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7.7-10028
CR-149131
3rd, 4th QTRS

GEOBOL
PROGRAMA DEL SATELITE DE RECURSOS NATURALES
ERTS - BOLIVIA

N77-11491
HC A03
MF A01
Unclas
G3/43 00028

(E77-10028) THE 29950 EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSOR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND REGIONAL LAND USE SURVEY, MARCH - AUGUST 1976 (Servicio Geologico de Bolivia, La

29950

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

MARCH - AUGUST 1 9 7 6

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BOLIVIA
La Paz - Bolivia

1.0 INTRODUCTION

Activities carried out during the months of March though August were designed to finish all pending work with LARS, ERIM, and EROS. This work has now been completed.

Other activities have begun, especially those related to the study and investigation of the images processed by JPL, work carried out with EROS covering the Salar de Uyuni, and the selection of the route for the Río Grande-Trinidad railroad (the latter combined with the taking of infrared aerial photographs.

The greatest application which will be made of LANDSAT images during the next two years will be in a multidisciplinary study, to be carried out under a contract with USAID/Bolivia to last two years,that will begin in September 1976.

The multidisciplinary study planned for the Department of El Beni,involving the study of 18 LANDSAT images has been deferred because of the lack of personnel needed to carry it out.

2.0 IMAGE FILES

During this March to August period, some additional images were received, either in the form of 70 mm. positive or negative film or 230 mm. (9 inch) positive film. This permitted completion of area coverage in our imagery files and the selection of the best available images for the preparation of the photomosaic of Bolivia (see belows).

As for CCT's processed for the office of the Bolivian ERTS Program by EROS, the images of Desaguadero, Oruro, Tucavaca, Buena Vista,Santa Cruz and Cabezas have been received. USGS tapes of images of Lake Titicaca, Salar de Uyuni, Laguna Colorada, Salar de Atacama and Lake Poopó also have been processed and printouts or other results have been received. There are also two tapes which have been received from INPE (Brasil), one of the Río Heath area and the other of an area north of Arica, outside of Bolivia.

3.9 IMAGE PROCESSING

The positive and negative films which have been received have been duplicited systematically using Kodak 2430 Aeroduplication film. A problem has developed in that the film grain appears, especially when making enlargements to a scale of 1:250.000.

Work is not done with 230 mm. negatives, because of the lack of certain necessary parts needed in the Durst M-184 enlarger being used.

During this period of time, 1395 images have been processed at a scale of 1:1.000.000 including all four bands and 87 images have been processed at a scale of 1:250.000 including both bands 5 and 7.

At present a new photographic laboratory is available. It has the capacity to make black and white enlargements to a scale of 1:250.000 from 70 mm. negatives It is estimated that by December 1976 it will be possible to make color enlargements from the scale of 1:1.000.000 to the scale of 1:250.000 for domestic test use, and that it will have the possibility of being able to offer services to neighboring countries in 1977.

4.0 MULTIDISCIPLINARY PROGRAM

4.1 Cartography

4.1.1 Black and white semi-controlled photomosaics

The Instituto Geográfico Militar (IGM) is continuing to investigate the preparation of a national semi-controlled photomosaic. A mosaic of the southwest sector of the country has been prepared, using the images of Charaña, Desaguadero, Payachata, Salar de Coipasa, Salar de Empexa, Salar de Uyuni, Laguna Colorada, and Salar de Atacama at a scale of 1:1.000.000. A conformal conic projection is being used, and an overlay with names, rivers, and the Bolivian-Chilean boundary has been placed on it.

The problem of density has been resolved with the careful use of Kodak Polycontrast paper.

The above experience together with experience gained in working with the northern part of the country, indicate that with bulk processed LANDSAT images it is possible to prepare photomosaics with the necessary cartographic precision at a scale of 1:1.000.000 using the Lambert Conformal Conic projection for the entire country.

4.1.2 Color Controlled Mosaics

During July the Bolivia ERTS Program sent the coinvestigator in cartography of the Instituto Geográfico Militar (IGM) to the Unites States to become familiar with the methodology,

equipment, and materials that are being employed in the USGS in the preparation of polychromatic controlled mosaics, such as the map of the state of Florida and others.

The Bolivian coinvestigator had the apportunity to work together with technicians of the Cartography Division of the USGS in Reston, using LANDSAT images of Bolivia, and prepared a color mosaic of the Laguna Colorada and Salar de Atacama images at a scale of 1:1.000.000, with excellent results.

On the basis of the above experience, the Bolivian ERTS Program is proceeding to acquire the equipment and material needed to prepare a photomosaic of Bolivia in color at a scale of 1:1.000.000. Before this works is carried out partial investigations will be made in different zones of the country.

4.1.3 Experimental Polychrome Photomaps

A polychrome photomap of the image of Potosí (# 2130-13414) has been prepared at a scale of 1:460.000. This is a continuation of previour cartographic investigations and is for the purpose of evaluating this application for blulk-processed images.

The above mentioned photomap is on the Lambert Conformal Conic Projection, with standard paralles of 12° and 20° South for Bolivia, using the method specified by the Interamerican Geodetic Survey.(I.A.G.S.).

The basic objective of the work was to prove that on the base of the Lambert Conformal Conic Projection it was possible to perfecty identify the location of the cities of Potosí, Uyuni and Cuzco (Bolivia) on the image, along with other topographic features. The conclusion was reached that the projection is adequate for the preparation of this class of photomaps.(Fig.1)

4.1.4 Photomosaics without Control

On the basis of a selection of 65 LANDSAT-1 and 2 images, a photomosaic of Bolivia has been prepared on an approximate scale of 1:1.000.000 as a first effort toward the preparation of the same mosaic, semicontrolled and in color, following the methodology described above under point 4.1.2 (Fig. 2)

An evaluation of this photomosaic indicates that in its prepa ration it was possible to detect certain problems, basic among which is the lack of longitudinal and transversi overlap. Because of this factor it was necessary in many zones to use images from various seasons, which resulted in great differences in tone.

Cloudiness has been another negative factor in the preparation of the photomosaic, especially in the sector north of the city of Cochabamba on the image of the same name and on the images of Covendo and Apolo, so that as many as three images had to be combined to make one image area mosaic with less cloudiness. This problem could have been resolved rapidly if the station at Cuyabá (Brazil) had taken images over theses sectors of Bolivia during the winter season (May-June-July-August). The problems mentioned above are a restriction.

PROGRAMA ERTS BOLIVIA
INSTITUTO GEOGRAFICO MILITAR
DEPARTAMENTO DE CARTOGRAFIA
Y RECURSOS NATURALES

FOLDOUT FRAME 2

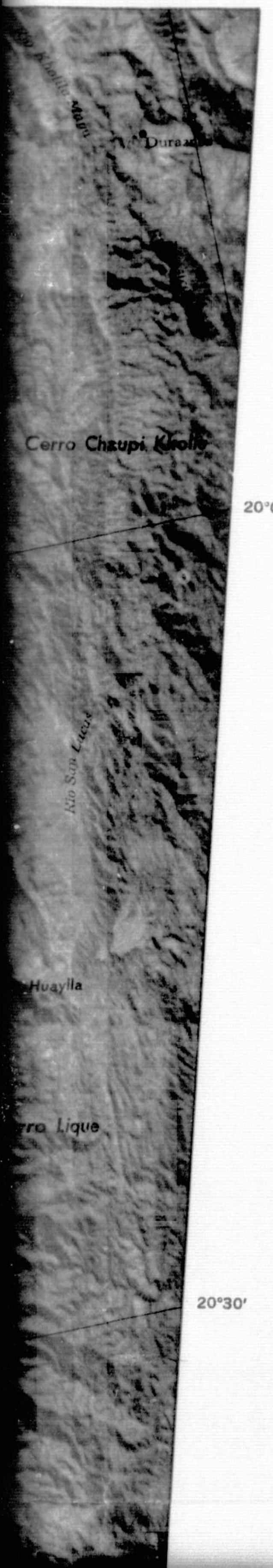
IMAGEN POTOSI

5a

EDICIÓN 1–IGM.

MAPA EXPERIMENTAL
ESCALA 1:460.000 (APROXIMADA)
IMAGEN ERTS E-2130-13414

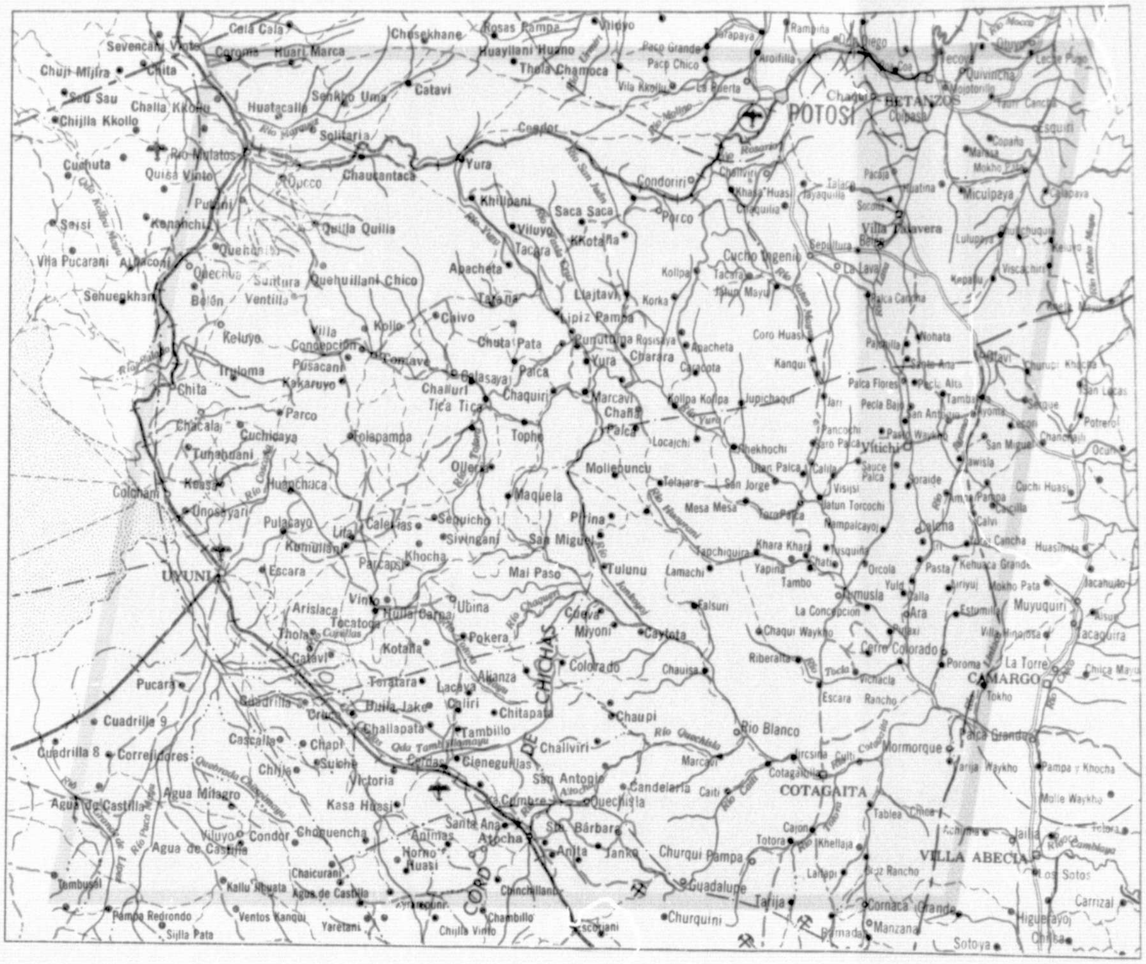
65°00′



20°00′

20°30′

MAPA DE LOCALIZACION



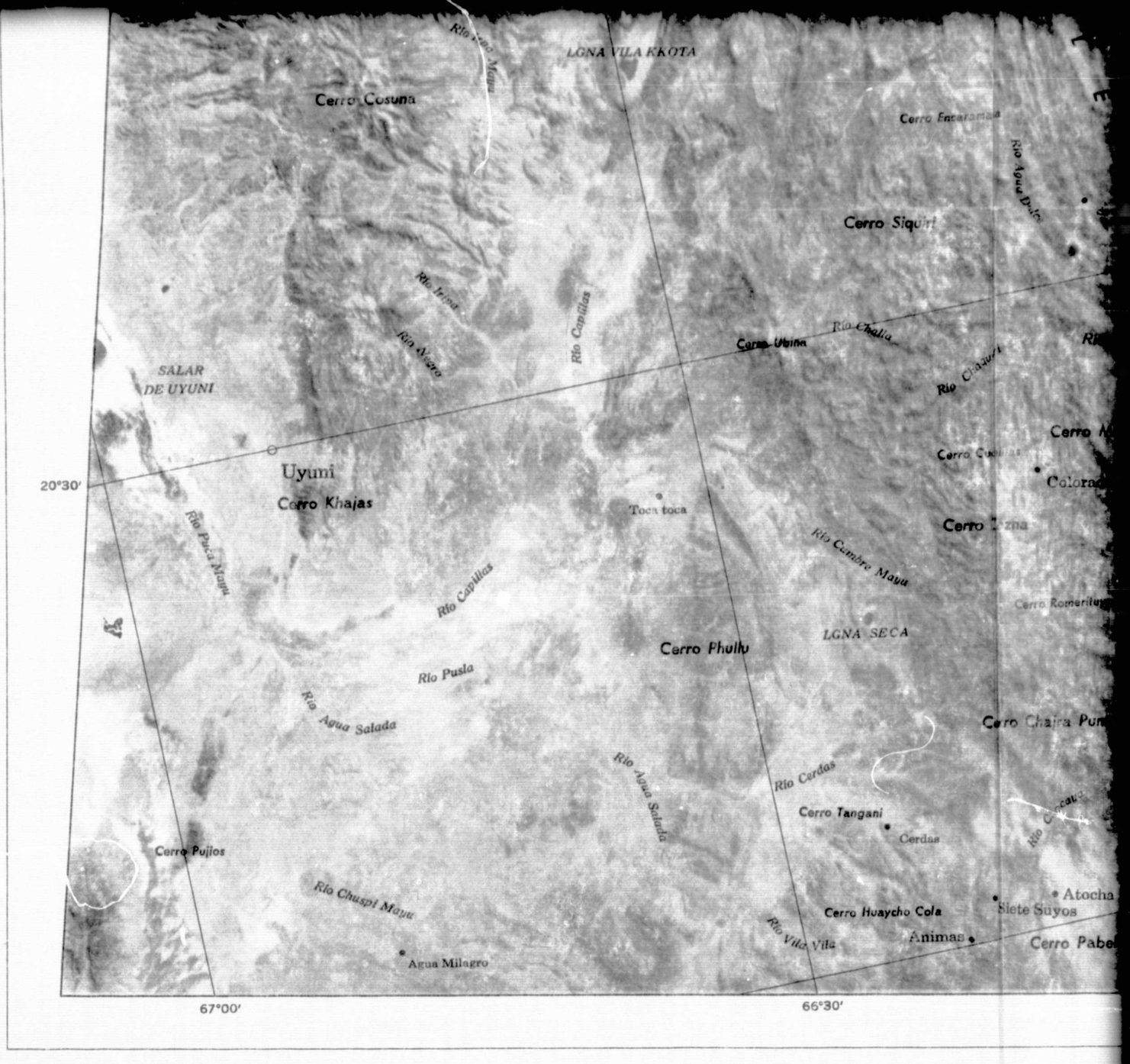
INDICE PARA ESCALA 1:250.000

69°00′ 63°00′
18°00′

SE-19-11	SE-19-12	SE-20-9	SE-20-10
SE-19-15	SE-19-16	SE-20-13	SE-20-14
SF-19-3	SF-19-4	SF-20-1	SF-20-2
SF-19-7	SF-19-8	SF-20-5	SF-20-6
SF-19-11	SF-19-12	SF-20-9	SF-20-10

INDICE DE IMAGENES DE SATELITE

1 Lago Poopo S2149W013471
2 Sucre S2148W013471
3 Vallegrande S2183W013352
4 Salar de Uyuni S2041W013474
5 Potosí S2130W013414
6 Monteagudo S2237W013345
7 Laguna Colorada



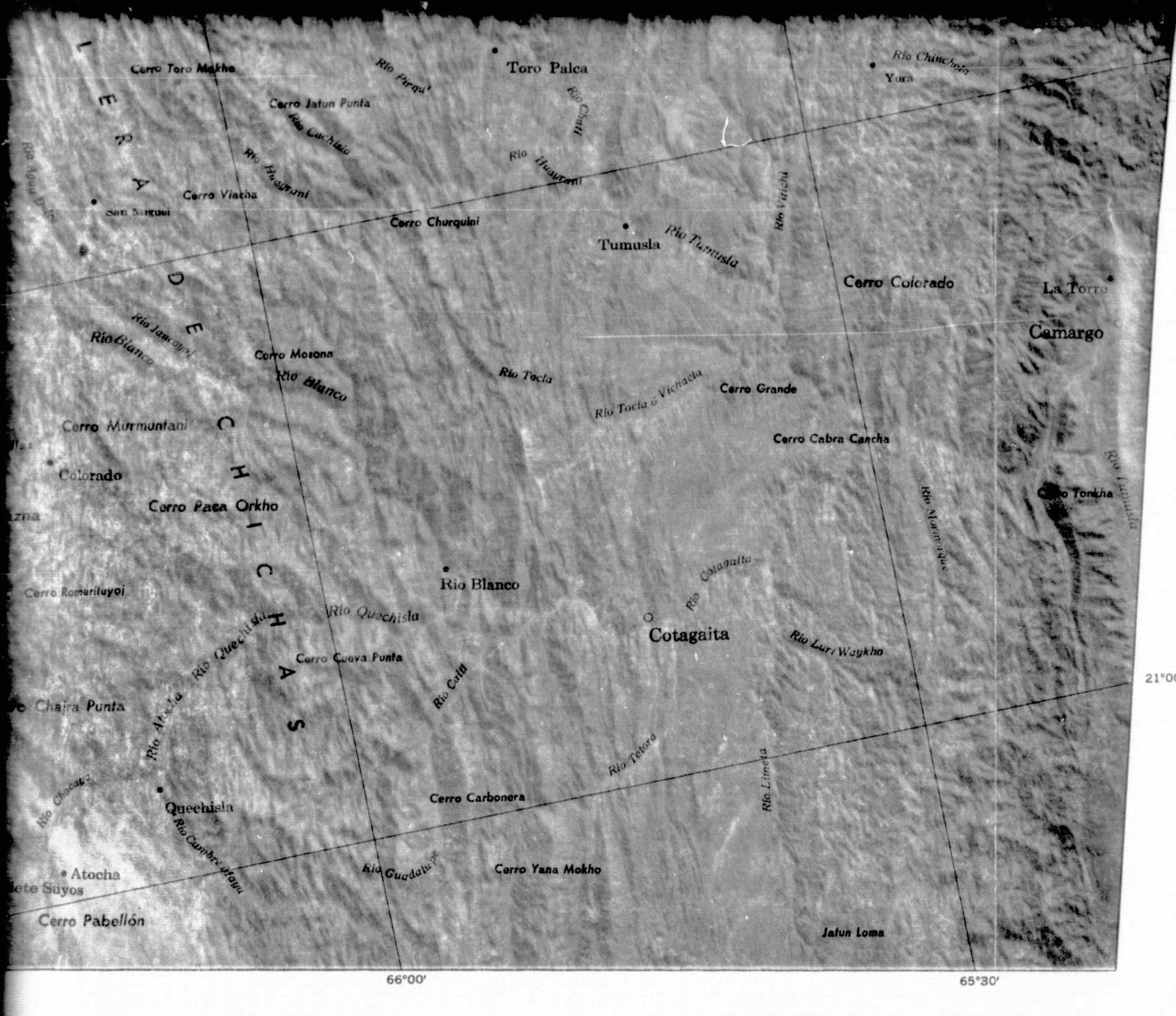
EDICIÓN 1–I.G.M.

Preparado por el Instituto Geográfico Militar (IGM) La Paz - Bolivia En colaboración con el Servicio Geodésico Interamericano (IAGS) Elaborado en 1.976 en base a imagenes MSS ERTS E-2130-13414 Bandas 4-5-7

GLOSARIO (QUECHUA)

Río	mayu	Cerro	orkho
Quebrada	waykho	Loma	pat,
Laguna	khocha	Roca	khakha
Agua	yacu	Rincón	khuchu
Pantano	kheta	Hoyo	thoko
Acequia	larkha	Habra	apacheta
Salar	kollpa	Planicie	pampa
Grande	jatun	Casa	huasi
Pequeño	juchuy	Camino	ñan
Viento	huayra	Piedra	rumi

FOLDOUT FRAME



L.P. VII-76 IMPRESO POR EL INSTITUTO GEOGR

ESCALA 1:460.000

20 10 0 10 20 30 40 Kilometros

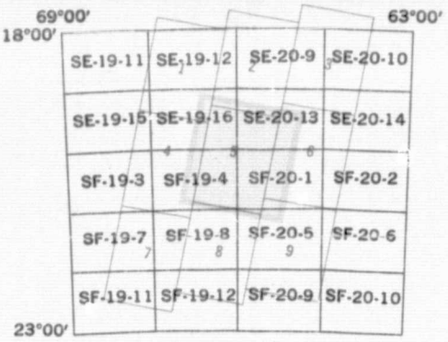
10 0 10 20 30 40 Millas Terrestres

ESTE ES EL TERCER MAPA EXPERIMENTAL CON IMAGENES DE SATÉLITE

Fig. I

FOLDOUT FRAME 5

INDICE PARA ESCALA 1:250.000



INDICE DE IMAGENES DE SATELITE

1 Lago Poopo
S2149W013471

2 Sucre
S21[illegible]

3 [illegible]

4 Salar de Uyuni
S2341W013474

5 Potosí
S2130[illegible]

6 Monteagudo
S2237W013345

7 Laguna Colorada
S2059W013480

8 Tupiza
S2058W013480

9 Tarija
S2021W013364

Imagén tomada con la cámara Multiespecial Scanner (MSS), el 1o. de Junio de 1975.
Altitud de la órbita 900 Km. (560 millas) Area 33.000 Km2. (13 millas cuadradas)
Toma simultanea en las bandas 4 5 y 7. Impresas en selección de colores, de acuerdo al siguiente detalle:

Banda 4 - 0.5 a 0.6 micrómetros
Banda 5 - 0.6 a 0.7 micrómetros
Banda 7 - 0.8 a 1.1 micrómetros (infrarojo)

Esta imágen, obtenida con sensores LANDSAT, mostrará las diferentes condiciones de la covertura terrestre, correspondiente al area de Potosí, como vegetación, hidrografía y poblaciones. etc.
La imágen fué controlada por fotoidentificación atraves de la posición de grandes objetos y ajustada mediante ellos a la proyección Lambert calculada.
Coordenadas Lambert cada 30 minutos con un error de posición estimado en los 100 metros.
Proyección Cónica Conforme de Lambert Paralelos Standard 12° y 20°
Información toponímica obtenida de los mapas topográficos a escala 1:250.000 y el Mapa político de Bolivia a escala 1:1.000.000 del Instituto Geográfico Militar. (La Paz - Bolivia)

ESO POR EL INSTITUTO GEOGRÁFICO MILITAR

RECURSOS NATURALES
INSTITUTO GEOGRAFICO MILITAR

EROS
EARTH RESOURCES OBSERVATION SYSTEMS PROGRAM
In cooperation with NASA and other agencies

restres

POTOSI, BOLIVIA

S2130W013414

1976

FOLDOUT FRAME

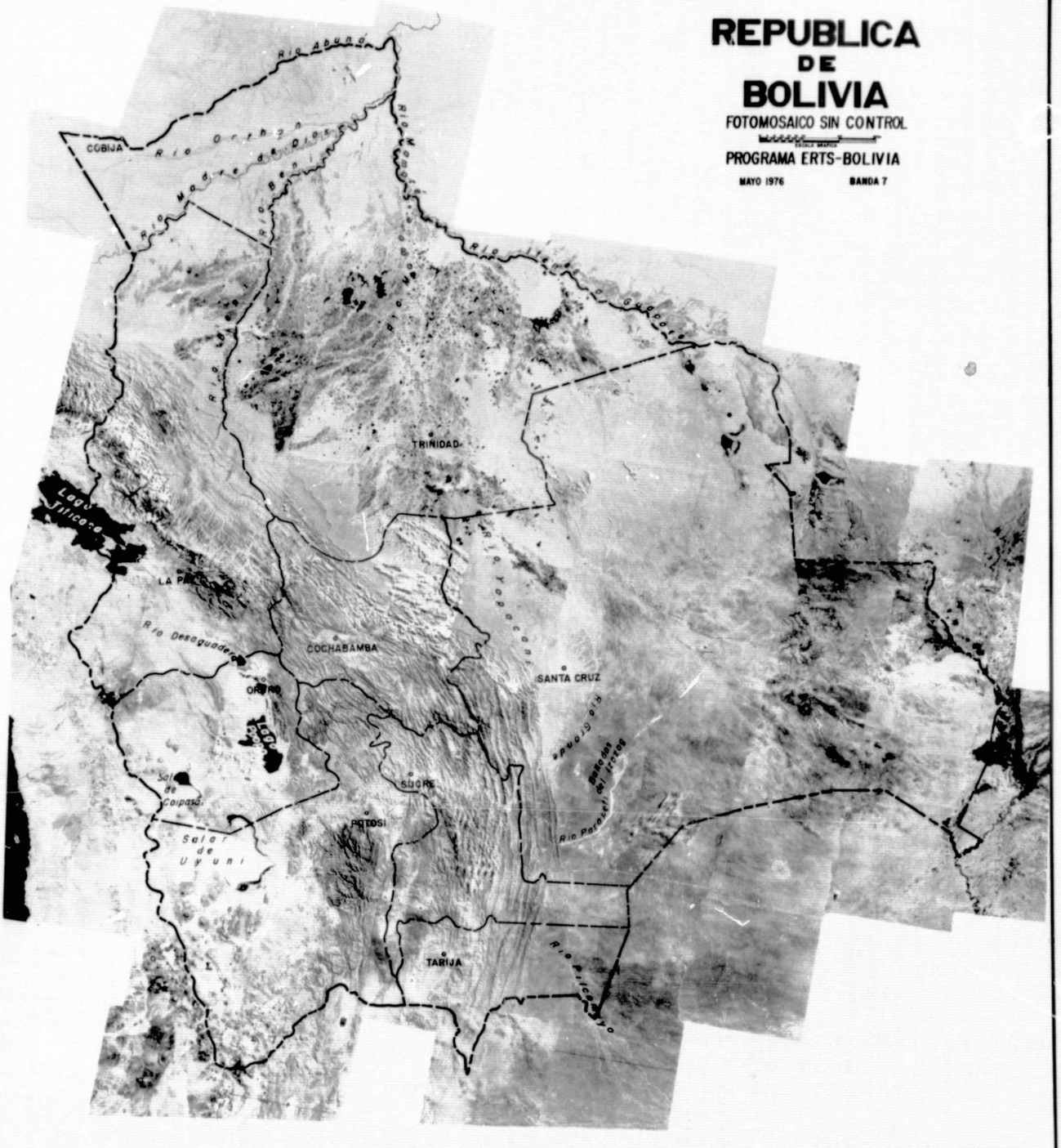


Fig. 2

on the preparation of the color photomosaic, because its preparation will use special photographic methodology which permits a very limited range of film density.

4.2 Geology

4.2.1 Regional Geology

4.2.1.1 Interpretation for the Preparation of the Geological Map of Bolivia at a Scale of 1:1.000.000

35 percent of the country is covered.

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

30 percent of the country is covered

4.2.1.3 Preparation of the Geological Map of Bolivia

After evaluating the information of the two above steps, it has been decided to reduce the maps at a scale of 1:250.000 to a scale of 1:1.000.000. Their information has proven to be excellent for this purpose and the photomosaic described under point 4.1.4 is being used as a map base.

4.2.2 Structural Geology

4.2.2.1 Preparation of Structural Maps

Under the agreement signed with the French Office of Investigation (ORSTOM), the structural map of the Central Andean Cordillera is being prepared. This work

is in the preparatory stage, and will be at a scale of 1:500.000.

4.2.2.2 Lineament Interpretation of Bolivia

This work is finished in the Cordillera Occidental, the Altiplano, and the Cordillera Real. The Chaco-Beni plains and the Brazilian shield remain to be finishied.

4.2.3 Mineralization

4.2.3.1 Study zones

Zones apt for making field studies in areas with lineaments were selected.

4.2.3.2 CCT Use for Iron Minerals Identification (Mutun Iron Deposit)

Aerial reconnaissance over the sector of interes was made on June 3, together with and expert geologist from ERIM. The conclusion was reached that the northern partion of the area should be ignored, because it is inaccessible due to lack of roads. Field investigations should be made in the partion closer to Mutún, where there is the possibility of locating iron deposits based on information obtained by studyng the ratios between bands 6 and 5 and between bands 4 and 5. Field work is expected to be carried out next winter (March 1977)

4.2.3.3 CCT Use in Prospecting for Mineral Deposits

Thanks to the cooperation of NASA, JPL has produced "Stretched Color Additive Composite Images" of bands 4, 5 and 7 and composed of color in the ratioed outputs of bands 4/5, 5/6 and 6/7, at a scala of 1:250.000. Images 1443-14073, 1243-13592, 1243-13595, 1243-14001, and 1243-14004 (of Lake Titicaca, Lake Poopó, Salar de Uyuni, Laguna Colorada, and Salar de Atacama, respectively) have been processed. Interpretation of these images has proceeded and 40 tonal anomalies have been detected, many of them related to recent volcanic processes white others are directly related to igneous bodies.

In order to verify the importance that these tonal anomalies may have, an aerial flight was made over a selectes sector of the area in order to verify the existence of 26 anomalies. Of these, 23 showed the typical halo of limonite-hematite alteration.

On the basis of this information field work is now being done to verify these alterations in the image areas of Salar de Atacama and Laguna Colorada. The results of these field investigations will be known by January 1977.

4.2.3.4 CCT Use for Copper Minerals in the Totora Formation (Desaguadero Image)

The use of CCT's for this purpose did not give the expected results because of the vegetation which masks

the geologic formations and because the copper is of sedimentary origen and therefore there is no altered zone to show an indication of the deposit. Neverthe-les, rocks can be separated from soil with great pre cision. A special report is being prepared on this work.

4.2.3.5 Mineralized Belts

This works has been finished on a scale of 1:1.000.000 together with a combination of maps showing lineaments and tonal anomalies (based on visual interpretation). These maps will be used in new mineral prospecting activities.

4.2.4 Geomorphology

4.2.1.4 Geomorphology Map at a Scale of 1:1.000.000

30 percent of the country is covered

4.2.4.2 Geomorphology Map at a Scale of 1:250.000

30 percent of the country is covered

4.2.4.3 Applied Geomorphology

LANDSAT images, SKYLAB photography, and conventional aerial photography are being used in the selection of the route for the Río Grande-Trinidad railway. The images are being used at scales of 1:250.000 and 1:1.000.000, and form the cartographic base for the work because of the lack of adequate maps of the zone.

4.2.5 Petroleum Exploration

4.2.5.1 Photointerpretation

Visual interpretation of potentially petrolifeous zones are being made.

4.2.5.2 Technical Development

Because of the importance of this energy resource to the country one technician will be sent to LARS to study the possibility of using enhancement techniques to locate potentially petroliferous areas.

4.2.6 Investigation of the Salar de Uyuni

In April 1976, together with EROS, and investigation of the Salar de Uyuni was begun.

"Image 100" processing of the CCT of image 1243-13595 was used; this permitted identification of 9 classes apparently related a range from water depth to old dry salt caps. With the use of multitemporal imagery of the Salar, it has been possible to detect the presence of superficial water at different times of the yesr, a factor that brings up the consideration of the existence of a dynamic aspect that may affect the area. Field studies will be made synchronously with the passage of LANDSAT 2 to study the possibility of identifyng salts.

A sample investigation carried out by EROS has detected the presence of high levels of Li and K, a factor that has determined that we will make studies in greater detail, together with the USGS.

Correlating information obtained in the field with the processing of "band ratioing" by JPL and the "Image 100" for the Salar de Empexa area has produced evidence that it is possible to separate salt (NaCl) from calcium sulfate ($CaSO_4$). They are presented in very distinct colors, a differentiation that was not possible with only the "stretched" method by which the Salar was shown as an extensive white surface.

4.3 Agronomy

Revised Soils Maps

Of the maps prepared from office interpretation, 75 percent were revised with more detailed information from field verification.

4.3.1 Soils Maps at a Scale of 1:1.000.000

30 percent of the country is covered

4.3.2 Soils Maps at a Scale of 1:250.000

33 percent of the country is covered

The latest investigations made in soils map preparation based on visual interpretation indicates that the quality of work is at exploratory and reconnaissance levels at a scale of 1:250.000.

4.3.3 CCT Soil Classification

The latest investigations made with CCT processing and test field work carried out in the Bosaguadero image area has permitted the preparation of soils maps at a semidetailed level

at a scale of 1:50.000. It is still considered possible to produce maps at a detailed level if the situation requires it.

4.3.4 Land Use

4.3.4.1 Legend

The Current Land Use Legend presented at the Earth Resourses Survey Symposium in Houston in June 1975 has been modified, based on field work. The new legend is presented in detail herewith.

TABLA I

LEGEND OF CURRENT LAND USE OF BOLIVIA

LEYENDA DE USO ACTUAL DE LA TIERRA EN BOLIVIA

NIVEL I (Level 1)	NIVEL II (Level 2)	NIVEL III (Level 3)
1 RANGELANDS Tierras con Pastizales	11 High Rangelands Pastizales de Altura	111 Wet High rangelands Pastizales de altura húmedos
		112 Temporally wet high rangelands Pastizales de altura temporalmente húmedos
		113 Dry high rangelands Pastizales de altura secos
		114 Dry high rangelands affected by salinity Pastizales de altura secos afectados por salinidad.
	12 Intermediate Altitude rangelands Pastizales de altura intermedia	121 Wet intermediate altitude rangelands Pastizales de alturas intermedias húmedos
		122 Temporally wet intermediate altitude rangelands Pastizales de alturas intermedias temporalmente húmedos.
		123 Dry intermediate altitude rangelands Pastizales de alturas intermedias secos
		124 Intermediate altitude pastures affected by salinity Pastizales de alturas intermedias afectados por salinidad.
	13 Lowland Rangelands Pastizales de tierras bajas	131 Wet savannas Sabanas húmedas
		132 Mesofitic savannas Sabanas mesofíticas
		133 Xerofihc savannas Sabanas xerofíticas
		134 Prairie lands Praderas

2 FOREST LANDS
Tierras con Bosques

21 Deciduous Forests
Bosque Deciduo

211 Dune deciduous forests
Bosque deciduo de dunas
212 Lowland deciduous forests
Bosque deciduo de tierras bajas
213 Galeria deciduous forests
Bosque deciduo de galería
214 Piedmont deciduous forests
Bosque deciduo de piedemonte
215 High hills deciduous forests
Bosque deciduo de colinas altas
216 Inter-Montane valley deciduous forests
Bosque deciduo de valles intermontanos
217 Montane deciduous forest
Bosque deciduo de montañas

22 Evergreen Forests
Bosque siempreverde

221 Meadowland evergreen forests
Bosque siempreverde de vegas
222 Lowland evergreen forests, not flooded
Bosque siempreverde de tierras bajas no inundables.
223 Galeria evergreen forest
Bosque siempreverde de galería
224 Piedmont evergreen forest
Bosque siempreverde de piedemonte
225 Hill-land evergreen forests
Bosque siempreverde de colina
226 Inter-Montane valley evergreen forests
Bosque siempreverde de valles intermontanos
227 Montane evergreen forests
Bosque siempreverde de montaña

23 Mixed forests
Bosque mixto

231 Meadowland mixed forests
Bosque mixto de vegas
232 Lowland mixed forests, not flooded
Bosque mixto de tierras bajas no inundables
233 Galeria mixed forests
Bosque mixto de galería
234 Piedmont mixed forest
Bosque mixto de piedemonte
235 Hill-and mixed forests
Bosque mixto de colina
236 Inter-Montane valley mixed forests
Bosque mixto de valles intermontanos
237 Montane mixed forests
Bosque mixto de montañas

3 CULTIVATED LANDS Tierras Cultivadas	31 Cultivation in High Altitudes and the Altiplano Cultivos en altura y Altiplano	311 Areas with one crop per year Areas con una cosecha anual
		312 Areas two or more crops per year Areas con 2 ó más cosechas anuales
		313 Irrigation areas Areas con riego
		314 Areas of dry-farming with fallowing Areas con cultivo sin riego y con descanso
		315 Undifferentiated crop pasture lands Areas con cultivos y pastizales indiferenciadas
	32 Cultivation in intermediate Altitudes Cultivos en alturas intermedias	321 Areas with one crop per year Areas con una cosecha anual
		322 Areas two or more crops per year Areas con dos ó más cosechas anuales
		323 Irrigation areas Areas con riego
		324 Areas of dry-farming with fallowing Areas con cultivo sin riego y con descanso
		325 Undifferentiated crop pastures lands Areas con cultivos y pastizales indiferenciados
		326 Undifferentiated crop and forest lands Areas con cultivos y arborización indiferenciadas
	33 Lowland cultivation Cultivos en tierras bajas	331 Areas with one crop per year Areas con una cosecha anual
		332 Areas two or more crops per year Areas con dos ó más cosechas anuales
		333 Irrigation areas Areas con riego
		334 Areas of dry-farming with fallowing Areas con cultivo sin riego y con descanso
		335 Undifferentiated crop pastures lands Areas con cultivos y pastizales indiferenciadas.

4 WETLANDS Tierras húmedas	41	High Altitude Vegetated Wetlands Tierras húmedas de zonas altas con vegetación	411 Permanent Wetlands Tierras húmedas permanentes 412 Temporary wetlands Tierras húmedas temporales
	42	Lowland Vegetated Wetlands Tierras húmedas de zonas bajas	421 Permanent wetlands Tierras húmedas permanentes 422 Temporary wetlands Tierras húmedas temporales
	43	Non-Vegetated Wetlands Tierras húmedas sin vegetación	
5 WATER Agúa	51	Lakes Lagos	
	52	Small Lakes (including ponds) Lagunas	521 Permanent Lakes Lagunas permanentes 522 Temporary Lakes Lagunas Temporales
	53	Rivers Ríos	531 Permanent rivers Ríos permanentes 532 Temporary rivers Ríos Temporales
	54	Reservoirs Reservorios	
6 BARREN LANDS Tierras eriales	61	Salt Flats Salares	
	62	Playas and Dunes Playas y dunas	
	63	Exposed Rock Zonas rocosas	
	64	Surface mines and quarries Desmontes mineros y Canteras	
	65	Saline Lands Tierras Salinas	
	66	Badlands Mal país	
	67	Other Otras	

7 PERMANENT SNOW AND ICE
Nieve y Hielo Permanente

71 Fields with Permanent Snow
Campos con Nieve Permanente

72 Glaciers
Glaciares

8 TUNDRA
Tundra

81 Wet Tundra
Tundra húmeda

82 Dry Tundra
Tundra seca

9 CULTURAL FEATURES
Rasgos culturales

91 Cities
Ciudades

92 Towns and Villages
Pueblos

93 Transportation and Communication Facilities
Transportes y Comunicaciones

931 Airports and Landing fields
Aereopuertos y Campos de Aterrizaje

932 Railroats and roads
Ferrocarriles, Carreteras y Caminos

933 Others (pipelines, powerlines, etc.)
Otros (oleoductos, gasoductos, líneas de energía eléctrica, etc.)

4.3.4.2 Land Use Map

4.3.4.2.1 Current Land Use Mapping at a Scale of 1:1.000.000

60 percent of the country is covered

4.3.4.2.2 Current Land Use Mapping at a Scale of 1:250.000

43 percent of the country is covered

4.3.4.2.3 CCT Applications in Land Use

The final land use classification developed in LARS is now available. The possibility of applying this final classification is being studied for the purpose of investigating the correlation betweens visual interpretation and digital processing.

4.4 General Forest Mapping

After correcting the land use legend for forest mapping, it has been possible to classify types of vegetation cover in general and in the form of specialized types of forest cover in accord with their ranges of quantitative measures of relative reflectance.

On the basis of imagery information and the preliminary interpretation of LANDSAT images, it was possible to estimate mt3/ha. (the average volume of wood per hectare).

4.5 Agricultural Use Capacity of the Land

Investigation of the use of images to study the agricultural use of the land have been made; complemented with conventionally-obtained information, the results of these investigations have been satisfactory. Nevertheless, it is necessary to indicate that this ability would increase with a greater quantity of multitemporal images and with greater resolution.

4.6 Hydrology

A new hydrologic map of Bolivia will be prepared on a scale of 1:1.000.000. It will be necessary to make a complete revision on the basis of information processed so far at a scale of 1:250.000.

5.0 SPECIAL PROJECTS

5.1 Remote Sensing Project in Demography and Current Land Use

All cartographic base maps have been finished, using LANDSAT images and SKYLAB photographs, for the entire country. These are being used for the preparation of census maps.

Investigations of population and current land use relations have begun in the Altiplano test area.

5.1.1 Digital Agricultural Mapping of the Santa Cruz Area

Continuing the investigations being carried out with LARS-Purdue, an investigation will be carried out to determine quantitatively the resources present in the test area by province.

The classification will employ the following categories: cropland, forest, rangelands, barren lands, water, wetlands, and cultural features.

To carry out this study aerial photographs were taken and field work will be carried out during the month of September.

5.2 Low Land Multidisciplinary Mapping

The agreement between USAID and the Instituto Nacional de Colenización for a study of 38 LANDSAT images is now in its final stage of preparation. The work under this agreement will start in October and will last for two years.

5.3 Training

5.3.1 Capacitation

5.3.1.1 In LARS

The Bolivia ERTS Program office will send two people to LARS for training in use of the LARSYS system. One is a computer specialist, the other is a geography and land use specialist.

The national oil company (YPFB) is expected to send a geologist to LARS for similar training in oil exploration.

5.3.1.2 In ITC, Einschede, the Netherlands.

The Bolivia ERTS Program office will send one geomorphologist to ITC for one year to receive training in all forms of imagery and remote sensing.

5.3.1.3 In the Centro Hidrologico, Milan, Italy

The Bolivia ERTS Program Office will send one hydrologist to this center for training in the application of remote sensing to hydrology.

5.3.2 Implementation of LARSYS 3.1

In Bolivia at present there are two distinct computer systems, IBM and DEC, neither of which is completely compatible with the IBM 360/67 of LARS. This creates problems for implementing LARSYS in Bolivia.

A CCT from LARS is being awaited, so that the problems which will be encountered during investigations using such tapes may become better known.

5.4 Data Collection Platforms (C/DCP)

A hydrometeorological investigation will begin, jointly with EROS (USGS); EROS will loan a platforms antenna, test set, manuals, etc. The Bolivia ERTS Program offices is interested in sensing air temperature, soil temperature, precipitation, water flow, water level, and evaporation. In the first part of the investigation we will only have one sensor until the interface problem is solved, which may be expensive.

All of the investigation will be coordinated by EROS.

The investigation is expected to by very important, since data on soil temperatures can be used in connection with data from the future LANDSAT-C.

6.0 PROBLEMS

6.1 Lack of information about images obtained in Brazil over Bolivia

6.2 Lack of coverage by LANDSAT-2 over Bolivia

6.3 CCT's from Brazil

The different format of the Brazilian CCT's will be a problem in the inmediate future for the users who are currently adopting a definiti system of image processing, such as LARSYS.

6.4 Quality of the CCT's

The complete study that was to be made of the Santa Cruz area, using the images of Buena Vista, Santa Cruz, and Cabezas, had to be reduced to only the first scene, because of the presence of dropped lines in the other images.

7.0 FUTURE ACTIVITIES

International Conference

Negotiations are under way with USAID to hold an international conference to present results of the application of satellite images to census operations and the study of land use in Bolivia. The tentative date for such a conference is in November, 1977.

Invitations will be sent by the Government of Bolivia to the various countries of the hemisphere, with attention concentrated on planners and financial managers, people who make decisions about allocation of resources, so as to permit them to become informed about the possible role of satellites in developing resource information while reducing costs for their countries.

The United Nations has expressed interest in supporting a similar international conference, but not restricted in scope of applications. It may be possible to arrange to have both conferences at the same time in La Paz, and to attract a common set of exhibitions and participants.
