EVALUATION OF ERTS-1 DATA APPLICATIONS TO GEOLOGIC MAPPING, STRUCTURAL ANALYSIS AND MINERAL RESOURCE INVENTORY OF SOUTH AMERICA WITH SPECIAL EMPHASIS ON THE ANDES MOUNTAIN REGION

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Greenbelt, Maryland 20771

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16. Abstract

ERTS-1 data is ideally suited for small-scale geologic mapping and structural analysis of remote, inaccessible areas such as the Andes of South America. The synoptic view of large areas, low sun-angle and multispectral nature of the images provide the right ingredients for improving existing geologic and other maps of the regions. In most areas we have successfully compiled geologic, drainage and cultural interpretive overlays to individual scenes mainly using MSS bands 4, 5, 7. A test image mosaic using MSS Band 6 is being compiled for Test Area 7 (La Paz, Bolivia). It will be at a scale of 1:1,000,000 and cover 4 x 6 degrees of latitude and longitude and will serve as a compilation base on which to join the overlays. Repetitive data shows changes in river channels and sedimentation plumes, changes in lake shorelines and surface moisture distribution. Vegetation and snow line changes in the Andes have been recognized. A year of seasonal data, however, has not yet been acquired due to tape recorder failure.

17. Key Words Suggested by Author	18. Distribution Statement
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Unclassified	N/A	28	

Figure 2A. Technical Report Standard Title Page. This page provides the data elements required by DoD Form DD-1473, HEW Form OE-6000 (ERIC), and similar forms.

INT: 2090-72

Type II Progress Report

a. Title: Geologic Mapping and Mineral Resource Inventory in South America
ERTS-A Proposal No.: SR 189

b. GSFC ID NO. of P.I.: IN-012

c. Statement and explanation of any problems that are impeding the progress of the investigation:

Failure of the MSS tape recorder has caused an abrupt drop in the collection of data over South America. This will cause a gap in repetitive coverage and evaluation of seasonal coverage as a geologic mapping and exploration tool. Unless some arrangement can be made between GSFC and INPE/Brazil for their data to be distributed to ERTS-1 investigators this part of the experiment will have to be dropped or deferred until ERTS-B is launched.

d. Discussion of the accomplishments during the reporting period and those planned for the next reporting period:

(1) Cataloguing of all data in hand was completed by Stuart Marsh and a report on the catalogue system was developed. A copy is attached. In summary, they are divided by Test Site No. 1 thru 12 and country. They are listed by frame number, local place name where feasible, date, percent cloudcover and ONC-ID No. Each is plotted on an ONC Index Map.

(2) Test site 7 (La Paz, Bolivia) has sufficient cloud-free data to compile a semi controlled mosaic of the 4 x 6 degree area at a scale of 1:1,000,000. Negotiations have been completed with the Topographic Division Branch of Special Maps to compile the mosaic and work has started. Hopefully a preliminary version will be ready by November 1, 1973. Areas where clouds are present will be replaced by cloud-free data as it becomes available. The mosaic will serve as a master plotting base for geologic interpretations that have been completed on individual frames.

(3) Stuart Marsh completed geologic interpretation of 15 images in Test Sites 7 (Bolivia) and 11 (Chile/Argentina). These will be reviewed as compilation to a mosaic base is undertaken during the next reporting period.

(4) Marsh also conducted an exhaustive review of data for test sites 1 through 11 for examples of change from repetitive data. A copy of his findings is attached and summarized below.

(5) Dr. Carlos Brockmann, Co-investigator for Bolivia, submitted a copy of a report summarizing the progress of the Bolivian ERTS-1 Experiment as presented to the PAIGH Symposium on Remote Sensing, Panama, May 1973. More recently he sent us copies of the Sucre, Bolivia, 1:250,000-scale color lithograph map mosaic of portions of two ERTS-1 scenes. They were compiled from Band 1 RBV by the Bolivian Instituto Geografico Militar as a subproject of the Bolivian Experiment. The maps are being evaluated by USGS personnel.

(6) Dr. Eduardo Gonzalez, Empresa Nacional del Petroleo, Punta Arenas, Chile, has joined the project as a co-investigator for test site 12. Unfortunately, the data thus far received is mostly cloud covered. If INPE Brazil cannot provide cloud-free data, we will have to defer study of the area for our follow-on ERTS-B experiment.

e. Discussion of significant scientific results and their relationship to practical applications or operational problems.

ERTS-1 data is ideally suited for small-scale geologic mapping and structural analysis of remote, inaccessible areas such as the Andes of South America. The synoptic view of large areas, low sun-angle and multispectral nature of the images provide the right ingredients for improving existing geologic and other maps of the regions. In most areas we have successfully compiled geologic, drainage and cultural interpretative overlays to individual scenes mainly using MSS bands 4, 5, 7. A test image mosaic using MSS Band 6 is being compiled for Test Area 7 (La Paz, Bolivia). It will be at a scale of 1:1,000,000 and cover 4 x 6 degrees of latitude and longitude and will serve as a compilation base on which to join the overlays. Repetitive data shows changes in river channels and sedimentation plumes, changes in lake shorelines and surface moisture distribution. Vegetation and snow line changes in the Andes have been recognized. A year of seasonal data, however, has not yet been acquired due to tape recorder failure.

f. List of published articles, and/or papers, preprints, in-house reports, abstracts of talks that were released during the reporting period:

Application of ERTS-1 Data with Emphasis on Cartographic Mapping, by W. D. Carter presented at the VI Congress of Brazilian Cartography. Carter spent two weeks briefing various government and commercial mapping agencies in Rio de Janeiro and Brasilia. Interest in using ERTS-1 as a cartographic tool was very high. Presented July 18, 1973. This talk will not be published.

Carter, W. D., 1973, Status of Geologic Mapping and Mineral Resource Inventory by ERTS-1 Satellite Data in South America, Proceedings of the Am. Cong. on Surveying and Mapping, 33rd Ann. Mtg., March 11-16, 1973, Washington, D. C. (Abstract), p. 221.

Carter, W. D., 1972, Geologic Questions and Significant Results Provided by Early ERTS Data: NASA Symposium Proceedings on Earth Resources Technology Satellite-1, September 29, 1972, Goddard Space Flight Center, Greenbelt, Maryland, p. 77-87.

Carter W. D., 1972, Use of Space Shuttle for Earth Resource Mapping, Inventory and Evaluation: Proceedings of the American Astronautical Society, Washington, D. C., December 27, 1972 (in press).

Carter, W. D., and Eaton, G. P., 1973, ERTS-1 Image Contributes to Understanding of Geologic Structures Related to the 1972 Managua Earthquake: NASA Symposium on Significant Results Obtained from ERTS-1, March 5-9, 1973, New Carrollton, Md.

Carter, W. D., 1973, Status of Geologic Mapping and Mineral Resources Inventory by ERTS-1 Satellite Data in South America (73-225): In Proceedings of the American Congress on Surveying and Mapping: 33rd Ann. Mtg., March 11-16, 1973, Washington, D. C. (Abstract), p. 221.

Stoertz, G. E., and Carter, W. D., 1973, Hydrogeology of Closed Basins and Deserts of South America, ERTS-1 Interpretations: Symposium on Significant Results Obtained from the Earth Resources Technology Satellite (ERTS-1), Goddard Space Flight Center, March 1973, Vol. I, p. 695-705.

Carter, W. D., 1973, EROS Program and ERTS-1 Satellite Applications to Geophysical Problems: XVIth Plenary Meeting of COSPAR, Konstanz, FRG, May 23-June 2, 1973 (in press).

g. Recommendation concerning practical changes in operations, additional investigative effort, correlation of effort and/or results as related to a maximum utilization of the ERTS-1 system:

Lack of funds and foreign travel constraints have so far prohibited me from visiting my South American counterparts except in Brazil. There, ERTS is being used primarily as backup to Projeto Radam for vegetation information. A limited amount of work is being done on selected areas using known mineral resources as points of departure in extending geologic information. I am confident that, with time, ERTS-1 data will become a prime tool for this work. Until additional funds become available, however, my personal contact with co-investigators will have to take place through mail and formal meetings of various kinds.

h. Changes in Standing Order Forms: None

i. ERTS Image Descriptor forms: See attached form.

j. Listing by date of any changed Data Request forms submitted to GSFC/NDPF during report period: None.

k. Status of Data Collection Platforms: N/A

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE August 2, 1973

PRINCIPAL INVESTIGATOR William Douglas Carter

GSFC I012

ORGANIZATION United States Geological Survey - EROS Program

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	SaltFlat	Pampas	Lineament	
1186-13461 M	✓	✓	✓	Mature stream, Dunes Bedrock.
1186-13455 M	✓	✓	✓	Fault, Alluvial Flat, Stream, Bedrock, Mine, Highway, Playa Lake.
1186-13452 M	✓	✓	✓	Fault, Dune, Bedrock, Railroad.
1239-13404 M	✓	✓	✓	Playa Lake, Consequent Stream, Bedrock, Mine, Fault, Volcano, Caldera.
1241-13523 M	✓	✓	✓	Consequent Stream, Playa Lake, Fault, Bedrock, Caldera, Volcano, Alluvial Flat.
1241-13525 M	✓		✓	Consequent Stream, Playa Lake, Arroyo, Bedrock, Fault, Mine, Volcano, Caldera

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO ERTS USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

GSFC 37-2 (7/72)

COPY

Copy

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

OFFICE OF THE DIRECTOR

August 21, 1973

Memorandum

To: Assistant Program Manager for Applications Research

From: Stuart Marsh

Subject: Repetitive ERTS data for South America

This memorandum concerns those sets of area frames that contain repetitive coverage and will note what, if any, changes are visible. The observations will be broken up by test site.

TEST SITE 1:

A. 1209-14024 17 Feb 73
1227-14025 07 Mar 73
1. Discharge of Orinoco River appears greater during 17th of February.

B. 1209-14031 17 Feb 73
1227-14032 07 Mar 73
1. Discharge of Orinoco River appears greater during February.

C. 1209-14033 17 Feb 73
1227-14034 07 Mar 73
1. Cloud cover in March is too great to make an analysis; however, February image is superlative.

D. 1209-14040 17 Feb 73
1227-14041 07 Mar 73
1. Cloud cover in March prohibits analysis.

E. 1156-14095 26 Dec 72
1174-14091 13 Jan 73
1. December image is quite poor but there seems to be no major hydrologic changes in river flow.

F. 1229-14142 09 Mar 73
1247-14143 27 Mar 73

1. A small lake in the upper part of the image has changed its shape.

2. Tonal variation in land appearance probably related to water content.

TEST SITE 2:

NO REPETITIVE COVERAGE AVAILABLE.

TEST SITE 3:

A. 1201-15041 09 Feb 73
1237-15043 17 Mar 73

1. There is a very marked increase in water content of the land in March with a series of rather large low lakes present where there were none in February.

2. River discharge is obviously greater in March and the land adjacent to the streams appears water soaked.

3. A large strip of land that exhibited no signs of cultivation in February is apparently being cultivated in March and its water content has increased.

TEST SITE 4:

NO REPETITIVE COVERAGE AVAILABLE.

TEST SITE 7:

A. 1152-13525 22 Dec 72
1134-13525 04 Dec 72

1. By comparison of a number of small ephemeral lakes water level has increased on December 22.

2. Arid areas are more extensive on December 4.

B. 1152-13531
1134-13532

1. Same conditions as A.

C. 1152-13534 22 Dec 72
1134-13534 04 Dec 72
1224-13533 04 Mar 73

1. Water level is higher in late December, and small ephemeral lakes and streams have greater discharge and content.

2. Land is obviously more arid in early December and the salt flat in the image has diminished in size in later December.

3. Vegetation has also appeared on December 22 where there was none in early December.

4. The 1224 image has far too much cloud cover for analysis.

D. 1225-13592 05 Mar 73
1243-13592 23 Mar 73
1225-13594 05 Mar 73
1243-13595 23 Mar 73

1. In these images of the Salar de Uyuni area noticeable changes in the water content, salt and sand conditions, and stream and wind blown sediment distribution are apparent. It is reasonable that within this area ground conditions can give a reasonable indication of recent but minor meteorological changes.

E. 1226-14053 06 Mar 73
1244-14053 24 Mar 73

1. This area, west of Salar de Empexa, is similar to the the area of Salar de Uyuni and one can note an increase in water level of the salars in latter March.

2. The land is much more arid on 6th of March, and there is a greater amount of salt and sediment in the flats which can be easily discerned.

F. 1155-14102 25 Dec 72
1173-14101 12 Jan 73
1227-14105 07 Mar 73
1191-14102 30 Jan 73

1. These coastal images exhibit a change in stream discharge, the amount of sediment coming out of the Andes, and the condition of the coast. The repetitive frames are listed below:

1245-14105, 1155-14105, 1191-14105, 1173-14103, 1227-14111

G. 1246-14161 26 Mar 73
1228-14161 08 Mar 73
1192-14161 31 Jan 73
1156-14160 26 Dec 73

1246-14164 26 Mar 73
1228-14163 08 Mar 73
1156-14163 26 Dec 73

1246-14170 26 Mar 73
1228-14170 08 Mar 73

1. This series of repetitive coastal images to the north exhibit coastline changes, and the amount of stream discharge. To the south the Pacific is visible without any land present.

TEST SITE 9-10:

A. 1236-13212 16 Mar 73
1146-13212 16 Dec 72

1. Cloud cover on 16 Mar prohibits a comparison.

B. 1240-13435 20 Mar 73
1222-13435 02 Mar 73

1. Cloud cover prohibits extensive study however streams do appear fuller on the 20th of March.

C. 1240-13442 20 Mar 73
1222-13441 02 Mar 73

1. A tonal change of some of the plowed fields appears with those on the 20th appearing as a lighter tone of gray.

D. 1240-13444 20 Mar 73
1222-13444 02 Mar 73

1. Cloud cover prohibits a comparison.

E. 1240-13451 20 Mar 73
1222-13450 02 Mar 73

1. The 1240 image is a fine frame for study and an ephemeral-lake present in late March does not appear on the 2nd of March image.

F. 1223-13493 03 Mar 73
1241-13493 21 Mar 73

1. Boarders of Salt Flats appear to have increased on 21 March 73.

G. 1223-13495 03 Mar 73
1221-13500 21 Mar 73

1. Ephemeral lakes visible on 3rd of March where they are absent on the 21st. Other lakes appear fuller on the 3rd as well.

2. Salt Flats and sandy areas are lighter in tone on the 21 March exhibiting a lower water content.

[It should be noted that during the 1240 and 1222 series 1240-13451 exhibited a greater water content than 18 days previous while a day latter for each pass the situation is reversed. This may point out the ephemeral nature of the water content in these often dry regions.]

H. 1223-13502 03 Mar 73
1241-13502 21 Mar 73.

1223-13504 03 Mar 73
1241-13504 03 Mar 73

1. The same comments as above apply.

I. 1188-13545 27 Jan 73
1224-13551 04 Mar 73

1188-13551 27 Jan 73
1224-13554 04 Mar 73

1188-13554 27 Jan 73
1124-13560 04 Mar 73

1188-13560 27 Jan 73
1224-13563 04 Mar 73

1. It can be generalized that on these two passes spearated by 36 days the Salt Flats and sandy areas are visibly dryer on the 27th of January and the small lakes are slightly larger and perhaps deeper on the 4th of March. Snow cover change is also apparent. Wind blown material and dune-like formations appear much more wide spread during January.

J. 1244-14065 24 Mar 73
1226-14064 06 Mar 73

1244-14071 24 Mar 73
1226-14071 06 Mar 73

1244-14074 24 Mar 73
1226-14073 06 Mar 73

1. Cloud cover obscures both passages along the coast so intense comparison cannot be made, however, little major change is visible except for the minor changes in the extent of dry streams and sandy regions which appear more extensive in late March.

TEST SITE 11:

A. 1239-13404 19 Mar 73
1221-13403 01 Mar 73

1. Definite changes in the grey and black tones of cultivated fields can be seen.

2. Water levels in lakes appear greater on the 19th of March.

B. 1239-13410 19 Mar 73
1221-13410 01 Mar 73

1239-13413 19 Mar 73
1221-13412 01 Mar 73

1. Cloud cover makes detailed changes impossible to discern, however, the same comments for the 1239 and 1221 series in A apply here as well.

C. 1186-13455 25 Jan 73
1222-13462 02 Mar 73
1240-13462 20 Mar 73

1. A great deal can be seen in the way of change in these images. Water is much more apparent in the stream and playa lake during January. In March on the 2nd a great influx of sediment is visible in the playa lake.

2. Changes in cultivated fields are also visible, their visibility is accentuated in January.

The same comments concern images: 1186-13461 1240-13471
1240-13465 1222-13471
1222-13464

D. 1188-13565 27 Jan 73
1224-13572 04 Mar 73

1188-13572 27 Jan 73
1224-13574 04 Mar 73

1188-13574 27 Jan 73
1224-13581 04 Mar 73

1188-13581 27 Jan 73
1224-13583 04 Mar 73

1. In this series the amount of snow capping the mountains is far greater in January and the lakes and streams water content also seems greater in January. In March the Salt Flats appear more extensive and the lowland ground appears quite a bit dryer.

2. Cultivation changes are also visible though no generalization can be made before a detailed study is undertaken--but the changes are there.

Stuart Marsh

Stuart E. Marsh

Thus the cataloguing order would be:

1200-0021
1200-0023
1201-0021
1201-0023
1202-0021
1202-0023

2. Obviously there is a great deal of repetitive coverage within each test site so the cataloguing system was modified so that when there are repetitive images, those that are the "best" (i.e. least cloud coverage), were placed in front of the poorer products. On the final inventory they were marked with an asterisk.

ex.:

Image ID #	C.C.
1200-0021	20%
1200-0023	30%
1218-0021	90%
1218-0023	90%
1236-0021	0
1236-0023	5%

Cataloguing Order:

1236-0021*
1236-0023*
1200-0021
1200-0023
1218-0021
1218-0023

3. A new compilation was then made for each test site. The order of image listings follows the examples stated above and includes: Image ID #; Location; Date; cloud cover; and ONC co-ordinates. An asterisk makes known those images of low cloud cover and best quality for study.

4. As image quality varies as an orbit series proceeds North to South it should be noted that an asterisk appears only on those images that are acceptable within a series. Therefore for one North to South corridor the images marked may each be in a different orbit series.

Review of Image Coverage -

Mosaic Prospective

Test Sites 1 - 6

Image coverage is too incomplete for consideration at this time.

Test Site 7

A good, fairly cloud free, mosaic appears possible with the exception of an area around LA PAZ, (1190-14035 & 1190-14041).

Test Site 9-10

Fine coverage is available for both test sites with the exception of the Eastern corridor in test site 10 where the 1220 series is either poor or absent.

Test Site 11

This area is fairly complete but good image coverage is lacking in the top of the 1223 corridor and is quite poor along the coast from Aconcagua to Curico.

Test Site 12

Coverage is far too incomplete for a mosaic study to begin, however fair imagery is present of the 1181 - 1145 orbit line.

Stuart E. Marsh

Venezuela - Test Site One

ERTS - Cataloguing Order

1224-13454*	Morawhana	04 Mar 73	40%	1-27 & K-27
1224-13465*	Deposito	" " "	10%	L-27
1242-13470	Orinduik	22 Mar 73	45%	"
1243-13524*	Parai-Tepui	23 Mar 73	10%	"
1226-13582	Rio Paraqua	06 Mar 73	70%	"
1209-14024	Ciudad Bolivar	17 Feb 73	85%	"
1209-14031*	Paragua	" " "	0	"
1209-14033*	Rio Caura	" " "	10%	"
1209-14040*	Aratana	" " "	45%	"
1227-14025*	El Tigre	07 Mar 73	60%	K-27
1227-14032	Cerro Bolivar	" " "	50%	L-27
1227-14034	Rio Caura	" " "	90%	"
1227-14041	Majanajanana	" " "	70%	"
1174-14082		13 Jan 73		
1174-14084*	Maigualida	" " "	20%	
1174-14091*	Ventuari	" " "	5%	
1156-14095	Ventuari	26 Dec 72	10%	
1210-14083	Zaraza	18 Feb 73	40%	K-27
1247-14143*	Mercedes	27 Mar 73	20%	"
1229-14142	Mercedes	09 Nar 73	30%	"

Columbia - Test Site Two

ERTS - Cataloguing Order

1195-14280	S.E. Colombia	3 Feb 73	100%	E-4
1232-14325	Orocue	12 Mar 73	95%	L-26
1196-14325*	Miraflores	4 Feb 73	5%	D-3
1196-14332*	S. Miraflores	" " "	20%	D-3
1196-14334	Yari River	" " "	95%	D-3
1179-14375	Puerto Concordia	18 Jan 73	70%	D-3
1179-14382*	Calamar	18 Jan 73	40%	D-3
1179-14384*	Yari River	" " "	50%	D-3
1179-14391	NE Of Peurto Lequzona	" " "	65%	E-3
1199-14510		7 Feb 73	50%	

Peru - Test Site Three

ERTS - Cataloguing Order

1163-14525	Trujillo	2 Jan 73	90%	M-25
1163-14531*	Chimabote	2 Jan 73	40%	N-25
1200-14592*	Pacific off Trujillo	8 Feb 73	30%	N-25
1201-15041	Balmia de Sechura	9 Feb 73	60%	M-25
1201-15044*	W of Chiclayo	9 Feb 73	40%	M-25
1201-15050*	W of Trujillo	9 Feb 73	30%	M-25
1237-15040*	Talara, Peru	17 Mar 73	20%	M-25
1237-15043*	Bahia Desechura	1 7Mar 73	30%	M-25
1237-15045	Pacific	17 Mar 73	70%	
1237-15052	Pacific	17 Mar 73	40%	
1203-15152	Pacific	17 Feb 73	20%	M-24
1203-15154	Pacific	17 Feb 73	30%	M-24

Brazil - Peru - Test Site 4

ERTS - Cataloguing Order

[illegible]-14291*	Iquitos	3 Feb 73	30%	M-25
[illegible]-14294*	Yavari	3 Feb 73	60%	M-25
[illegible]-14300	Ipixuna	3 Feb 73	90%	M-25
[illegible]	Cruzeorodo Sul	3 Feb 73	70%	M-25
[illegible]-14361	Pucallpa	4 Feb 73	100%	N-26
[illegible]-14402	Sta.Maria-Nanay	18 Jan 73	90%	M-25
[illegible]-14411*	Onellana	18 Jan 73	40%	M-25

BOLIVIA - CHILE - PERU - TEST SITE SEVEN

ERTS - CATALOGUING ORDER

IMAGE ID #	LOCATION	DATE	C.C.	COORDINATES
1152-13525	Todos Santos	22 Dec. 72	60%	P-26
1152-13531*	Aiguila	" " "	40%	P-26
1152-13534*	Potosi	" " "	20%	P-26
1134-13525	Sucre N.	4 Dec. 72	90%	P-26
1134-13532*	Sucre S.	" " "	40%	P-26
1134-13534*	Huenchaca	" " "	20%	P-26
1224-13533	Sucre S.	4 Mar. 73	90%	P-26
1224-13540*	Uyuni	4 Mar. 73	40%	P-26
1188-13531	Totora	27 Jan. 73	90%	P-26
1188-13533	Potosi	" " "	90%	P-26
1153-13581*	Rio Sucre	23 Dec. 72	60%	P-26 & N-25
1153-13583*	Cahabanba	" " "	10%	P-26
1243-13590	Independencia	23 Mar. 73	90%	P-26
1243-13592*	Lake Poopo	" " "	5%	P-26
1243-13595*	Salar de Unyuni	" " "	5%	P-26
1225-13583	Cochabamba	5 Mar. 73	100%	P-26
1225-13592	Lake Poopo	" " "	85%	P-26
1225-13594	Salar de Uyoni	" " "	65%	P-26
1190-14035	Lapaz N.	29 Jan. 73	80%	P-26 & N-25
1190-14041	Lapaz S.	" " "	100%	P-26

IMACE ID #	LOCATION	DATE	C.C.	COORDINATES
1190-19044	Sabaya	29 Jan. 73	95%	P-26
1190-14050	Mamiña	" " "	70%	P-26
1244-14051*	Todos Santos	24 Mar. 73	5%	P-26
1244-14054*	Mamiña	24 Mar. 73	0%	P-26
1226-14053	Mamiña	6 Mar. 73	40%	P-26
1245-14100*	Lake Titicaca	25 Mar. 73	65%	P-26 & N-25
1245-14103*	Laguna Marca	" " "	5%	P-26
1245-14105*	Pacific & Arica	" " "	0	P-26
1245-14105*	Pacific & Iquique	" " "	5%	P-26
1155-14102*	Arica	25 Dec. 72	0	P-26
1155-14105*	Iquique	30 Jan. 73	0	P-26
1191-14102	Arica	30 Jan. 73	50%	P-26
1191-14105	Iquique	30 Jan. 73	10%	P-26
1173-14101	Arica	12 Jan. 73	40%	P-26
1173-14103	S. Iquique	12 Jan. 73	10%	P-26
1173-14112*	Mejillones	12 Jan. 73	20%	P-26
1227-14105	Pacific & Arica	7 Mar. 73	70%	P-26
1227-14111	" & Iquique	" " "	70%	P-26
1083-14111	Chilian Coast	14 Oct. 72	85%	P-26
1246-14155	E. Chivay	26 Mar. 73	40%	P-26
1246-14161*	Moquegua	26 Mar. 73	20%	P-26
1246-14164*	Pacific off Arica	26 Mar. 73	0	P-26
1246-14170*	" off Iquique	26 Mar. 73	10%	P-26
1228-14161	Moquequa	8 Mar. 73	60%	P-26
1228-14163	Pacific off Arica	8 Mar. 73	50%	P-26

IMAGE ID #	LOCATION	DATE	C.C.	COORDINATES
1228-14170	Pacific off Iquique	8 Mar. 73	90%	P-26
1192-14152	Patina	31 Jan. 73	70%	N-25 & P-26
1192-14154	Toquepala	31 Jan. 73	70%	P-26
1192-14161	Tacma & Pacific	31 Jan. 73	80%	P-26
1156-14160	Pacific off Tacma	26 Dec. 73	90%	P-26
1156-14163	Pacific off Iquique	26 Dec. 73	100%	P-26
1121-14211*	Cailloma	21 Nov. 72	5%	N-25
1247-14213*	Cailloma	27 Mar. 73	30%	P-26 & N-25
1247-14220*	Camaná	27 Mar. 73	5%	P-26
1193-14210	Chivay	1 Feb. 73	50%	P-26 & N-25

ARGENTINA • CHILE - TEST SITES 10 • 9

ERTS 1 - CATALOGUING ORDER

IMAGE ID #	LOCATION	DATE	C.C.	COORDINATES
1236-13212	Pirane	16 Mar. 73	95%	Q-27
1236-13214	Resistencia	16 Mar. 73	90%	Q-27
1146-13212*	Corrientes	16 Dec. 72	20%	Q-27
1218-13220	Reconquista	26 Feb. 73	40%	Q-27
1219-13263*	Pozo del Tigre	27 Feb. 73	5%	Q-27
1219-13270*	Fortin Lavalle	27 Feb. 73	0	Q-27
1219-13272*	Saenz Pena	27 Feb. 73	5%	Q-27
1219-12375*	Chorotis	27 Feb. 73	20%	Q-27
1220-13322	El Pintado	28 Feb. 73	50%	Q-27
1220-13333*	Añatuya	28 Feb. 73	45%	Q-27
1221-13380*	Rivadavia	1 Mar. 73	20%	Q-27
1221-13383*	Monte Guemado	1 Mar. 73	30%	Q-27
1221-13385*	La Banda	1 Mar. 73	40%	Q-27
1221-13392	Loreto	1 Mar. 73	75%	Q-27
1240-13435	E. Salta	20 Mar. 73	60%	Q-27
1240-13442*	Metan	20 Mar. 73	10%	Q-27
1240-13444*	Tucuman	20 Mar. 73	10%	Q-27
1240-13451*	Catamarca	20 Mar. 73	75%	Q-27
1222-13435*	E. Salta	2 Mar. 73	20%	Q-27
1222-13441	Metan	2 Mar. 73	40%	Q-27
1222-13444	Tucuman	2 Mar. 73	90%	Q-27

(SITE 10 • 9)

IMAGE ID #	LOCATION	DATE	C.C.	Coordinates
1222-13450	Catamarca	2 Mar. 73	60%	Q-27
1223-13493*	Salta	3 Mar. 73	30%	Q-27
1223-13495*	Cafayate	3 Mar. 73	30%	Q-27
1223-13502*	Capillitas	3 Mar. 73	30%	Q-27
1223-13504	La Rioja	3 Mar. 73	80%	Q-27
1241-13493	Salta	21 Mar. 73	50%	Q-27
1241-13500	Cafayate	21 Mar. 73	30%	Q-27
1241013502	Capillitas	21 Mar. 73	50%	Q-27
1241-13504*	La Rioja	21 Mar. 73	30%	Q-27
1188-13545*	San Antonio de Calalaste	27 Jan. 73	10%	Q-27
1188-13551*	Sierra de Calalaste	27 Jan. 73	5%	Q-27
1188-13554*	Cerro del Salado	27 Jan. 73	0	Q-27
1188-13560*	Cerro Bonete	27 Jan. 73	5%	Q-27
1224-13551	Salar de Anizaro	4 Mar. 73	95%	Q-27
1224-13554	Salar de Autofalla	4 Mar. 73	80%	Q-27
1224-13560	Sierra de Narvaez	4 Mar. 73	50%	Q-27
1224-13563	Sierra de la Punilla	4 Mar. 73	70%	Q-27
1243-14010*	Salar de Ponta Negra	23 Mar. 73	0	G-27 & G-26

IMAGE ID #	LOCATION	DATE	C.C.	COORDINATES
1243-14013*	Salar de Pajonaleo	23 Mar. 73	0	G-26 & G-27
1243-14015*	E. Copiapo	23 Mar. 73	10%	Q-26
1243-14022*	Vallinar	23 Mar. 73	15%	Q-26
1244-14065*	Los Vientos	24 Mar. 73	5%	Q-26
1244-14071*	Altamira	24 Mar. 73	5%	Q-26
1244-14074*	Copiapo	24 Mar. 73	80%	Q-26
1244-14080	Vallenar	24 Mar. 73	80%	Q-26
1226-14064	Los Vientos	6 Mar. 73	40%	Q-26
1226-14071	Altamira	6 Mar. 73	70%	Q-26
1226-14073	Copiapo	6 Mar. 73	90%	Q-26
1245-14130	Pacific off Taltal	25 Mar. 73	80%	Q-26
1245-14132	Pacific off Copiapo	25 Mar. 73	80%	Q-26
1245-14135	Pacific off Vallenar	25 Mar. 73	100%	Q-26

CHILE - ARGENTINA - TEST SITE ELEVEN

ERTS - CATALOGUING ORDER

Image ID #	Location	Date	C.C.	Coordinates
1239-13404*	Santa Rosa	19 Mar 73	10%	R-23
1239-13410*	Mercedes	" " "	5%	"
1239-13413*	La Union	" " "	0	"
1221-13403	Santa Rosa	01 Mar 73	50%	"
1221-13410	Mercedes	" " "	95%	"
1221-13412	La Union	" " "	60%	"
1186-13452*	Chepes	25 Nan 73	0	Q-27 & R-23
1186-13455*	San Louis	" " "	0	R-23
1186-13461*	Monte Caman	" " "	0	"
1240-13460*	Chepes	20 Mar 73	5%	"
1240-13462*	General Roca	" " "	5%	"
1240-13465*	San Rafael	" " "	0	"
1240-13471*	Sierra de Nevado	" " "	20%	"
1222-13455	Chepes	02 Mar 73	20%	Q-27 & R-23
1222-13462	Genreal Roca	" " "	25%	R-23
1222-13464	San Rafael	" " "	30%	"
1222-13471	Sierra de Nevado	" " "	65%	"
1223-13513	San Juan	03 Mar 73	95%	"
1223-13520	San Martin	" " "	85%	"
1223-13522	San Rafael (W)	" " "	50%	"
1223-13525	Lake Llancanelo	" " "	30%	"

1241-13525*	W. San Rafael	21 Mar 73	0	R-23
1241-13525*	Lake Llancanelo	" " "	0	"
1183-13565*	San Juan	27 Jan 73	10%	"
1188-13572*	Mendoza	" " "	30%	"
1188-13574*	Santiago	" " "	5%	"
1188-13581*	S.E. Curico	" " "	5%	"
1224-13572	San Juan	04 Mar 73	60%	Q-26 & R-23
1224-13574	N. Santiago	" " "	40%	R-23
1224-13581	S. Santiago	" " "	20%	"
1224-13583	E. Linares	" " "	15%	"
1243-14031*	Salamanca	23 Mar 73	40%	Q-26
1243-14033	Valparaiso	" " "	70%	R-23
1243-14040	Melipilla	" " "	95%	"
1243-14042	Talca	" " "	60%	"
1225-14042*	Curico	05 Mar 73	10%	"
1226-14085	Ovalle	06 Mar 73	90%	Q-26

CHILE - ARGENTINA TEST SITE TWELVE

ERTS I - CATALOGUING ORDER

IMAGE ID #	LOCATION	DATE	C.C.	COORDINATES
1196-13064	Tierra del Fuego	4 Feb. 73	90%	T-18
1198-13170	S. Atlantic	6 Feb. 73	90%	T-18
1198-13172	S. Atlantic	6 Feb. 73	50%	T-18
1181-13222*	S. Atlantic	20 Jan. 73	5%	T-18
1181-13225*	S. Atlantic	20 Jan. 73	30%	T-18
1145-13224*	Bamia Grande	15 Dec. 72	30%	T-18
1145-13231*	Ponta de Arenas	15 Dec. 72	10%	T-18
1199-13233	Tierra del Fuego	7 Feb. 73	100%	T-18
1199-13240	Tierra del Fuego	7 Feb. 73	90%	T-18
1235-13230	S. Atlantic	15 Mar. 73	80%	T-18
1200-13283	Tierra del Fuego	8 Feb. 73	90%	T-18
1200-13292	Tierra del Fuego	8 Feb. 73	90%	T-18
1200-13294	Monte Italia	8 Feb. 73	95%	T-18
1182-13281*	S. Atlantic	21 Jan. 73	60%	T-18
1201-13341	St. of Magellan	9 Feb. 73	90%	T-18
1201-13344	Porvenir	9 Feb. 73	80%	T-18
1202-13400	Puerto Caig	10 Feb. 73	60%	T-18
1202-13402	Turbio	10 Feb. 73	90%	T-18