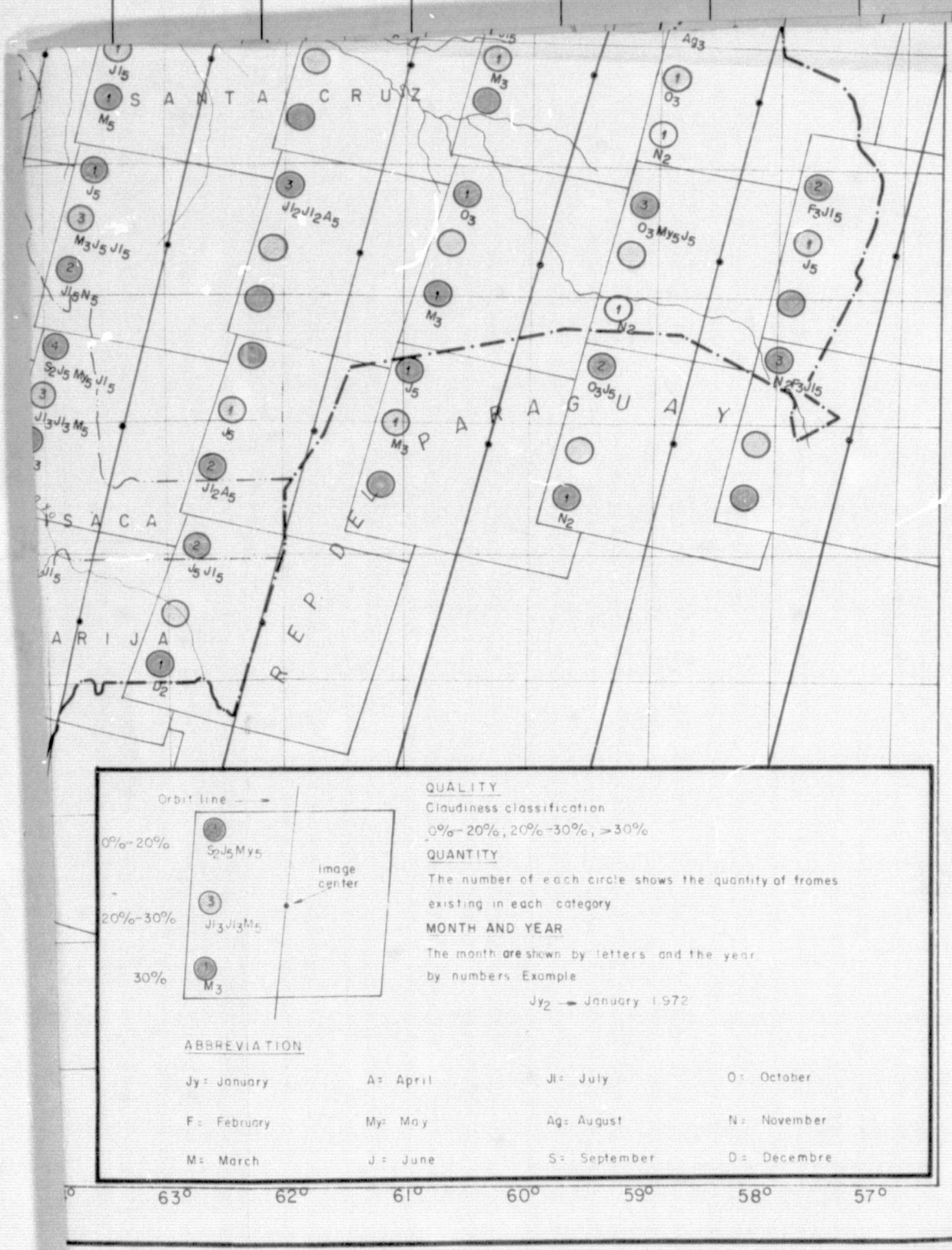
ESCALA 1:5.000.000

JULY 1.972 TO JANUARY 1.976





FOLDOUT FRAME 3



FOLDOUT FRAME 4