Cruise Report

R/V OCEANUS Cruise 299 to Georges Bank

U. S. GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

2 - 12 March 1997

Acknowledgments

We thank Captain Everett McMunn and the crew of the R/V Oceanus for their expert help, positive attitude and good humor through two weeks of rough conditions. Jim Bisagni and Mike Caruso provided satellite images which played a key role in guiding our sampling strategy. Brian Connolly and Harvey Seim helped us configure the broadband ADCP, and Dick Limeburner provided us with the critical, last minute fix which allowed us to find the drifting Northeast Peak mooring.

This report was prepared by Craig Lee and Frank Bahr. The work described herein was sponsored by the National Science Foundation as part of the U.S. GLOBEC Georges Bank Study.

1. Purpose

Project Summary: Retention Processes- Highly Resolved Hydrography

Georges Bank is a broad, shallow section of continental shelf that supports a productive, though heavily stressed, fishery. Several important fish species have extensive hatching areas on the bank, where their larvae enjoy an increased chance of success. Processes which remove larvae from the bank to the deeper surrounding waters decrease their chances of survival, and thus play a strong role in determining the success of the fishery. Two cruises, the first undertaken in unstratified wintertime conditions and the second in a stratified, summertime regime will examine the physics and biology of several processes which may remove water, nutrients and larvae from the southern flank of Georges Bank. Of specific interest are the effects of Gulf Stream rings, strong wind events and instabilities in the flow along the edge of the bank. A towed, undulating instrument package, known as the SeaSoar, will make three-dimensional surveys of physical and biological variability along the southern flank of Georges Bank, while shipboard instrumentation provides simultaneous measurements of currents and meteorological variables. Typical along-track horizontal resolution will be finer than 2 km, with a depth range from the surface to 10 m off the bottom (or to a maximum depth of approximately 150 m, whichever is shallower). As the processes of interest are episodic, remote sensing will be used to devise sampling strategies suitable to the variability present at the time of each cruise.

The March SeaSoar Cruise

The primary goal of this cruise was to make observations of processes which may remove shelf water and associated biota from the southern flank of Georges Bank. We also planned to redeploy a mooring which had been part of Ron Schlitz's array examining recirculation in the southwest corner of the bank. Priority was given to obtaining observations of interactions between Gulf Stream rings and the shelf break front. Prior to sailing, satellite imagery revealed a warm core ring sitting southeast of the bank, but through the course of the cruise, it remained too far south to participate in removing water from the shelf. The imagery also revealed an intrusion of cold water originating on the Scotian Shelf, crossing the Northeast Channel and extending southwestward along the southern flank of Georges Bank. In an effort to examine storm-induced cross-shelf transport, the region surrounding the intrusion and the shelf-break front was extensively sampled before and after the passage of a strong storm system. Following the pre- and post-storm surveys in the southeastern region of the bank, we detoured to recover Jim Irish's Northeast Peak mooring, which had broken loose during one of the storms. We then returned to the southwest corner of the bank and occupied a pair of survey lines paralleling the southern leg of Ron Schlitz's moored array.

2. Cruise Narrative: Oceanus Voyage 299

Local time is used throughout this narrative- GMT is five hours ahead.

2 March, 1997

R/V Oceanus sailed from Woods Hole at 11:00 in moderate fog. As both weather and sea state were calm, we proceeded towards Ron Schlitz's moored array with the intent of redeploying the mooring while conditions remained favorable. Satellite imagery revealed a warm core ring to the southeast of the bank, but too far from the shelf to be of interest. A prominent intrusion of Scotian Shelf Water also extended along the southern flank of the bank, near the 100 m isobath. We chose to begin SeaSoar operations by surveying the intrusion while monitoring the progress of the ring in hopes that it would propagate northward.

3 March, 1997

We arrived at 40° 52.02' N, 68° 30.61' W (mooring site 4) at 04:00. The mooring was successfully deployed in 53 m of water at 40° 52.04' N, 68° 30.63' W at 06:24. Following the deployment, we followed the mooring line offbank until we reached 80 m of water, where we deployed SeaSoar. We planned to tow outward along the mooring line and then proceed eastward following the 200 m isobath until we reached the Scotian Shelf Water intrusion. Our intent was to use the along-bank survey to identify interesting features extending in the cross-shelf direction. Shortly after deployment at 08:24, 40° 37.60' N, 68° 18.09' W, CTD failures indicated a short in the system. We recovered SeaSoar and traced the problem to a leak originating at a junction box cover screw. Repairs were completed and SeaSoar redeployed at 12:45. We then began an eastward transect along the southern edge of the bank between the 200 m and 300 m isobaths, looking for intrusions or other cross-bank features while enroute to the eastern survey site. At 21:15, 40° 41.91' N, 66° 49.62' W, SeaSoar ran down a high-flyer, shorting the CTD and precipitating a recovery. Closer inspection failed to reveal any apparent damage, and the vehicle was immediately redeployed. The South Flank survey line was displaced southward into deeper water to reduce the chances of more nighttime collisions with lobster gear.

4 March, 1997

We arrived at the start of the eastern (intrusion) survey site a few hours before first light. Although we had originally intended to begin the survey by running towards the bank, concerns over visibility and further collisions with lobster gear motivated us to initially tow southeast into deeper water. The intrusion had a vertical extent of about 50 m and was marked by temperatures colder than 2° C and salinities fresher than 31.5 psu. It extended a few kilometers inshore of the shelfbreak front, near the 100 m isobath, and had a width of approximately 50 km. To map the cross-shelf extent of the intrusion, we ran off bank well past its southeastern edge. We then began a second line running northwest to approximately the 80 m isobath, separated by 10 km from the initial track. Building seas forced us to recover the SeaSoar at 12:30, shortly after beginning the second line. We remained hove to until 20:20 waiting for conditions to improve enough to resume work, at which time we redeployed SeaSoar and continued towing to the northwest.

5 March, 1997

A CTD failure at 04:00 forced us to recover SeaSoar near 41° 28.71' N, 66° 30.86' W, the northwestern end of a survey leg. The problem was traced to the failure of a plastic connector, possibly due to increased brittleness brought on by prolonged oil immersion within the junction box assembly. We replaced the connector and redeployed SeaSoar at 08:30, resuming the sampling of the eastern radiator survey.

6 March, 1997

Deteriorating weather and an approaching storm forced us to recover SeaSoar after completing the first pass of the eastern radiator survey. The vehicle was brought on board at 40° 57.71' N, 65° 53.87' W, 04:20, and we moved south to ride out the storm in deeper water. Considerable effort was spent securing equipment in anticipation of the upcoming storm. As we steamed south, SST increased to over 15° C and the ADCP revealed strong (over 1m/s) eastward currents. This was the northern edge of the warm-core ring observed earlier in satellite images. We remained hove to in 30-

50 knot winds for the entire day. Winds increased and waves reached 6+ meters as the evening progressed.

7 March, 1997

We spent the day hove to in deep water southeast of the eastern survey site under heavy weather. Winds subsided to 20 knots and wave height decreased through the day, but it remained too rough to SeaSoar. A fax arrived from Bill Williams relaying his suspicion that Jim Irish's Northeast Peak mooring had come adrift during the storm.

8 March, 1997

Conditions calmed enough to deploy SeaSoar at around 06:00. We redeployed SeaSoar at the southwestern corner of the east survey site, but experienced electrical problems shortly after we began the initial transect. After recovering SeaSoar, we returned to the start of the survey pattern. The problem was traced to seawater penetration through a weakened, potted termination on the interior side of a high voltage junction box connector. We redeployed SeaSoar at 10:00 and began a second survey of the eastern site to observe how the Scotian Shelf water intrusion and the shelf break front had evolved in response to the storm. We found that the intrusion had shifted slightly offshore of the shelfbreak front and that intrusion waters had warmed and become more saline, presumably due to vigorous mechanical mixing with underlying slope waters during the storm.

9 March, 1997

By 01:30, conditions had deteriorated severely, forcing us to recover SeaSoar under extremely rough conditions after completing only half of the second survey. Bill Williams confirmed that the Northeast Peak mooring was adrift and near the eastern survey site, though weather conditions prevented us from attempting a recovery. We remained hove to until 16:15, when rapidly settling seas allowed us to redeploy SeaSoar and complete the second half of the eastern survey. Forecasts indicated that we would have only a brief window of favorable weather before another storm materialized, so we planned to quickly complete the survey, search for the mooring and then make the transit to the southwestern mooring site during the period when conditions were too rough to SeaSoar. Conditions during this brief interlude were the best we experienced through the entire cruise.

10 March, 1997

We recovered SeaSoar at 03:00 and began our search for the drifting mooring based on a 24-hour old ARGOS fix. After five hours of unsuccessful hunting, Dick Limeburner provided a more recent fix, which allowed us to quickly locate the buoy at 40° 44.01' N, 66° 15.39' W. The crew of the Oceanus executed a quick, flawless recovery and we were steaming for the southwestern mooring site by 11:30. Shortly after leaving the recovery site, winds picked up and seas roughened, slowing our westward progress.

11 March, 1997

Seas settled enough to deploy SeaSoar at 05:30, allowing us to run a pair of transects bracketing the north-south component of Ron Schlitz's moored array. A waypoint which was incorrectly entered into the navigation computer created an eastward jog in the first survey line. Weather forecasts predicted yet another storm to arrive late in the afternoon. We recovered SeaSoar at 14:55 and secured the vehicle on deck, ending GLOBEC SeaSoar operations for the March cruise.

12 March, 1997

R/V Oceanus returned to Woods Hole at 13:00.

3. List of Participants

Name	Institution	Project
Craig Lee	WHOI	SeaSoar, Chief Scientist
Frank Bahr	WHOI	SeaSoar
Mark Berman	NMFS, Narragansett	SeaSoar/TAPS
Onno Bokhove	WHOI	SeaSoar
Jerome Dean	WHOI	SeaSoar
Paul Fucile	WHOI	SeaSoar
Allan Gordon	WHOI	SeaSoar
Craig Marquette	WHOI	SeaSoar

4. Data and Preliminary Results

SeaSoar is a towed, undulating instrument package which we use in conjunction with shipboard sensors to make quasi-synoptic, three-dimensional surveys of the upper ocean. Typical tow speeds of 8 knots with a vertical range of 130 m yield along-track horizontal resolutions finer than 2 km. Anticipating considerable small-scale variability, we kept cross-track separations smaller than 10 km. We designed survey patterns to resolve the semidiurnal tide, but severe weather prevented us from performing the repeat occupations necessary to fulfill this goal. In waters shallower than 130 m, SeaSoar typically flew within 7 m of the bottom. Sensor payload included redundant temperature and conductivity sensors, PAR, chlorophyll fluorometer, transmissometer, Video Plankton Recorder (VPR), Tracor Acoustic Plankton Recorder (TAPS) and an experimental bioluminescence sensor. Shipboard instrumentation included narrowband and broadband Acoustic Doppler Current Profilers (ADCP), a suite of meteorological sensors, P-code GPS and an Ashtech phase carrier GPS heading system.

The results presented here are preliminary- no corrections or calibrations have been applied. A Seabird 911+ CTD acquired SeaSoar sensor data at 24 Hz, which are converted to physical units using a precruise calibration and averaged into 1 second bins. Narrowband ADCP processing incorporates preliminary hull alignment and GPS heading corrections.

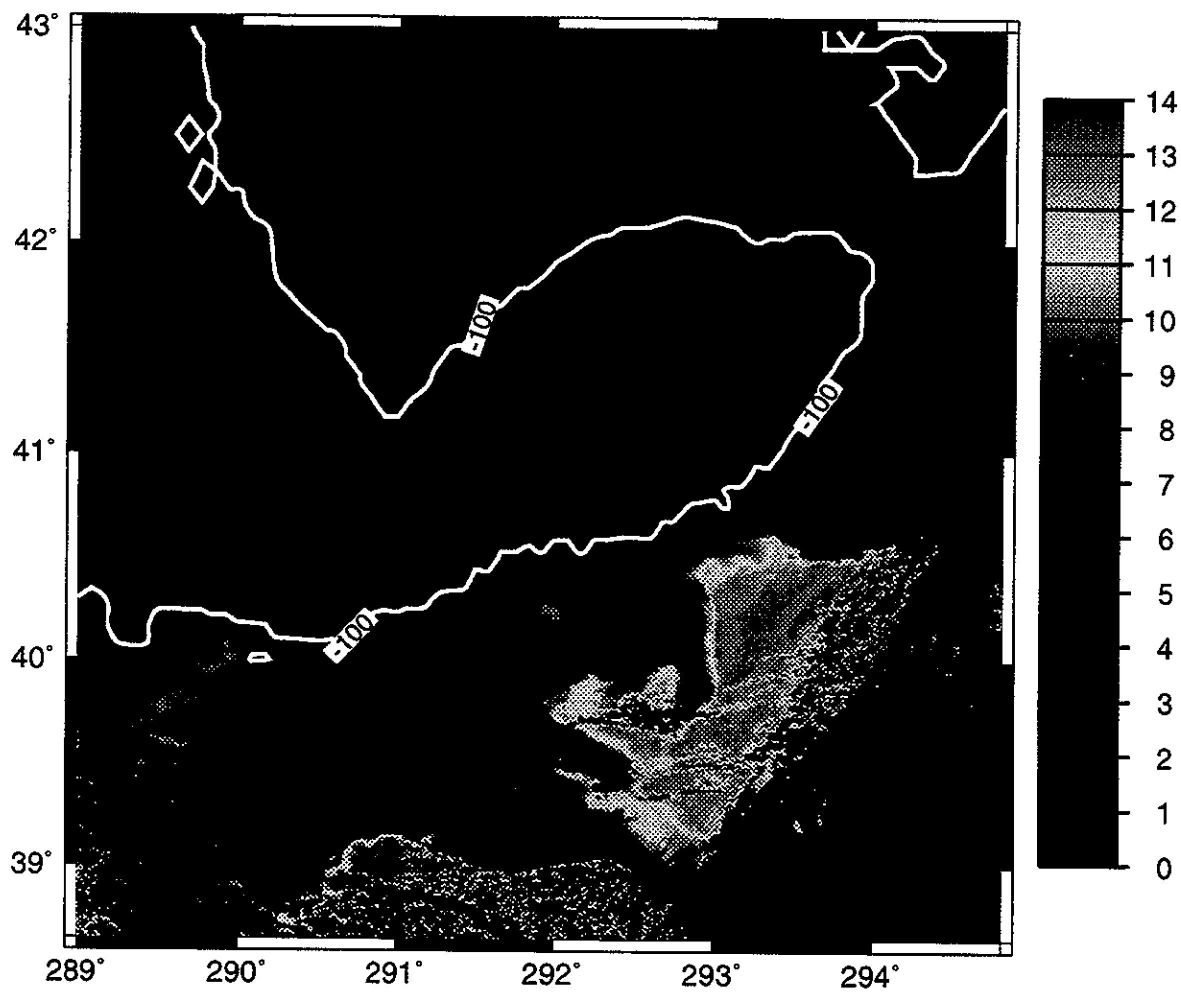
A remotely sensed sea surface temperature image from 3 March, 1997 shows the major features present during the survey period and illustrates their initial positions relative to the bank. Note the warm core ring sitting southeast of the bank, well downslope from the 100 m isobath. A tongue of cold Scotian Shelf water extends across the Northeast Channel southwestward along the southern edge of Georges Bank. The accompanying chart traces the SeaSoar survey track in heavy, black lines with the 60 m, 200 m and 2000 m isobaths plotted in the background. A circle-x marks the position of mooring 4 of Ron Schlitz's southeastern array, while a circle-+ marks the recovery position of Jim Irish's Northeast Peak mooring.

Preliminary sections of temperature, salinity and σ_θ show considerable small scale variability in both along- and cross-shelf directions. Accompanying plots show the SeaSoar flight path through each section and highlight the horizontal resolution provided by these observations. Heavy black lines on the small chart of Georges Bank (oriented perpendicularly to each section plot) indicate the portion of the survey track displayed. An exponential filter interpolated data to a regular grid for contouring. The gridding algorithm used scales chosen to reflect the horizontal and vertical resolution of the observations. Regions where the section depth shoals to less than 130 m indicate SeaSoar flight over shallow water, where profiles typically extended to within 7 m of the bottom.

Sections taken prior to the storm on 6-8 March show the foot of the shelf break front near the 100 m isobath, separating cold, fresh shelf waters from the warmer, saltier slope waters. The Scotian Shelf Water intrusion extends approximately 10 km inshore of the shelfbreak front, overlaying it with a 50 m deep layer of cold, fresh water. Inshore of the intrusion, bank waters are unstratified. A preliminary comparison with post-storm sections (8 and 9 March) suggest that intrusion waters have become warmer and more saline, presumably due to storm-induced mixing with the underlying shelf water. The on-bank edge of the intrusion appears to have shifted offshore of the shelfbreak front. Note that tidal excursions have not been removed from the data, and thus the relative positions of various features should be considered with caution.

Maps of ADCP currents, averaged over 15 minutes and between depths of 44 m and 55 m, show a clear semidiurnal tide, particularly in shallow water over the bank. M2 tidal currents reach speeds of above 1 m/s, and stand out as large velocity vectors turning clockwise as one progresses along the survey track.

6 March, 1997



43°
42°
41°
40°
39°
289°
290°
291°
292°
293°
294°
-100
-100
-100
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13
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4
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2
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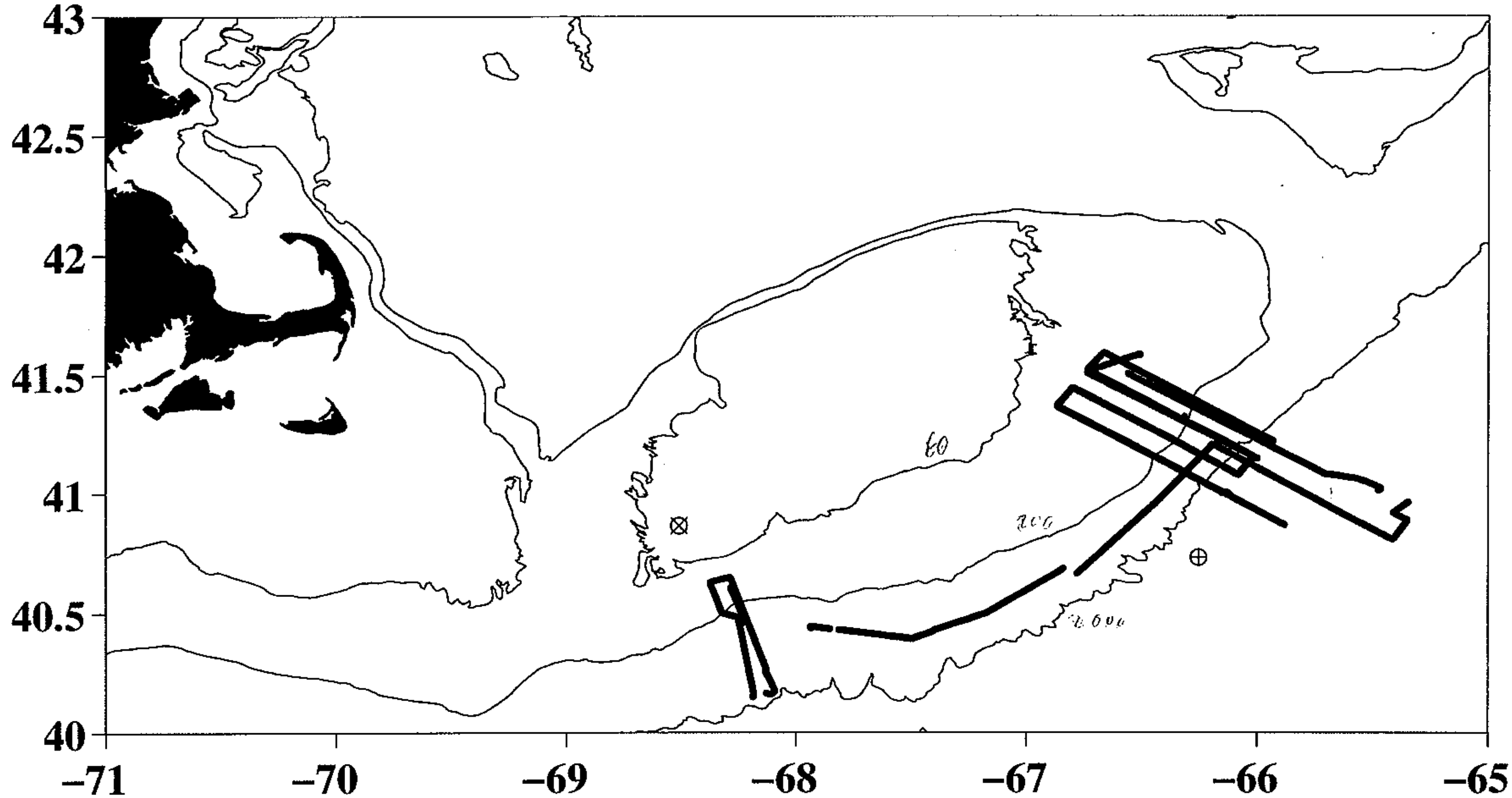

43
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41.5
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40.5
40
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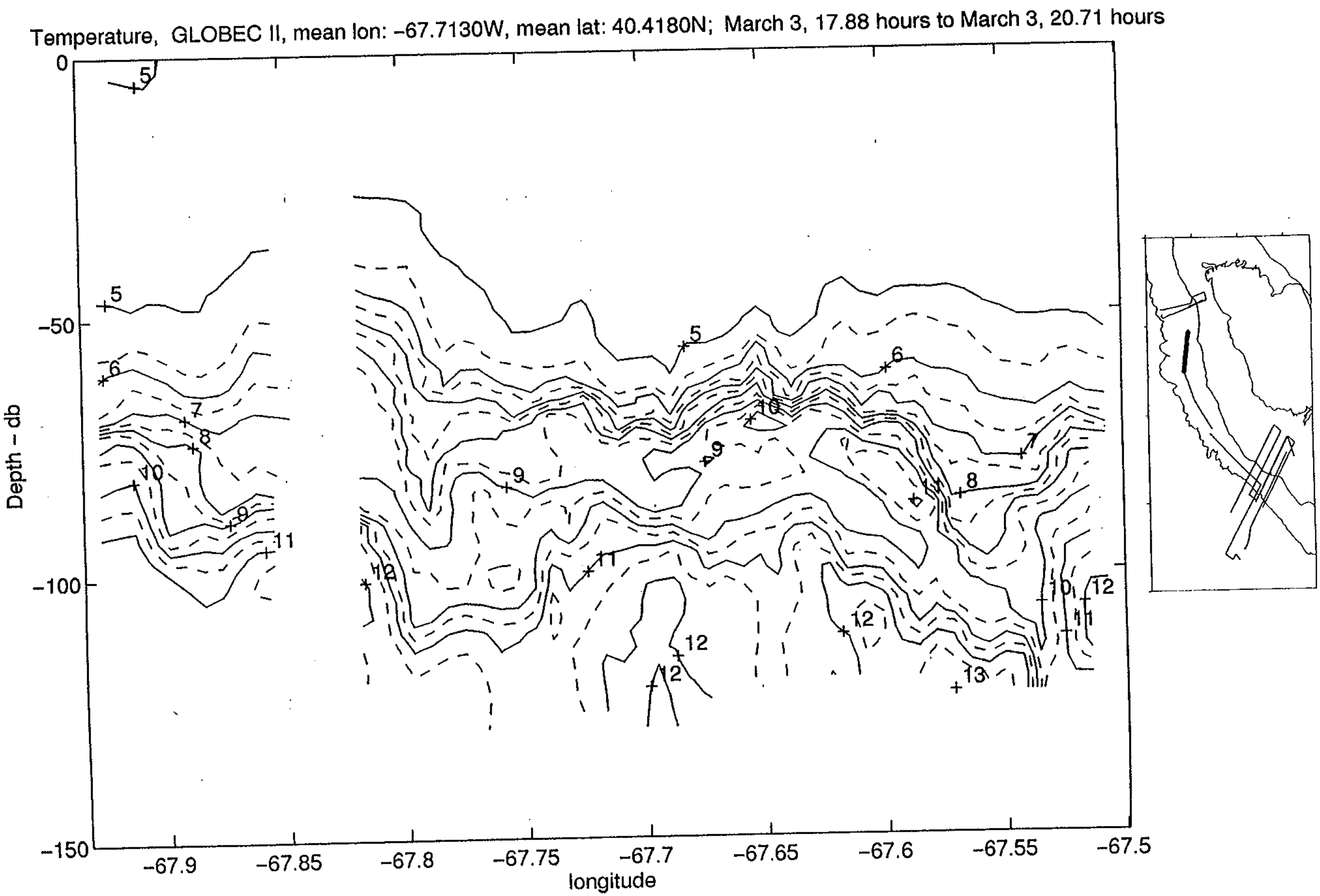
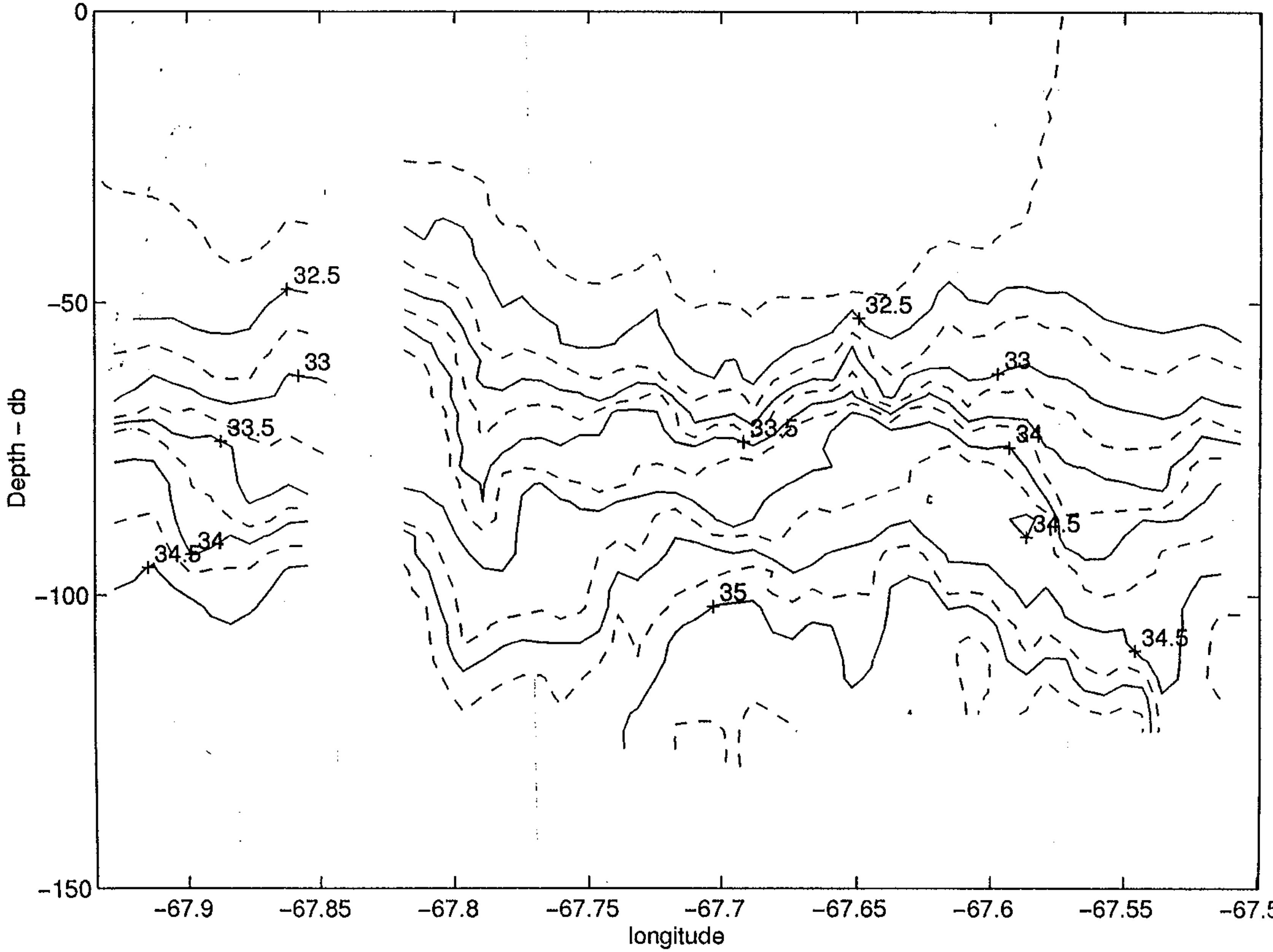
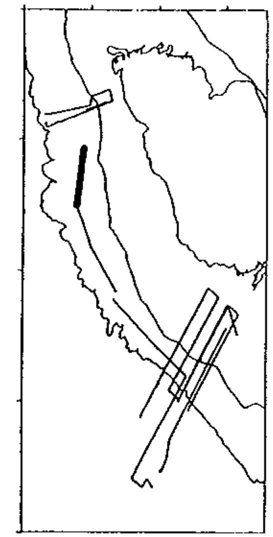
−70
−69
−68
−67
−66
−65



Temperature, GLOBEC II, mean lon: -67.7130W, mean lat: 40.4180N; March 3, 17.88 hours to March 3, 20.71 hours
Depth - db
0
-50
-100
-150
-67.9
-67.85
-67.8
-67.75
-67.7
-67.65
-67.6
-67.55
-67.5
longitude

Salinity, GLOBEC II, mean lon: −67.7130W, mean lat: 40.4180N; March 3, 17.88 hours to March 3, 20.71 hours





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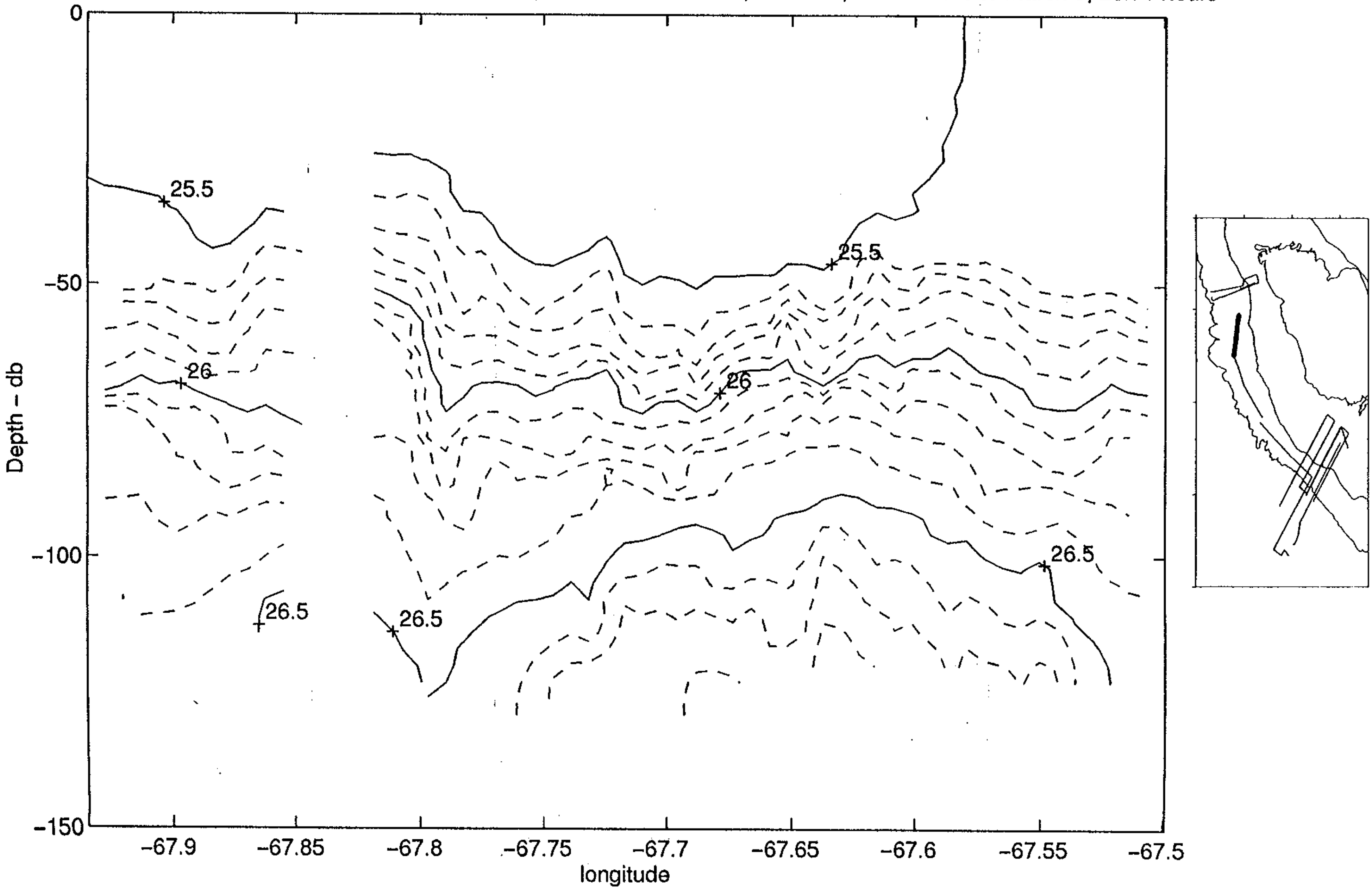
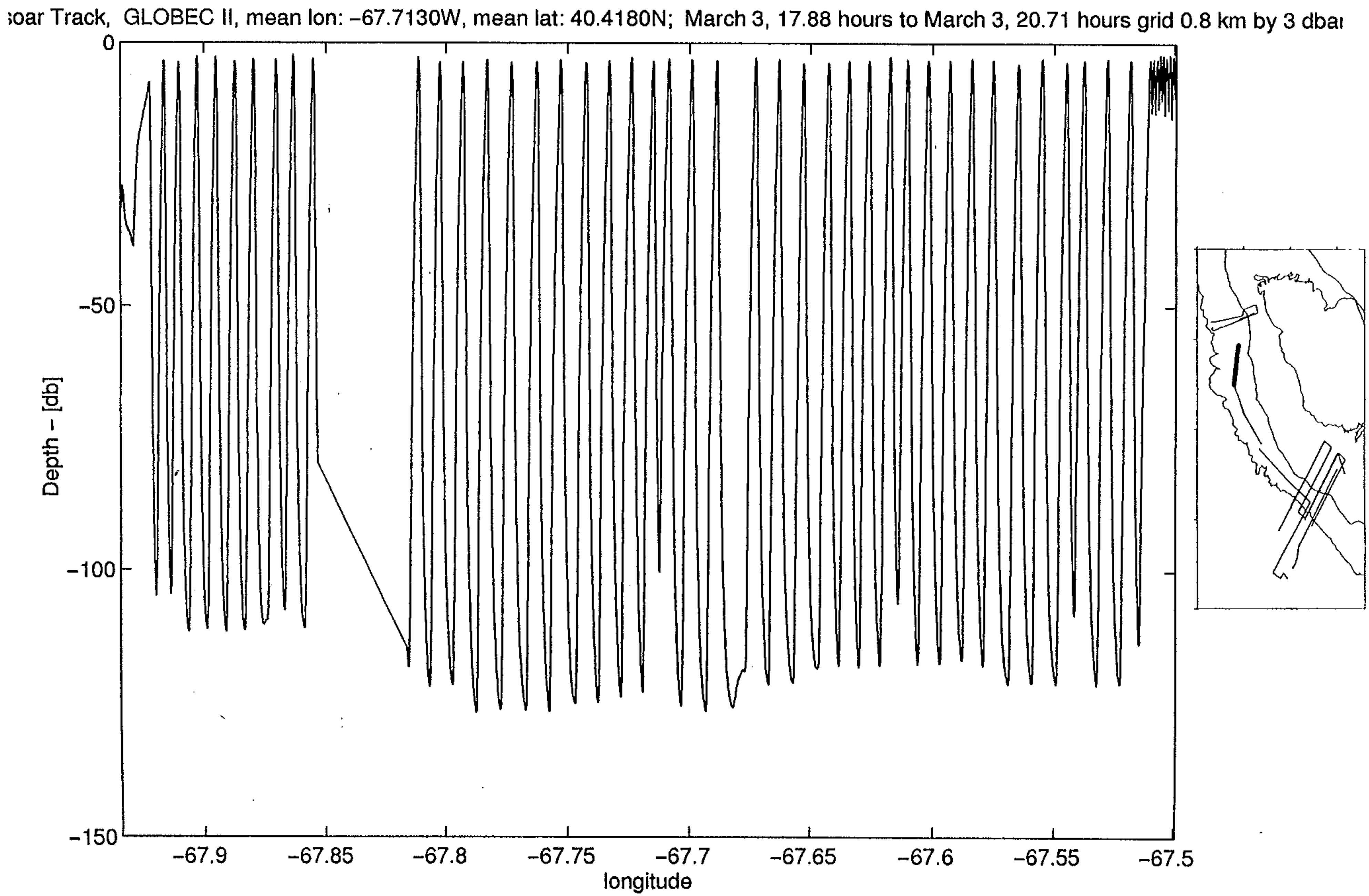
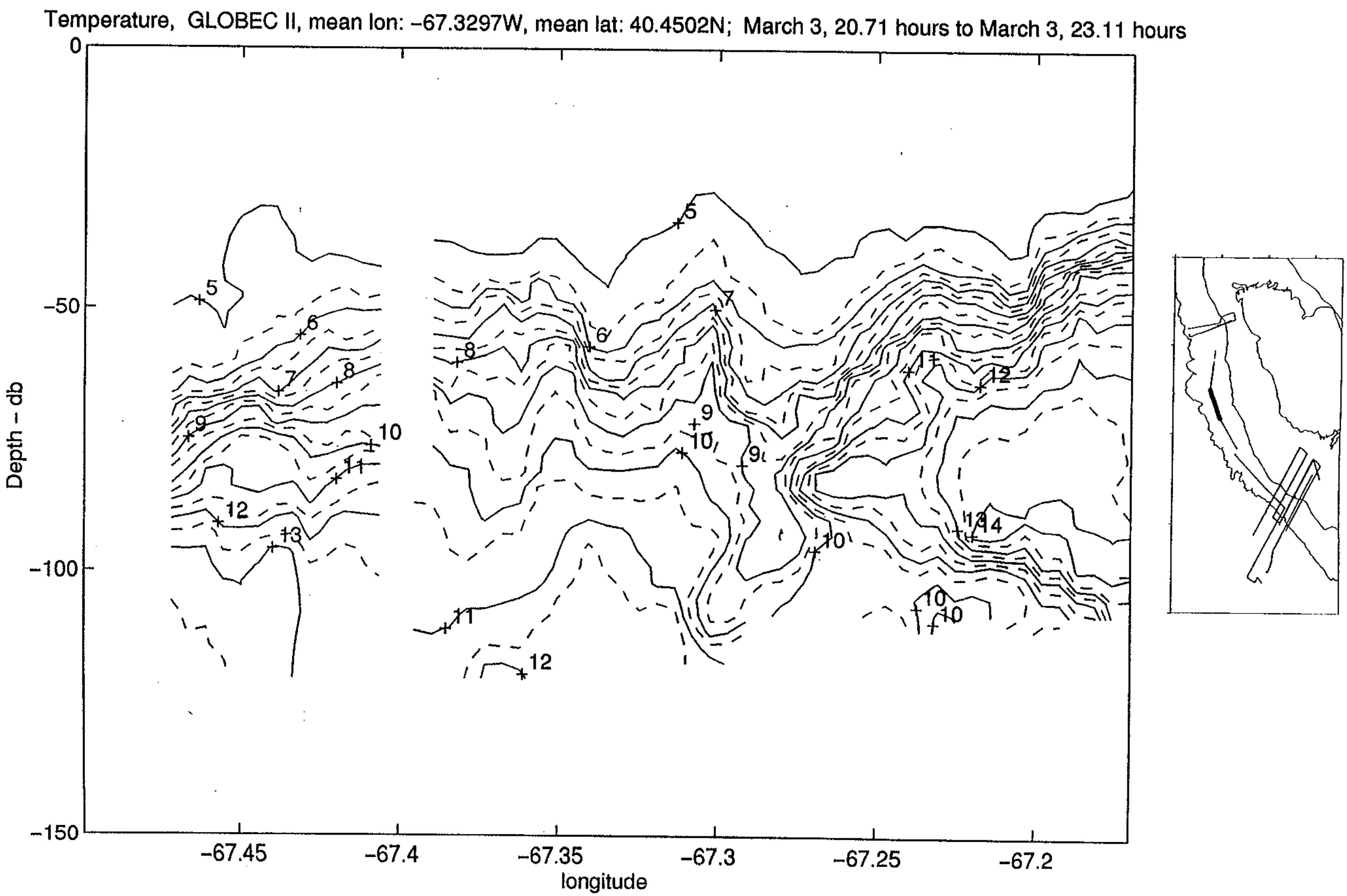




ɜoar Track, GLOBEC II, mean lon: −67.7130W, mean lat: 40.4180N; March 3, 17.88 hours to March 3, 20.71 hours grid 0.8 km by 3 dbar
Depth – [db]
0
−50
−100
−150
−67.9
−67.85
−67.8
−67.75
−67.7
−67.65
−67.6
−67.55
−67.5
longitude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Depth - db
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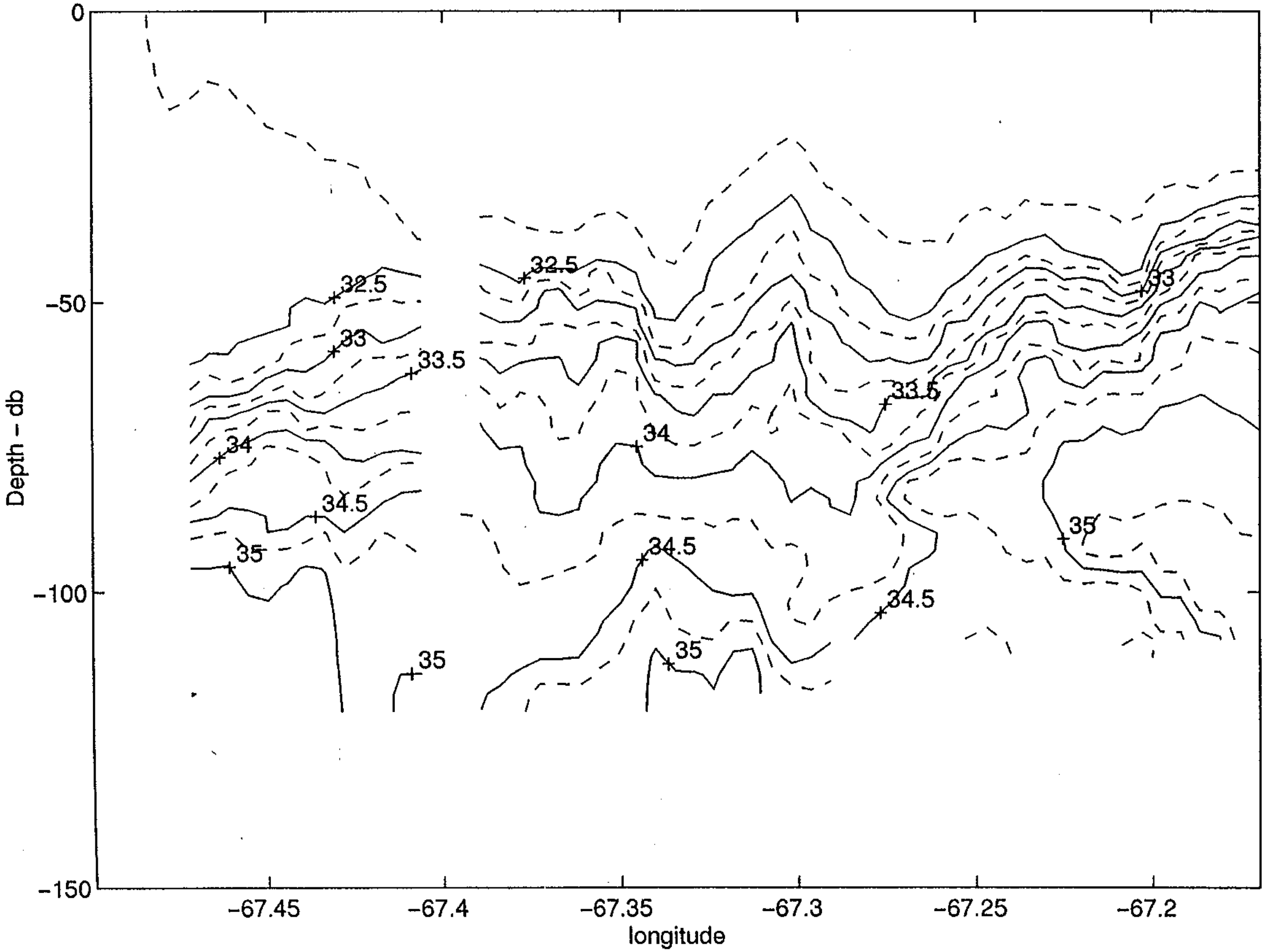
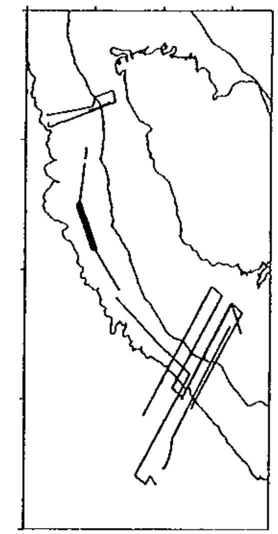
-50
-100
-150
-67.45
-67.4
-67.35
-67.3
-67.25
-67.2
longitude

Salinity, GLOBEC II, mean lon: −67.3297W, mean lat: 40.4502N; March 3, 20.71 hours to March 3, 23.11 hours





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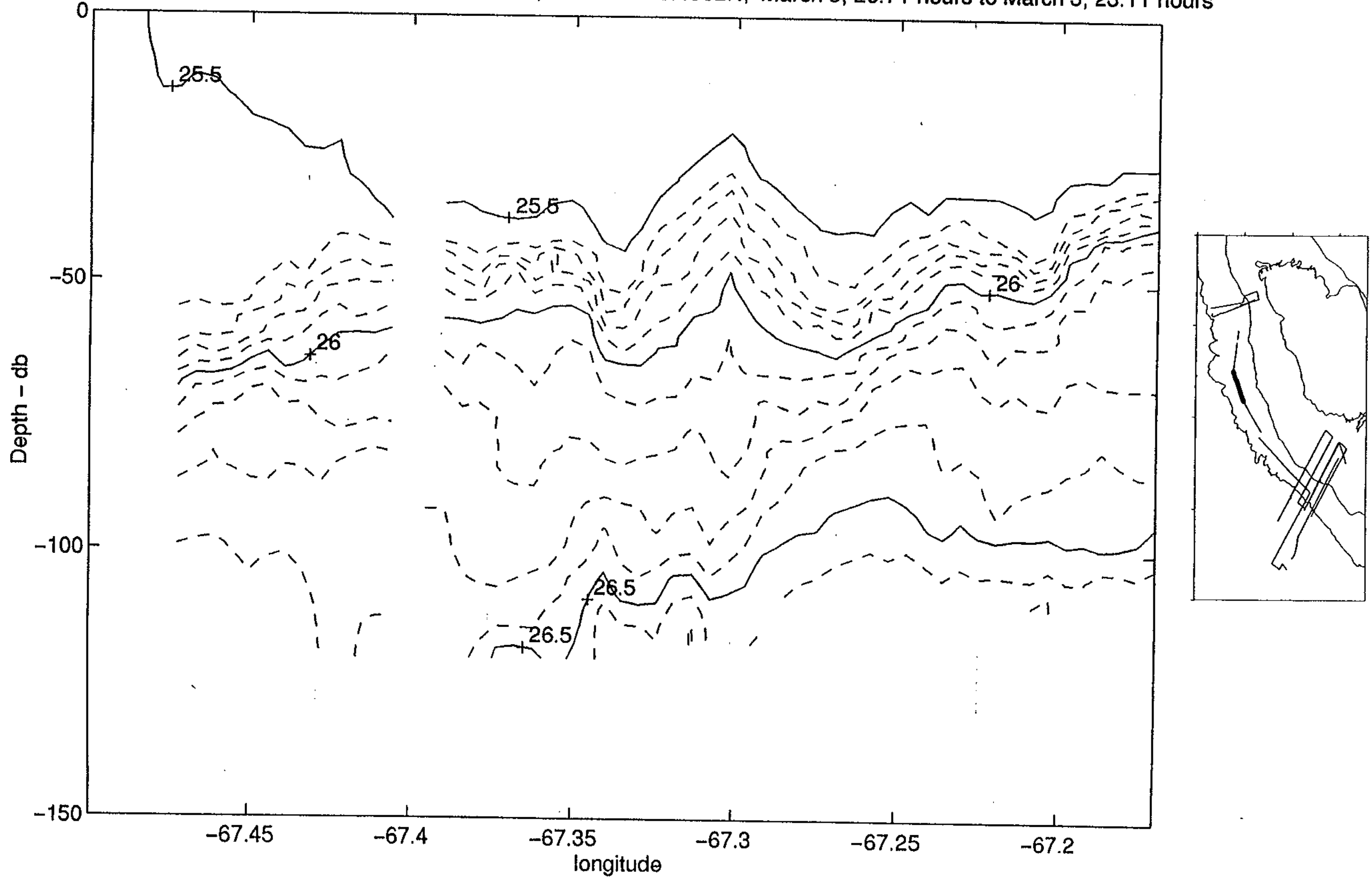

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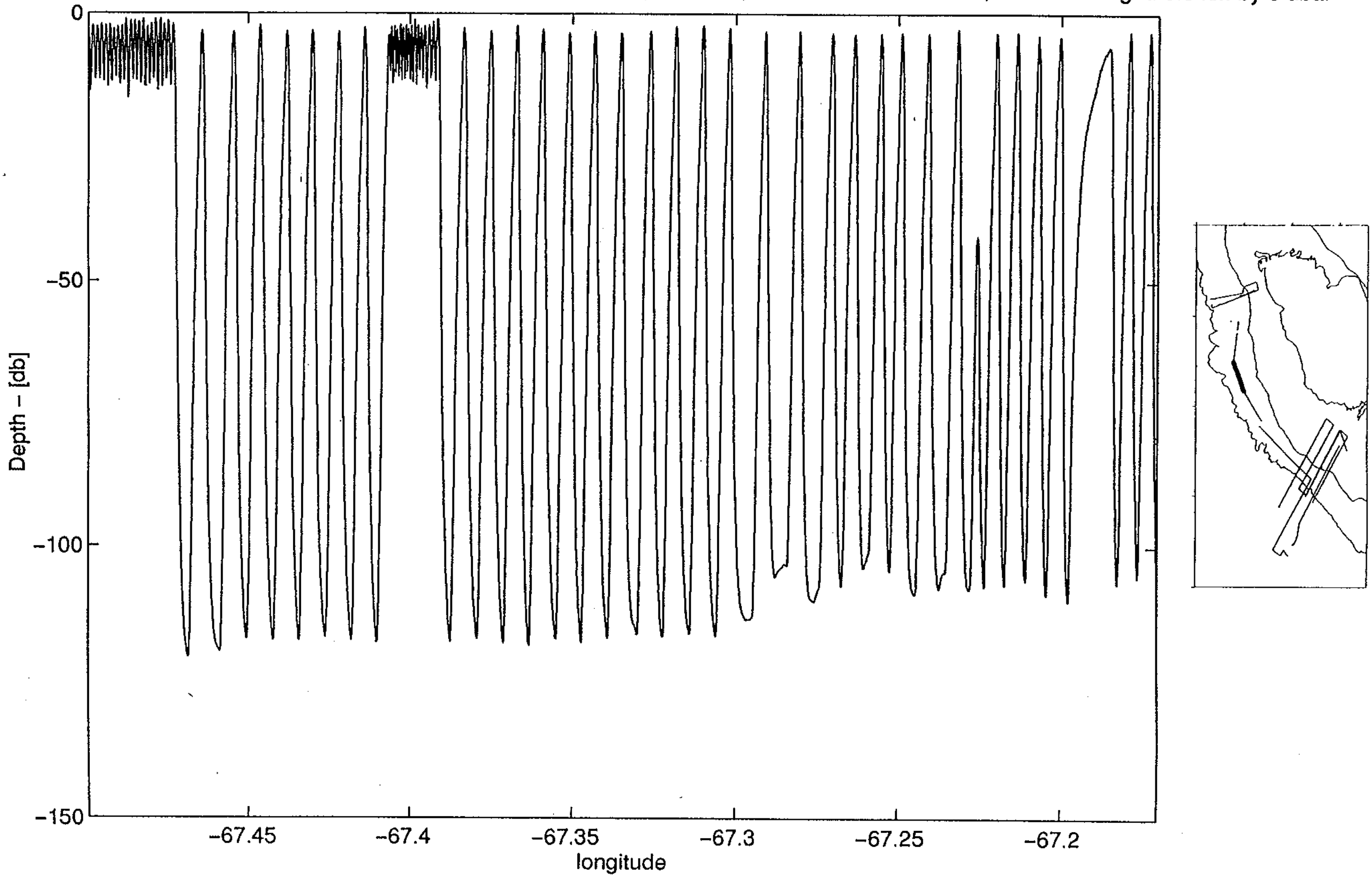

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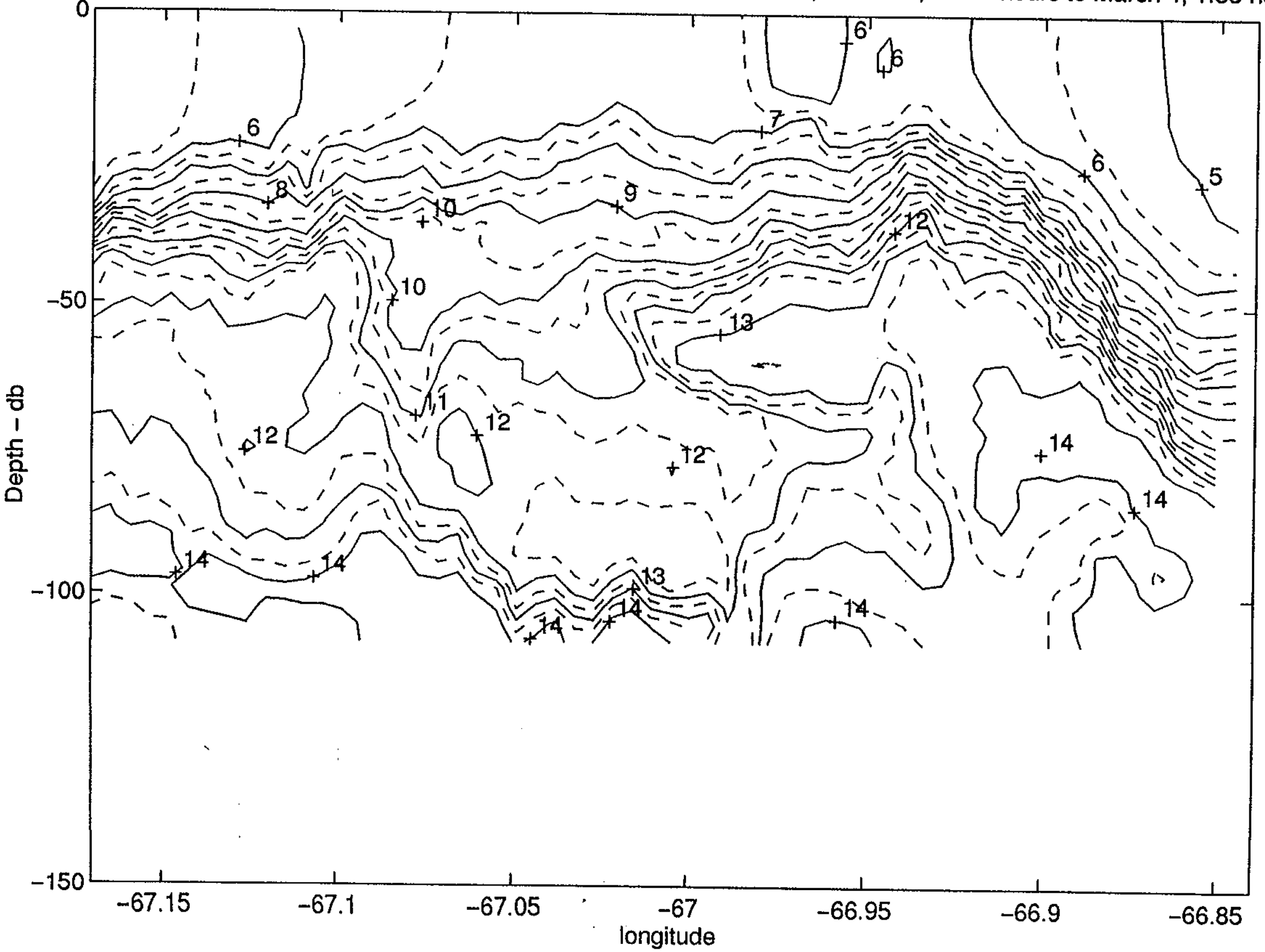

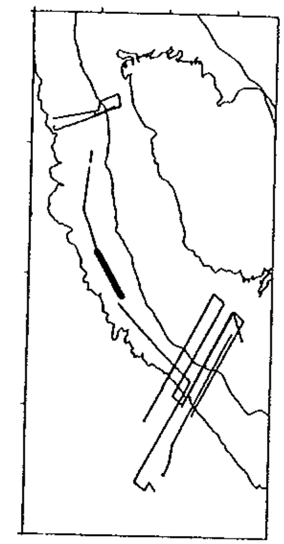

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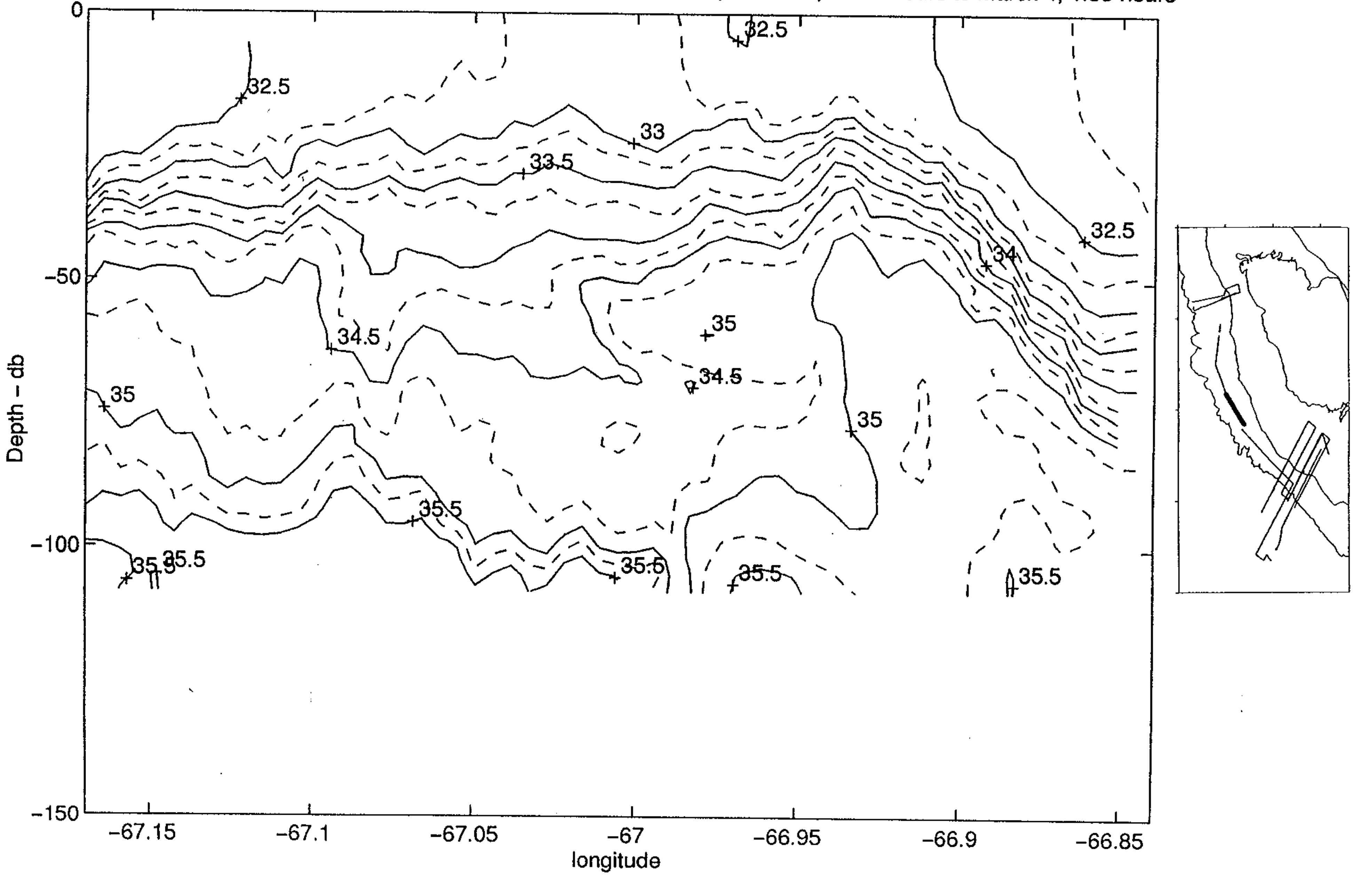

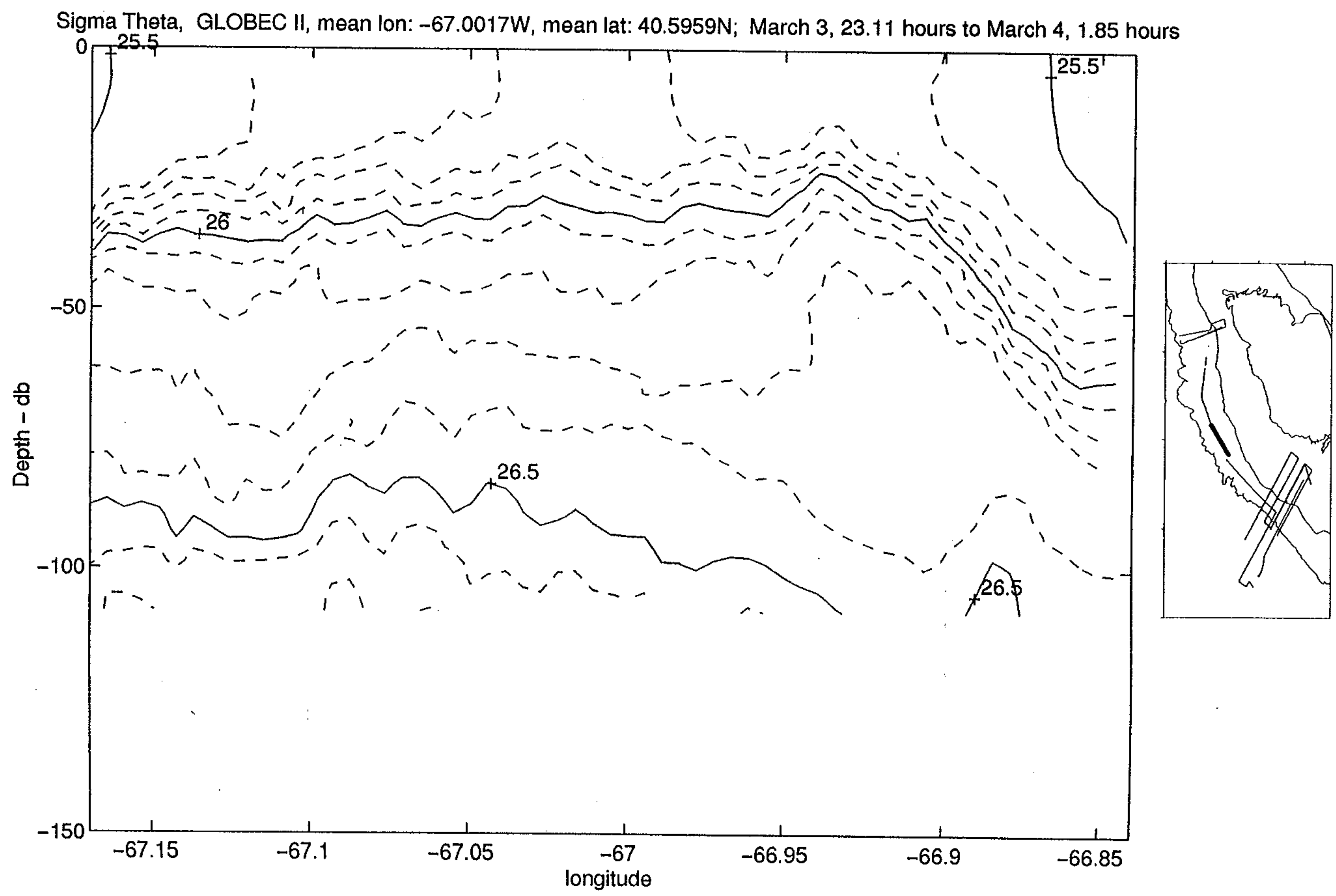

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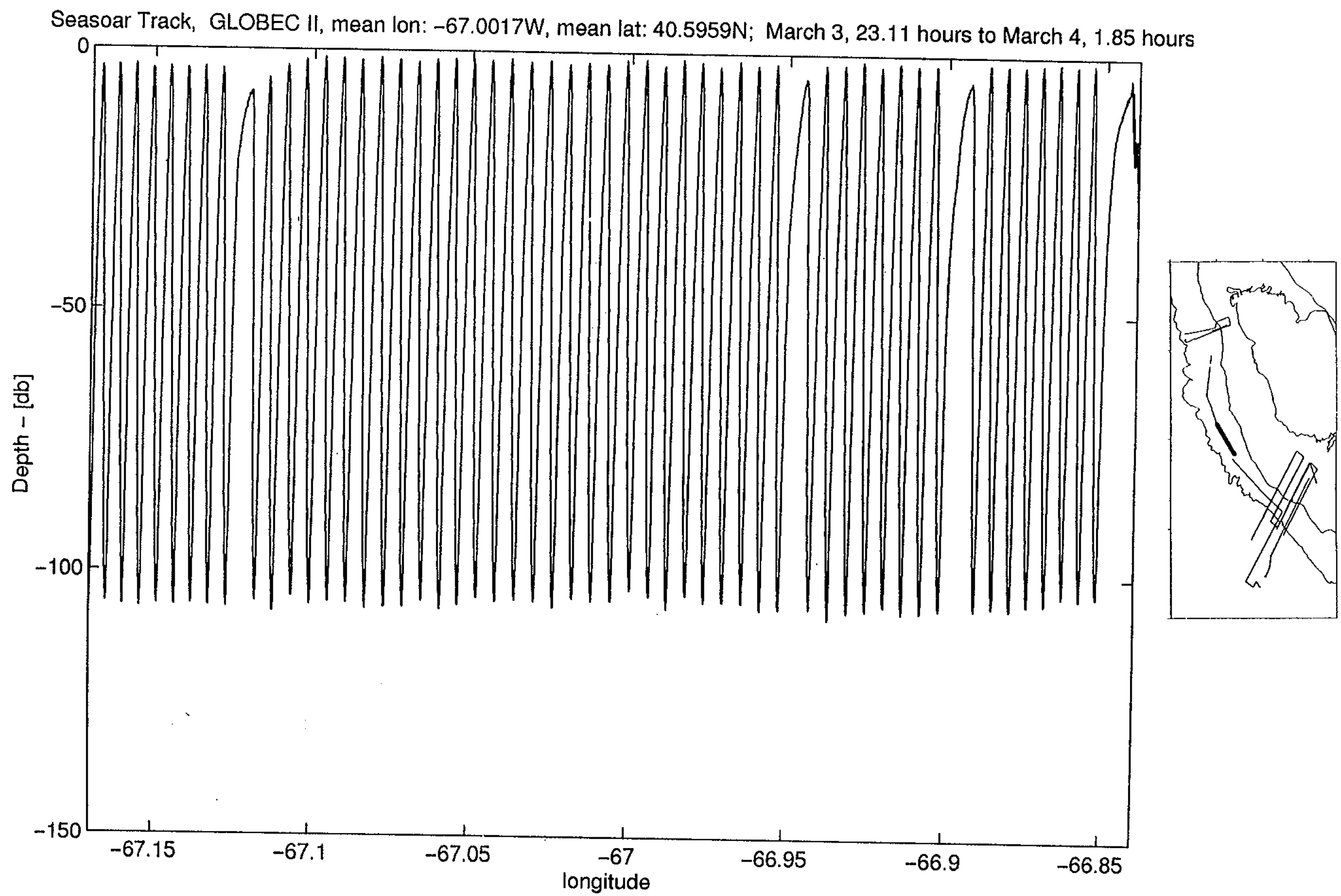
Depth - db
longitude
0
-50
-100
-150
-67.15
-67.1
-67.05
-67
-66.95
-66.9
-66.85
25.5
26
26.5



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0
−50
−100
−150
Depth – [db]
−67.15
−67.1
−67.05
−67
−66.95
−66.9
−66.85
longitude

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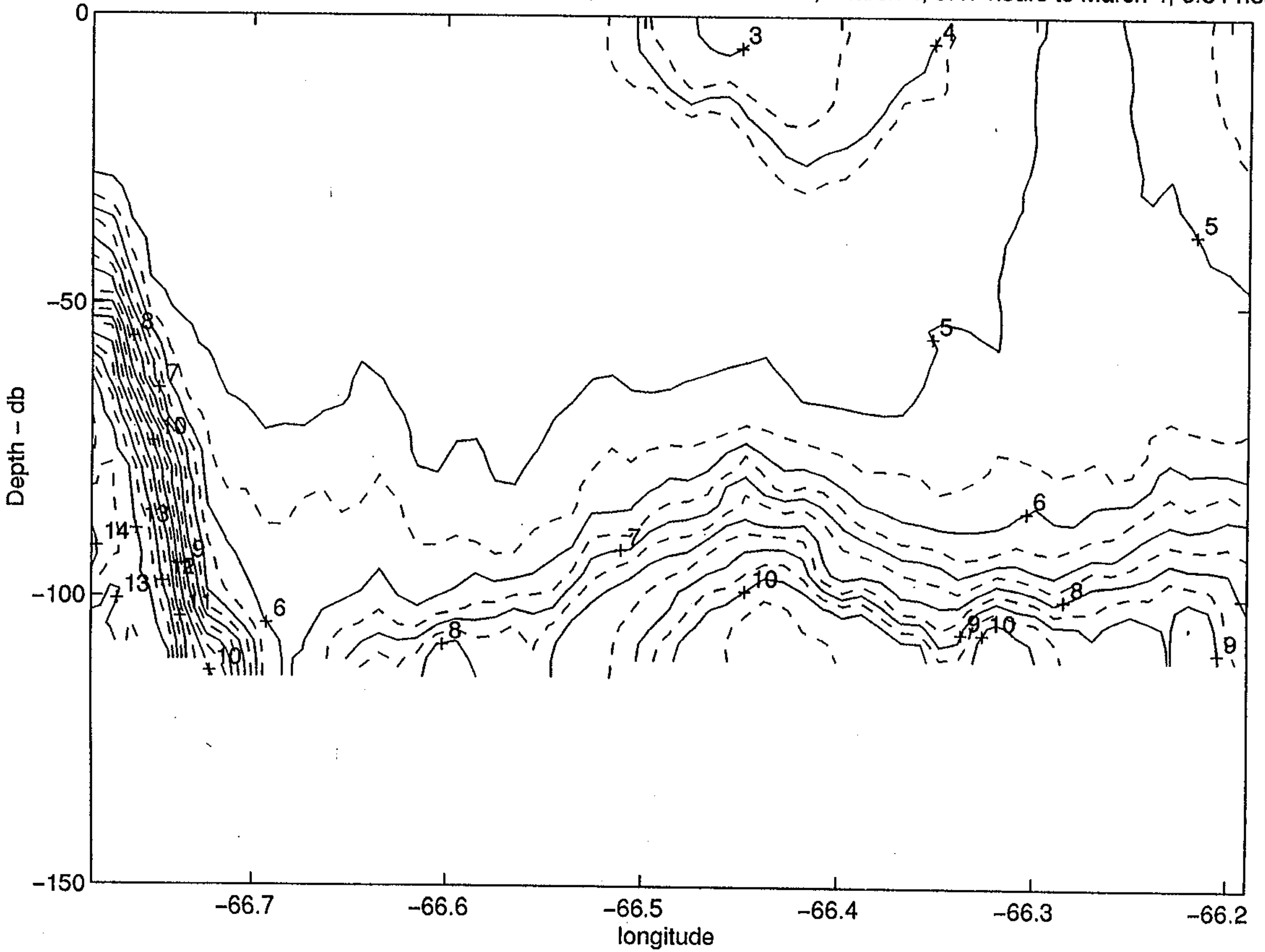

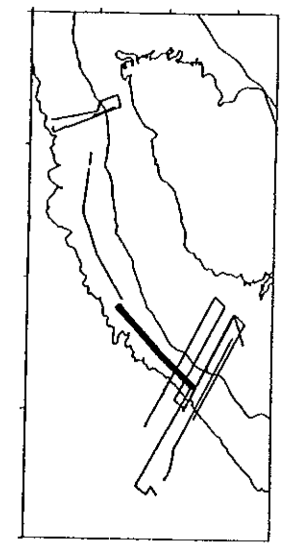

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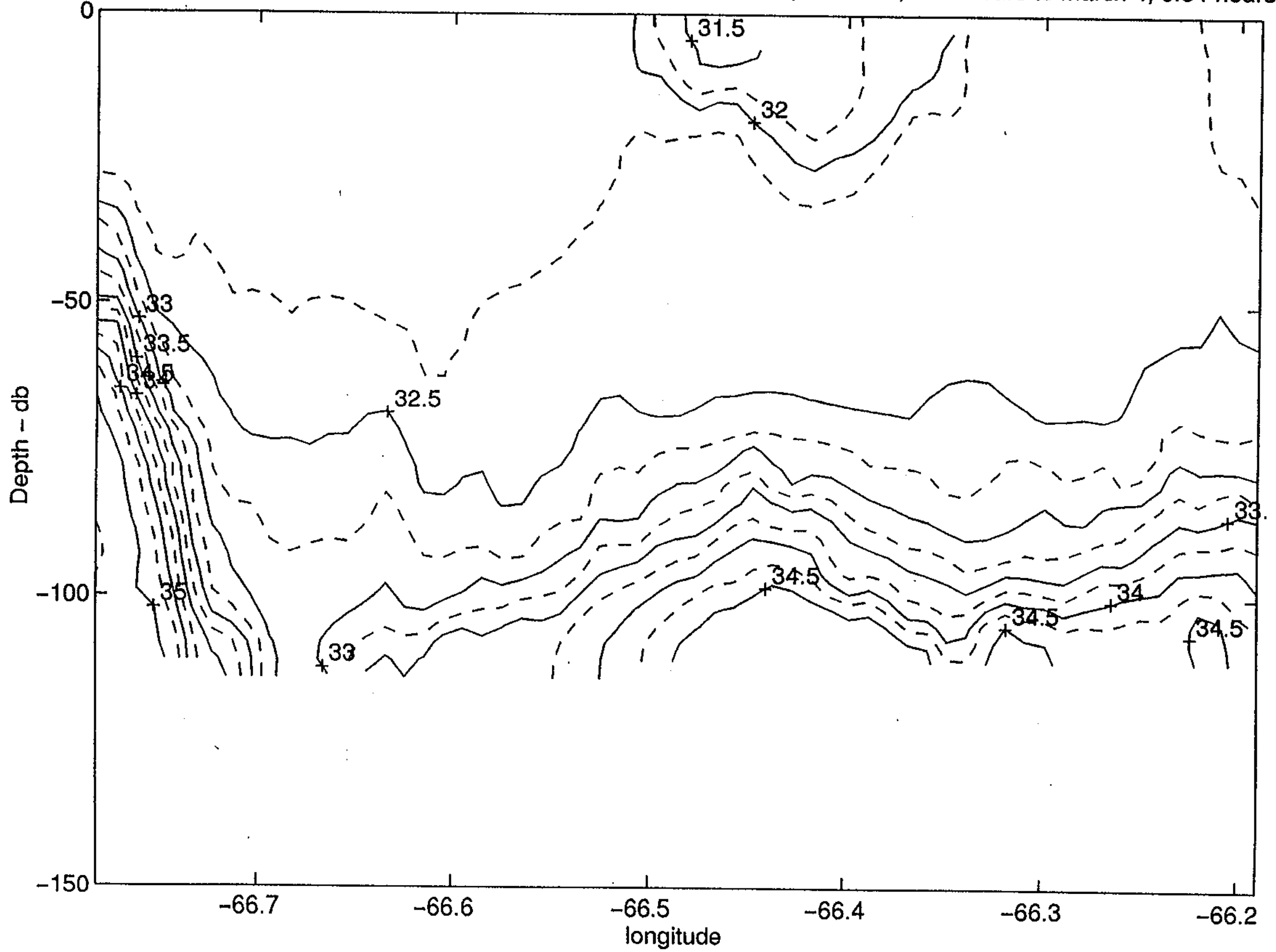

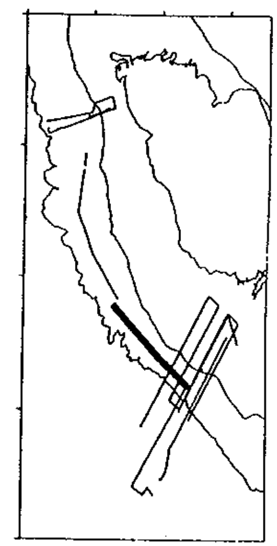

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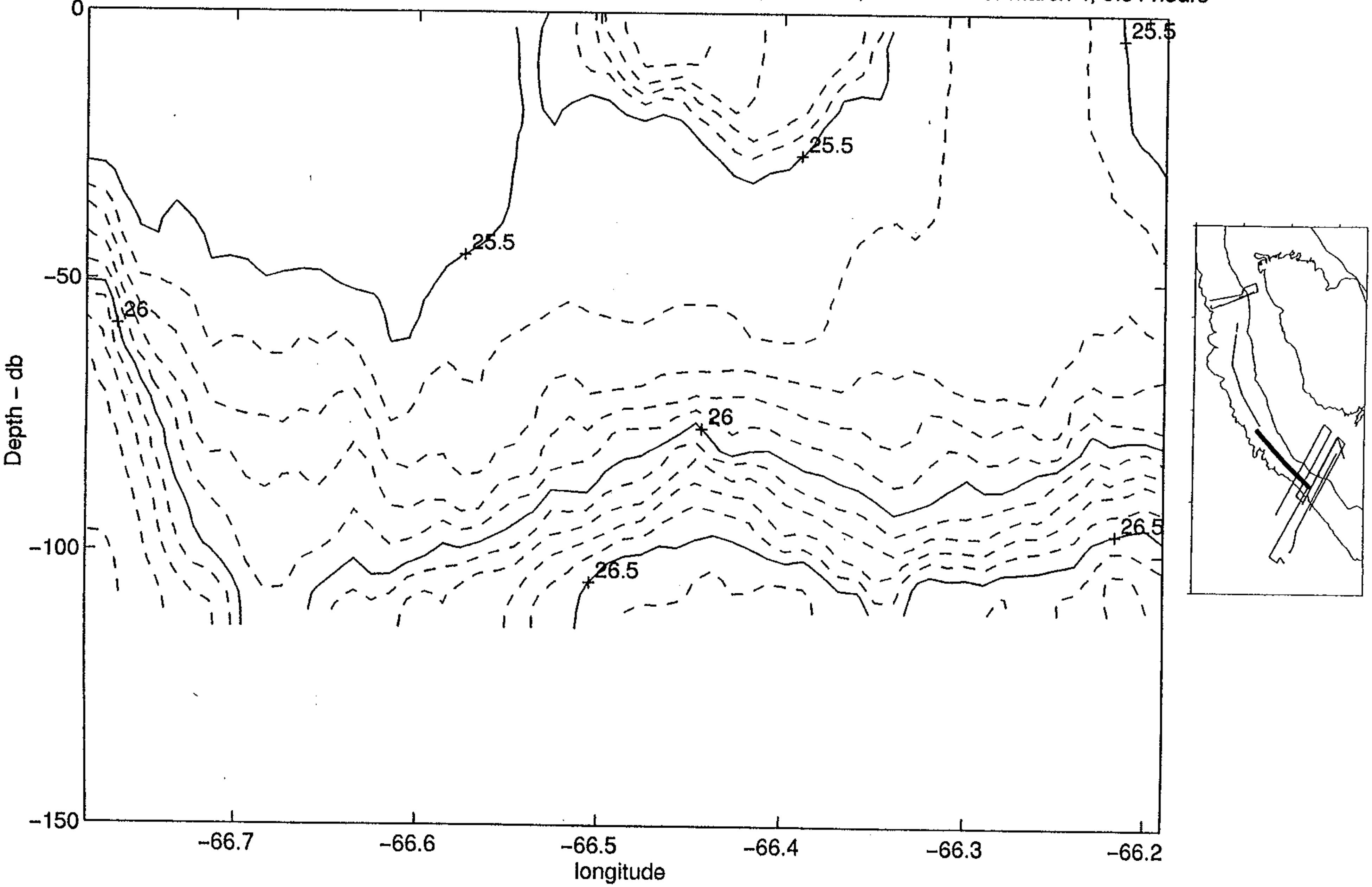

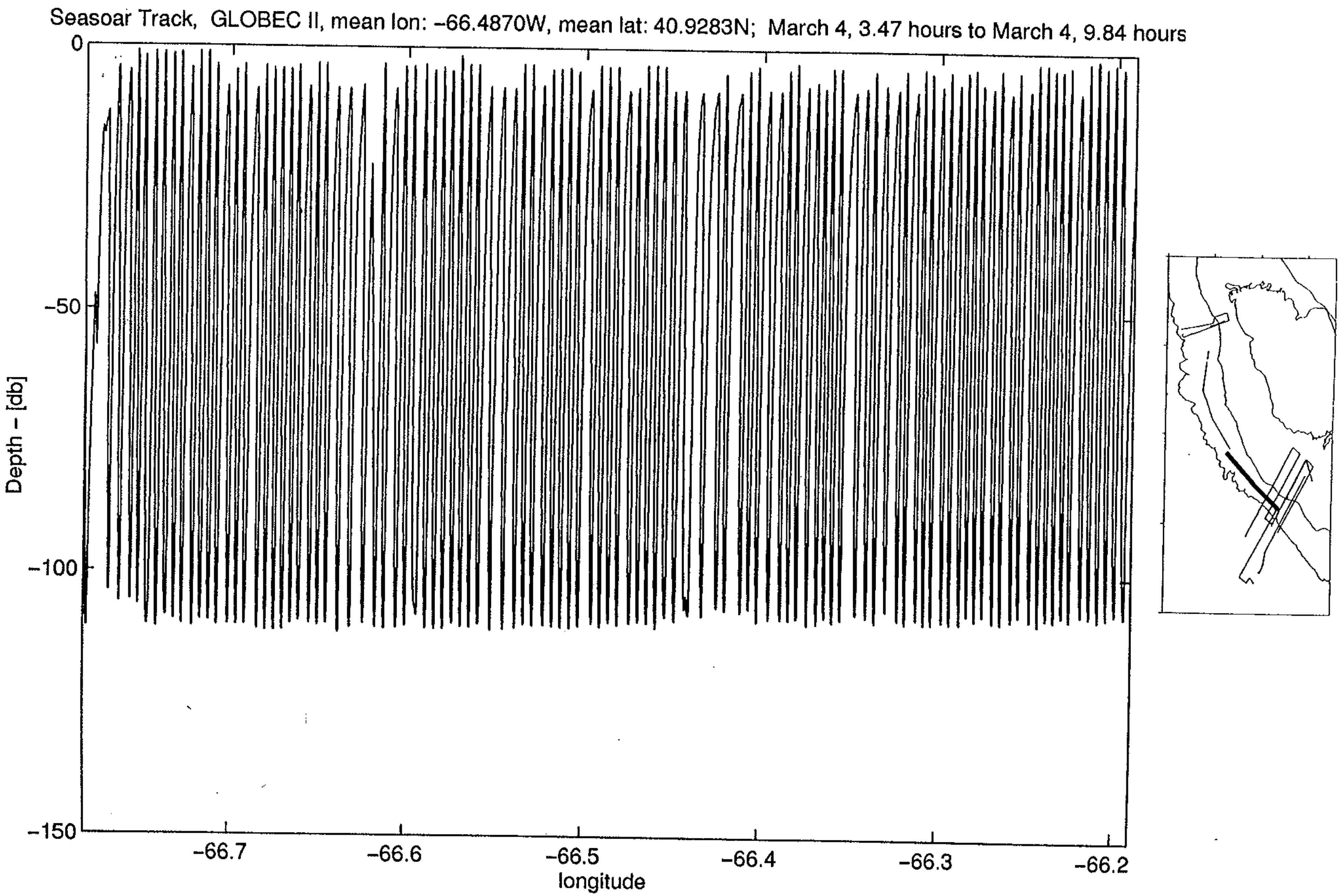
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0
−50
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Depth – [db]
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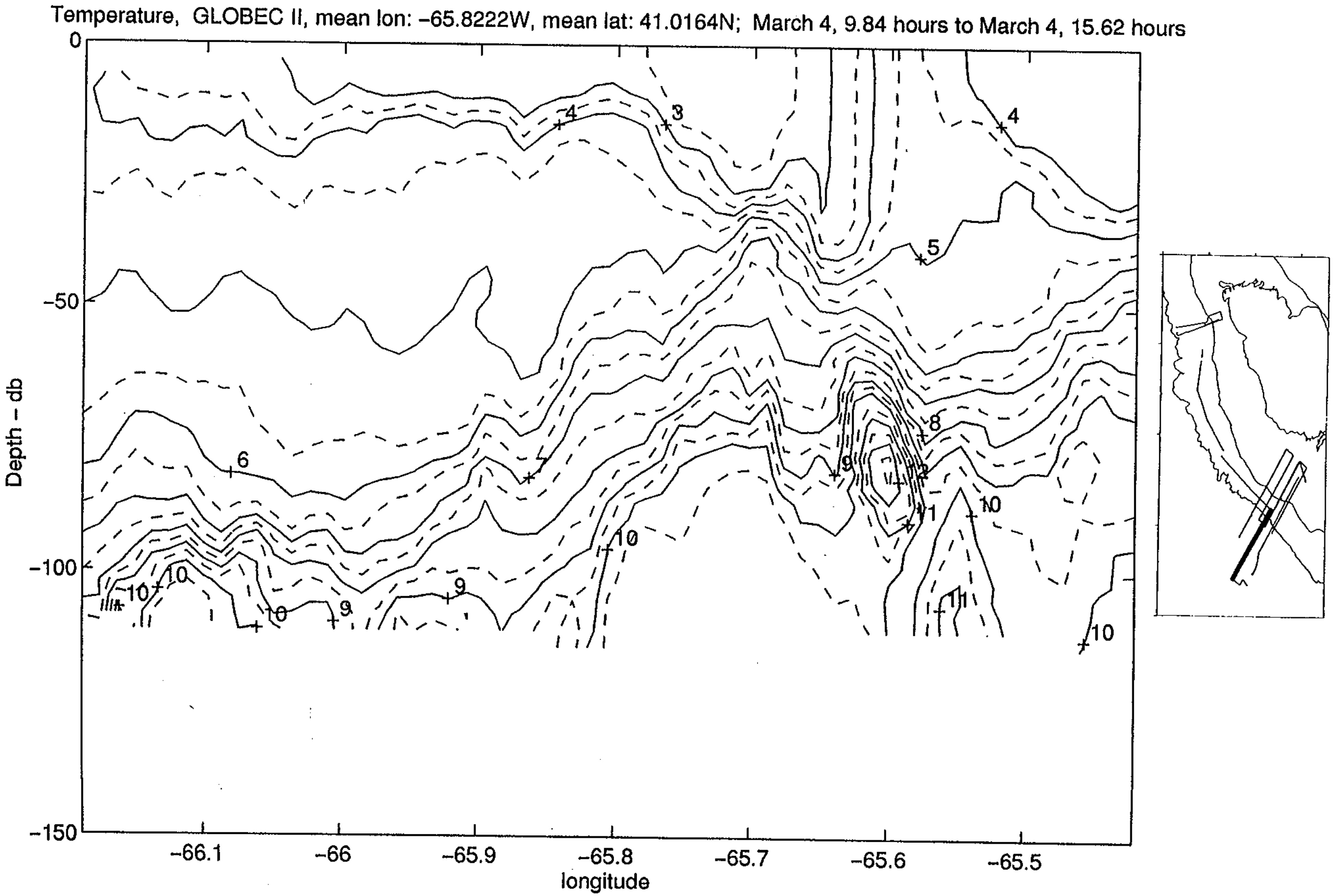
−66.3
−66.2
longitude



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−150
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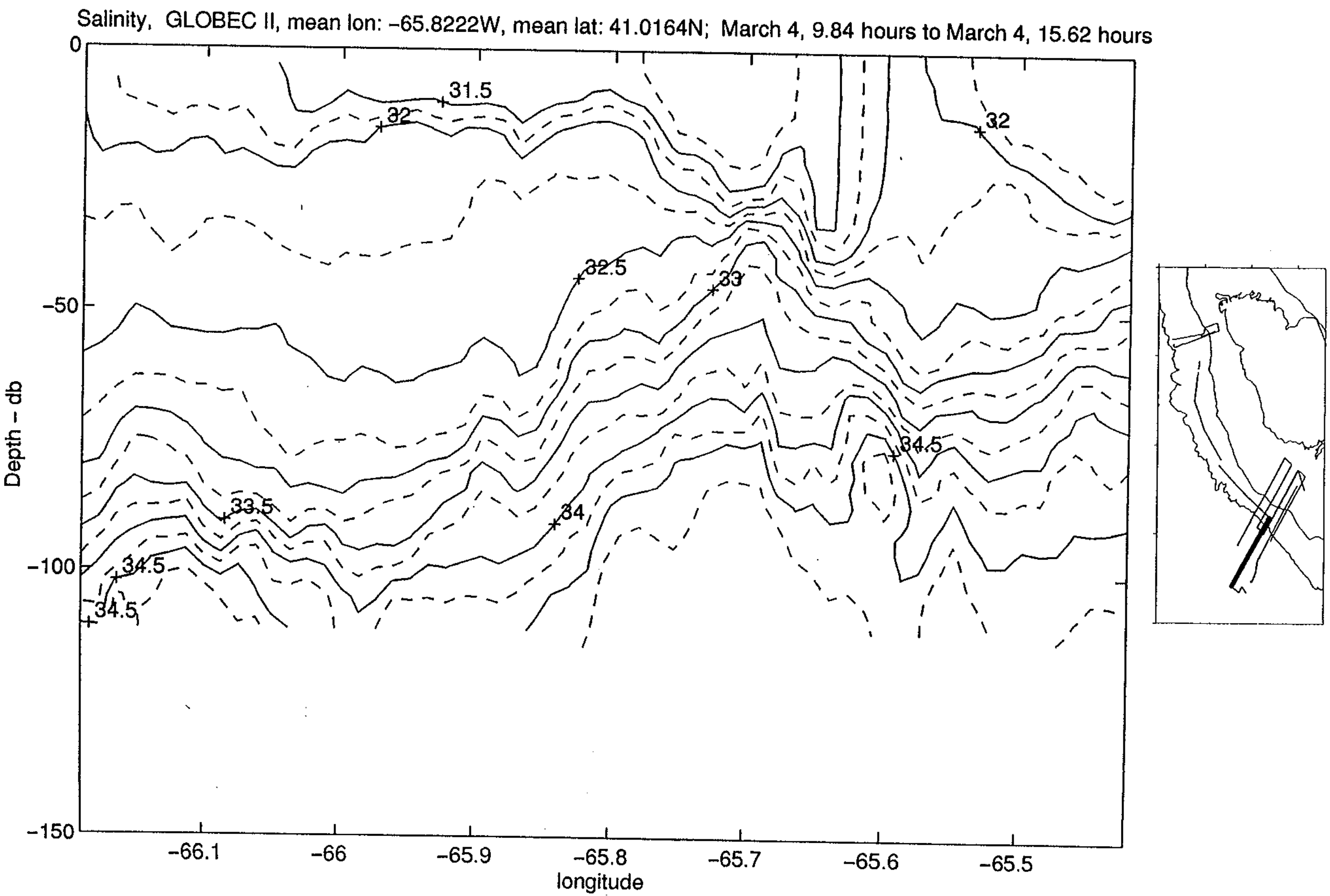
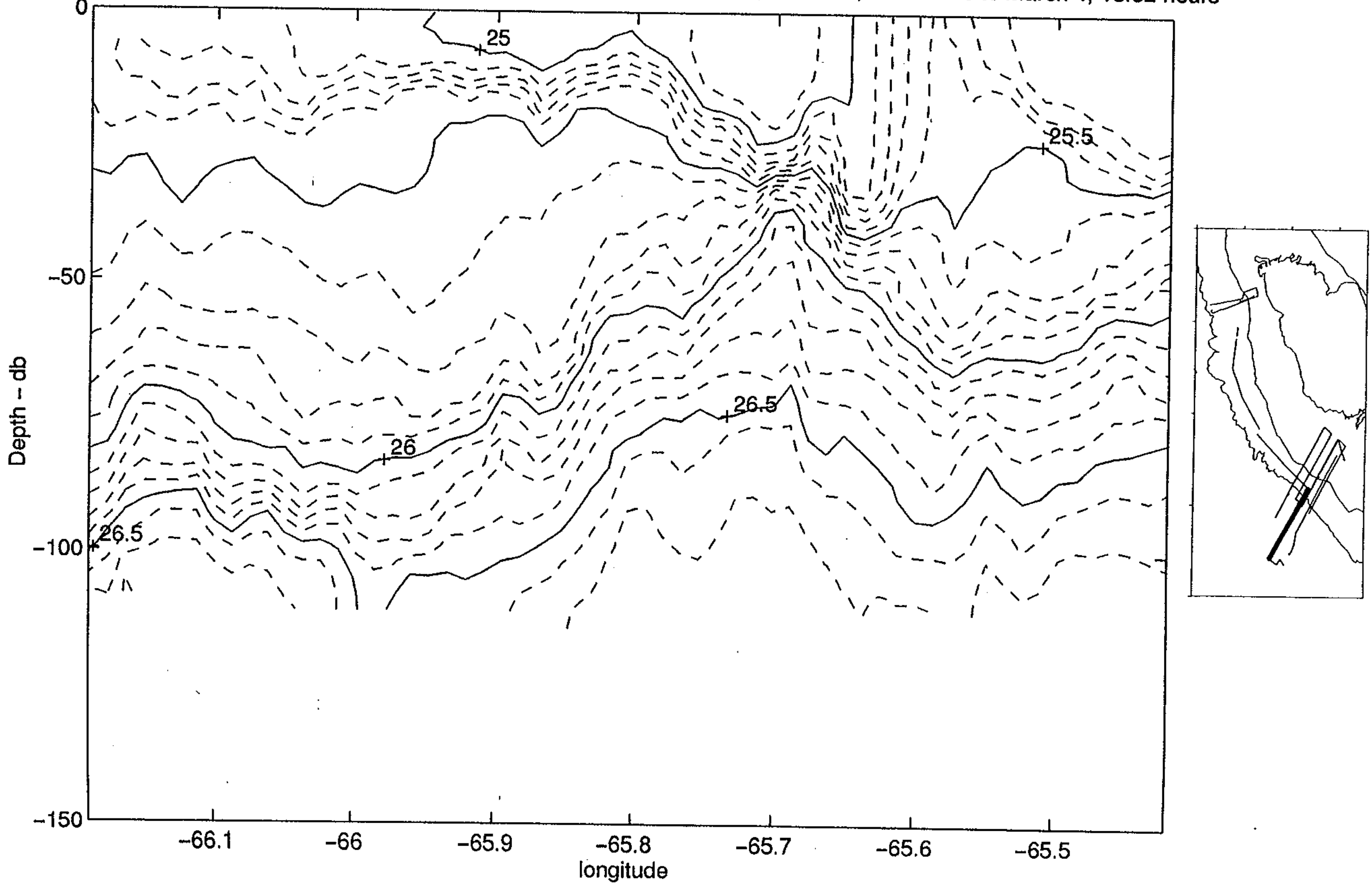
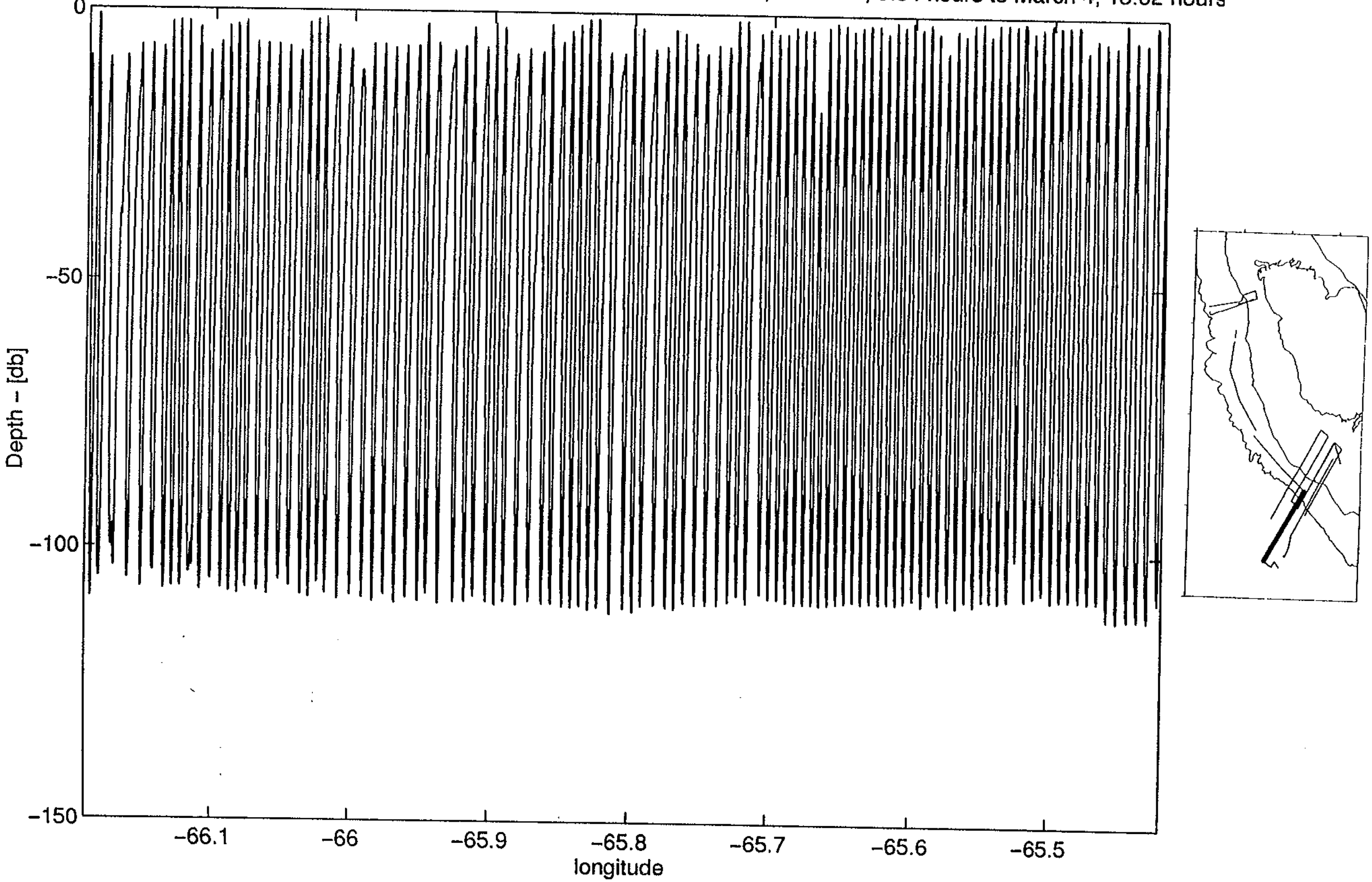
−66
−65.9
−65.8
−65.7
−65.6
−65.5
longitude


Salinity, GLOBEC II, mean lon: −65.8222W, mean lat: 41.0164N; March 4, 9.84 hours to March 4, 15.62 hours
Depth - db
0
−50
−100
−150
31.5
32
32
32.5
33
33.5
34
34.5
34.5
34.5
−66.1
−66
−65.9
−65.8
−65.7
−65.6
−65.5
longitude

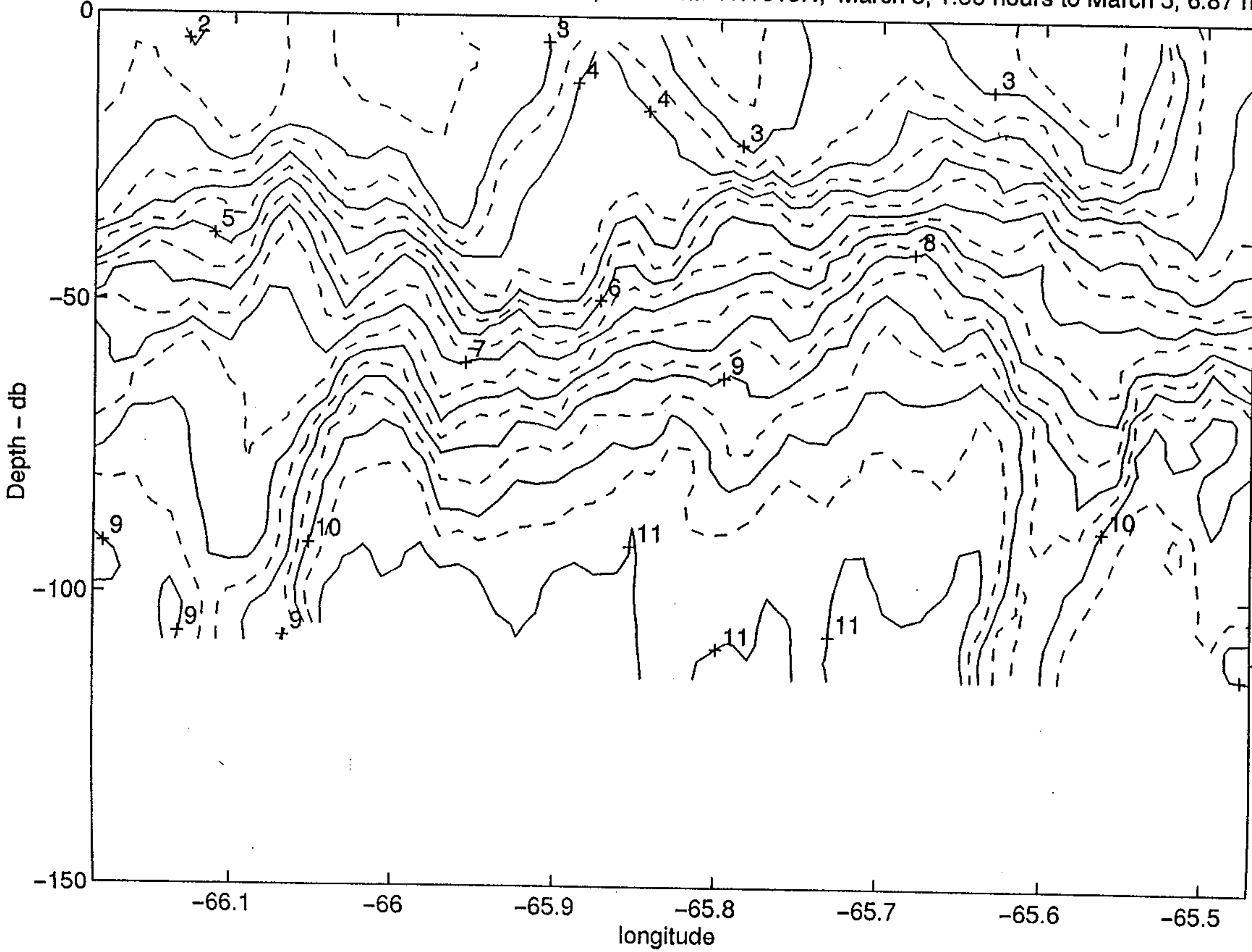
Sigma Theta, GLOBEC II, mean lon: −65.8222W, mean lat: 41.0164N; March 4, 9.84 hours to March 4, 15.62 hours

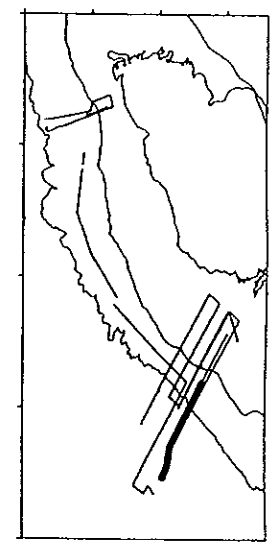


Seasoar Track, GLOBEC II, mean lon: −65.8222W, mean lat: 41.0164N; March 4, 9.84 hours to March 4, 15.62 hours

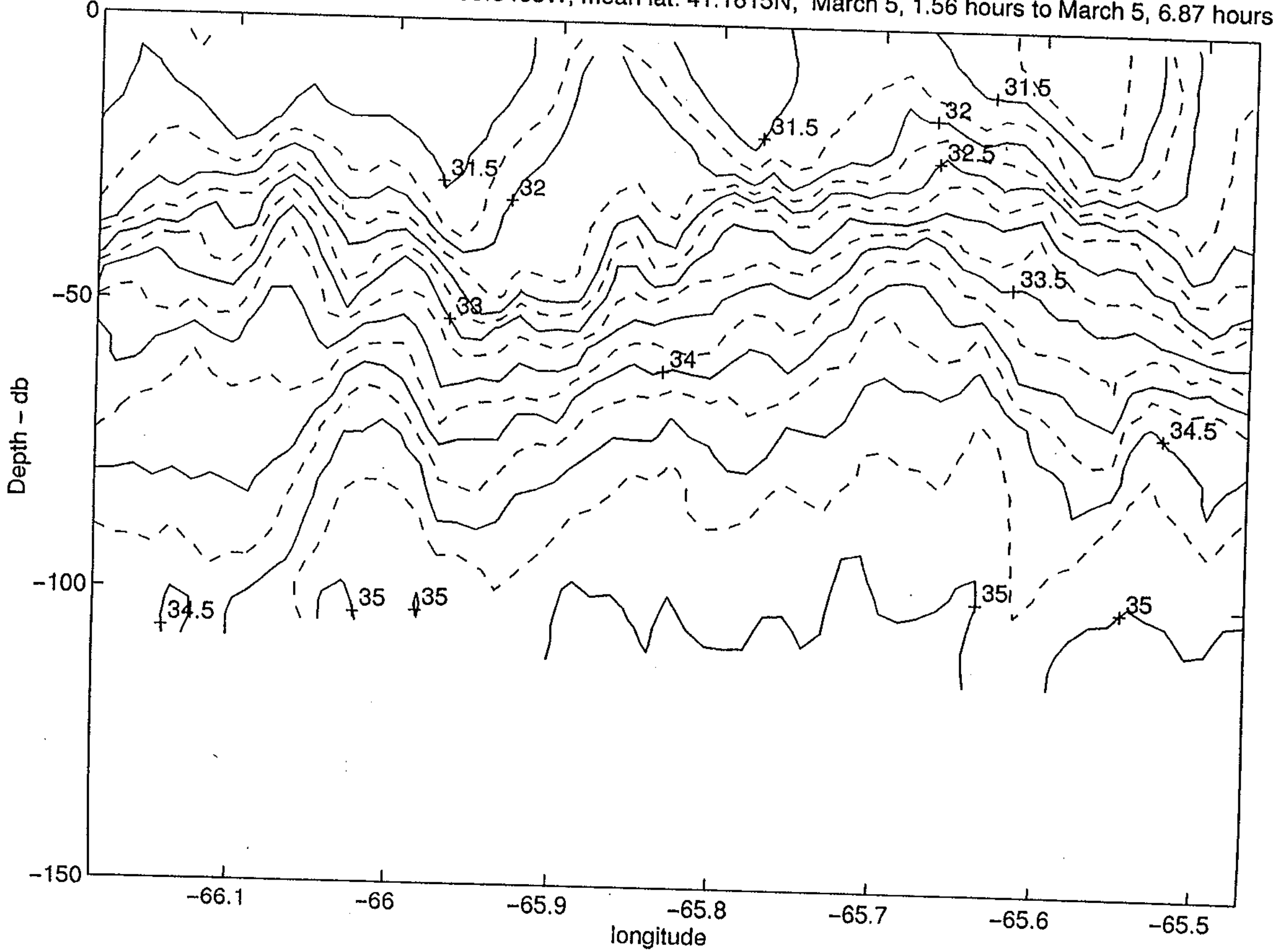


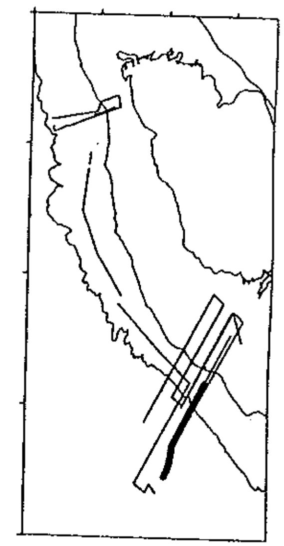
Temperature, GLOBEC II, mean lon: −65.8463W, mean lat: 41.1615N; March 5, 1.56 hours to March 5, 6.87 hours

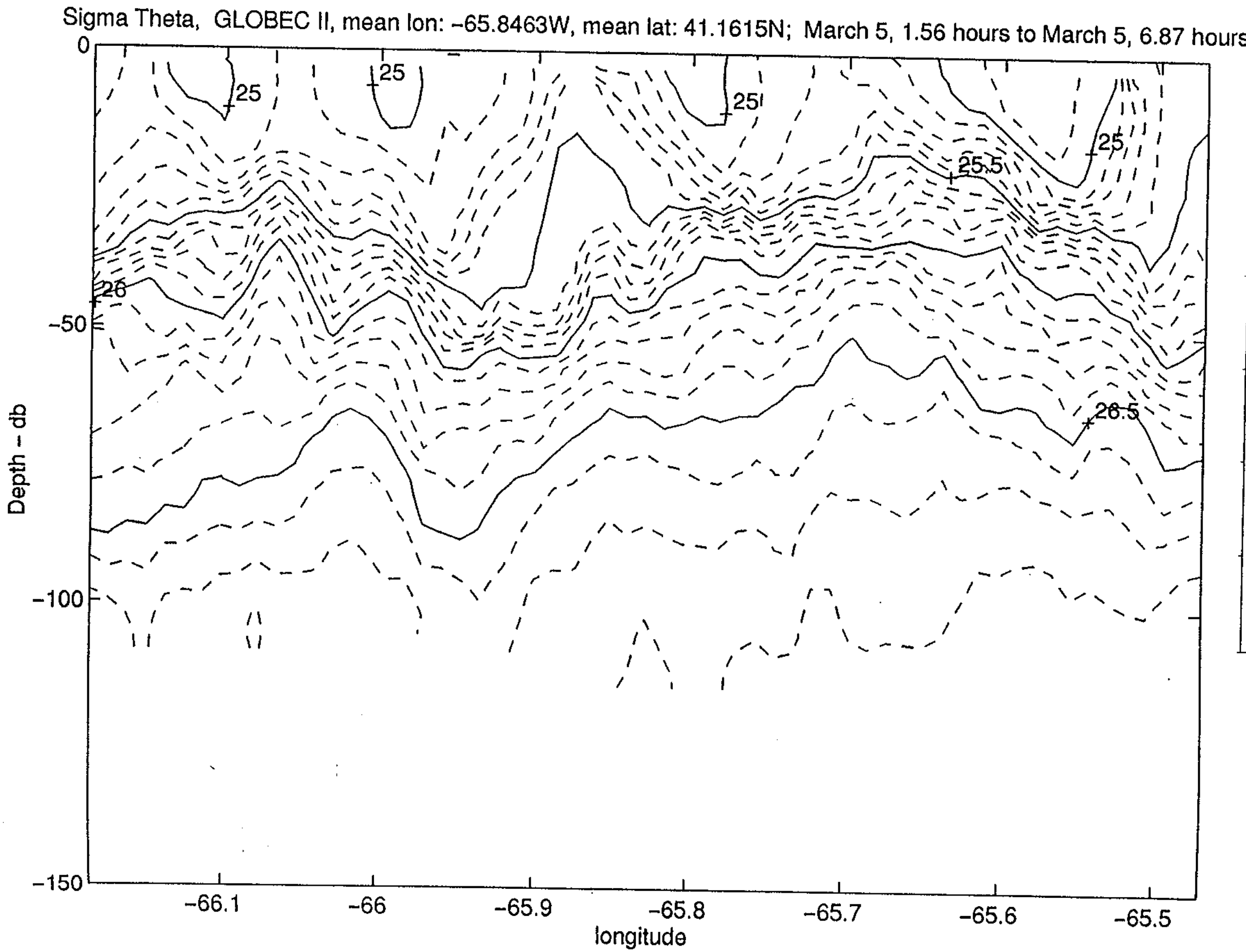


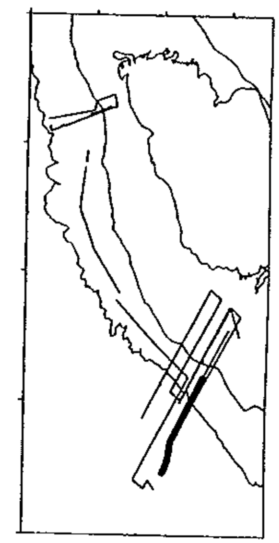


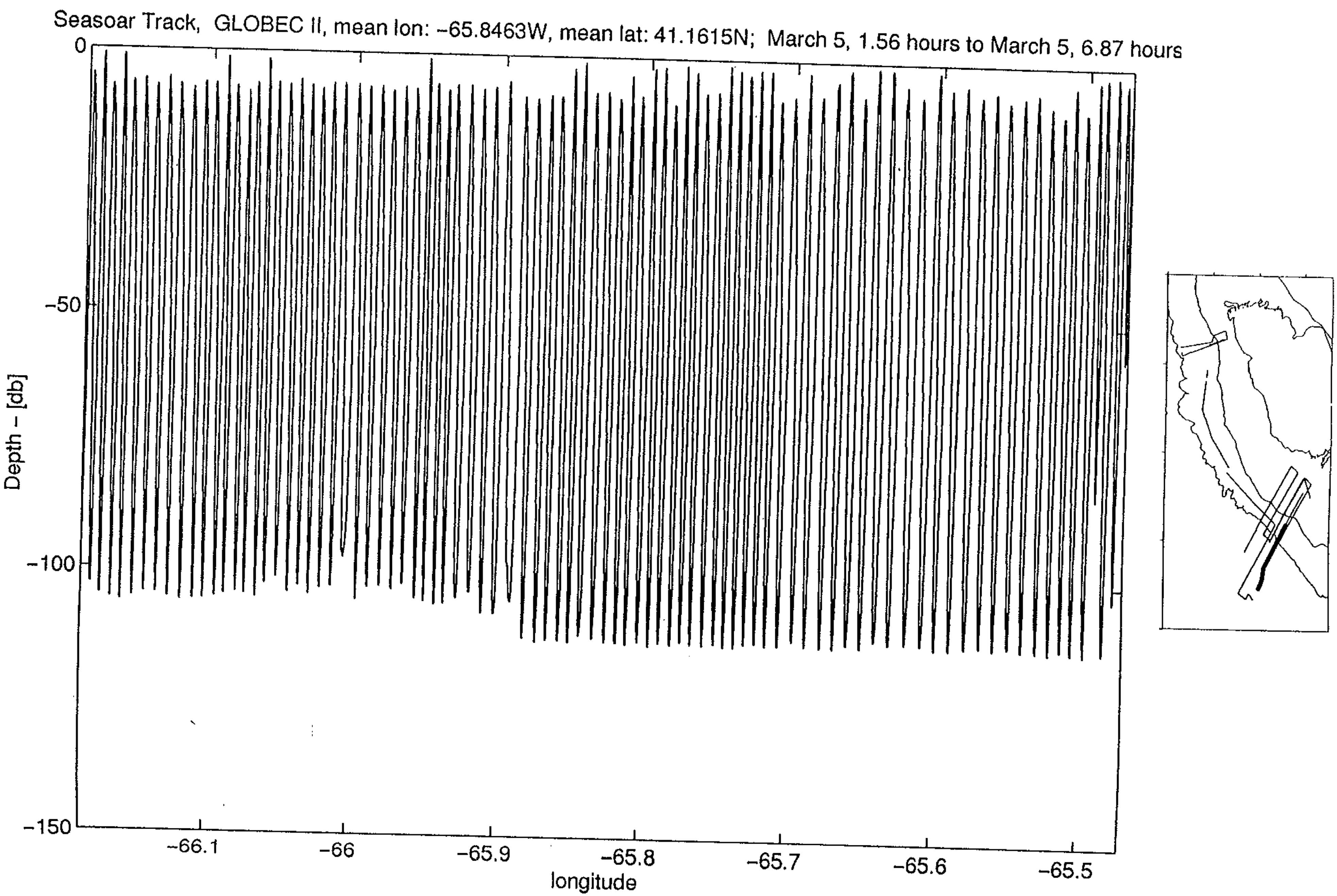
Salinity, GLOBEC II, mean lon: −65.8463W, mean lat: 41.1615N; March 5, 1.56 hours to March 5, 6.87 hours

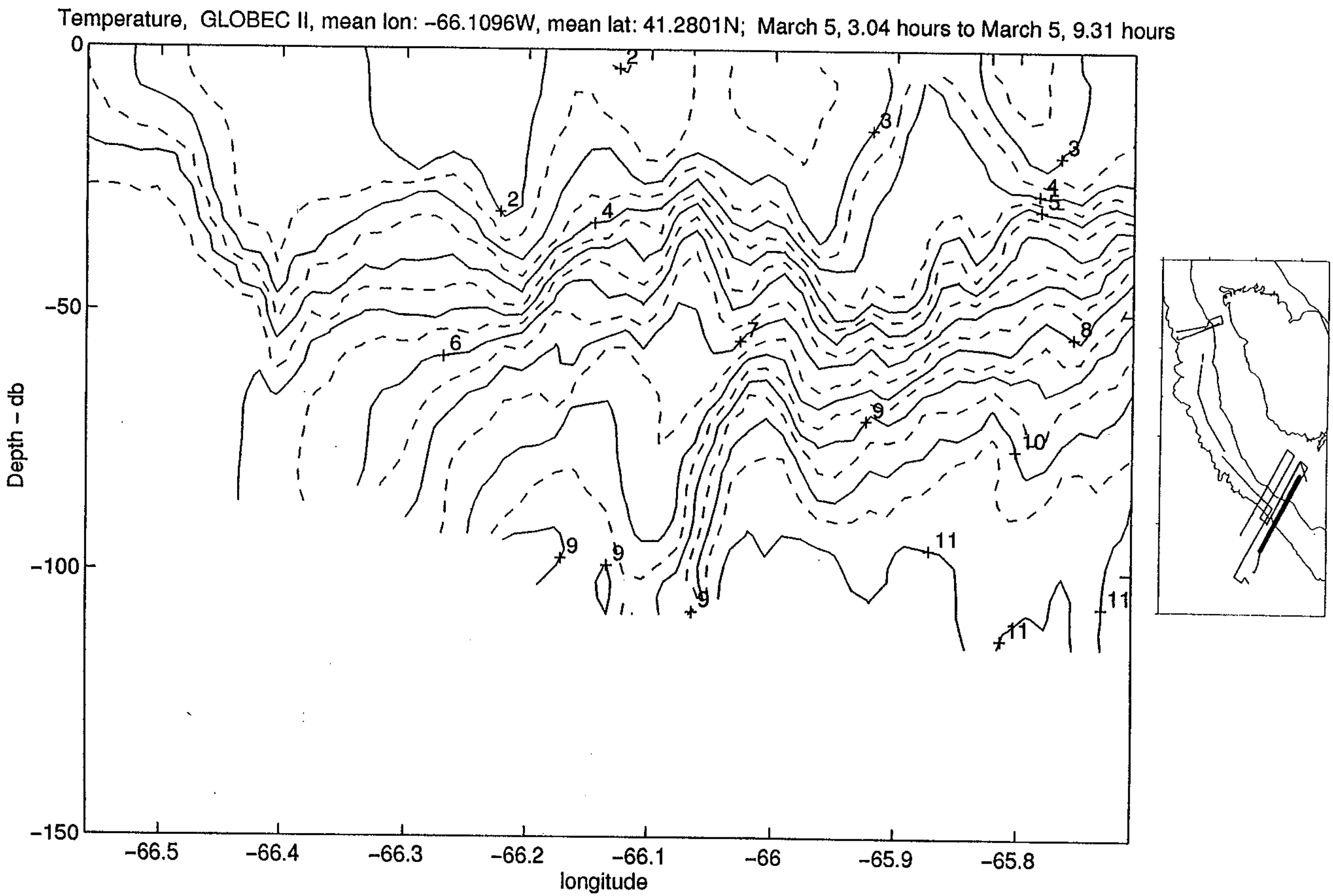




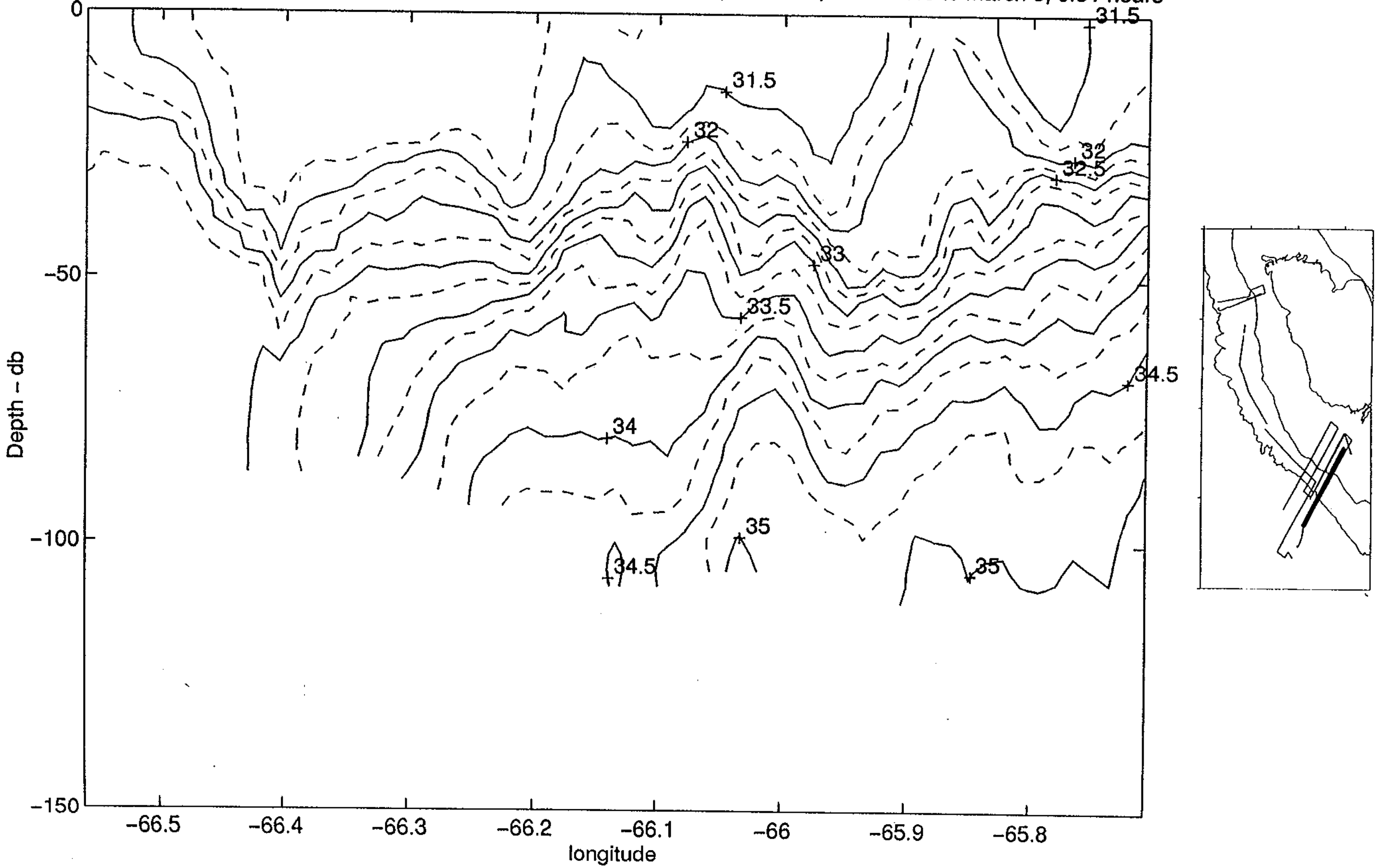

Sigma Theta, GLOBEC II, mean lon: -65.8463W, mean lat: 41.1615N; March 5, 1.56 hours to March 5, 6.87 hours
Depth - db
0
-50
-100
-150
-66.1
-66
-65.9
-65.8
-65.7
-65.6
-65.5
longitude
25
25
25
25
25.5
26
26.5



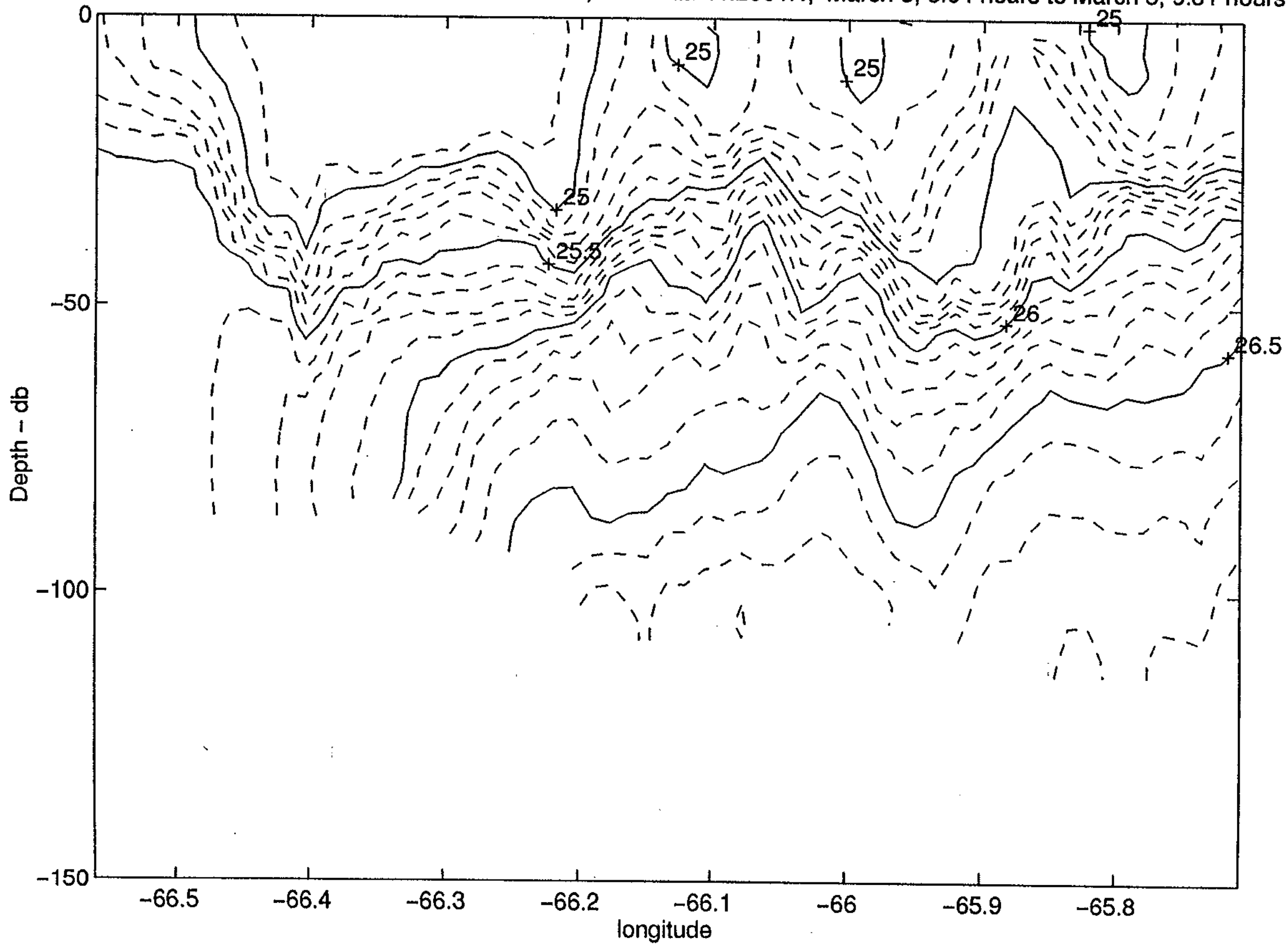

Seasoar Track, GLOBEC II, mean lon: -65.8463W, mean lat: 41.1615N; March 5, 1.56 hours to March 5, 6.87 hours
Depth - [db]
0
-50
-100
-150
-66.1
-66
-65.9
-65.8
-65.7
-65.6
-65.5
longitude

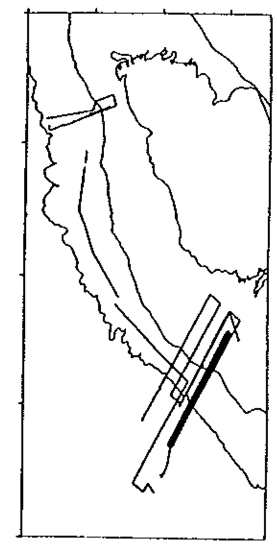

Temperature, GLOBEC II, mean lon: −66.1096W, mean lat: 41.2801N; March 5, 3.04 hours to March 5, 9.31 hours
Depth – db
0
−50
−100
−150
−66.5
−66.4
−66.3
−66.2
−66.1
−66
−65.9
−65.8
longitude
2
2
3
3
4
4
5
6
7
8
9
9
9
9
10
11
11
11

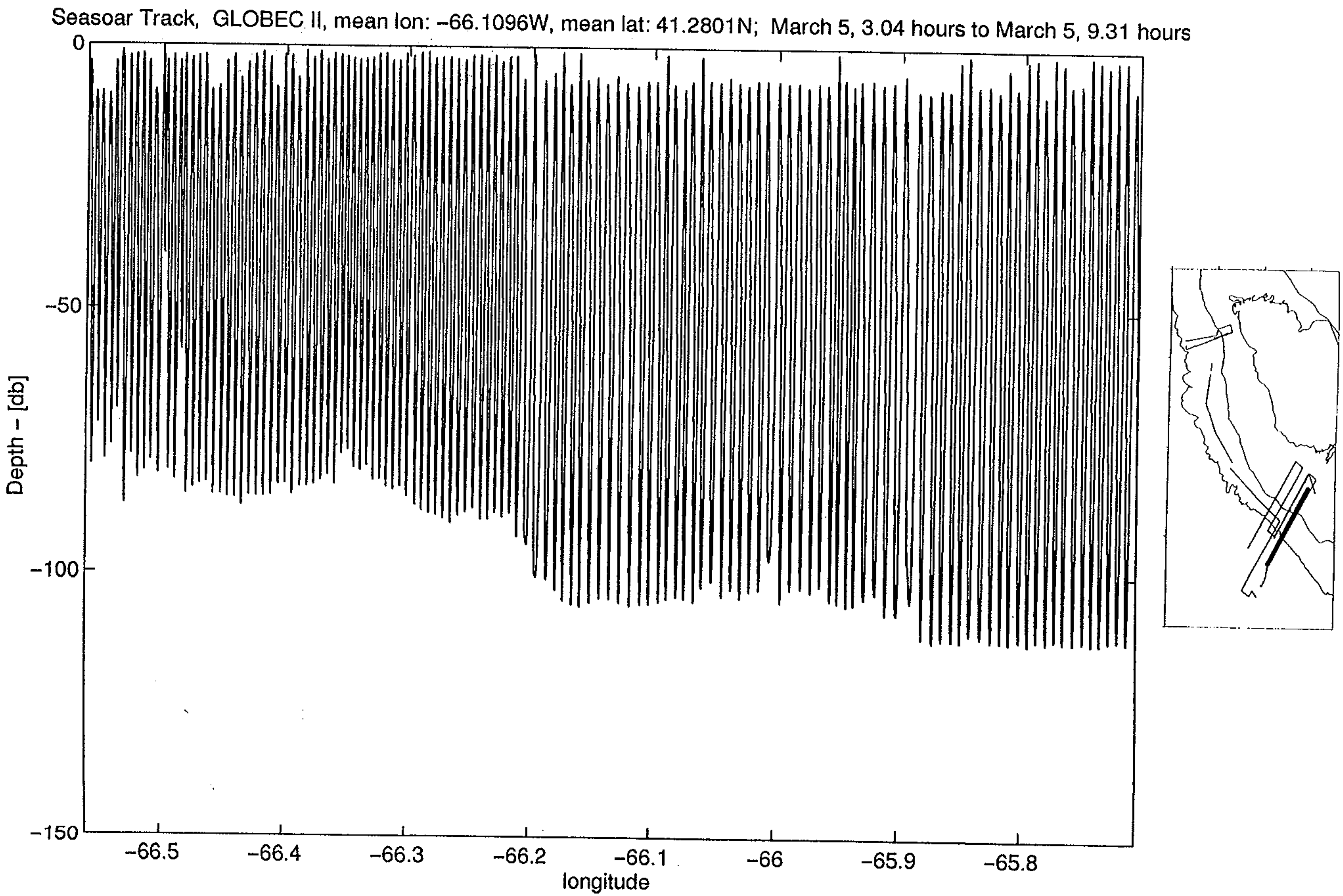
Salinity, GLOBEC II, mean lon: -66.1096W, mean lat: 41.2801N; March 5, 3.04 hours to March 5, 9.31 hours

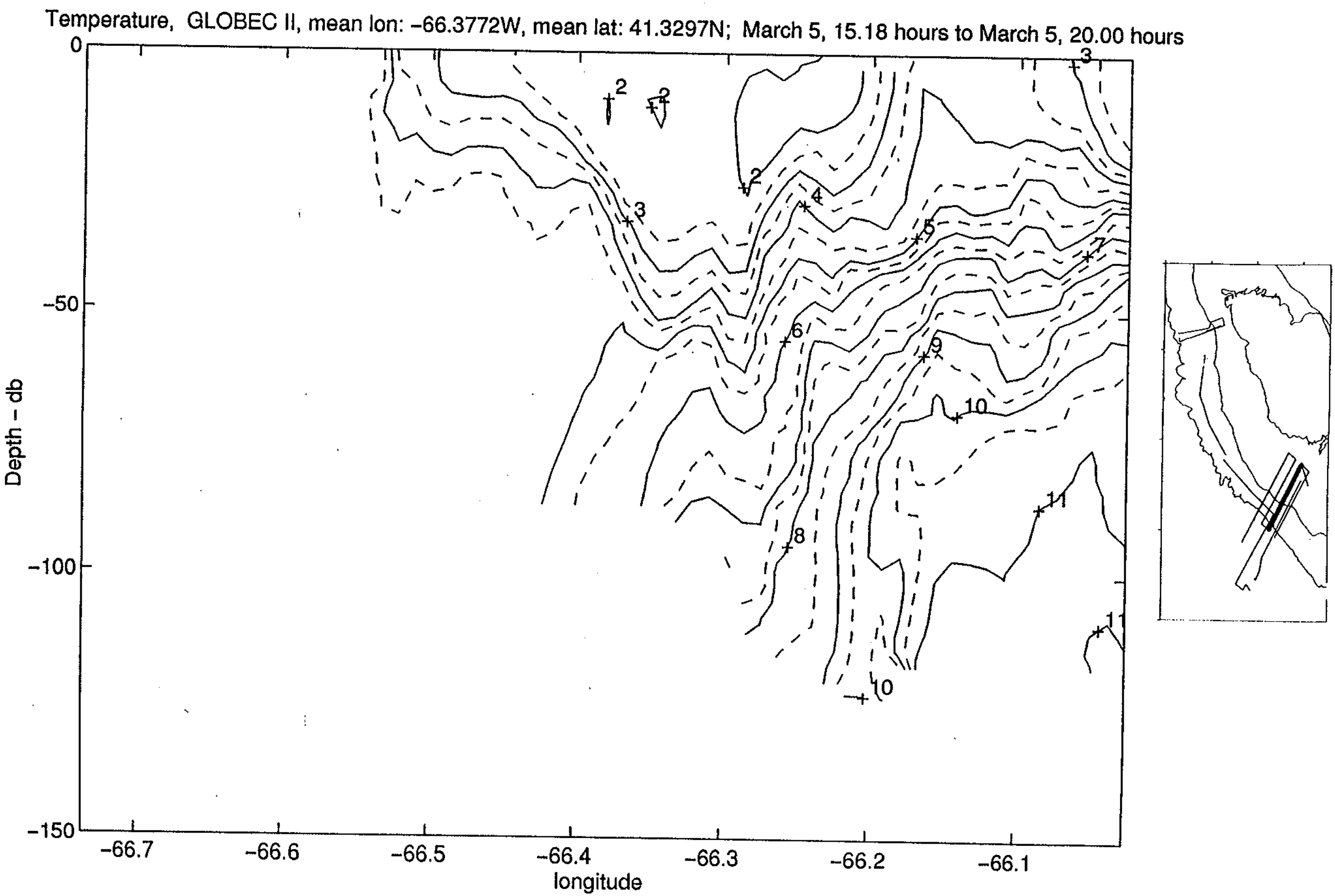


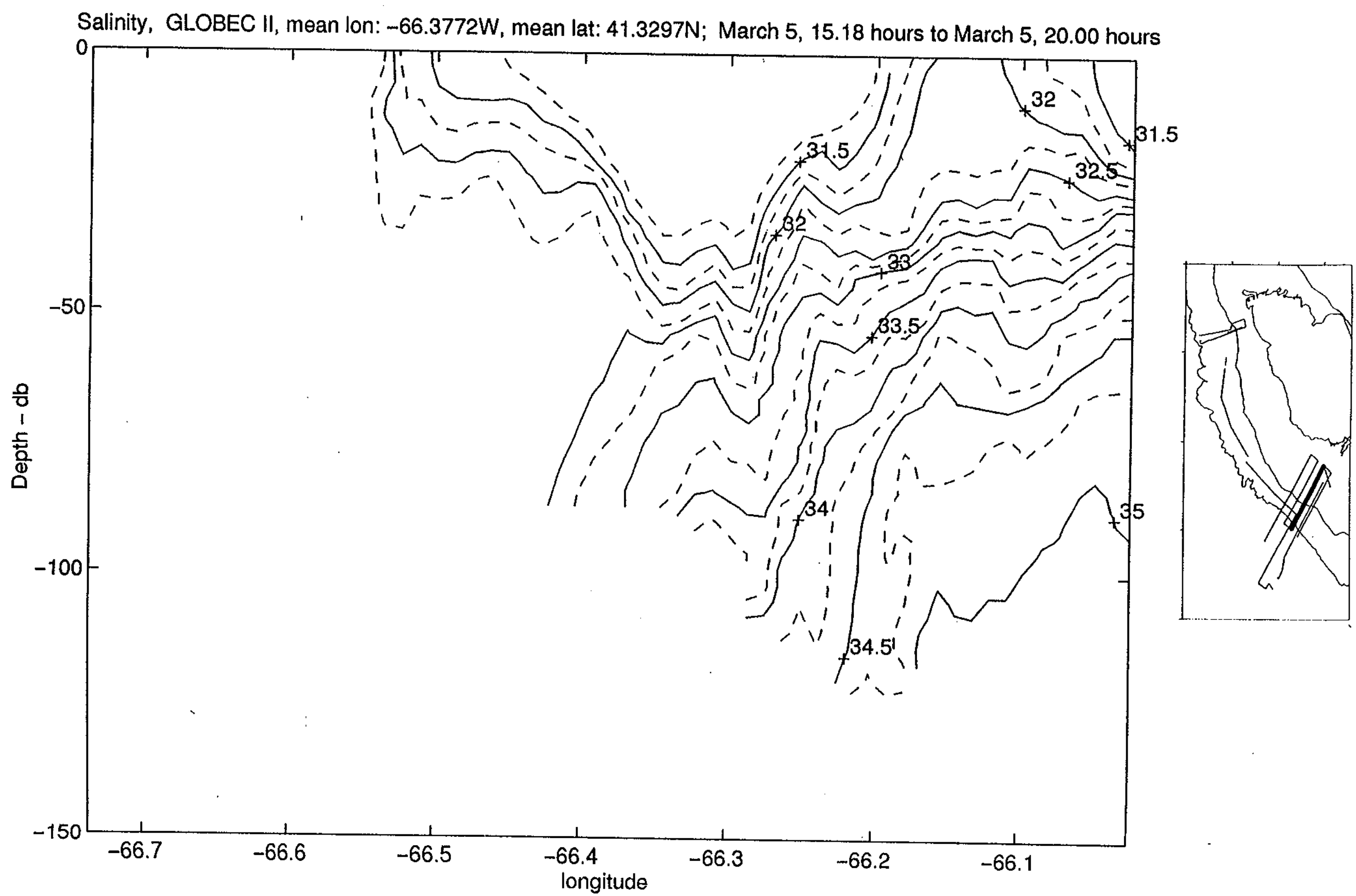
Sigma Theta, GLOBEC II, mean lon: −66.1096W, mean lat: 41.2801N; March 5, 3.04 hours to March 5, 9.31 hours





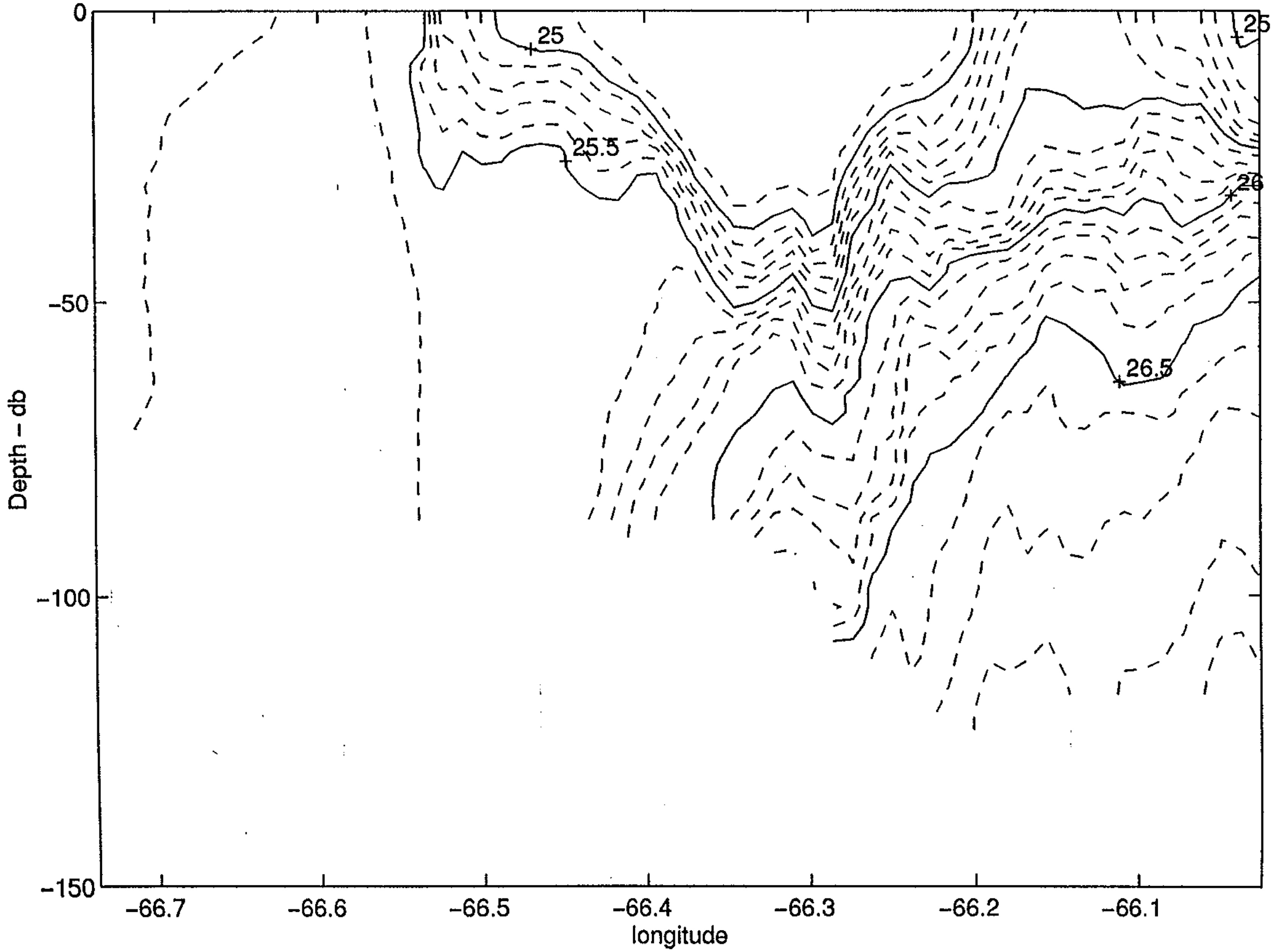

Seasoar Track, GLOBEC II, mean lon: −66.1096W, mean lat: 41.2801N; March 5, 3.04 hours to March 5, 9.31 hours
0
−50
−100
−150
Depth – [db]
−66.5
−66.4
−66.3
−66.2
−66.1
−66
−65.9
−65.8
longitude

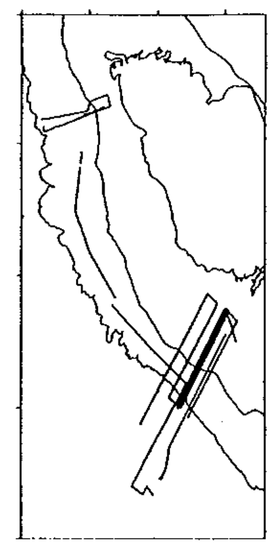

Temperature, GLOBEC II, mean lon: -66.3772W, mean lat: 41.3297N; March 5, 15.18 hours to March 5, 20.00 hours
Depth - db
0
-50
-100
-150
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
longitude
2
2
2
3
3
4
5
6
7
8
9
10
10
10
11
11



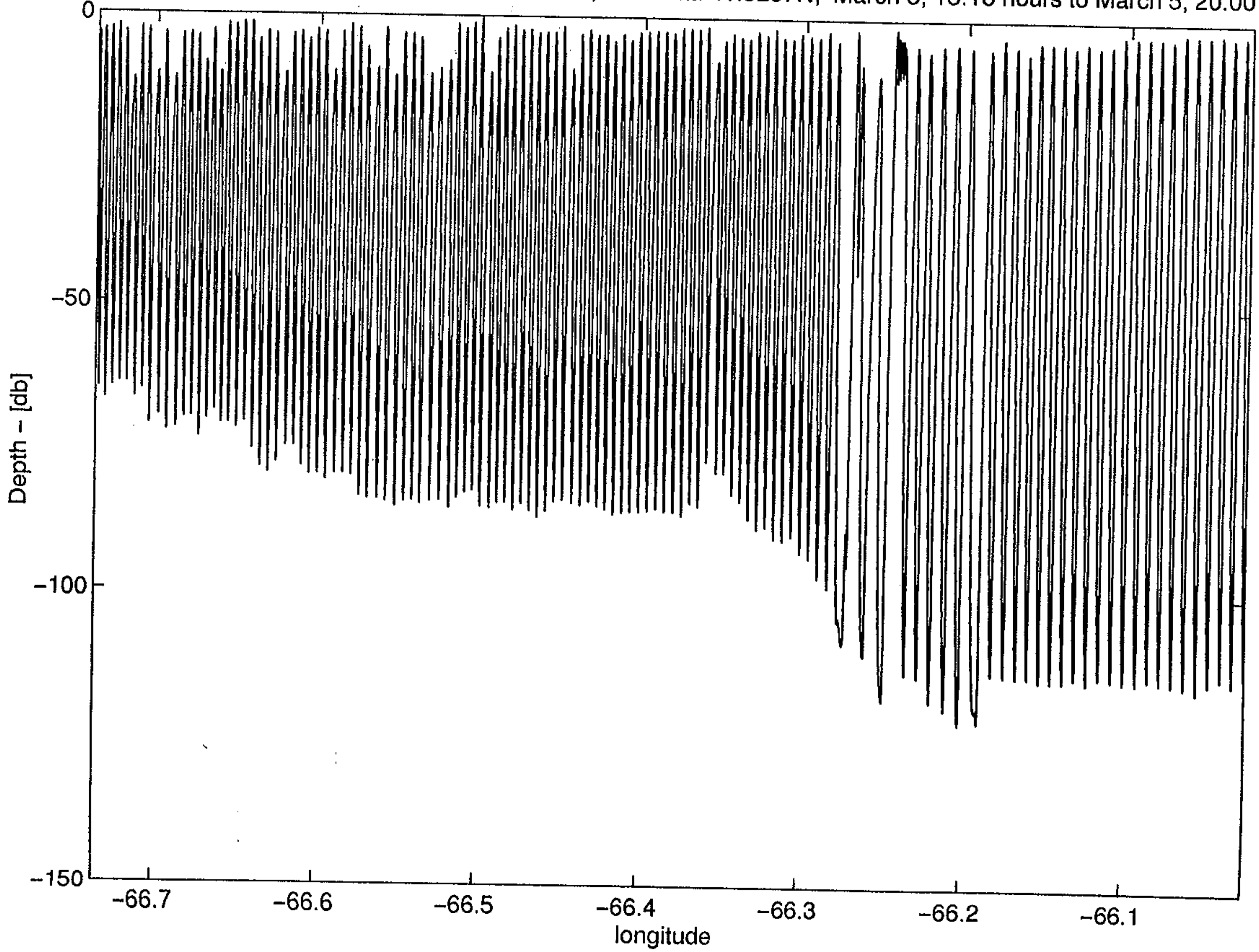
Salinity, GLOBEC II, mean lon: -66.3772W, mean lat: 41.3297N; March 5, 15.18 hours to March 5, 20.00 hours
Depth - db
0
-50
-100
-150
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
longitude
31.5
32
32.5
33
33.5
34
34.5
35

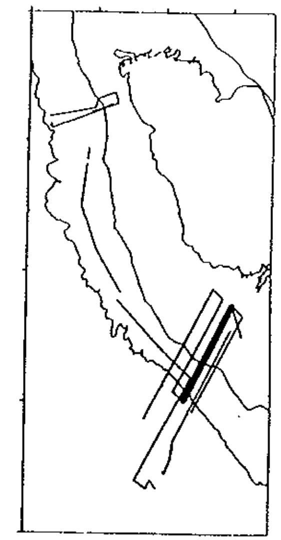
Sigma Theta, GLOBEC II, mean lon: -66.3772W, mean lat: 41.3297N; March 5, 15.18 hours to March 5, 20.00 hours



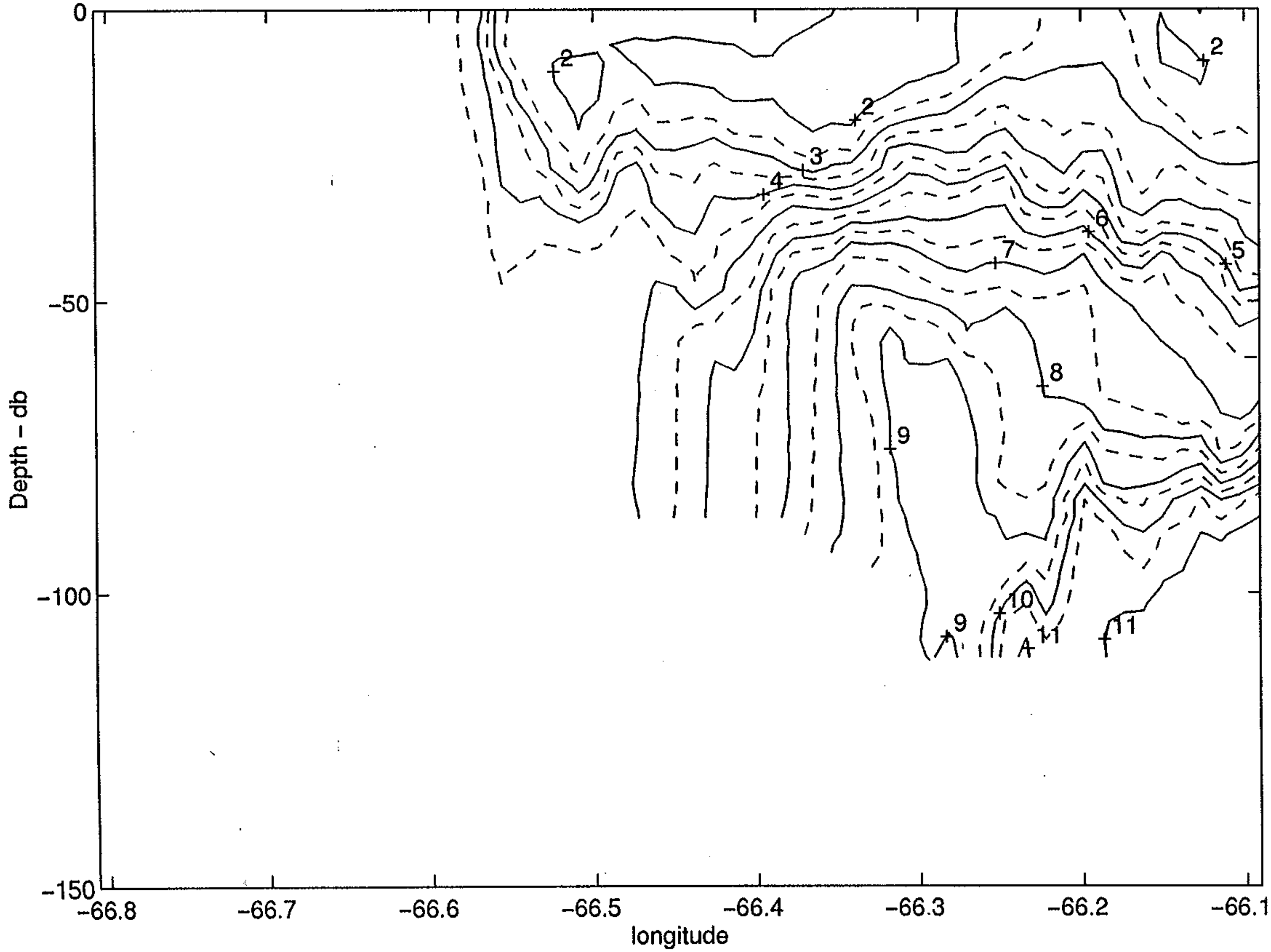


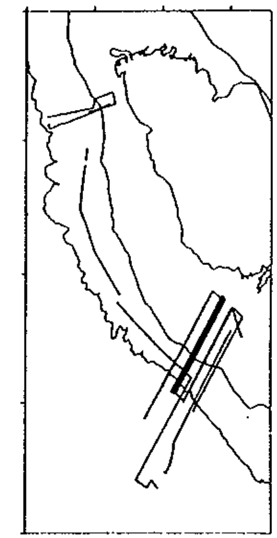
Seasoar Track, GLOBEC II, mean lon: -66.3772W, mean lat: 41.3297N; March 5, 15.18 hours to March 5, 20.00 hours



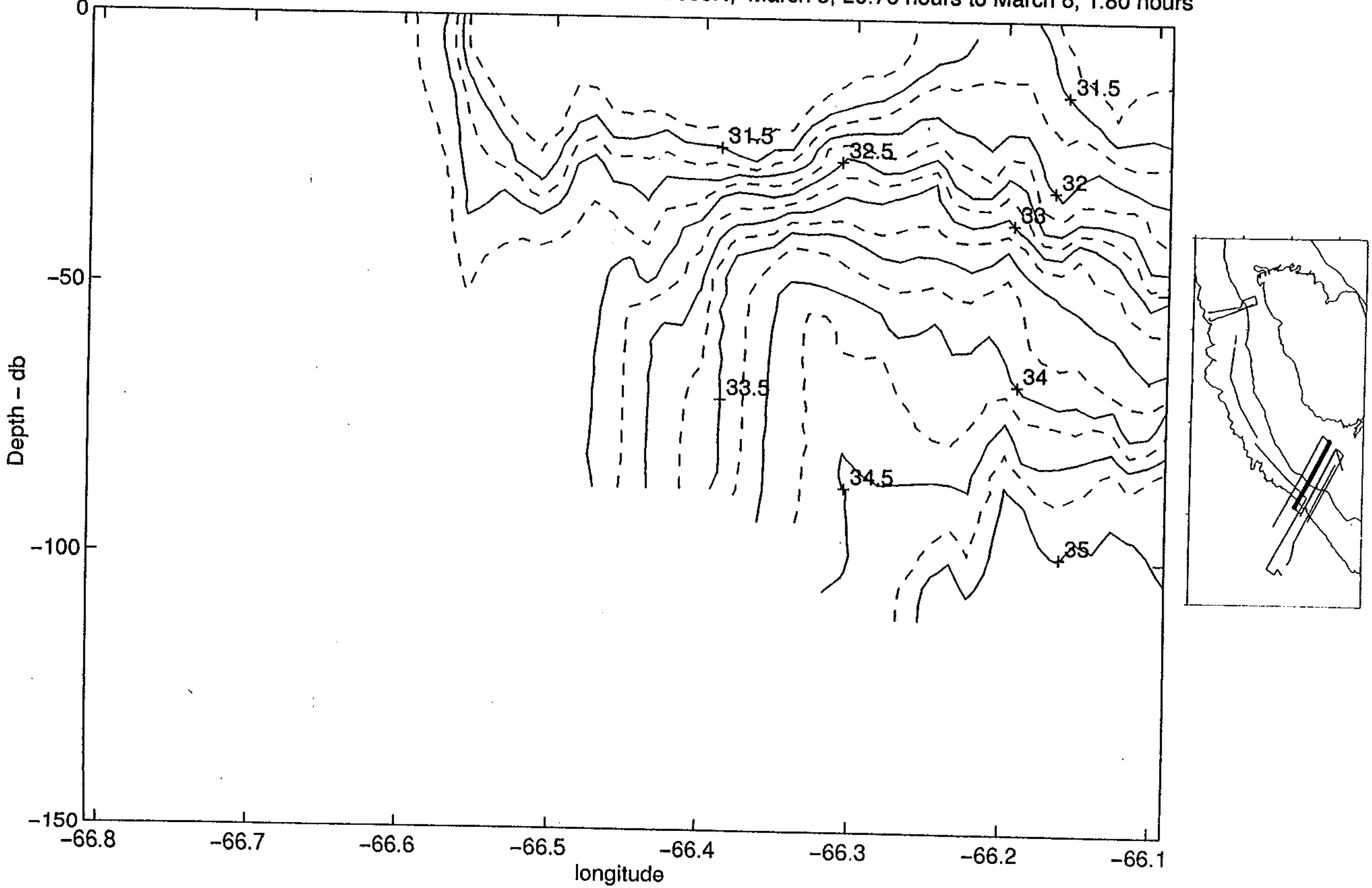


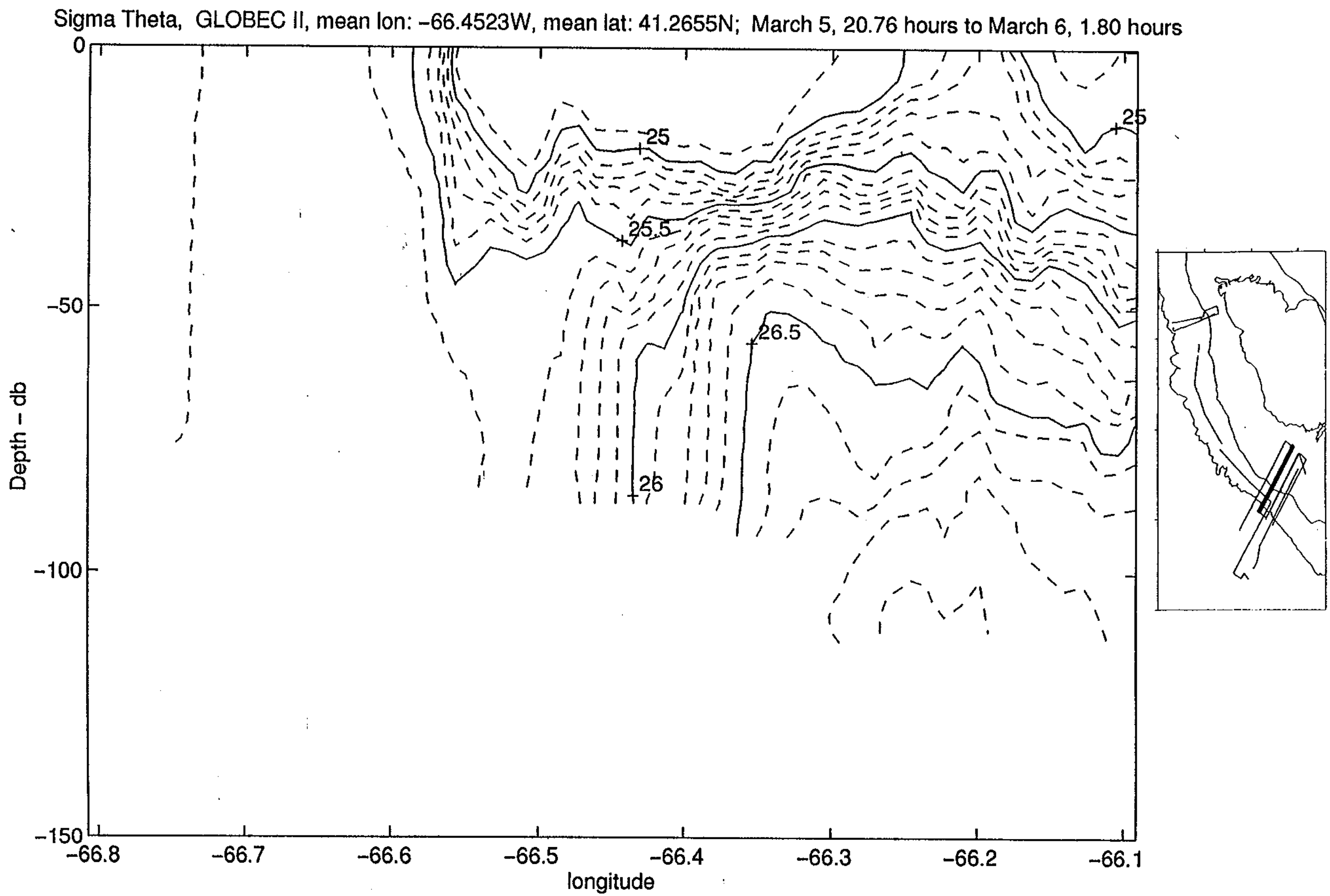
Temperature, GLOBEC II, mean lon: −66.4523W, mean lat: 41.2655N; March 5, 20.76 hours to March 6, 1.80 hours



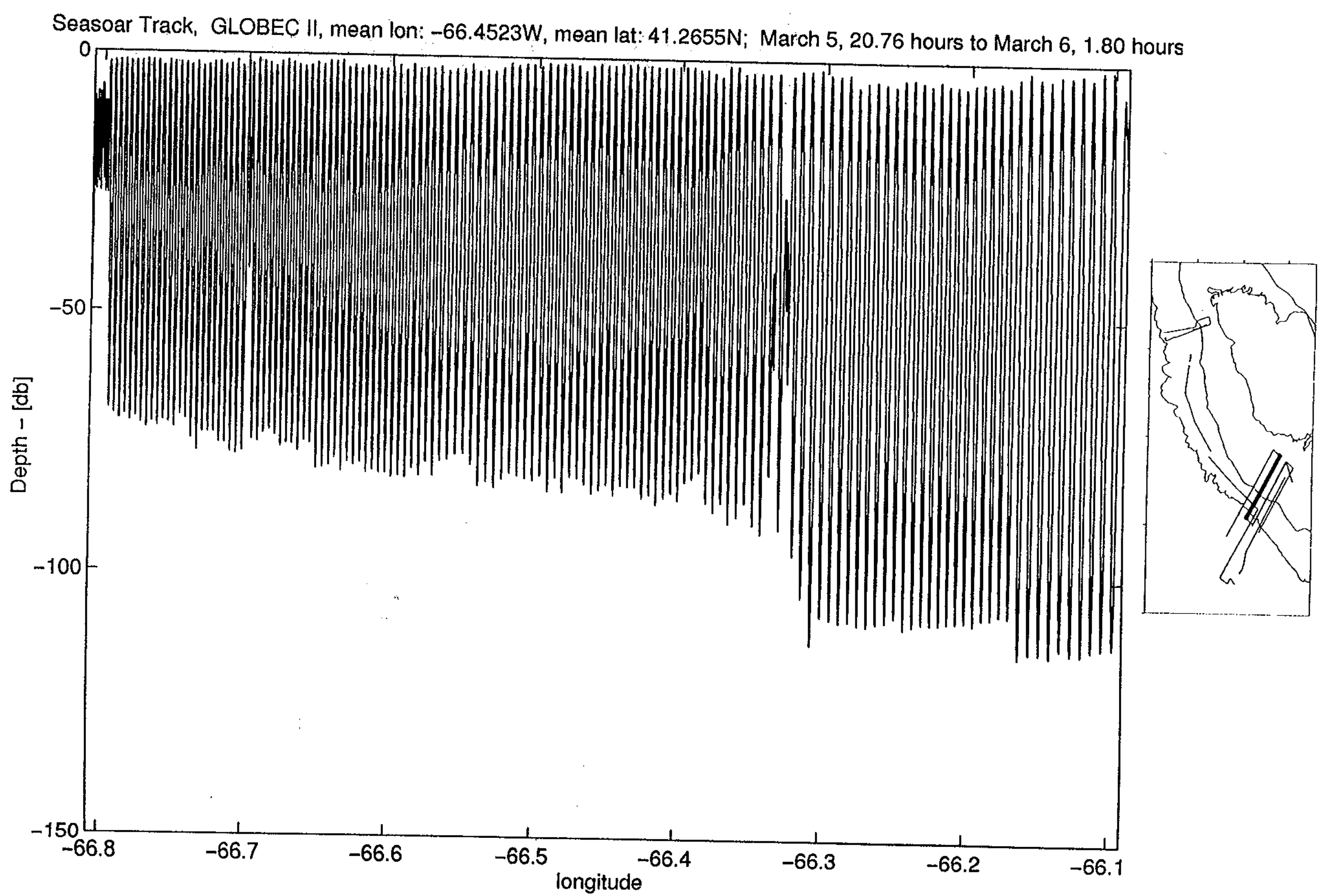


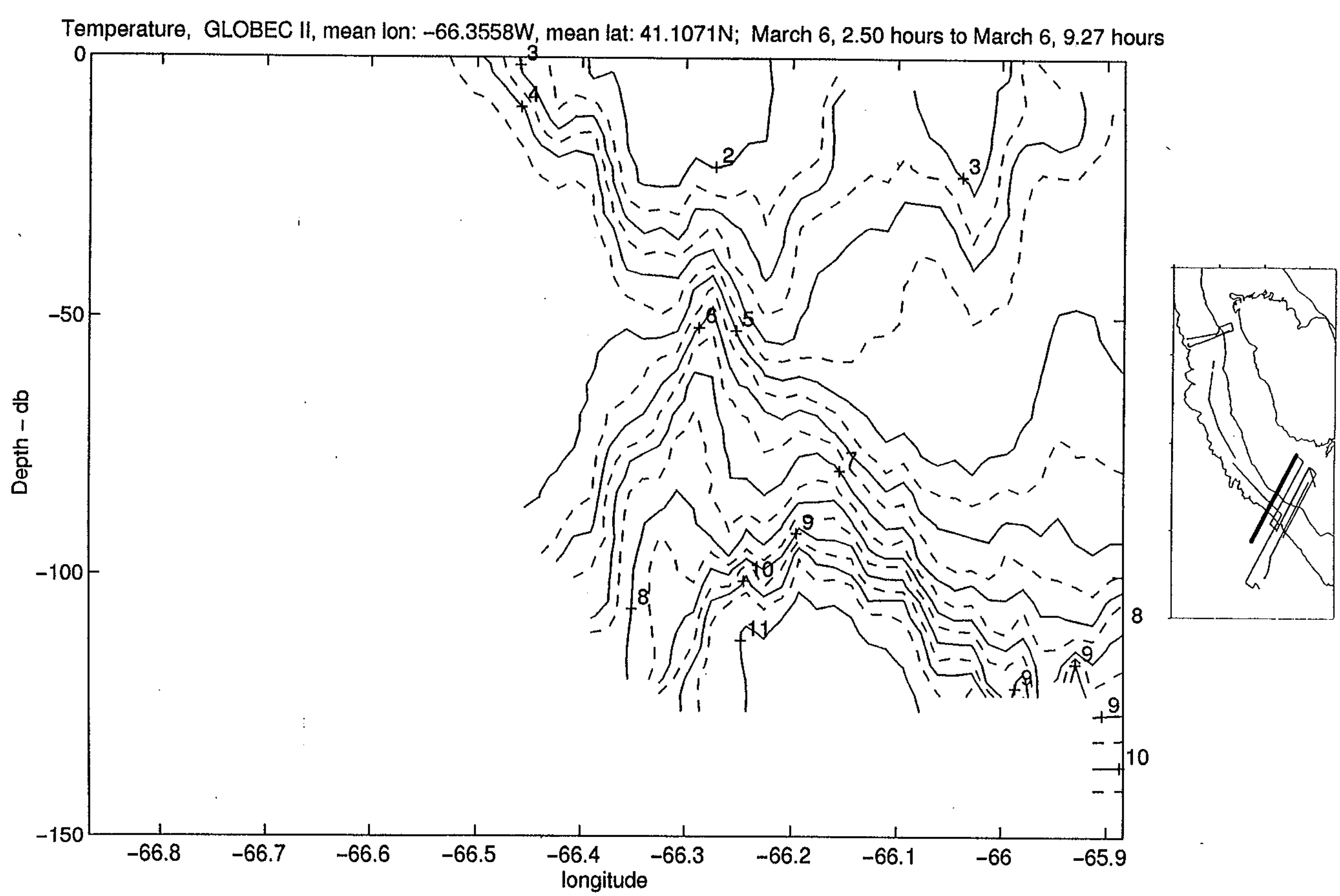
Salinity, GLOBEC II, mean lon: −66.4523W, mean lat: 41.2655N; March 5, 20.76 hours to March 6, 1.80 hours





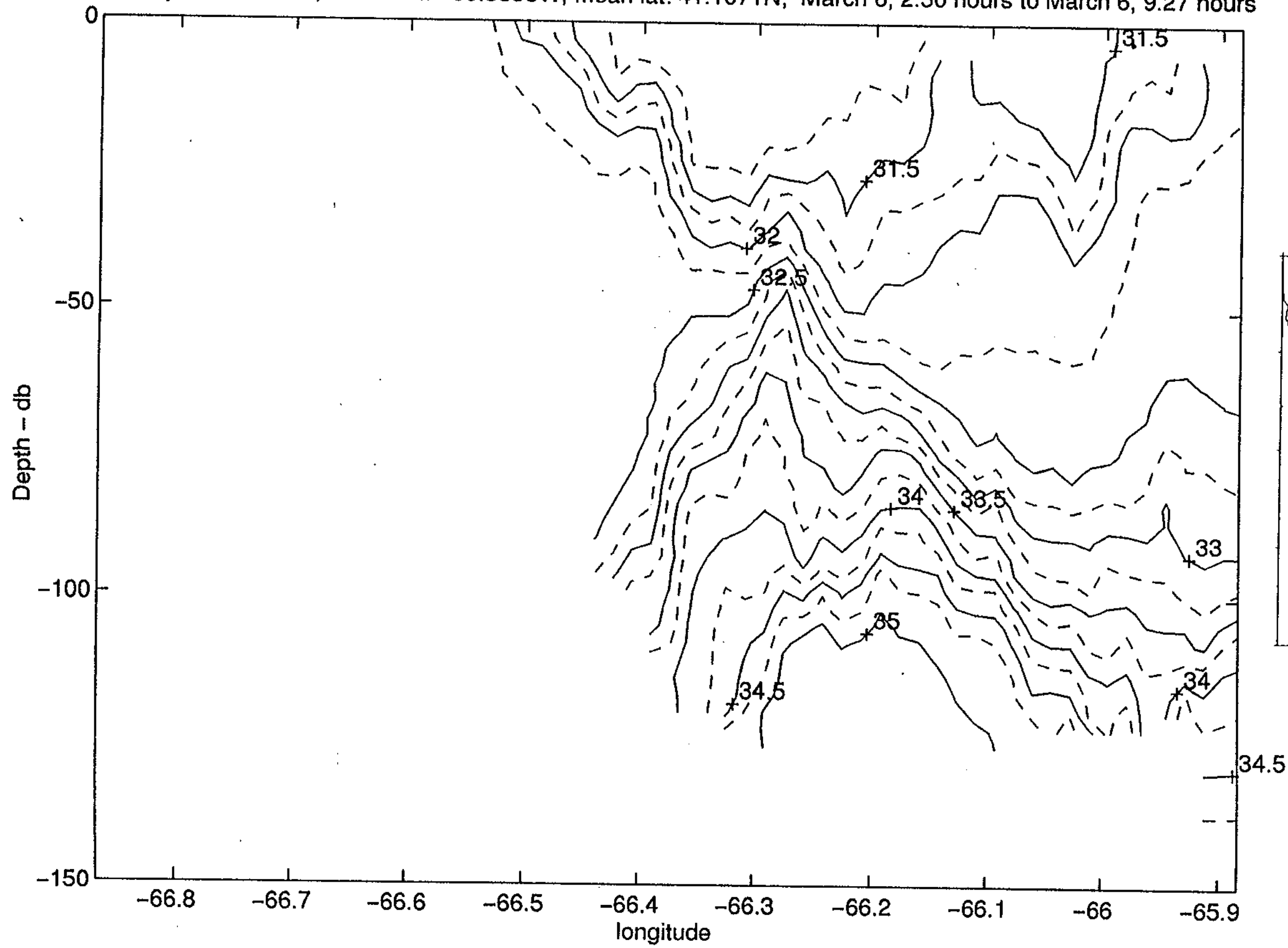
Sigma Theta, GLOBEC II, mean lon: -66.4523W, mean lat: 41.2655N; March 5, 20.76 hours to March 6, 1.80 hours
Depth - db
0
-50
-100
-150
-66.8
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
longitude
25
25.5
26
26.5
25

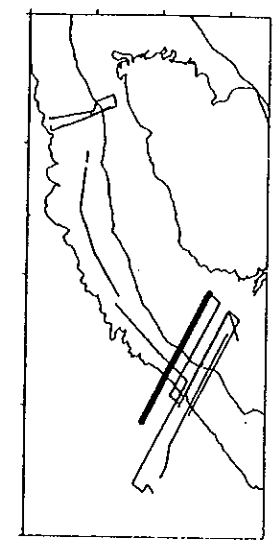

Seasoar Track, GLOBEC II, mean lon: -66.4523W, mean lat: 41.2655N; March 5, 20.76 hours to March 6, 1.80 hours
Depth – [db]
0
-50
-100
-150
-66.8
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
longitude

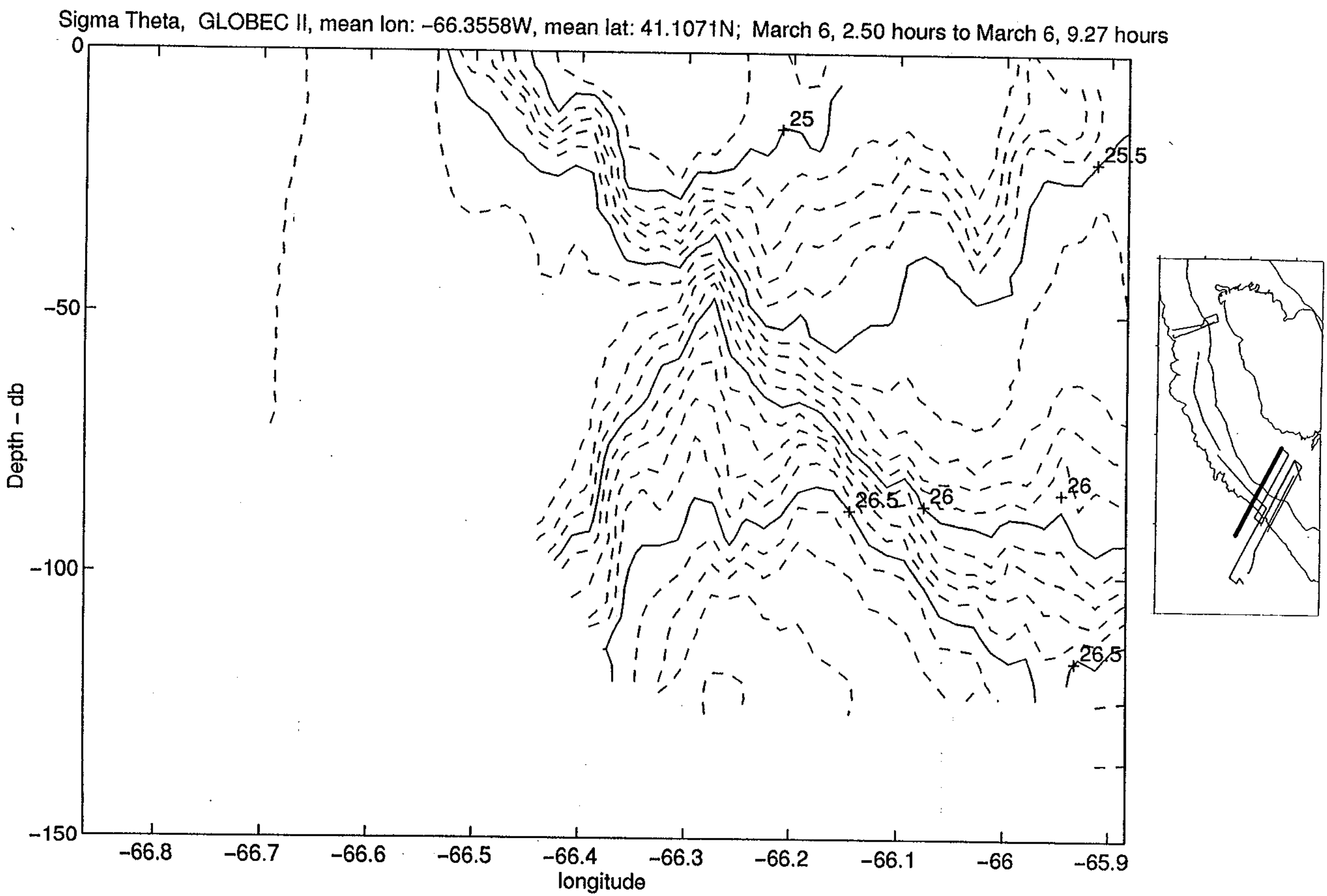


Temperature, GLOBEC II, mean lon: -66.3558W, mean lat: 41.1071N; March 6, 2.50 hours to March 6, 9.27 hours
Depth - db
longitude
0
-50
-100
-150
-66.8
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
-66
-65.9
2
3
4
5
6
7
8
9
10
11

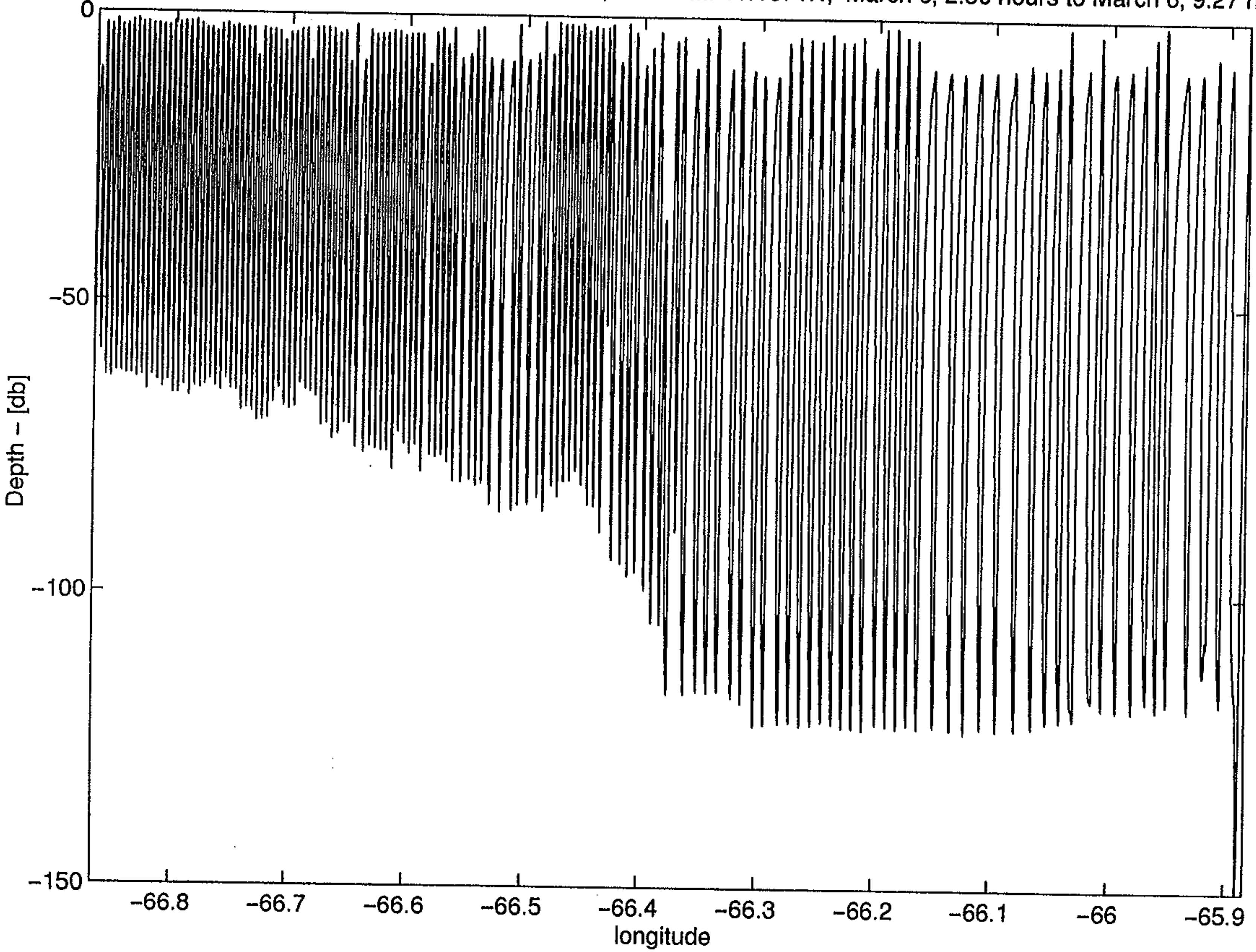
Salinity, GLOBEC II, mean lon: -66.3558W, mean lat: 41.1071N; March 6, 2.50 hours to March 6, 9.27 hours

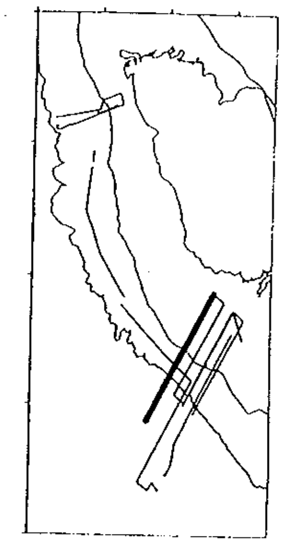




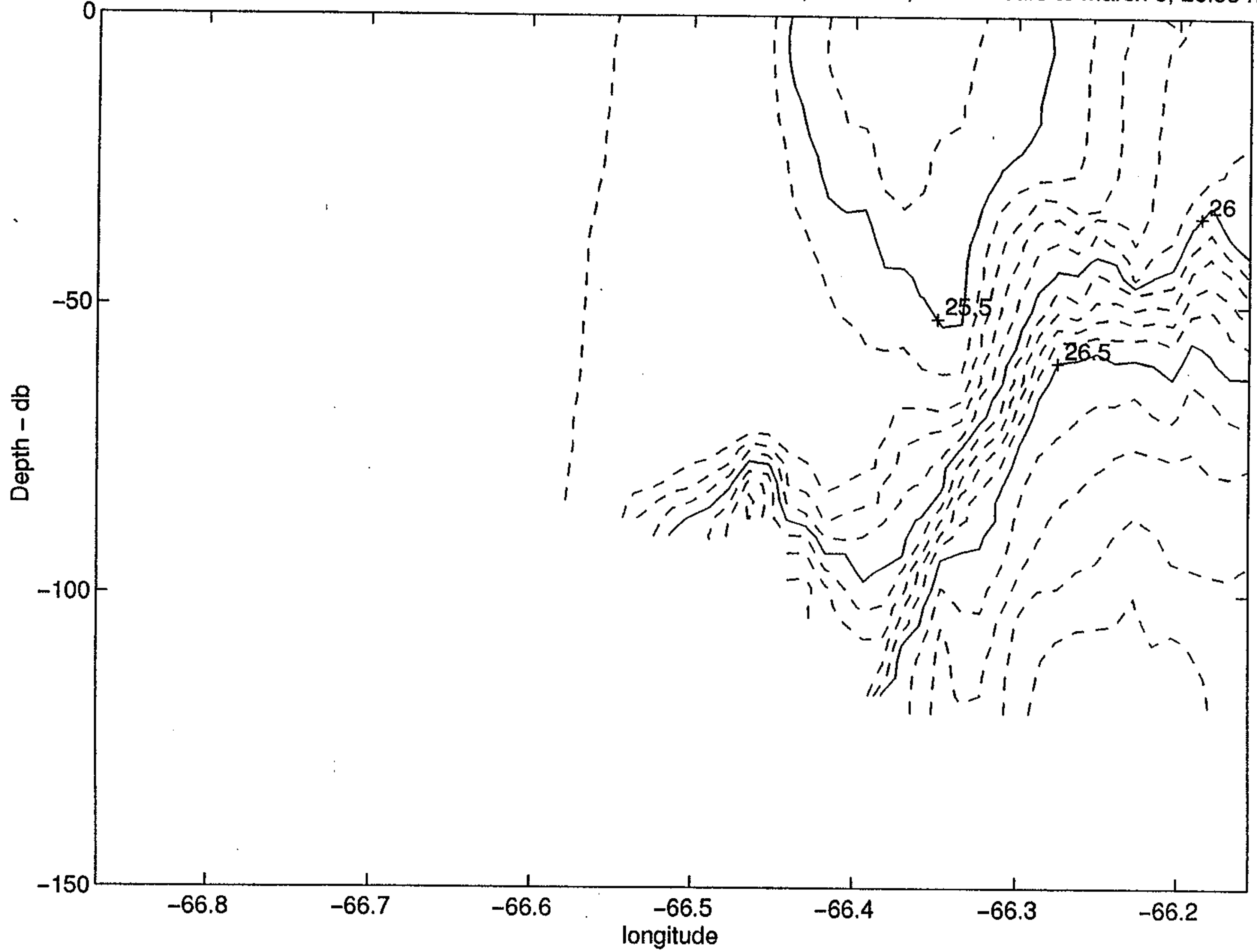

Sigma Theta, GLOBEC II, mean lon: −66.3558W, mean lat: 41.1071N; March 6, 2.50 hours to March 6, 9.27 hours
Depth – db
0
−50
−100
−150
−66.8
−66.7
−66.6
−66.5
−66.4
−66.3
−66.2
−66.1
−66
−65.9
longitude
25
25.5
26.5
26
26
26.5

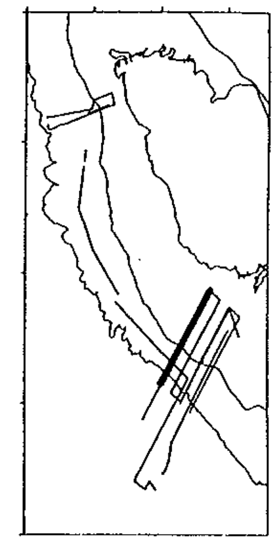
Seasoar Track, GLOBEC II, mean lon: −66.3558W, mean lat: 41.1071N; March 6, 2.50 hours to March 6, 9.27 hours

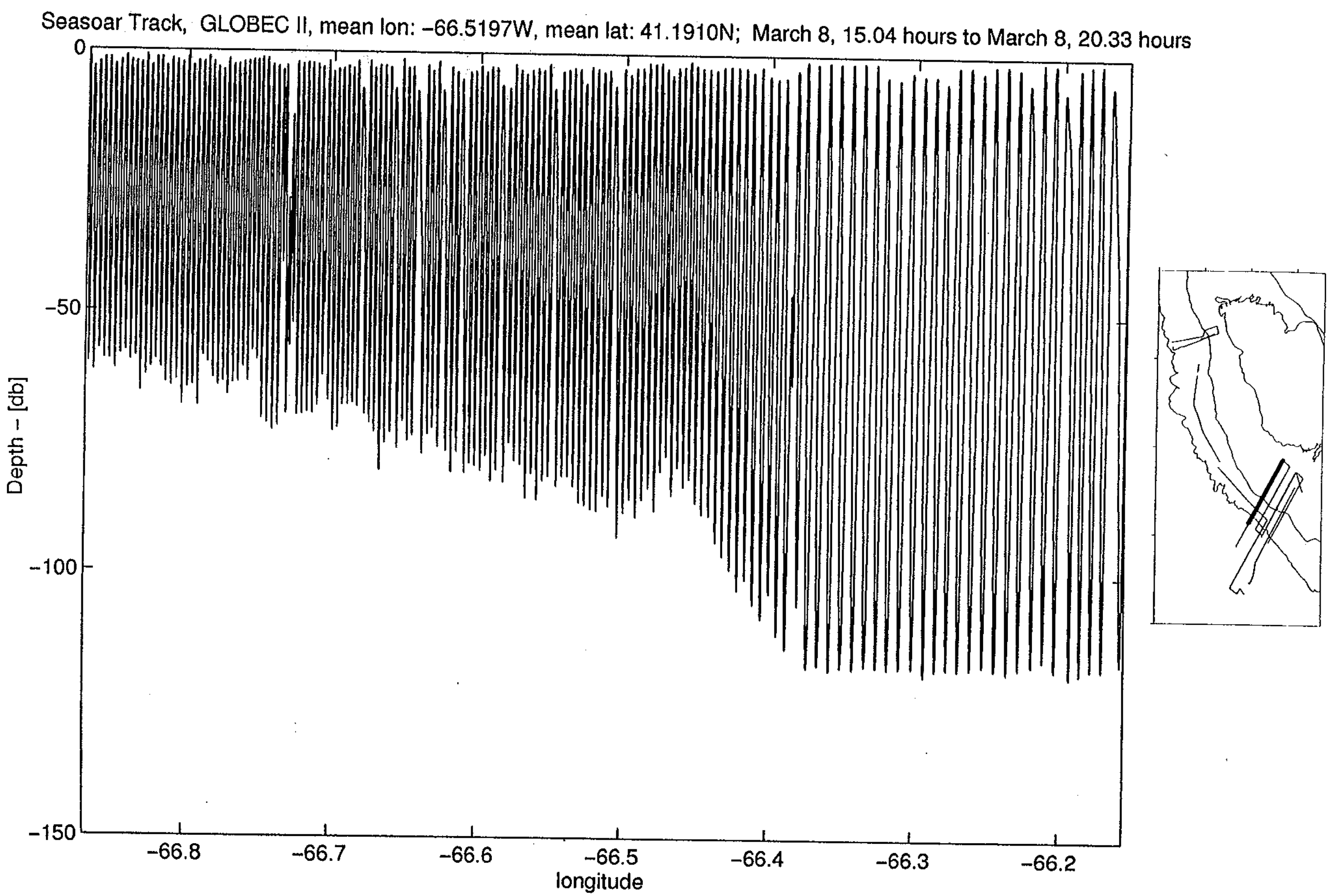




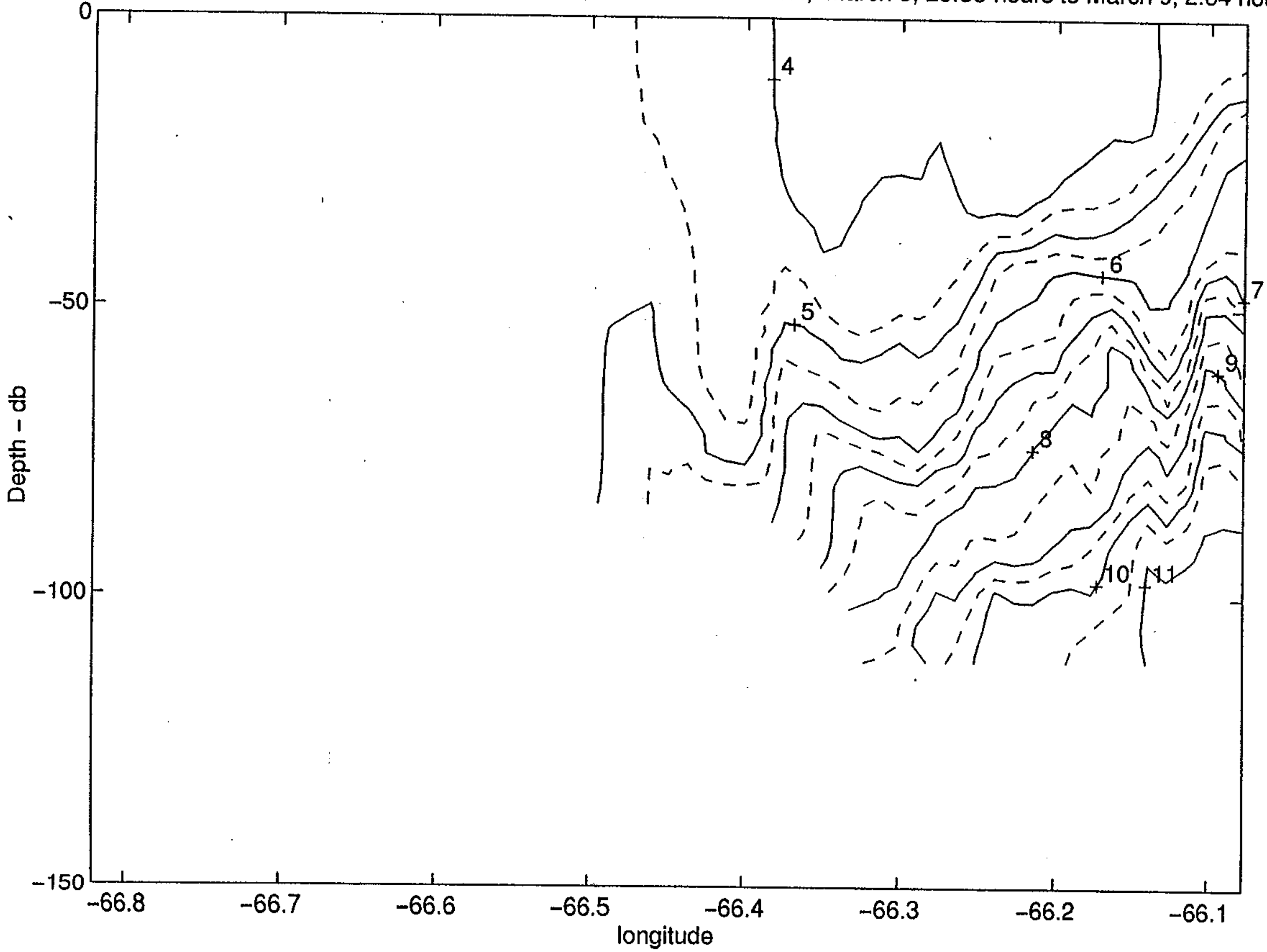
Sigma Theta, GLOBEC II, mean lon: −66.5197W, mean lat: 41.1910N; March 8, 15.04 hours to March 8, 20.33 hours

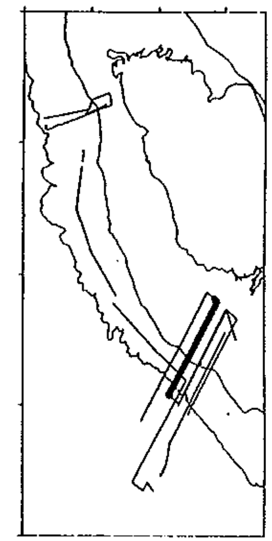


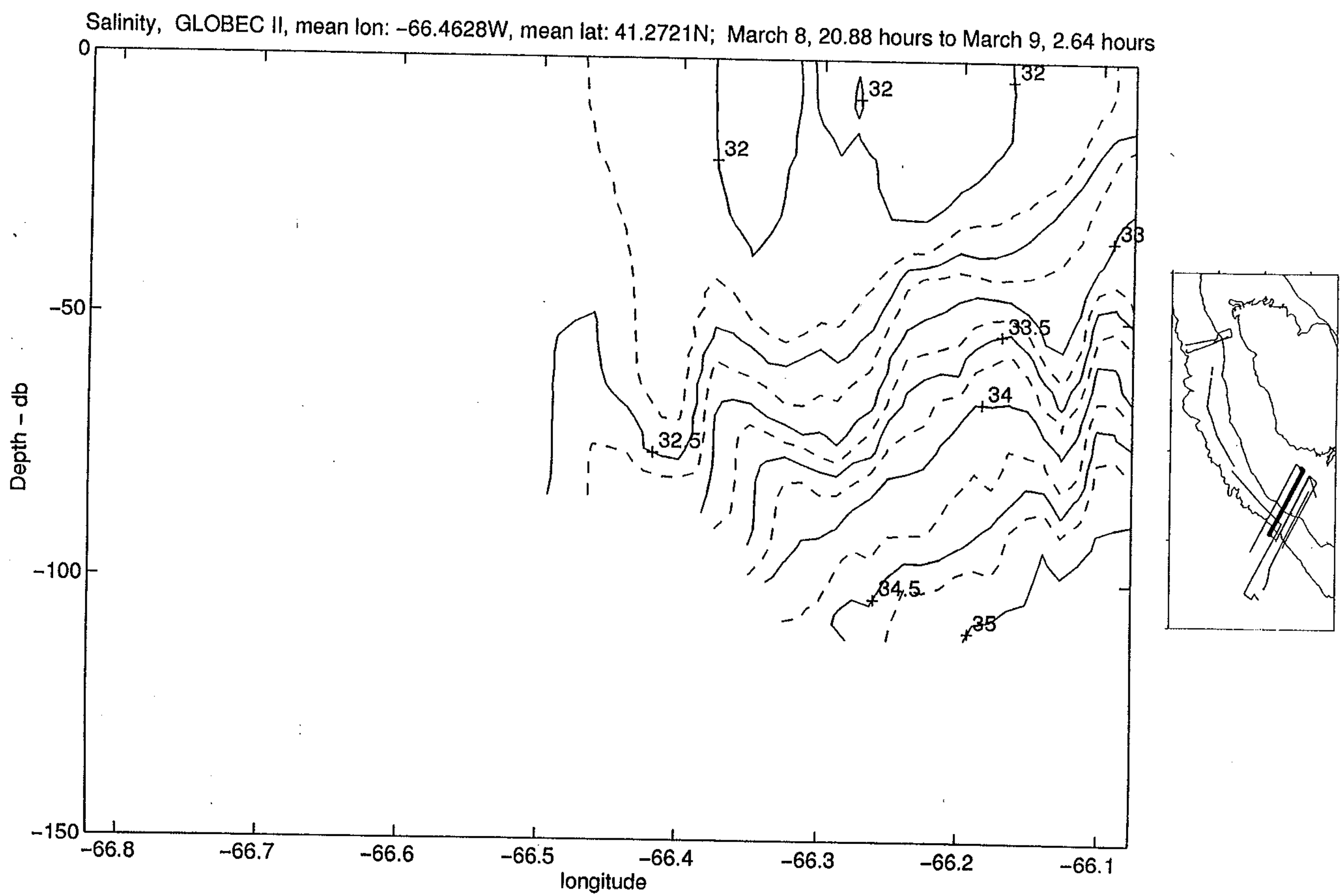



Seasoar Track, GLOBEC II, mean lon: −66.5197W, mean lat: 41.1910N; March 8, 15.04 hours to March 8, 20.33 hours
0
-50
-100
-150
Depth – [db]
-66.8
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
longitude

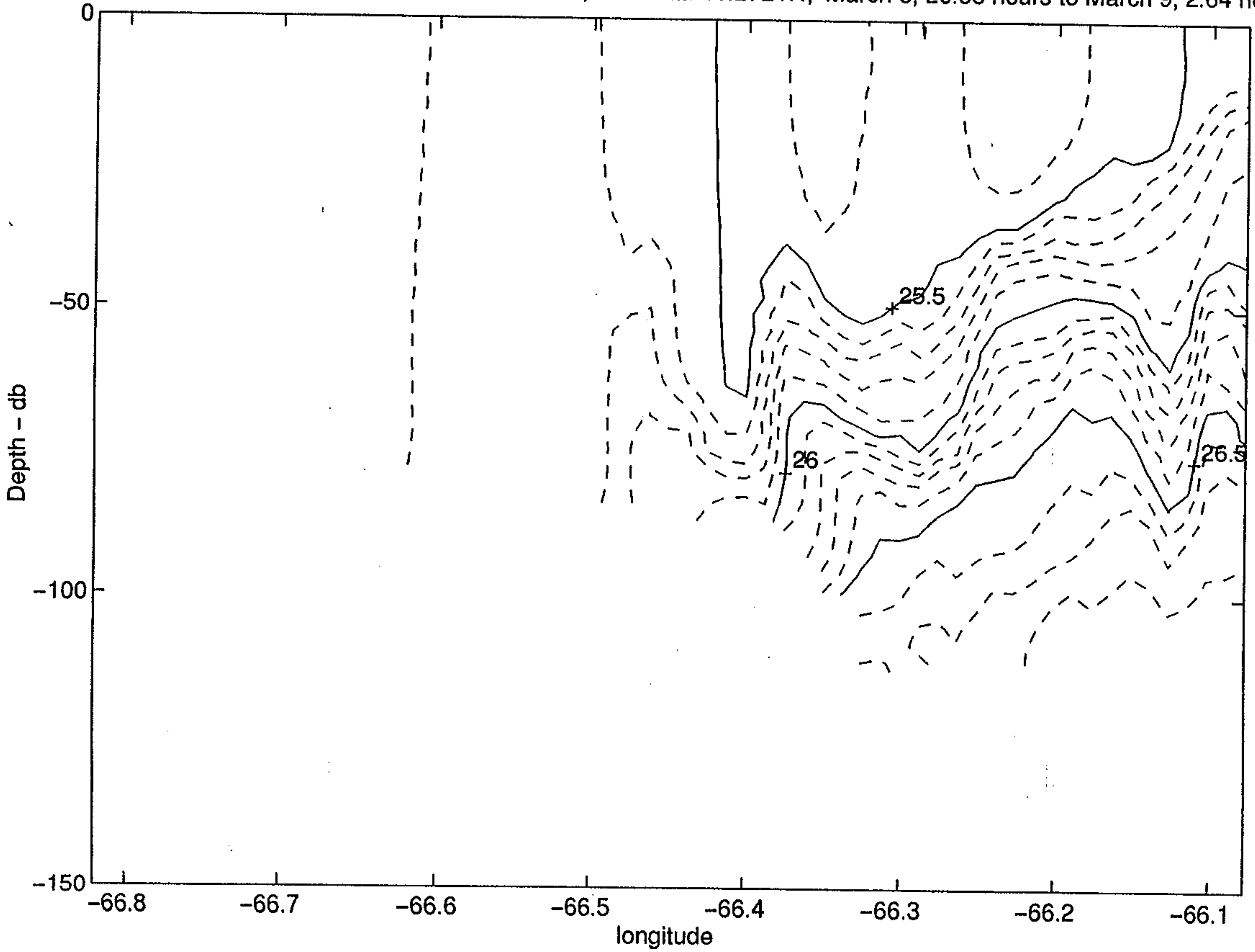
Temperature, GLOBEC II, mean lon: -66.4628W, mean lat: 41.2721N; March 8, 20.88 hours to March 9, 2.64 hours

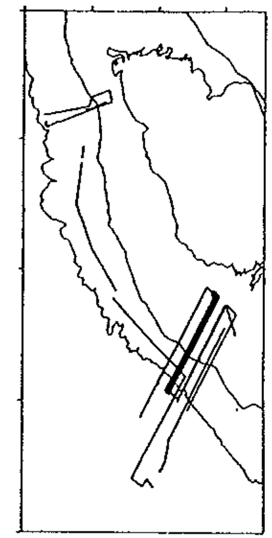


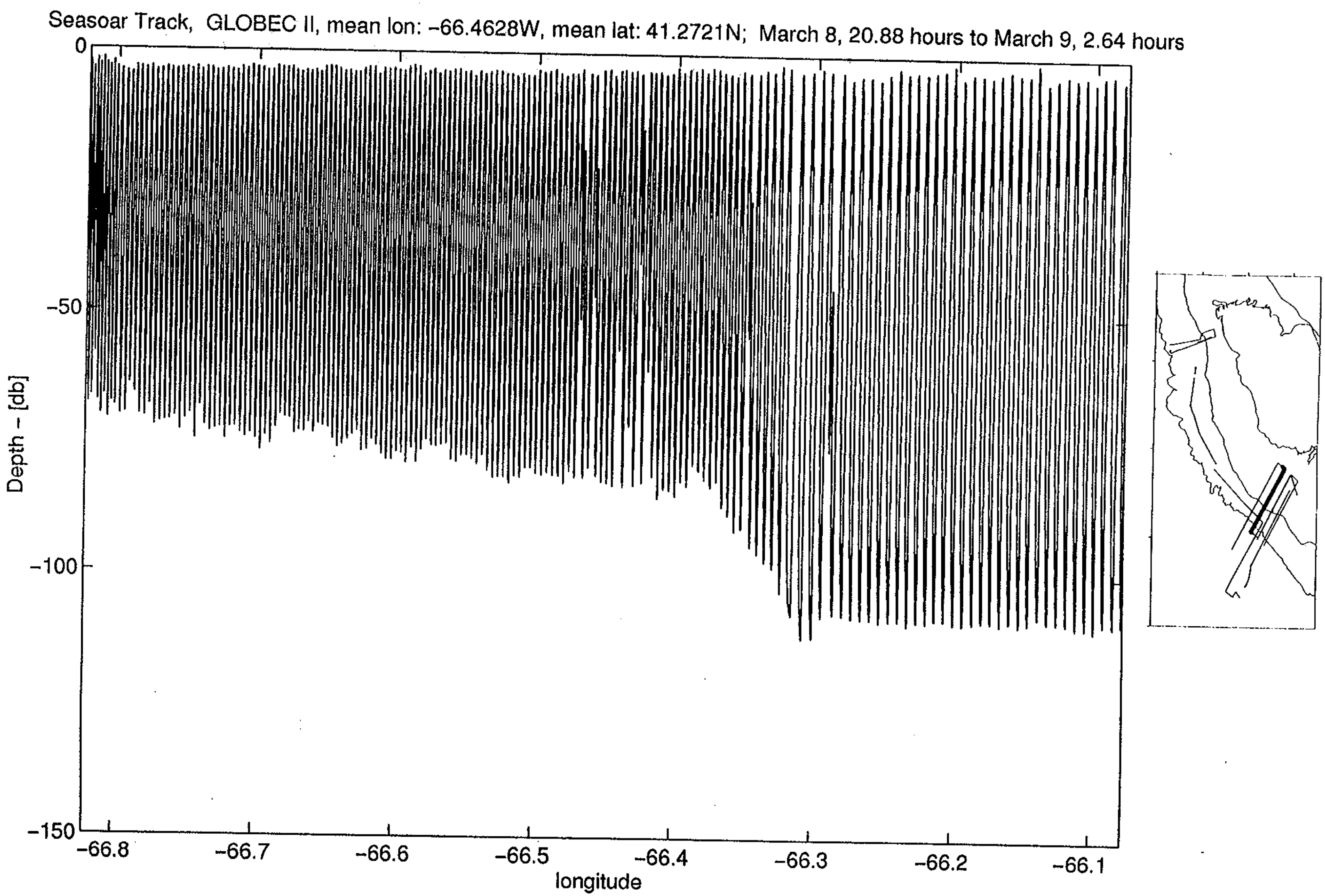



Salinity, GLOBEC II, mean lon: −66.4628W, mean lat: 41.2721N; March 8, 20.88 hours to March 9, 2.64 hours
Depth – db
0
−50
−100
−150
−66.8
−66.7
−66.6
−66.5
−66.4
−66.3
−66.2
−66.1
longitude
32
32
32
32.5
33
33.5
34
34.5
35

Sigma Theta, GLOBEC II, mean lon: −66.4628W, mean lat: 41.2721N; March 8, 20.88 hours to March 9, 2.64 hours

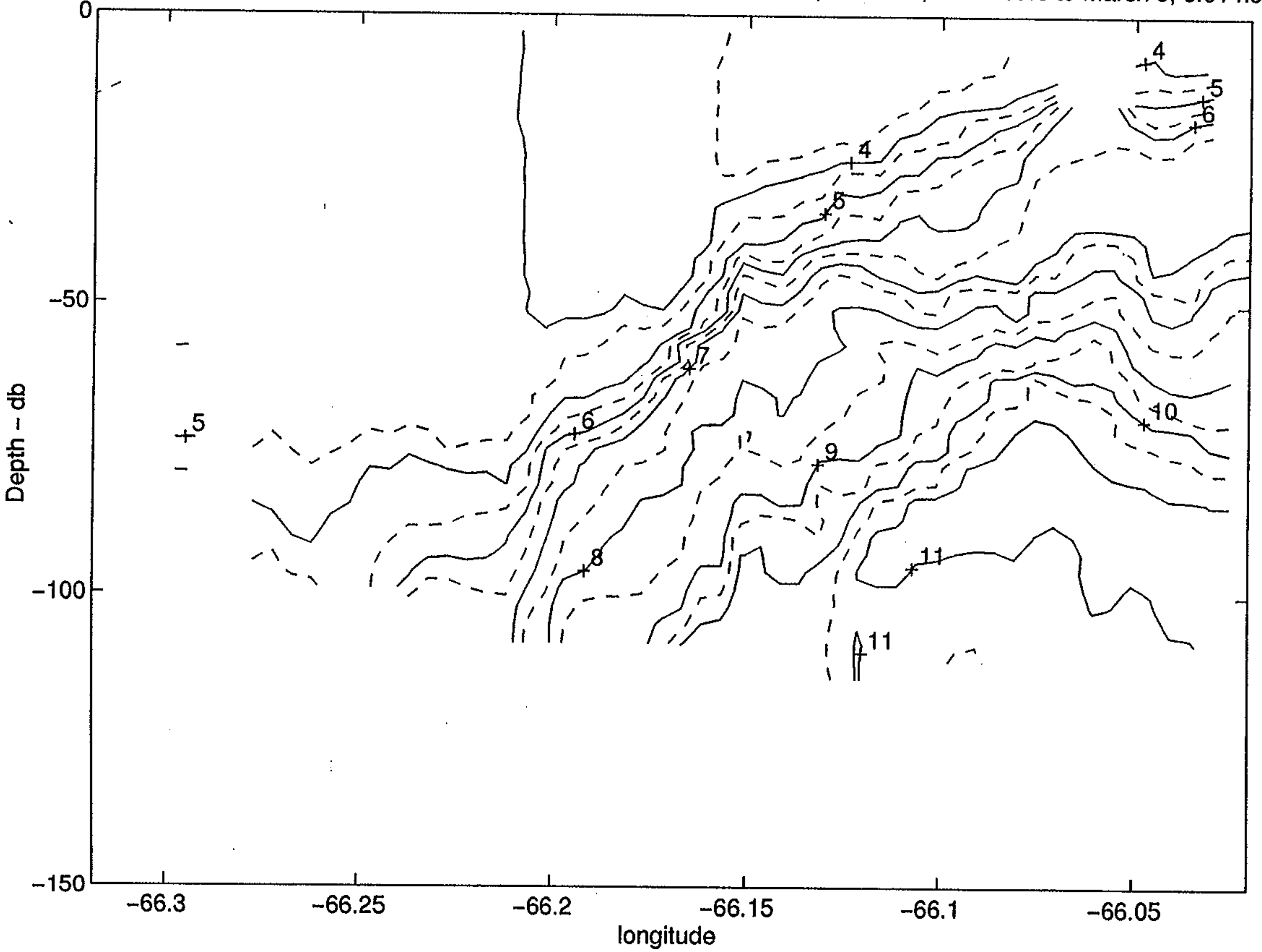


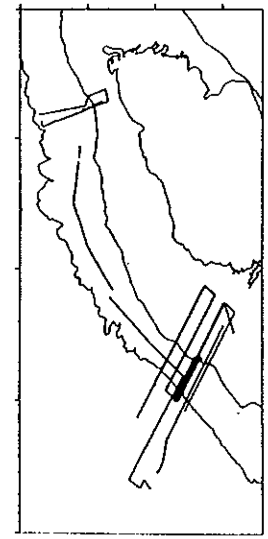




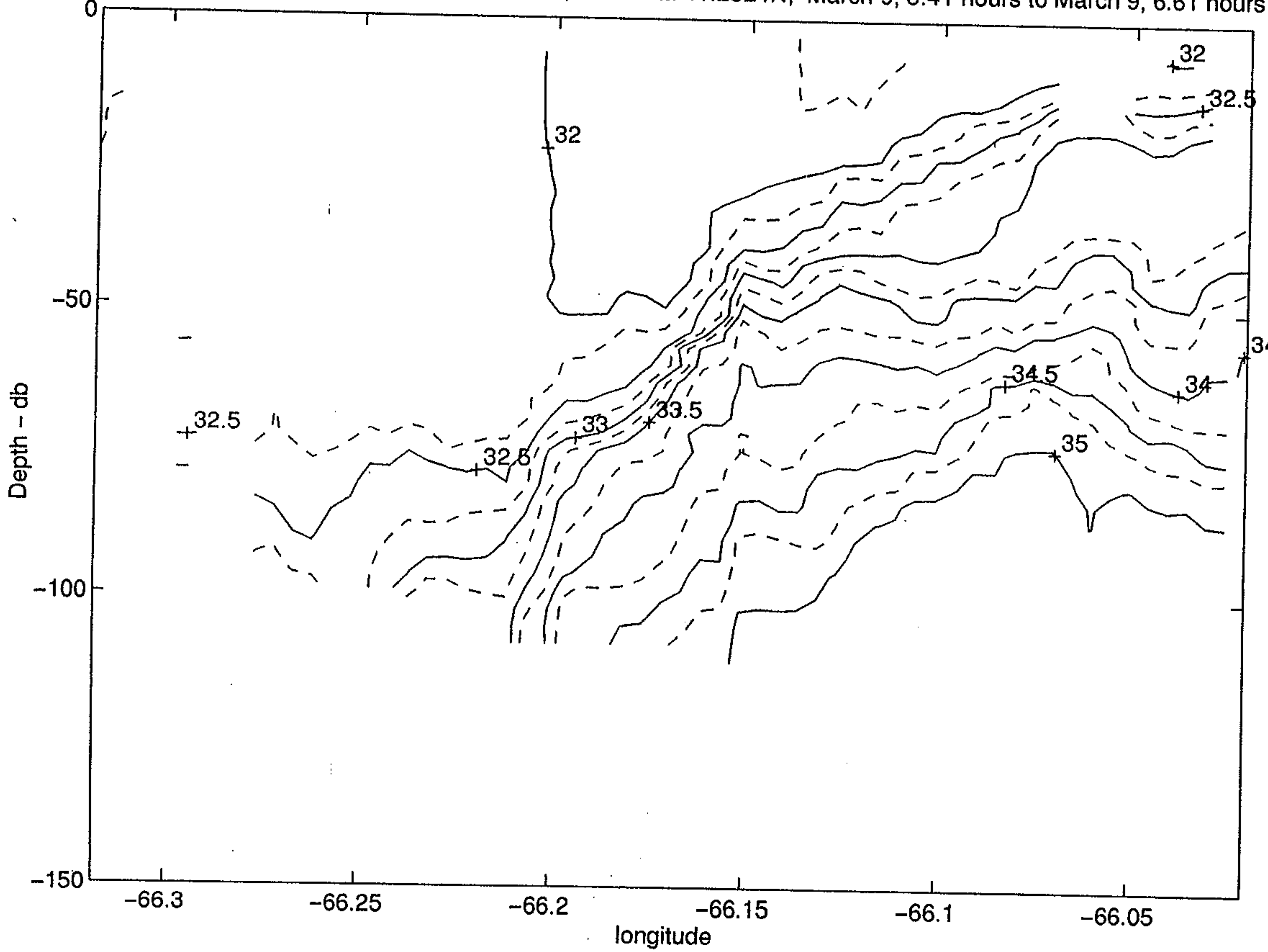
Seasoar Track, GLOBEC II, mean lon: -66.4628W, mean lat: 41.2721N; March 8, 20.88 hours to March 9, 2.64 hours
Depth - [db]
0
-50
-100
-150
-66.8
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
longitude

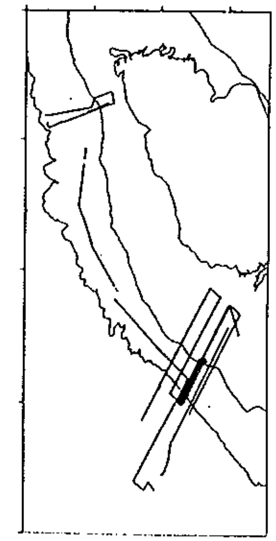
Temperature, GLOBEC II, mean lon: −66.2078W, mean lat: 41.2524N; March 9, 3.41 hours to March 9, 6.61 hours



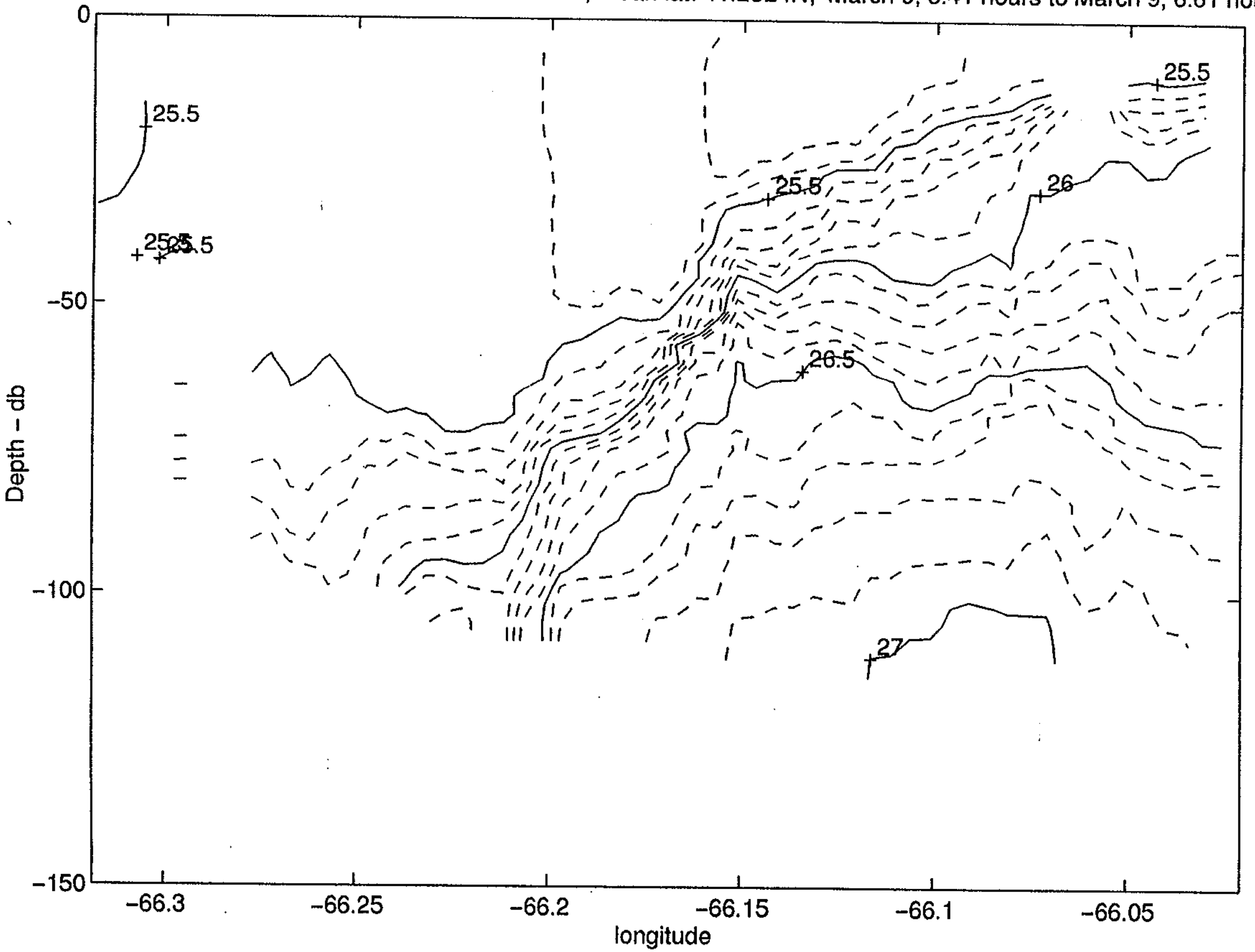


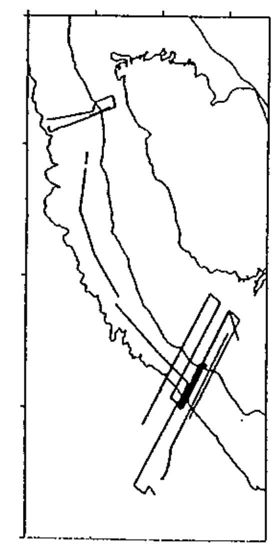
Salinity, GLOBEC II, mean lon: −66.2078W, mean lat: 41.2524N; March 9, 3.41 hours to March 9, 6.61 hours

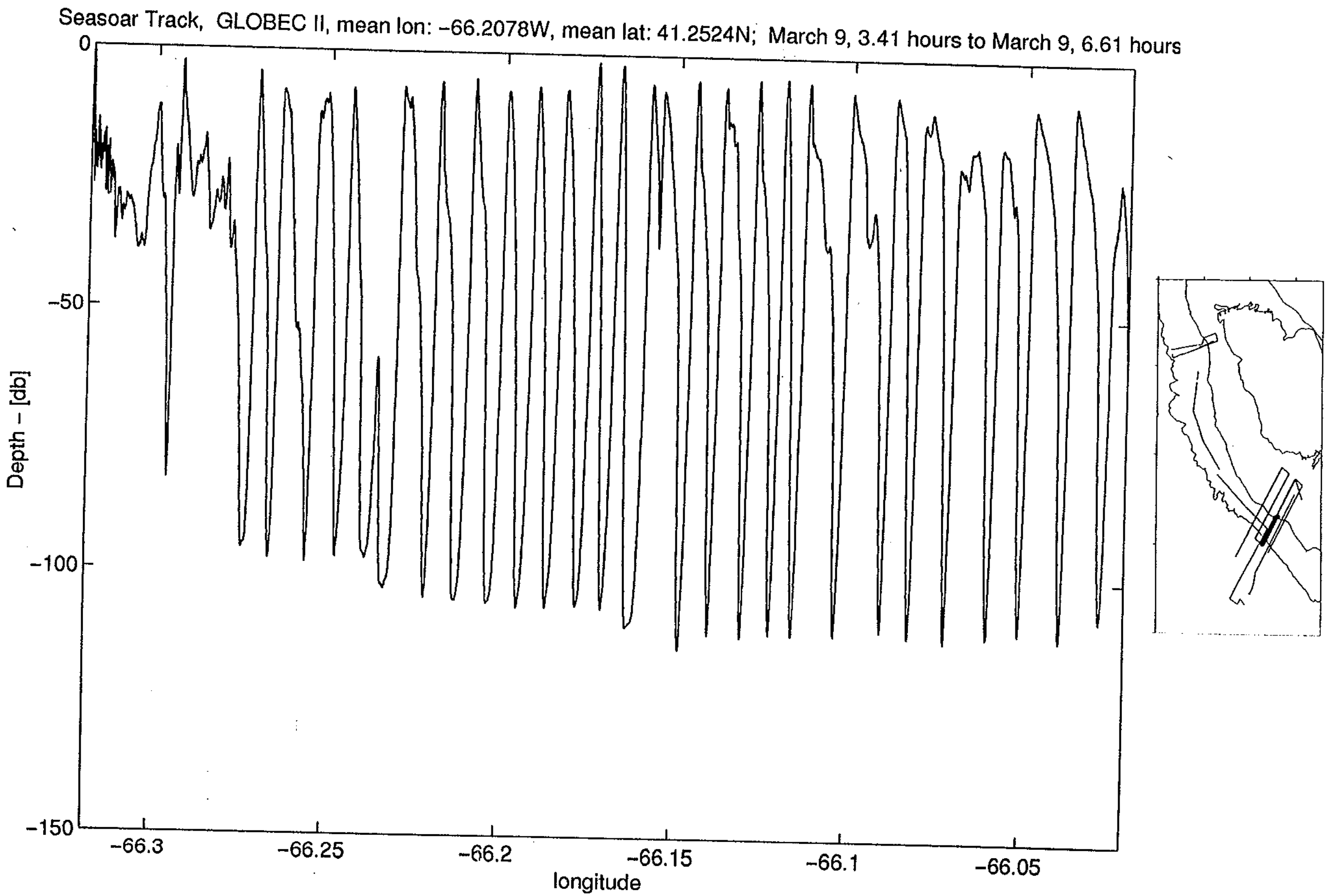


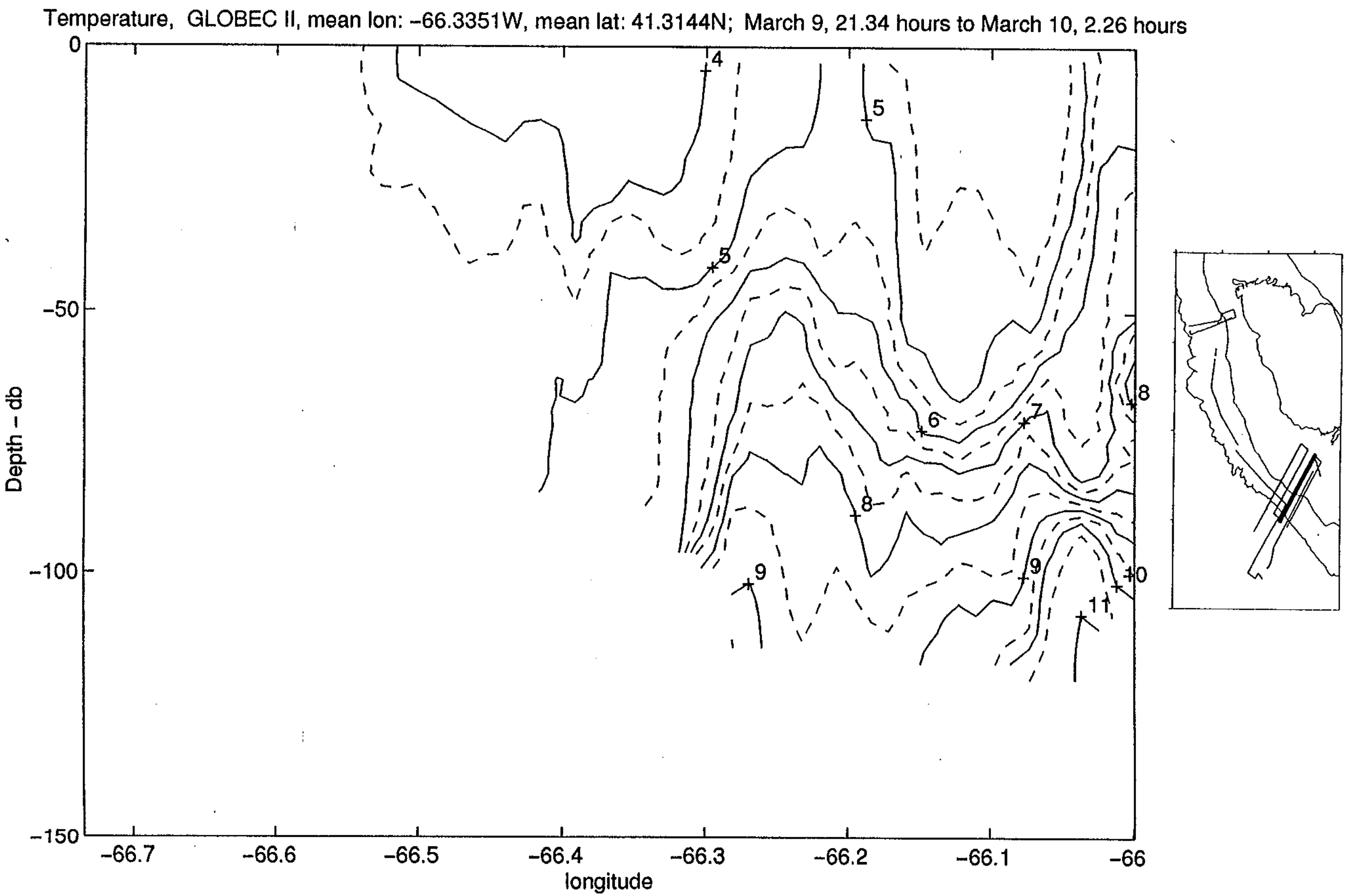


Sigma Theta, GLOBEC II, mean lon: -66.2078W, mean lat: 41.2524N; March 9, 3.41 hours to March 9, 6.61 hours






Seasoar Track, GLOBEC II, mean lon: −66.2078W, mean lat: 41.2524N; March 9, 3.41 hours to March 9, 6.61 hours
Depth − [db]
0
−50
−100
−150
−66.3
−66.25
−66.2
−66.15
−66.1
−66.05
longitude


Temperature, GLOBEC II, mean lon: -66.3351W, mean lat: 41.3144N; March 9, 21.34 hours to March 10, 2.26 hours
Depth - db
0
-50
-100
-150
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
-66
longitude
4
5
5
6
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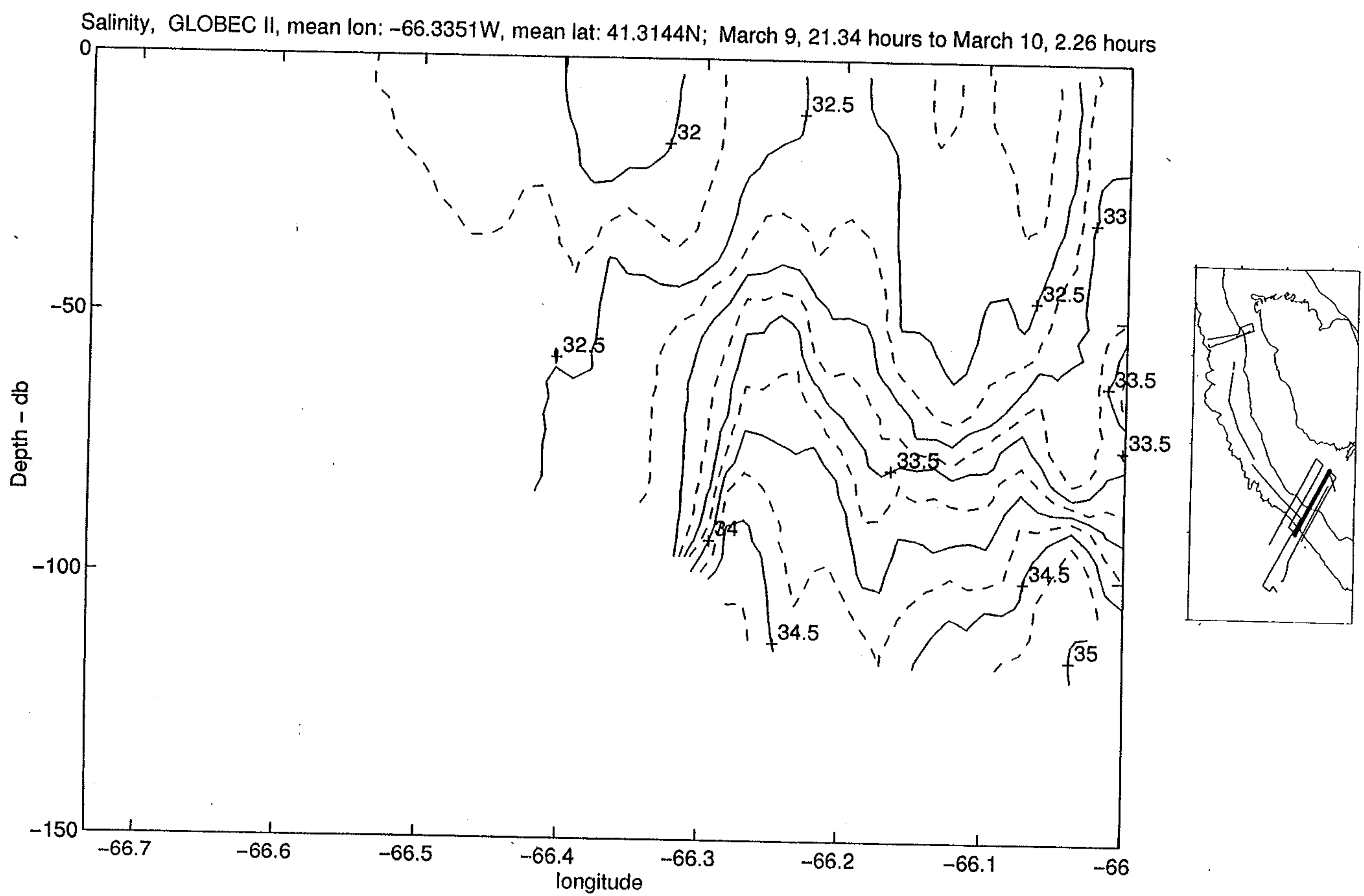
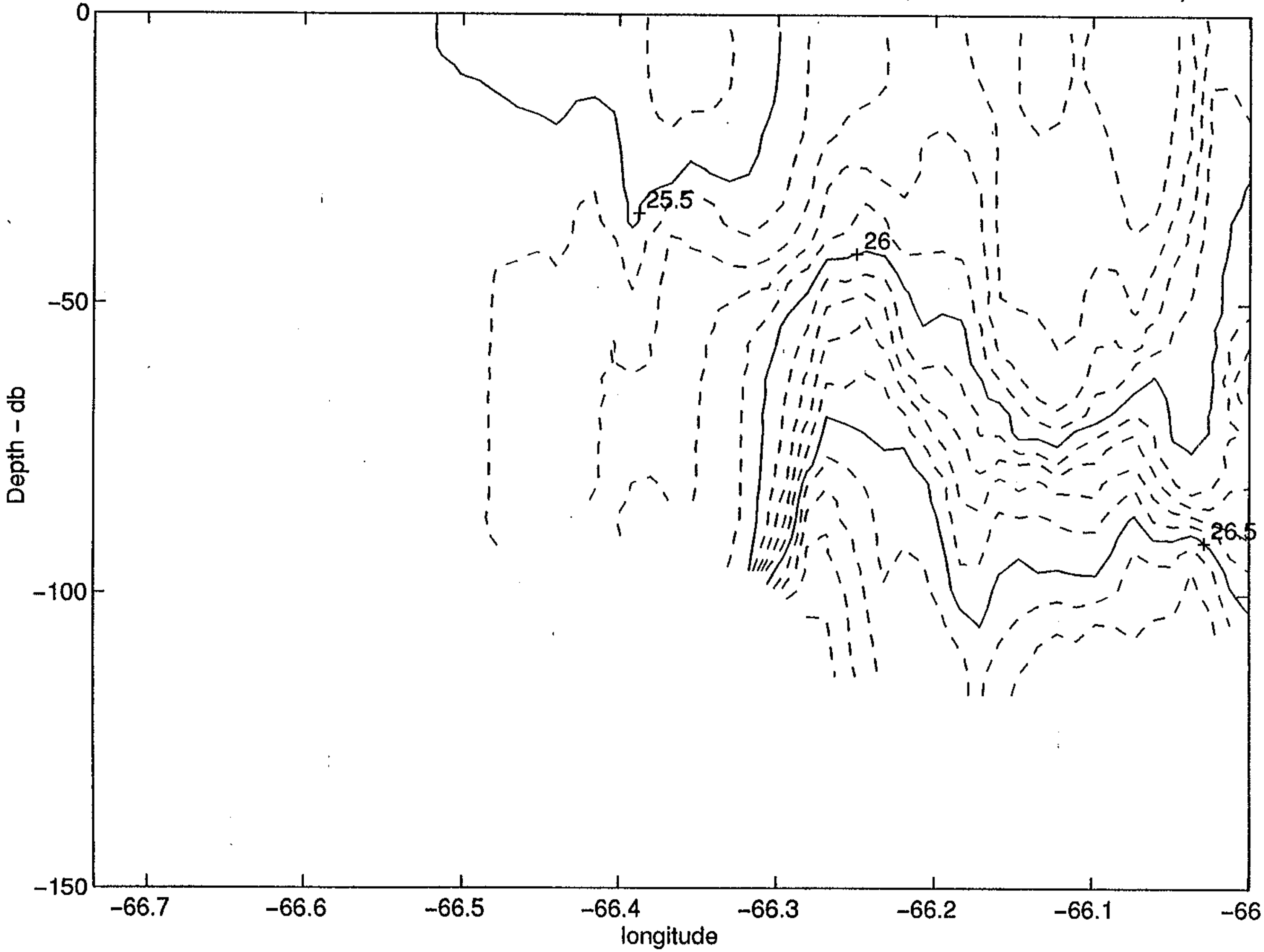
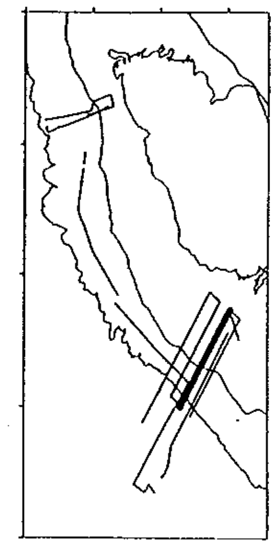
8
9
9
10
11

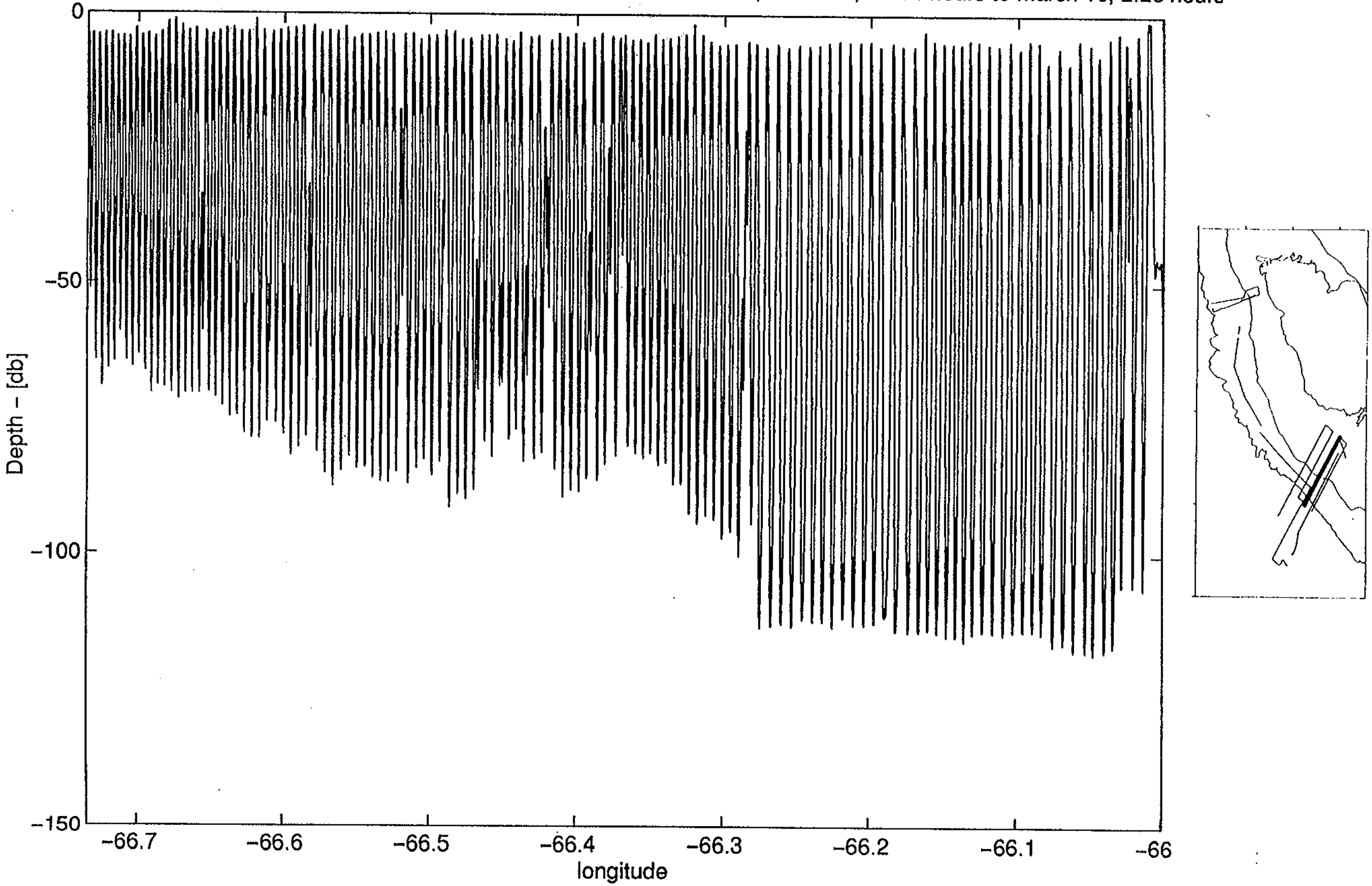

Salinity, GLOBEC II, mean lon: -66.3351W, mean lat: 41.3144N; March 9, 21.34 hours to March 10, 2.26 hours
Depth - db
0
-50
-100
-150
-66.7
-66.6
-66.5
-66.4
-66.3
-66.2
-66.1
-66
longitude
32
32.5
32.5
32.5
33
33.5
33.5
33.5
34
34.5
34.5
35

Sigma Theta, GLOBEC II, mean lon: -66.3351W, mean lat: 41.3144N; March 9, 21.34 hours to March 10, 2.26 hours

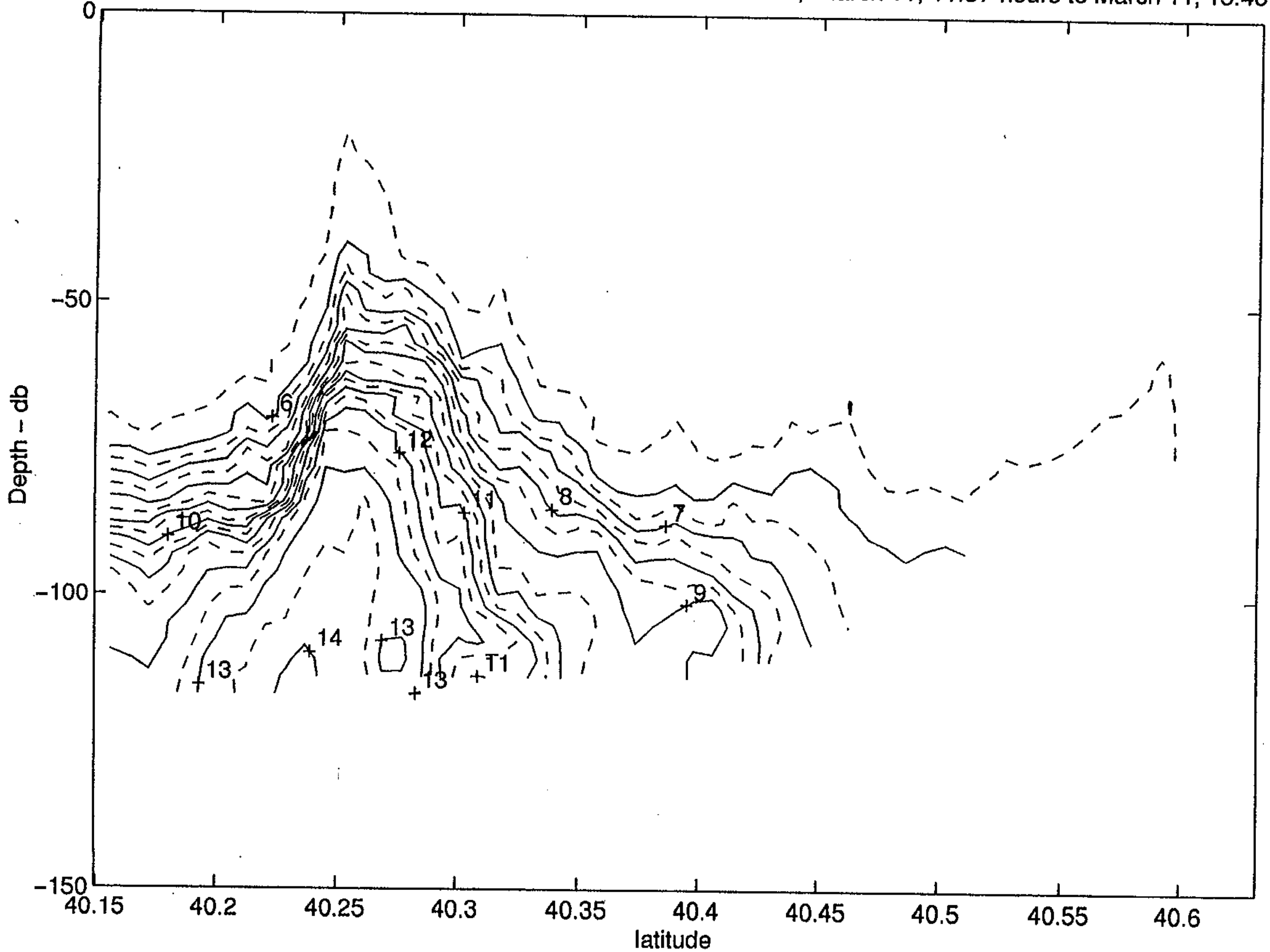


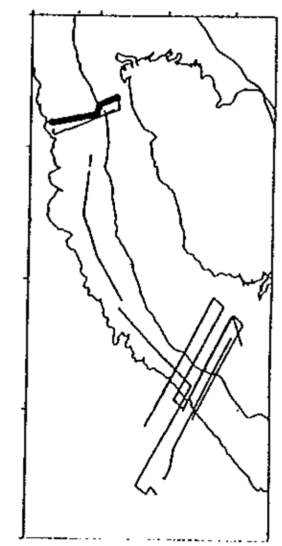


Seasoar Track, GLOBEC II, mean lon: −66.3351W, mean lat: 41.3144N; March 9, 21.34 hours to March 10, 2.26 hours

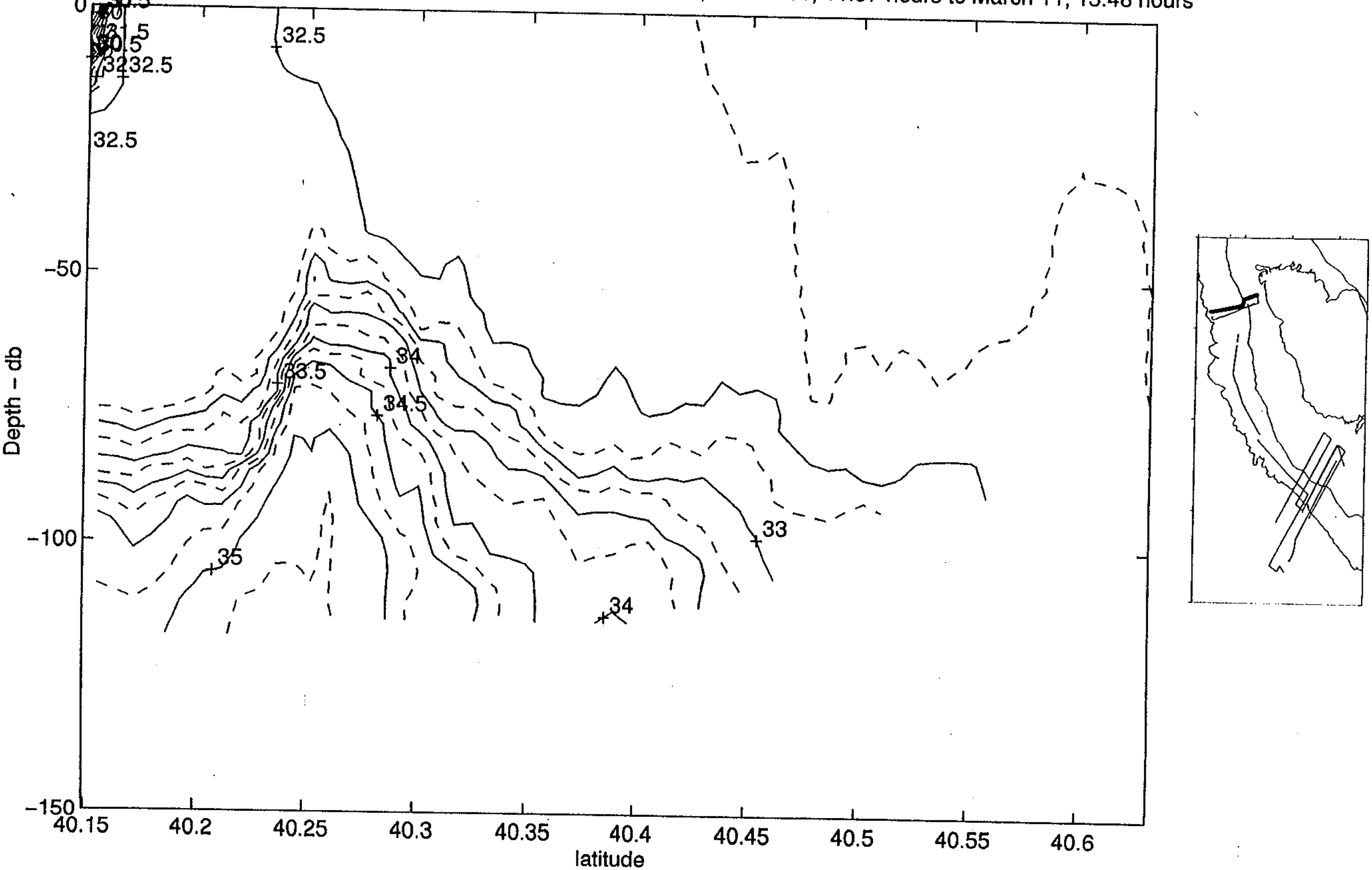


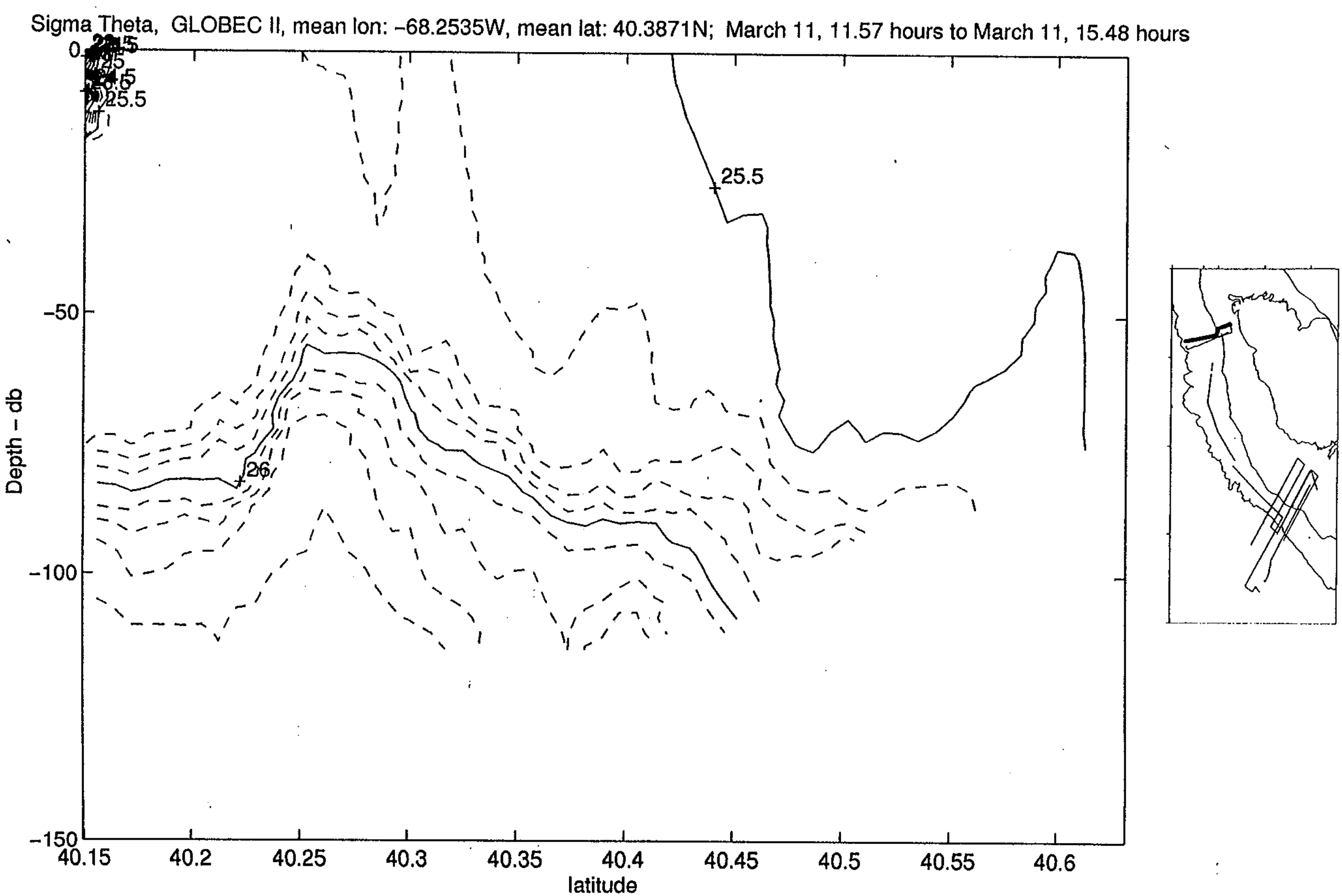
Temperature, GLOBEC II, mean lon: -68.2535W, mean lat: 40.3871N; March 11, 11.57 hours to March 11, 15.48 hours

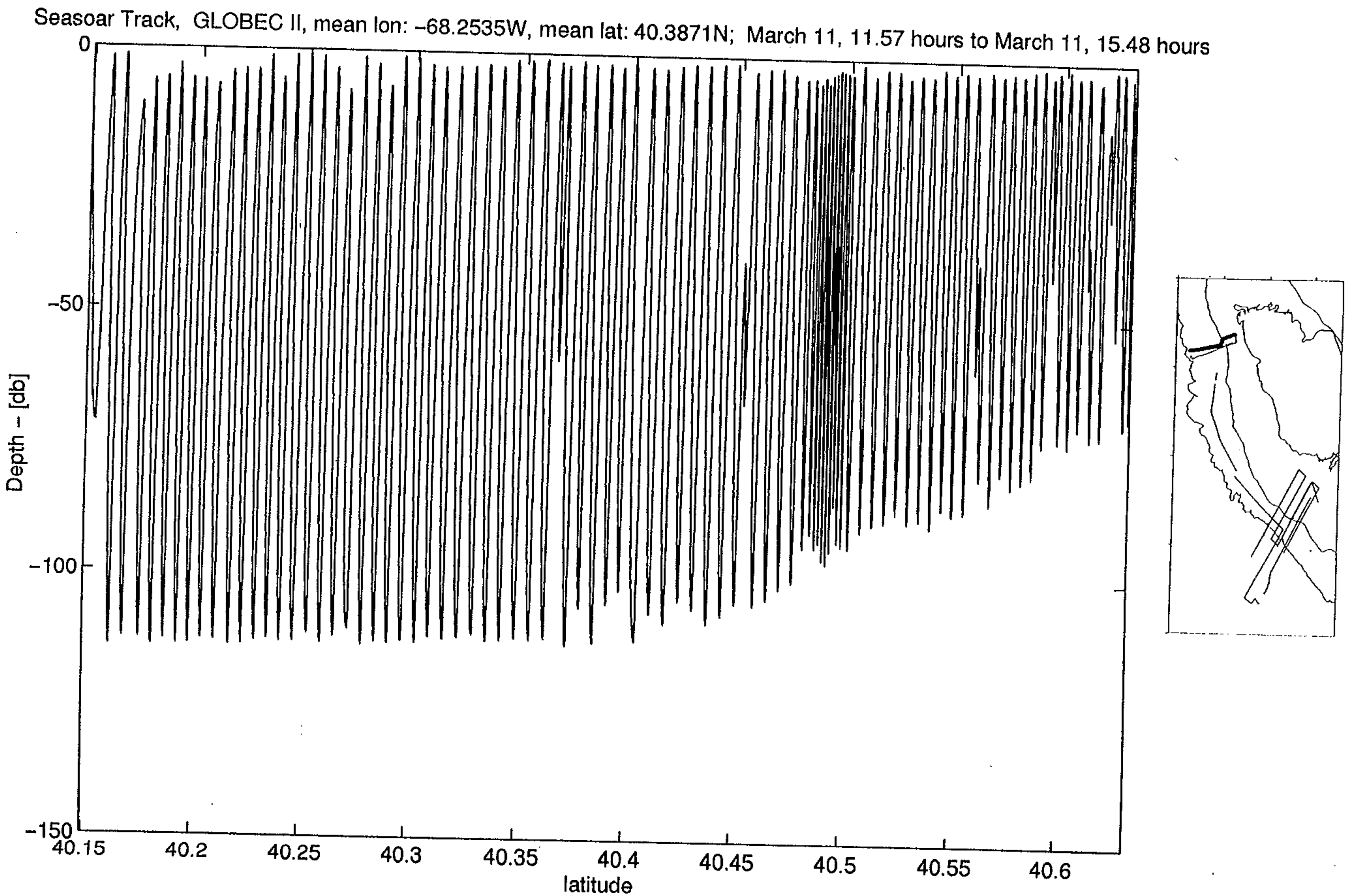


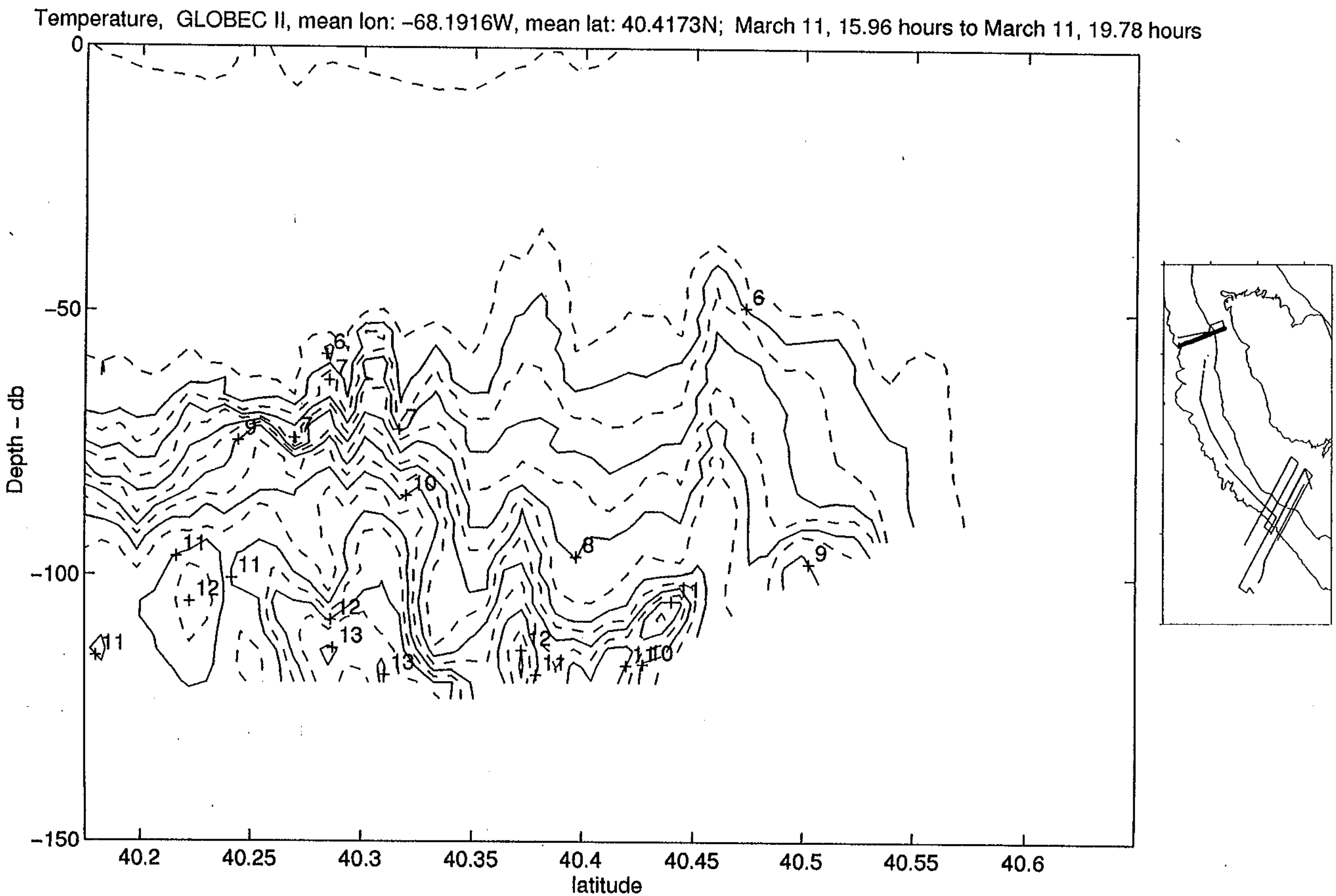


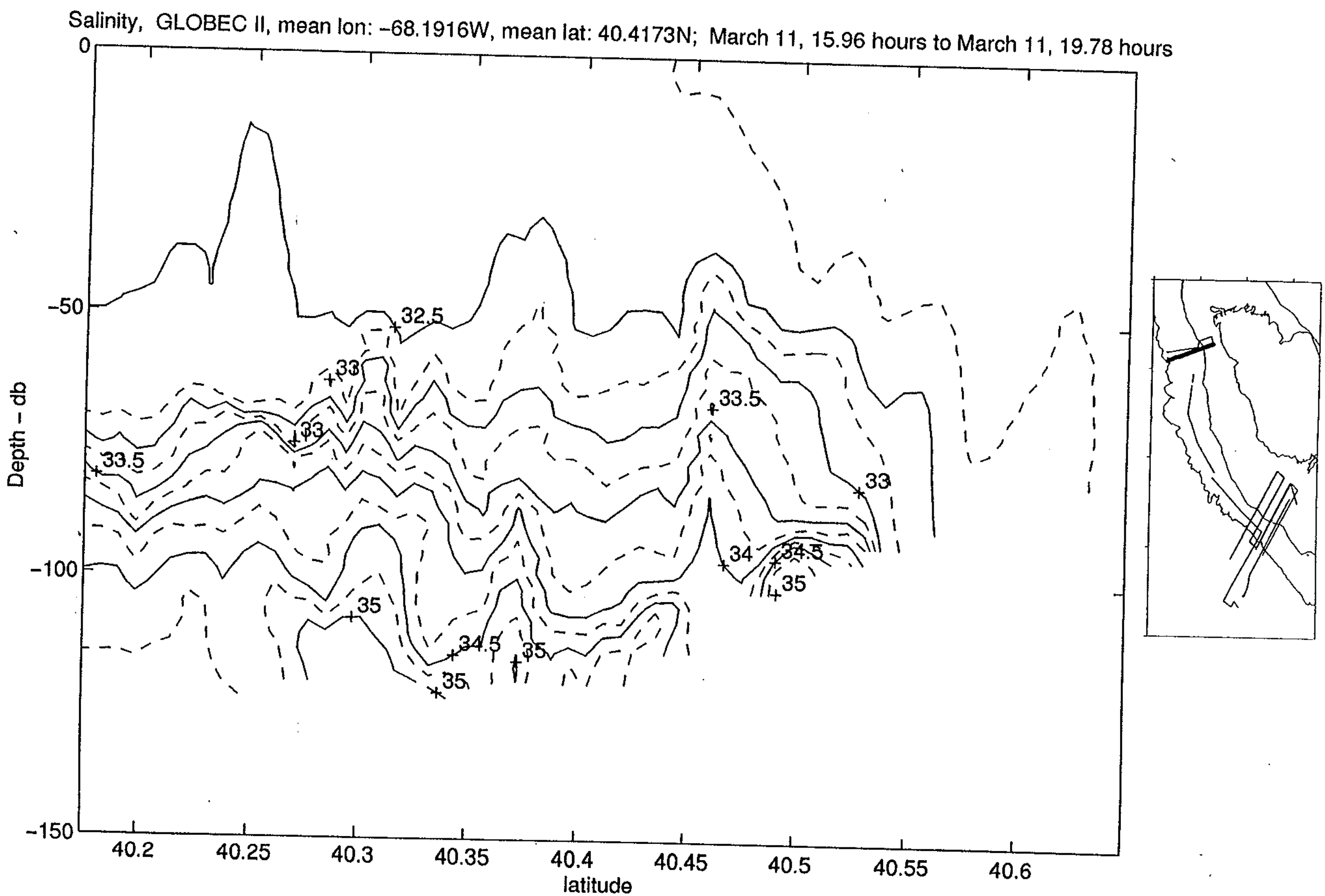
Salinity, GLOBEC II, mean lon: −68.2535W, mean lat: 40.3871N; March 11, 11.57 hours to March 11, 15.48 hours

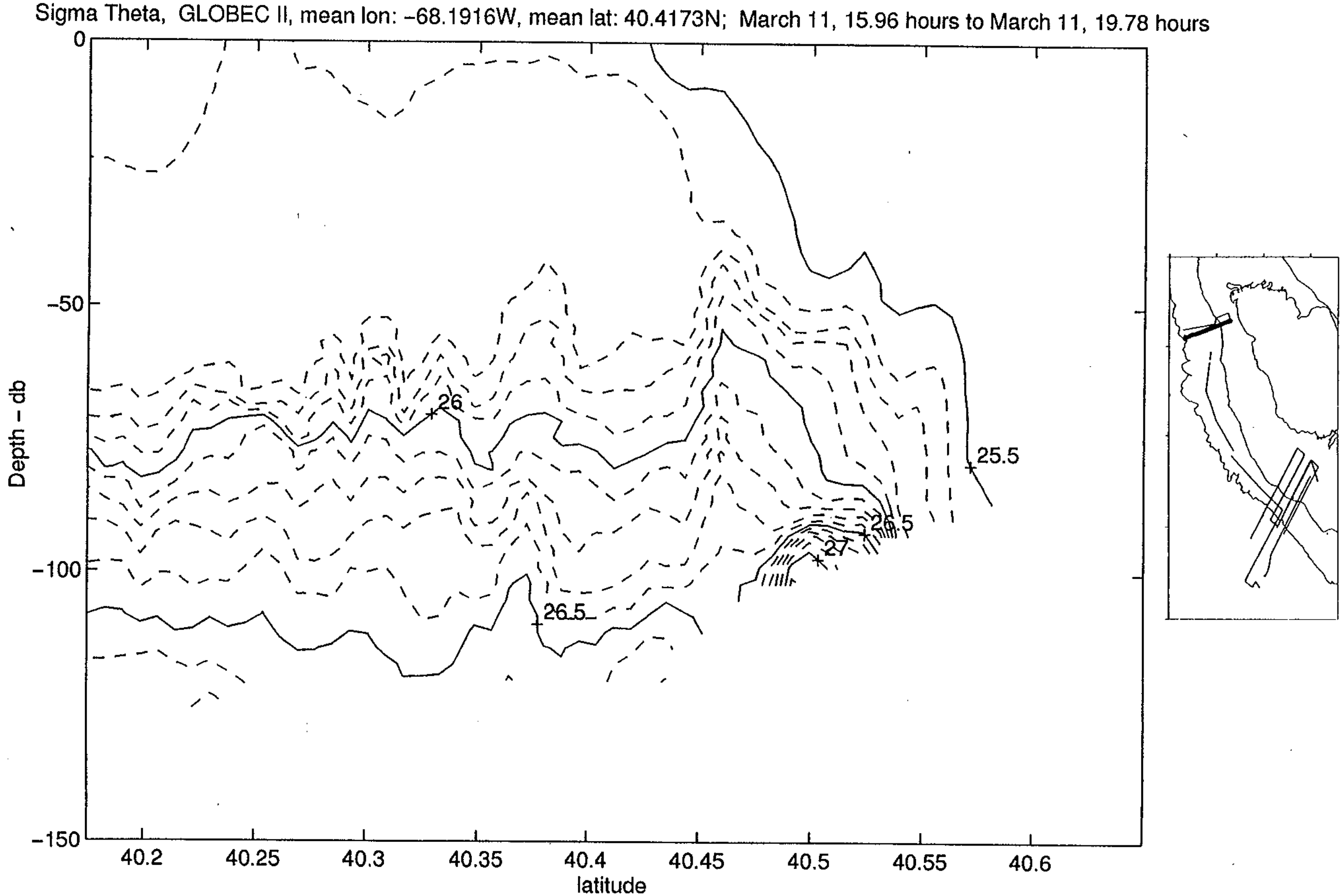


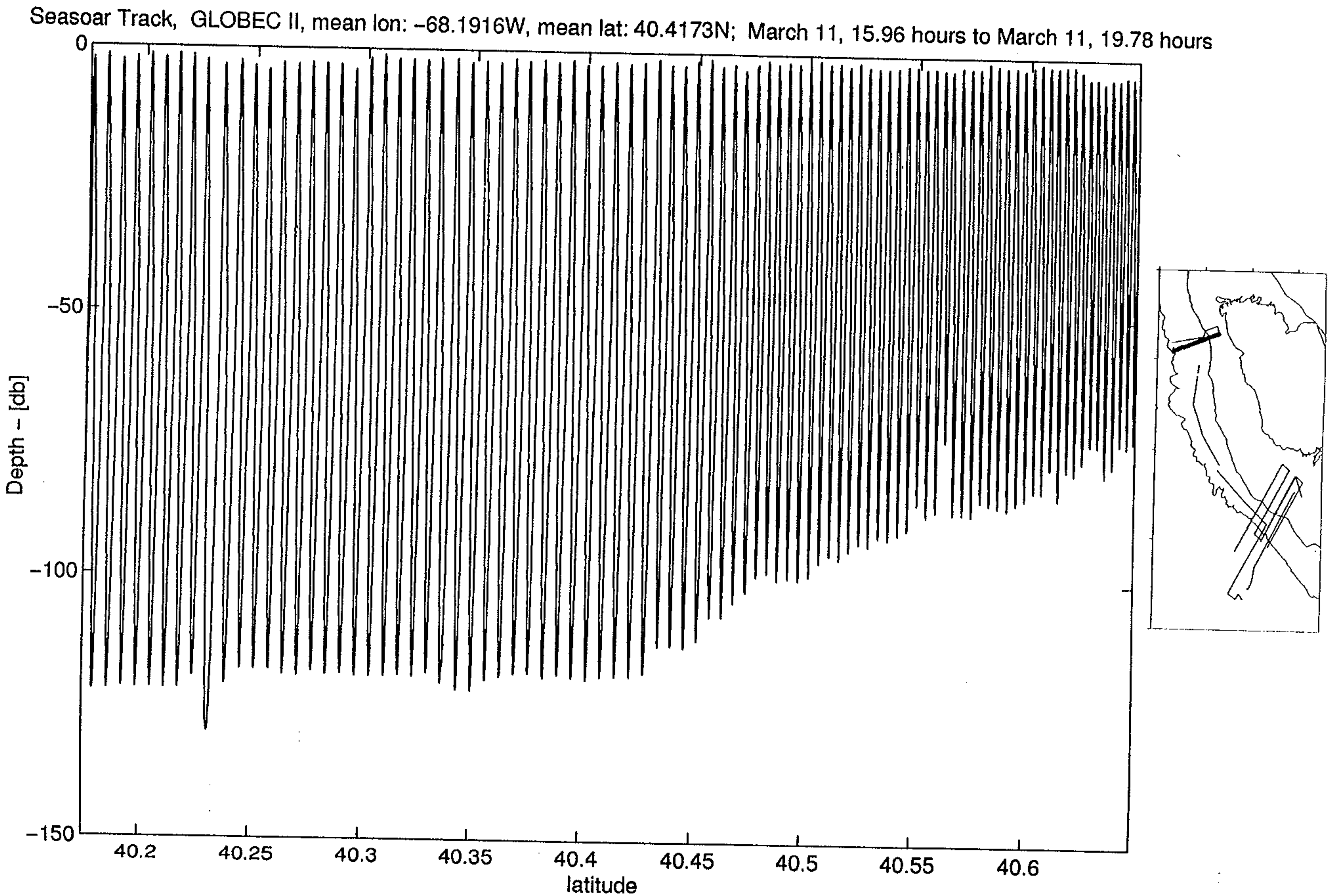

Sigma Theta, GLOBEC II, mean lon: −68.2535W, mean lat: 40.3871N; March 11, 11.57 hours to March 11, 15.48 hours
25.5
26
0
−50
−100
−150
Depth – db
40.15
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
latitude


Seasoar Track, GLOBEC II, mean lon: −68.2535W, mean lat: 40.3871N; March 11, 11.57 hours to March 11, 15.48 hours
Depth – [db]
0
−50
−100
−150
40.15
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
latitude


Temperature, GLOBEC II, mean lon: -68.1916W, mean lat: 40.4173N; March 11, 15.96 hours to March 11, 19.78 hours
Depth - db
0
-50
-100
-150
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
latitude
6
7
9
10
11
12
13
8
9
6


Salinity, GLOBEC II, mean lon: −68.1916W, mean lat: 40.4173N; March 11, 15.96 hours to March 11, 19.78 hours
Depth – db
latitude
0
−50
−100
−150
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
32.5
33
33.5
34
34.5
35

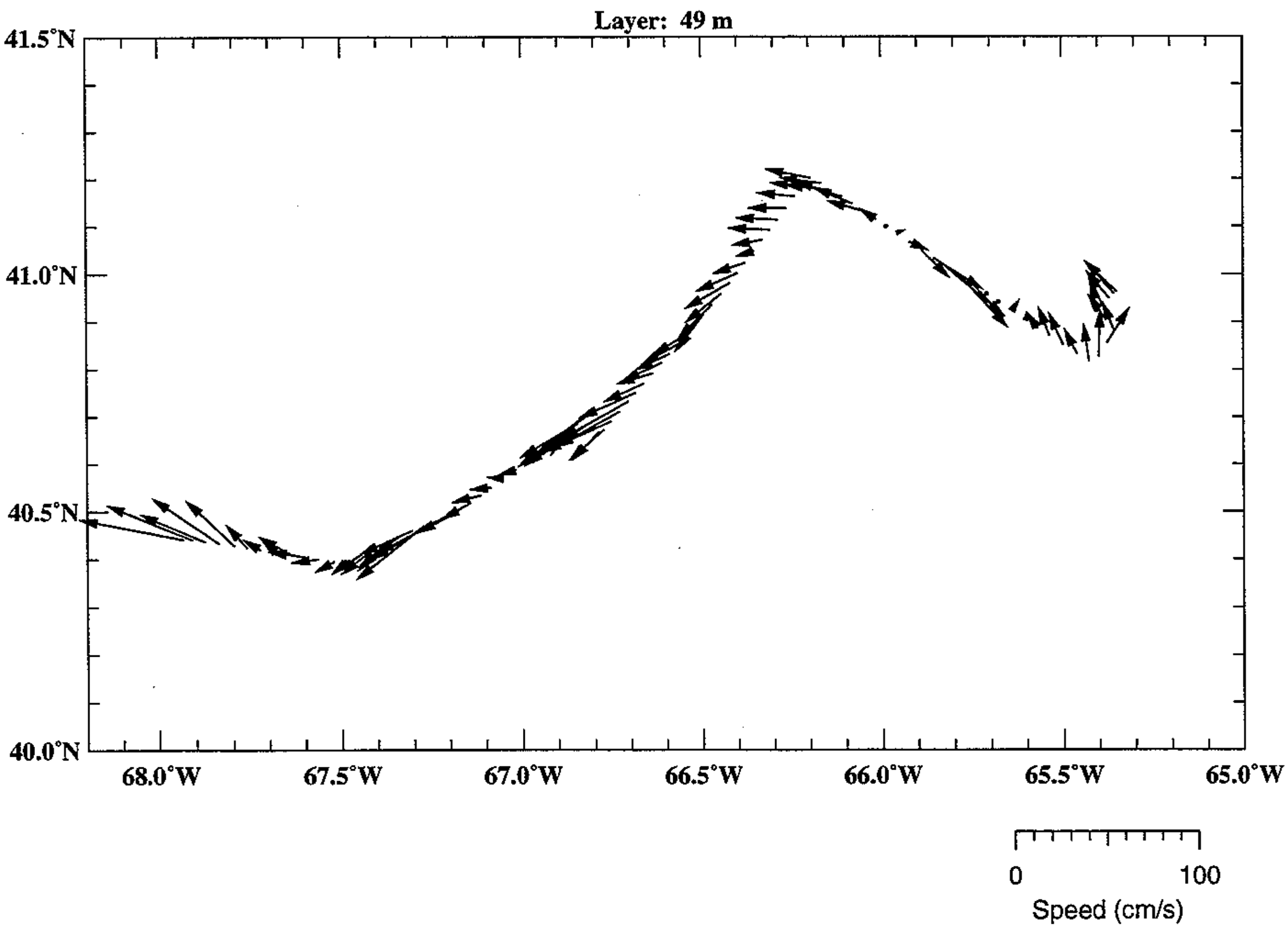

Sigma Theta, GLOBEC II, mean lon: −68.1916W, mean lat: 40.4173N; March 11, 15.96 hours to March 11, 19.78 hours
Depth – db
0
−50
−100
−150
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
latitude
26
26.5
27
26.5
25.5



Seasoar Track, GLOBEC II, mean lon: −68.1916W, mean lat: 40.4173N; March 11, 15.96 hours to March 11, 19.78 hours
Depth − [db]
0
−50
−100
−150
40.2
40.25
40.3
40.35
40.4
40.45
40.5
40.55
40.6
latitude

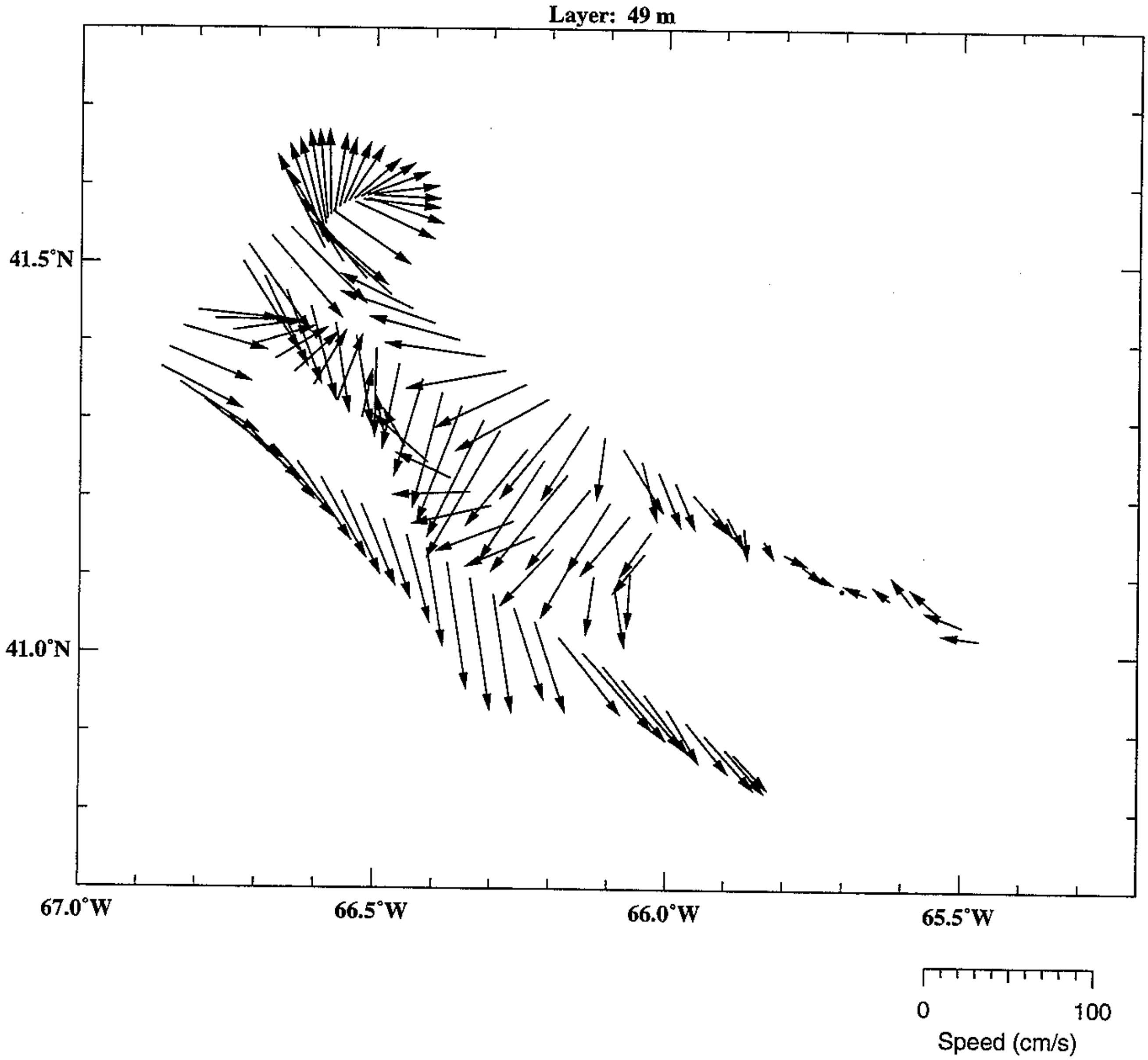
ADCP OC299

1997/03/03 17:42:06 to 1997/03/04 17:47:39 GMT



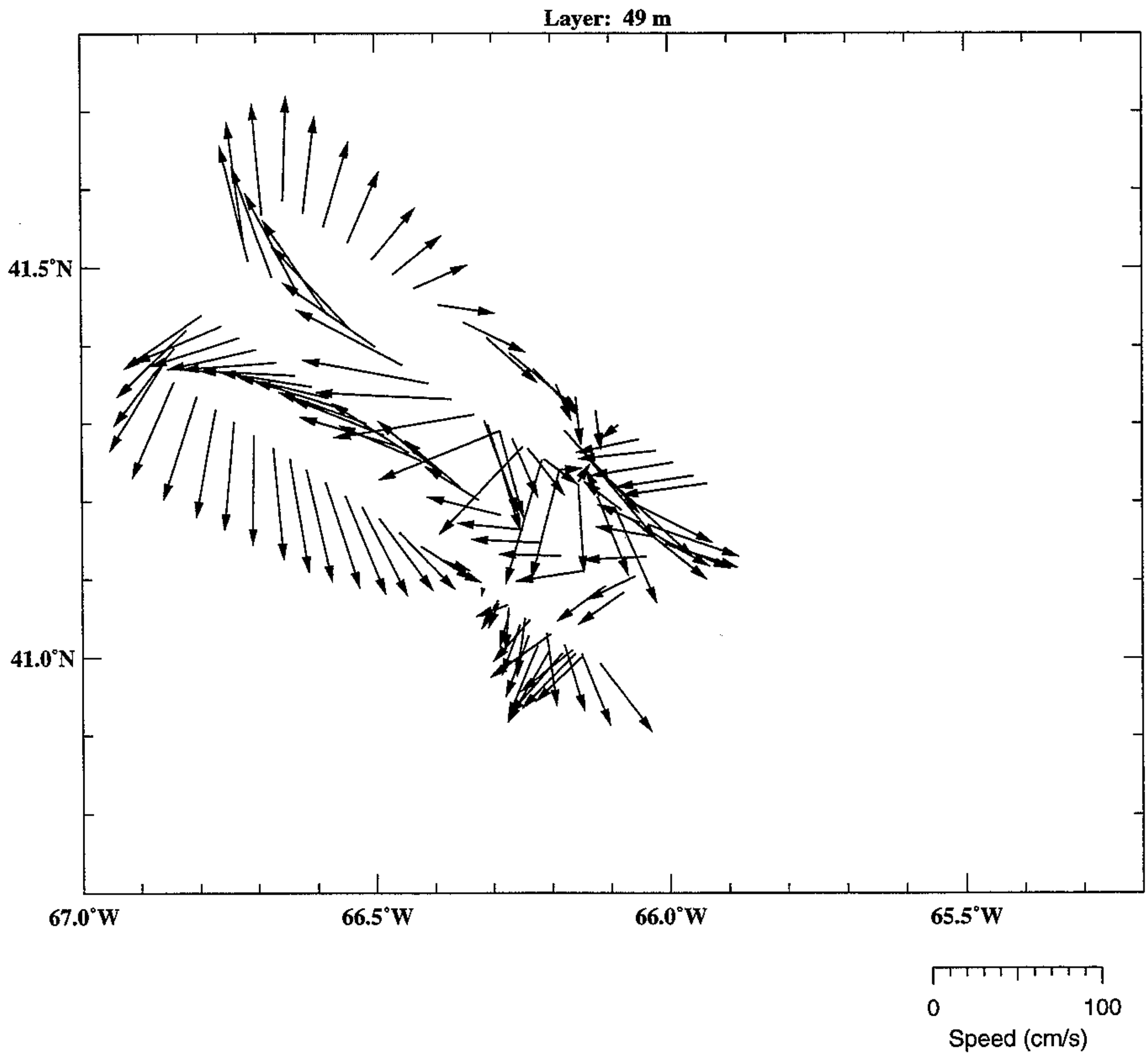
ADCP OC299

1997/03/05 01:23:04 to 1997/03/06 09:23:46 GMT



ADCP OC299

1997/03/08 11:01:04 to 1997/03/10 08:05:04 GMT



ADCP OC299

1997/03/11 11:26:36 to 1997/03/11 20:14:04 GMT