21. UNDERWAY OBSERVATIONS

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INTRODUCTION

On Leg 6, the *Glomar Challenger* was equipped for underway observations with a proton precession magnetometer, a 12 kHz echo sounder and a seismic reflection profiler employing a 30-cubic inch air gun. The seismic records, while generally meeting minimum needs in site location, were not of sufficient clarity and contrast to meet the greater demands of detailed interpretation or reproduction for publication. Thus, in interpretation and in actual hole selection extensive use was made of the *Argo* "Scan expedition" profiles described and reproduced in Chapters 19 and 20.

It would have been preferable to illustrate the *Glomar Challenger* seismic reflection records in this volume, but the low contrast of the wet paper records, the unfortunate noise level and the interference resulting from long radio transmissions made that plan impossible. Reproduced in this chapter are the underway profile of topography and total magnetic intensity for the entire leg; plotted soundings for the area of each site are given in the site reports (Chapters 2 to 18). The soundings are recorded in the standard unit (tau) ($t = \frac{1}{400}$ th second travel time). The position of the ship was determined several times each day by a satellite navigation system. The track was completed by dead reckoning.

CHALLENGER TRACK

From Site 45 to Site 47 the *Challenger* ran close to the R/V *Argo* "Scan expedition" track so that drilling sites could be selected on the basis of the *Argo's* profiler record. The *Challenger* line was purposely run 10 to 20 miles to one or the other side of the *Argo* line so as not to duplicate data and to allow the determination of the trends of persistent linear features of topography and linear magnetic anomalies.

When the ship ran southwest from Site 51 the *Argo* profile was left and from here on only the *Challenger* records were used only to establish regional continuity of subbottom reflection and for the selection of Sites 52, 54, 55, 56, 57 and 58. Following completion of Site 58, the seismic profiler failed and for the selection and interpretation of Sites 59 and 60 use was made of schematic diagrams of the Scan profiler records prepared by D. Karig and transmitted to the *Challenger* by radio facsimile.

UNDERWAY OBSERVATIONS

The Leg 6 track went from Honolulu across the rough and generally sediment-free flanks of the Hawaiian pedestals to the archipelagic apron which flanks the Hawaiian Chain. The bottom was descernibly rough along portions of the track leading from the apron to the Horizon Ridge. Horizon Ridge is frequently called Horizon Guyot because of its flat top and the fact that a normal traverse across this Ridge resembles a profile across a flat topped seamount. However, the authors prefer to restrict the term Guyot to flat topped seamounts although the probably similar origin and the similar summit level of the Horizon Ridge is recognized.

Proceeding west-northwest from the Horizon Ridge, the Necker Ridge was crossed and then a gently rolling sea floor – which was decidedly smoother than the ocean basin floor – was traversed between the Hawaiian apron and the Horizon Ridge. On approaching Site 45 the record became quite difficult to interpret and did not show a clear cut stratigraphic sequence. With no feeling of constraint to follow the recommendation of the site selection panel, this site probably would have been relocated. However, the panel had at their disposal two seismic reflection profiles across the site and apparently had been aware when they made their selection of the peculiar record quality to be obtained in the area.

When running west-northwest from Site 45, a search was made for a site where it might be possible to obtain a sample of the sediment lying above the deepest seismic reflector. In this search the *Argo* record was used almost entirely.

The chert layer which stopped the drilling at Site 45 could not be correlated to any reflector, due to the ill defined records obtained by all profilers through that site. In Site 46 the sediment only slightly above the basement was sampled, but again this age and composition could not be related to any of the reflectors within the sedimentary section.

From Site 46, the ship crossed the subdued topography of the western Pacific to the Shatsky Rise (Chapters 5 to 8).

The *Challenger* underway records from Hawaii to Site 51 thus contributed little new information not already revealed on the *Argo* records. Drilling at abyssal basin Sites 45 and 46 did not contribute definitive results on the age of the reflectors observed on the seismic profiler records.

The seismic profile obtained from Site 51, west of the Shatsky Rise to Site 52 east of the Bonin Trench, revealed an increasing thickness of sediment. The deepest reflectors observed seemed to become smoother, and it was seriously questioned whether the deepest horizons were really basement and not just more sediments. The profile across the Mariana Trench and Island Arc revealed extremely rugged topography with little sediment cover. West of the Iwo Jima Ridge, however, the thick apron of sediment indicated by Ewing *et al.* (1968) and Karig (in press) was detected. This area has been described by Karig in Chapter 20. Sites 53 and 54 were on the same apron of sediment in similar physiographic settings.

The profile from Site 54 southeast across the Mariana Arc and Trench revealed little sediment. On crossing the Mariana Trench, the sea floor leveled. Further southeast the *Challenger* encountered the Caroline Ridge which rose in a series of steps. The topography of each step is somewhat rounded by sedimentation, but the step-like quality of the underlying basement is nearly perfectly expressed on the seismic records (Chapter 13). The sediment covering each step thins towards the outer edge, and sediment was not detectable on the risers between steps. Sites 55, 56 and 57 were drilled on three of these steps. Only one of the three holes sampled the basement (Hole 57). The steps are probably faults, and judging from the sediments lying over basement the depths of water at the time of creation did not greatly differ from the present depths.

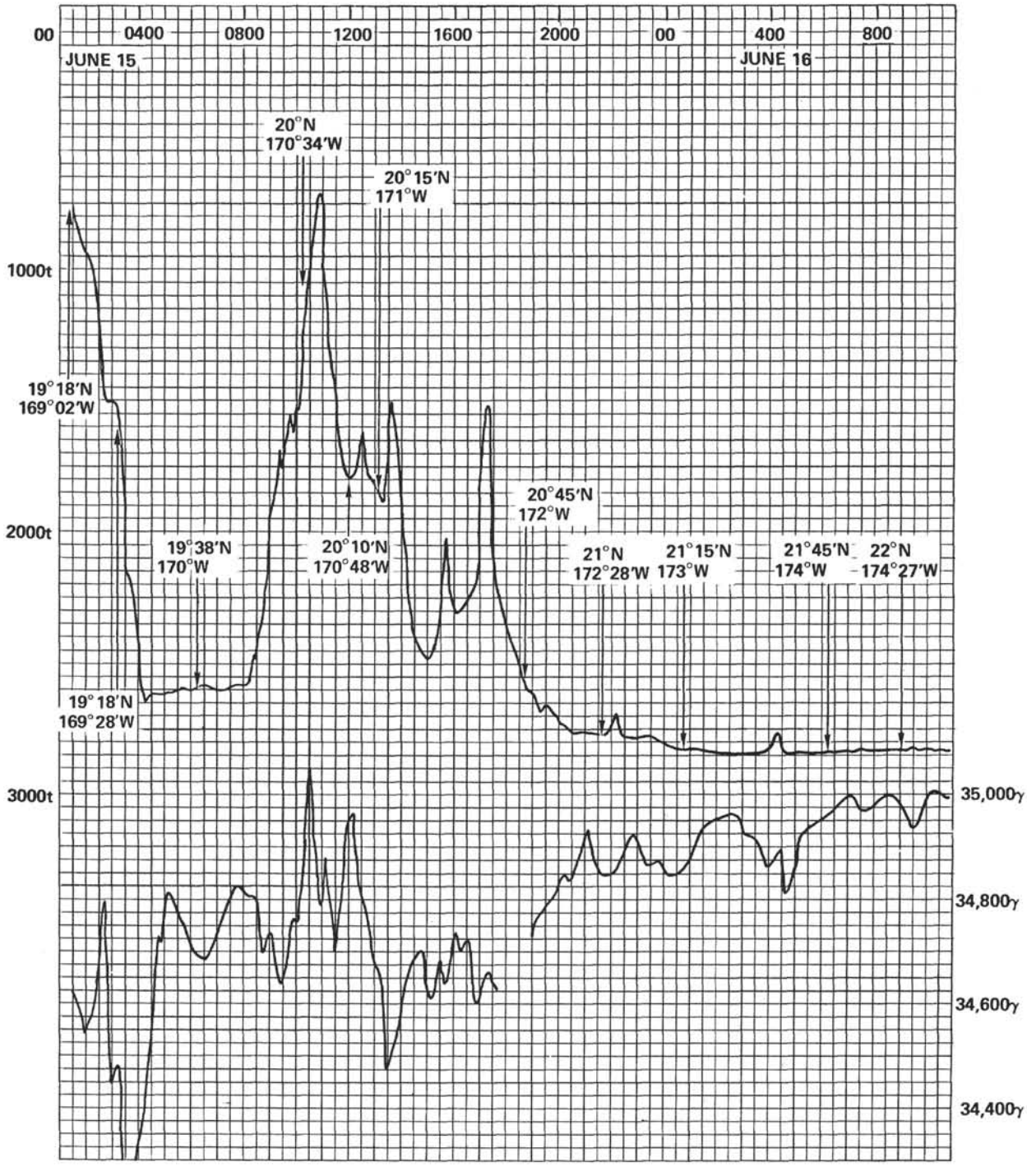
The Caroline Ridge, judging from the geology of the islands and the results of these three holes, is Mid-Tertiary in age. Judging from the configuration of the sediments covering the steps the faulting occurred soon after the Ridge was formed and before sediments of a measurable thickness were deposited.

REFERENCES

Ewing, J., Ewing, M., Aitken, T. and Ludwig, W.J., 1968. North Pacific sediment layers measured by seismic profiling. *Geophys. Mono. No. 12, Am. Geophys. Union.* **147**

Karig, D. E. (in press), Structural history of the Mariana Island Arc System. *Bull. Geol. Soc. Am.*

This page and succeeding pages present the bathymetric profiles recorded along the track of the Glomar Challenger from Hawaii to Guam. Positions fixed by satellite navigation are indicated along the bathymetric profile.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171°W
1000t
19°18'N
169°02'W
20°45'N
172°W
2000t
19°38'N
170°W
20°10'N
170°48'W
21°N
172°28'W
21°15'N
173°W
21°45'N
174°W
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169°28'W
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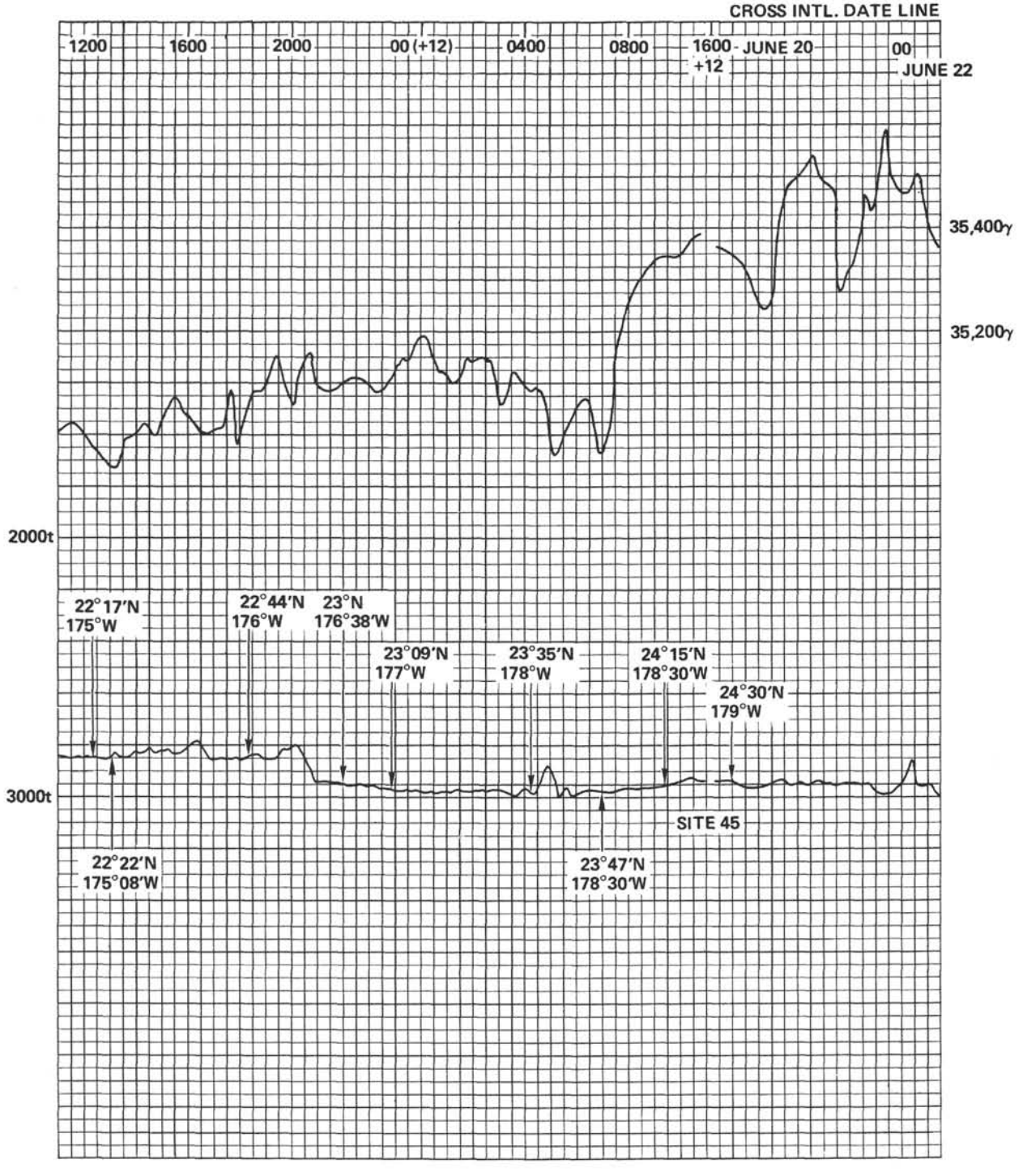
34,800γ
34,600γ
34,400γ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00
JUNE 22
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35,200γ
2000t
3000t
22°17′N 175°W
22°44′N 176°W
23°N 176°38′W
23°09′N 177°W
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24°30′N 179°W
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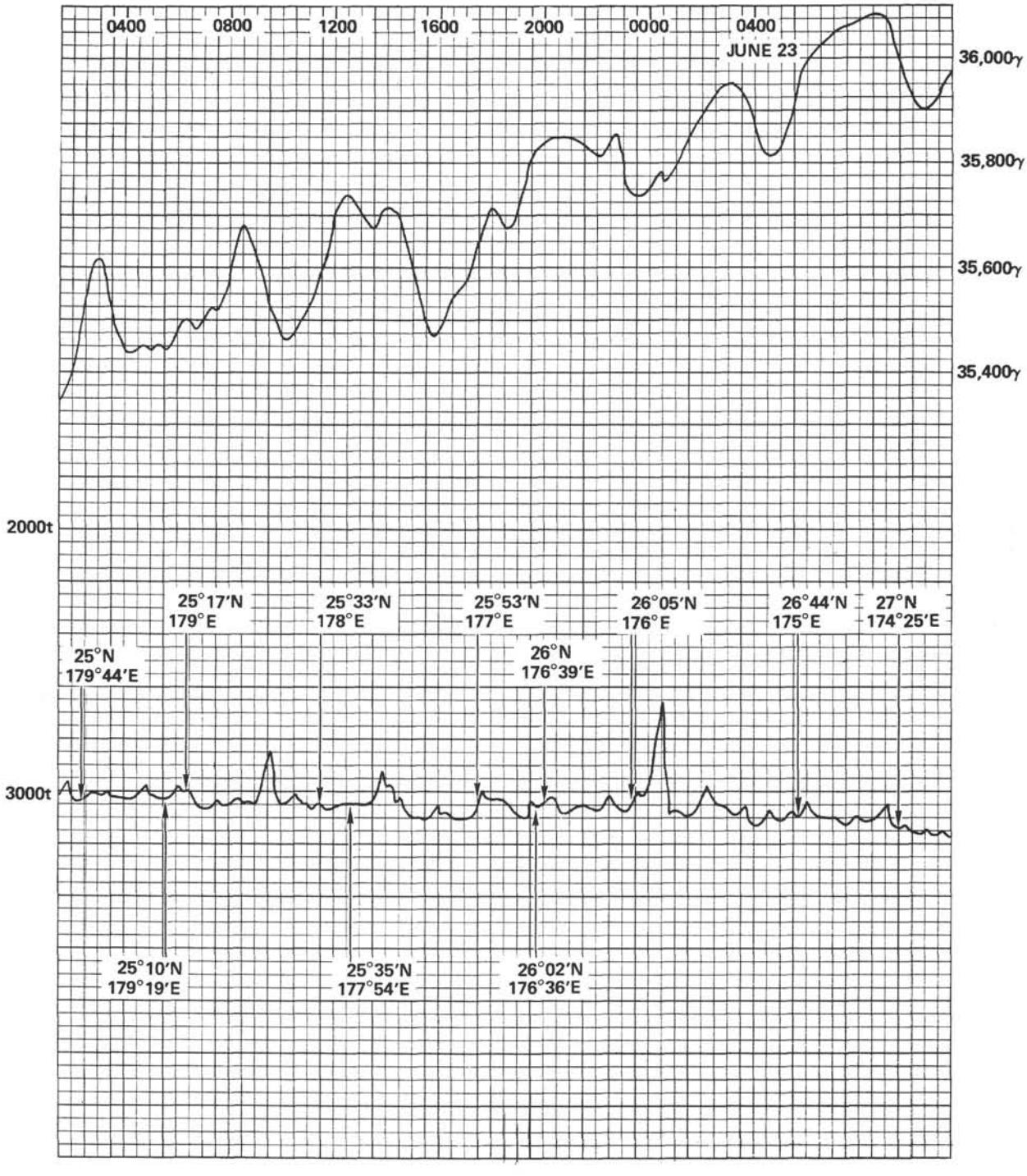
23°47′N 178°30′W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179°E
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25°53′N
177°E
26°05′N
176°E
26°44′N
175°E
27°N
174°25′E
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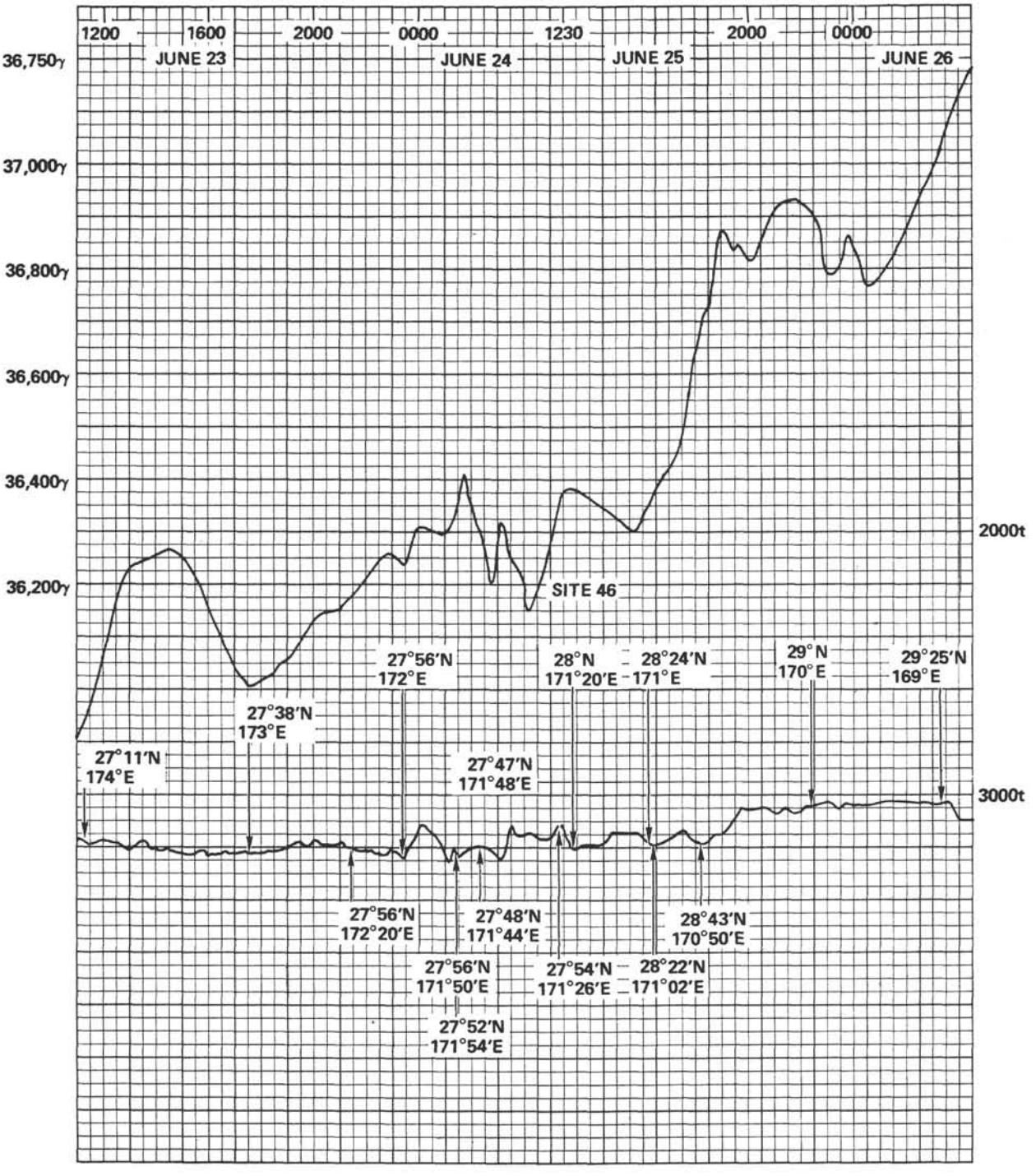
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36,600γ
36,400γ
36,200γ
2000t
3000t
SITE 46
27°11′N
174°E
27°38′N
173°E
27°56′N
172°E
27°47′N
171°48′E
28°N
171°20′E
28°24′N
171°E
29°N
170°E
29°25′N
169°E
27°56′N
172°20′E
27°48′N
171°44′E
28°43′N
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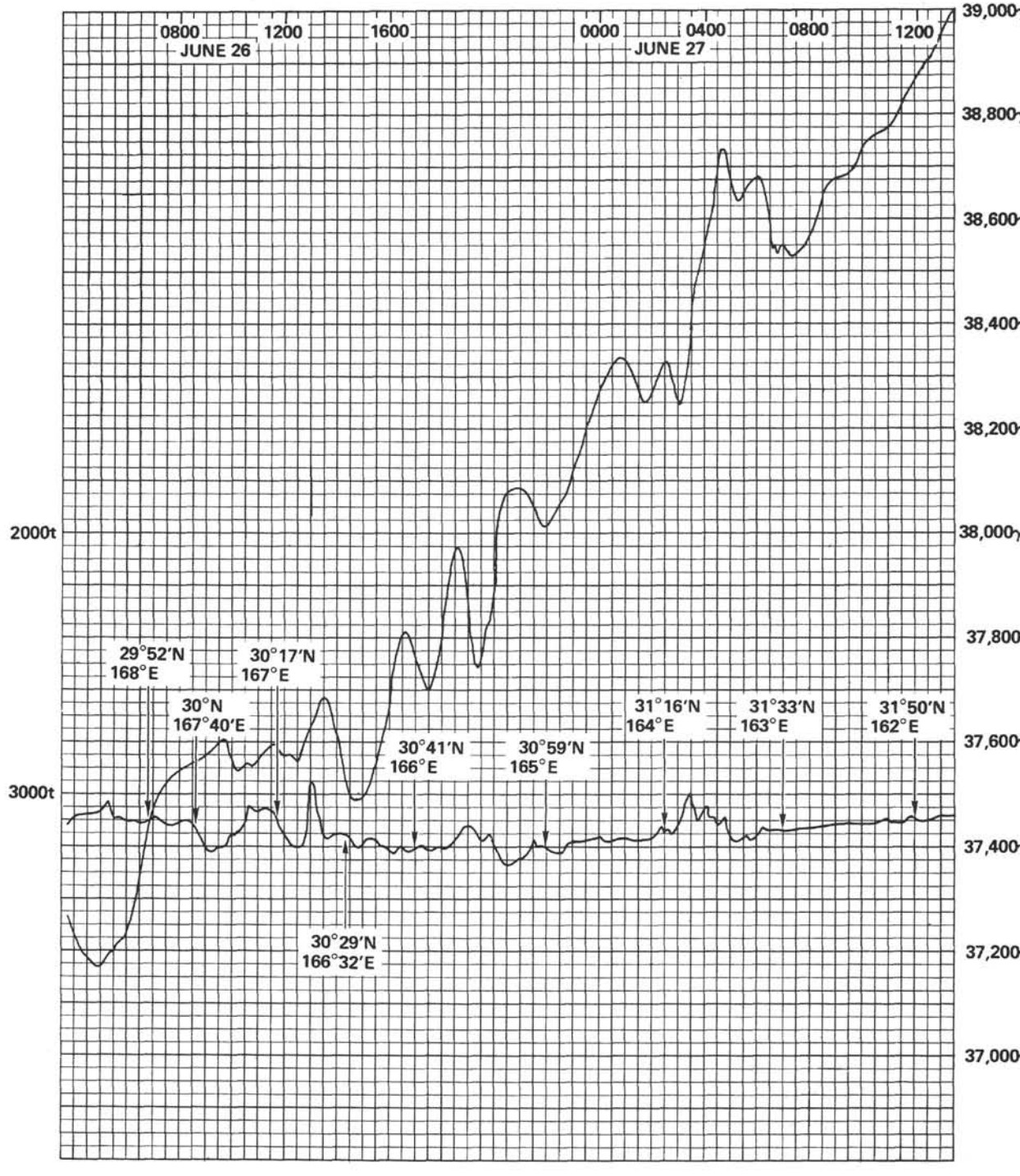
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38,600γ
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37,800γ
37,600γ
37,400γ
37,200γ
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2000t
3000t
29°52′N
168°E
30°17′N
167°E
30°N
167°40′E
30°41′N
166°E
30°59′N
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31°50′N
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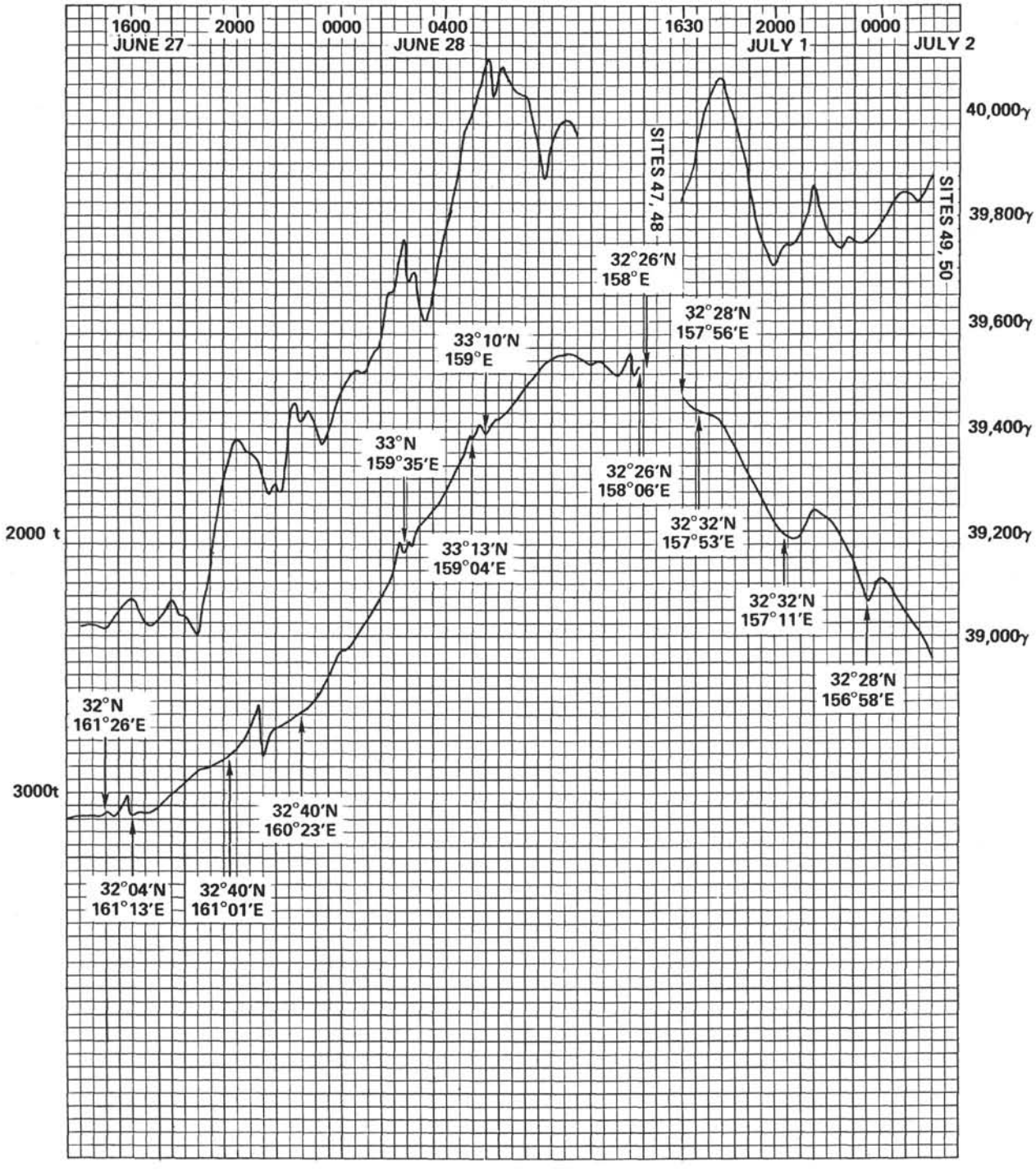
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39,600γ
39,400γ
39,200γ
39,000γ
SITES 47, 48
SITES 49, 50
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3000t
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32°04'N
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32°40'N
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32°28'N
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JULY 6
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41,000γ
40,800γ
40,600γ
40,400γ
40,200γ
40,000γ
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SITE 51
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32°38′N
156°E
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151°58′E
32°49′N
155°24′E
33°28′N
153°25′E


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1200
1600
JULY 7
JULY 8
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39,800γ
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30°N
150°02′E
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150°E
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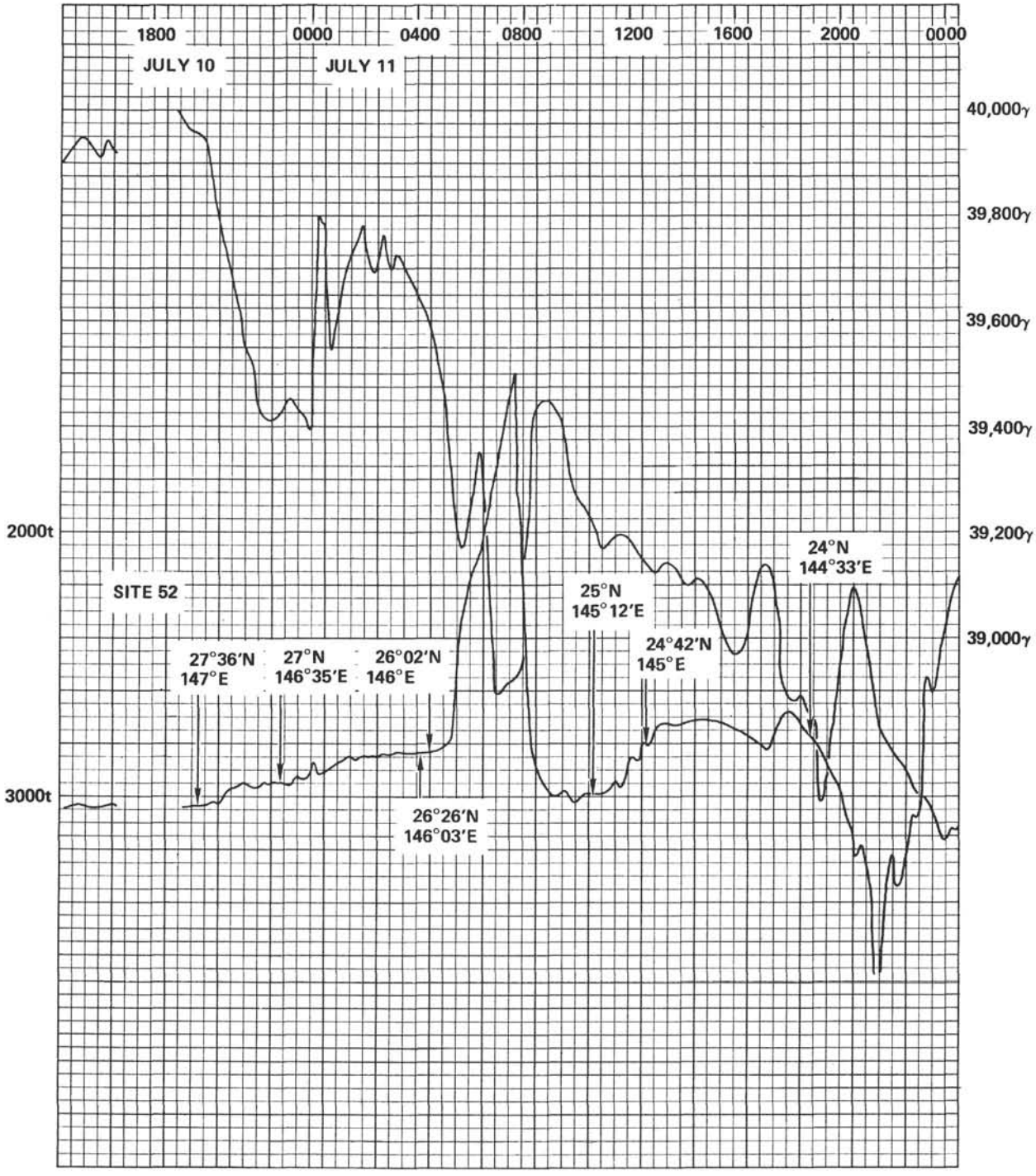
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39,000γ
2000t
3000t
SITE 52
27°36′N
147°E
27°N
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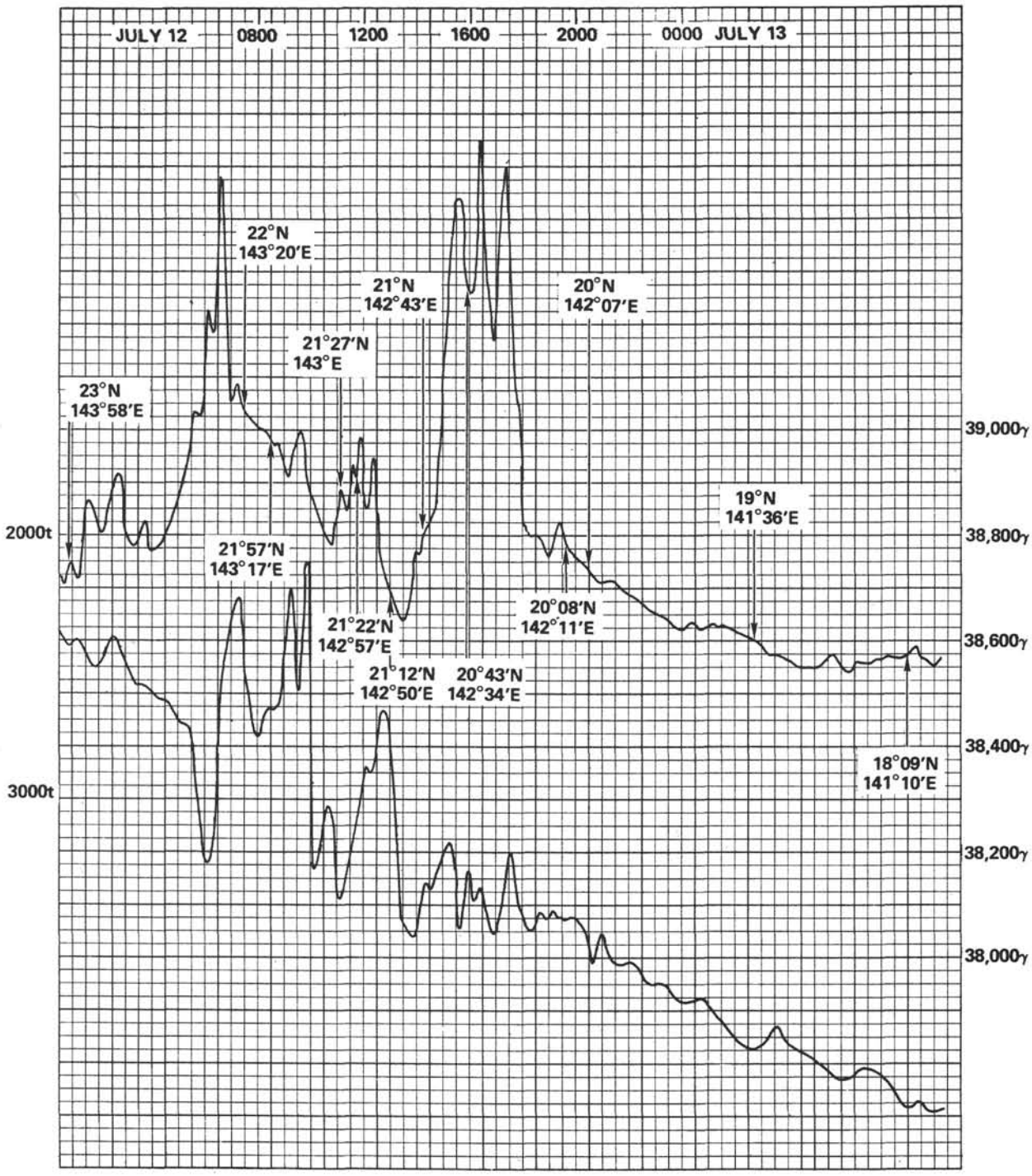
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21°27′N
143°E
23°N
143°58′E
39,000γ
19°N
141°36′E
2000t
38,800γ
21°57′N
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142°11′E
21°22′N
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38,600γ
21°12′N
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141°E
17°N
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16°N
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SITE 54
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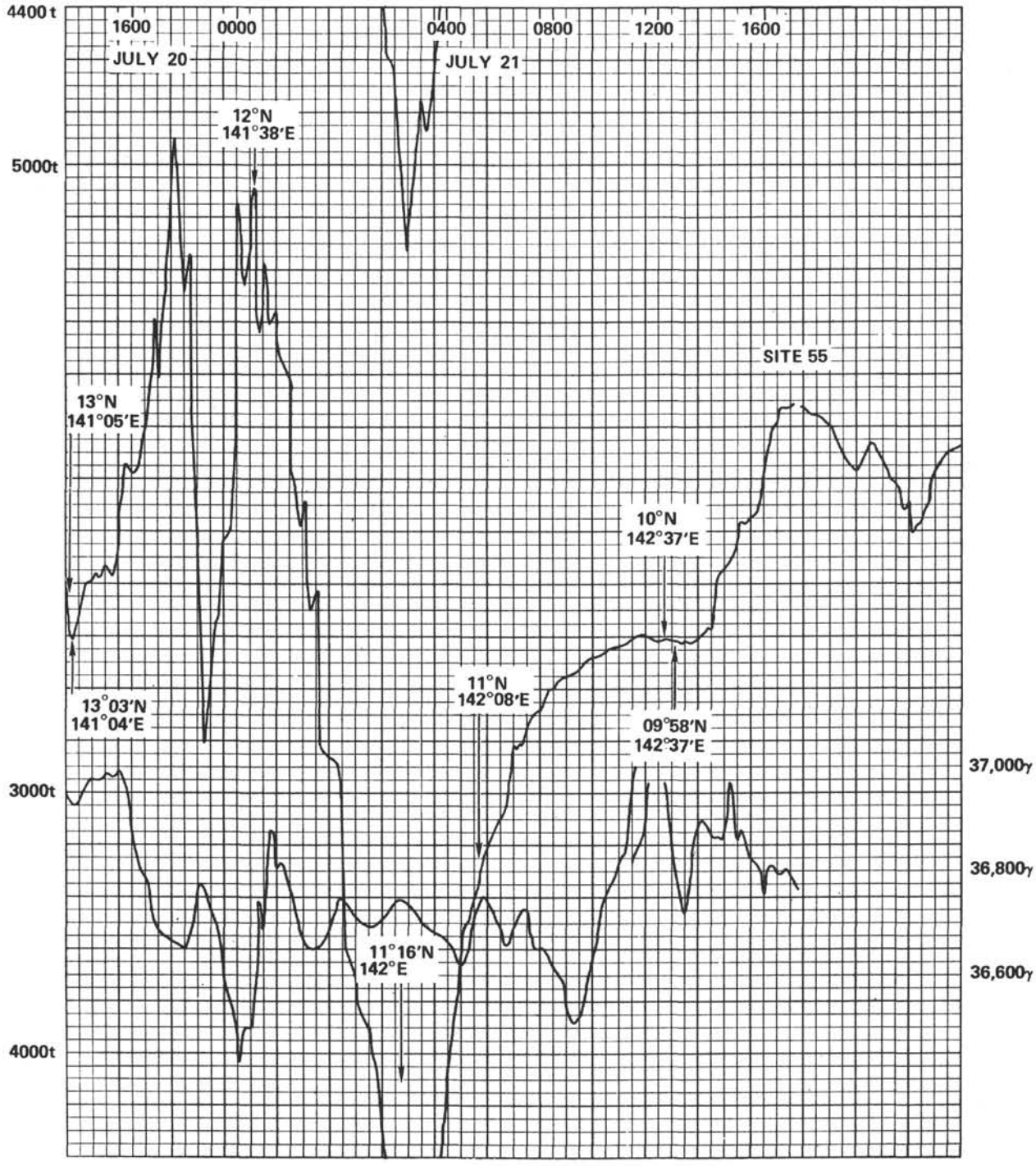
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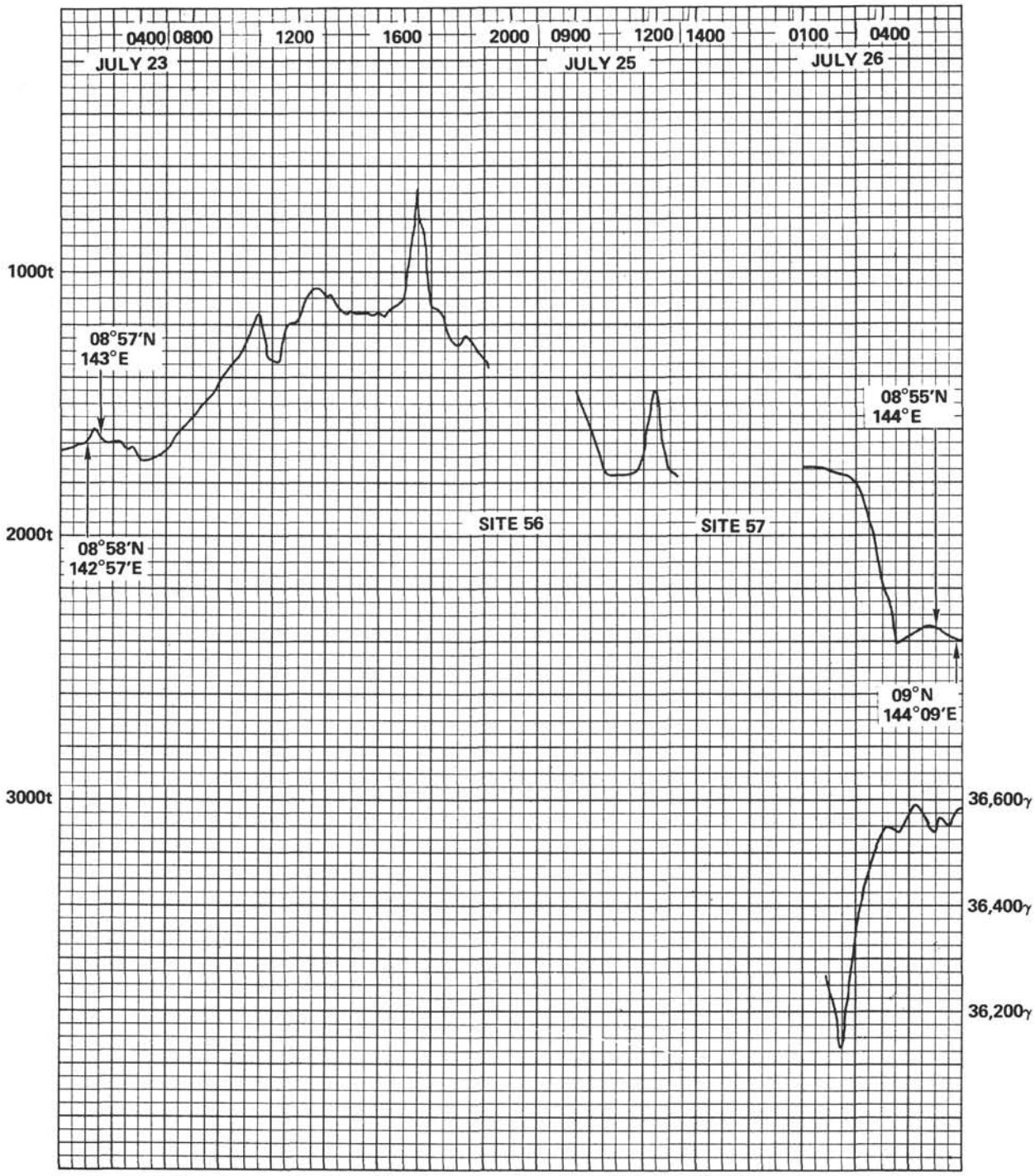
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08°57′N
143°E
08°58′N
142°57′E
SITE 56
SITE 57
08°55′N
144°E
09°N
144°09′E
36,600γ
36,400γ
36,200γ


0800
1130
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JULY 28
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JULY 30
JULY 31
AUG 2
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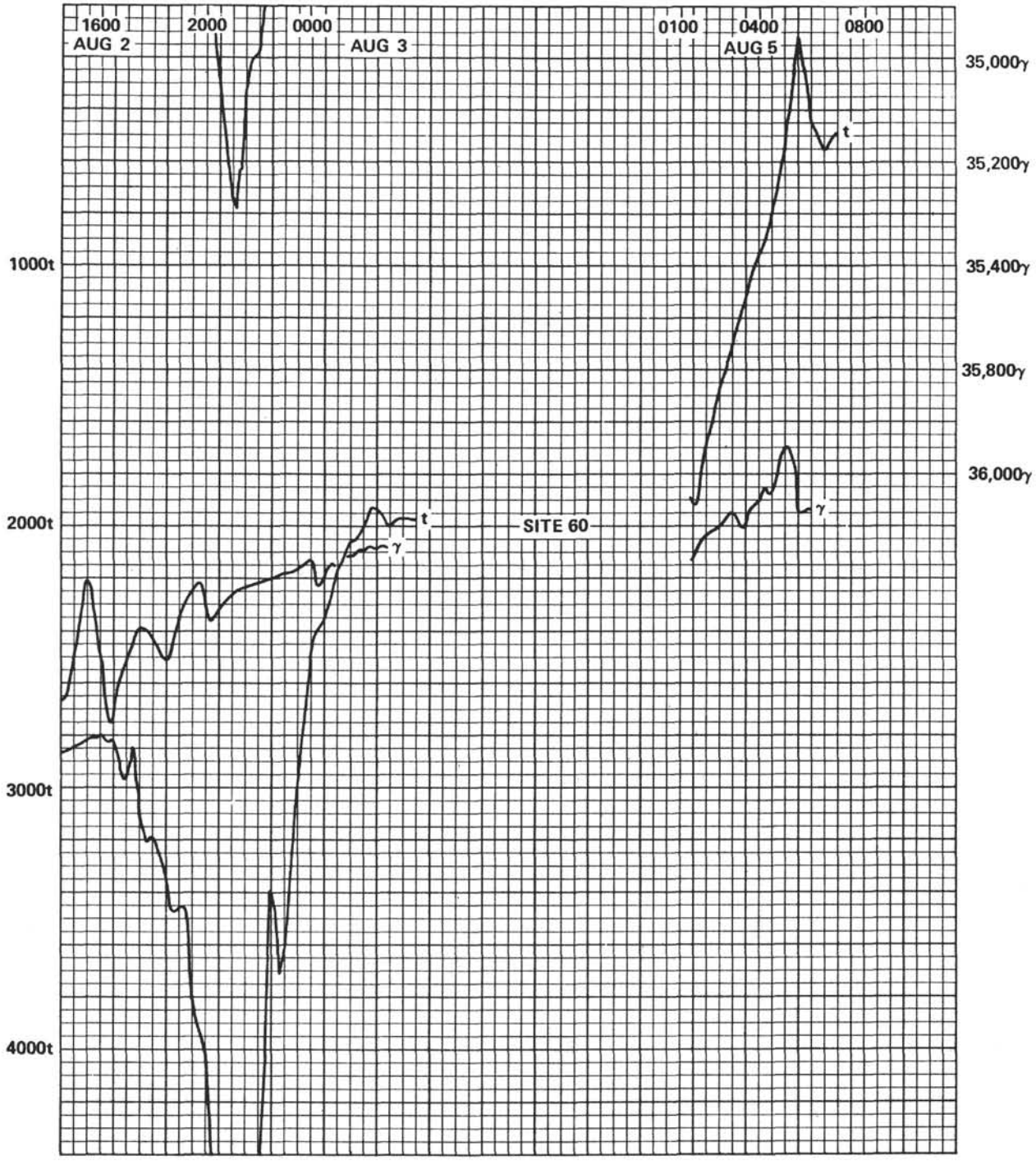
SITE 59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