CRUISE REPORT
R/V ENDEAVOR
EN-113

SCHEDULE

The schedule was originally planned to be from February 21 to March 21, 1984, from Easter Island to Easter Island. Due to a winch-main generator breakdown, the actual cruise ended to be:

Leg 1	Depart	Feb. 21, 1984	Easter Island
	Return	Mar. 4, 1984	Easter Island
Leg 2	Depart	Mar. 8, 1984	Easter Island
	Arrival	Mar. 25, 1984	Easter Island

REGION OF INVESTIGATION AND PURPOSE

Rock sampling of the two branches of the East Pacific Rise between 21^{o}S and 29^{o}S, an area referred to as the Easter Microplate, for petrological and geochemical studies. The petrological and geochemical results should provide a means of:

(1) Testing existing tectonic models for the evolution of the Easter Microplate.
(2) Evaluating the effect of spreading rates on the petrology and geochemistry of eruptive products within a limited region.
(3) Delineating in a preliminary fashion the nature and scales of mantle heterogeneities beneath the area, and probable mantle flow patterns with respect to the Easter Island hotspot.

The cruise is part of a long-term coordinated effort with SIO (Drs. R. Hey, J.D. MacDougall, and H. Craig) and other URI scientists (Drs. H. Sigurdsson, R. Larson, and J. Fox).

SCIENTIFIC PARTY

1.	Jean-Guy Schilling	Chief Scientist	URI
2.	Richard Kingsley	Marine Res. Spec.	URI
3.	Brian McCully	Marine Res. Asst.	URI
4.	Andrew Davis	Marine Res. Spec.	URI
5.	Melanie Cole	Graduate Res. Asst.	URI
6.	Holly Turton	Marine Res. Asst.	URI
7.	Jill Harvey	Geology Student	URI
8.	George Beaulieu	Research Asst.	URI
9.	Mark O'Rourke	Research Asst.	URI
10.	K.C. Guernsey	Grad. Student	URI
11.	Stephen Imms	Marine Technician	URI
12.	Dave Nelson	Marine Technician	URI
13.	Susanna Sichel	Marine Geologist	U.F. Rio de Janeiro
14.	Eduardo Valenzuela	Marine Geologist	U. Chile, Santiago
15.	Hernan P. Vergara	Cartographer	Hydr. I. Chile, Valp.

SHIP'S COMPANY

1.	John S. Tate	Master
2.	Adrian L. Lonsdale	Mate
3.	Jonathon C. Alberts	Mate
4.	Henry B. Bickford	Bosn
5.	Charles E. Parks	A/B
6.	Jack E. Buss	A/B
7.	John J. Bochynski	A/B
8.	John P. Symonds	Chief Engineer
9.	Arthur C. Butterworth	Asst. Engineer
10.	John F. Rutledge	Asst. Engineer
11.	Douglas G. Lindner	Oiler
12.	William E. Benders	Stew/Cook
13.	Bradford N. Evans	Cook/MM
14.	Ralph Metz	Port Engineer-Asst. Mar. Supt.

OPERATIONS AND RESULTS

Breakdown of ship operations is the following:

	Time (Hrs.)	Mileage (N. miles)
Transit	91	1000
Geophysical Survey	339	1974
Stations (Dredging)	230	
Breakdown	130	
	790	

The following data and results were obtained during the cruise:

(1) Approximately 3,000 miles of bathymetric and seismic reflection profiling(3.5 and 12 KHz) and total magnetic field intensity (1 min. intervals) were recorded. The tracks are shown in Fig. 1. The tracks include 47 short profiles (approx. 25 nm) across the crest of the East Pacific Rise for the purpose of locating rock dredging targets and studying morphological change of the crest of East Pacific Rise along its strike, around the east and west boundaries of the Easter Microplate. The ridge crest of both the east and west boundaries of the Easter Microplate, and north of it, is generally elevated but often asymmetrical with respect to the ridge axis. A rift is apparently present north of 24°S on the east boundary of the Easter Microplate, and this eastern boundary is probably displaced westward en echelon fashion between 23°50'S and 23°S. The region probably represents a broad zone of deformation rather than a well-defined fracture zone. The main axis of the East Pacific Rise south of the Easter Microplate, between 28°S and 29°S, is irregular and mostly ill-defined. The elevation of the ridge axis on the east branch of the Easter Microplate reaches a maximum (-2250 m) at 26°30'S and decreases nearly symmetrically north and south to reach a minimum of approximately -3250 m at 25°S and 28°30'S. The depth shoals again south of 28°30'S or north of 25°S. A major depth discontinuity occurs around 24°S because of a rift (approx. 3900 m) and the fracture zone. The elevation of the ridge axis on the west branch of the Easter Microplate

rises progressively from 26°50'S (approx. -3000 m) to 25°S (approx. -2100 m), and stays essentially constant northward (approx. -2700 m) until the major 23°S Fracture zone is approached. The depth of the axis of the East Pacific Rise north of the Easter Microplate boundary (23°S Fracture Zone) slightly increases between 22°30'S and 23°S (2900 to 3100 m) and a deep nodal hole is reached at the intersection with the 23°S Fracture zone (3800 m).

(2) Fifty dredge stations were occupied (Fig. 1). Location depth and a brief description of the rock recovery and weight are given in Table 1. A total of approximately 5400 kg. of rocks were bagged. Forty-seven of these stations successfully recovered rocks; one station had to be occupied twice to recover rocks (18DB), one had to be aborted due to rough weather and was reoccupied later (3D), and one station was abandoned after losing the dredge and a breakdown of the winch-generator system (19D). Basalts ranging from partly altered to extremely fresh and glassy were recovered in 46 stations; serpentinized peridotite was recovered in one dredge haul (18D); and both types of rocks were recovered in one station (38D). Hydrothermal activity was often apparent from stains on the volcanic rocks recovered. Particularly intense hydrothermal alteration was evident at station 29D. Stations 25D and 26D were occupied apparently over the top of a lava lake formed probably recently. Evidence of very recent volcanic activity was found on both the east and west branch as well as north of the Easter Microplate, but south, the active part of the East Pacific Rise could not be readily identified.

(3) At least one basalt sample per station was analyzed for Fe, Ti, Mn, and Cr during the cruise using a portable XRF unit (Model Portaspec 2501) which was kindly lent to us by the Hankison Co., Canonsburg, PA. The purpose was to determine the spacial variation of Fe, Ti, Mn, and Cr in lavas erupted along the two spreading axes of the Easter Microplate, to dictate dredging targets and locate in real-time the probable position of the tip of propagating rifts, as well as test geochemically the tectonic models previously proposed for the development of the Easter Microplate. This new approach turned out to be most successful. For example, it helped us to confirm directly during the cruise the presence of the tip of a northward propagating rift on the East branch of the Easter Microplate at around 25°S, which had previously been proposed on the basis of a seabeam survey and magnetic anomalies by Hey et al. (EOS 64, 855, 1983); and possibly another tip of a southeastward propagating rift on the the western branch at around 26°45'S - but time lost due to a winch-generator breakdown did not allow us to complete this latter test.

(4) We spent four days sampling and studying the volcanic formations of Easter Island. Seventeen volcanic localities were sampled. Their locations are shown in Fig. 2. These samples will be petrologically and geochemically compared with those we dredged along the spreading boundaries of the Easter Microplate.

(5) Thirty-one volcanic rocks and xenoliths from 19 localities were sampled on Tahiti by four members of the scientific party on their way to join the ship (Fig. 3). Rock types are listed in Table 2.

ACKNOWLEDGEMENTS

The devoted assistance and cooperation of Captain John S. Tate and his ship company is greatly appreciated. Particular thanks is extended to Ralph Metz, Port Engineer, and John Symonds, Chief Engineer, for overcoming hydraulic, mechanical, and electrical problems we encountered with our newly installed deep-sea winch and the aging ship's generators. Their expertise made the difference in successfully completing the cruise. We are also thankful to the Government of Chile for allowing us to work in their territorial waters, and Mr. E. Valenzuela and Dr. H. Vergara for their participation and assistance during the cruise. Finally we wish to thank many of the new friends we made on Easter Island during our short visit including; Roberto and his wife, Marguerita, for their help in commuting between R/V Endeavor and the island, and for our initiation to the art of riding safely over the surfs! Benito and Pedro for their patience and good humor in dealing with neverending requests, and Raul Paoa for sharing with us his archaelogical knowledge and love of Easter Island. We also thank Professor M.A. Gorini of the Universidade do Federal de Rio de Janeiro for arranging the financing and participation of Ms. Susanna Sichel to the cruise. We also thank Hankison Corporation for generously lending us a brand new portable XRF unit for the cruise and Mr. R. Cianflone for making the arrangements. This work was generously supported by NSF grant OCE 8214744.

TABLE I: EN 113 DREDGE HAUL RECOVERY

Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.)
1D	28°28.9'S 112°39.2'W	2875-3025	EPR*, Graben	2/23	Pillow basalts with some glass; 3 possible types	50
2D	28°05.1'S 112°39.9'W	2779-2790	EPR, Graben	2/23	Pillow basalts and sheets, fresh to partly altered with some glass; possibly 3 types	54
3D	27°53.1'S 112°48.4'W	2050-2550	EBEP**, Volcano in center of graben	2/24	Fresh pillow basalts with abundant glass - some older types with minor glass and Mn stain	399
4D	27°31.8'S 112°45.9'W	2455-2585	EBEP, Ridge crest	2/24	Fresh glassy pillow basalts and toes; glass abundant	32
5DA	27°12.6'S 112°46.4'W	2515-2750	EBEP, Valley on ridge crest	2/25	Fresh glassy pillow basalts; glass abundant	185
6D	26°48.8'S 112°38.4'W	2275-2450	EBEP, Ridge crest?	2/26	Fresh glassy pillow basalts and sheets	60
7D	26°27.4'S 112°34.3'W	2105-2440	EBEP, Ridge crest	2/26	Fresh glassy sheet flow fragments	152
8D	25°58.9'S 112°33.1'W	2610-2725	EBEP, Valley over ridge	2/27	(1) Pillow and slabs of basalts with minor glass (2) Fresh glassy sheet flow fragments	166
9D	25°39.3'S 112°22.5'W	2825-2905	EBEP, Central valley	2/27	Fresh glass toes with mud; one partly altered pillow	3
10D	25°28.1'S 112°23.3'W	2950-2990	EBEP, Central valley	2/27	Altered pillow and sheets of basalts; minor glass	110
11D	25°14.3'S 112°22.9'W	3037-3280	EBEP, East side of broad valley	2/28	Partly altered pillow basalts; minor glass	120

TABLE I (cont.)

Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.
12D	25°01.7'S 112°24.8'W	3210-3300	EBEP, Central valley; tip of propagator	2/28	Fresh pillow basalts with thin glass rind; minor ooze along fractures	30
13D	24°51.3'S 112°26.8'W	2825-3070	EBEP, North of tip of propagator	2/29	Fresh, highly glassy pillow basalt and older sheet flow fragments	150
14D	24°47.1'S 111°58.2'W	2590-2670	EBEP, Axis of broad crest	2/29	Glassy pillow basalts partly hydrothermally altered, diabase and fresh glass nuggets and salmon-colored ooze	234
15D	24°31.7'S 111°47.6'W	2850-3100	EBEP, rift?	3/1	Altered pillow basalts with Mn stain; a piece of pumice	80
16D	24°12.0'S 111°55.8'W	2880-3020	EBEP, Axis of blocky ridge crest	3/1	Pillow basalt fragments: (1) relatively fresh and glassy (2) altered with minor glass	99
17D	23°51.9'S 111°49.4'W	3885-3925	EBEP, Center of rift	3/2	Very fresh glassy pillow basalts and sheet flow fragments; abundant glass	275
18DB	23°32.6'S 111°48.8'W	3450-3625	EBEP, Fracture zone?	3/3	Serpentinite rubble; one piece of greenstone	177
19D	23°13.2'S 111°51.4'W			3/3	Lost dredge	
20D	26°42.0'S 114°55.2'W	2825-3010	WBEP***, Peak within graben	3/9	Partly altered pillow basalt fragments; only very minor glass	158
21D	26°31.2'S 115°05.2'W	2560-2850	WBEP, Crest center	3/10	Fresh to partly altered pillow basalts with glass; some Mn stain and ooze	128

TABLE I (cont.)

Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.)
22D	26°20.9'S 115°19.5'W	2700 2875	WBEP, Axis of dome-like ridge crest	3/10	(1) Partly altered pillow basalts with minor glass (2) Fresh glassy sheet flow fragments; some ooze	70
23D	26°07.7'S 115°38.7'W	2580-2635	WBEP, Central valley on ridge crest	3/11	Very fresh glassy pillow basalts and sheet flow fragments; abundant glass	202
24D	25°53.9'S 115°51.4'W	2200-2225	WBEP, Flat top of asymmetric ridge crest (lava lake?)	3/11	Very fresh glassy pillow and slabs; spectacular flow structures	104
25D	25°39.6'S 116°07.8'W	2240-(constant)	WBEP, Flat top of ridge crest - lava lake bordered by two small ridges	3/12	Very fresh glassy sheet flow fragments; multi-layers of glass and basaltic sheets	170
26D	25°16.5'S 116°16.1'W	1960-2140	WBEP, Top of ridge crest	3/12	Pillow basalts ranging from very fresh and glassy to partly altered; abundant glass, salmon-colored ooze, agglomerates of glass and mud	140
27D	24°59.4'S 116°21.8'W	1950-2170	WBEP, Valley on top of ridge crest	3/13	Partly altered pillow basalts; Mn stain	100
28D	24°38.3'S 116°25.0'W	2700-2780	WBEP, Ill-defined ridge crest	3/14	One pillow with thick glass rind, mud along cracks and Mn stain; a few basalt fragments	17
29D	24°18.5'S 115°28.5'W	2610-2775	WBEP, Ill-defined ridge crest, asymmetric near hydrothermal vent?	3/15	Hydrothermally altered pillow basalt and slabs with thick Mn coating; Breccia	112
30D	24°06.4'S 115°24.4'W	2775-2825	WBEP, Ridge crest	3/15	Very fresh glassy pillow basalts, plagiophyric and aphyric; abundant glass	120

TABLE I (cont.)

Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.)
31D	23°46.4'S 115°28.1'W	2570-2750	WBEP, Top of ridge crest	3/15	Fresh glassy pillow and slabs of basalts and glass fragments	10
32D	23°29.0'S 115°22.5'W	3200-3340	WBEP, Ill-defined ridge axis, asymmetric	3/16	Pillow basalts and slabs ranging from glassy and fresh to partly altered with no glass; possibly 4 different ages	170
33D	23°15.0'S 115°26.1'W	2740-2890	WBEP, Top of ridge within rift?	3/16	Old, partly altered pillow basalts and massive blocks of greenstones; thick Mn-coating and ooze	80
34D	22°54.3'S 114°30.6'W	2950-3000	EPR - Axis	3/17	Very fresh glassy basalt sheet flow fragments; thick glass	15
35D	22°31.9'S 114°28.1'W	2875-2950	EPR, Small valley on ridge crest	3/17	Very fresh glassy pillow basalts and slabs; some hydrothermal stains, abundant glass, flow structures	125
36D	22°41.1'S 114°30.4'W	2930-2970	EPR, West side of ridge crest	3/17	Pillow basalts and slabs ranging from very fresh and glassy to slightly altered and older looking	70
37D	23°00.0'S 114°31.7'W	3000-3070	EPR, Volcano within graben near 23°S FZ	3/18	Fresh pillow basalts, hydrothermal stains, minor glass	19
38D	23°04.7'S 114°32.4'W	2550-3700	EPR, South wall of 23°S FZ at intersection with EPR-axis	3/18	Tallus material; breccia basalt fragments in serpentinized glass shards matrix, hydrothermally altered basalts and some fresh glassy fragments	145
39D	24°21.6'S 111°58.5'W	2815-2980	EBEP, Ill-defined ridge crest	3/19	Partly altered pillow basalt fragments with minor glass	154

TABLE I (cont.)

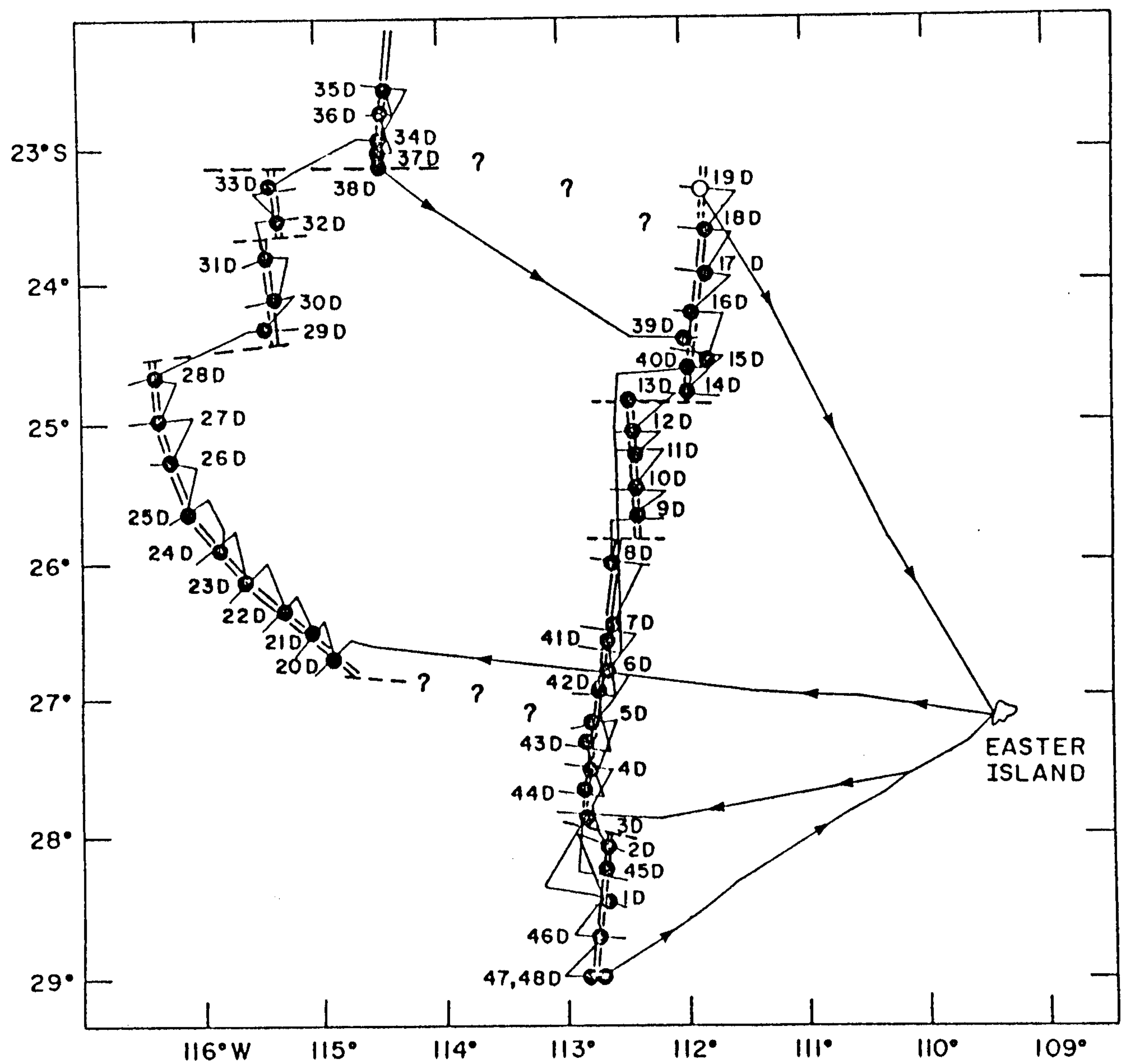
Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.)
40D	24°36.5'S 111°57.2'W	2750-2900	EBEP, Ill-defined ridge axis, asymmetric	3/20	Pillow basalt and sheet flow fragments and gravel, several flows ranging from very fresh with plag. rich glass to partly altered	46
41D	26°34.9'S 112°38.8'W	2275-2290	EBEP, asymmetric ridge axis	3/21	Very fresh, glassy sheet flow fragments; spectacular flow structures - aphyric	44
42D	26°55.4'S 112°42.3'W	2530-2650	EBEP, West flank of ridge crest	3/21	Relatively fresh pillow basalts with some glass patches and palagonite crust and Mn-coating; plagiophyric - one spectacular pillow	170
43D	27°18.1'S 112°48.4'W	2400-2475	EBEP, Small valley on top of ridge crest	3/21	Tongue of solid glass with spongy brown palagonite curst - some Mn-coating and ooze	2
44D	27°38.7'S 112°50.6'W	2495-2550	EPR, Ill-defined ridge axis?	3/22	Very large to small pillow basalts ranging from fresh and glassy to partly altered with minor glass, palagonite and Mn-coating, some ooze	85
45D	28°17.6'S 112°39.6'W	2690-2825	EPR, Ill-defined ridge axis?	3/23	Partly weathered pillow basalt fragments with minor glass, palagonite and Mn-coating, partly indurated poze	125
46D	28°42.9'S 112°43.9'W	2525-2975	EPR, Ill-defined ridge axis? Flank of hill	3/23	Partly altered pillow basalt fragments with minor glass and palagonite	90
47D	29°00.8'S 112°47.5'W	2475-2500	EPR, Ill-defined ridge axis, valley on top of blocky ridge	3/24	Partly altered pillow basalt fragments with minor glass; Mn stains	120

Sta.	Location	Depth	Feature	Date	Description	Weight (Kg.)
48D	29°01.0'S 112°42.3'W	2380-2515	EPR, Axis ill-defined east flank of blocky ridge (same as 47D)	3/24	Partly altered pillow basalt fragments with some glass (fresher and thicker than 47D) and Mn-coating	130

*EPR = East Pacific Rise
**EBEP = East Branch of Easter Micro-plate
***WBEP = West Branch of Easter Micro-plate

TABLE II: Rock samples from Tahiti

Sample No.	Rock Type	Location
TA 1	Gabbro	Road cut
TA 2	Trachyte	Road cut
TA 4	Volcanic tuff	Road cut
TA 5	Fine-grained olivine basalt	Road cut
TA 6	Weathered massive basalt	Road cut
TA 7	Diorite	Road cut
TA 8	Trachy-basalt	Road cut in area of lava tube
TA 9	Trachy-basalt	Road cut
TA 10	Vesicular basalt	Road cut
TA 11A	Massive basalt	Road cut - columnar jointing
TA 11B	Porphyritic basalt	Road cut - columnar jointing
TA 12	Trachy basalt	3 Waterfalls Park
TA 13	Plagophyric basalt	Road cut
TA 14	Massive basalt	Road cut
TA 15	Weathered basalt	Road cut
TA 16	Basalt	Vaitepiha Riverbed
TA 17	Syenite	Vaitepiha Riverbed
TA 18	Light-colored massive nodule	Vaitepiha Riverbed
TA 19	Weathered gabbro	Vaitepiha Riverbed
TA 20	Basalt with laths of plag.	Vaitepiha Riverbed
TA 21	Tahitite (blue mineral Hauynite)	Road cut near beach
TA 22	Mafic Nodule	Road cut near beach
TA 23	Phonolite	Road cut from dyke 6′ x 20′
TA 24	Trachyte	Road cut
TA 25	Nodule (w/gar. or altered opx?)	Papenoo Riverbed
TA 26	Dunite	Papenoo Riverbed
TA 27	Syenite	Papenoo Riverbed
TA 28	Fresh plagophyric basalt	Papenoo Riverbed
TA 29	Massive basalt	Papenoo Riverbed
TA 30	Agglomerate	Papenoo Riverbed
TA 31	Massive basalt	Papenoo Riverbed



23°S
24°
25°
26°
27°
28°
29°
116°W
115°
114°
113°
112°
111°
110°
109°
EASTER
ISLAND
1D
2D
3D
4D
5D
6D
7D
8D
9D
10D
11D
12D
13D
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15D
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36D
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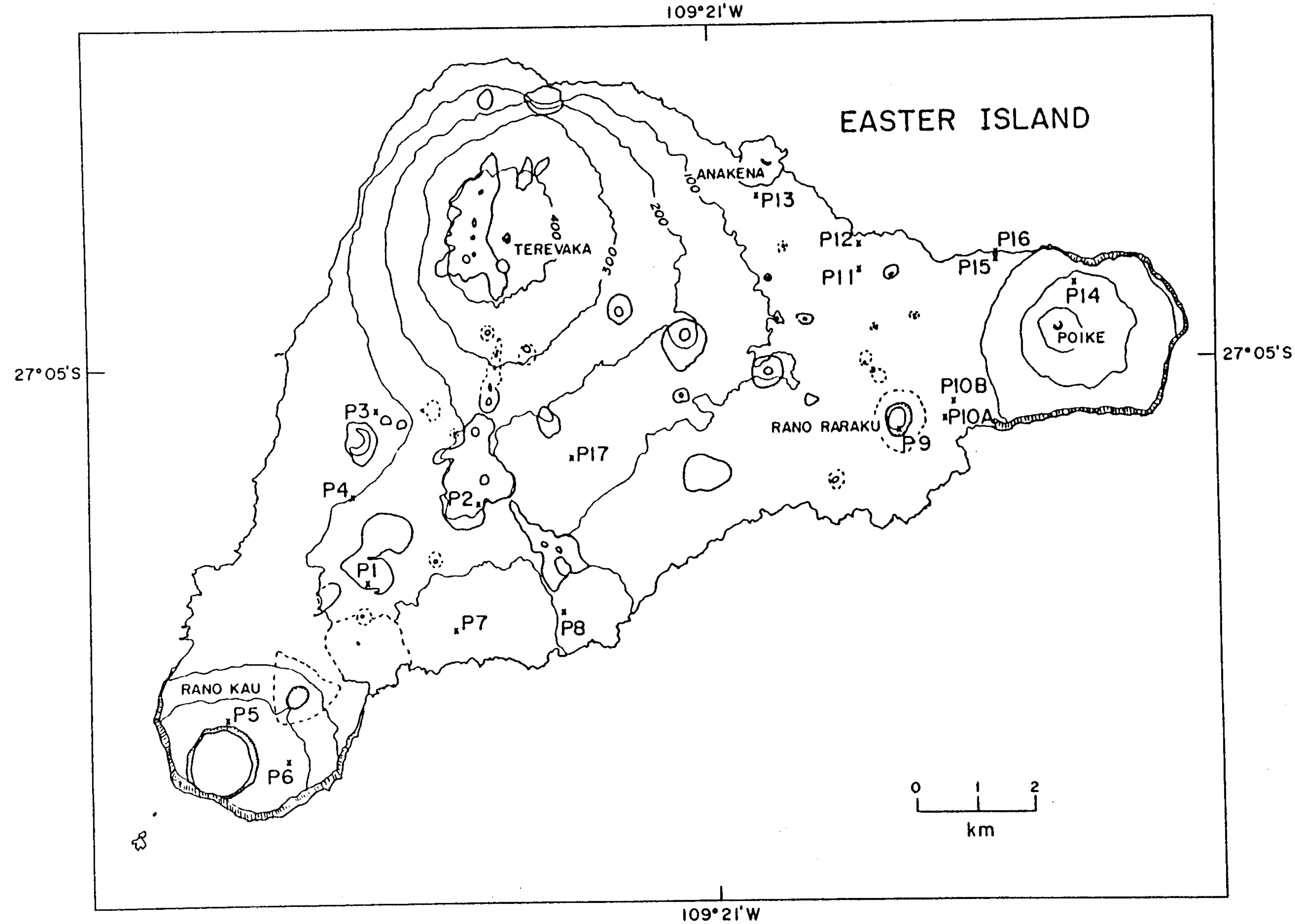
38D
39D
40D
41D
42D
43D
44D
45D
46D
47,48D

FIG. 1



EASTER ISLAND
109°21'W
27°05'S
ANAKENA
100
200
300
400
TEREVAKA
P13
P12
P11
P16
P15
P14
POIKE
P10B
P10A
RANO RARAKU
P9
P17
P3
P4
P2
P1
P7
P8
RANO KAU
P5
P6
0
1
2
km

FIG. 2

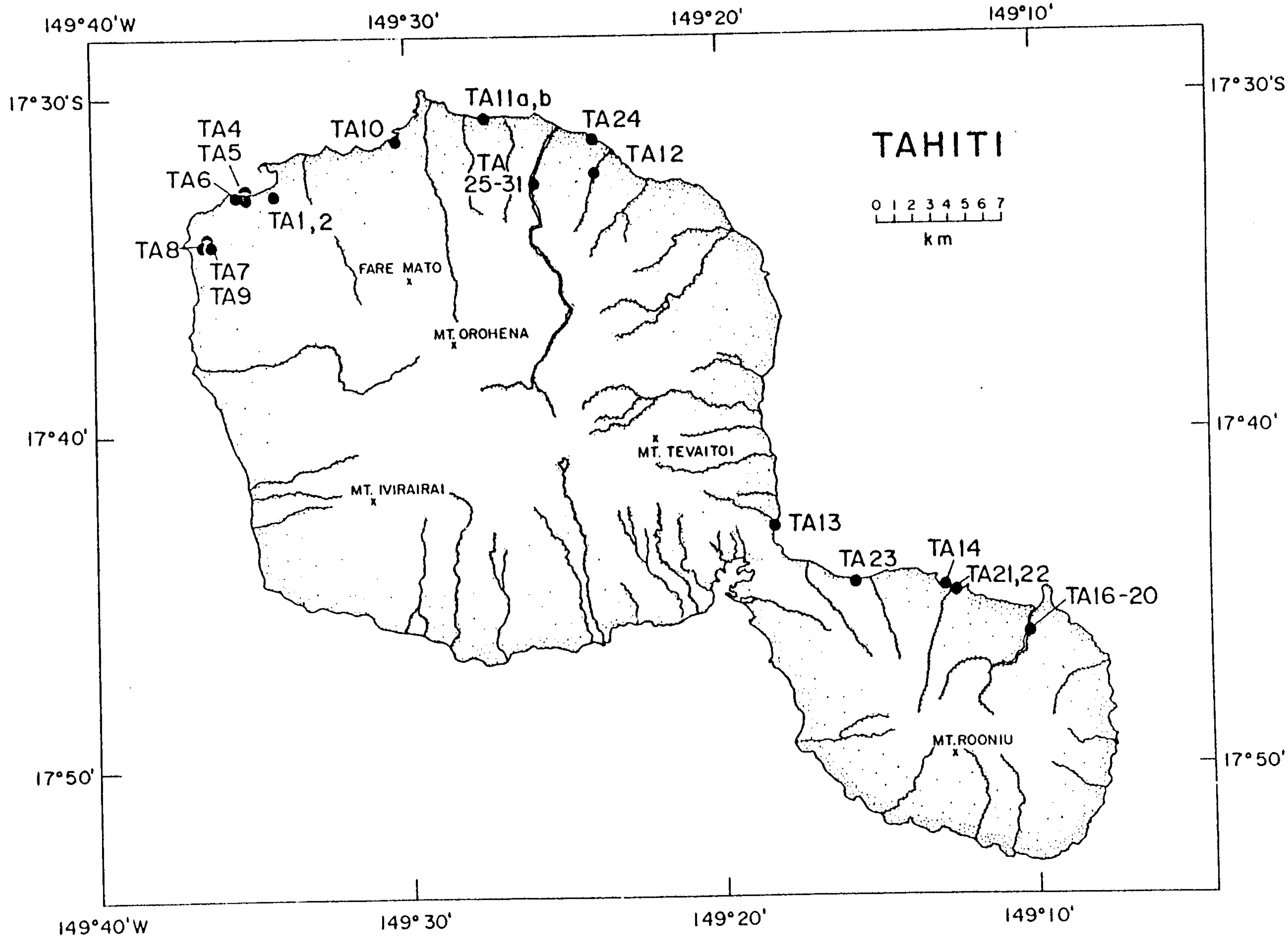

TAHITI
0 1 2 3 4 5 6 7
km
149°40'W
149°30'
149°20'
149°10'
17°30'S
17°40'
17°50'
TA11a,b
TA24
TA12
TA10
TA4
TA5
TA6
TA1,2
TA 25-31
TA8
TA7
TA9
FARE MATO
MT. OROHENA
MT. TEVAITOI
MT. IVIRAIRAI
TA13
TA23
TA14
TA21,22
TA16-20
MT. ROONIU

FIG. 3

UNOLS
Rev. 4/

CRUISE REPORT

SHIP UTILIZATION DATA

SHIP NAME R/V ENDEAVOR	OPERATING INST. URI	
CRUISE (LEG) NO. EN-113	DATES 2/21/84-3/26/84	
AREA OF OPERATIONS: East Pacific	PORT CALLS: PLACE: Easter Island	DATES: 2/21, 3/7-3/8, 3/26
DAYS AT SEA 31 / DAYS IN PORT 5		

PARTICIPATING PERSONNEL

CODE	NAME	TITLE	AFFILIATION
1.	Jean-Guy Schilling	Ch. Scientist	URI
2.	Richard Kingsley	Res. Spec.	URI
3.	Brian McCully	Res. Assoc.	URI
4.	Andrew Davis	Res. Spec.	URI

Use Reverse If Additional Space Required.

WAS RESEARCH CONDUCTED IN FOREIGN WATERS? Yes COUNTRY: Chile

PRIMARY PROJECTS (those which govern the principal operations, area and movements of the ship)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)
Petrological and Geochemical Evolution of the Easter Micro (Jean-Guy Schilling)	NSF	OCE82-14744	all
DISCIPLINE			

ANCILLARY PROJECTS (which are accomplished on a not-to-interfere basis and contribute to the overall effectiveness of the cruise)

PROJECT TITLE AND PRINCIPAL INVESTIGATOR	SPONSORING ACTIVITY	GRANT OR CONTRACT NUMBER	PARTICIPATING PERSONNEL (AS CODED ABOVE)

SIGNATURE Dr. Jean-Guy Schilling DATE 1/10/85
CHIEF SCIENTIST

TOTAL SCIENTISTS ____ TOTAL TECHNICIANS ____
TOTAL GRAD STUDENTS ____ TOTAL STUDENTS/OBSERVERS ____

ATTACH PAGE SIZE CRUISE TRACK

COST ALLOCATION DATA

DAYS CHARGED	AGENCY OR ACTIVITY CHARGED	GRANT OR CONTRACT NO
36	NSF	OCE82-14744

SIGNATURE [signature] DATE 1-31-85

R/V ENDEAVOR
EN-113
21 February-26 March 1984