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CRUISE REPORT

Ship Name: R/V CONRAD Cruise No: 20-02

Departure: 0200 10 June - 1976 (Date) from Balboa, Panama (Port)

Arrival: 1200 20 July 1976 (Date) at Honolulu, Hawaii (Port)

Days at Sea: 40½ Days Foreign Port: _____
No. of days in arrival port

Area of Operation:

Eastern Pacific Ocean

Program Description:

IPOD Site Survey of candidate sites PAC 4 and 5

Participants: (All L-DGO unless otherwise specified)

NAME	SHIPBOARD TITLE
W.J. Ludwig	Chief Scientist
J. Stennett	MCS Engineer
I. Bitte	OBS Engineer
D. Grob	Electronic Tech.
D. Hill	Electronic Tech.
B. Crowell	Electronic Tech.
M. Gavin	Electronic Tech. MCS
M. Iltzsche	Air Gun Tech.
R. Crimmins	Core Bosun
A. Engvik	Gravity Engineer
P. Casagrande	Gravity Obs.

All inquiries regarding cruise should be made to the chief scientist.

ROBERT D. CONRAD departed Panama early morning of 10 June 1976 and arrived Honolulu afternoon of 20 July 1976, upon completion of a 40-day long cruise leg (Figure 1). The objectives of the cruise were to survey IPOD candidate sites 4 and 5 and make a line of geophysical measurements between PAC sites 5 and 6, according to the statement of work prepared by the IPOD Site Survey Management (appended). All objectives of the cruise were accomplished.

Site 4 lies in the vicinity of the intersection of the Sequieros fracture zone and the East Pacific rise. The Sequieros fracture zone is a ridge-ridge transform fault, about 150 km long, that is one of the most seismically active in the eastern Pacific. At average spreading rates of 60 mm/yr, the age offset is about 2.5 m.y. Magnetic anomalies 2-5 have been identified along several tracks through the Sequieros region. The vicinity of site 4 has been surveyed extensively by scientists from Scripps Institution of Oceanography and the Hawaii Institute of Geophysics (Figure 2).

Seismic refraction studies of the East Pacific rise in the vicinity of the Sequieros fracture zone indicate profound changes in velocity structure with increasing distance from the ridge crest (Orcutt, 1976; Rosendahl et al., 1976a,b,c). The crustal zone has velocities of about 5.2, 6.0, 7.0, and 7.8 km/sec. On the flank of the ridge the 6.0 km/sec disappears

while the depth to mantle decreases. Furthermore, there appears to be a low-velocity layer about 2 km below the sea floor that thins away from the crestal zone. A velocity reversal is required to explain the large amplitude arrivals that come in about 1.5 sec after the first P-wave at ranges greater than 30 km. At PAC 4 we obtained 500 n. miles of multi-channel seismic reflection data along the track shown in Figure 3. Several sonobuoy refraction profiles were made to provide velocity data. Gravity, magnetics, and bathymetric measurements were obtained enroute.

We found the site proposed by S.I.O. (the center of an OBS array at 09°10'N, 105°08.5'W) virtually barren of sediments. We found a site about 6 miles to the west where there is a small depression containing 100-200 m of ponded sediments. The MCS cross line was routed through this area.

It is rather difficult at this time to evaluate the MCS data from the shipboard (single channel) monitor record alone. Side echoes from sea floor topography complicate the sub-bottom reflection data. In areas of relatively smooth sea floor topography, our monitor record shows a succession of sub-bottom events down to about 0.75 sec; however, the regularity of the events suggests a bubble-pulse phenomenon rather than true sub-bottom reflections. Closer examination of the records and comparison with sonobuoy data are required. In any event, it

appears certain that areas of subtle sea floor relief are caused by high-speed sediments and(or) volcanics deposited in basement depressions. Weaker reflections from within the crustal layers will most probably be enhanced through computer processing of the data.

Site PAC 5, originally located by the OCP near 24°N, 125°W on magnetic anomaly 10 (33 m.y.), was relocated by the IPOD Site Survey Management to an area bounded by 21°N and 22°N and 125°W and 126°W, where the major magnetic anomalies might be easier to identify. Site 6 is located near 21°N, 144.5°W at anomaly 32 (76 m.y.). Figure 4 shows the location of the sites in relation to major magnetic anomalies. The problems to be studied by drilling in these localities include the petrologic and magnetic properties of the basement rocks (layer 2) and facies of the overlying sediments and then to characterize and reconcile the properties with a fast (half-rate > 3 cm/yr) spreading ridge. The results of the coreholes will be compared to the results of holes drilled in crust of the same (magnetic anomaly) age in the Atlantic Ocean.

An area centered on anomaly 13 (?) was surveyed in orthogonal grid fashion with a 10-mile track spacing (Figure 5). Data obtained will allow us to construct maps of the bathymetry, gravity and magnetic anomalies, and sediment thickness. Seismic refraction measurements were made using ocean bottom seismographs

and radio-sonobuoys to determine the velocity structure of the oceanic crust in this area. The OBS experiment was designed to further evaluate the system; the data from an OBS containing 3 seismometers (2 horizontal, 1 vertical) will be compared to those from a standard L-DGO instrument having 2 seismometers and a hydrophone. Sonobuoys were launched over the OBS sites and elsewhere and the data recorded wiggly line on a standard oscillograph camera. The resulting pattern gives unreversed, reversed, split, and reversed-overlapped profiles from which to ascertain the velocity structure of the crust and upper mantle. Shipboard travel time plots indicate that the thickness of the main crustal layer (layer 3) in this area may be thinner than normal by about 1-2 km.

There are a number of good drill sites in the PAC 5 area. Because there are several magnetic lineations, the choice of prime site will depend on the identification as to age of the particular anomaly. Here, as in the site 4 area, fairly smooth sea floor topography is caused by ponding of high-speed sediments and(or) volcanics. No additional site survey work is required in the PAC 5 area.

Lastly, a line of underway geophysical measurements between site 5 and site 6 was made enroute to Hawaii. We made two unreversed seismic refraction profiles by use of long-range radio-sonobuoys and explosives. The sea floor along the track was too rough to obtain air gun-sonobuoy profiles.

William J. Ludwig
July 21, 1976

REFERENCES

Rosendahl, B.R., R.W. Raitt, L.K. Dorman, L.D. Bibee, D.M. Hussong and G.H. Sutton, Evolution of Oceanic Crust: Part I. A physical model of the East Pacific rise crest, in press, 1976a.

Orcutt, J.A., B.L.N. Kennett, L.K. Dorman, Structure of the East Pacific rise from an ocean bottom seismometer survey, in press, 1976.

Handschumacher, D.W., and J.E. Andrews, Kanakeoki fracture zone: Interaction with the Hawaiian ridge, Geology, 1, 25-28, 1975.

Rosendahl, B.R., et al., Evolution of Ocean Crust: Part IV. A physical model of the flank of the East Pacific rise derived from seismic-refraction data, in preparation, 1976b.

Rosendahl, B.R., Evolution of Oceanic Crust: Part II. Constraints, implications, and inferences, in press, 1976c.

PAC 4 & 5 APPENDIX 2-4-76

STATEMENT OF WORK

The site survey for IPOD drilling will be conducted as part of the National Ocean Sediment Coring Program of NSF.

Lamont-Doherty Geological Observatory will plan and carry out marine geophysical and geological investigations as specified below to provide essential data for determining the best location for IPOD holes at the candidate sites to meet the prescribed scientific objectives and provide data in the vicinity of the drill hole for interpretation of sample return in a geological and geophysical context.

1) As co-principal investigators for this work, W.J. Ludwig and P.D. Rabinowitz are responsible for the work performed, data reduction, analysis and interpretation.

2) The RV CONRAD, operated by L-DGO, will be used for this work during the period from about 10 June 1976 to about 20 July 1976.

3) The principal objective of these surveys will be to collect underway geophysical data at candidate sites Pacific 4 and Pacific 5 as described in Exhibit II and amended by this statement of work. Pacific 4 lies in the vicinity of the intersection of the Sequieros Fracture Zone and the East Pacific Rise. Pacific 5 is located at about 24°N and 125°W over magnetic anomaly 10, or crust with an age of 33 m.y., just south of the Molokai F.Z.

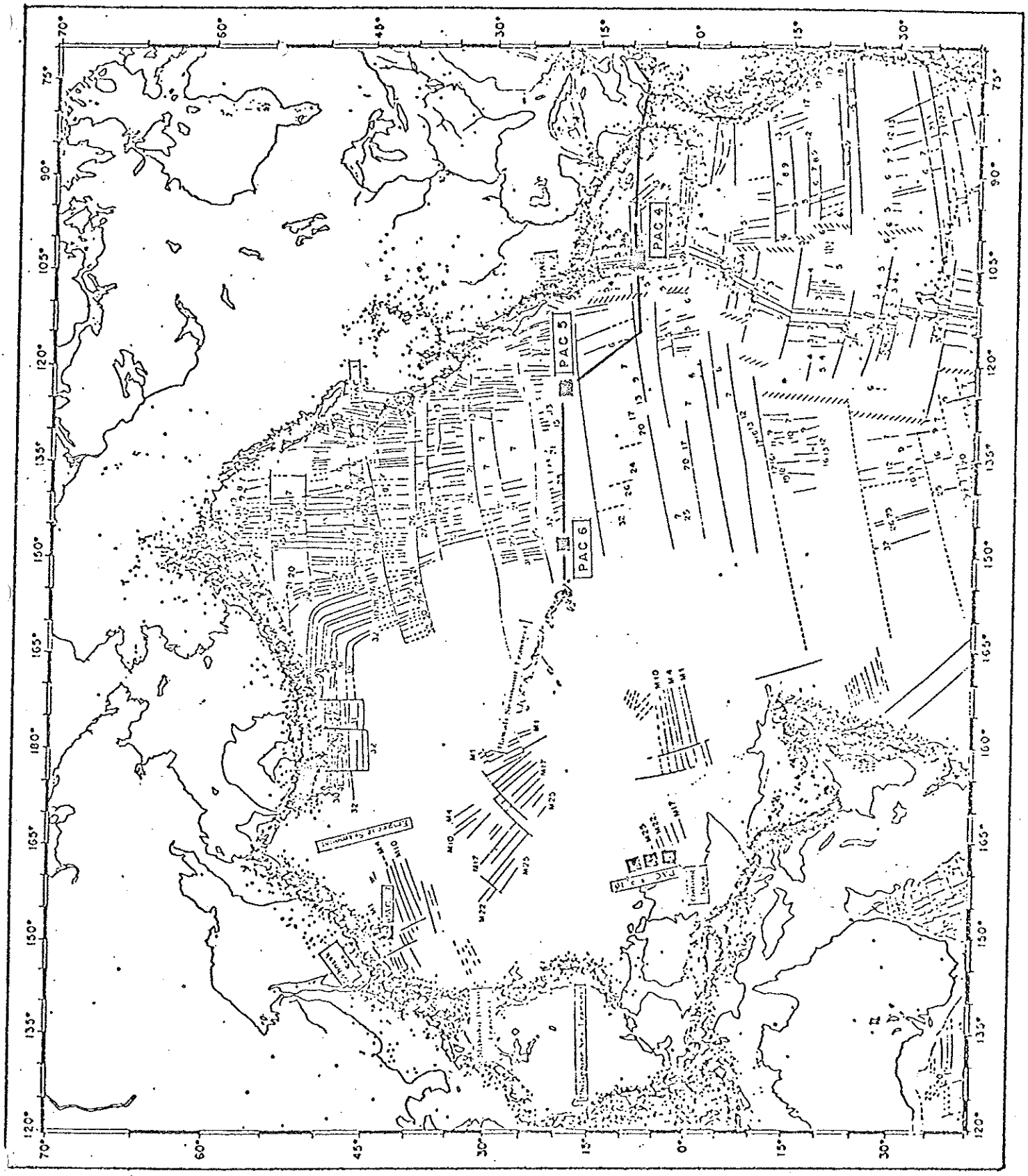
a) At Pacific site 4: (i) reflection data will be acquired using the 24-channel seismic system, recording digitally on magnetic tape, along a line approximately 700 km long across the East Pacific Rise spreading center at 8.5°N. (ii) Sonobuoy reflection/refraction profiles will be made at appropriate intervals to provide the crustal velocity structure. (iii) Underway geophysical data - 12 kc and 3.5 kc bathymetry, magnetics, and gravity data will be made along the multichannel line. General guidelines for multichannel data acquisition are described in Exhibit I.

b) At Pacific site 5: (i) A detailed grid-type survey employing underway geophysical instrumentation will be made in the vicinity of site 5 according to the general specifications given in Exhibit I for survey for ocean crust drilling. (ii) Seismic refraction studies will be made using OBS's to determine the velocity structure of the oceanic crust and upper mantle at the site. The general guidelines for OBS refraction studies are set forth in Exhibit I.

c) A line of underway geophysical data will be acquired approximately parallel to 23°N, between site 5 and the vicinity of site 6, which is at 21°N and 144.5°W. These data will include 12 kc, 3.5 kc echosounding, magnetics, and gravity.

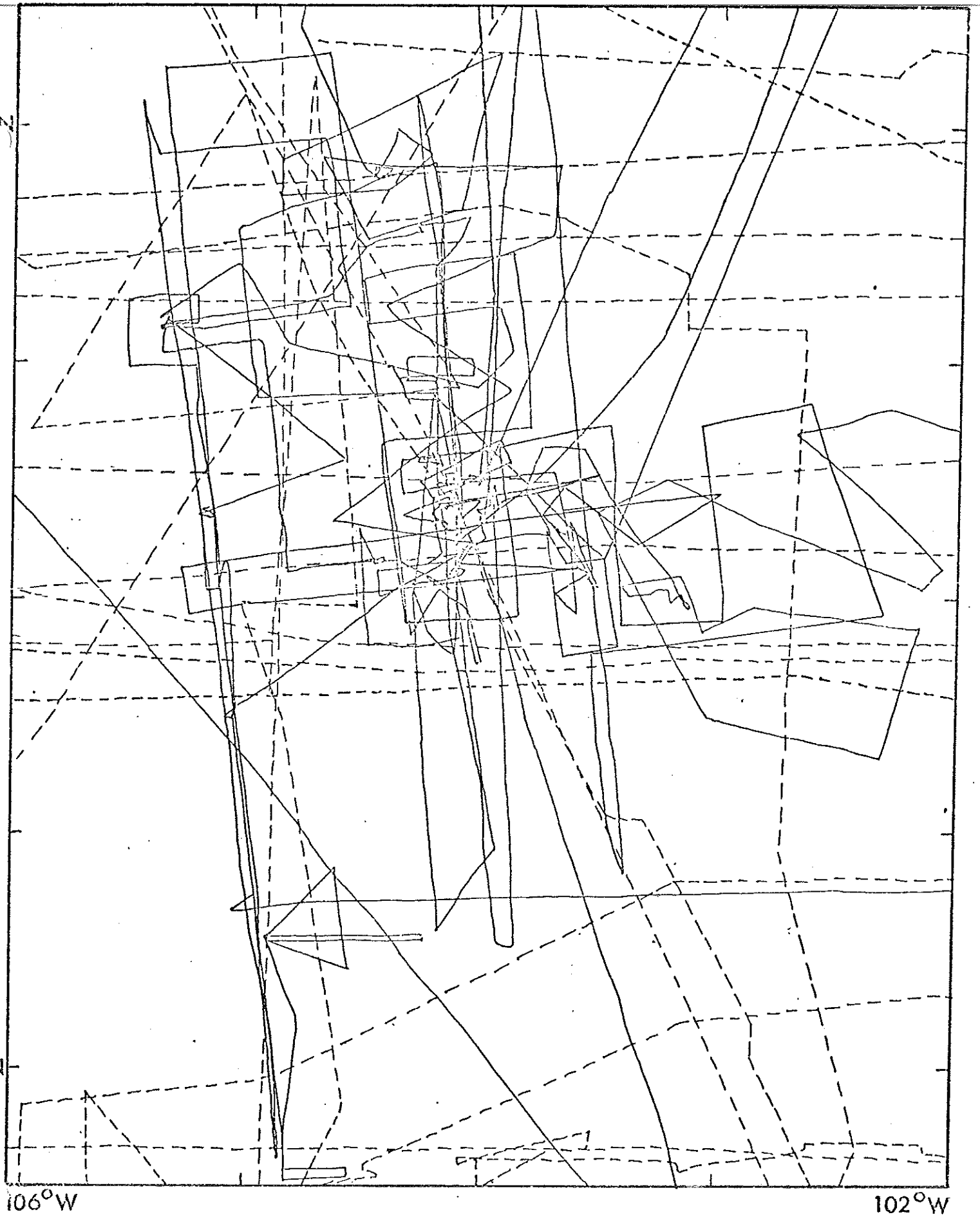
REPORT REQUIREMENTS DELETED

Exhibit I is the November version of the Site Survey Guidelines (1975). Exhibit II is the original proposal.



Location of IPOD Candidate Sites in the Pacific Ocean.
Heavy lines denote the track of CONRAD 20-02.

Figure 1



Pre-Deepsonde 02 Bathymetric Coverage in Sequieros Region.

Figure 2

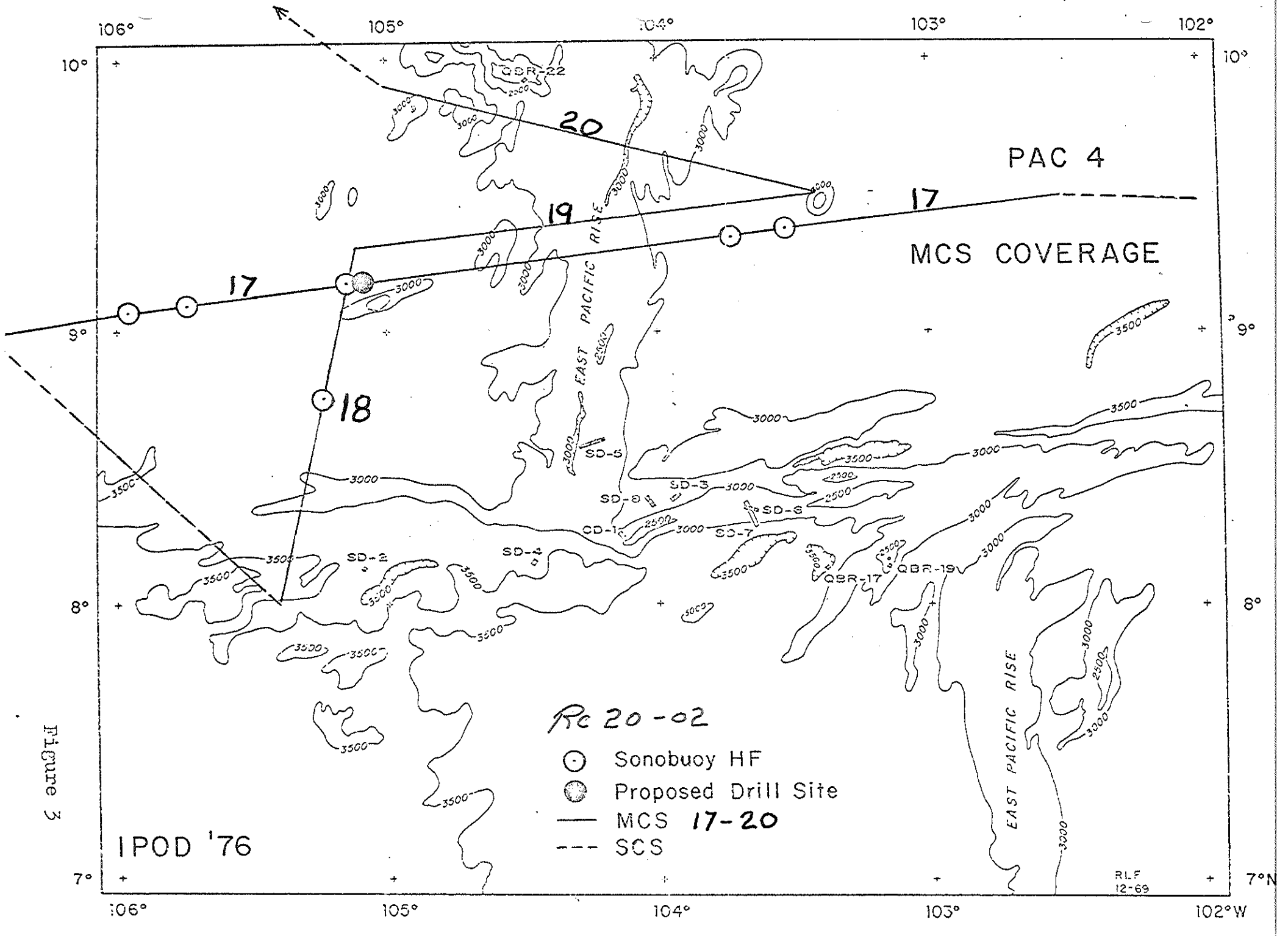

106°
105°
104°
103°
102°
10°
9°
8°
7°
PAC 4
MCS COVERAGE
20
19
17
17
18
EAST PACIFIC RISE
EAST PACIFIC RISE
QSR-22
SD-5
SD-3
SD-8
SD-6
CD-1
SD-7
SD-2
SD-4
QBR-17
QBR-19
3000
3500
2500
Rc 20-02
Sonobuoy HF
Proposed Drill Site
MCS 17-20
SCS
IPOD '76
RLF
12-69
102°W
7°N

Figure 3

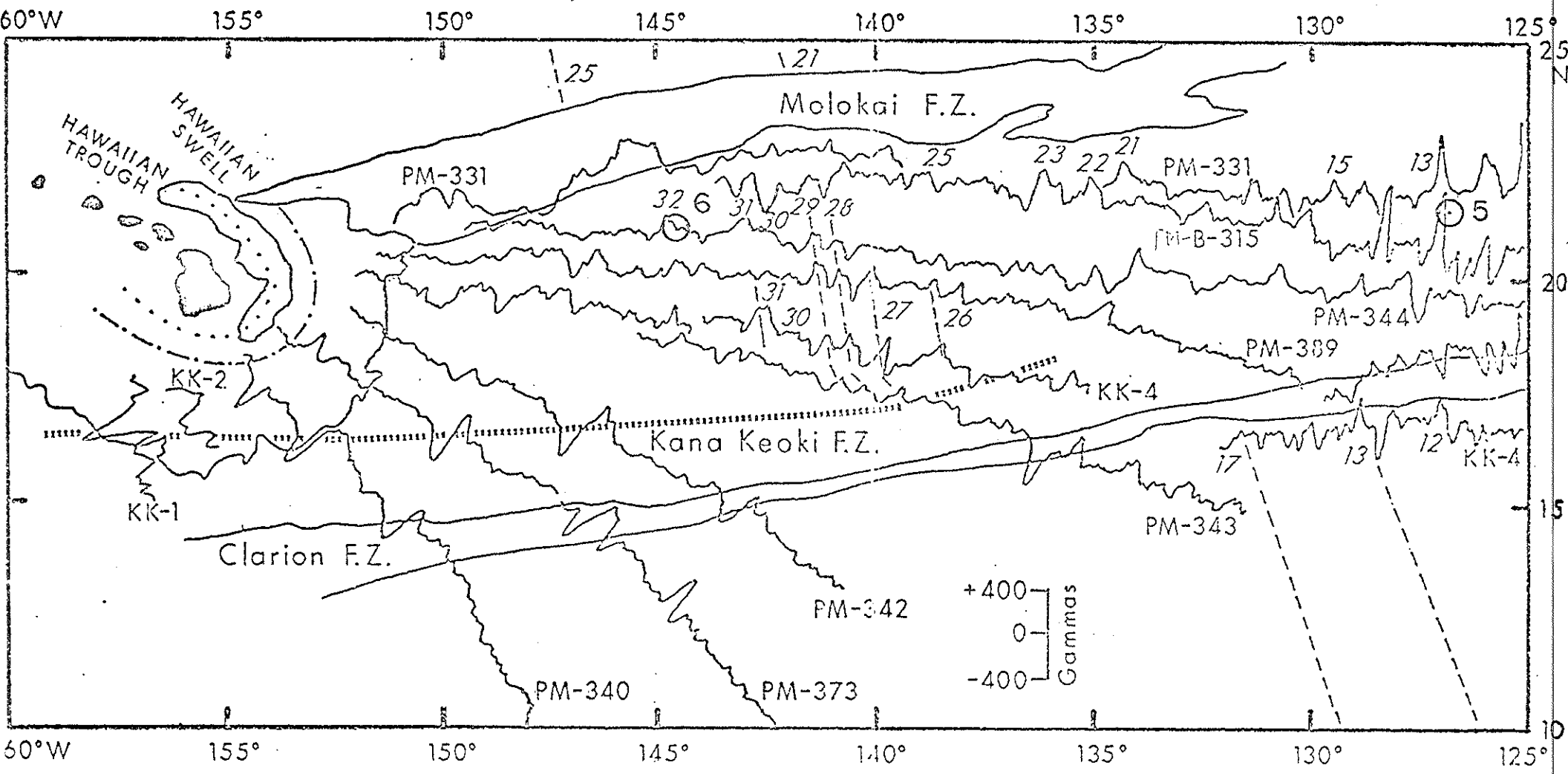


Figure 4

Major magnetic anomalies in the PAC 5 and 6 region, after Handschumacher and Andrews, 1975.

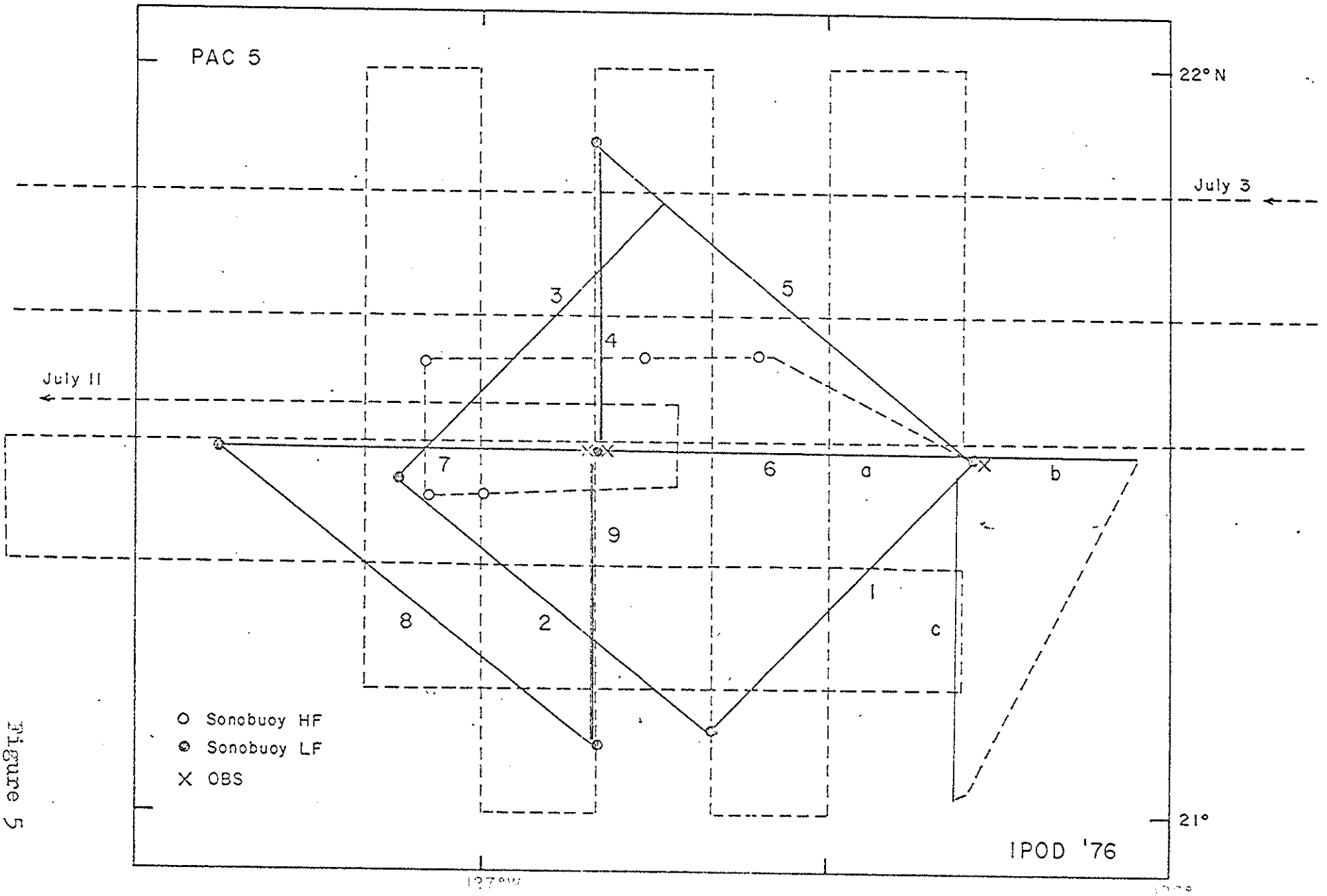

PAC 5
22° N
July 3
July 11
3
5
4
7
6
a
b
9
1
8
2
c
Sonobuoy HF
Sonobuoy LF
OBS
21°
IPOD '76
127°W

Figure 5