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CRUISE REPORT

Ship Name: R/V VEMA Cruise No: 34-02

Departure: March 25, 1977 (Date) from Guam (Port)

Arrival: April 22, 1977 (Date) at Guam (Port)

Days at Sea: 28 Days Foreign Port: 3 (No. of days in arrival port)

Area of Operation:
Eastern Philippine Sea

Program Description:

IPOD Site Survey of SP 508 Sites

Participants: (All L-DGO unless otherwise specified)

Marcus Langseth	Chief Scientist
George Gunther	OBS Specialist
Dennis Quick	Electronics Technician
Robert Peterson	Electronics Technician
Van Paisley-Smith	Gravity Technician
Charles Gove	Heat Flow Technician
Nicholas Leiser	Computer Technician
Herbert Steeves	Air Gun Technician
Michael Sundvik	Core Describer
Malakai Banuve	Core A.B.
Ropate Qali	Core Bosun

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

SHIPBOARD REPORT

VEMA 34-02

Guam to Guam

March 25 to April 22, 1977

IPOD SITE SURVEY OF SP 5-8 SITES

Scientific Staff:

Marcus Langseth	Chief Scientist
George Gunther	OBS Specialist
Dennis Quick	Electronics Technician
Van Paisley-Smith	Gravity Technician
Charles Gove	Heat Flow Technician
Robert Peterson	Electronics Technician
Michael Sundvik	Core Describer
Nicholas Leiser	Computer Technician
Herbert Steeves	Air Gun Technician

Marcus G. Langseth
25 April 1977

IPOD SITE SURVEYS IN THE SOUTH PHILIPPINE SEA TRANSECT

During VEMA cruise 34, leg 02, geophysical surveys of five potential IPOD drill sites were carried out. The principal tools used were seismic profiler and sonobuoy refraction studies of the sediment distribution and basement velocity structure at each site. Underway geophysics also included marine magnetics and gravity along the tracks. With the exception of site 8 in the regions surveyed, magnetics was not a very useful guide to crustal age or trends because anomalies were of extremely low amplitude. The ocean crust appears to have obtained its magnetization at very low magnetic latitudes. The gravity results will be useful in determining the deep structure of the two ridges studied but were not analyzed on board the ship.

At all sites, cores were taken, and at some sites heat-flow stations. At site SP-8 in the eastern part of the Philippine basin, an OBS refraction study and small heat-flow study were carried out.

Principal results:

The VEMA sailed 25 March as scheduled and steamed to site SP-5 on the West Mariana Ridge on a northern course that was roughly along the strike of the ridge. Arriving at site SP-5 (17°30' to 18°00'W and 142°40' to 143°20'E: see enclosed track chart), we made a few east-west traverses of the ridge spaced ~ 7 miles apart to map the major topographic trends. In this region, the ridge is bounded by a steep scarp on the east, facing the Mariana trough. We successfully dredged this face at about 1600 fms and retrieved highly weathered rocks along with Mn crust and pumice fragments. The basement forming the scarp appears to dip down more gently toward the west and is a massive structure. In the west there is a second crest of the ridge formed by volcanic

peaks. One such peak in the southwestern part of the survey area reaches to within 33 fms of the sea surface. All the shoal peaks along the ridge seem to be associated with this western crest of the ridge and, judging by the steepness of the slopes of the volcanic peaks, they may be quite young. Between the two crests of the ridge, there is thick sediment, which has been folded rather recently. The reflection profiler can not see basement through this sediment pile but the refraction results indicate about 2 km of material with seismic velocities less than typical basement. However, topography is rough and the sonobuoy records were not good.

With regard to drilling, the sediment over the crest of the ridge seems too thick to be penetrable to basement. The westernmost ridge crest formed by volcanic peaks is devoid of sediment but may not be typical. It seems to me that the best chance to get rock that would help date this ridge and give information about its subsidence history and composition would be to penetrate basement on one of the broad down-faulted terraces on the eastern face of the ridge. (See contour map in Figure 1.)

Site 6A

Site 6A was selected at the distal end of a wedge of sediment that lies west of the West Mariana Ridge. The multichannel line run earlier shows that the thickness of these deposits is very great adjacent to the ridge, which suggests that the West Mariana Ridge during its emergent phase was an abundant source of sediments. About 3^{o} west of the ridge, a rough basement emerges and sediment becomes thin and confined to basement deeps. Site 6A is located in this region about 50 km west of DSDP hole #53.

In the eastern part of the area, sediment is acoustically well stratified and basement is seldom detected below the thicker deposits. When the thickness and extent of these deposits were realized, we moved the area of the

survey about 30 mi westwards because it is unlikely that the drill could reach basement without penetrating at least 1 km of sediment. Here basement emerges in broad ridges. Rough mapping of basement consists of broad ridges that trend roughly NE. However, the limited areal extent of the survey area makes this trend very tentative. The ridges appear to be continuous in a roughly N-S direction because they effectively dam the turbidite deposits flowing in from the crust, so that significant thicknesses rarely extend westward of 140°E.

Interesting features of these sediments are long furrows in the sea floor formed by undulations of the stratigraphy indicating small recent fault movements that have gently folded the sediments. Because these folds extend right to the surface, they represent deformation that is subsequent to the subsidence of the sediment source, the West Mariana Ridge.

Reversed sonobuoy profiles shot on N-S lines show the basement to have velocities in the range 4.8 to 5.6, which are reasonable Layer 2 velocities. Three sonobuoys obtained velocities of 6.6 to 7.0 at depths of 6.8 to 7.8 km. Thus basement appears to be typically oceanic within the resolution of the sonobuoy results.

The best place to sample this basement with the GLOMAR drill is over the higher side of a tilted fault block in the southwestern corner of the area. Here basement can be reached at about 5½ km beneath a few hundred meters of pelagic sedimentation. The sedimentary fill of the half-graben formed by this tilted block shows extremely interesting small fault structures roughly parallel to the main fault lineaments.

IPOD trough

Just west of site 6A, we traversed the area of a deep V-shaped trough sounded by CONRAD and THOMAS WASHINGTON in earlier survey cruises. This trough is one of a series of troughs that lie on a line extending northward from the Yap trench. Several traverses of the feature show that it has a trend of about 340-350° and its long axis is only about 20 mi long. The deepest depths at

about 18°N are 3700 fms, about 1200 fms deeper than the surrounding terrain.

We dredged the northern end of this trough successfully and obtained several large chunks of solid, fresh-looking basalt mixed with much Mn crust. The lack of weathering suggests that these samples may be young.

Site 6B

Between IPOD trough at 139°20'E and the Parece Vela ridge at about 135°E, the sea floor is exceptionally rough. The basement relief is about 400 fms with wavelengths of 5 to 10 mi, and covered conformably by a generally thin sediment cover. The sediment cover, however, thickens westward, and thicknesses on the order of a few hundred meters are found near the Parece Vela ridge. In some rare cases, the sediment is ponded in deep basement depressions.

The location of Site 6B was rather arbitrarily chosen to be in the western part of the Parece Vela basin, ~ 136°E, where the sediment is generally thick enough to permit spudding in of the drill bit. There are very few distinctive geophysical characteristics to guide the surveys. Magnetic anomalies are virtually non-existent and parallel tracks oriented N-S and E-W showed no consistent trend to the basement topography. However, there is evidence for sitnificant large-scale block faulting in the sea floor shown by our local survey at 17°45'-18°10'N and 136°-136°45'E and other traverses through the region, V24, V28, C20, and THOMAS WASHINGTON tracks (INDOPAC 5). Sizeable regions, 20-50 mi across, have different average elevations and are separated by steep scarps. Generally, the difference in elevation between these blocks is about 400 fms.

Seismic refraction work in this area is very difficult because of the great roughness of the topography. The preliminary analysis of 6 sonobuoys in the area shows that basement has a normal oceanic structure. A hole to obtain valid basement samples in this region could be placed almost anywhere, with the exception of two unusually deep areas of about 3000 fms and an elevated area of very rough sediment-free peaks in the NW corner of the area. A useful plan

might be to drill two one-bit holes; one on a deep block (2700 fm) and one on a shallow block (2400 fm). Future analysis of gravity profiles in the area may help determine whether there are differences in composition between the blocks.

Site 8

Six days were spent in the vicinity of the site at about 18°N and 133°E, which is in the western part of the Philippine Basin. Depths in this area average about 3150 fms. There is a gradual decrease in elevation toward the NNE (~ 015°) suggesting a positive age gradient in this direction. The decrease in elevation is accompanied by a diminution of basement relief and a small increase in sediment thickness. A clear trend in the topography is delineated by the survey tracks (see contour map). Magnetic lineations have a clear trend also (parallel to topo trends) so that the area can be placed in the larger scale magnetic anomaly pattern established for the Philippine Basin.

A reversed pair of sonobuoy measurements show relatively shallow, about 1 km, subbottom, very high velocity refractors, 7 - 8 km/sec. These results are very tentative, however, and must await reduction of the OBS survey that was made in the area.

Three bottom seismometer packages were dropped in the area but one inexplicably released its weights after only 2 hours on bottom and returned to the surface. We did not realize the unit had surfaced early and were very lucky to recover it some two days later about 24 mi west of the deployment site.

The other two units performed perfectly. Unfortunately, we later learned that OBS #104 at Station "C" had no time code so that the data are virtually useless even though good ground arrivals were obtained. As a consequence, we got one OBS out of three! The shooting pattern consisted of two orthogonal lines oriented at 01° and 100° about 45 mi long and one oblique line about 20 mi long. (See Fig. 4).

The shooting along these lines was severely compromised by the lack of sufficiently large caps to detonate the TNT blocks at depth. This limited us to shot sizes of 32 lbs or less and the 32# size could be used only if some flotation was added to slow the sinking of the charge. The small-sized caps available also led to numerous duds. Thus some of the lines are too sparsely shot and I fear that in certain directions the shot density is insufficient.

Playback of the tapes of the returned units is encouraging. All shots fired can be heard on all channels regardless of distance, even the caps. Ground waves can be clearly heard on all channels.

Site SP-7

Our last survey area, site SP-7, was over the Parece Vela ridge. We chose to survey an area about 2^{o} south of the transect line because earlier data suggested that the ridge was broader and higher there. We made closely spaced traverses over the ridge. (See contour map in Fig. 6 .) The ridge seems to have two small right lateral offsets, probably along faults that trend east-west. The minimum depth of the ridge along profiles varies. The average depth is about 1800 fms but one peak rises to 1310 fms. In the northern part of the area, the crestal zone is comprised of two ridges about 20 mi apart.

We dredged volcanic samples from a steep westward face in the southwestern corner of the survey area. The rocks are very vesicular, suggesting that they were emplaced when the ridge was much shallower or even emergent.

Sediment over the crest of the ridge is generally thick except near isolated peaks. Seismic profiler records do not give a good indication of the true basement. A single sonobuoy that has not been analyzed may provide our best indication of sediment thickness.

One good drill target may be the broad, relatively flat crestal region in the southern part of the survey area.

E-W tracks to and from the survey areas were designed to augment other long traverses across the area.

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Notes on Equipment

Underway Geophysical Equipment

By and large, this equipment is working very well. The magnetometer shows anomalous tares of about 10 chart units, which I understand is an old problem. It also was very noisy on courses near 180°. (This problem could be easily solved if someone thinks it is important enough to do.) The gravimeter is giving satisfactory records although they may be noisy compared to other records made at comparable moderate sea states. Both depth recorders are working well except for the fact that the encoder that gives 20 fm tics on the 12 kHz recorder failed during the last week of the leg. Profilers worked well; one of the standard L-DGO eels was used throughout the leg and was quiet and sensitive. The accutronics eel was tried but proved very noisy, especially the first section. The noise seems to be electrical. The other L-DGO eel was not tried. The airgun worked well and is well maintained.

Station Equipment

The thermograd instrumentation was in rather poor shape. Two units were on board; one had been flooded two legs earlier and is useless. This unit has been returned for refurbishment. The second unit was repaired so that useful gradient measurements can be made but the pressure guage does not operate. The conductivity apparatus were also in poor condition because they were stored in the wet lab. This situation was corrected.

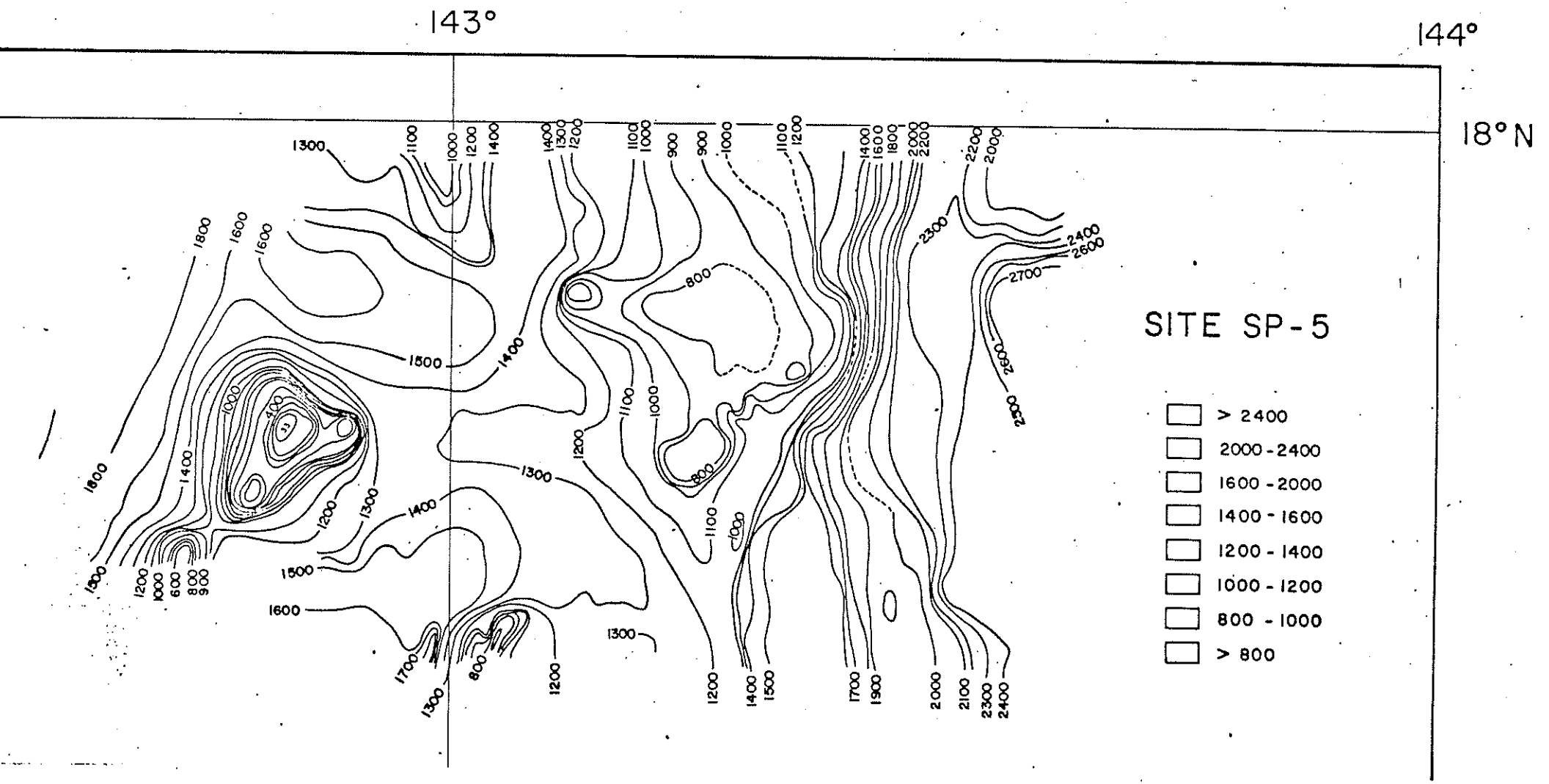
The cameras were not used during the leg.

The core apparatus, the dredges, and associated apparatus are working well.

The Computer

More computer was working this time out than on my last trip. Both the disk drives and the plotter were working, which allowed us to work on the data aboard ship. This was especially useful during survey work.

The bus switch, the A-D converter, and the DEC tape drives are still down. A strong effort to get the DEC tape working so that data stored at sea could be brought home would be very worthwhile. This might lend impetus to getting the other parts of the computer working as well.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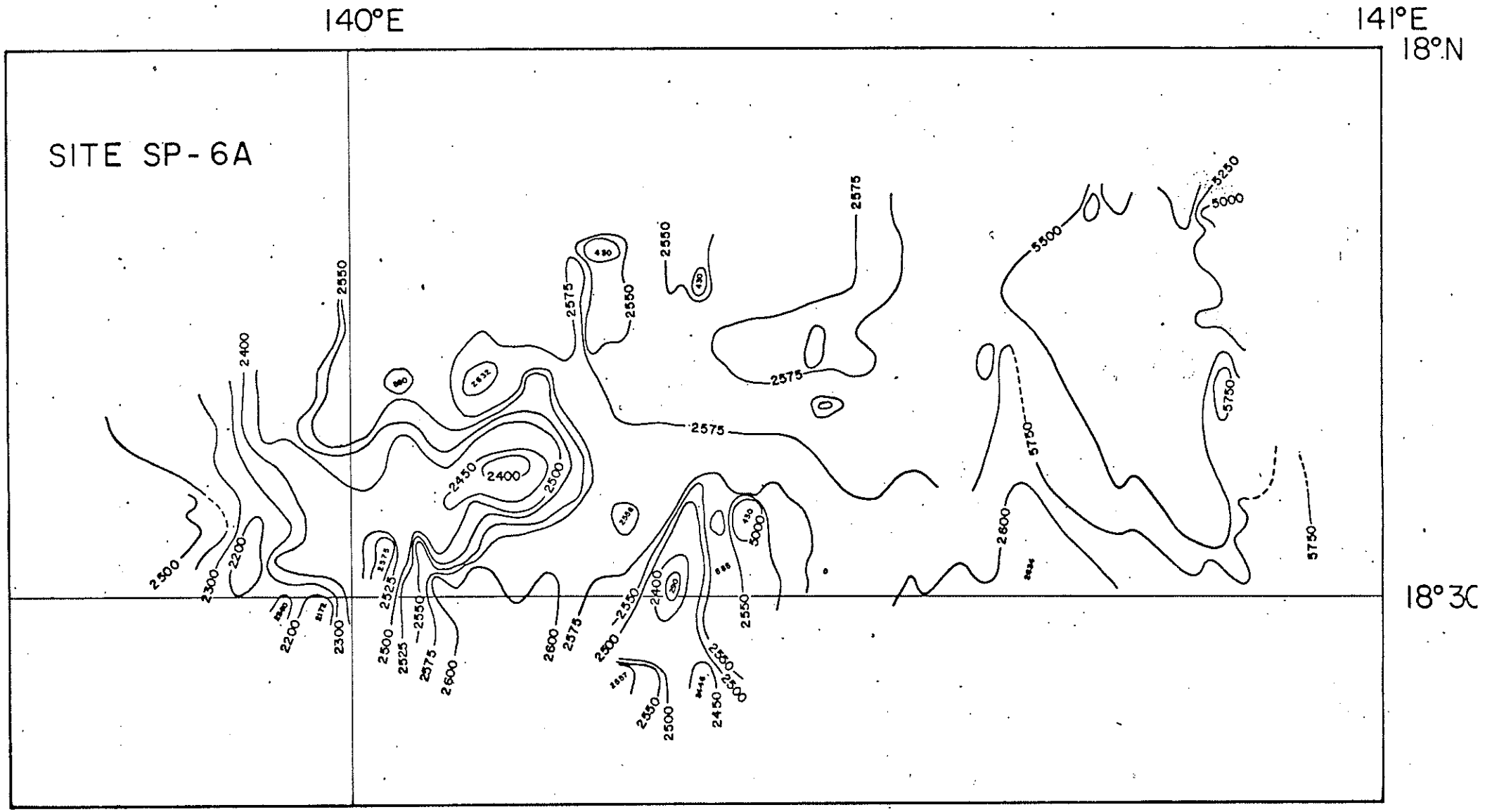
144°
18°N
SITE SP-5
> 2400
2000 - 2400
1600 - 2000
1400 - 1600
1200 - 1400
1000 - 1200
800 - 1000
> 800


140°E
141°E
18°N
18°30
SITE SP-6A
2550
2400
2575
2550
2575
2575
2450
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2500
2300
2200
2200
2300
2525
2550
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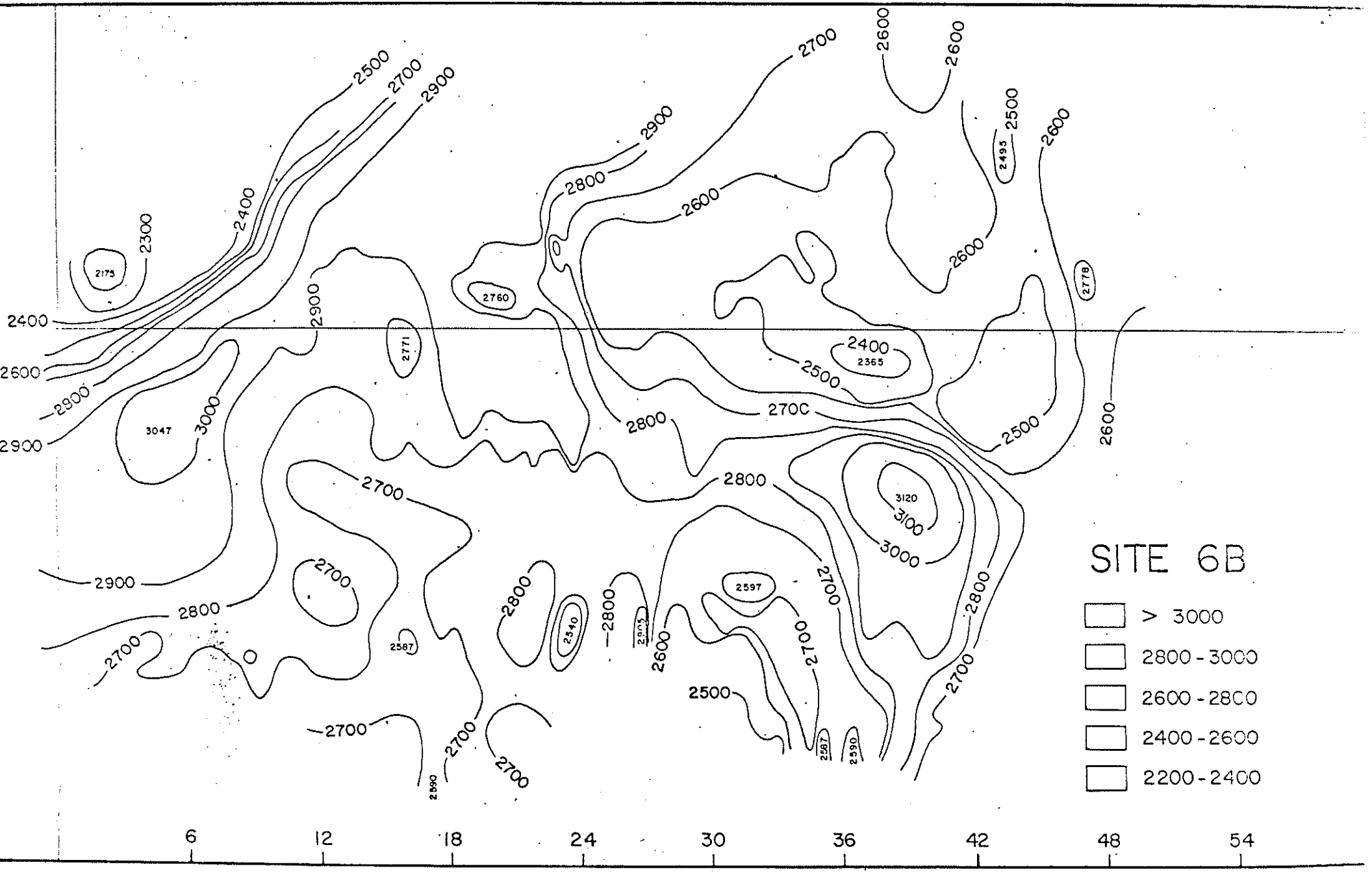
SITE 6B
> 3000
2800 - 3000
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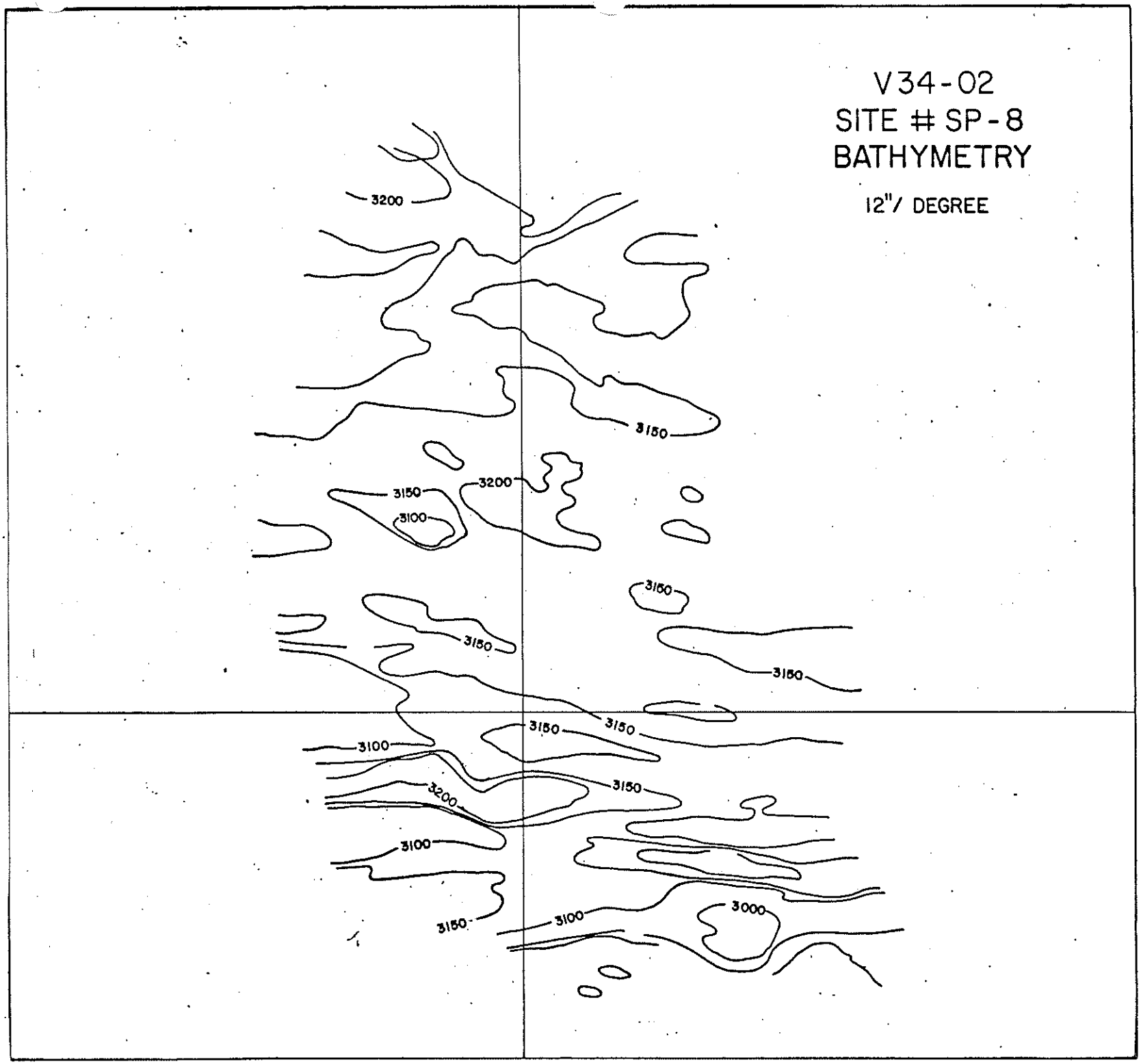
6
12
18
24
30
36
42
48
54

133°


V34-02
SITE # SP-8
BATHYMETRY
12"/ DEGREE
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3150
3150
3200
3100
3160
3150
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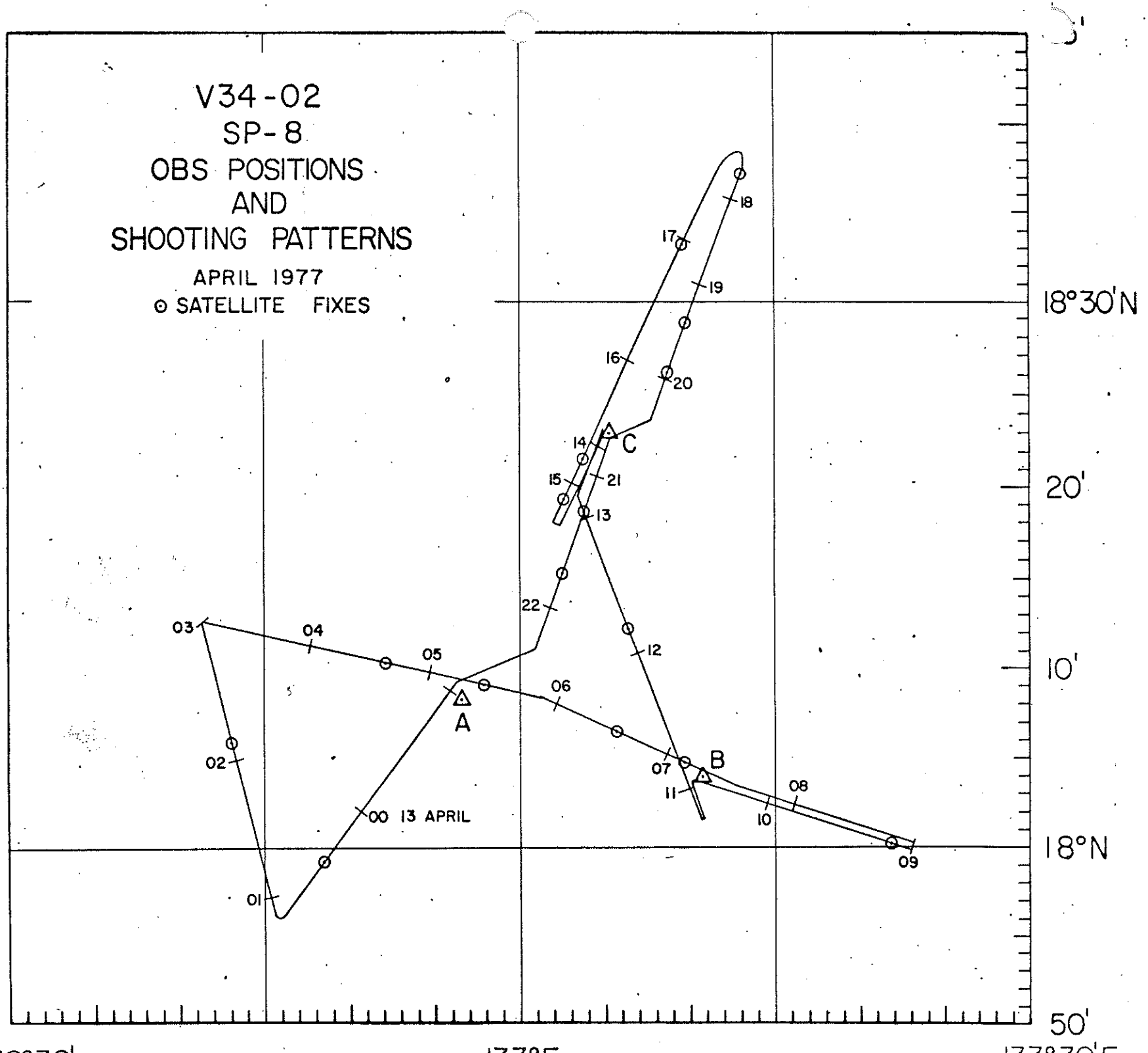
3200
3150
3100
3150
3100
3000

18°N


V34-02
SP-8
OBS POSITIONS
AND
SHOOTING PATTERNS
APRIL 1977
⊙ SATELLITE FIXES
18°30'N
20'
10'
18°N
50'
A
B
C
00 13 APRIL
01
02
03
04
05
06
07
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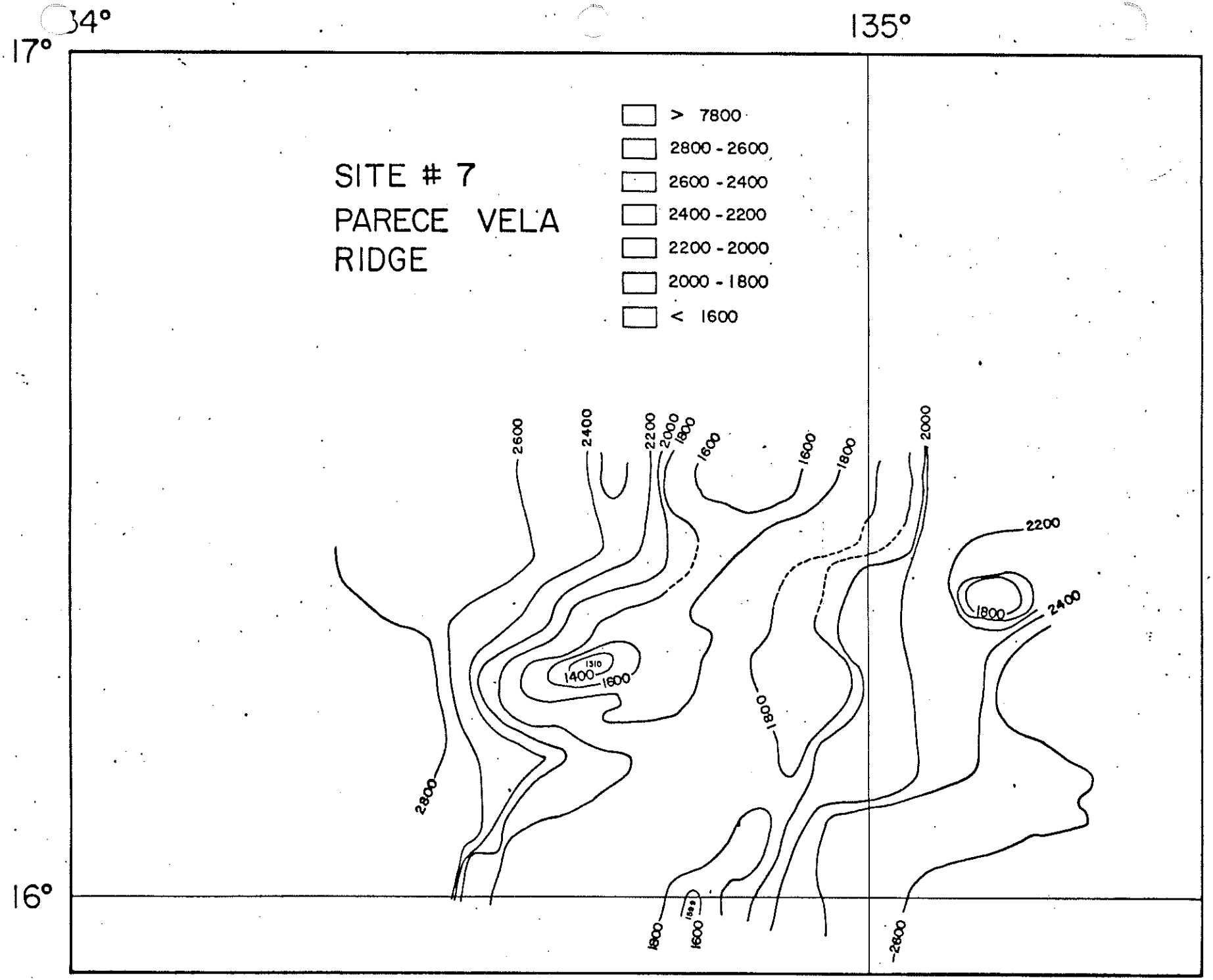
134°
135°
17°
16°
SITE # 7
PARECE VELA
RIDGE
> 7800
2800 - 2600
2600 - 2400
2400 - 2200
2200 - 2000
2000 - 1800
< 1600
2600
2400
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2200
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1310
1400
1600
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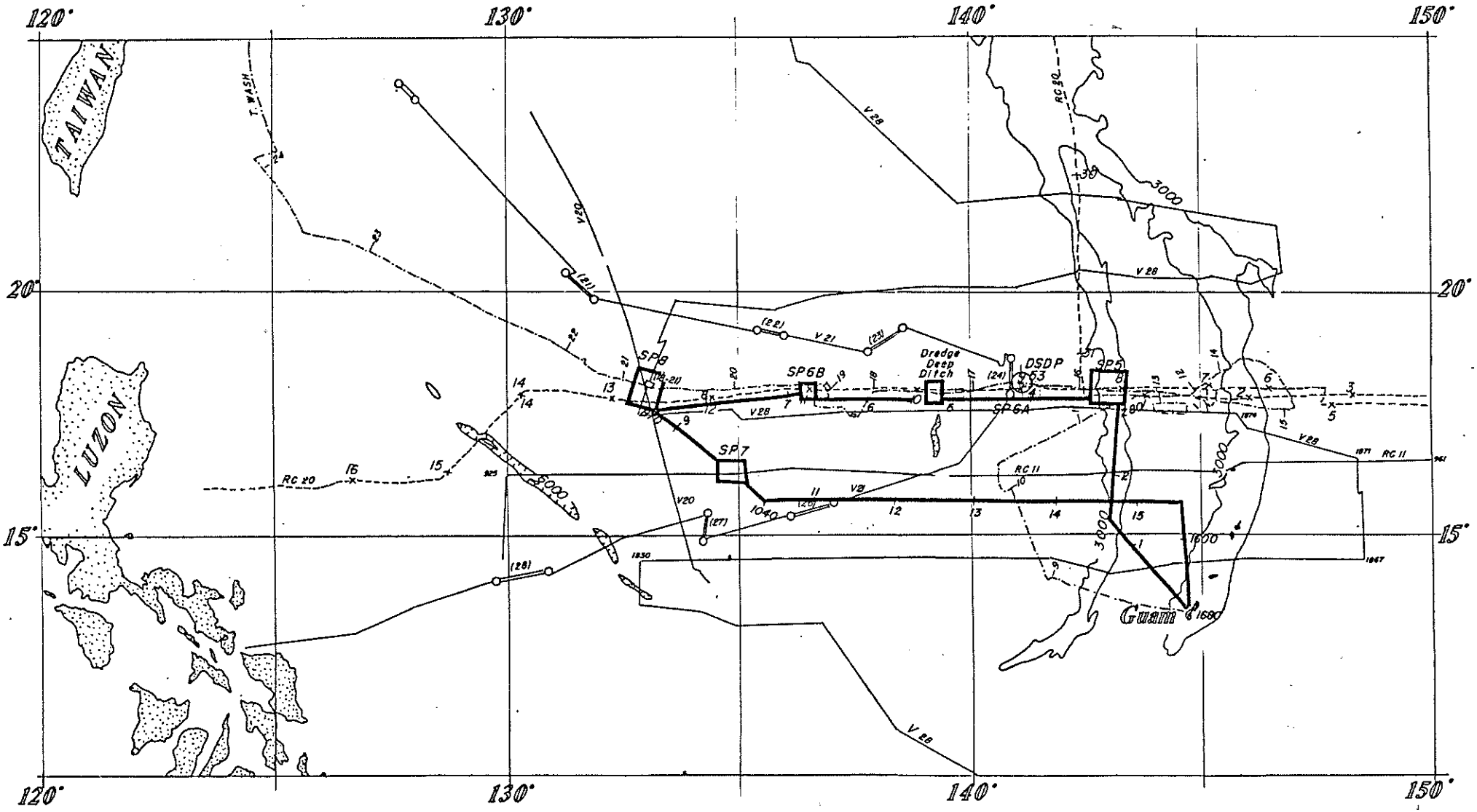
2800
1800
1600
2600


120°
130°
140°
150°
20°
15°
TAIWAN
LUZON
Guam
SP8
SP6B
SP7
SP6A
SP5
DSDP
Dredge Deep Ditch
T. WASH
RC 20
RC 11
RC 32
V 28
V 21
V 20
3000
8000
1600
1680