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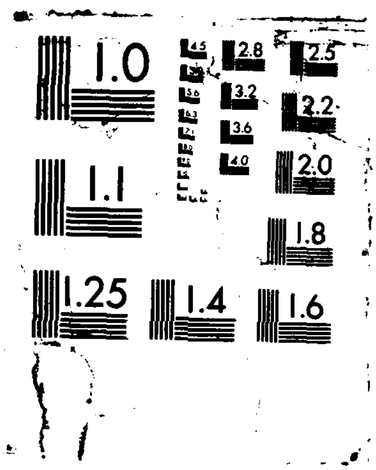
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MARINE PHYSICAL LABORATORY

SCRIPPS INSTITUTION OF OCEANOGRAPHY

San Diego, California 92152

**Freely Drifting Swallow Float Array:
September 1986 Trip Report**

R.L. Culver, W.S. Hodgkiss, G.L. Edmonds, and V.C. Anderson

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Self-contained, freely-drifting Swallow floats capable of recording very low frequency (VLF) ambient ocean noise are under development at the Marine Physical Laboratory, Scripps Institution of Oceanography, San Diego, California. The floats are ballasted to neutral buoyancy at midwater depth where they record the components of particle velocity from which sound pressure levels may be derived. A high frequency acoustic mutual interrogation system may be used to determine relative float positions. During an experiment conducted between 16 and 18 September 1986 approximately 50 miles west of San Diego, twelve Swallow float buoys were deployed to depths of 1000 to 2000 meters over a 24 hour period. This Technical Memorandum reports the preliminary analysis of data acquired from that experiment.

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Table of Contents

Freely Drifting Swallow Float Array:

September 1986 Trip Report

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ABSTRACT

Self-contained, freely-drifting Swallow floats capable of recording very low frequency (VLF) ambient ocean noise are under development at the Marine Physical Laboratory, Scripps Institution of Oceanography, San Diego, California. The floats are ballasted to neutral buoyancy at midwater depth where they record the components of particle velocity from which sound pressure levels may be derived. A high frequency acoustic mutual interrogation system may be used to determine relative float positions. During an experiment conducted between 16 and 18 September 1986 approximately 50 miles west of San Diego, twelve Swallow float buoys were deployed to depths of 1000 to 2000 meters over a 24 hour period. This Technical Memorandum reports the preliminary analysis of data acquired from that experiment.

Introduction

Under Office of Naval Research sponsorship, the Marine Physical Laboratory has been involved in the design, fabrication and testing of prototype, self-contained Swallow floats which can record very low frequency (VLF) ambient ocean noise over extended periods of time. In operation, the floats may be ballasted to neutral buoyancy at a desired depth or deploy to the ocean bottom. Once deployed, the floats operate autonomously to measure and record the components of particle velocity in the 1 - 20 Hz band. They generate and receive high frequency acoustic signals which may be used to determine their relative positions. The deployment of several floats forms a freely drifting array of sensors.

The Swallow float design minimizes self-noise which can limit accurate ambient ocean noise measurements. The untethered floats do not experience flow noise or cable strumming. They measure particle velocity and are thus insensitive to variations in local pressure. Single element spectrum levels have been shown to agree closely with omni-directional hydrophone measurements acquired under similar conditions.[1] Operation of the floats is as described in earlier publications[1,2,3] except that the velocity signal sampling rate has been increased to 50 Hz and the anti-aliasing filter cutoff-frequency increased to 25 Hz. Record duration is 45 seconds.

MPL has conducted Swallow float deployments annually since 1982. This technical memorandum reports preliminary results from the most recent deployment, made between 16 and 19 September 1986 approximately 50 miles west of San Diego, California (32°35′ N, 118°10′ W). Three floats were deployed to the ocean bottom, about 2000 meters, to serve as references for the acoustic positioning system. Five floats were deployed to about 1000 meters depth. Four other floats intended for deployment to 1000 meters surfaced prematurely and yielded little data. All floats were recovered without incident.

Range data between the bottomed floats contain the surface bounce range but not the direct path arrival, apparently due to shadow zones. Other interelement range data appear to contain the direct path arrivals.

All velocity data contain signals produced by resonant float oscillations excited by their tape recorders. Investigation is ongoing to reduce those resonances, however it is believed that signal processing techniques can be applied to remove much of their effect on this data set. The x axis velocity data channel in one mid-water column float apparently developed a loose connection, however, there appears to be a 12 hour period in which the four other mid-water column floats contain valid velocity data. It is thought that 1986 deployment data are sufficiently complete and of sufficient quality to permit the application of beamforming techniques.

I. Narrative Summary

On Tuesday, 16 September 1986, 6 MPL personnel together with 12 Swallow floats and supporting equipment embarked aboard the 110′ fishing/survey vessel *Scorpius*, a commercial charter, berthed at the University of California's Nimitz Marine Facility in San Diego. The *Scorpius* has two shafts, one diesel engine per shaft, 3.8:1 reduction gears, and four-bladed propellers. The intended deployment site, 32°35′ N, 118°10′ W, lay some 50 miles to the west, about 6 hours steaming for the *Scorpius*. This was the fifth such experiment conducted as part of an ongoing engineering development project sponsored by the Office of Naval Research and directed at measuring ocean ambient noise in the very low frequency (1 - 20 Hz) band. A brief narrative of events comprising the experiment is given below. Figure 1.1 is the experiment Test Plan. Figure 1.2 contains a summary of entries from the experiment logbook. Figure 1.3 is a map of the deployment area showing generally where the floats were deployed and recovered.

The *Scorpius* arrived on station early on Wednesday, 17 September. Water depth was about 2000 meters. All floats were checked out and found to be operating satisfactorily. They were initialized synchronously at 0515.

Ballast had been attached to the floats before leaving San Diego. Heavy weights were attached to floats 0, 1 and 2 so that they would deploy to the ocean bottom. Floats 3 through 11 were ballasted so as to be neutrally buoyant at 1000 meters. Inside each buoy, the automatic ballast release time had also been set before leaving San Diego. Preset ballast release times are shown in the Test Plan, Figure 1.1.

Deployment of the floats began at 0555 generally at the positions shown in the Test Plan. The bottomed buoys, 0, 1 and 2 were deployed first. By about 1000 all 12 floats had been deployed. Within a short time, however, a signal was detected with the radio direction finder indicating that one or more floats were on the surface rather than on their way to depth. During the next hour, three floats, 6, 8 and 11, were found floating on the surface and recovered. Floats 6 and 8 had stopped running, but 11 was still running. Float 11 was resynchronized, new ballast attached and redeployed at 1252.

A survey of float positions was conducted between 1408 and 1612. The range from *Scorpius* to each float is measured by sending out interrogation pulses, which trigger the floats to respond with another pulse, and measuring the total elapsed time. Radio frequency signals were again detected, indicating one or more floats had surfaced. Floats 7 and 11 were found floating on the surface and recovered at 1603 and 1630, respectively. There was no attempt to redeploy these floats. Therefore the experiment primarily consisted of floats 0, 1 and 2 on the bottom and 3, 4, 5, 9 and 10 drifting freely at about 1000 meters depth.

Thirty-four seal bombs were exploded at known times and locations between 1723 and 1740 in order to produce a recognizable event in the Swallow floats records. By 1745, activity at the deployment site was complete and *Scorpius* set course for nearby San Clemente Island making about 4 kts. Several US Navy ships were spotted in the area. Bearing, range, time of contact and *Scorpius*' position were recorded for possible use later in analyzing Swallow float data. At 2030, the ship anchored for the night at Pyramid Cove located on the south side of San Clemente Island.

On Thursday, 19 September, *Scorpius* got underway at 0400 to return to the deployment area and retrieve floats. Several ships were observed enroute and in the deployment area, and contact information was again recorded. The ship arrived on station at 0556 and commence another float position survey. A radio frequency signal was heard at about 0630, indicating that one of the floats had surfaced. At 0700, float 3 was found floating on the surface and recovered. It's timed release had apparently incremented an extra day on a false count, thus releasing one day early.

The remainder of day was spent recalling and recovering floats one at a time, beginning with the floats deployed to 1000 meters. Ascent from 1000 meters took about 1.5 hours, while ascent from the bottom took about 2.5 hours. The last float was aboard by 1600 and *Scorpius* got underway for San Diego.

Subsequent inspection revealed that all floats had maintained their watertight integrity. Data tapes were removed from the floats, read and the information they contained written to 9 track tape for further analysis using another computer. Preliminary analysis results are contained in this report.

II. General Indication of Data Integrity

The first thing to notice about the Swallow float data tapes are their lengths. As shown in Table II.1, tapes from the floats which surfaced early, 6, 7, 8 and 11 contain significantly fewer records than do the other 8 tapes. Maximum tape capacity is approximately 2000 records, or 25 hours. Record length is 45 seconds. Tapes from the three bottomed floats, 0, 1 and 2, are approximately the right length, as are five of the mid-water column floats, 3, 4, 5, 9 and 10.

Table II.1. Total Internal Records versus Total Records on Tape

Float Number	Total Internal Records	Bad Initial Records	Broken-up Records	Bad Trailing Records	Total Records
0	1966	1	2	21	1990
1	2014	1	-	1	2016
2	1949	1	-	-	1950
3	1891	1	1	1	1894
4	1981	1	-	-	1982
5	1978	1	1	1	1981
6	429	1	-	-	430
7	872	1	-	1	874
8	121	1	-	-	122
9	1940	1	-	1	1942
10	1963	1	1	3	1968
11	471	1	1	-	473
11	334	4	-	1	339

Next, individual records on each tape may be inspected to verify that they contain resync characters at the proper locations and that groups of bytes sum to the same value as checksums embedded in the record. Figure II.1 shows the format of records written to the cassette tape.

The first 9 bytes of each record form the header subrecord. Its quality may be checked by comparing the sum of the first 7 bytes to the value of the checksum stored as bytes 8 and 9. The next 517 bytes comprise the range subrecord. It starts with a 3-byte resync sequence composed of 2 bytes which are each 10101010 binary (hex AA, decimal 170) followed by one byte which is 00000001 binary (hex and decimal 1). The next 512 bytes contain acoustic ranging information, and they may be checked for errors by comparing their sum with the value of the checksum stored as the last 2 bytes.

The remaining 7120 bytes in each record consist of 89 80-byte acoustic subrecords. Each acoustic subrecord contains the 3 byte resync sequence followed by 75 bytes of velocity data and a 2 byte checksum. The 89th acoustic subrecord does not contain any data because the buoy tape recorder is operated during that part of the record. Each of the first 88 acoustic subrecords may be checked for errors by comparing their sum to the value of the checksum.

When the Swallow float cassette tape is read and the contents written to 9-track digital tape, each record is altered in two ways. First, the number of bytes read from each cassette tape record is prepended to each record written to the 9-track tape. This done in order to flag short records which may exist on the cassette tape. Second, the checksum of the 88th acoustic subrecord of each record is unavoidably removed. This occurs as a result of a firmware bug in the tape reader, which is no longer supported by the manufacturer.

Figure II.2 shows the results of inspecting individual records of the 12 Swallow float tapes. The *record number* indicates where that record may be found on the 9-track tape. It is nearly always different from the *internal record number*, which is generated by the Swallow float program. The *number of bytes written* indicates how many bytes were read from the digital cassette tape and written to the 9-track tape. If less than 7642 or more than 7646 bytes were read, an error is said to have occurred. The variability exists because of the tape reader firmware bug.

The *first missing resync* indicates the number of the first 3 byte resync sequence which is found to be missing, indicating synchronization was lost during that record. If the *first missing resync* is *0*, all 90 resync characters were found. The header, range and first 87 acoustic subrecords are each inspected for checksum errors. If any occur, they are listed in the last three columns, *pass header checksum?*, *pass range checksum?* and *# of failed acoustic checksums?*.

There appear to be five kinds of bad records. The first type occurs when one or more bad records are generated at the start of the tape as the float is checked out just prior to deployment. All of the tapes have one bad initial record and the tape from float 11 has an additional 4 such records apparently made when the float was checked out just prior to its second deployment.

A second type of record error apparently occurs when a cassette tape record contains a gap which the tape reader interprets as a record break. Two records are consequently written to the 9-track tape. One contains the first part of the cassette tape record up to the gap and padded out to 7644 bytes with whatever the tape reader buffer contains, and the other contains some portion of the remainder of the cassette tape record again padded with whatever the tape reader buffer contains. This type of record error is referred to as a *broken-up record*. Records 1926 and 1931 from float 0, 1767 from float 3, 1924 from float 5, 1404 from float 10 and 195 from float 11 are *broken-up records*.

A third type of bad record apparently occurs when a cassette tape record ends prematurely. Float 0's record 1334 is a *truncated record* in that only 7598 bytes were found. A *truncated record* may be a *broken-up record* except that the gap occurs so close to the end of the record that the remaining bytes are lost.

A fourth type of bad record apparently occurs when the cassette tape slips a very small amount and synchronization is lost. It is manifested by resync characters not being at the proper locations within in a record. When this happens, the part of the record after synchronization is lost is of no value. Float 0's record 453 lost synchronization between the 32nd and 3rd resync characters, approximately 3000 bytes into the record. Float 3's records 325 and 328 lost synchronization near bytes 2100 and 500, respectively. Float 11's record 0 (during its second deployment) lost synchronization apparently at the outset.

The last type of bad record consists of records added to the end of the 9-track tape. Most instances of this problem are thought to be caused by an error in the tape reading program. However, two full records appended to float 10's tape have internal record numbers 1957 and 1958 and passed all of the resync and checksum tests. Their cause is unknown.

Table II.1 summarizes the kinds bad records on each tape which caused the number of records to be larger than the largest internal record number. Much of this information is taken from Figure II.2, however, the bad initial records on all tapes and bad trailing records on float 10's tape were found with another program which reads only the header information from each record.

Float Number	Total Internal Records	Broken-up Records	Truncated Records	Lost Sync Records	% Bad Records
0	1966	2	1	1	.20
1	2014	-	-	-	0
2	1949	-	-	-	0
3	1891	1	-	2	.16
4	1981	-	-	-	0
5	1978	1	-	-	.05
6	429	-	-	-	0
7	872	-	-	-	0
8	121	-	-	-	0
9	1940	-	-	-	0
10	1963	1	-	-	.05
11	471	1	-	-	.21
11	334	-	-	1	.30

Table II.2. Summary of bad records.

Table II.2 summarizes the bad internal records contained on each Swallow float data tapes. It does not include bad initial or trailing records which are fairly easy to spot and avoid. The remaining types of bad records may all be caused by small data gaps on the cassette tape. Whatever their cause, they generally occur in less than 0.2% of the records.

III. Surface Echo Data

Each float's acoustic positioning system records the arrival of its own pulses reflected by the ocean surface as well as pulses emitted by other floats. The arrival time of pulses reflected by the ocean surface can be used to determine float depth.

Figures III.1 through III.3 contain surface echo data for the three floats deployed to the ocean bottom. The series of dashes at 0 depth in all three Figures are reflections from the adjacent ocean bottom. Figures III.4 through III.12 contain surface echo data for the 9 remaining floats. The sampling interval in all of the Figures is 9 minutes. Deployment depths and the time required to reach those depth are summarized in Table III.1.

Table III.1: Deployment Depths and Descent Times.

Float	Depth, meters	Time, hours
0	2010	1.1
1	1820	1.0
2	1900	1.3
3	960	4.3
4	1040	4.8
5	1060	4.7
6	310	1.4
7	1000	4.4
8	0	-
9	800	3.8
10	990	4.6
11	0	-

Floats 6, 7, 8 and 11 dropped their ballasts and returned to surface earlier than was desired. Float 6 descended for approximately 1 hour before dropping it's ballast. Float 7 arrived at it's deployment depth and almost immediately dropped it's ballast. Floats 8 and 11 appear to have dropped their ballasts very shortly after being deployed. Investigation by Greg Edmonds indicates that the problem was caused by acoustic ranging pulses transmitted from the support ship and which contained subharmonic frequency components which apparently triggered floats 6, 7, 8 and 11 to release their ballast. The problem is thought to be solved for future deployments by the use of a different pulse generation method which reduces subharmonics considerably and placement of the transmit transducer at the sea surface to eliminate the surface bounce path.

The other eight floats which appear to have undergone normal, complete deployments. The three bottomed floats required approximately 1 hour for their descent. Four floats deployed to about 1000 meters while one remained at a somewhat shallower depth. All of the mid-water floats required 4 to 5 hours to attain their depths.

IV. Interelement Range Data

Each float's record of the time of arrival of acoustic positioning pulses transmitted by other floats can be used to determine the range between pairs of floats.[2] Received pulses must have sufficient signal to noise ratio (SNR) and be free of multipath interference in order for the direct path arrival time to be determined.

Figures IV.1a and IV.1b contain float 0's record of receiving acoustic pulses transmitted by floats 1 and 2, respectively. The five short dashes in the upper left hand corner, at 0 meters range, are the interelement range when the floats were adjacent on deck prior to being put into the water. In Figure IV.1a, the 5 very short dashes ascending from the left starting at record 133, range 6500 meters, indicate interelement range as float 1 descends to the bottom. Float 0 is already on the bottom and the range is decreasing as float 1 descends. The 5 longer dashes starting at the same record, slightly longer range, and descending from the left indicate the length of the path which includes one surface bounce. The surface-bounce range is increasing as float 1 descends. The descending dashes continue as a row of dashes whose upper edges form a line which extends across the page with small negative slope. They indicate the surface-bounce range once float 1 bottomed. This range would be constant but for small differences in the floats' internal clock rates.[2] Other dashes scattered throughout the Figure are noise of sufficiently high level to be mistaken for acoustic positioning pulse arrivals, or interrogation pulses from the hydrophone suspended from *Scorpius*.

Figure IV.1b is very much like Figure IV.1a. The 6 very short dashes ascending from the left starting at record 206, range 7400 meters, indicate interelement range as float 2 descends to the bottom. The 8 longer dashes descending from the left starting at the same place indicate the surface bounce path as float 2 descends. The row of dashes whose upper edges form a line which extends across the page with small positive slope indicates the surface bounce range once float 2 bottomed. Non-zero slope is caused by differences in clock rates between floats 0 lnd 2. The row of faint dashes which descend from the left starting at 206, range 9200 meters, and extend across the page indicate the surface-bottom-surface bounce range as float 2 descended and bottomed. Other dashes scattered throughout Figure IV.1b indicate noise or interrogation pulses as in Figure IV.1a.

Figures IV.1c through IV.1g contain float 0's record of receiving acoustic pulses transmitted by the five floats which successfully deployed to about 1000 meters depth: 3, 4, 5, 9 and 10, respectively. The four short dashes in the upper left hand corner of each Figure indicate the interelement range when float 0 was on deck adjacent to the other floats prior to being put into the water. The row of short dashes extending across each Figure indicates interelement range. The row of longer dashes starting at roughly the same place in each Figure and extending across the page indicates the surface bounce range. Rows of faint dashes seen at longer ranges in some of the Figures indicate the bottom-surface or surface-bottom-surface bounce ranges. Other dashes scattered throughout the Figures indicate noise or interrogation pulses as before.

Figures IV.2a and IV.2b contain float 1's record of receiving acoustic pulses transmitted by floats 0 and 2, respectively. The short dashes in the upper left hand corner, very short dashes ascending from the left starting at record 144 in Figure IV.2a and record 206 in Figure IV.2b, and longer dashes descending and extending across the page at slight positive angles have the same interpretation as in Figures IV.1a and IV.1b. Other dashes indicate noise or interrogation pulses as before. Figures IV.2c through IV.2g contain float 1's record of receiving acoustic pulses transmitted by the mid-water column floats as in Figures IV.1c through IV.1g. The features in Figures IV.2c through IV.2g are interpreted in the same manner as those in Figures IV.1c through IV.1g.

Figures IV.3a and IV.3b contain float 2's record of receiving acoustic pulses transmitted by floats 0 and 1, respectively. These Figures are interpreted in the same manner as Figures IV.1a and IV.1b. Figures IV.3c through IV.3g contain float 2's record of receiving acoustic pulses transmitted by the mid-water column floats as in Figures IV.1c through IV.1g. These Figures are interpreted in the same manner as Figures IV.1c through IV.1g.

Figures IV.4a through IV.4g contain float 3's record of receiving acoustic pulses transmitted by the three bottomed floats and other 4 mid-water column floats. These Figures are interpreted in the same manner as Figures IV.1c through IV.1g. Figures IV.5a through IV.5g, IV.6a through IV.6g, IV.7a through IV.7g, and IV.8a through IV.8g, contain the record of acoustic pulses received by floats 4, 5, 9 and 10, respectively, and transmitted by the three bottomed and other mid-water column floats. All of these Figures are interpreted in the same manner as Figures IV.1c through IV.1g.

V. AGC Level and Float Heading

A feel for the quality of the particle velocity data recorded by each float may be obtained from the gain set by the automatic gain control (AGC) circuit. It is useful as a general indicator of signal level because the float is programmed to increase AGC level as signal decreases, and vice versa, in an effort to keep the analog to digital converter (ADC) input signal within the ADC's dynamic range. The AGC level is constrained to change in 0.5 dB steps only between records.

Figures V.1 through V.3 depict AGC level, compass heading and battery voltage for the bottomed floats, 0, 1 and 2. AGC levels for these floats are generally low, indicating that signal level was generally high. The bottomed floats are tethered to large weights and are subjected to high level flow and tether strumming noise, so that their velocity measurements are generally clipped and cannot be used. However, the purpose of the bottomed floats is to provide references for the acoustic positioning system.

The irregularly spaced peaks in AGC level which occur intervals of 500 to 600 records, or about 7 hours, are correlated with changes in float heading. There is also some correlation between heading changes made by the three bottomed floats, although this is difficult to see from Figures V.1, V.2 and V.3 because all float headings are mapped into one 0 to 360° window. This reduces the visual impact of major float rotations which occur for example near record 360 for Float 0, near records 260, 360, 815 and 1000 for Float 1, and near record 1400 in Float 2. Figure V.4 shows their *unwrapped* compass headings in which rotations are kept track of so that 360° rotations do not map onto the same point. Note that float headings appear generally constant for roughly 7 hour periods. When they do change, they nearly always increase, which indicates clockwise rotation.

The heading of the bottomed floats is thought to be controlled by the local current, perhaps the tidal current. A steady current exerts a horizontal force, which is balanced by tension in the tether, and stabilizes float heading. Tether strumming and flow noise are high and the AGC steps down. The Figures show that AGC is generally low when float heading is stable. Float heading changes occur during current reversals. As the currents slows, the horizontal force it exerts decreases, as do tension in the tether and strumming, and the float is free to rotate. Flow noise is also lower and the AGC steps up. The Figures generally reflect an increase in AGC when float heading changes.

Figures IV.5 through IV.5 depict AGC level, compass heading and battery voltage for the remaining 9 floats. AGC levels are low as the floats descend, and increases once they reach depth and their motion is reduced. Dips in AGC level correspond to increased signal level, caused for the most part by nearby ship traffic or responding to acoustic interrogation pulses from the support ship.

All of the mid-water column floats appear to fluctuate randomly about a mean heading of about 300°. The mechanism aligning their headings is thought to be the earth's magnetic field. The floats are thought to contain a weak magnetic dipole which attempts to align itself with the earth's magnetic field.

VI. Root Mean Square Velocity

A more detailed assessment of particle velocity data quality may be made from the root mean square (rms) signal level. Figures VI.1 through VI.8 contain the rms signal level for the three bottomed and 5 mid-water column floats. The averaging period is 10 seconds, and the vertical axis has units of volts rms, with full scale being 2.5 volts rms.

Figure VI.1 contains rms signal level for float 0 which was deployed to the bottom. The signal rises slowly from record 0 to record 25 at the AGC decreases from 12 to 0 in 1/2 dB per record steps. The float entered the water at record 53 and reached the bottom by about record 140. Signal level during the float's descent was approximately 5 volts peak-to-peak, which is the maximum analog-to-digital-converter (ADC) voltage. Between records 133 and 250, signal levels in the x and y (horizontal) directions fluctuate around a mean value of 1.5 volts rms. They then slowly decrease and between records 350 and 425 are less than 0.5 volts rms. This period of lower signal level corresponds to an increase in AGC level and a 600° clockwise rotation in float 0's heading (see Figure V.1). Float rotation is attributed in Section V to changes in local current direction. The dropout at record 453 occurs because synchronization was lost about 1/3 of the way through this record (see Figure II.2). Spikes evident at one record intervals between records 350 and 425 are attributed in Section VII to resonant float motion excited by the tape recorder inside the float.

Average signal level in the horizontal directions fluctuates for the most part between about 0.5 and 1.5 volts rms from record 450 to 1375 as the float heading rotated very slowly counterclockwise. Signal level is lower from record 1375 to 1450 as the float rotated 225° in the clockwise direction. Signal level in the horizontal directions then increased and remained high until record 1675, during which time float heading was stable. The float then began a 180° counterclockwise rotation and signal levels decreased to a mean value of about 0.5 volts rms. Levels began to rise again near record 1950 as float heading stabilized. The tape became full at record 1966, prior to float 0 receiving the command to drop its ballast.

The z axis (vertical) channel in float 0 contains dropouts indicating a poor connection. They are especially evident after record 475. Spikes at 12 record intervals correspond to acoustic positioning pulses emitted by float 0.

Figure VI.2 contains rms signal level for float 1 which was also deployed to the bottom. The rise in signal from record 0 to record 25 again is due to the AGC decreasing. The float entered the water at record 115 and reached the bottom by about record 195. Signal level during the float's descent was the same as that of float 0. Thereafter, signal level in all three channels decreased and remained approximately stable until about record 325. Levels dipped and then increased gradually between records 325 and 480, during which time the float rotated (see Figure V.2). As float 1's heading stabilized at about record 480, signal level stabilized at approximately 5 volts peak-to-peak, the level at which clipping occurs at the ADC. Signal level remained clipped until approximately record 750, at which time the float began to rotate.

Signal level fluctuated between 0.1 and 2.5 volts rms between records 750 and 950. The float slowly rotated approximately 480° in the clockwise direction between records 950 and 1025, during which time signal level was very low, about 0.1 volts rms. Signal level again fluctuated between 0.1 and 2.5 volts rms between records 1025 and 1410. At record 1410, float 1's heading stabilized to about the same direction as it had at record 480, and signal level again began to clip at the ADC. The clipping continued until aproximately record 1875, at which time the float began to rotate. The tape became full at record 2014, prior to float 1 being recalled.

Figure VI.3 contains rms signal level for float 2, the third float deployed to the ocean bottom. Float 2 entered the water at record 200 and reached the bottom by about record 300. A data dropout in the x axis channel between records 70 and 115 indicates a poor connection. After float 2 bottomed, signal levels dipped and then increased gradually as the float rotated about 90° counterclockwise (see Figure V.3). The float's heading stabilized at about record 430 and signal level stabilized at approximately 5 volts peak-to-peak, the level at which clipping occurs at the ADC. Signal level remained clipped until aproximately record 715, at which time the float began to rotate.

Signal level decreased and then increased between records 715 and 960 as float 2 rotated approximately 200° to clockwise. Between records 960 and 1175, float heading was relatively stable and the signal remain clipped at the ADC. X axis data contain primarily dropouts after record 975. Y and z axis signal levels decreased and then increased between records 1175 and 1490 as float 2 slowly rotated approximately 100° counterclockwise and then very rapidly about 270° clockwise. Between records 1490 and 1765, float heading was relatively stable and the signal was once again clipped at the ADC. Signal levels then decreased while the float rotated approximately 100° counterclockwise. The tape became full at record 1949, prior to the float being recalled.

Figure VI.4 contains rms signal level for float 3, one of five floats which deployed to about 1000 meters depth. Float 3 entered the water at about record 234 and arrived at depth by about record 640. Average signal levels decrease gradually in the horizontal directions and much more rapidly in the vertical direction as the float descends. Data dropouts in the all channels at records 325 and 328 occur because synchronization was lost during those records (see Figure II.2). The average signal level from record 640 until the end of the tape has a mean value of less than 0.5 volts rms except for short periods and discreet events. Spikes evident at one record intervals are caused by the tape recorder inside the float. The events which occur at record 563, between records 570 and 640, at record 668, between records 720 and 750, between records 805 and 925, at records 963, 1112, 1152, 1156, 1227, between records 1325 and 1335, between records 1430 and 1590, at record 1669, and between records 1840 and 1880 can be seen in each of the other 4 mid-water column floats. They are probably caused by ship traffic near the array. Evidence of the seal bomb explosions may be seen between records 970 and 995. Float 3's tape became full at record 1891, prior to its internal timer causing the ballast to be released.

Figure VI.5 contains rms signal level for float 4 which also deployed to about 1000 meters depth. Float 4 entered the water at about record 253 and arrived at depth by about record 650. Average signal level decreases gradually in the y axis direction and much more rapidly in the vertical direction as the float descends. The x axis channel went bad near record 260 as indicated by very low signal level thereafter. Average signal level from record 650 until the end of the tape is very much like that of float 3, having a mean value of less than 0.5 volts rms except for events common to all of the mid-water floats and containing spikes at one record intervals. Float 4's tape became full at record 1981, prior to being recalled.

Figure VI.6 contains rms signal level for float 5, the third mid-water column float. It entered the water at about record 264 and arrived at depth by about record 650. Average signal level decreases gradually in the horizontal directions and much more rapidly in the vertical direction as the float descends. Average signal level thereafter is very much like that of floats 3 and 4. Float 5's tape became full at record 1978, prior to the float being recalled.

Figure VI.7 contains rms signal level for float 6, which entered the water at about record 276 but stopped its descent and surfaced at about record 385. Float 6 was recovered on the surface at about record 410 and powered down at record 429.

Figure VI.8 contains rms signal level for float 7, which was deployed to about 1000 meters but surfaced prematurely. It entered the water at about record 291 and arrived at depth by about record 640. Average signal levels are very much like those of floats 3, 4 and 5 until record 783 when the float dropped its ballast and began to ascend. Float 7 was recovered on the surface at about record 827 and powered down at record 872.

Figure VI.9 contains rms signal level for float 8, which entered the water at about record 317, but its program had already stopped at record 121. The float was recovered on the surface at about record 431 and powered down shortly thereafter.

Figure VI.10 contains rms signal level for float 9, the fourth float successfully deployed to mid-water column depth. Float 9 entered the water at about record 340 and completed its descent by about record 640. Average signal levels are very much like those of floats 3, 4 and 5. Float 9's tape became full at record 1940, prior to the float being recalled.

Figure VI.11 contains rms signal level for float 10, the fifth mid-water column float. Float 10 entered the water at about record 355 and completed its descent by about record 720. Average signal levels are very much like those of floats 3, 4 and 5. Float 10's tape became full at record 1963, prior to the float being recalled.

Figure VI.12 contains rms signal level for float 11, which entered the water at about record 372 but stopped its descent and surfaced at about record 390. Float 11 was recovered on the surface at about record 460. The float was resynchronized and redeployed but again returned to the surface after a very short time.

VII. Velocity Time Series

This Section contains plots of particle velocity data from the five floats successfully deployed to mid-water depth: floats 3, 4, 5, 9 and 10. Records 940, and 1200 were selected for inclusion to provide a flavor of the appearance of the time series from the 5 floats rather than to display particular events. It has been shown previously that particle velocity data do contain a record of events such as seal bomb explosions known to have occurred during a deployment.[4]

Figures VII.1 and VII.2 contain velocity data from float 3's records 940 and 1200, respectively. X axis data are clipped for about 2 seconds and y axis data for about 4 seconds at the beginning of both records. This clipping accounts for the spikes seen at one record intervals in the average signal plots (Figure VI.4). The dominant signal at the start of the record has a frequency of about 4.5 Hz. It is thought to be caused by the float's resonant oscillation excited by impulses imparted by the tape recorder cycling on and off between records. Other resonances identified at 0.4, 1.7, 2.4 and 4.0 Hz and a current surge-related signal at 2.0 Hz are the subject of current investigation by Greg Edmonds.

Figures VII.3 and VII.4 contain velocity data from float 4. Data are not clipped at the beginning of the records. Note that spikes are not seen at one record intervals in the average signal plots except in the bad x axis channel (Figure VI.5). X and z axis data contains a 2 Hz signal which is thought to be caused by periodic current surges within the float. Clipping which occurs for about 1.5 seconds starting 10 seconds into record 940 is caused by float 4's emission of an acoustic range pulse.

Figures VII.5 and VII.6 contain velocity data from float 5. Data are not clipped at the beginning of the records. Note that spikes are not seen at one record intervals in the average signal plots (Figure VI.6). X axis data contain a 0.4 Hz signal and y axis data contain a 4 Hz signal. Both frequencies are thought to be float resonances.

Figures VII.7 and VII.8 contain velocity data from float 9. Data are clipped at the beginning of the records, and spikes are seen in the average signal plots (Figure VI.10). A 4 Hz signal is dominant at the beginning of all three channels. X axis data contain a 2 Hz signal and y axis data contain a 0.4 Hz signal. These frequencies are thought to be float resonances.

Figures VII.9 and VII.10 contain velocity data from float 10. Data are clipped at the beginning of the records, and spikes are seen in the average signal plots (Figure VI.10). A 4 Hz signal is dominant at the beginning of all three channels. X and y axis data also contain 0.4 Hz signals.

VIII. Velocity and Acoustic Pressure Power Spectra

As the final step in evaluating particle velocity data, power spectral estimates were made for the records shown in Section VII. The first 12 seconds of each record were not used in order to avoid clipped data, leaving 32 seconds (1600 points) of data. Fourier transform length was 512 points (20.48 seconds) and consecutive segments were 50% overlapped. A Kaiser-Bessel window with $\alpha = 2.5$ was used. Seven spectral estimates obtained for each axis of each record were incoherently averaged to produce one spectrum per axis per record. A fourth spectrum generated for each record consisting of the scaled power sum of the spectra from the axes. It has been shown previously that acoustic pressure spectra may be derived from the power sum of directional velocity spectra.[1]

Figures VIII.1 and VIII.2 contain the velocity and acoustic pressure power spectra from float 3. The 2.0, 4.0 and 4.5 Hz signals are thought to be float resonances. Signals at 9.2, 10.8, 12.0, 18.7 and 24.2 Hz in record 940 and 8.0, 13.3, 15.9, 18.7 and 23.8 Hz in record 1200 are thought to be present in the ambient noise.

Figures VIII.3 and VIII.4 contain the velocity and acoustic pressure power spectra from float 4. Signals at 2.0 and harmonics are thought to be float resonances. Signals at 9.2, 10.8, 18.7 and 24.2 Hz in record 940 and 8.0, 18.7 and 23.8 Hz in record 1200 are thought to be present in the ambient noise.

Figures VIII.5 and VIII.6 contain the velocity and acoustic pressure power spectra from float 5. Signals at 9.2, 10.8, 11.2, 18.7 and 24.2 Hz in record 940 and 8.0, 9.3, 18.7, 20.0 and 23.8 Hz in record 1200 are thought to be present in the ambient noise.

Figures VIII.7 and VIII.8 contain the velocity and acoustic pressure power spectra from float 9. Signals at 9.2, 10.8, 11.2, 16.4, 18.7 and 24.2 Hz in record 940 and 8.0, 9.3, 18.7, 20.0 and 23.8 Hz in record 1200 are thought to be present in the ambient noise.

Figures VIII.9 and VIII.10 contain the velocity and acoustic pressure power spectra from float 10. Signals at 2.0 and harmonics are thought to be float resonances. Signals at 9.2, 11.2, 16.4, 18.7 and 24.2 Hz in record 940 and 8.0 and 9.3 Hz in record 1200 are thought to be present in the ambient noise.

Acknowledgments

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References

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2. Culver, R. L., W. S. Hodgkiss, V. C. Anderson, J. C. Nickles, and G. L. Edmonds, "Freely drifting Swallow float array: Initial estimates of interelement range," MPL TM-380, Marine Physical Laboratory, Scripps Institution of Oceanography, San Diego, CA, 1985.

3. Hodgkiss, W. S., V. C. Anderson, G. Edmonds, J. C. Nickles, and R. L. Culver, "A freely drifting infrasonic sensor system," *Fourth Working Symposium on Oceanographic Data Systems*, February 4-6, 1986.

4. Culver, R. L., G. L. Edmonds, W. S. Hodgkiss, V. C. Anderson, and J. C. Nickles, "Freely Drifting Swallow Float Array: September 1985 Trip Report," MPL TM-383, Marine Physical Laboratory, Scripps Institution of Oceanography, San Diego, CA, 1986.

16 September 1986 SHALLOW Trip Schedule

16 Sept. 86

0800 Load Scorpius at MARFAC pier.
1200 Depart MARFAC for San Clemente.
1800 Arrive San Clemente.

17 Sept. 86

0200 Depart for Basin
0400 Arrive at Basin and prepare for deployment. (Check operation and sync to trip box).

0600	*DeployBouy*	0	Bottom Tethered
0630		1	
0700		2	

0600	*DeployBouy*	3	1000 Meter Swallows
0730		4	
0745		5	
0800		6	
0830		7	
0845		8	
0900		9	
0915		10	
0930		11	

Make way to SP - a for buoyfield survey.

1000 Begin survey #1. Record ships position for each range/time sample taken for each 12 buoys and deploy seal bombs while making way to SP - b.

1130 Change course at SP - b and begin second leg of survey to SP - c.

1300 Complete survey #1. Make way at 3 knots (1000 rpm) toward San Clemente loggin position along the way (10 km).
Log start and stop time (1000 rpm).

Figure I.1a.

18 Sept. 86

0600 Begin Survey #2 and proceed as in Survey #1

1000 Recall Buoy #3, (~ 1 hr to surface)
1100 " " 4, recover 3
" " 5, " 4
" " 6, " 5
" " 7, " 6
" " 8, " 7
" " 9, " 8
" " 10, " 9
" " 11, " 10
Recover Buoy 11.

19 Sept. 86

0400 Recall Buoy 0 (~ 2 hr to surface)
0600 " " 1, recover Buoy 0
0800 " " 2, " " 1
1000 Recover Buoy 2, make way to San Diego

1700 Arrive San Diego.

16 Sept. 86 Sea Trip Plan (San Clemente Basin)					
I.D.#	SN	Position	Depth	Date	Release Time
0	0	32°36.0'N, 118° 8.0'W	Bottom	19 Sep	1400
1	1	32°37.0'N, 118°12.0'W	"	"	1600
2	2	32°33.0'N, 118°11.0'W	"	"	1800
3	12	32°35.2'N, 118°10.6'W	1000 m	"	0500
4	4	32°35.2'N, 118°10.4'W	"	"	0600
5	5	32°35.2'N, 118°10.2'W	"	"	0700
6	6	32°35.4'N, 118°10.2'W	"	"	0800
7	7	32°35.4'N, 118°10.4'W	"	"	0900
8	8	32°35.4'N, 118°10.6'W	"	"	1000
9	9	32°35.6'N, 118°10.6'W	"	"	1100
10	10	32°35.6'N, 118°10.4'W	"	"	1200
11	11	32°35.6'N, 118°10.2'W	"	"	1300

Figure I.1b.

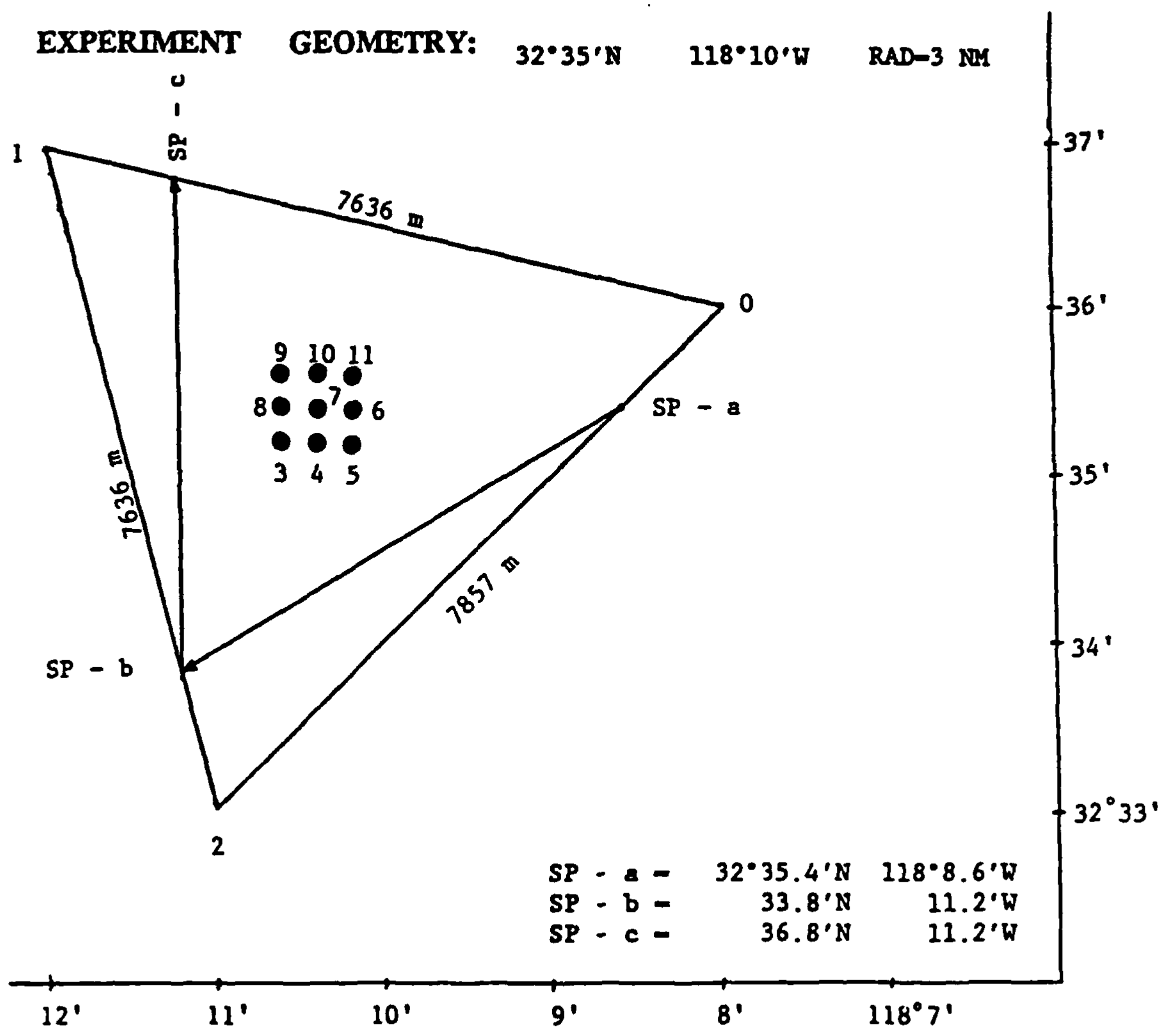

EXPERIMENT GEOMETRY: 32°35'N 118°10'W RAD=3 NM
SP - c
1
7636 m
0
9 10 11
8 7 6
3 4 5
SP - a
7636 m
7857 m
SP - b
2
37'
36'
35'
34'
32°33'
SP - a = 32°35.4'N 118°8.6'W
SP - b = 33.8'N 11.2'W
SP - c = 36.8'N 11.2'W
12'
11'
10'
9'
8'
118°7'

Figure I.1c.

Figure I.2.: Log Book Summary, 16-18 September 1986

16 September

0800 - 1200	Load 12 Swallow floats and associated equipment aboard the 110′ commercial charter fishing/survey vessel *Scorpius*, berthed at Nimitz Marine Facility pier, San Diego, Ca.
1300	Underway for intended deployment site, 32°35′ N, 118°10′ W, approximately 50 miles west of San Diego.

17 September

0400	Arrive on station. Begin predeployment float checkout.
0515	All floats observed to be functioning properly. Synchronize floats.
0555	Float 0 deployed at 32°35.6′ N, 118°08.2′ W.
0641	Float 1 deployed at 32°37.01′ N, 118°11.96′ W.
0745	Float 2 deployed at 32°33.1′ N, 118°10.96′ W.
0811	Float 3 deployed at 32°35.23′ N, 118°10.57′ W.
0825	Float 4 deployed at 32°35.21′ N, 118°10.37′ W.
0833	Float 5 deployed at 32°35.26′ N, 118°10.22′ W.
0842	Float 6 deployed at 32°35.37′ N, 118°10.16′ W.
0853	Float 7 deployed at 32°35.40′ N, 118°10.32′ W.
0913	Float 8 deployed at 32°35.35′ N, 118°10.56′ W.
0930	Float 9 deployed at 32°35.66′ N, 118°10.55′ W.
0941	Float 10 deployed at 32°35.62′ N, 118°10.37′ W.
0954	Float 11 deployed at 32°35.64′ N, 118°10.17′ W.
1034	Recover float 6 32°35.9′ N, 118°10.44′ W. Program display stopped at 73.
1038	Recover float 8 32°35.86′ N, 118°10.49′ W. Program display stopped at HL.
1115	Recover float 11 32°35.64′ N, 118°10.0′ W. Program still running.
1150	Resynchronize float 11.
1252	Redeploy float 11 at 32°35.6′ N, 118°10.15′ W.
1408	Commence float position survey at point SP-a.
1603	Recover float 11 at 32°35.27′ N, 118°09.29′ W.
1612	Complete float position survey.
1630	Recover float 7 32°35.29′ N, 118°09.68′ W.
1719	Ship's position 32°35.74′ N, 118°10.06′ W.
1723	Commence deploying seal bombs at about 1 minute intervals. Ship's course 270° magnetic; speed 1000 rpm (both shafts).
1730	Ship's position 32°35.81′ N, 118°10.57′ W.
1734	Ship's position 32°35.85′ N, 118°10.82′ W.
1736	Ship's position 32°35.88′ N, 118°10.99′ W.
1739	Ship's position 32°35.94′ N, 118°11.15′ W.
1740	Seal bomb deployment complete.
1745	Ship's position 32°36.04′ N, 118°11.68′ W. US Navy LSD sighted at bearing 055° magnetic, range 9.5 miles. Another contact sighted at bearing 335° magnetic, range 11.5 miles.
1800	Ship's position 32°36.19′ N, 118°12.56′ W.
1804	Change course to 310° magnetic; speed increased to 1500 rpm (both engines).
1820	Speed increased to 1800 rpm (both engines).
1834	Speed decreased to 1500 rpm (both engines).

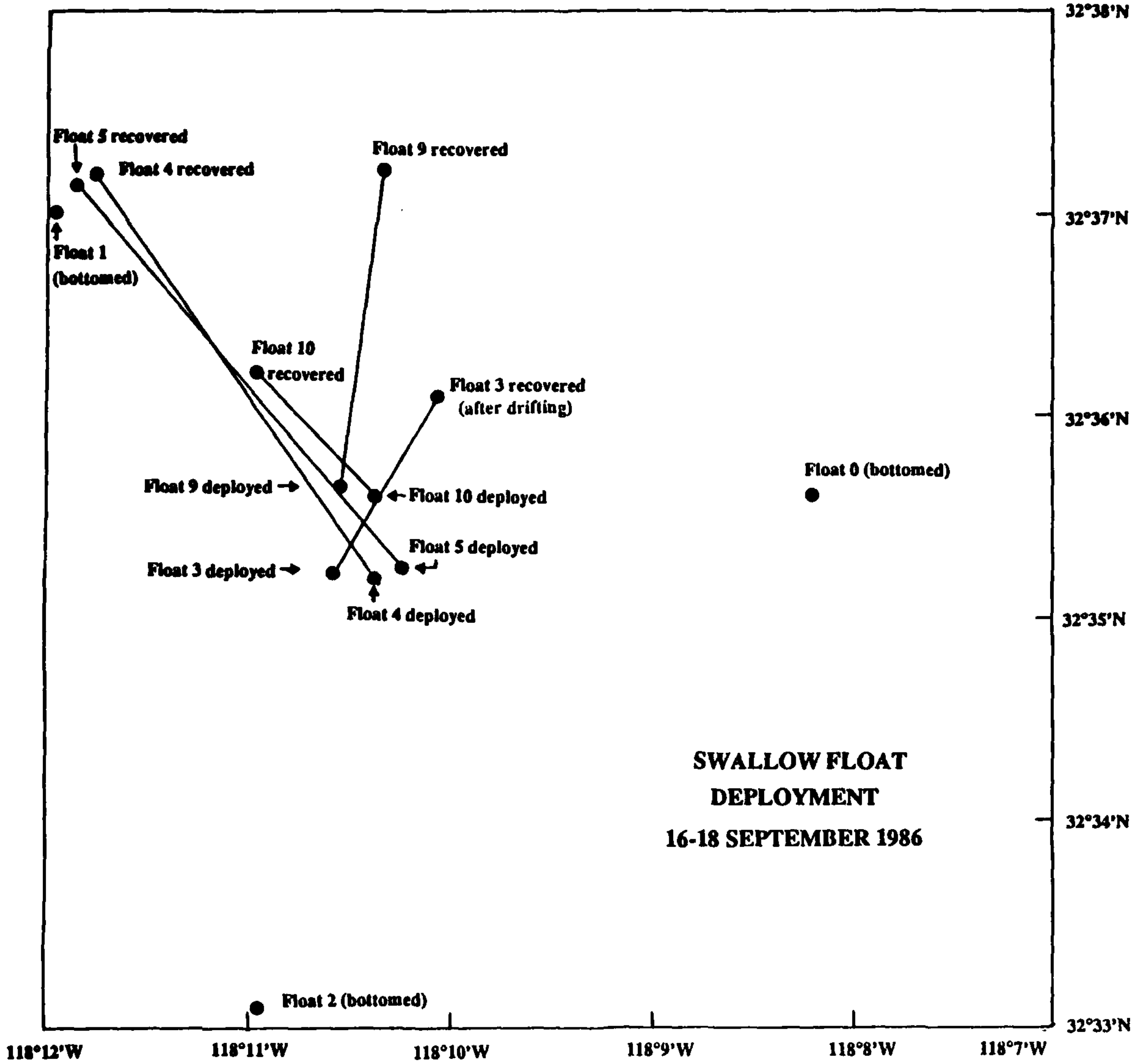
1900	Ship's position 32°41.24′ N, 118°17.30′ W.
2000	Ship's position 32°46.81′ N, 118°21.18′ W.
2030	Anchor for the night at Pyramid Cove, San Clemente Island.

18 September

0400	Get underway for deployment area. Course 126° magnetic; speed 1750 rpm (both engines).
0449	Contact sighted at bearing 190° magnetic, range 8 miles.
0456	Contact sighted at bearing 106° magnetic, range 6 miles.
0458	Contact sighted at bearing 220° magnetic, range 9 miles.
0500	Ship's position 32°42.66′ N, 118°16.34′ W.
0502	Contact sighted at bearing 090° magnetic, range 4 miles.
0513	Contact sighted at bearing 014° magnetic, range 1.75 miles.
0556	Arrive at point SP-c. Commence float position survey.
0630	Float 3 detected on the surface. Maneuvering to make recovery.
0700	Recover float 3 at 32°36.01′ N, 118°10.06′ W. Timed release set for 0.
0702	US Navy destroyer sighted at bearing 350° magnetic, range 1.5 miles.
0708	Complete float position survey.
0719	US Navy LSD sighted at bearing 275° magnetic, range 5 miles. USNS oiler sighted at bearing 060° magnetic, range 2.5 miles. US Navy destroyer sighted at bearing 055°, range 3 miles.
0728	Ship's position 32°36.18′ N, 118°10.78′ W.
0739	Recall float 10.
0740	USNS oiler (hull #142) sighted at bearing 180° magnetic, range 1000 meters. US Navy destroyer (FF1060) sighted at bearing 125°, range 1000 meters. Both ships are making 8.5 kts.
0748	Both ships increasing speed to 9.7 kts.
0858	Recover float 10 at 32°36.22′ N, 118°10.95′ W. Recall float 9.
0957	Recall float 4.
1001	Recover float 9 at 32°37.20′ N, 118°10.32′ W.
1016	Recall float 5.
1110	Recover float 4 at 32°37.20′ N, 118°11.76′ W. Recall float 1.
1120	Recover float 5 at 32°37.15′ N, 118°11.85′ W.
1218	Recall float 0.
1338	Recover float 1 at 32°37.03′ N, 118°11.68′ W.
1402	Recall float 2.
1449	Recover float 0 at 32°35.78′ N, 118°07.81′ W.
1600	Recover float 2 at 32°33.09′ N, 118°10.43′ W.
1615	Underway for San Diego.
2230	Arrive at Nimitz Marine Facility, San Diego.

19 September

0800 - 1200	Offload Swallow floats and equipment.



Float 5 recovered
Float 4 recovered
Float 9 recovered
Float 1
(bottomed)
Float 10
recovered
Float 3 recovered
(after drifting)
Float 0 (bottomed)
Float 9 deployed
Float 10 deployed
Float 5 deployed
Float 3 deployed
Float 4 deployed
SWALLOW FLOAT
DEPLOYMENT
16-18 SEPTEMBER 1986
Float 2 (bottomed)
32°38'N
32°37'N
32°36'N
32°35'N
32°34'N
32°33'N
118°12'W
118°11'W
118°10'W
118°9'W
118°8'W
118°7'W

Figure I.3.

```
0       RECORD #(LB)     H      526    RESYNC(AA)       V
        RECORD #(HB)     E             RESYNC(AA)       L
        AGC CODE         A             RESYNC(01)       F
        COMPASS          D             CHAN X
        BUOY ID          E             CHAN Y           A
        BATTERY          R             CHAN Z           C
        SPARE                          CHAN X           O
        CHECKSUM(LB)                   CHAN Y           U
        CHECKSUM(HB)__________         CHAN Z           S
9       RESYNC(AA)                       |              T
        RESYNC(AA)                       |              I
        RESYNC(01)                     CHECKSUM(LB)     C
12      RANGE INDEX 1    R             CHECKSUM(HB)
        DETECTION        A      606    RESYNC(AA)       D
        TIME(LB)         N             RESYNC(AA)       A
        TIME(HB)         G             RESYNC(01)       T
        DETECTION        E             CHAN X           A
        TIME(LB)                       CHAN Y
        TIME(HB)         P             CHAN Z
          |              U               |
          |              L               |
        DETECTION        S      7645   CHECKSUM(LB)
        TIME(LB)         E             CHECKSUM(HB)    ______
        TIME(HB)                                        G
268     RANGE INDEX 2    D                              A
        DETECTION        A                              P
        TIME(LB)         T      0      RECORD #(LB)
        TIME(HB)         A               |              N
        DETECTION                        |              E
        TIME(LB)                         |              X
        TIME(HB)                         |              T
          |                              |
          |                              |              R
        DETECTION                        |              E
        TIME(LB)                         |              C
        TIME(HB)                         |              O
        CHKSUM(LB)                       |              R
525     CHKSUM(HB)       _________       |              D
```

Figure II.1.

Figure II.2. - 1986 Deployment Data Screening Results

record number	internal record number	# of bytes written	first missing resync	pass header checksum?	pass range checksum?	# of failed acoustic checksums?
			Float 0			
455	453	7642	33	yes	yes	58
1336	1334	7598	0	yes	yes	0
1928	1926	256	0	yes	no	0
1929	****	6678	1	no	no	77
1934	1931	1678	0	yes	yes	1
1935	****	7232	1	no	no	84
1970	1965	0	0	yes	yes	0
1971	1965	0	0	yes	yes	0
1972	1965	0	0	yes	yes	0
1973	1965	0	0	yes	yes	0
1974	1965	0	0	yes	yes	0
1975	1965	0	0	yes	yes	0
1976	1965	0	0	yes	yes	0
1977	1965	0	0	yes	yes	0
1978	1965	0	0	yes	yes	0
1979	1965	0	0	yes	yes	0
1980	1965	0	0	yes	yes	0
1981	1965	0	0	yes	yes	0
1982	1965	0	0	yes	yes	0
1983	1965	0	0	yes	yes	0
1984	1965	0	0	yes	yes	0
1985	1965	0	0	yes	yes	0
1986	1965	0	0	yes	yes	0
1987	1965	0	0	yes	yes	0
1988	1965	0	0	yes	yes	0
1989	1965	0	0	yes	yes	0
1990	1965	0	0	yes	yes	0
			Float 1			
2016	2013	0	0	yes	yes	0

Figure II.2 (cont.)						
record number	internal record number	# of bytes written	first missing resync	pass header checksum?	pass range checksum?	# of failed acoustic checksums?
			Float 2			
none.						
			Float 3			
327	325	7640	22	yes	yes	59
330	328	7642	2	yes	no	88
1769	1767	2752	0	yes	yes	1
1770	****	6134	1	no	no	71
1894	1890	0	0	yes	yes	0
			Float 4			
none.						
			Float 5			
1926	1924	3088	0	yes	yes	1
1927	****	5388	1	no	no	61
1981	1977	0	0	yes	yes	0
			Float 6			
none.						
			Float 7			
874	871	0	0	yes	yes	0

Figure II.2 (cont.)

record number	internal record number	# of bytes written	first missing resync	pass header checksum?	pass range checksum?	# of failed acoustic checksums?
Float 8						
none.						
Float 9						
1942	1939	0	0	yes	yes	0
Float 10						
1406	1404	1158	0	yes	yes	1
1407	****	5728	1	no	no	66
1966	1962	0	0	yes	yes	0
Float 11						
197	195	6576	0	yes	yes	1
198	****	344	1	no	no	1
474	0	7648	1	no	no	88
812	333	0	0	yes	yes	0

Float 0, 86 deployment: surface & bottom bounces

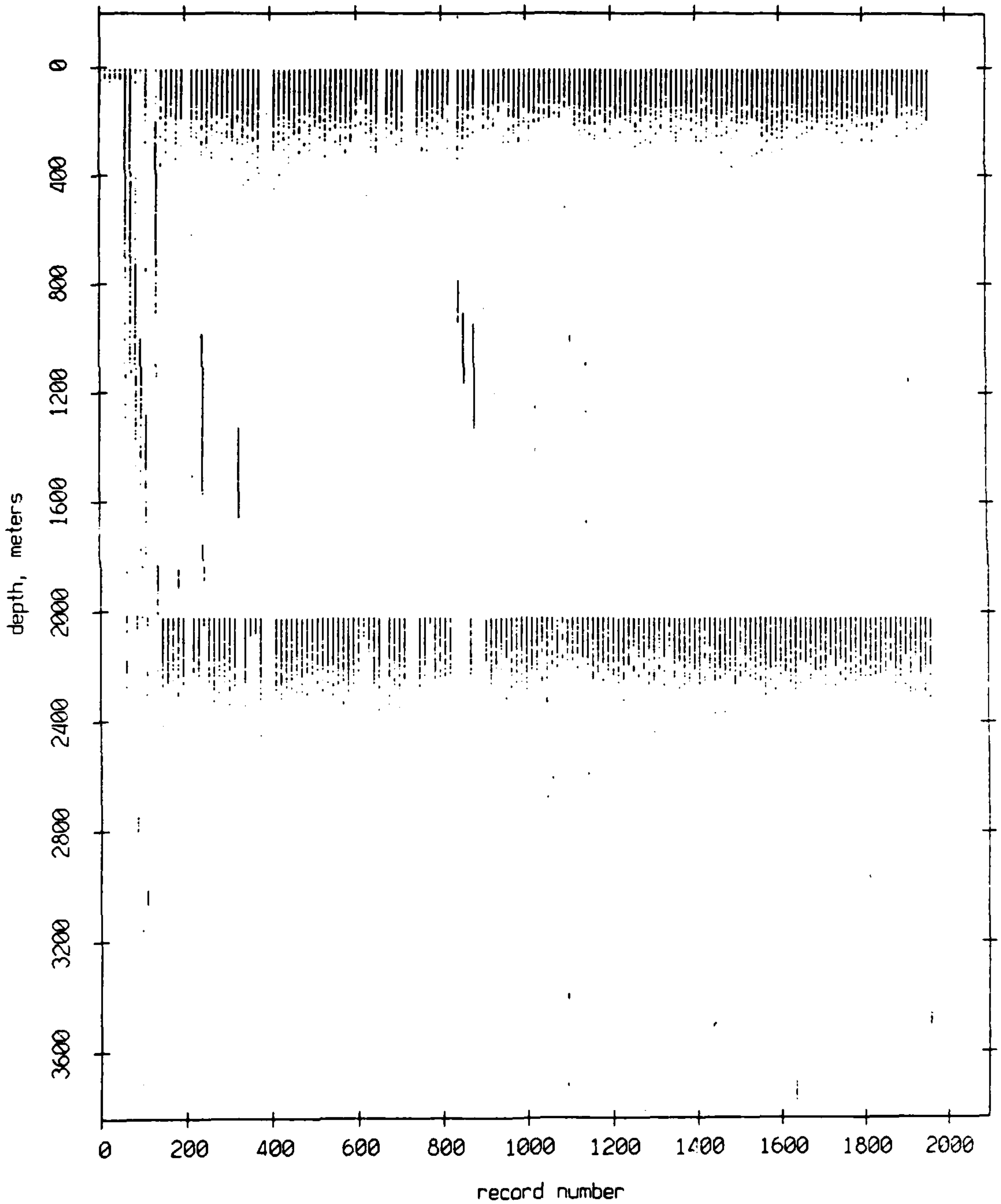
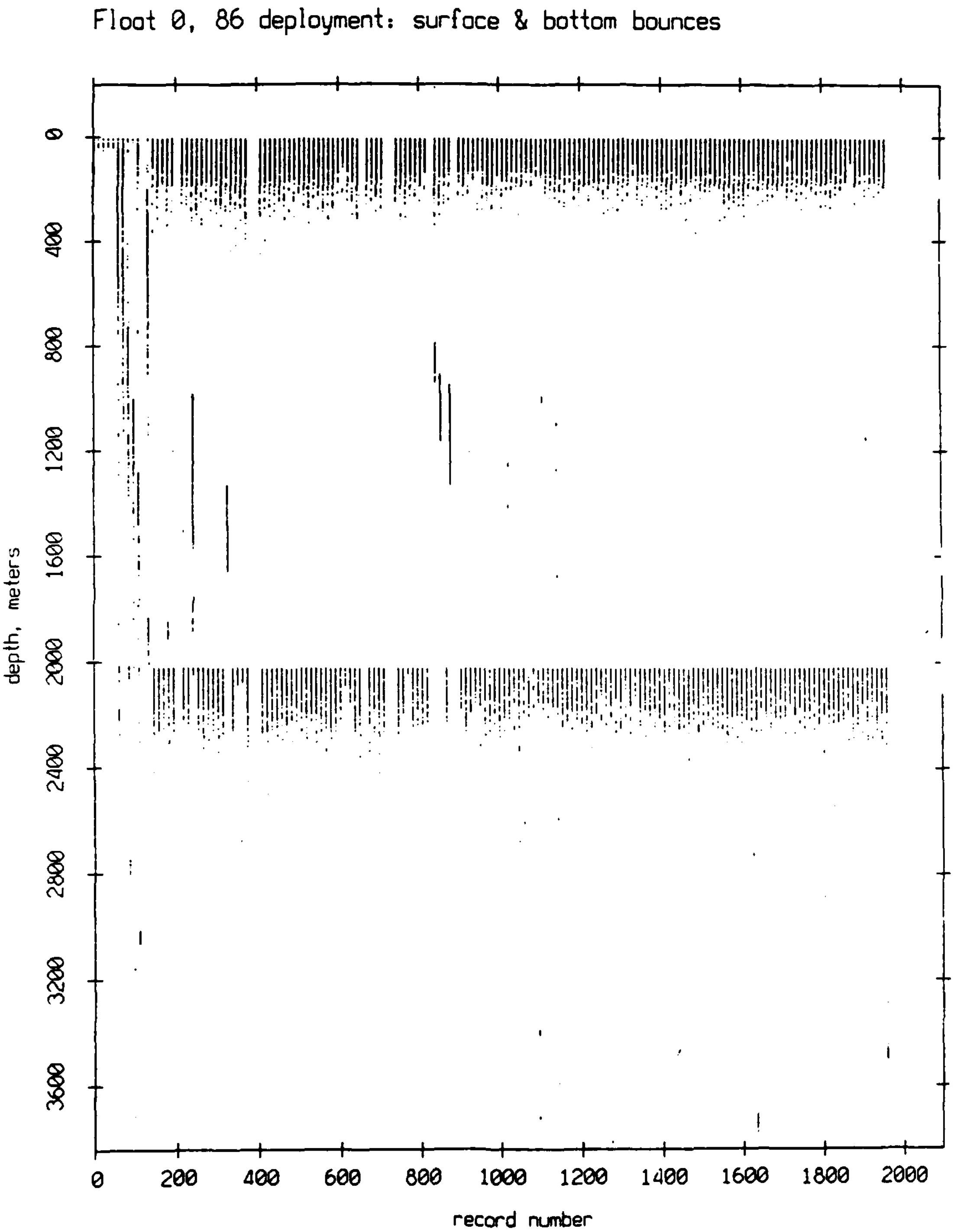


Figure III.1.



Float 0, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.2.

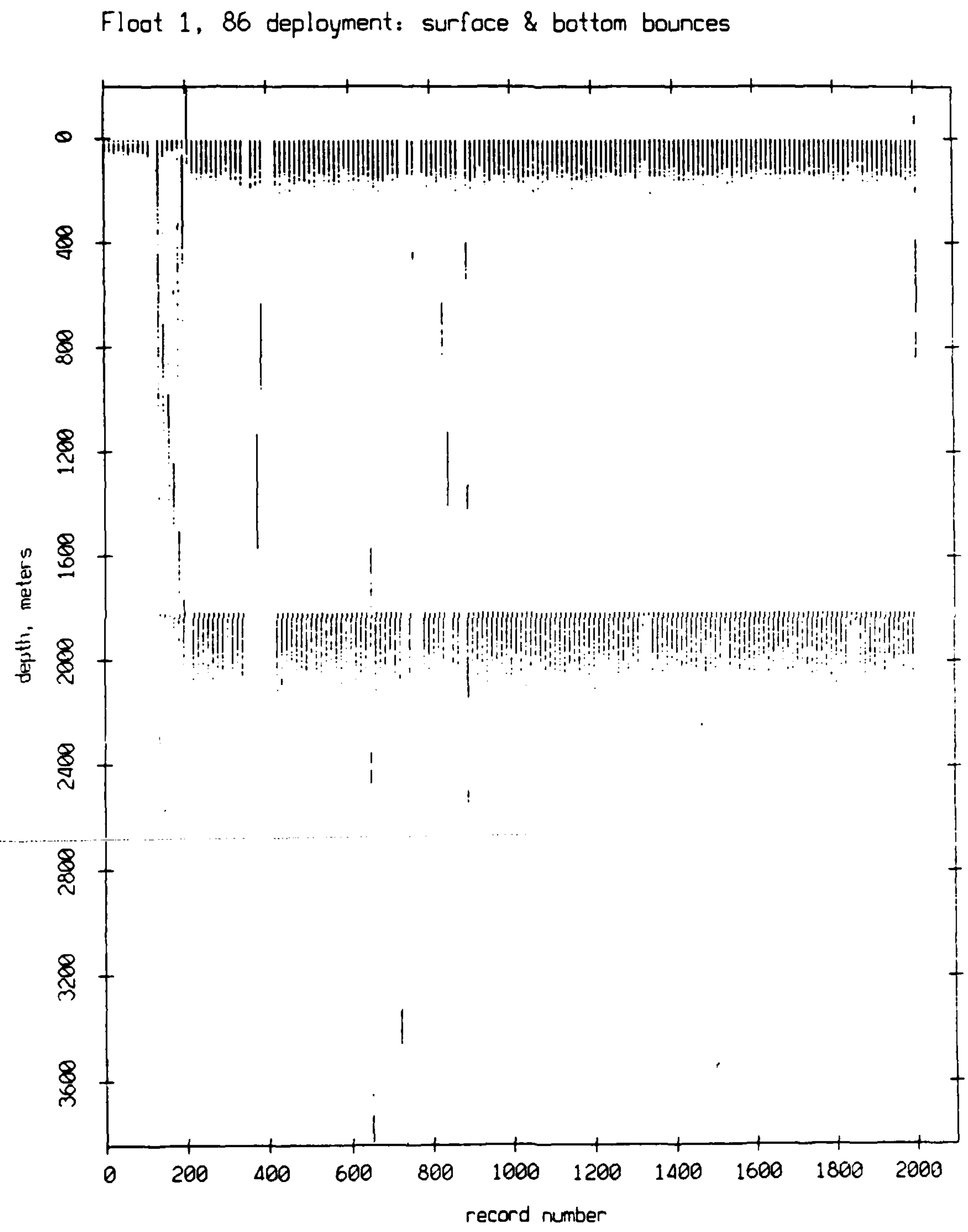

Float 1, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.3.

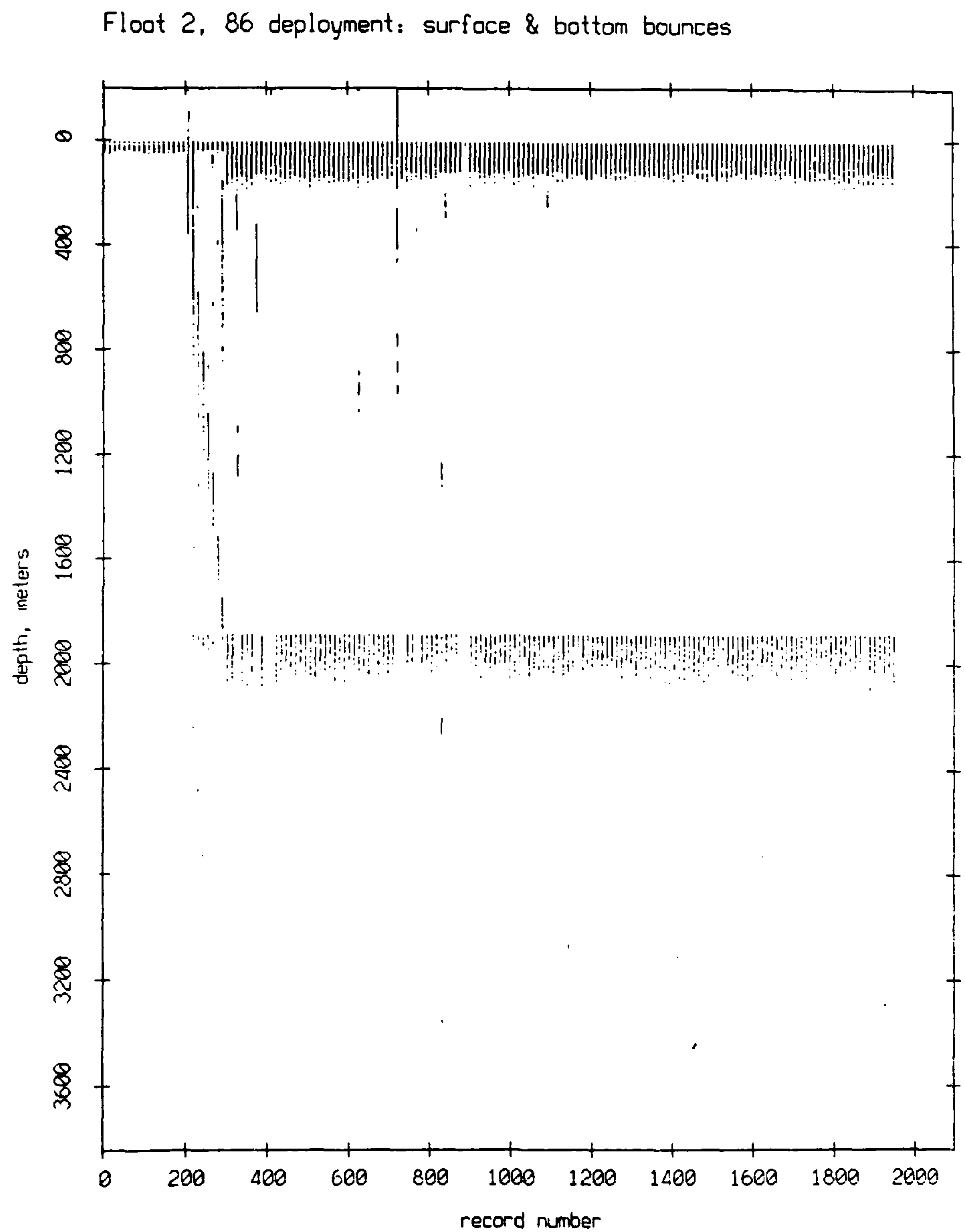

Float 2, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.4.

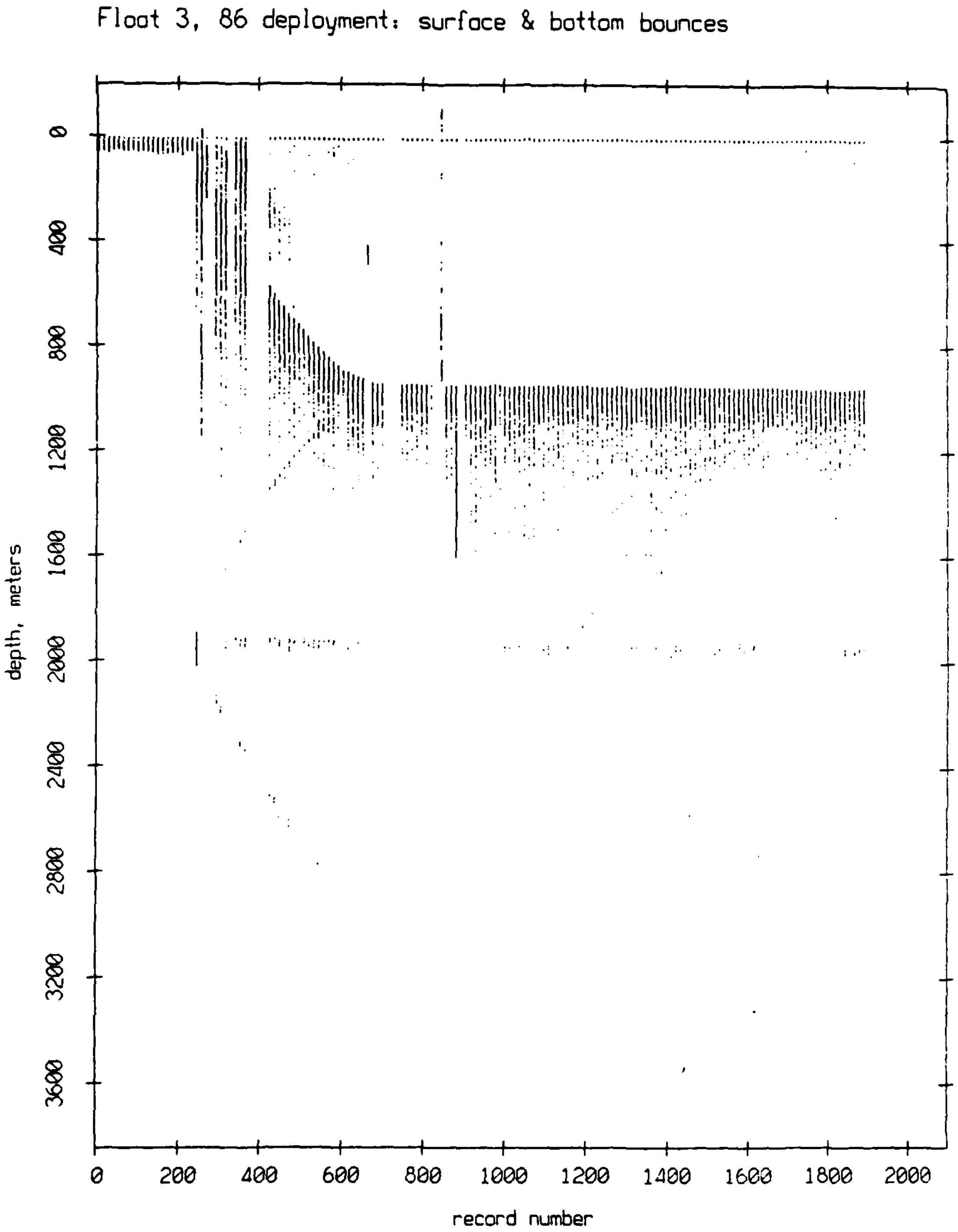

Float 3, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
record number
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Figure III.5

Float 4, 86 deployment: surface & bottom bounces

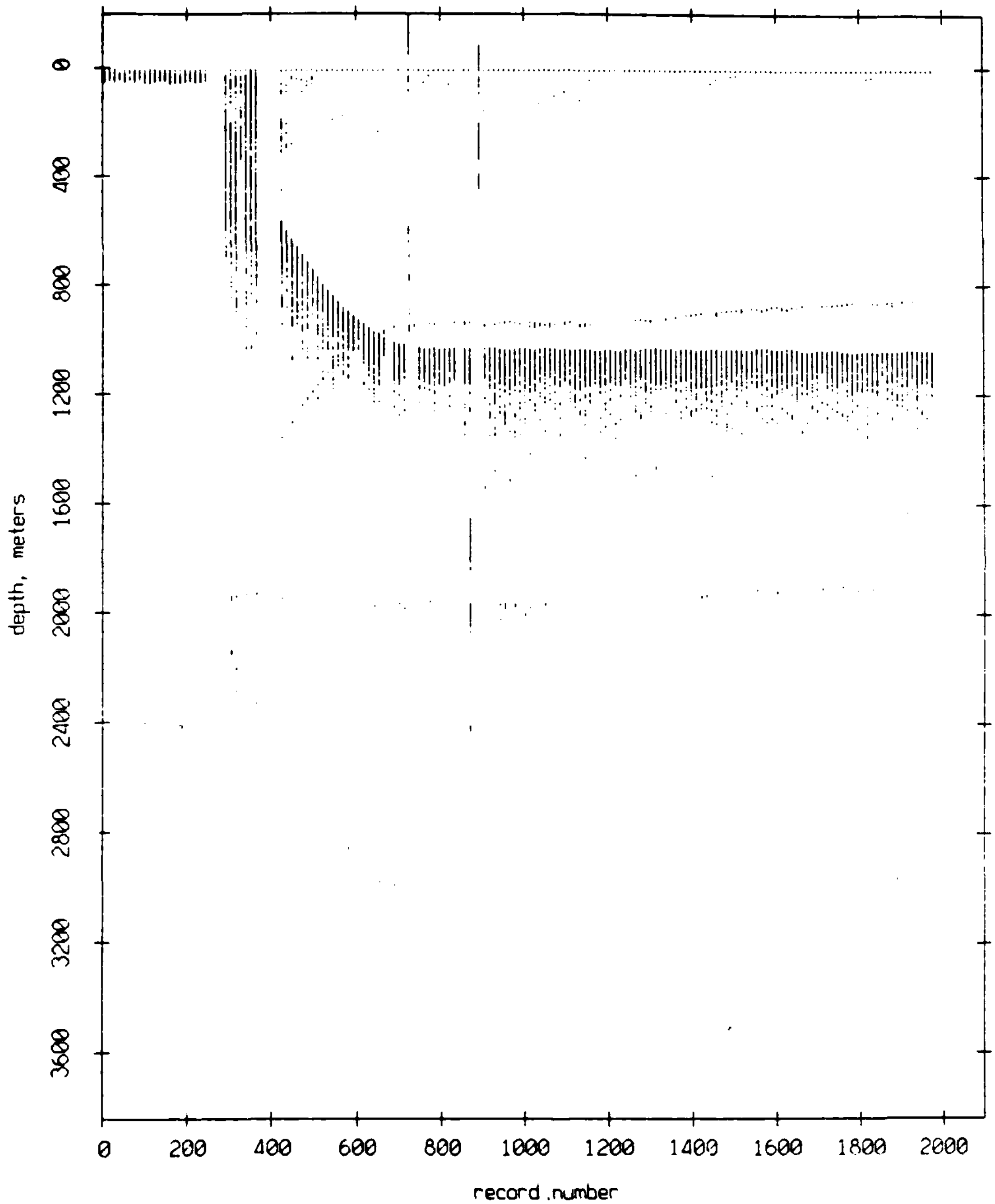


Figure III.6

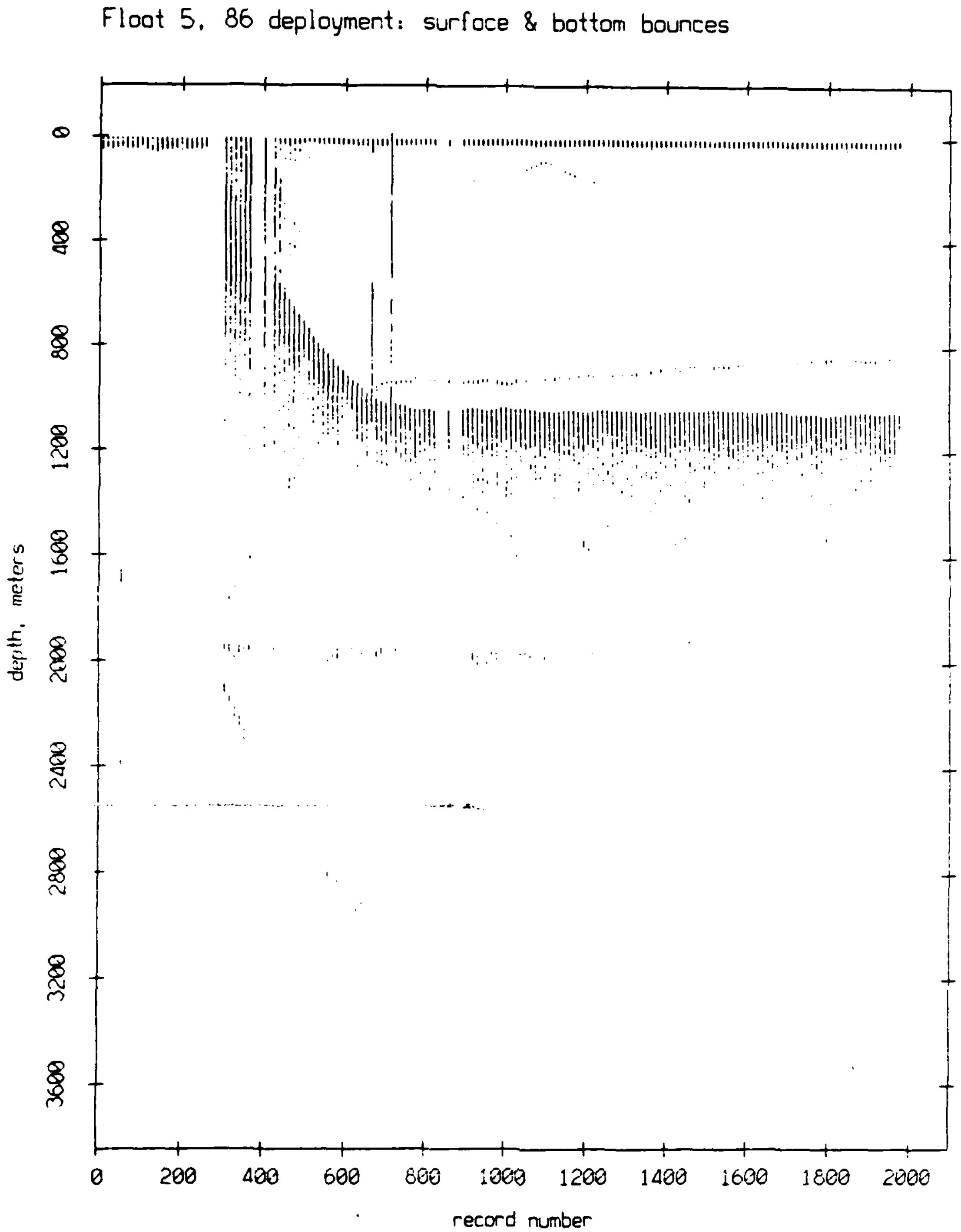

Float 5, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.7

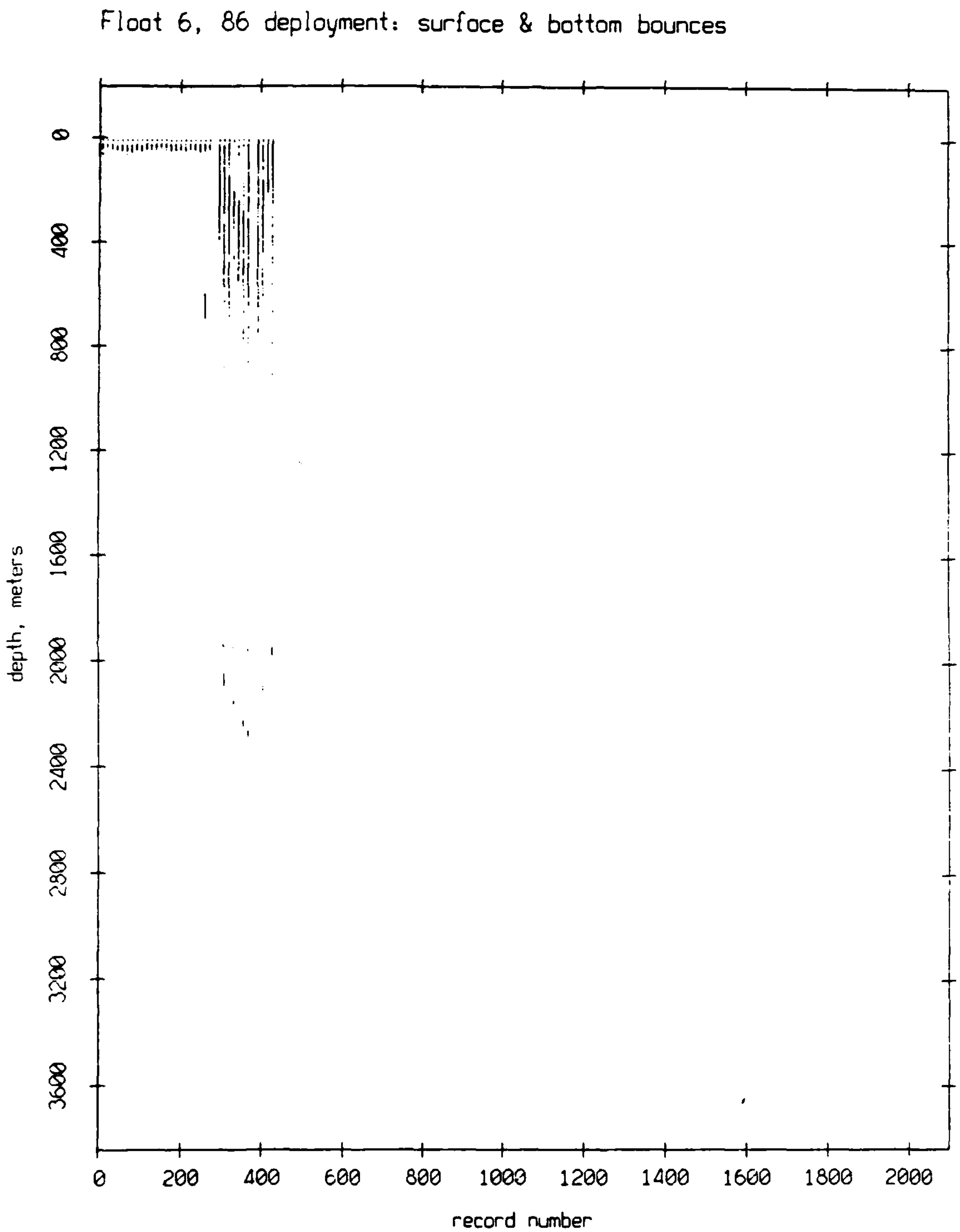

Float 6, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.8

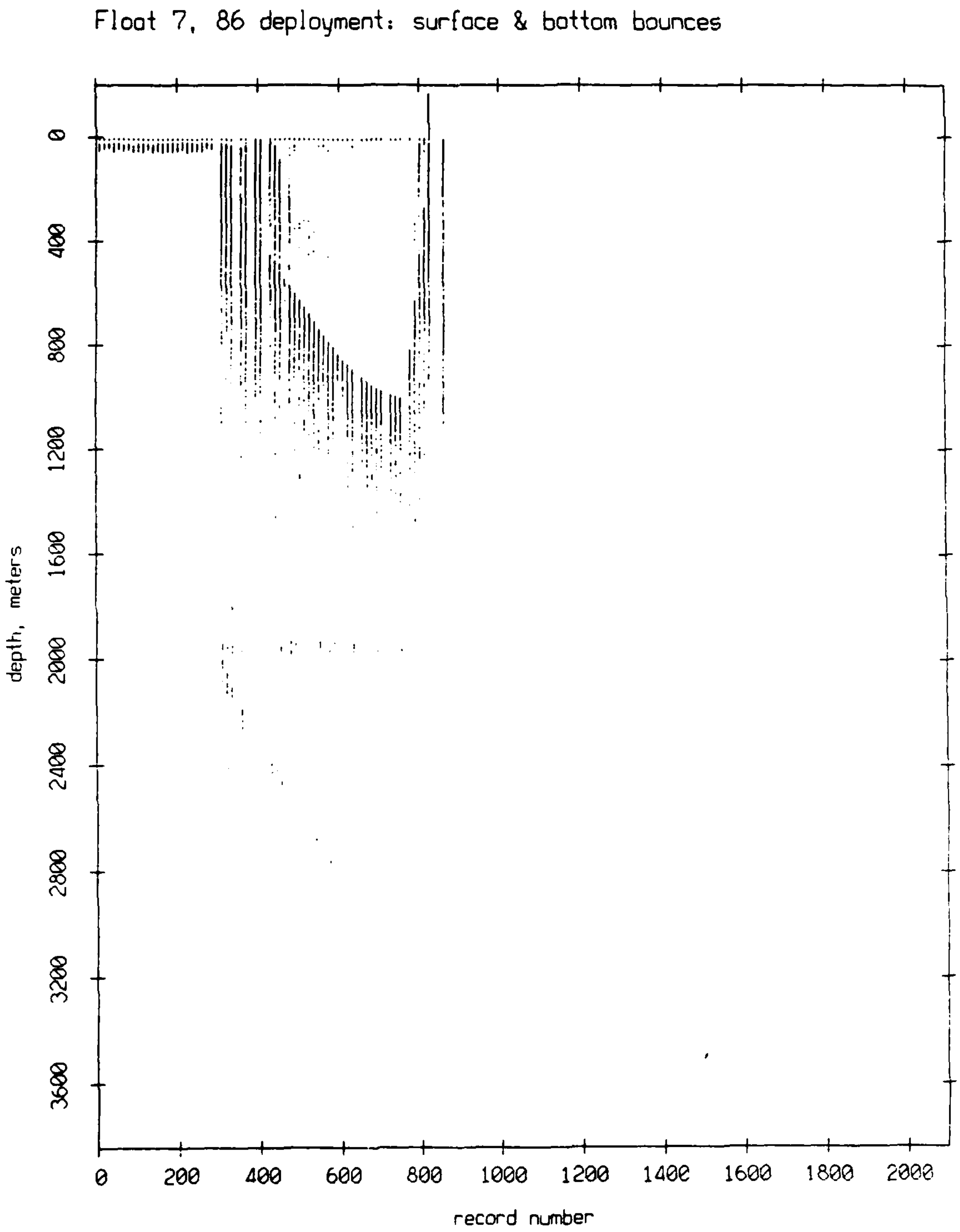

Float 7, 86 deployment: surface & bottom bounces
depth, meters
0
400
800
1200
1600
2000
2400
2800
3200
3600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure III.9

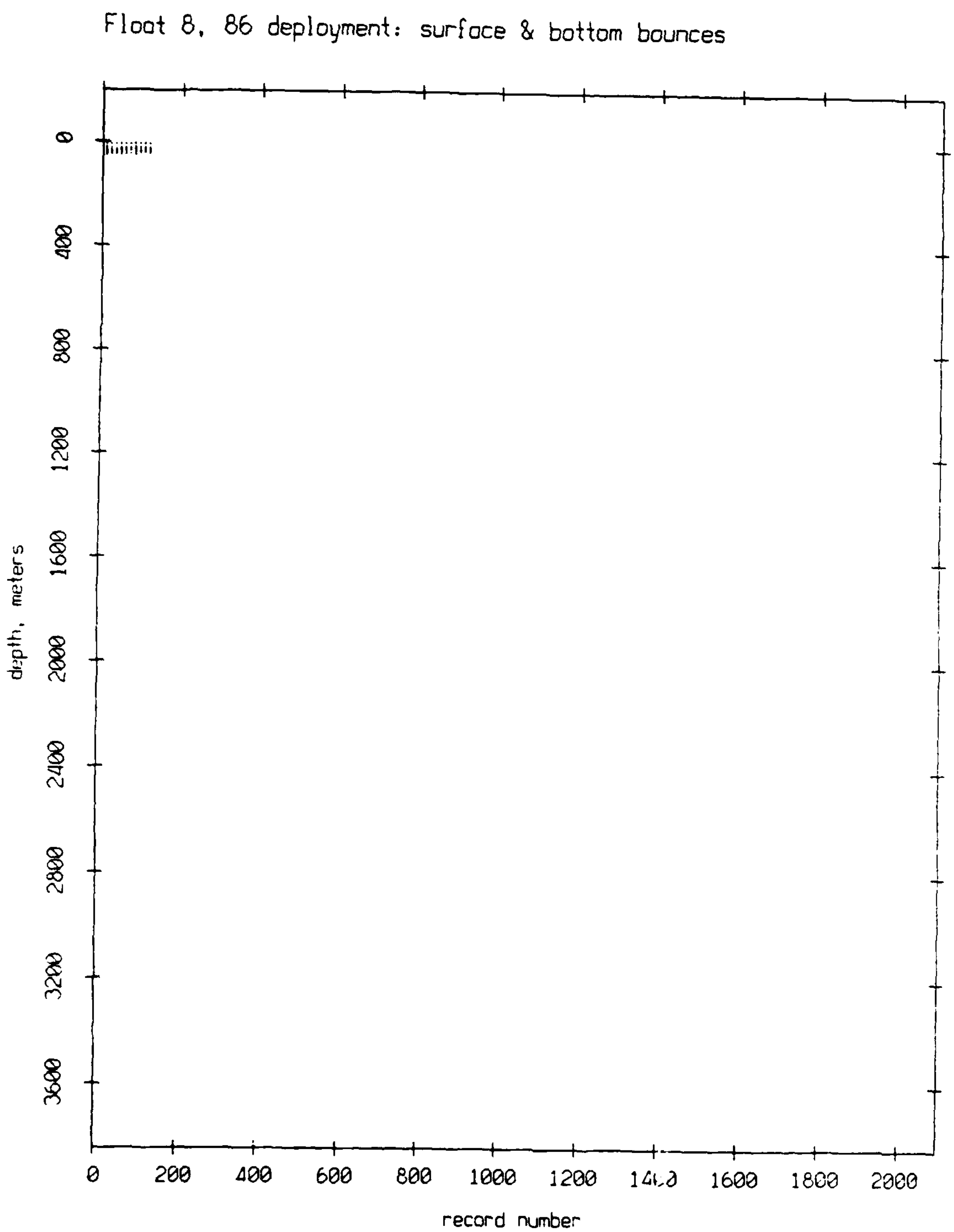


Figure III.10.

Float 9, 86 deployment: surface & bottom bounces

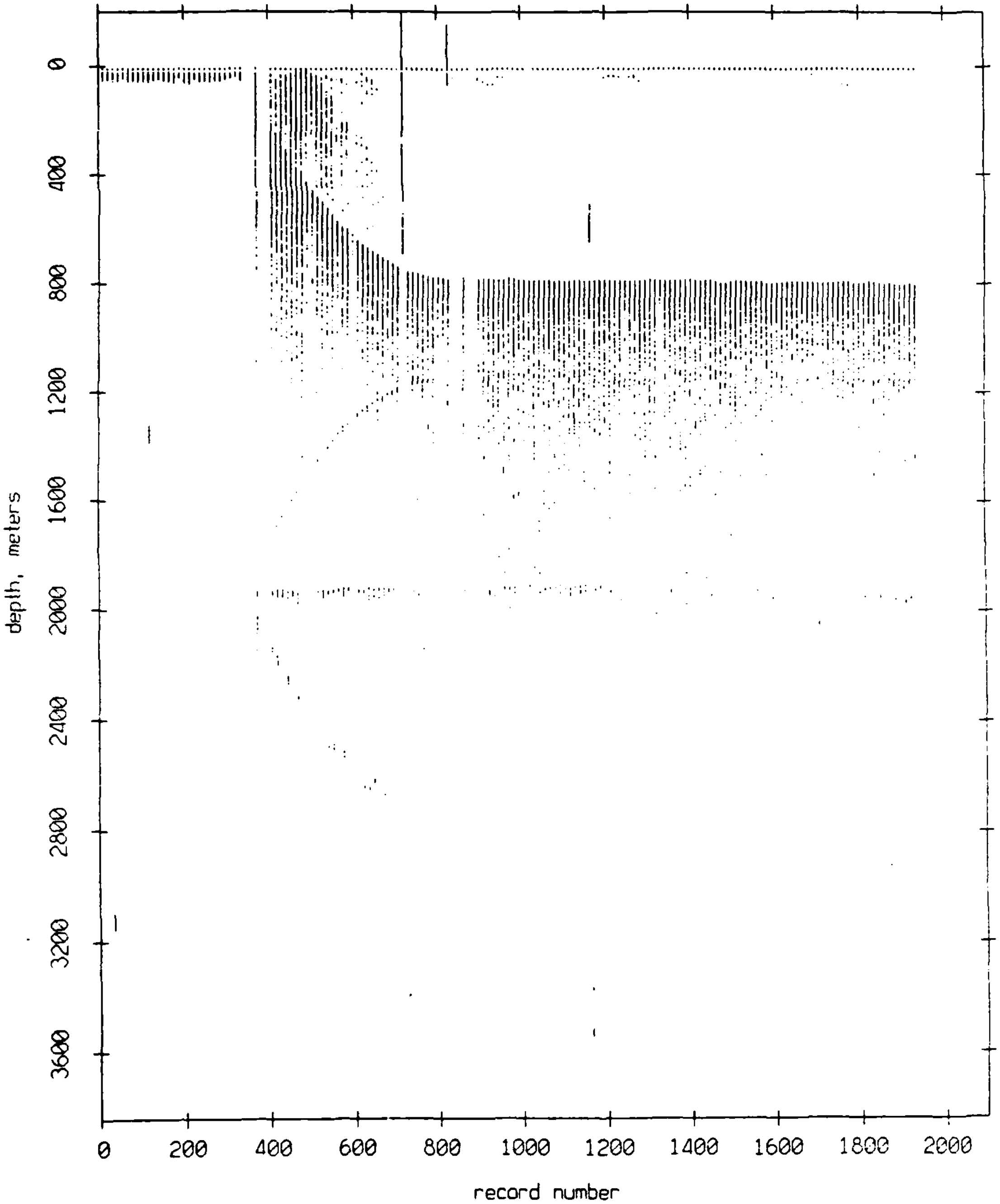


Figure III.11.

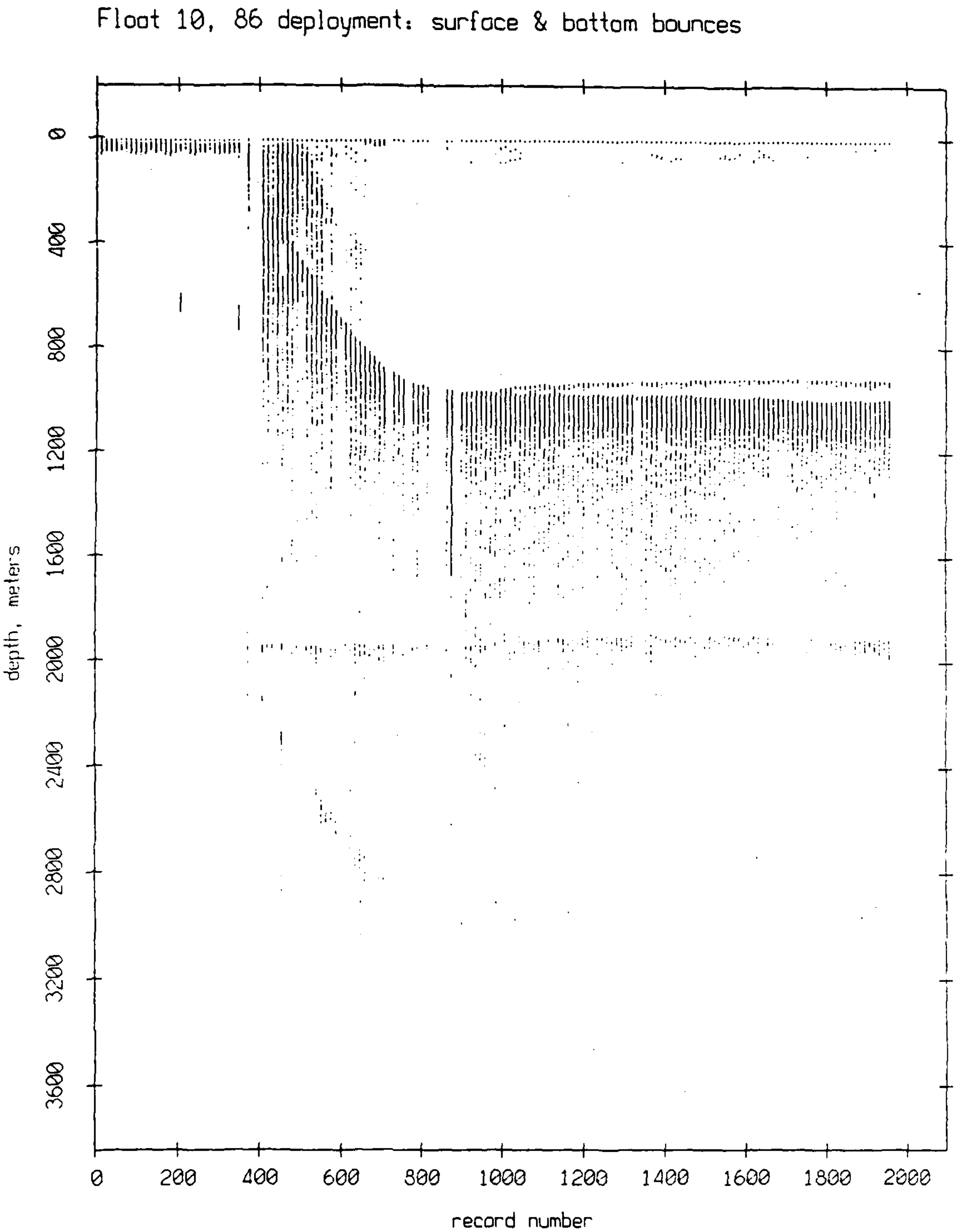


Figure III.12.

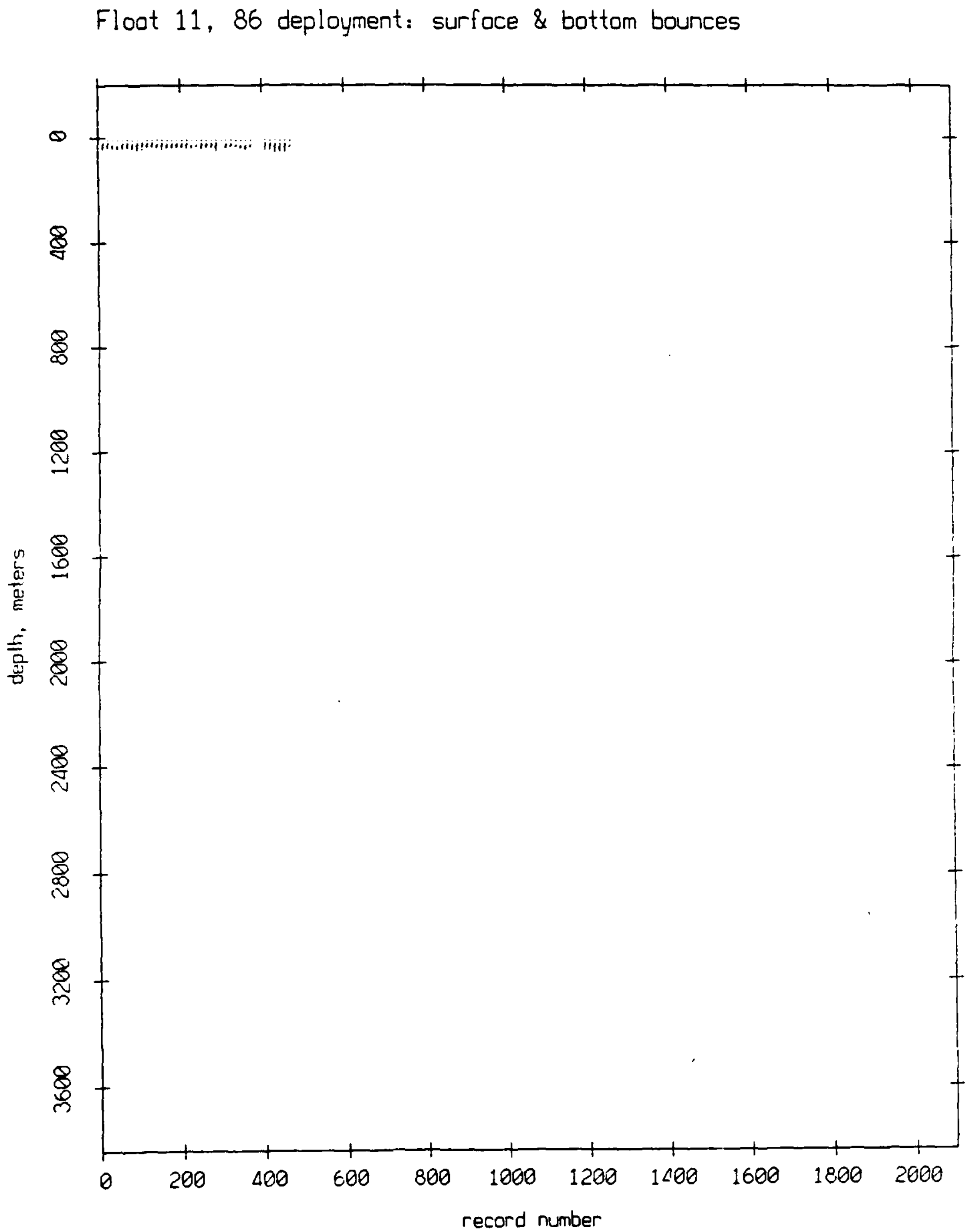


Figure III.13.

Float 0, 86 deployment: range from float 1

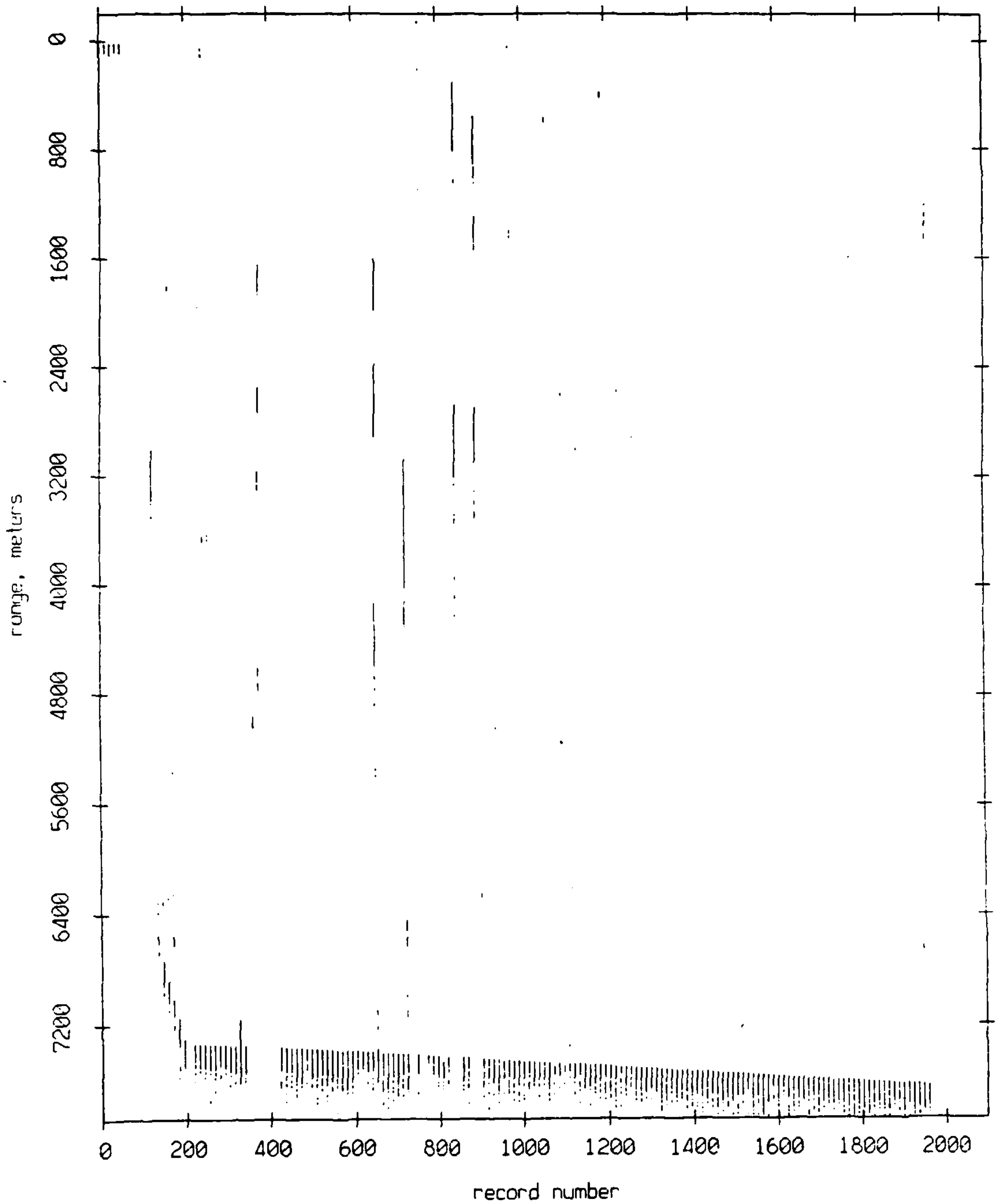


Figure IV.1a.

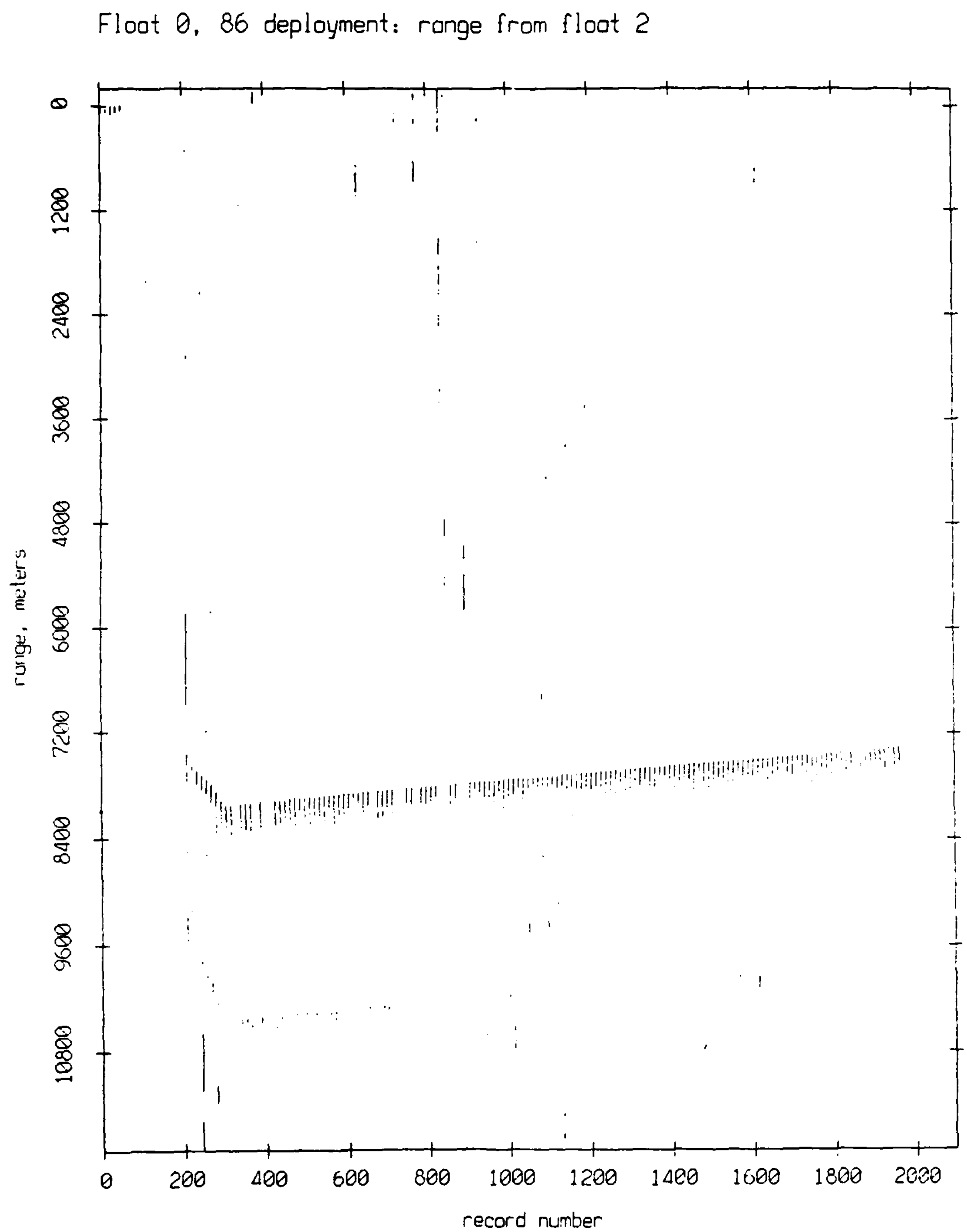

Float 0, 86 deployment: range from float 2
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.1b.

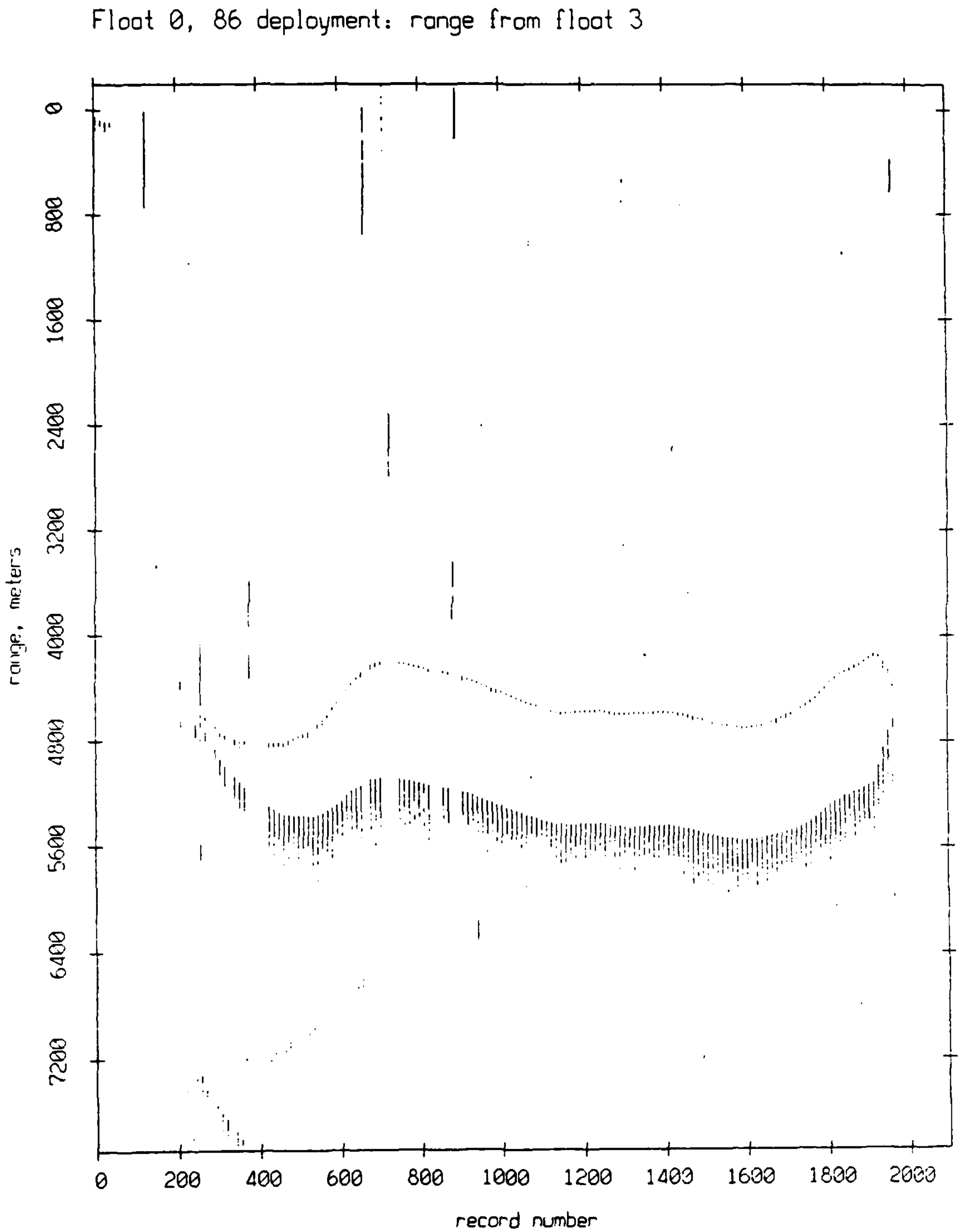

Float 0, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.1c.

Float 0, 86 deployment: range from float 4

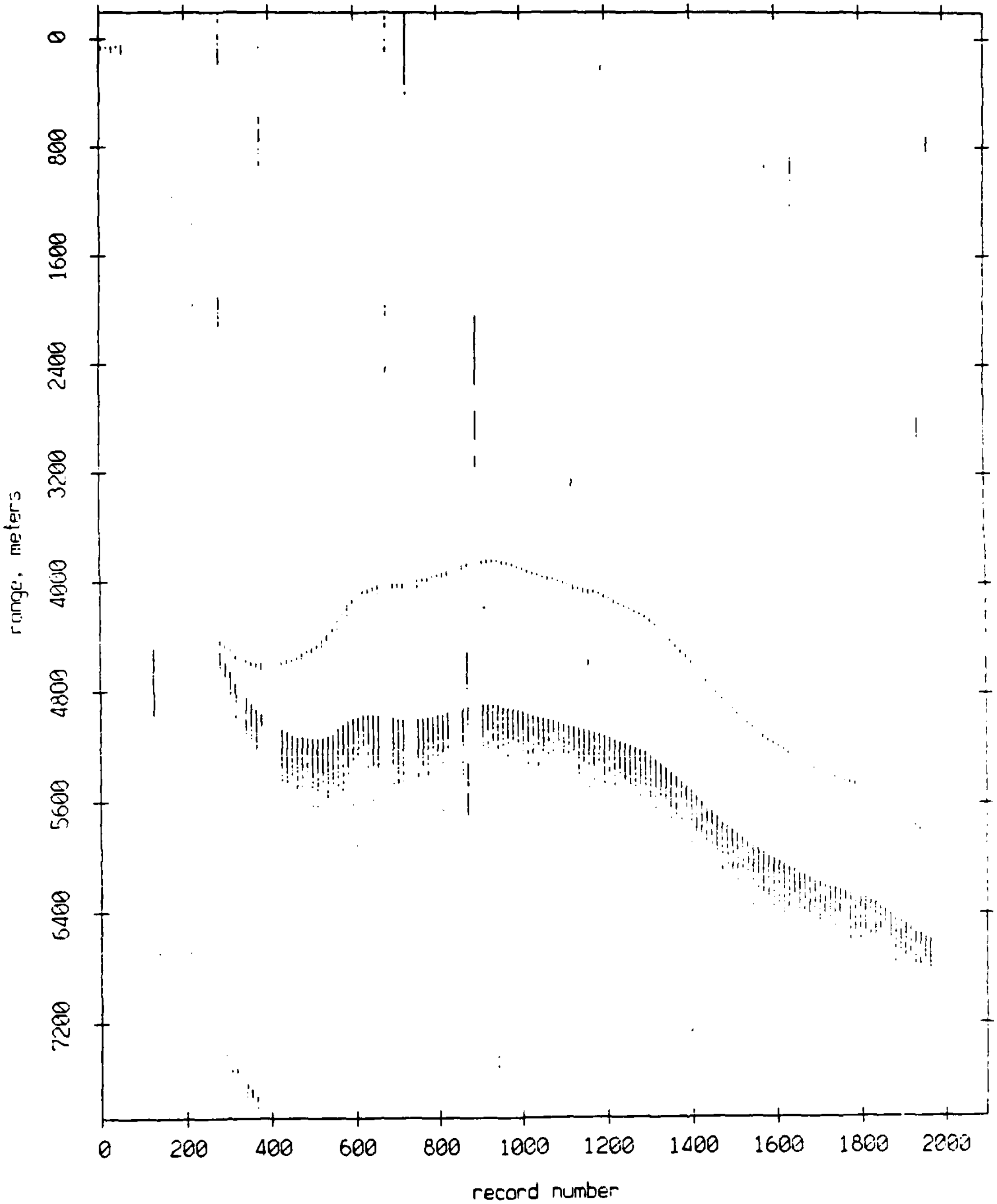


Figure IV.1d.

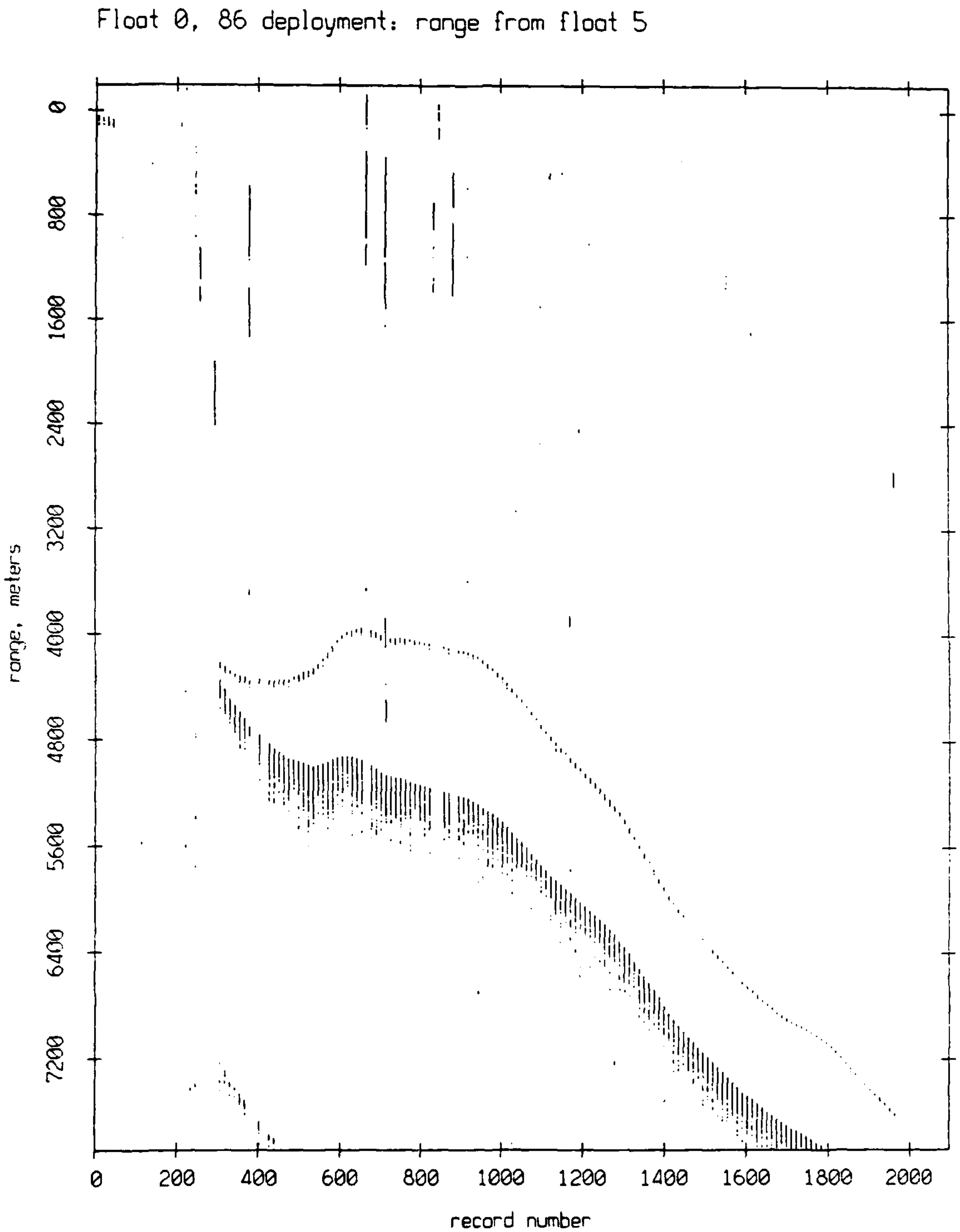

Float 0, 86 deployment: range from float 5
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.1e.

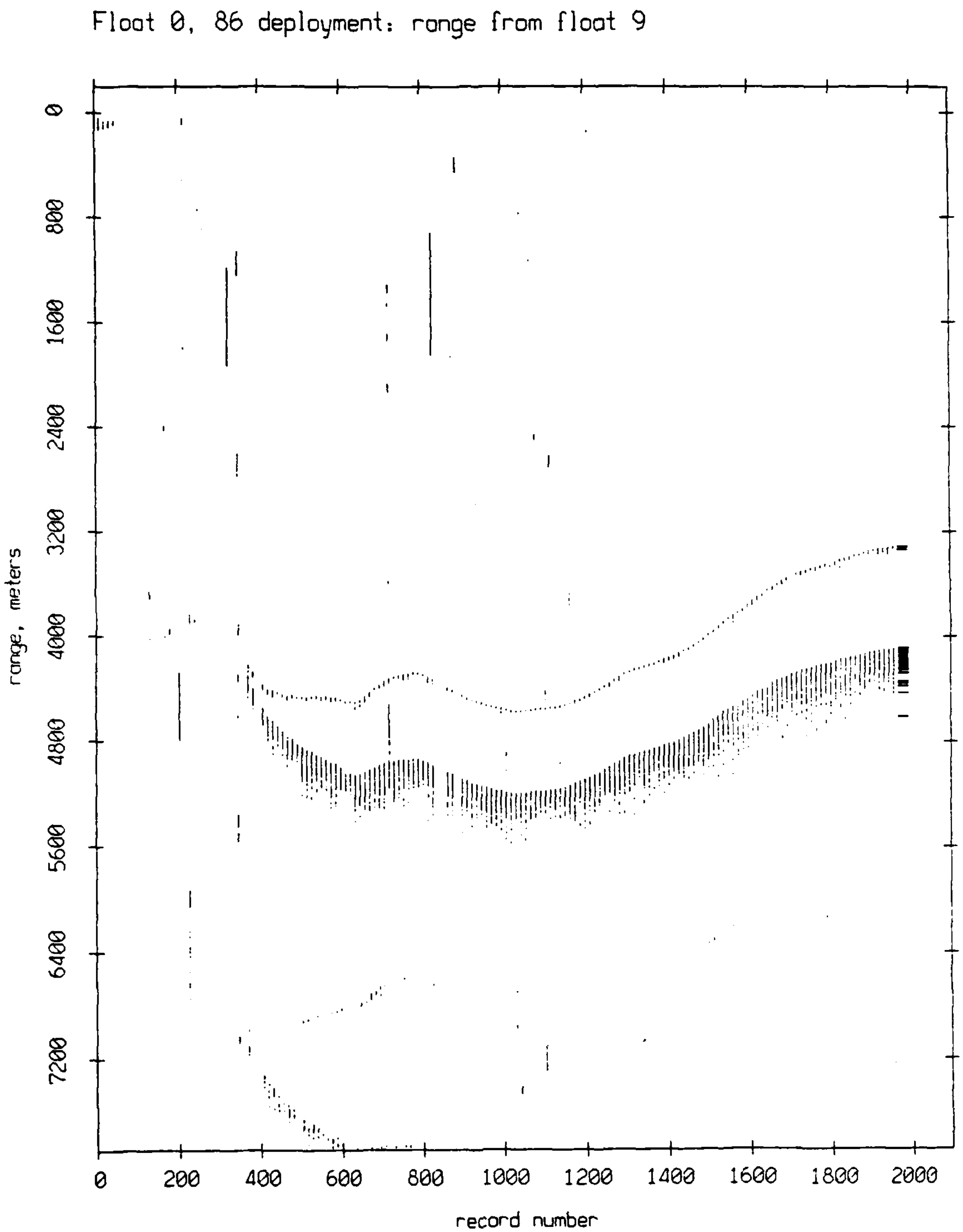

Float 0, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.1f.

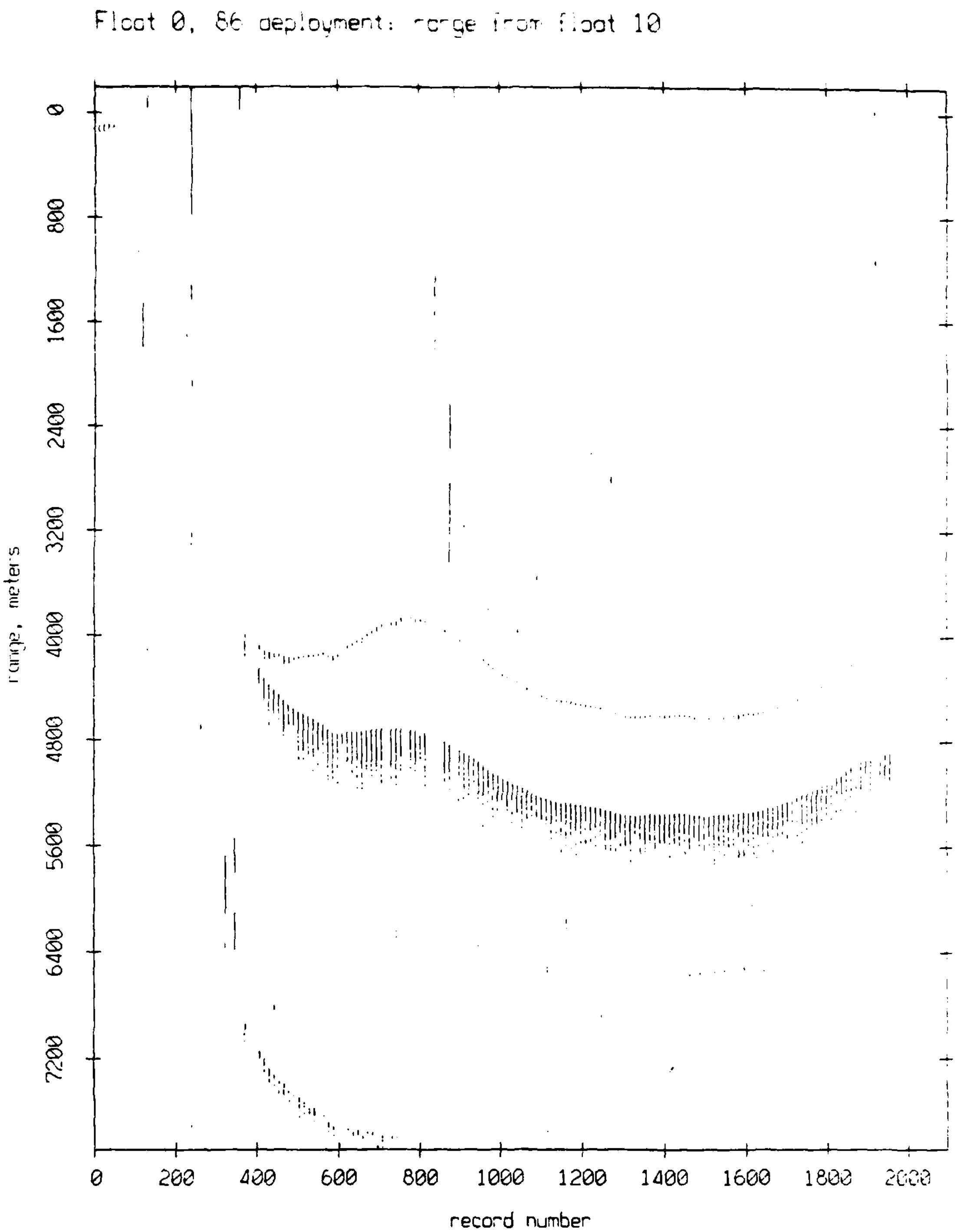

Float 0, 86 deployment: range from float 10
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.1g.

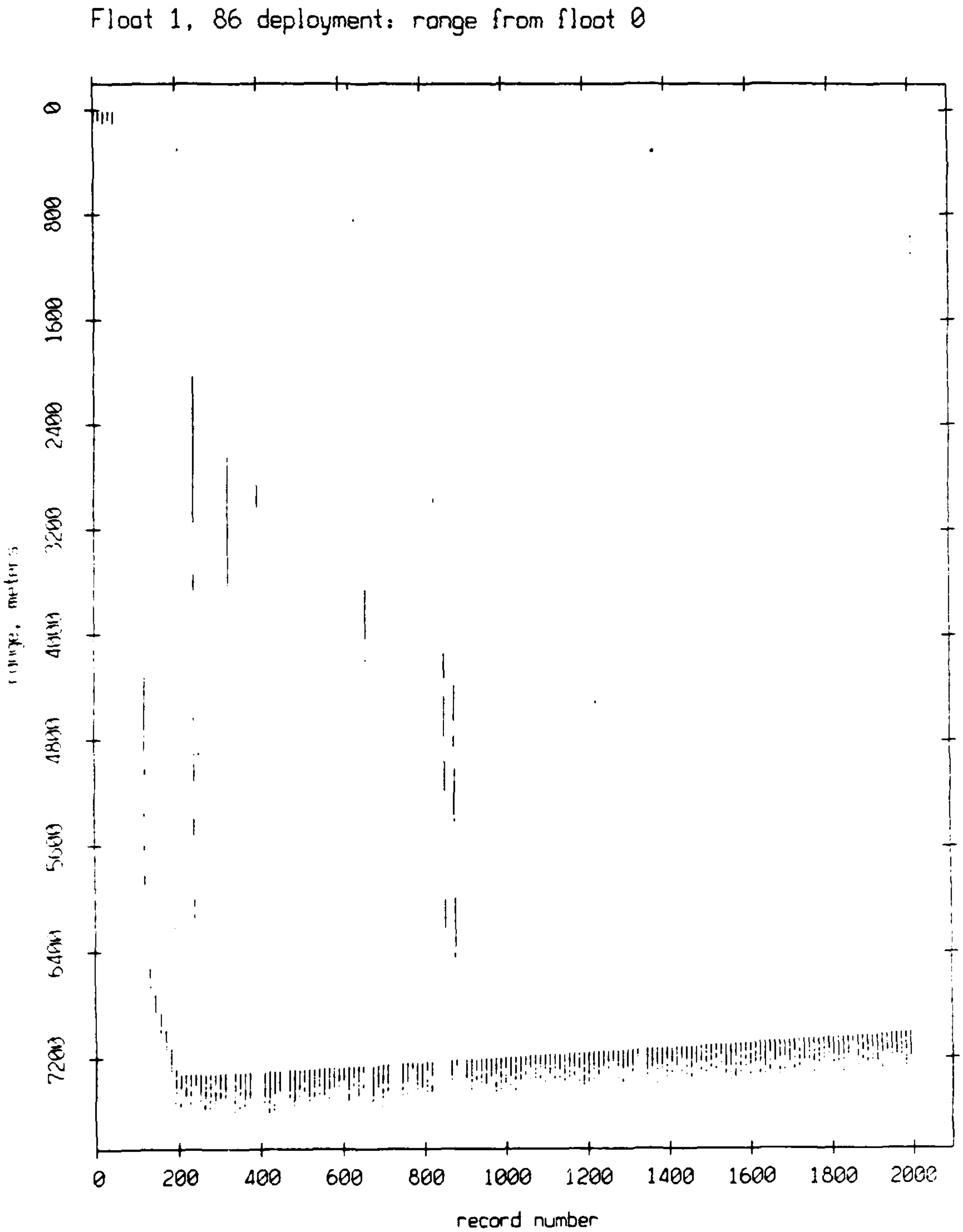
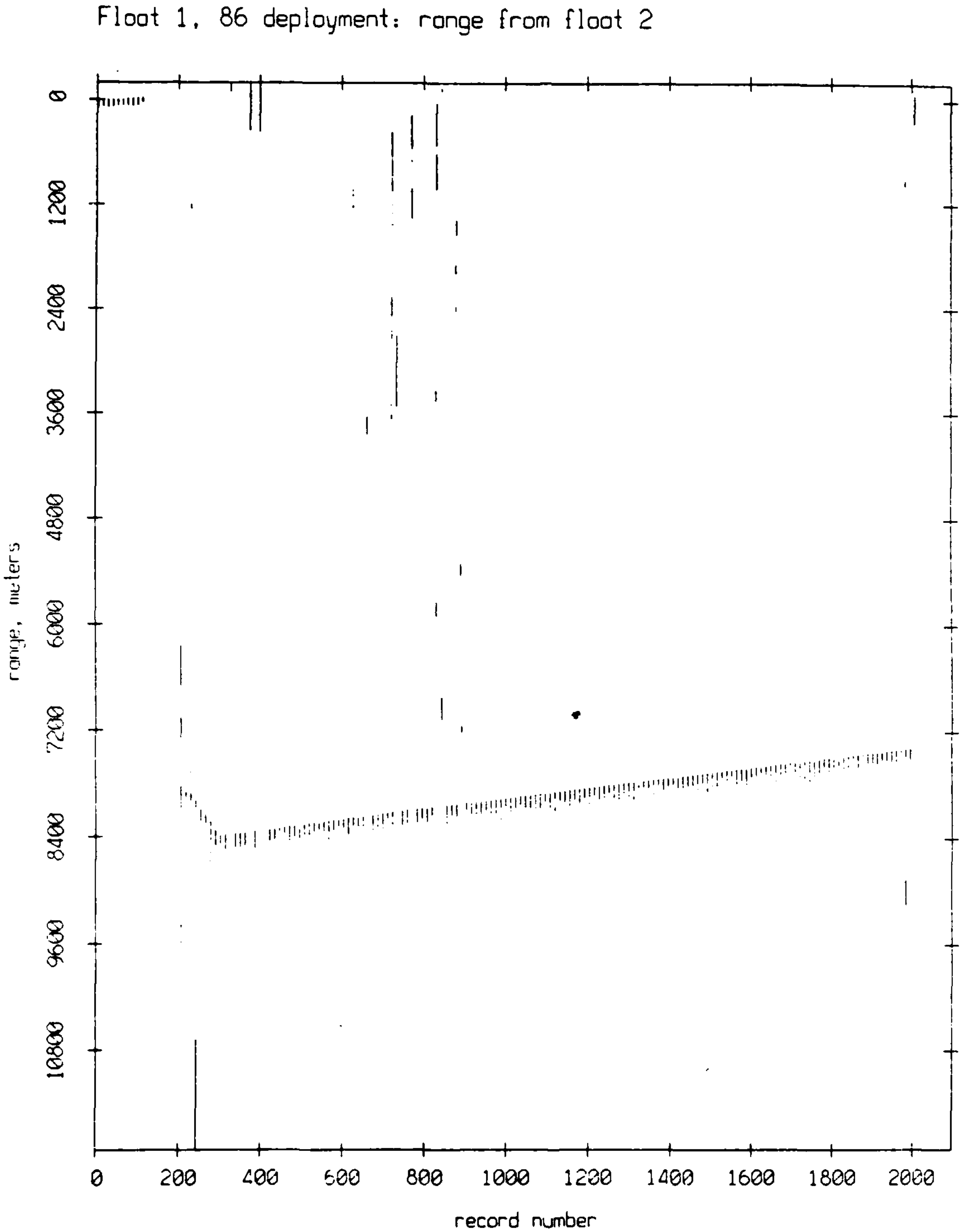

Float 1, 86 deployment: range from float 0
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2a.



Float 1, 86 deployment: range from float 2
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2b.

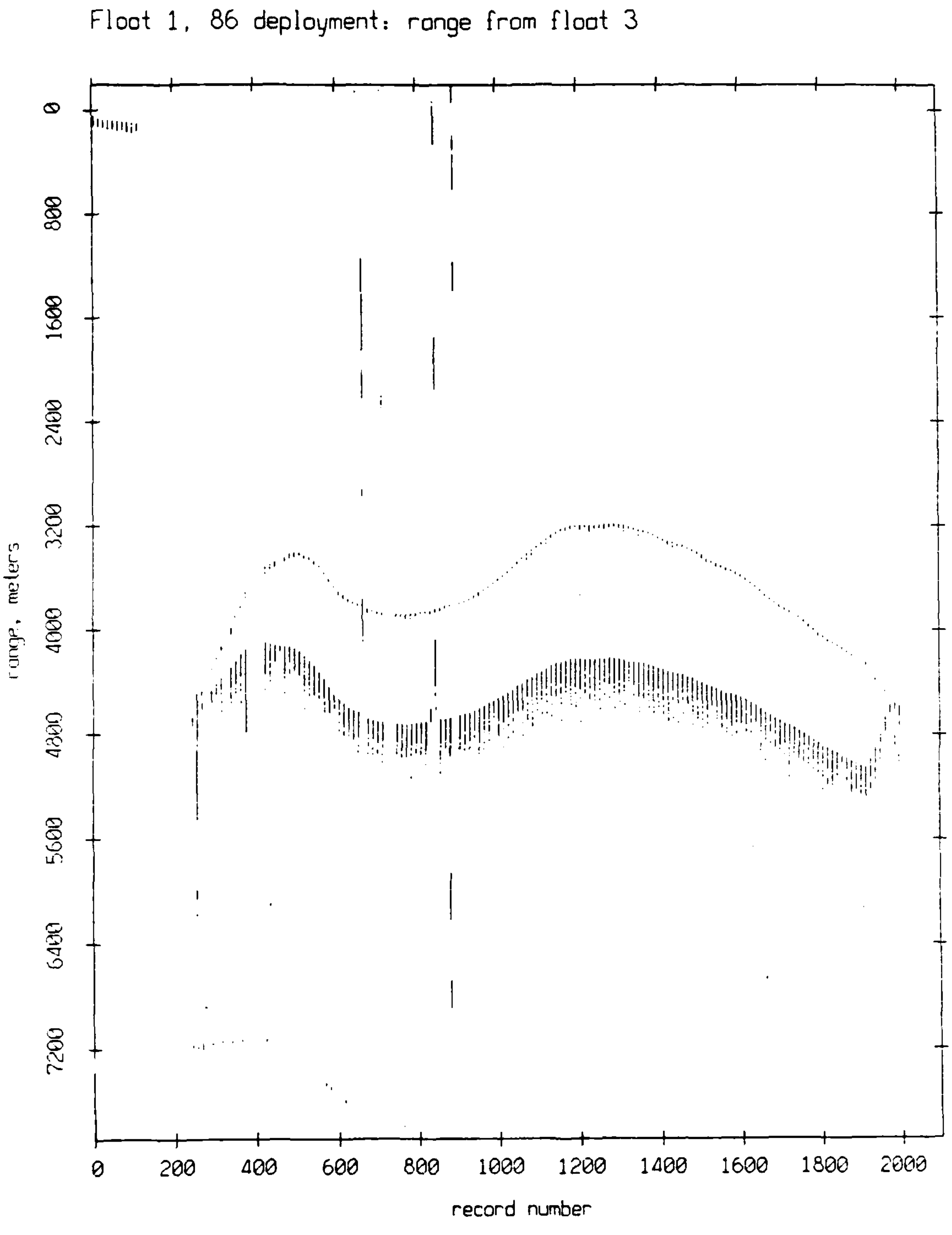

Float 1, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2c.

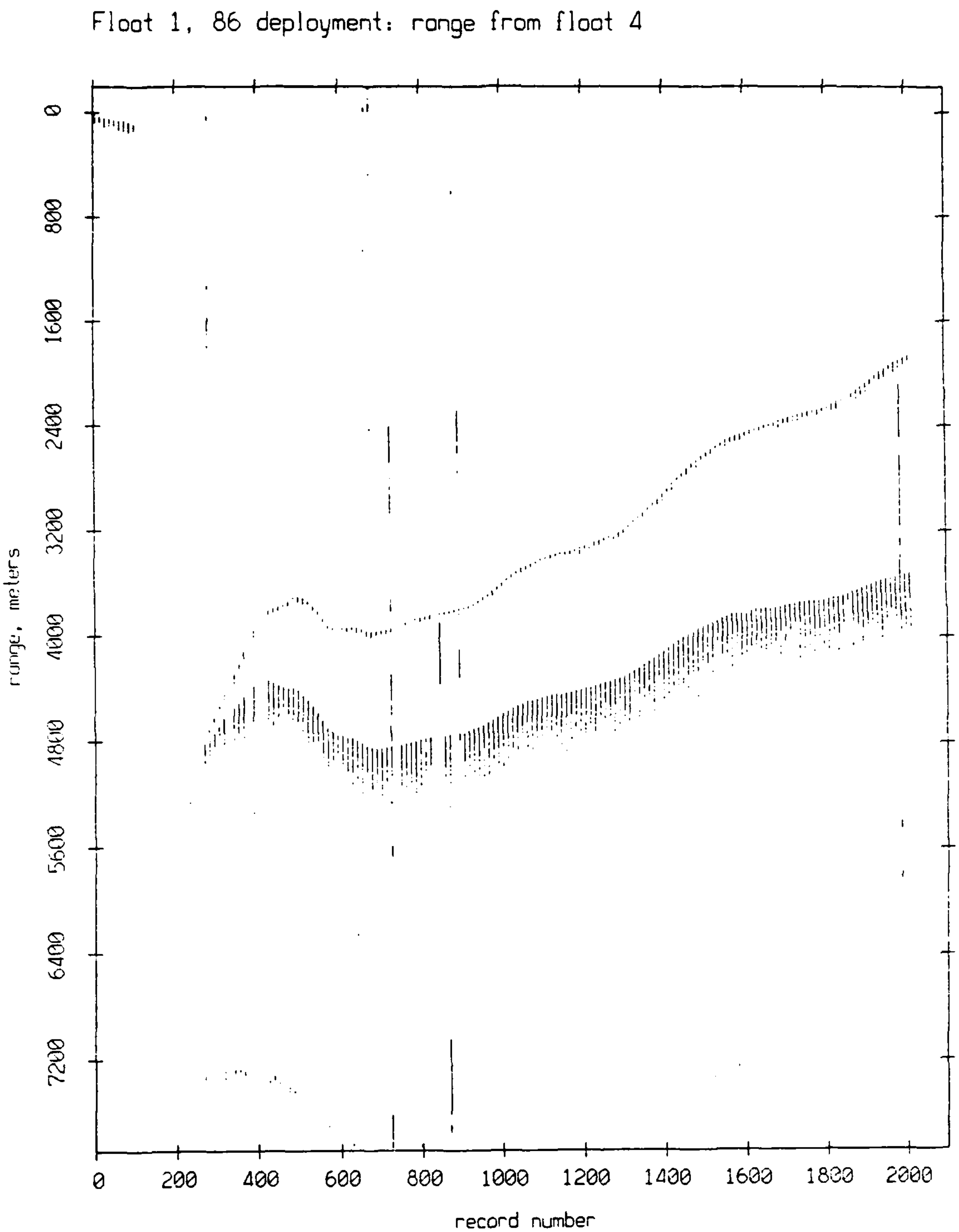

Float 1, 86 deployment: range from float 4
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2d.

Float 1, 86 deployment: range from float 5

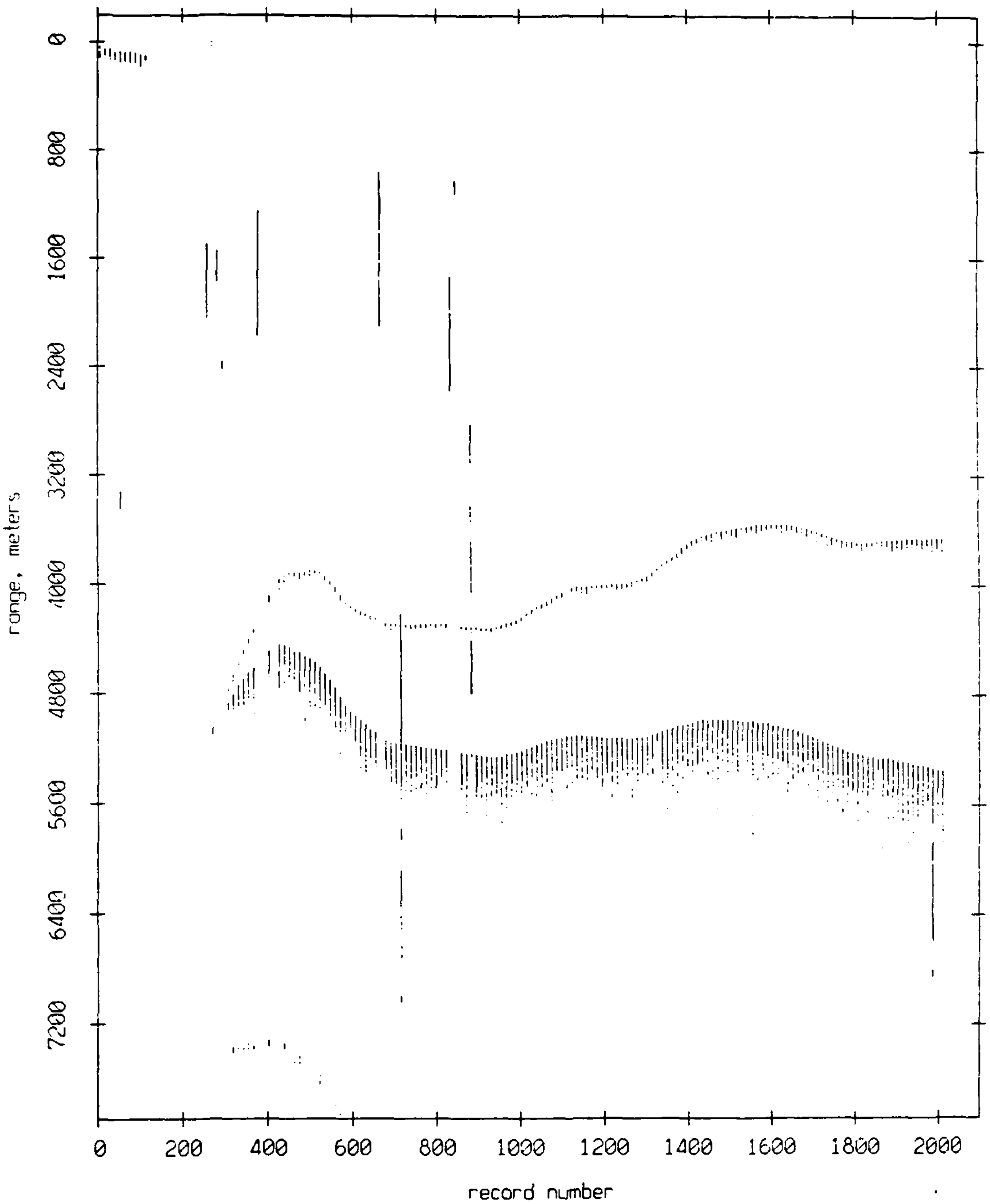


Figure IV.2e.

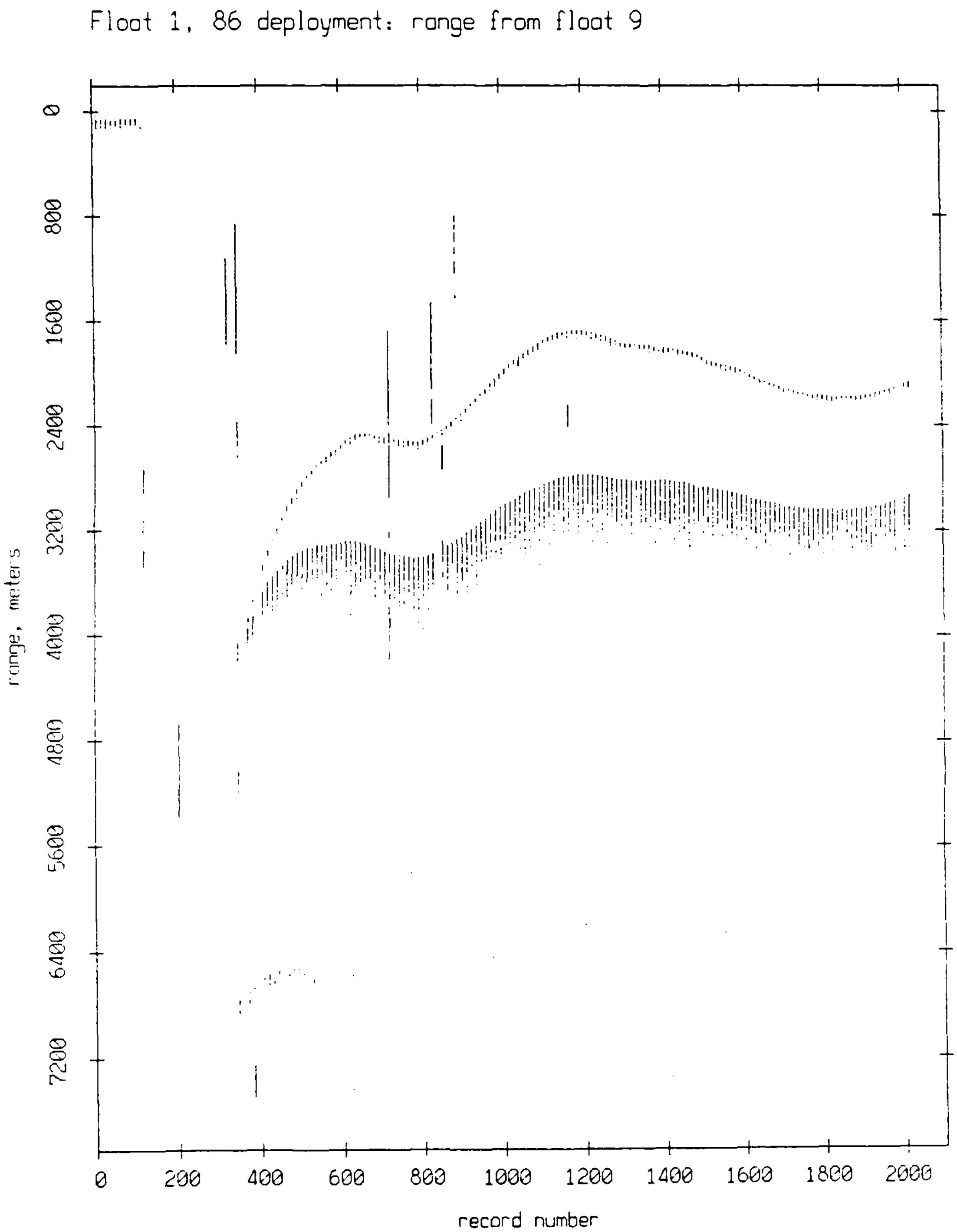

Float 1, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2f.

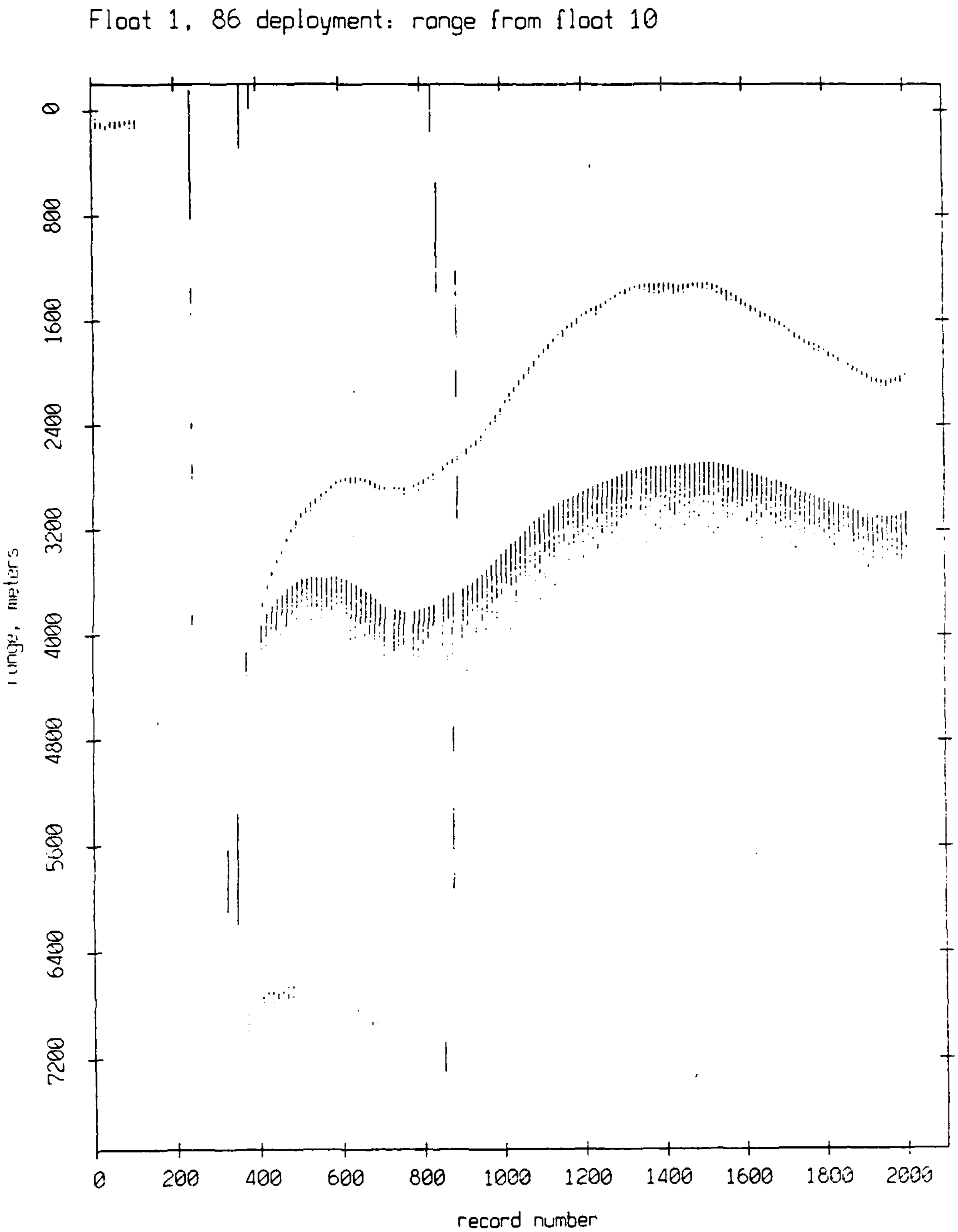

Float 1, 86 deployment: range from float 10
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.2g.

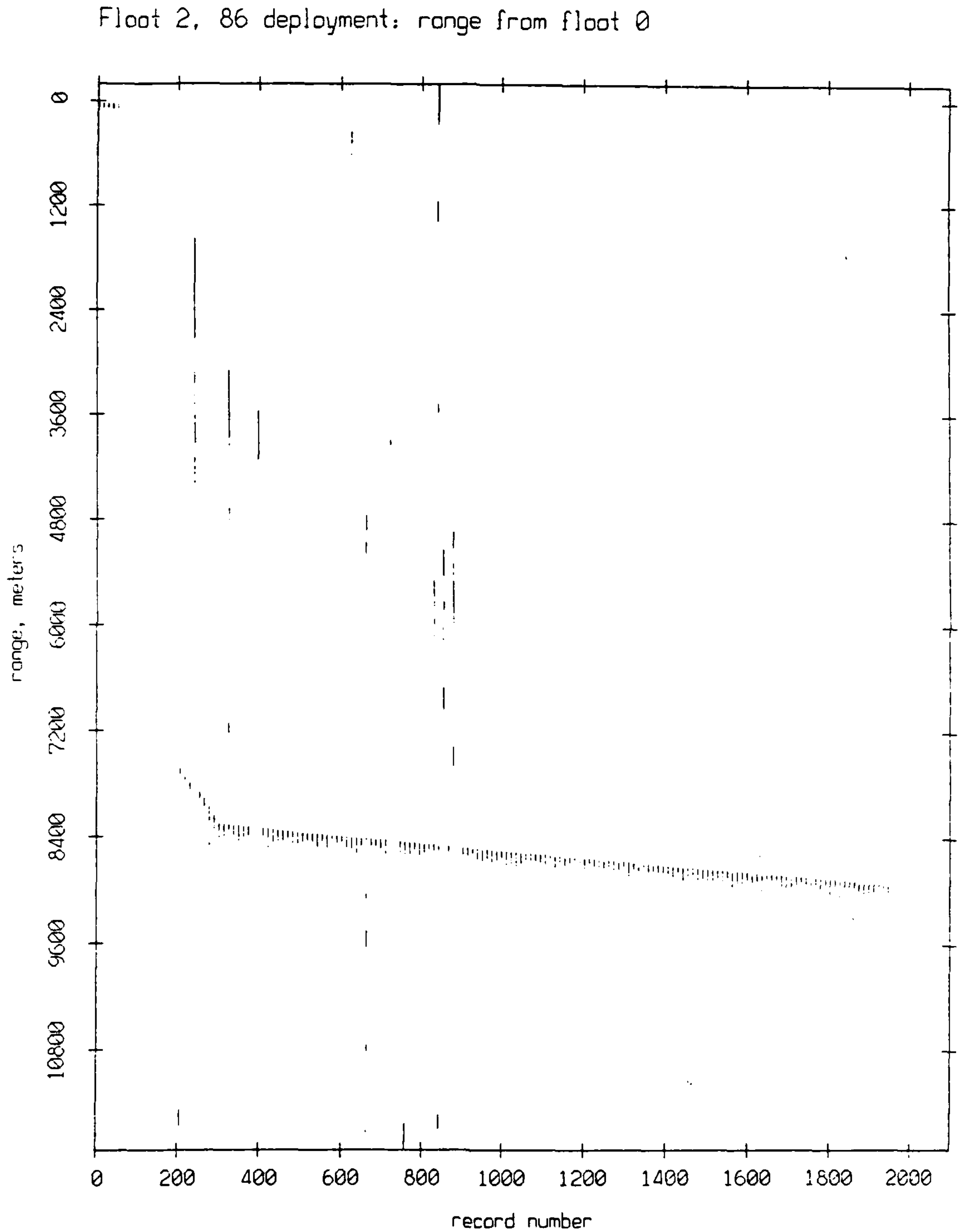
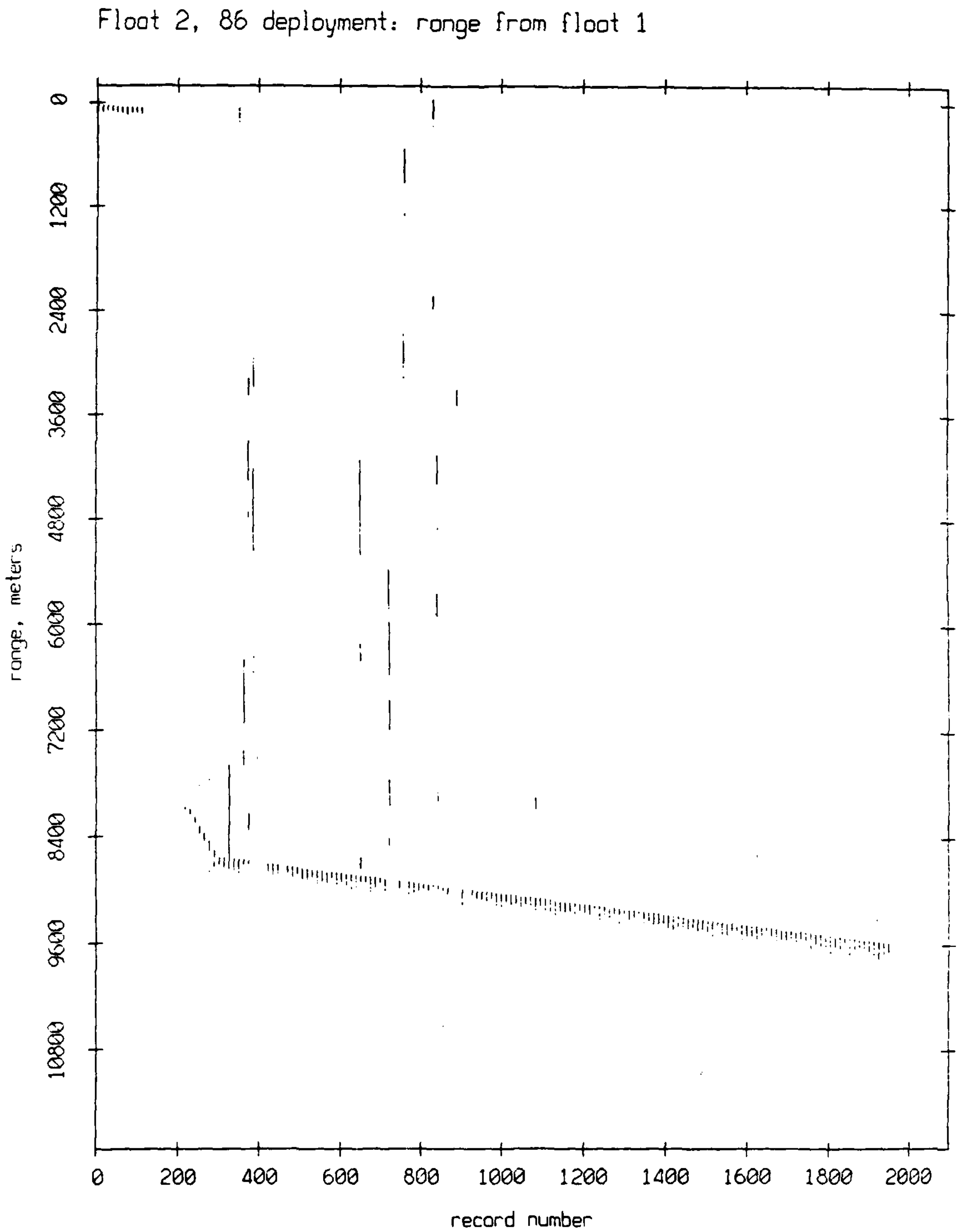
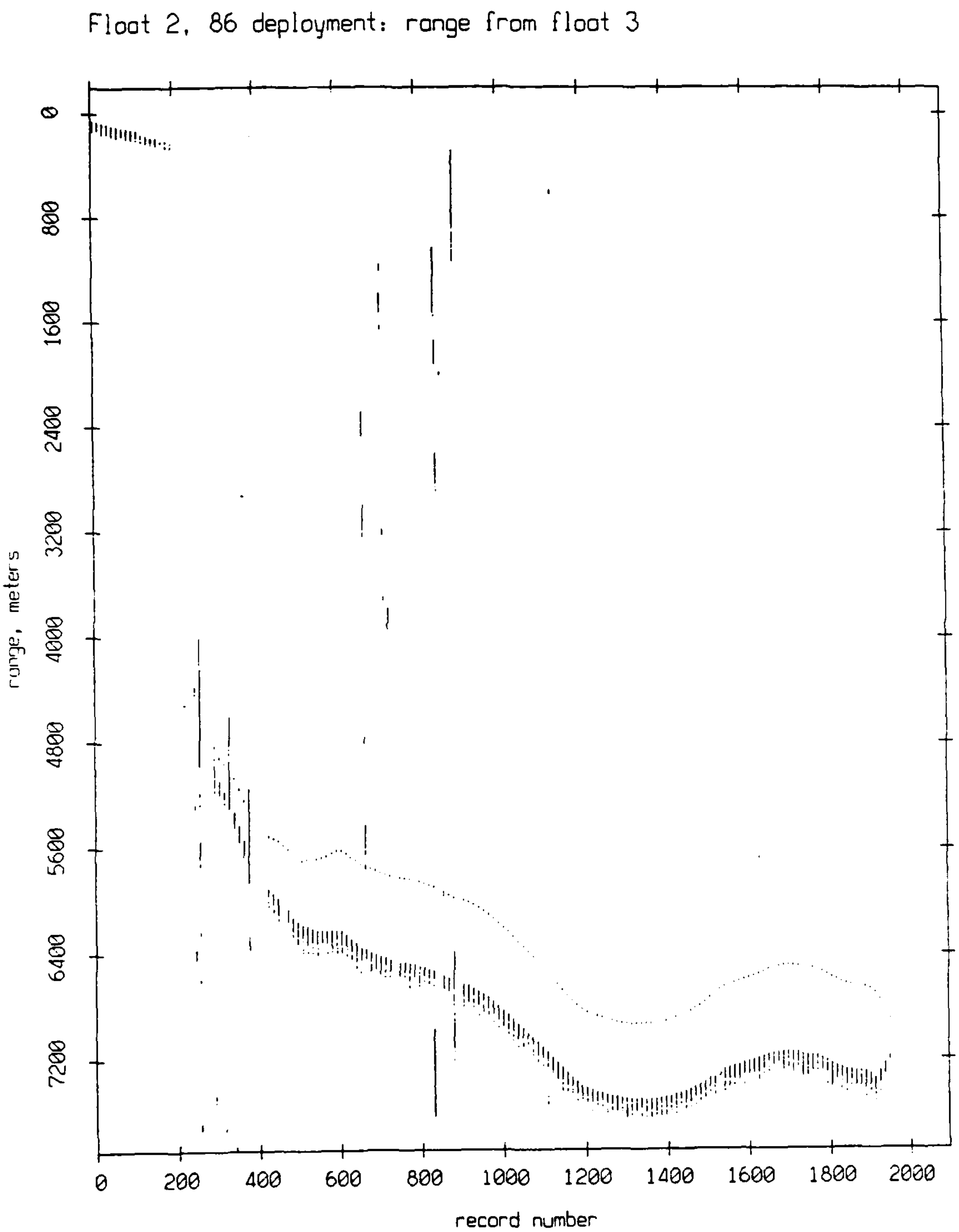

Float 2, 86 deployment: range from float 0
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3a.



Float 2, 86 deployment: range from float 1
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3b.



Float 2, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3c.

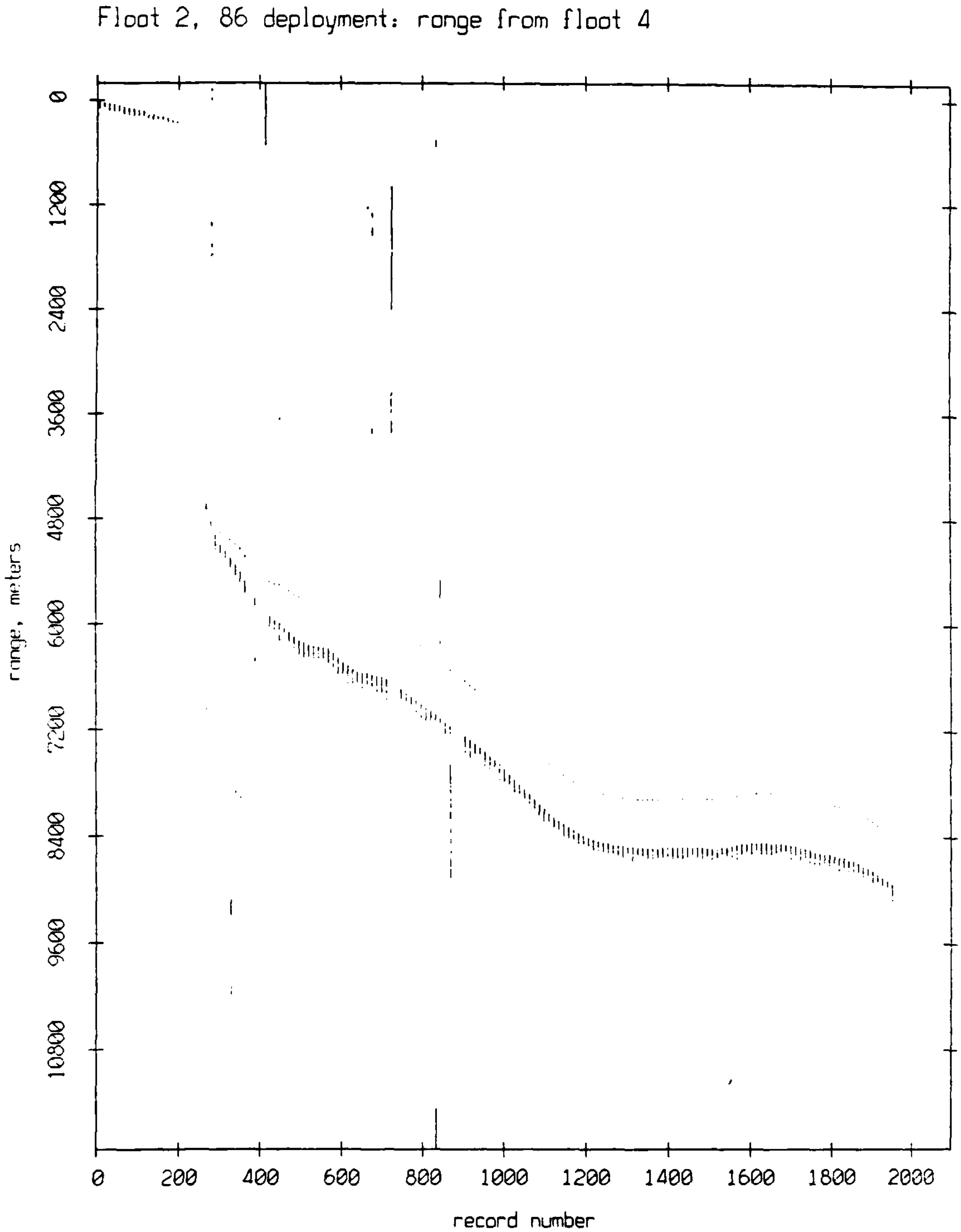

Float 2, 86 deployment: range from float 4
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3d.

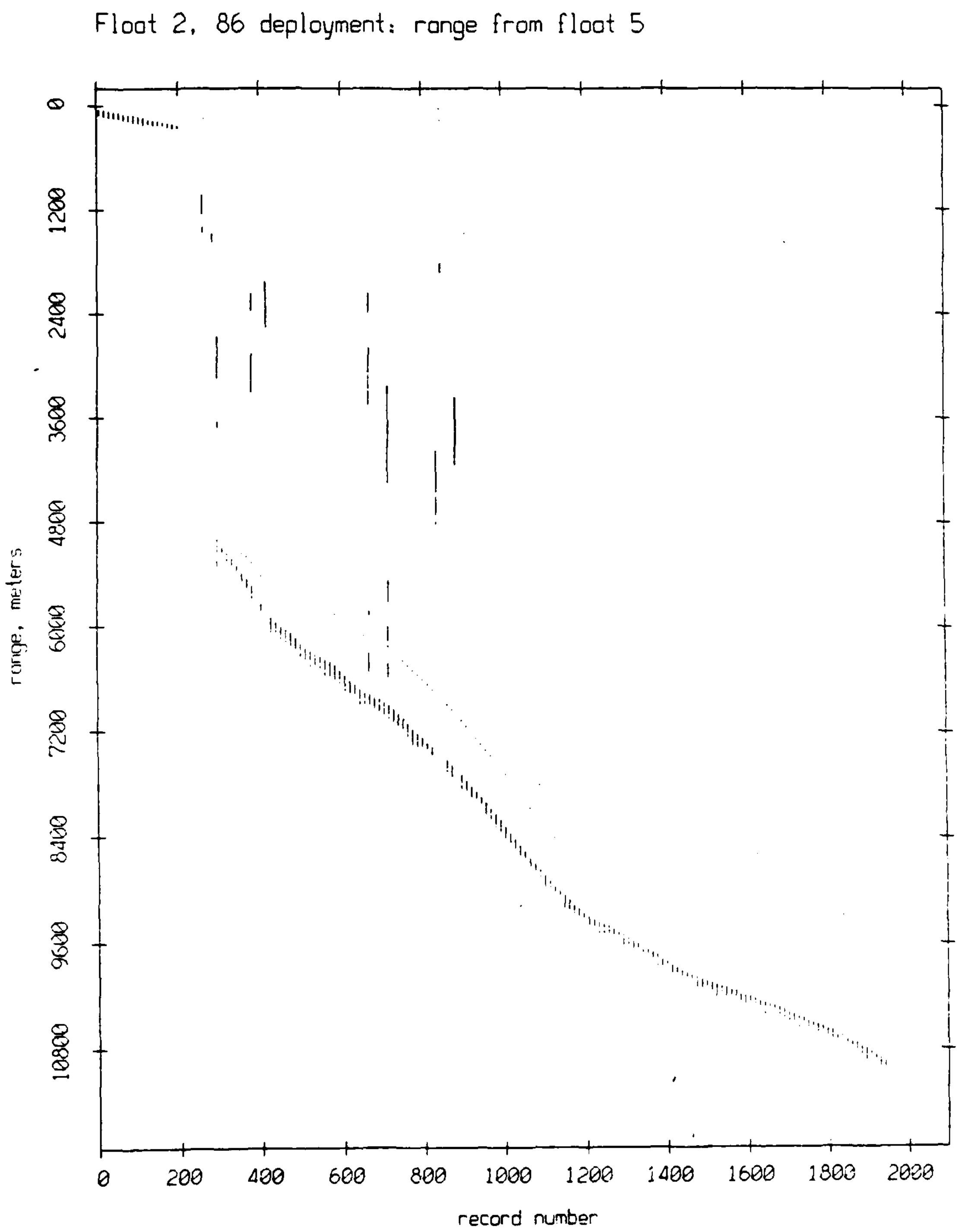

Float 2, 86 deployment: range from float 5
range, meters
0
1200
2400
3600
4800
6000
7200
8400
9600
10800
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3e.

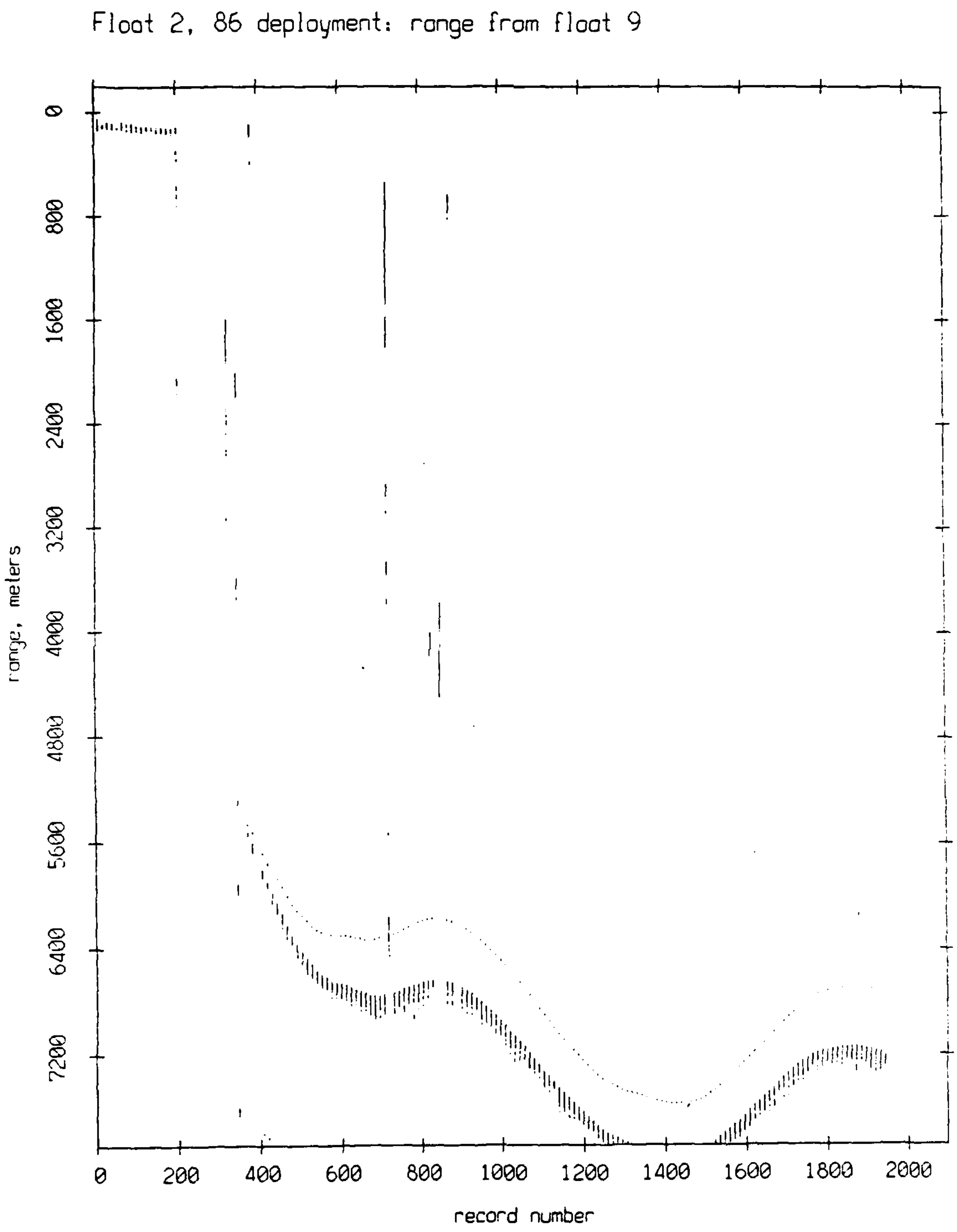

Float 2, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3f.

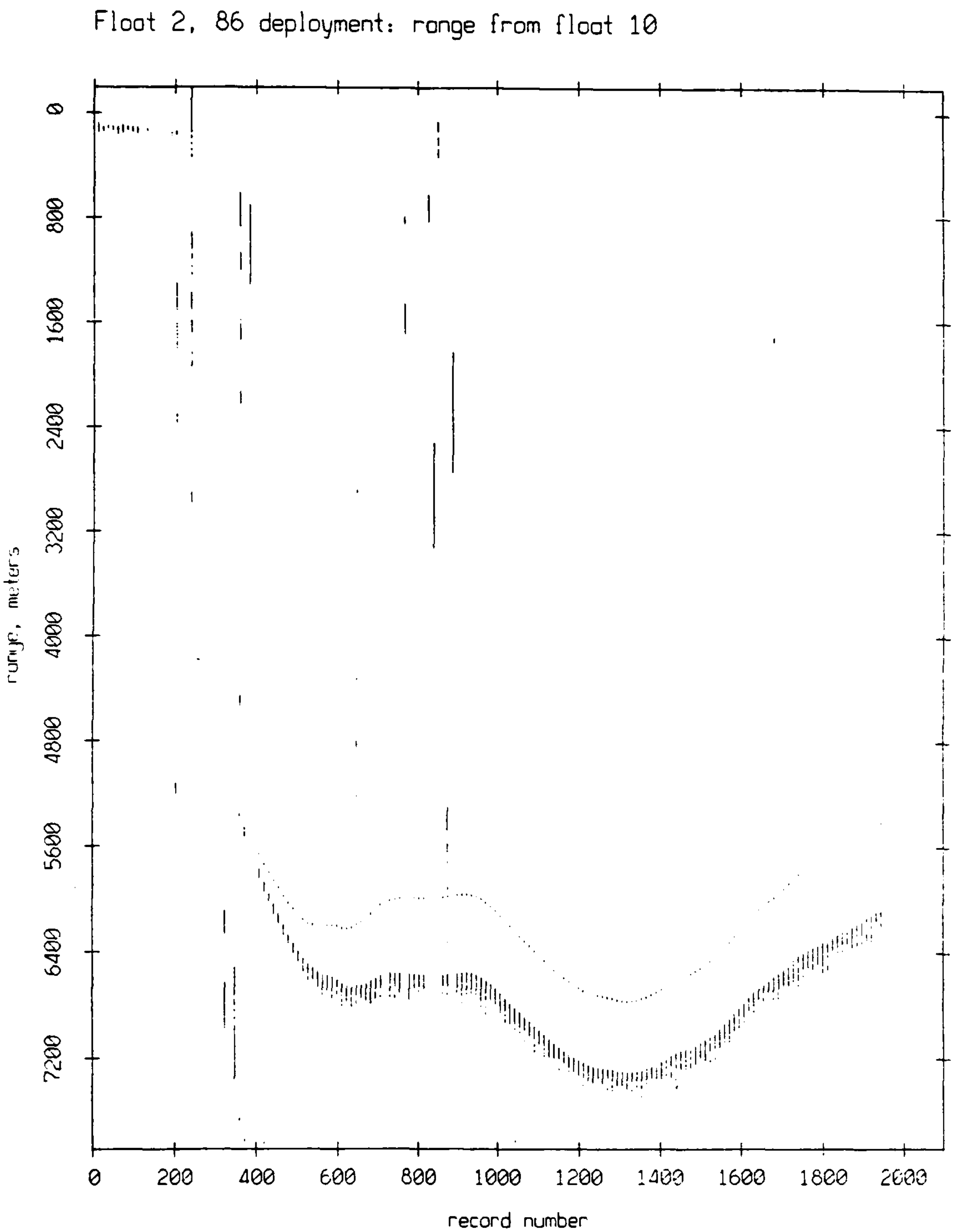
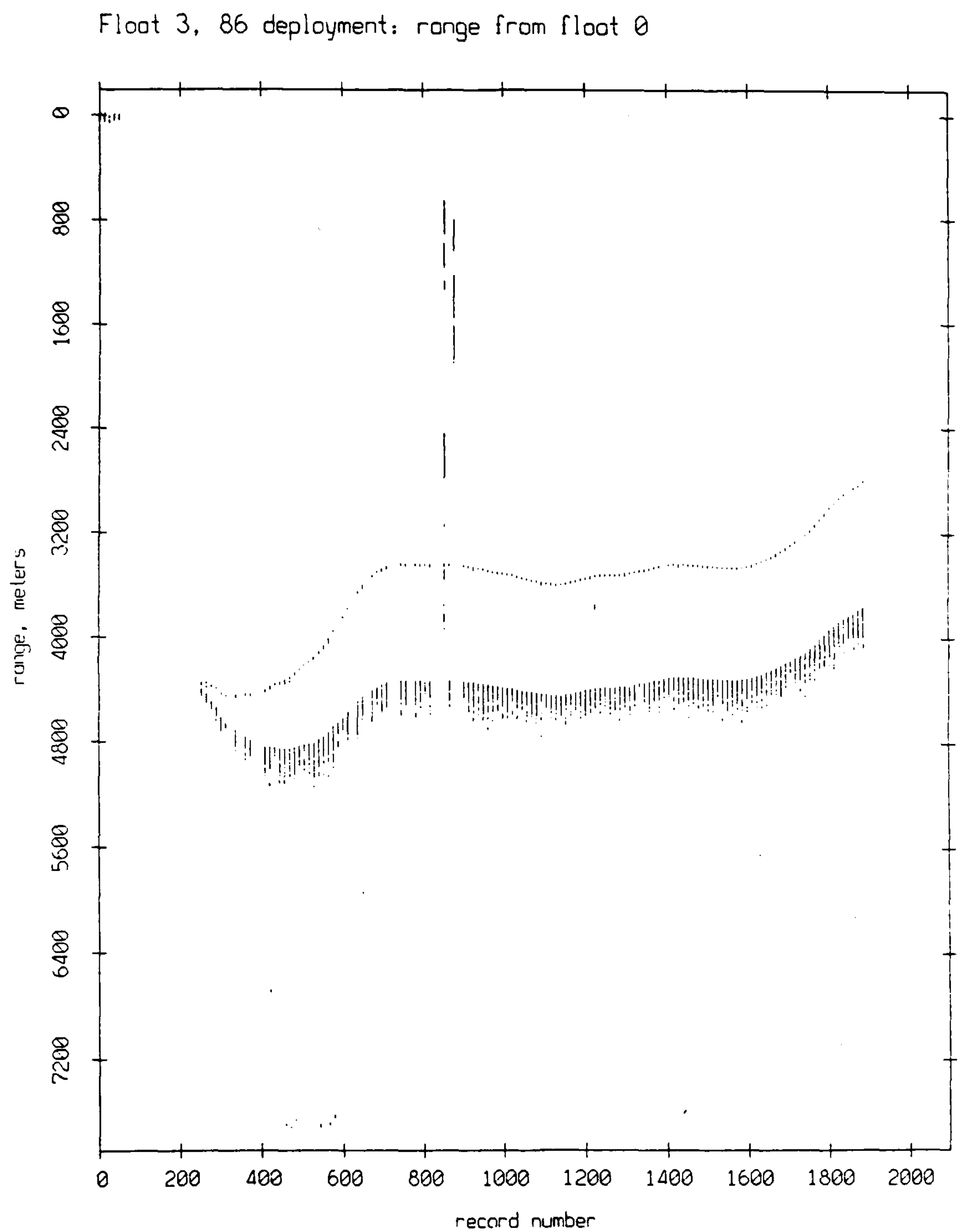

Float 2, 86 deployment: range from float 10
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.3g.



Float 3, 86 deployment: range from float 0
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4a.

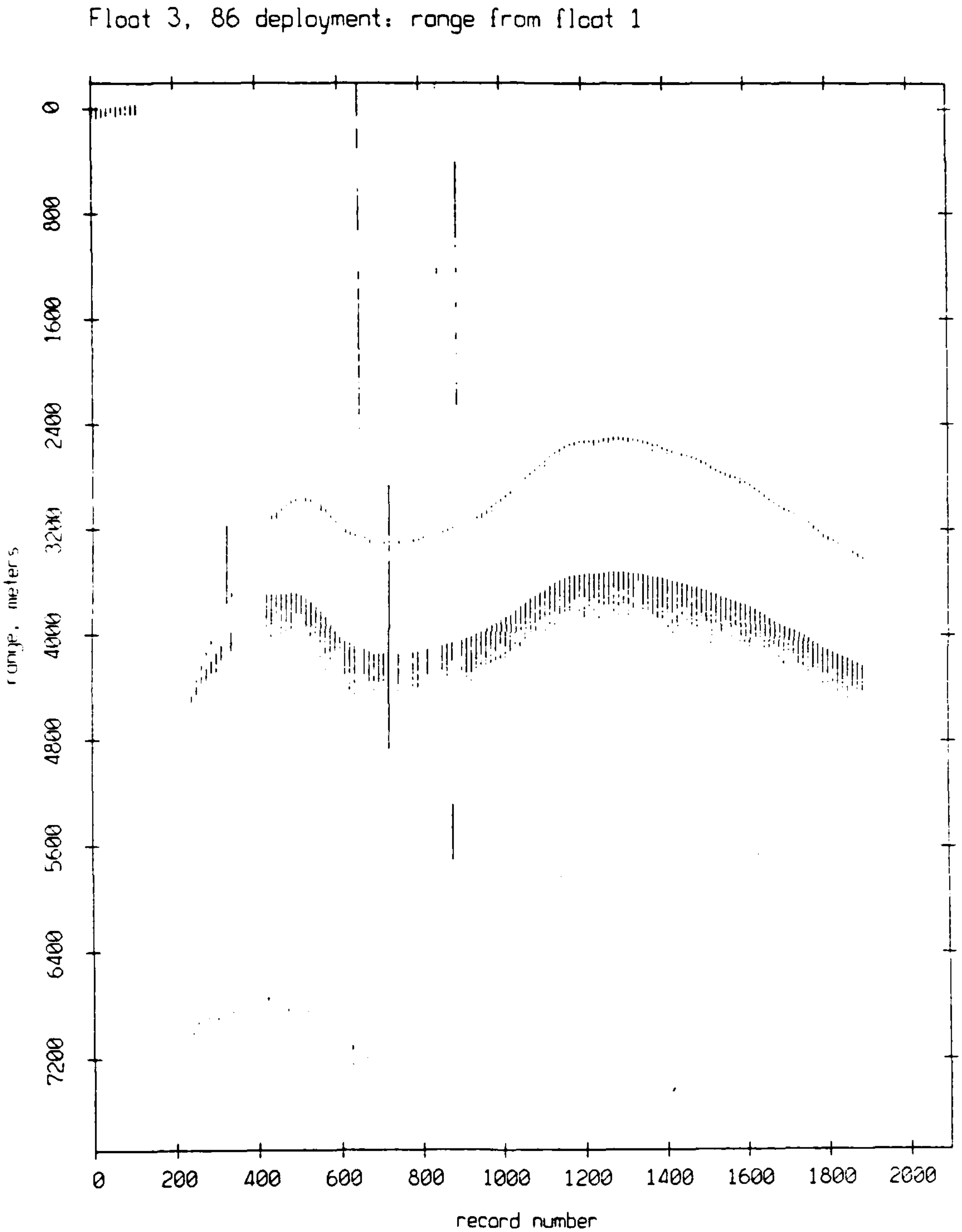

Float 3, 86 deployment: range from float 1
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4b.

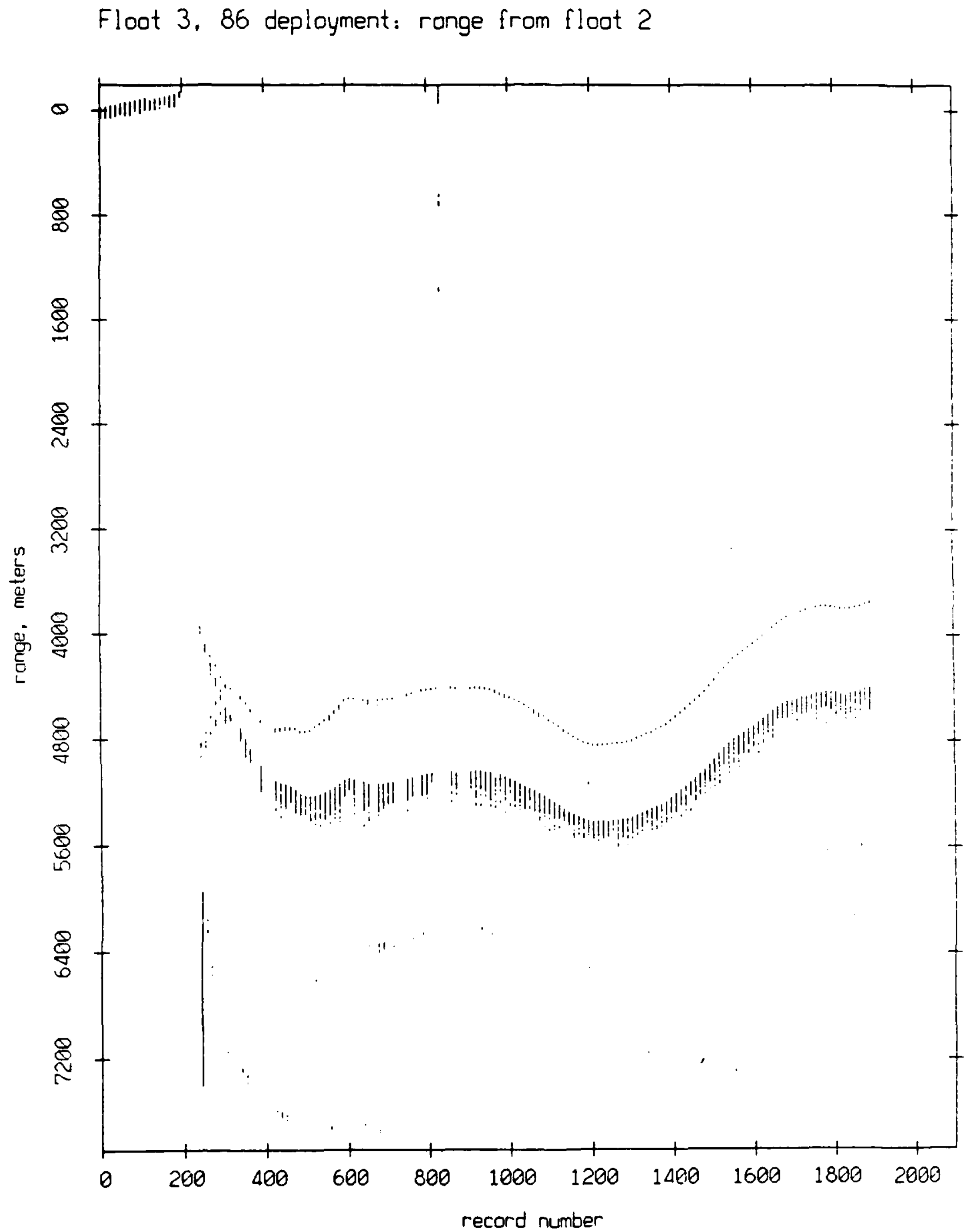

Float 3, 86 deployment: range from float 2
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4c.

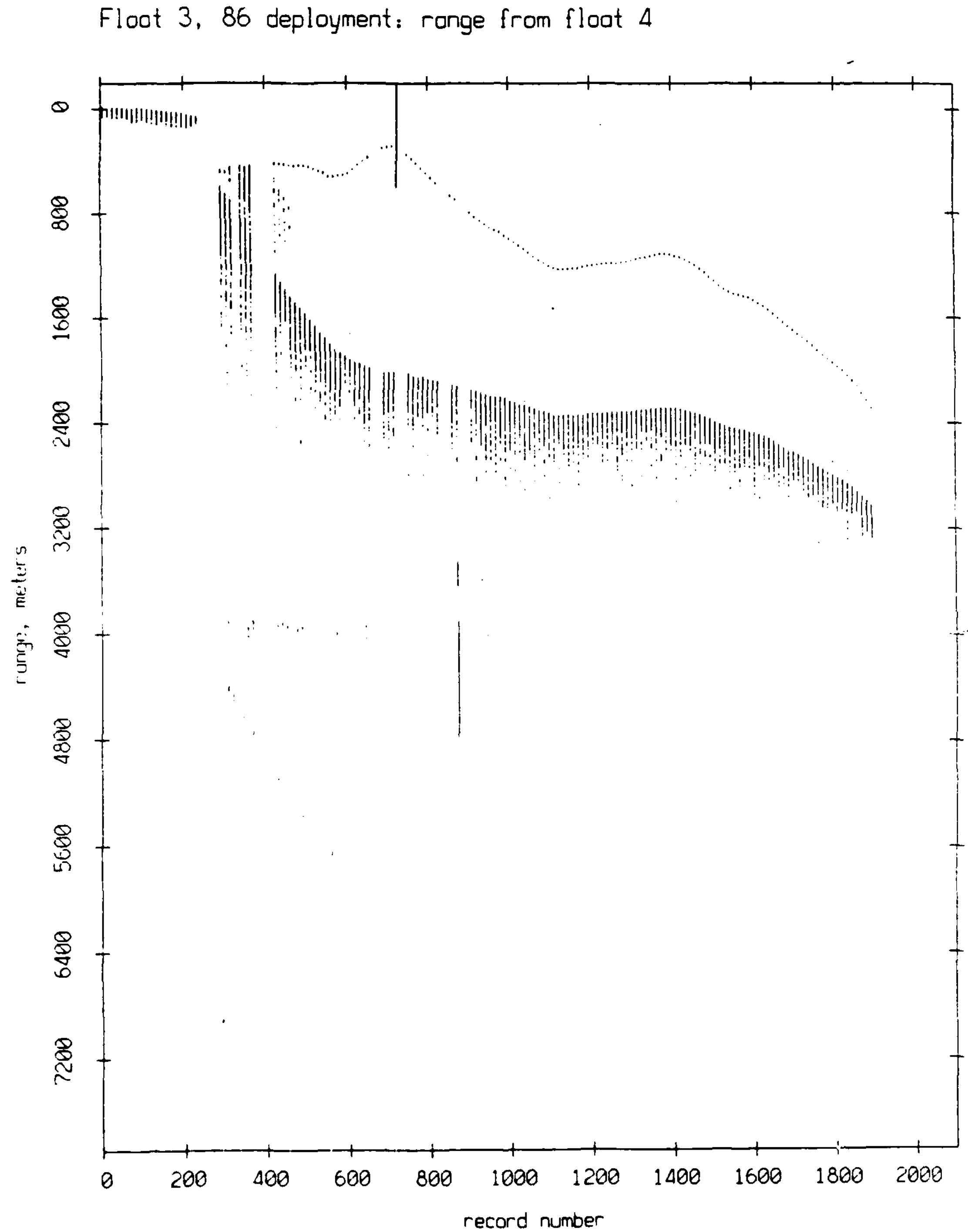
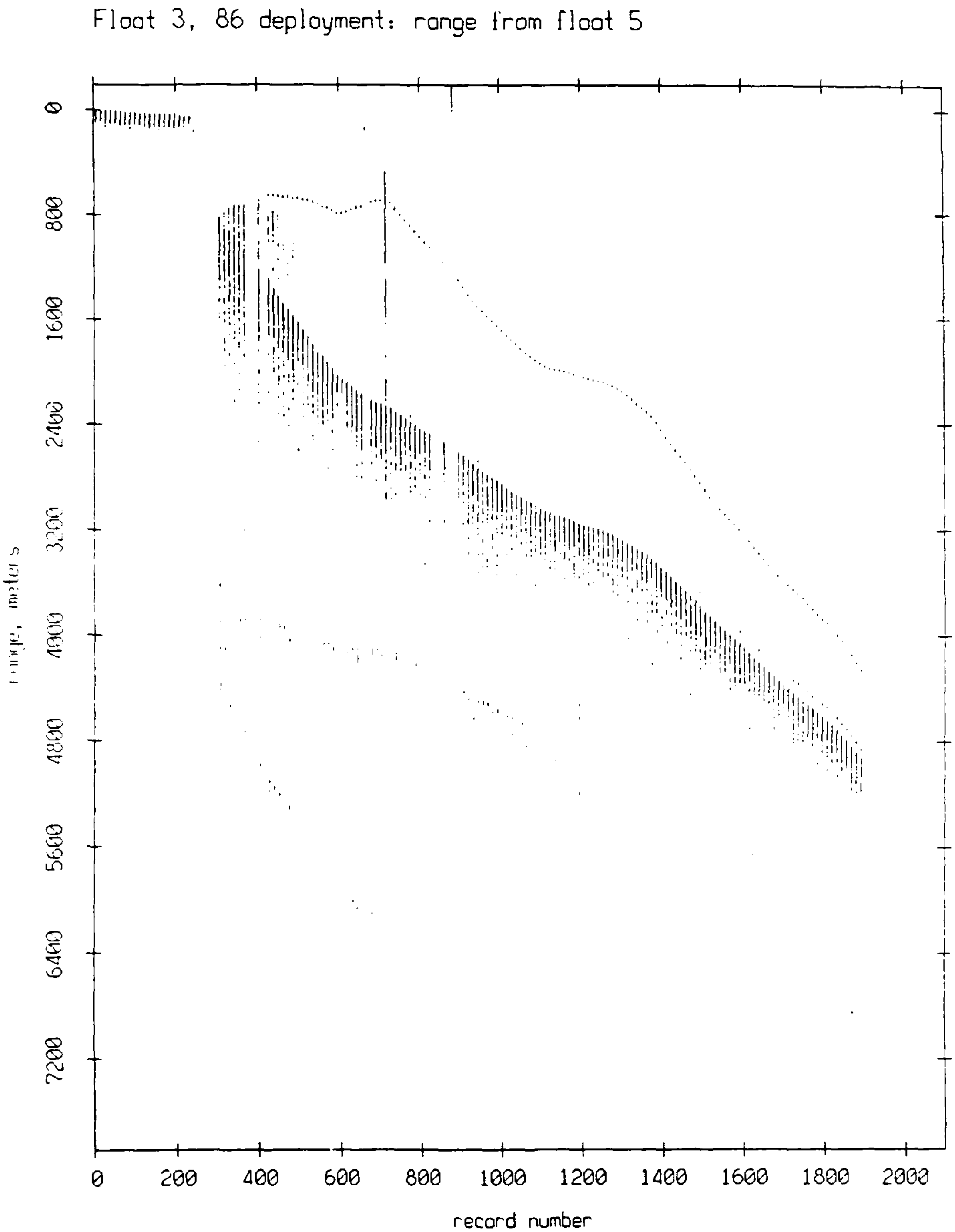
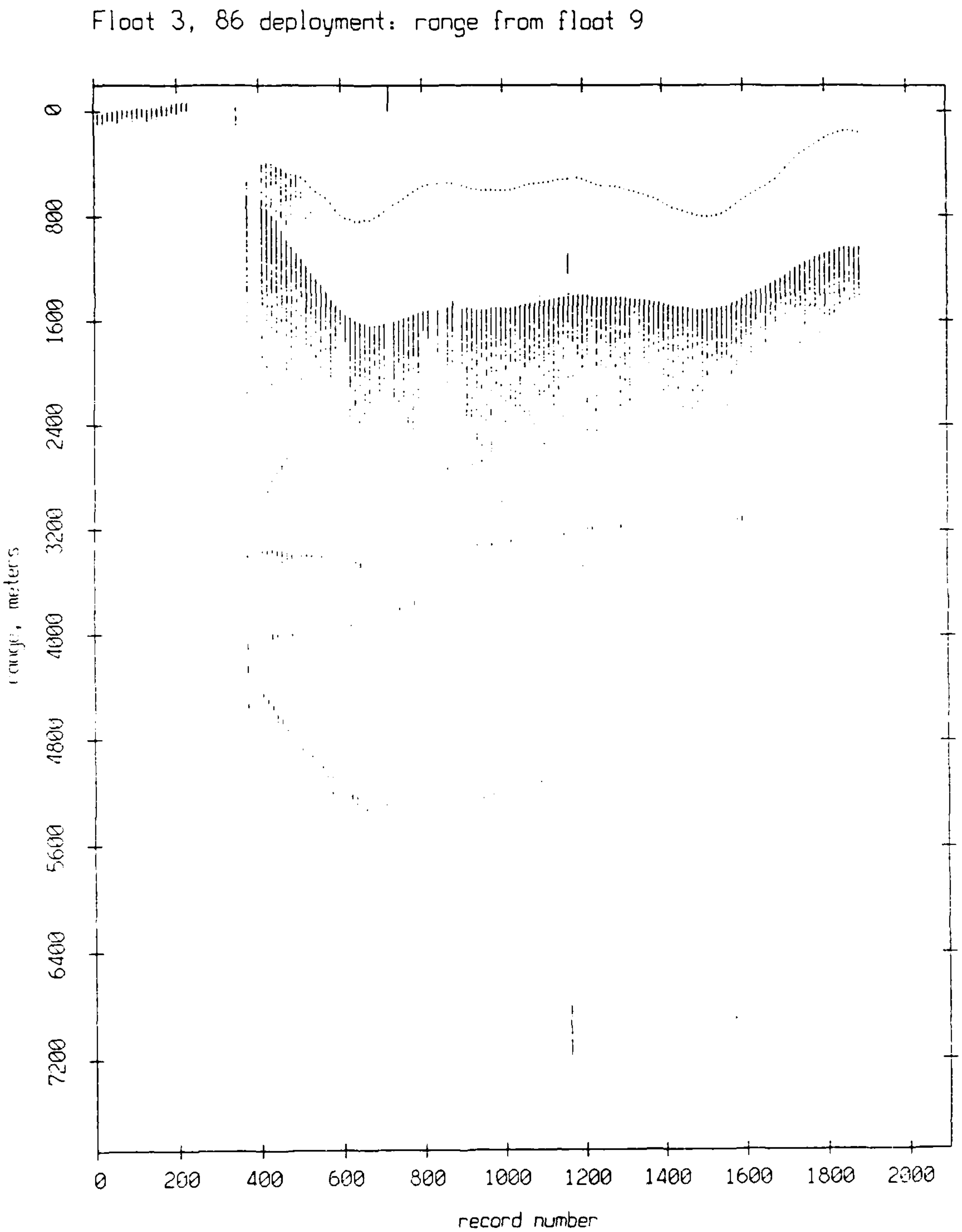

Float 3, 86 deployment: range from float 4
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4d.



Float 3, 86 deployment: range from float 5
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4e.



Float 3, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4f.

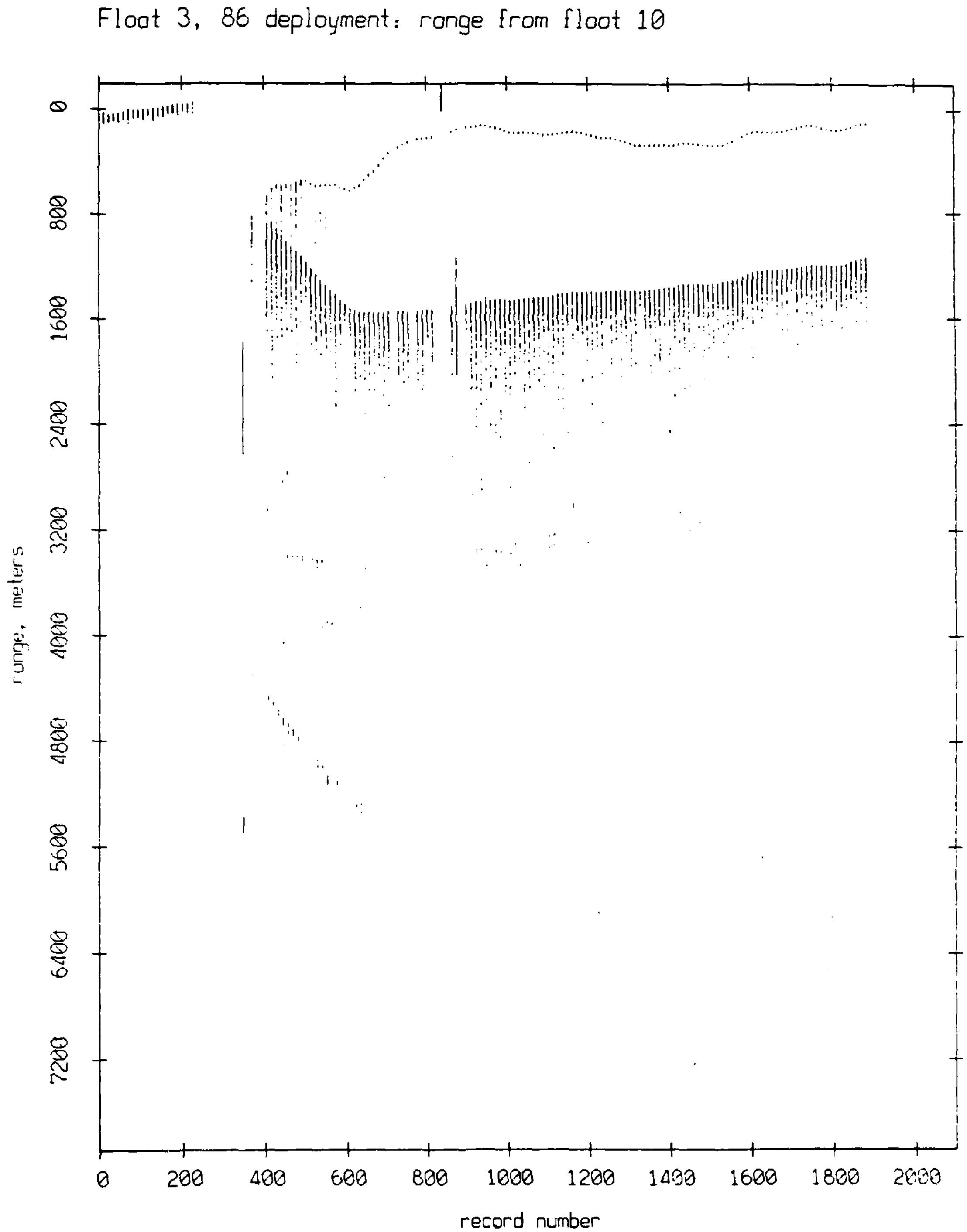

Float 3, 86 deployment: range from float 10
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.4g.

Float 4, 86 deployment: range from float 0

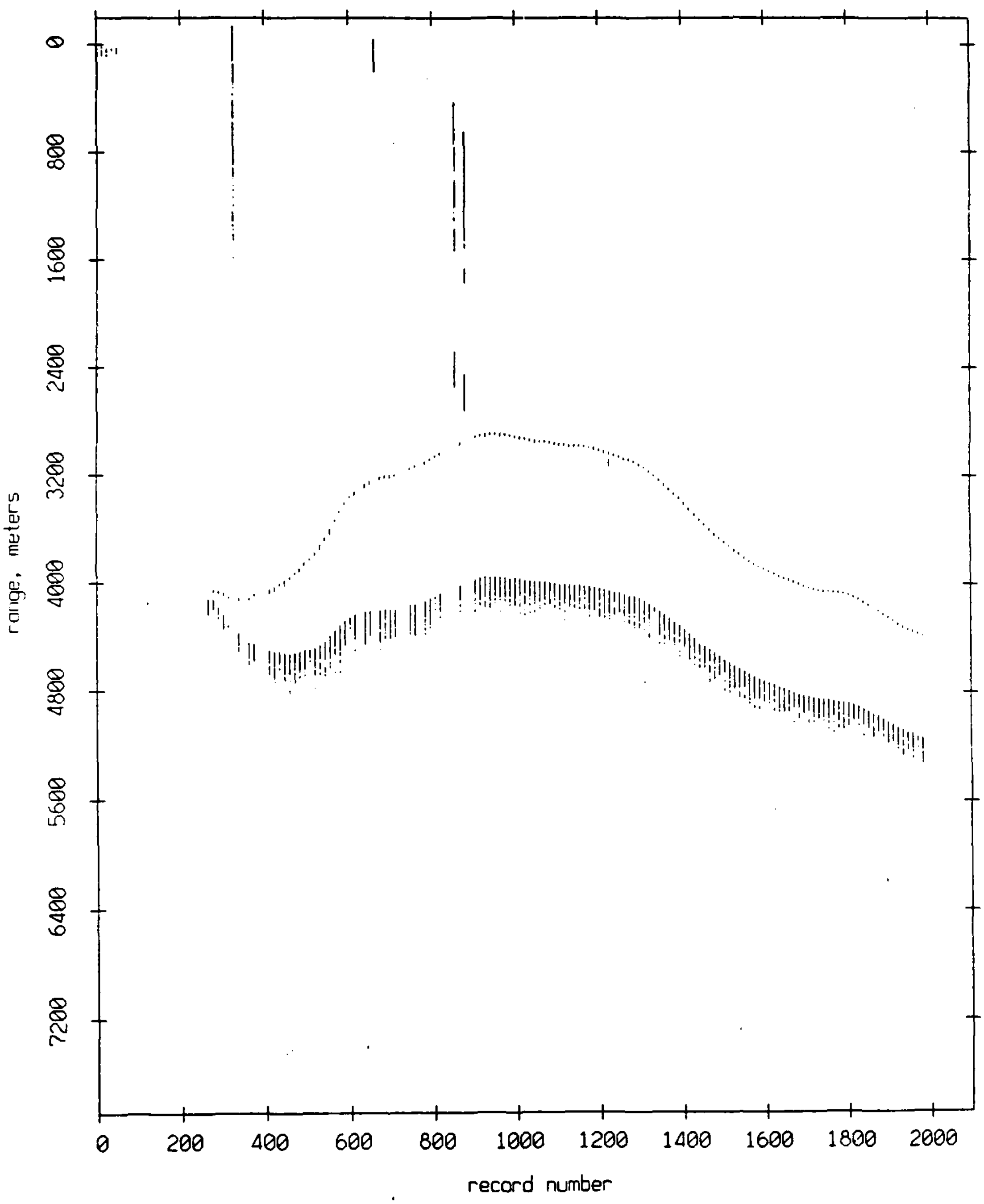


Figure IV.5a.

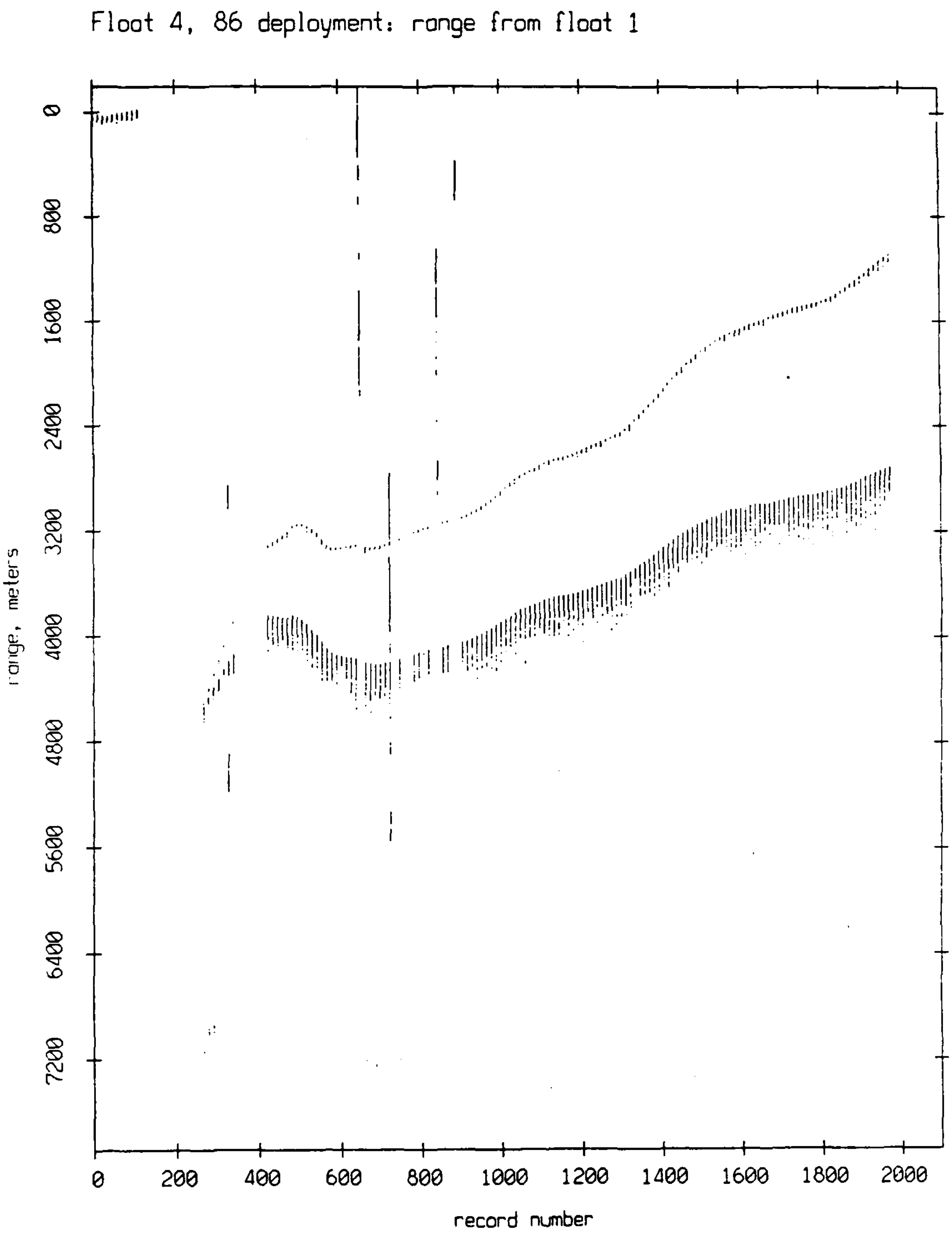

Float 4, 86 deployment: range from float 1
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.5b.

Float 4, 86 deployment: range from float 2

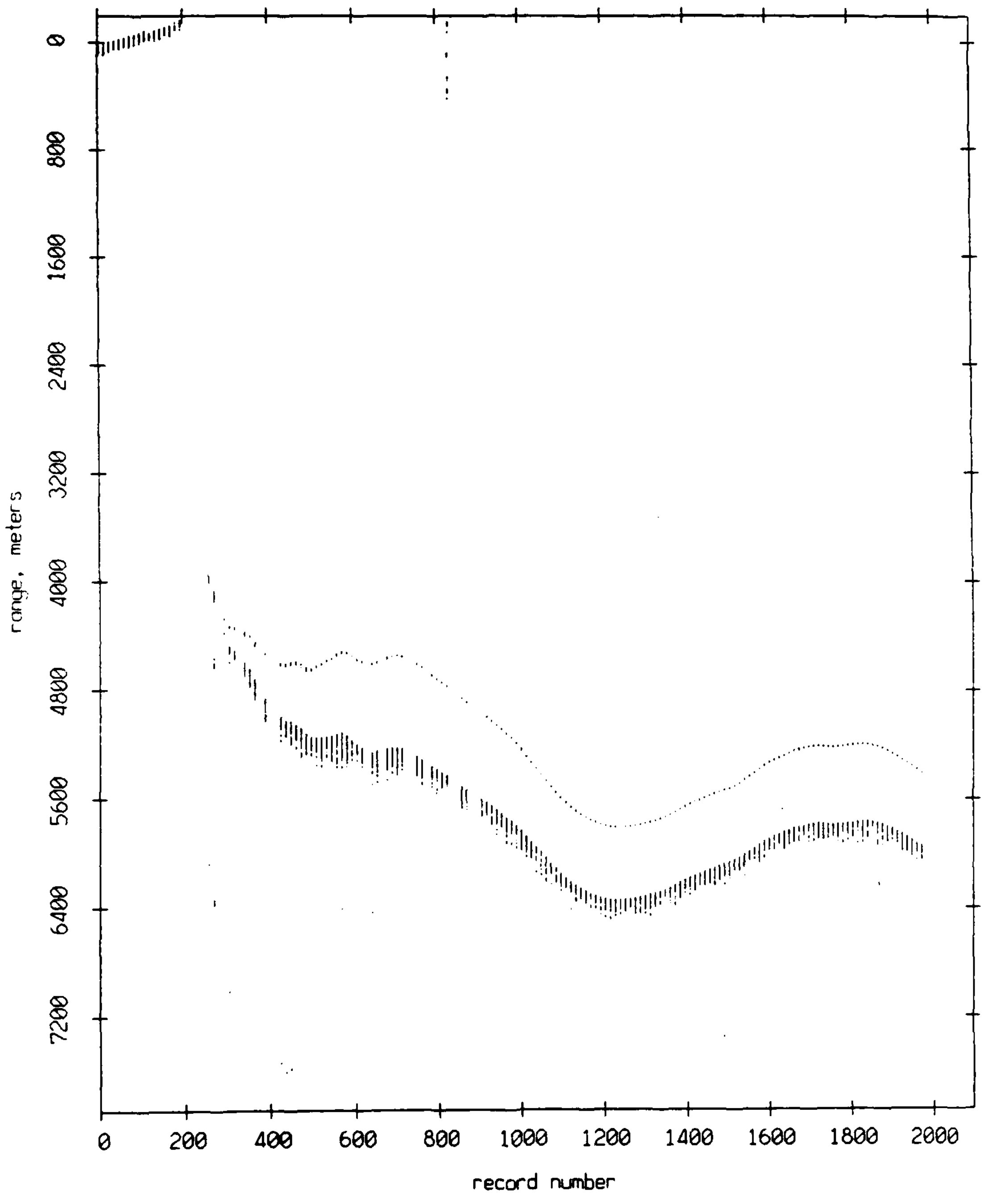


Figure IV.5c.

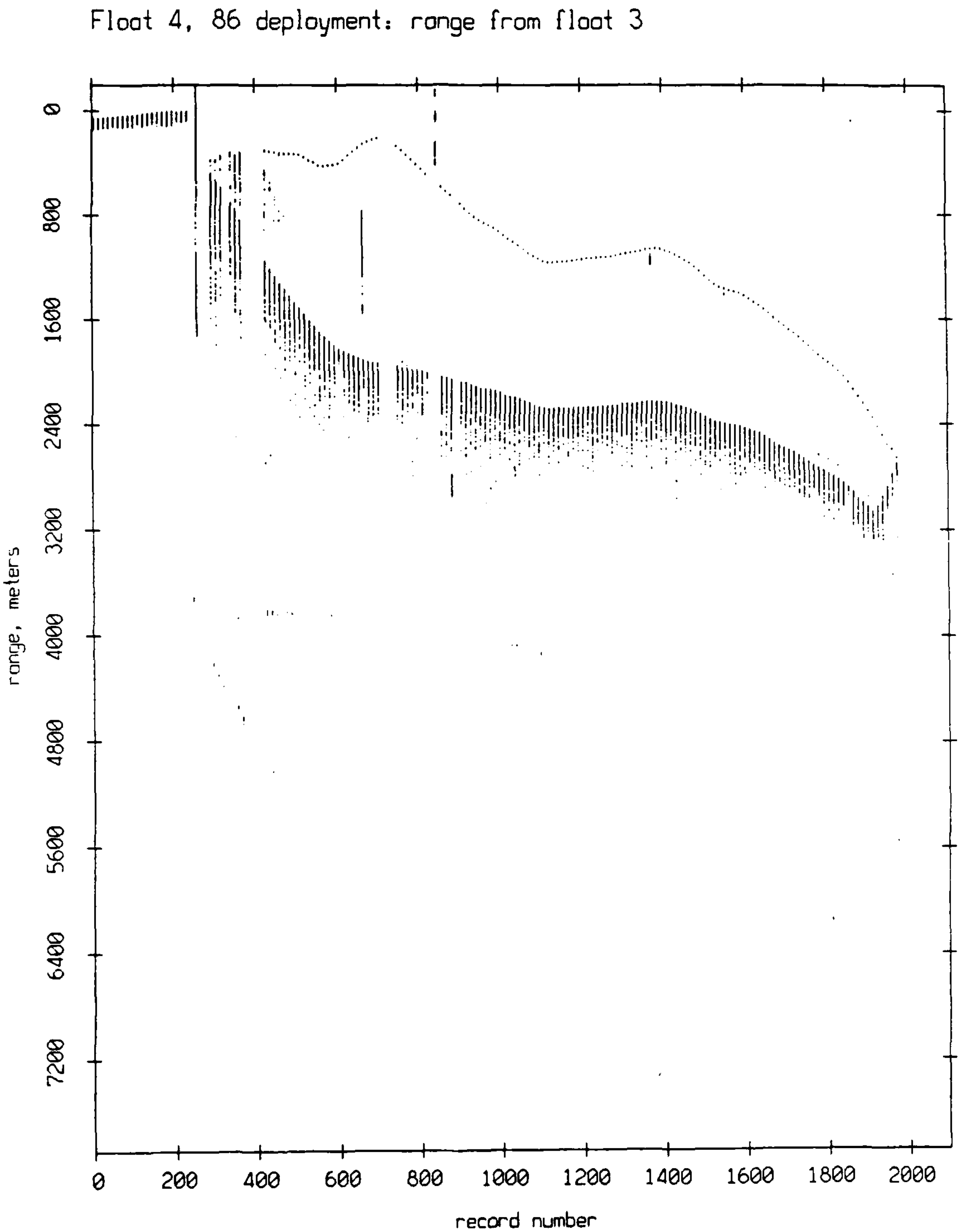

Float 4, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.5d.

Float 4, 86 deployment: range from float 5

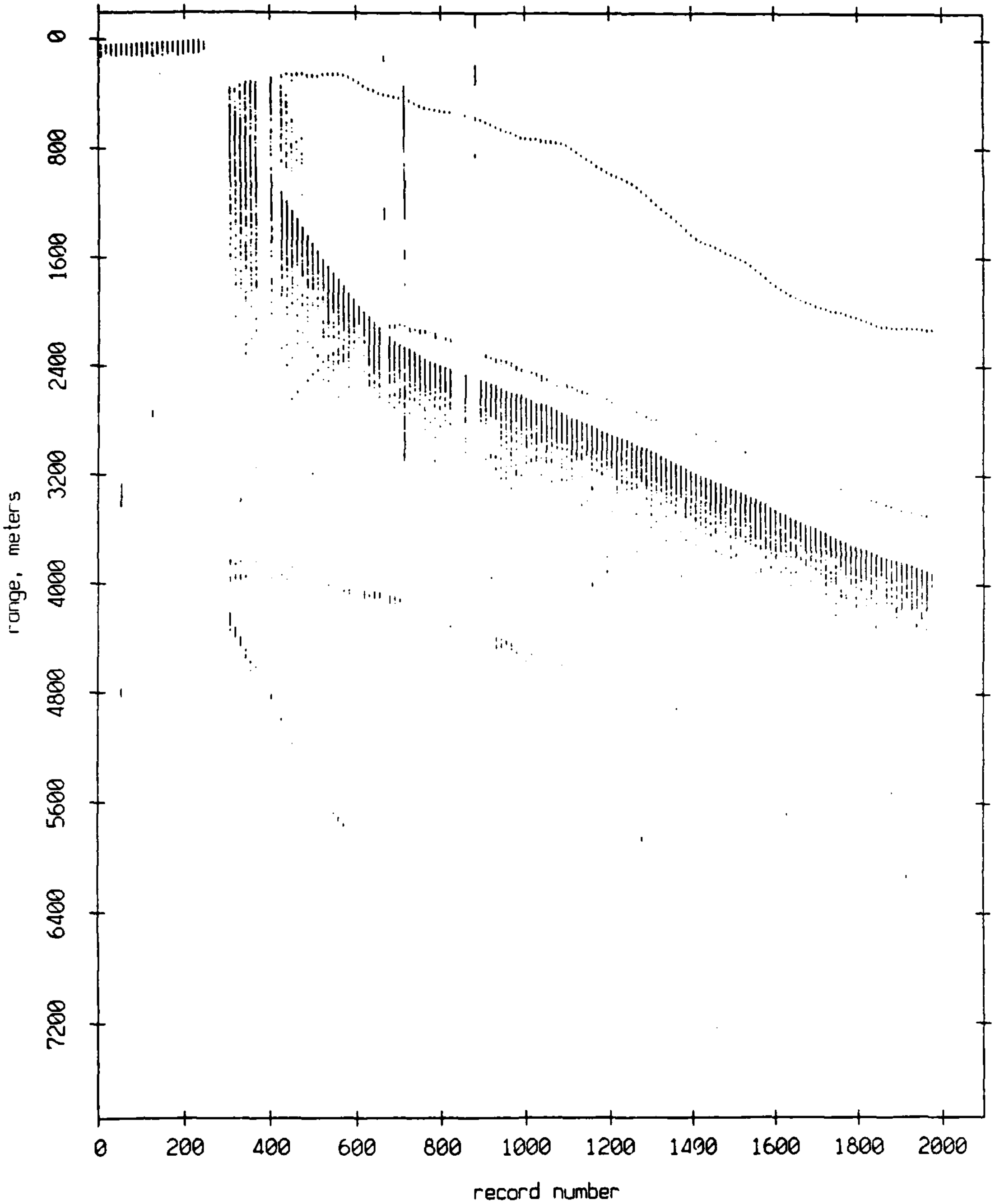


Figure IV.5e

Float 4, 86 deployment: range from float 9

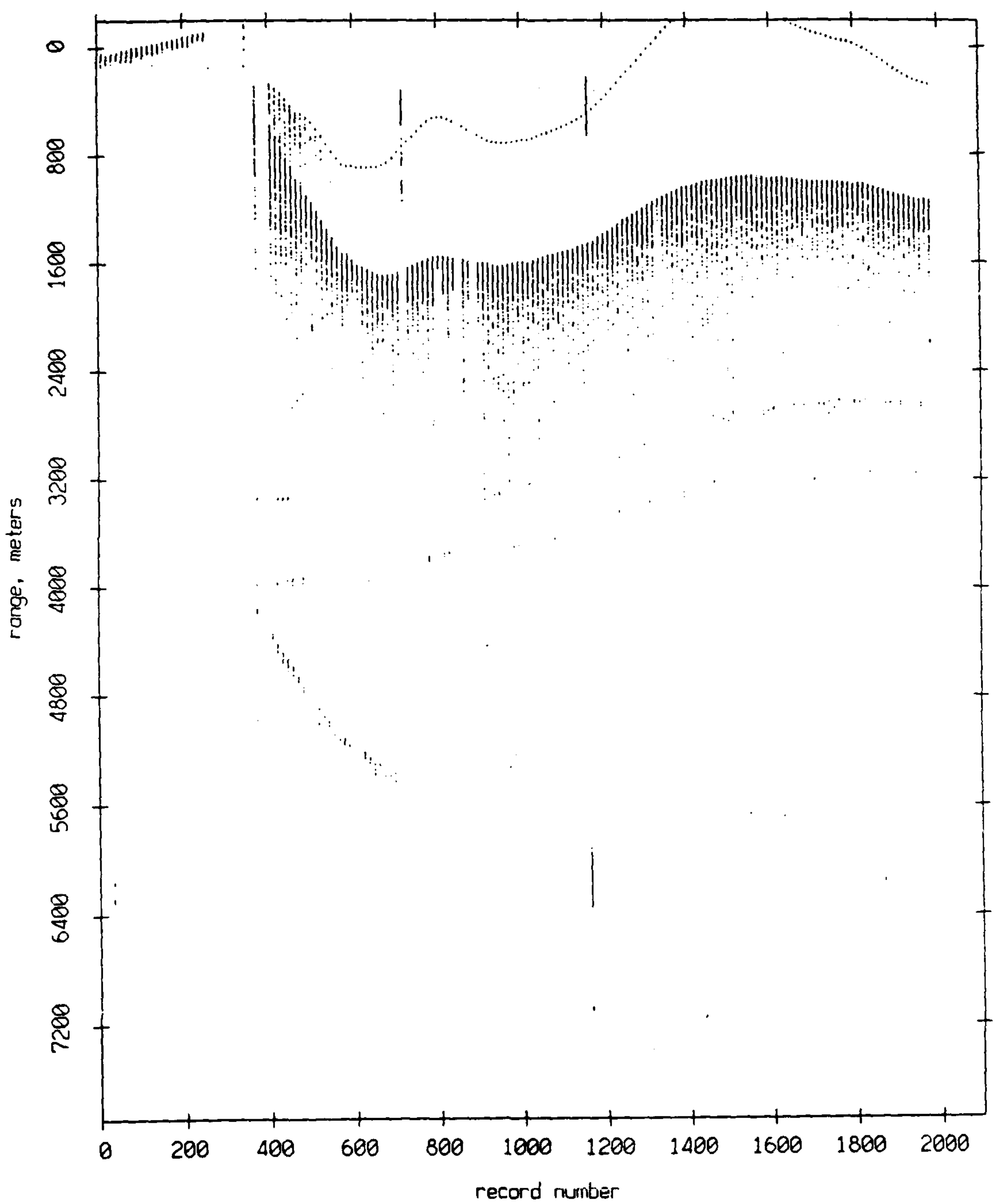


Figure IV.5f.

Float 4, 86 deployment: range from float 10

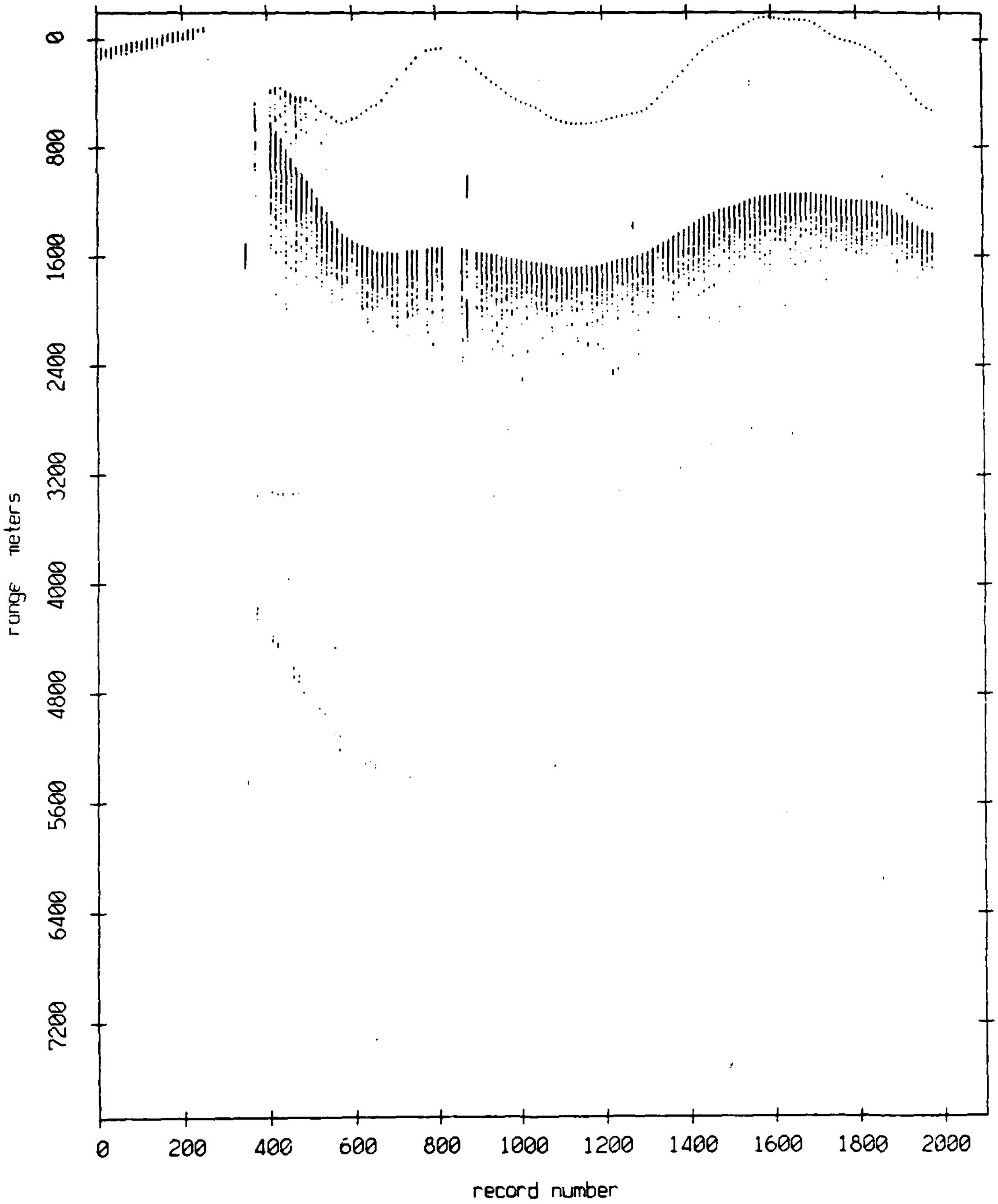


Figure IV.5g.

Float 5, 86 deployment: range from float 0

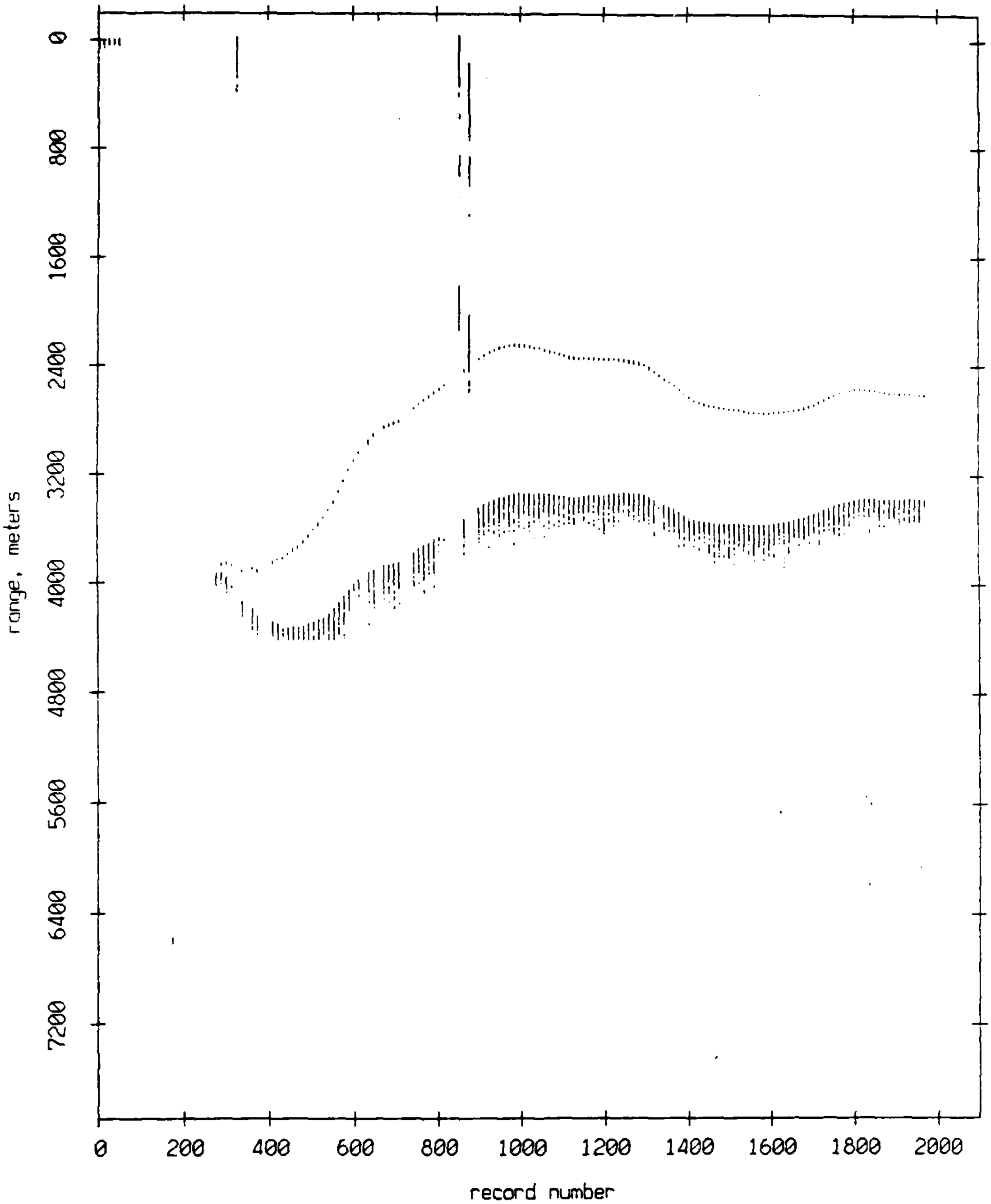


Figure IV.6a.

Float 5, 86 deployment: range from float 1

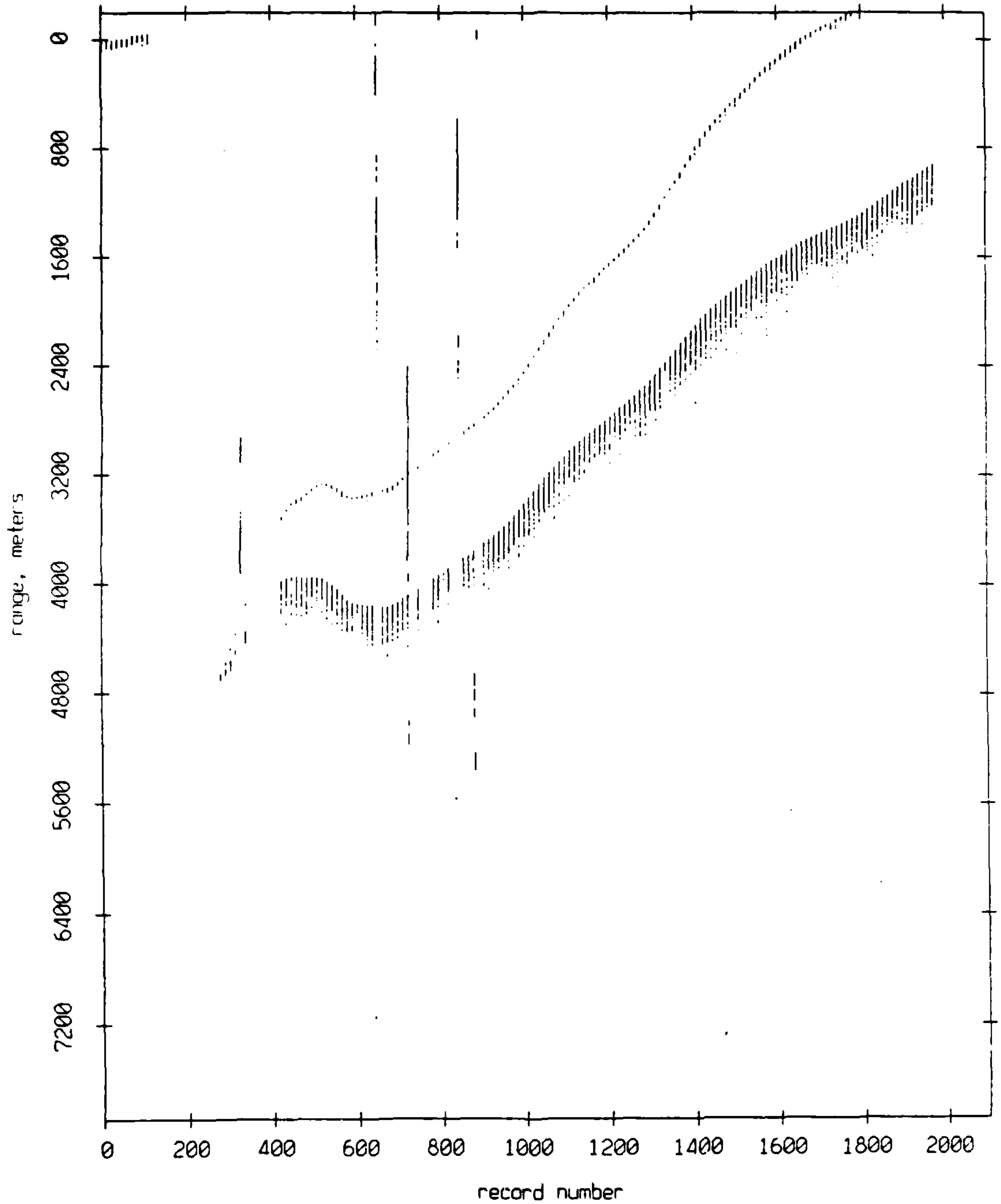
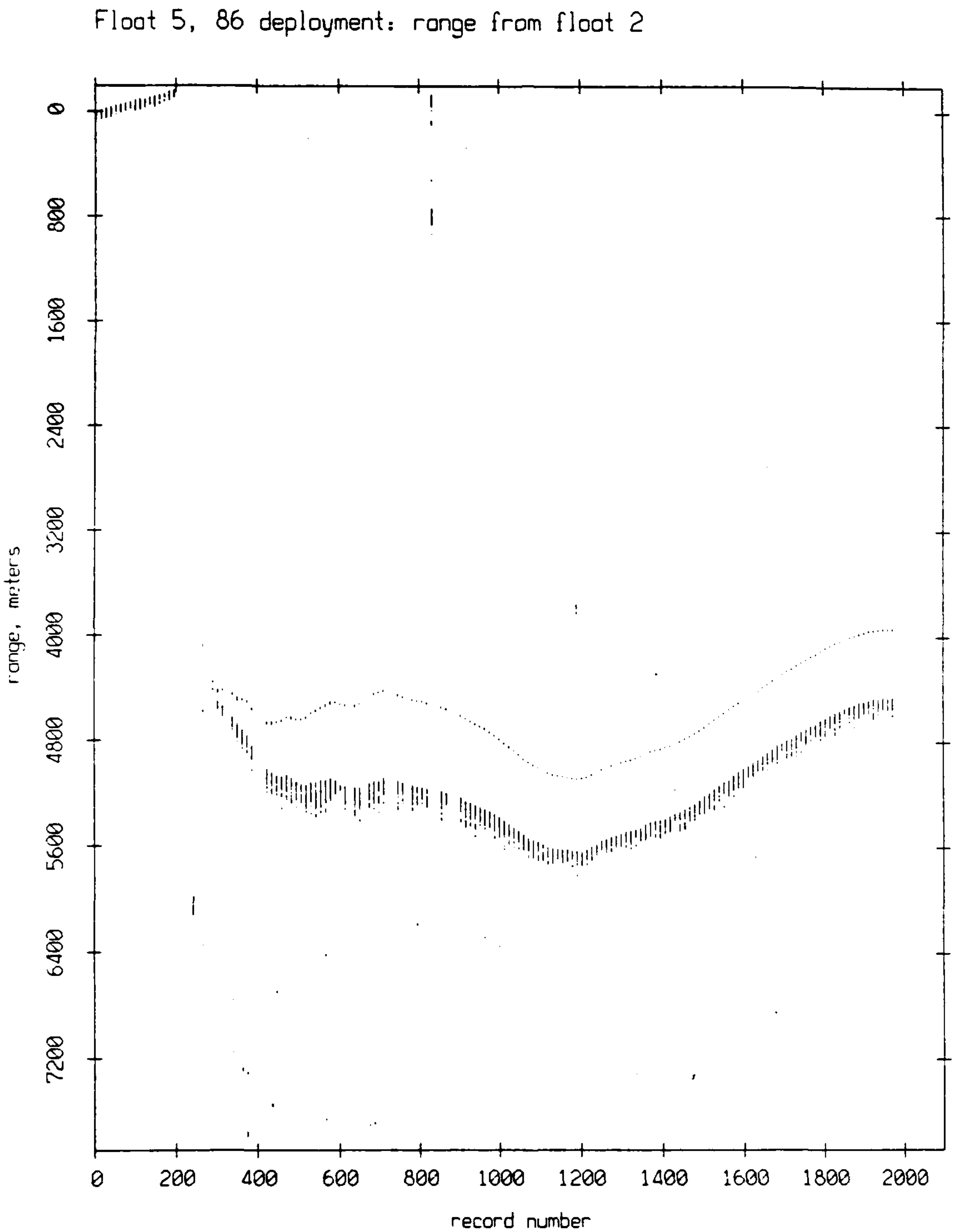


Figure IV.6b.



Float 5, 86 deployment: range from float 2
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.6c.

Float 5, 86 deployment: range from float 3

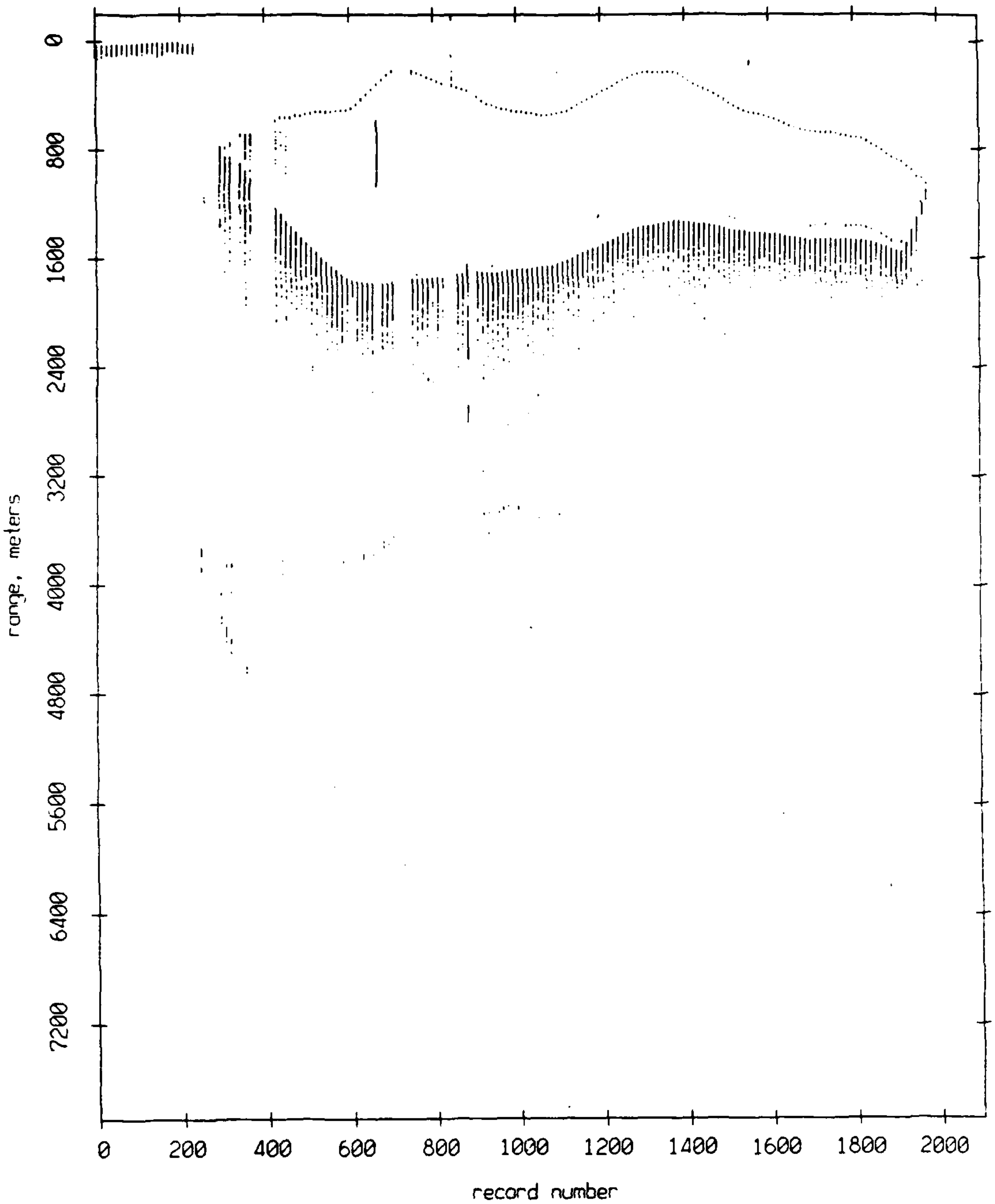


Figure IV.6d.

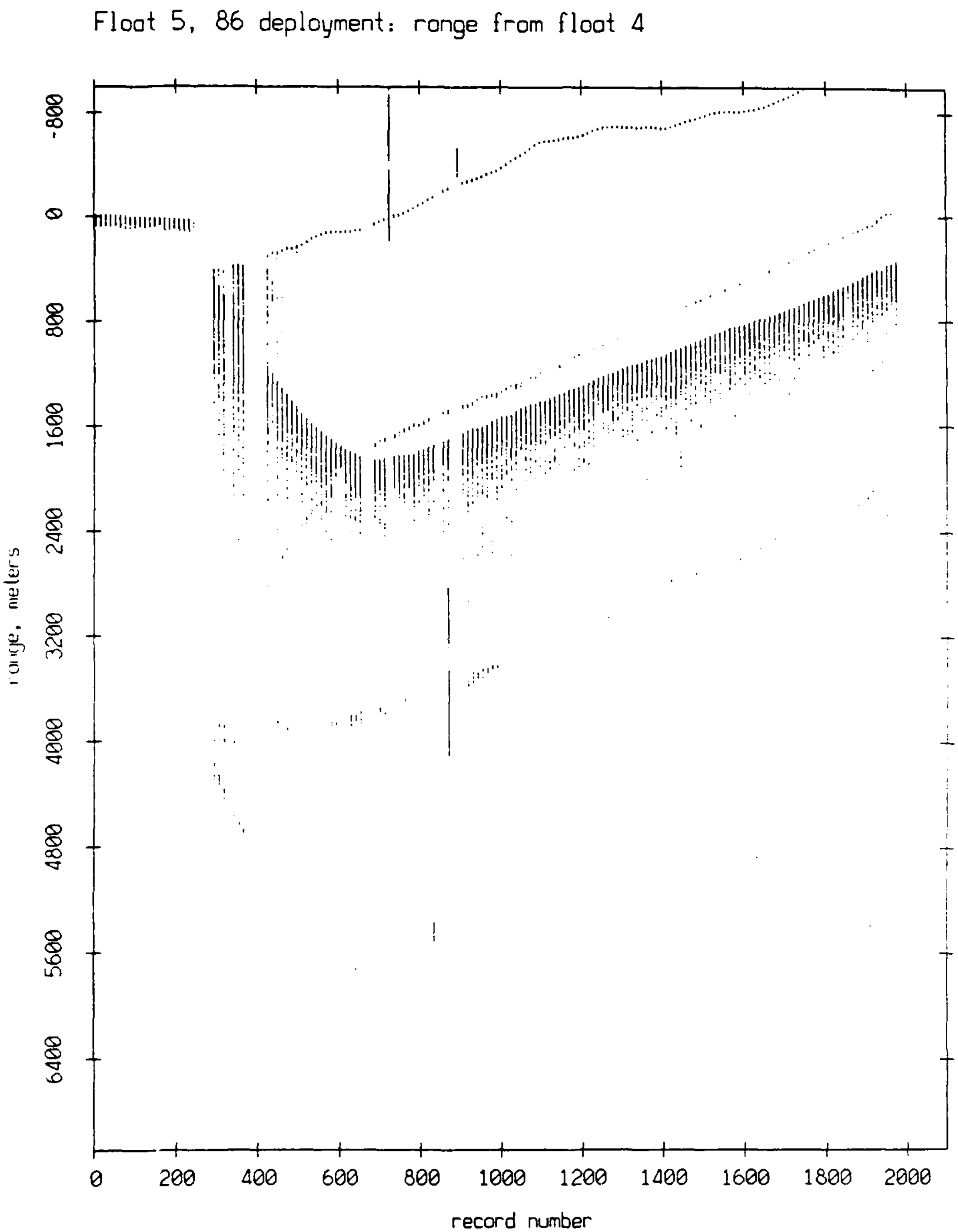

Float 5, 86 deployment: range from float 4
range, meters
-800
0
800
1600
2400
3200
4000
4800
5600
6400
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.6e.

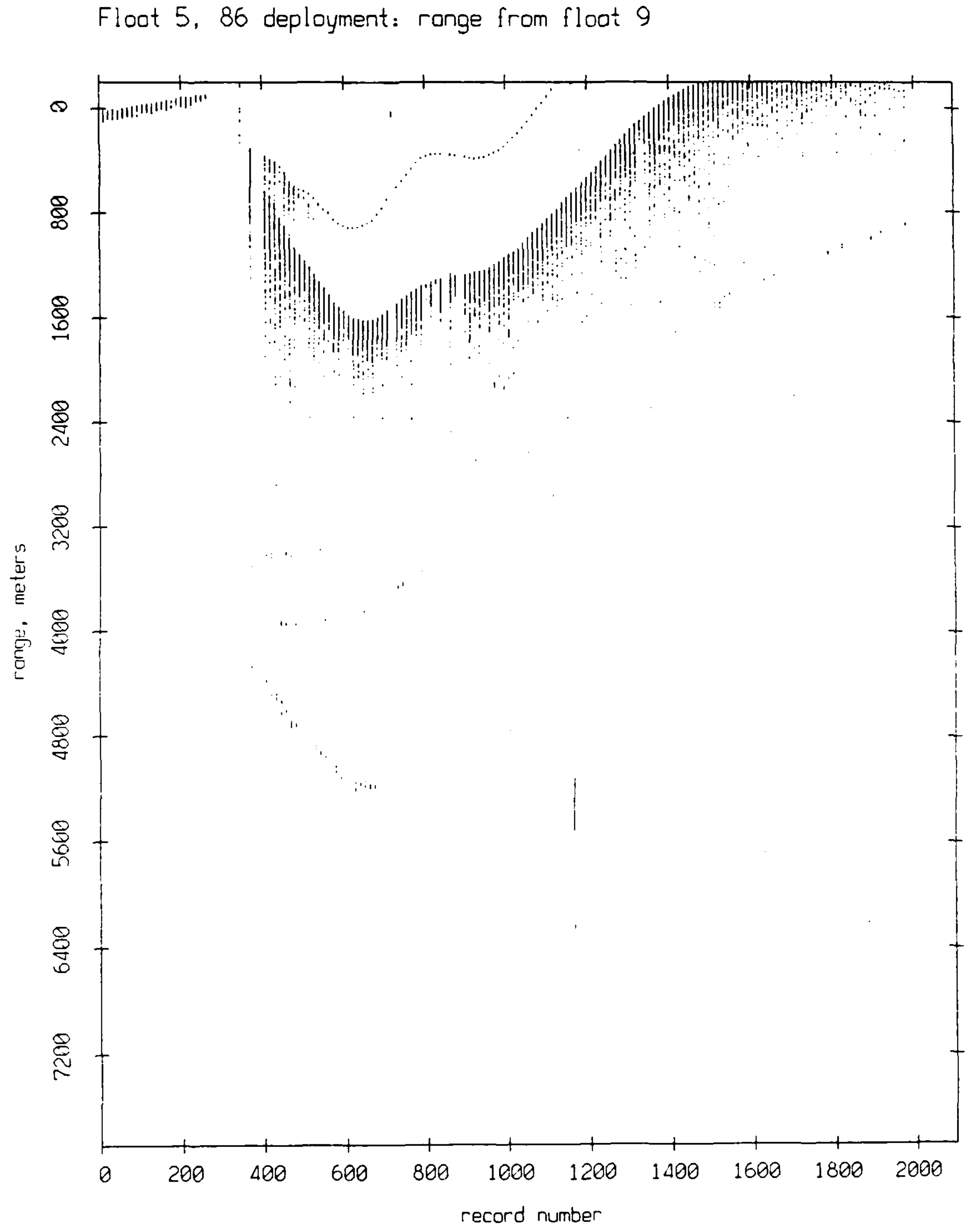

Float 5, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.6f.

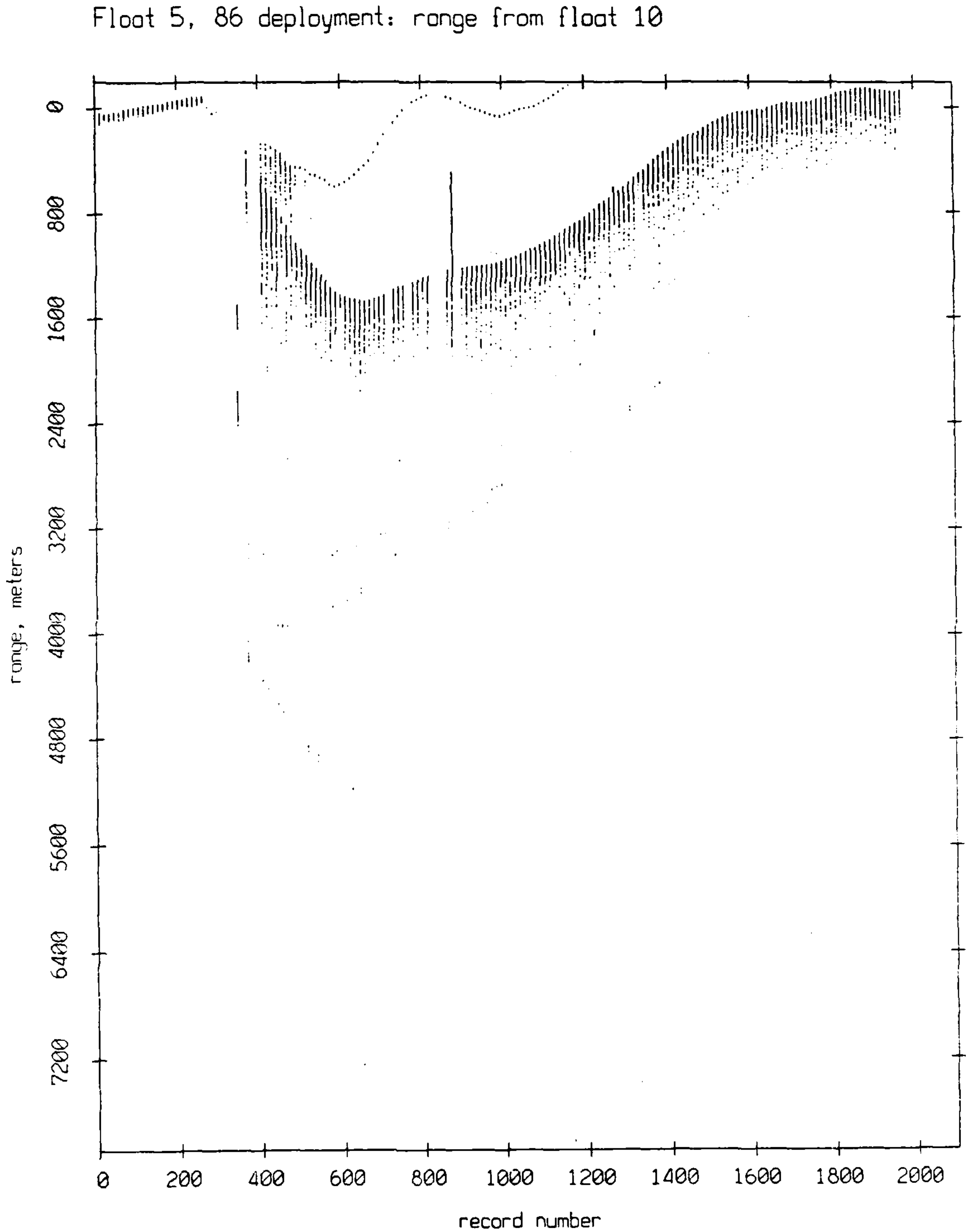

Float 5, 86 deployment: range from float 10
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.6g.

Float 9, 86 deployment: range from float 0

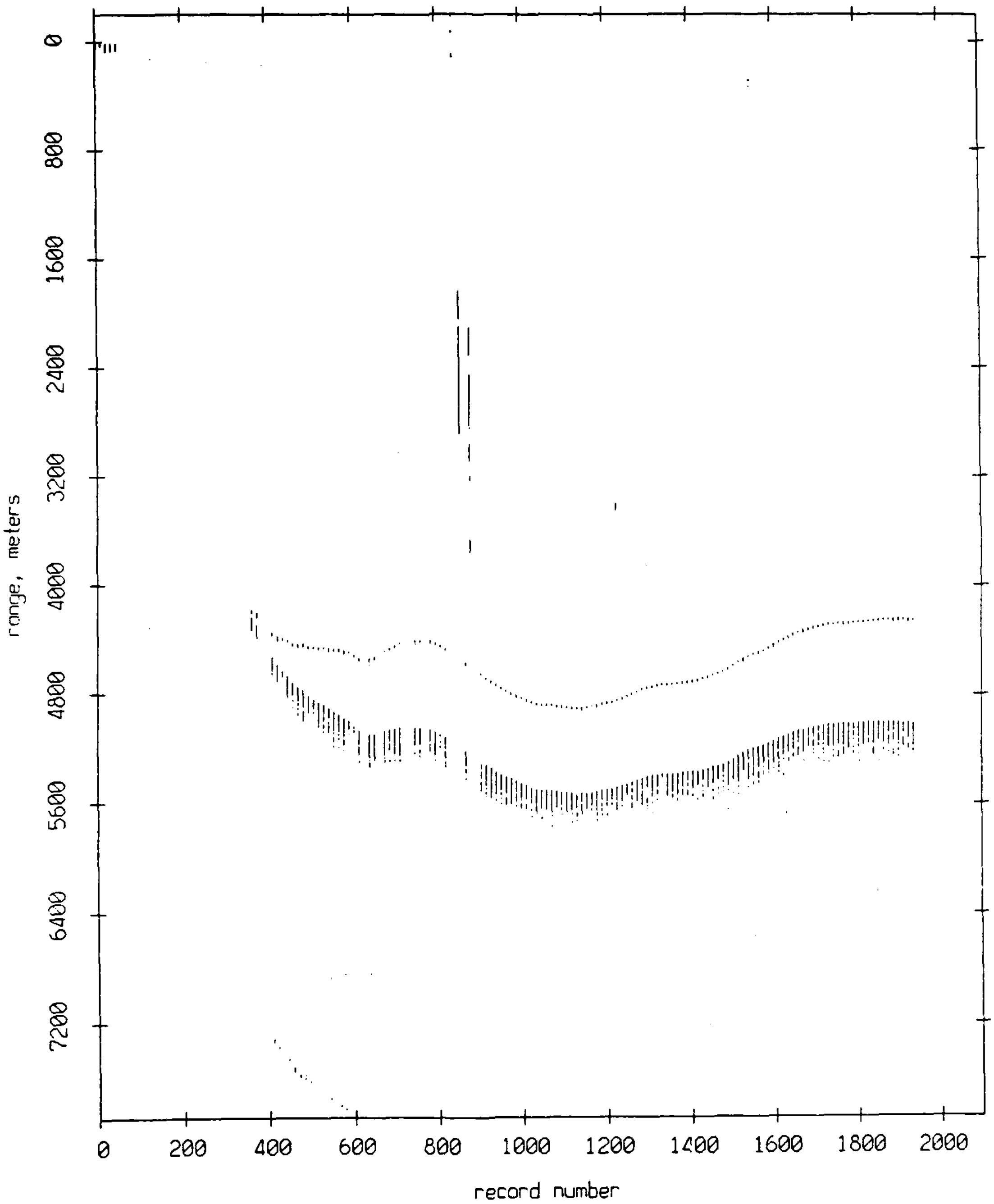


Figure IV.7a.

Float 9, 86 deployment: range from float 1

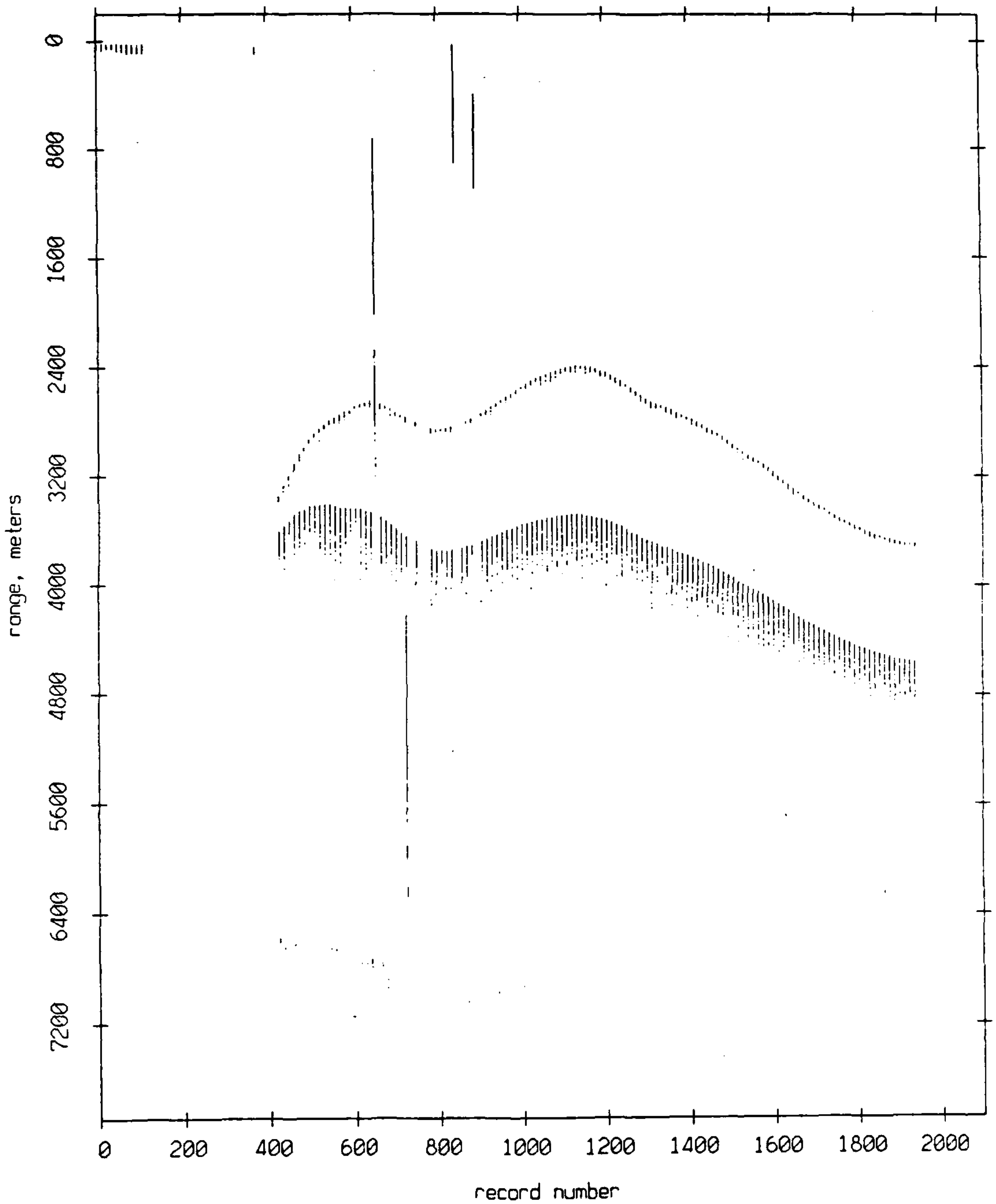


Figure IV.7b.

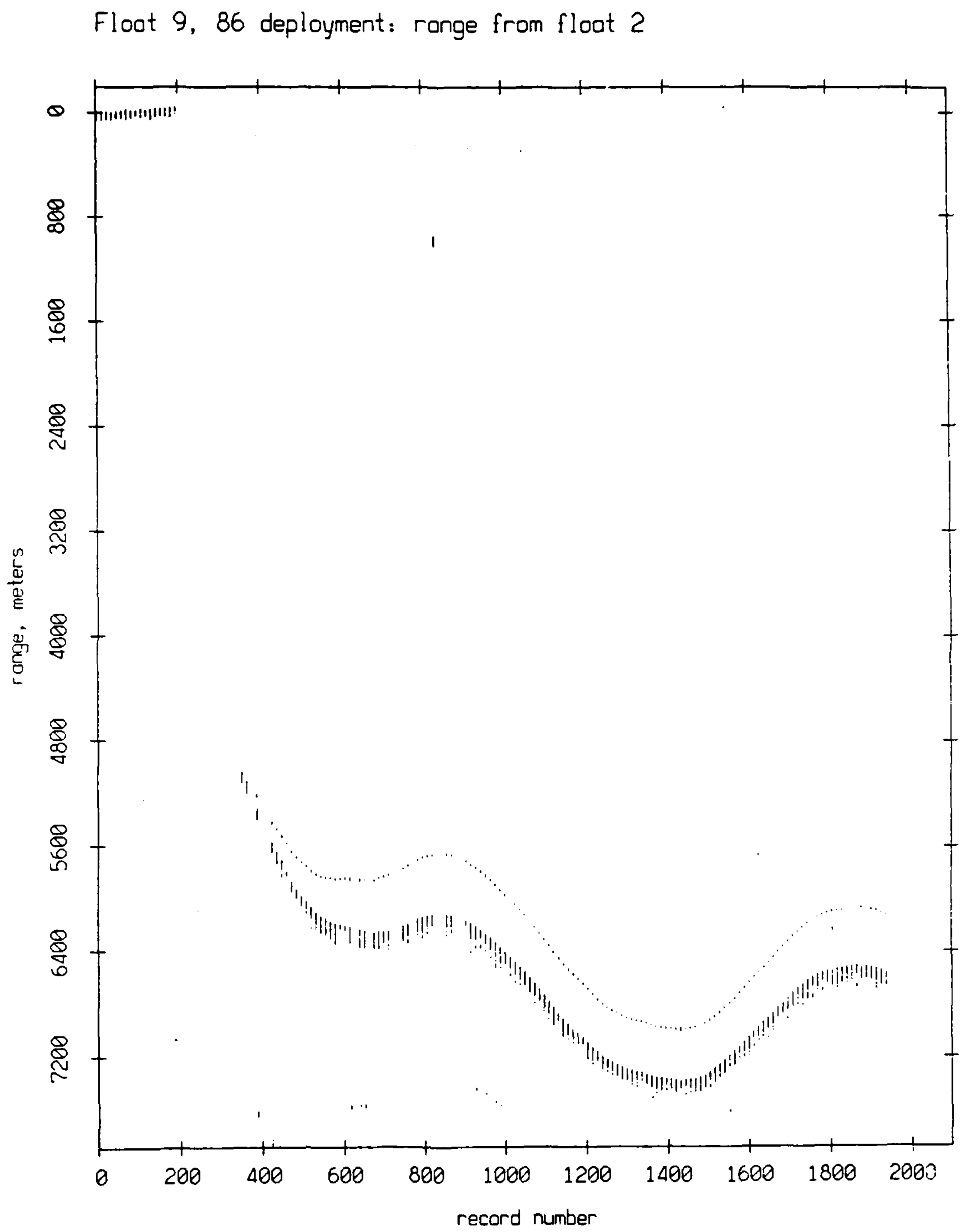

Float 9, 86 deployment: range from float 2
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.7c.

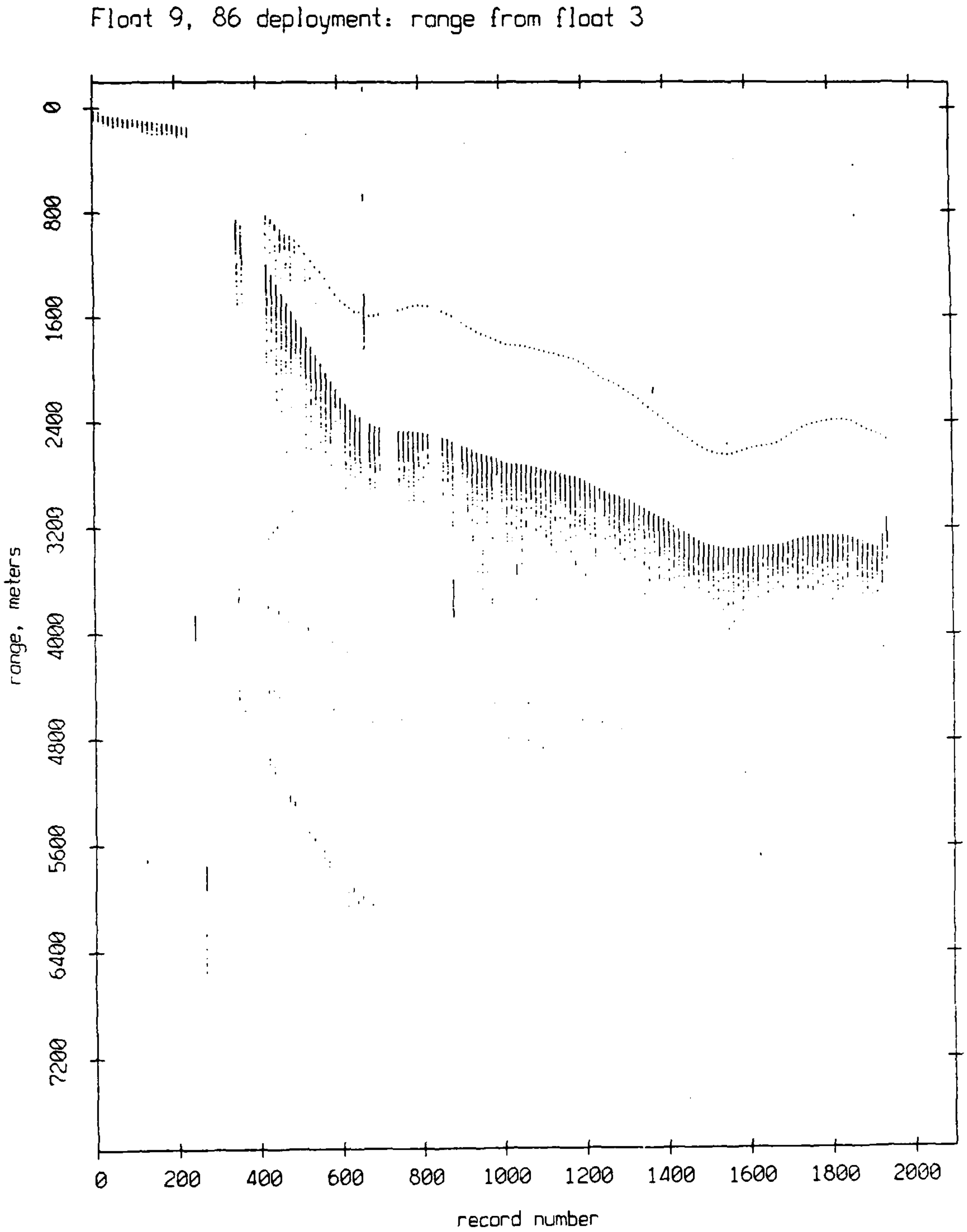

Float 9, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.7d.

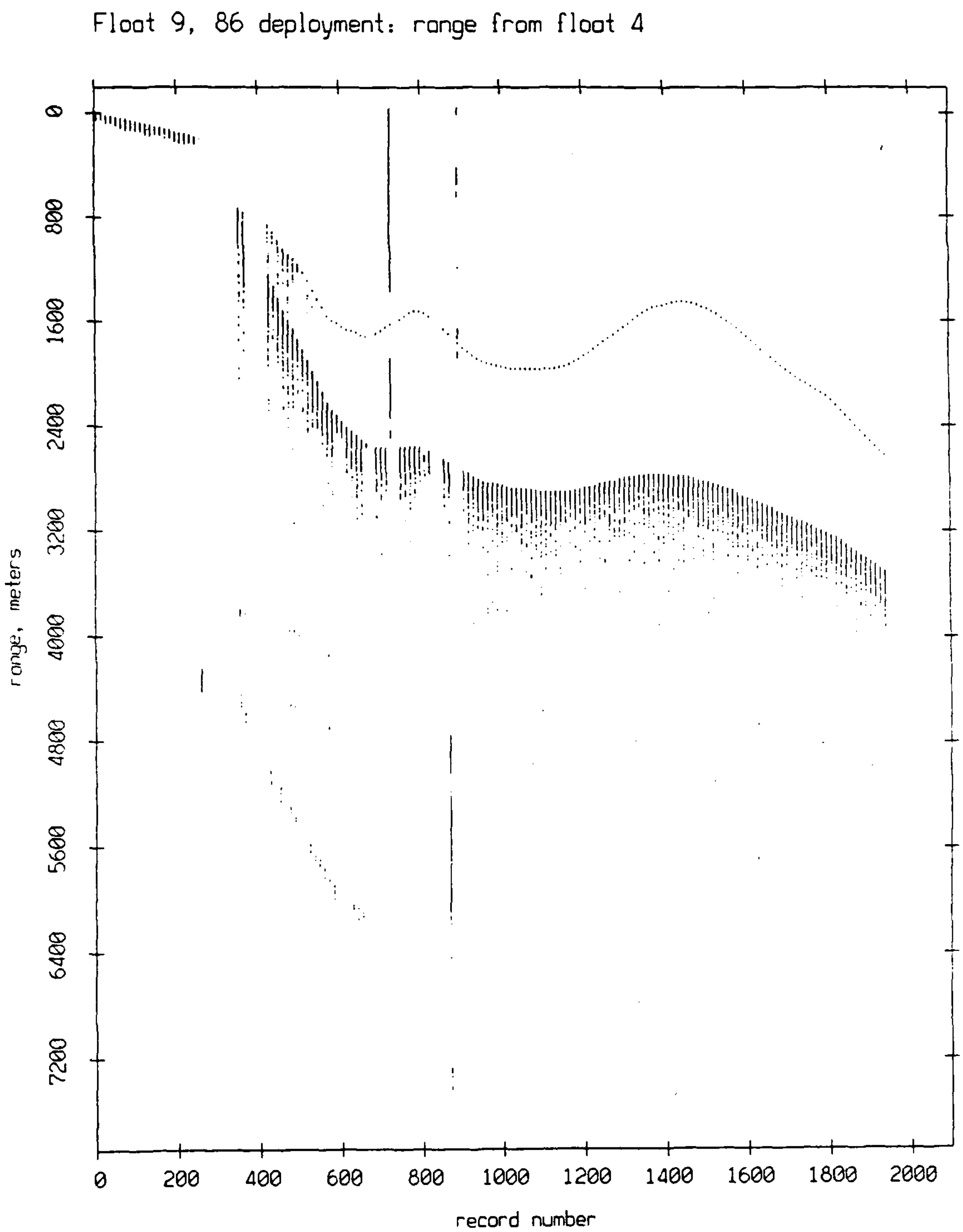

Float 9, 86 deployment: range from float 4
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
record number
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Figure IV.7e.

Float 9, 86 deployment: range from float 5

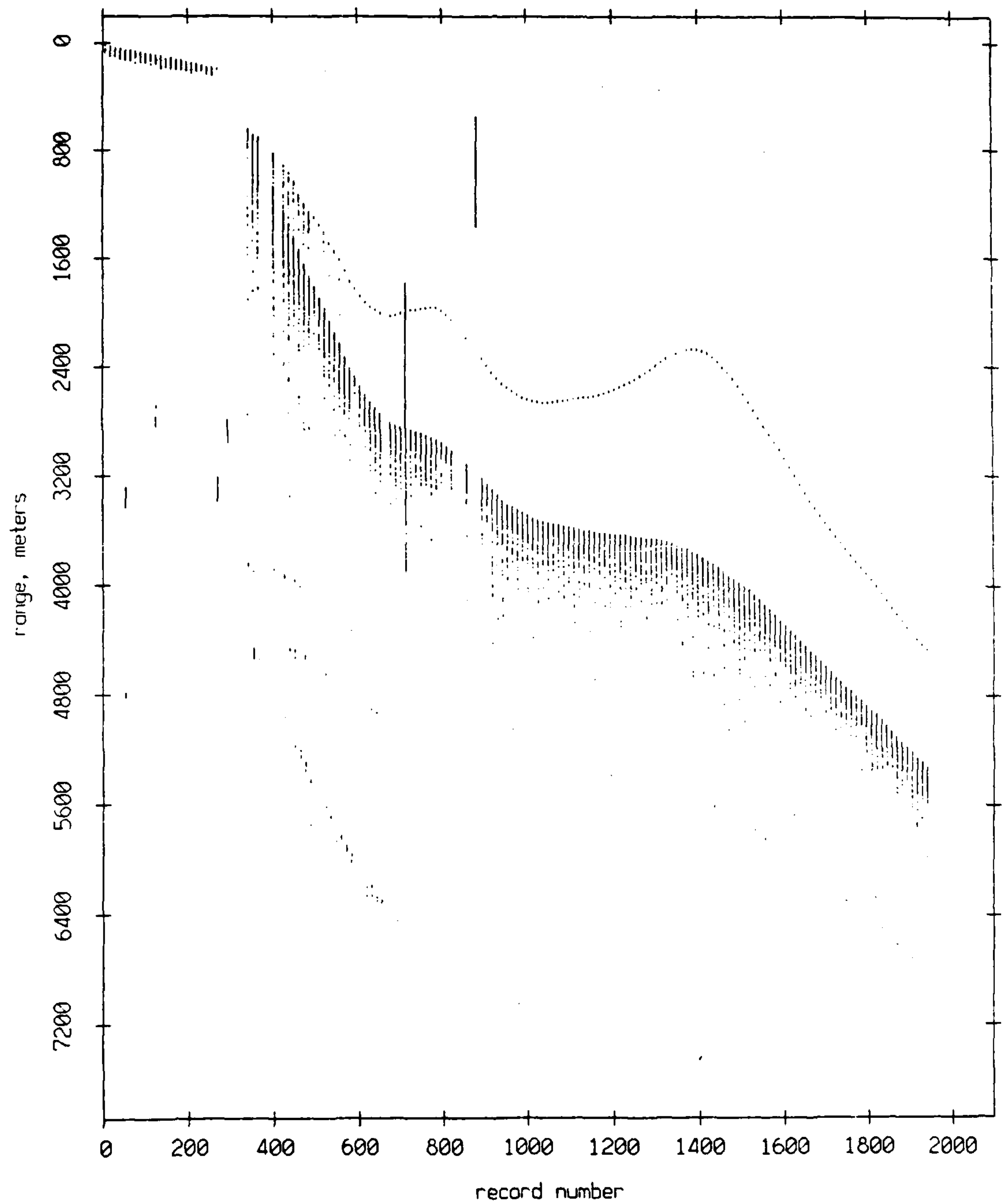


Figure IV.7f.

Float 9, 86 deployment: range from float 10

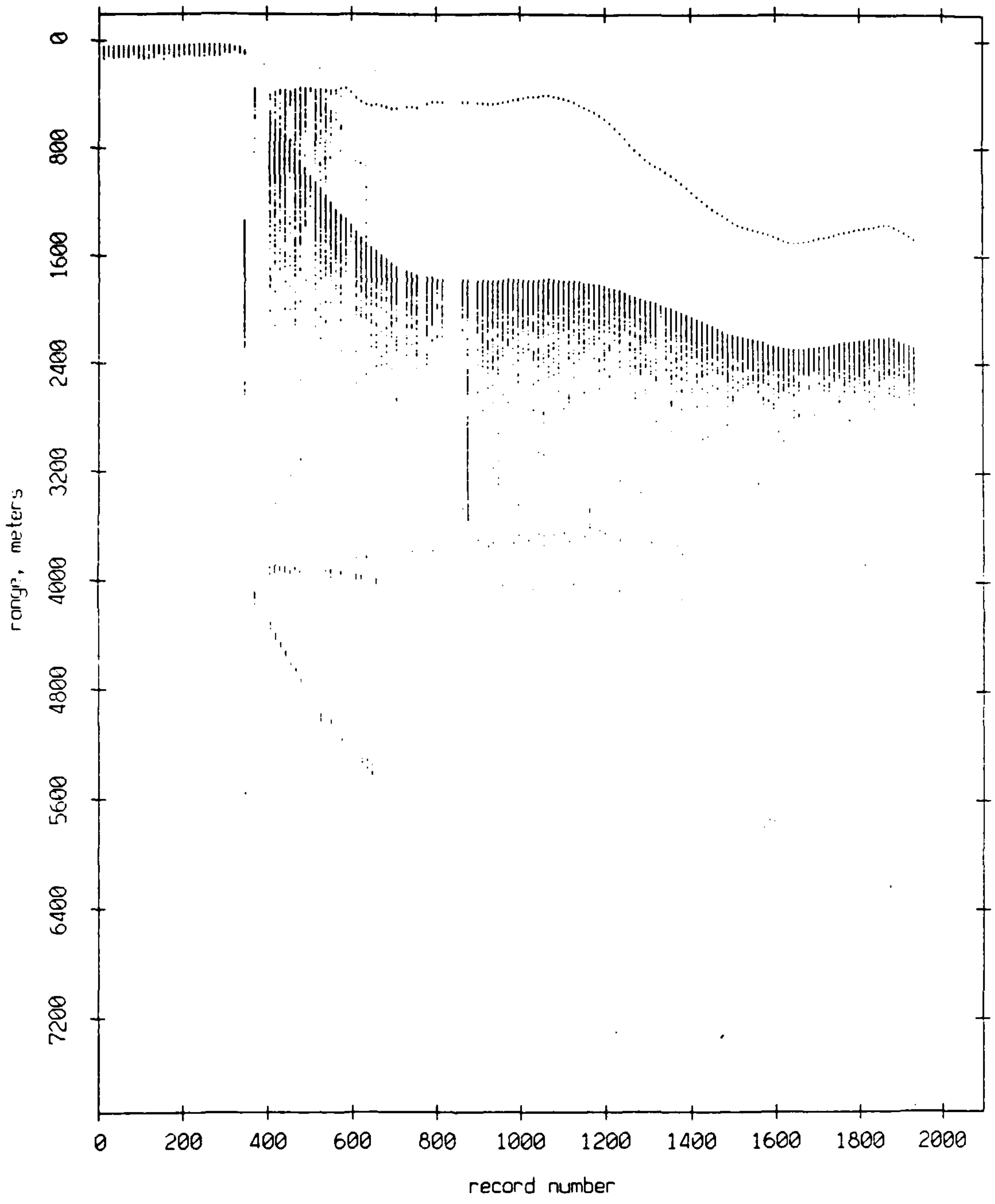


Figure IV.7g.

Float 10, 86 deployment: range from float 0

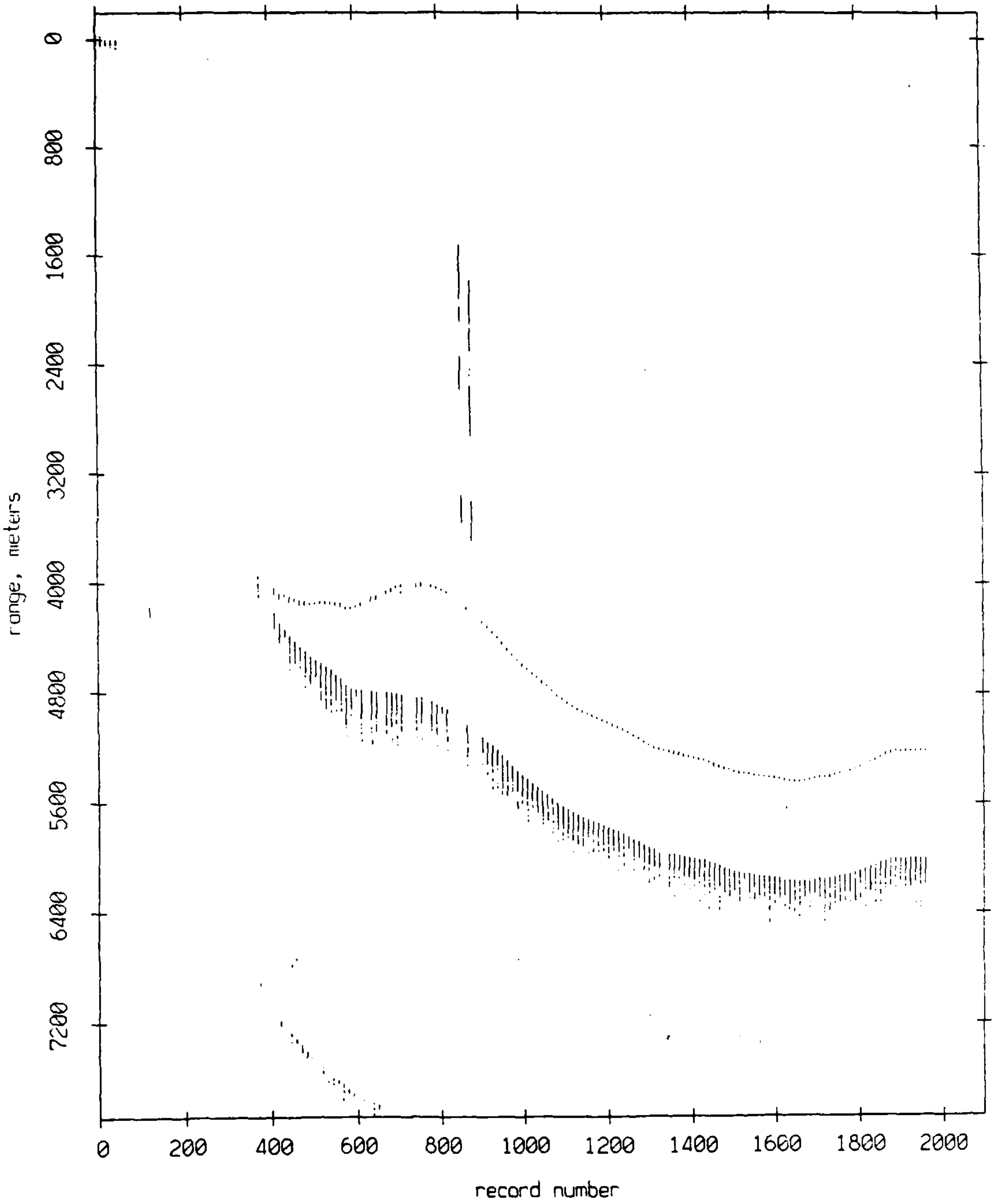


Figure IV.8a.

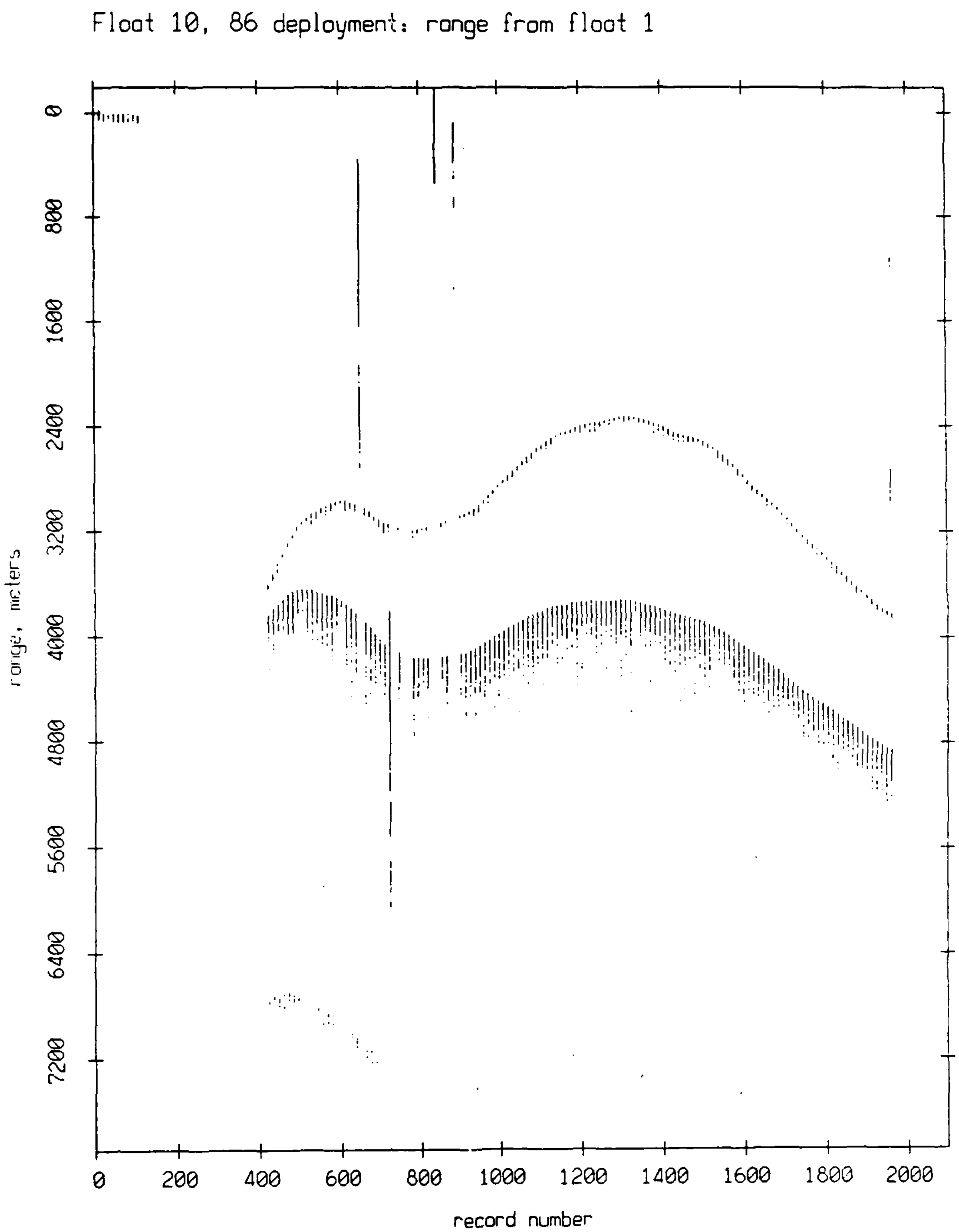

Float 10, 86 deployment: range from float 1
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.8b.

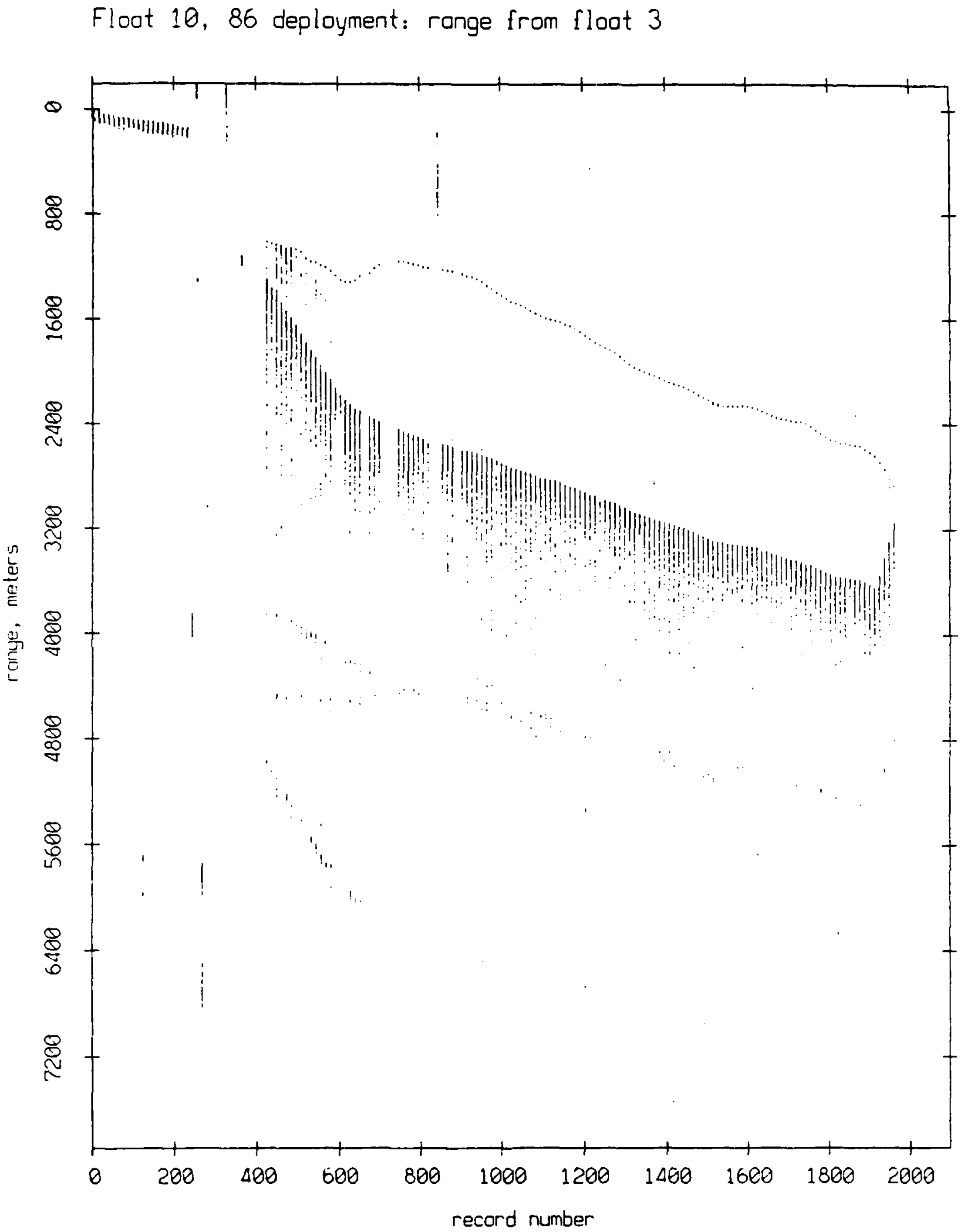

Float 10, 86 deployment: range from float 3
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.8d.

Float 10, 86 deployment: range from float 2

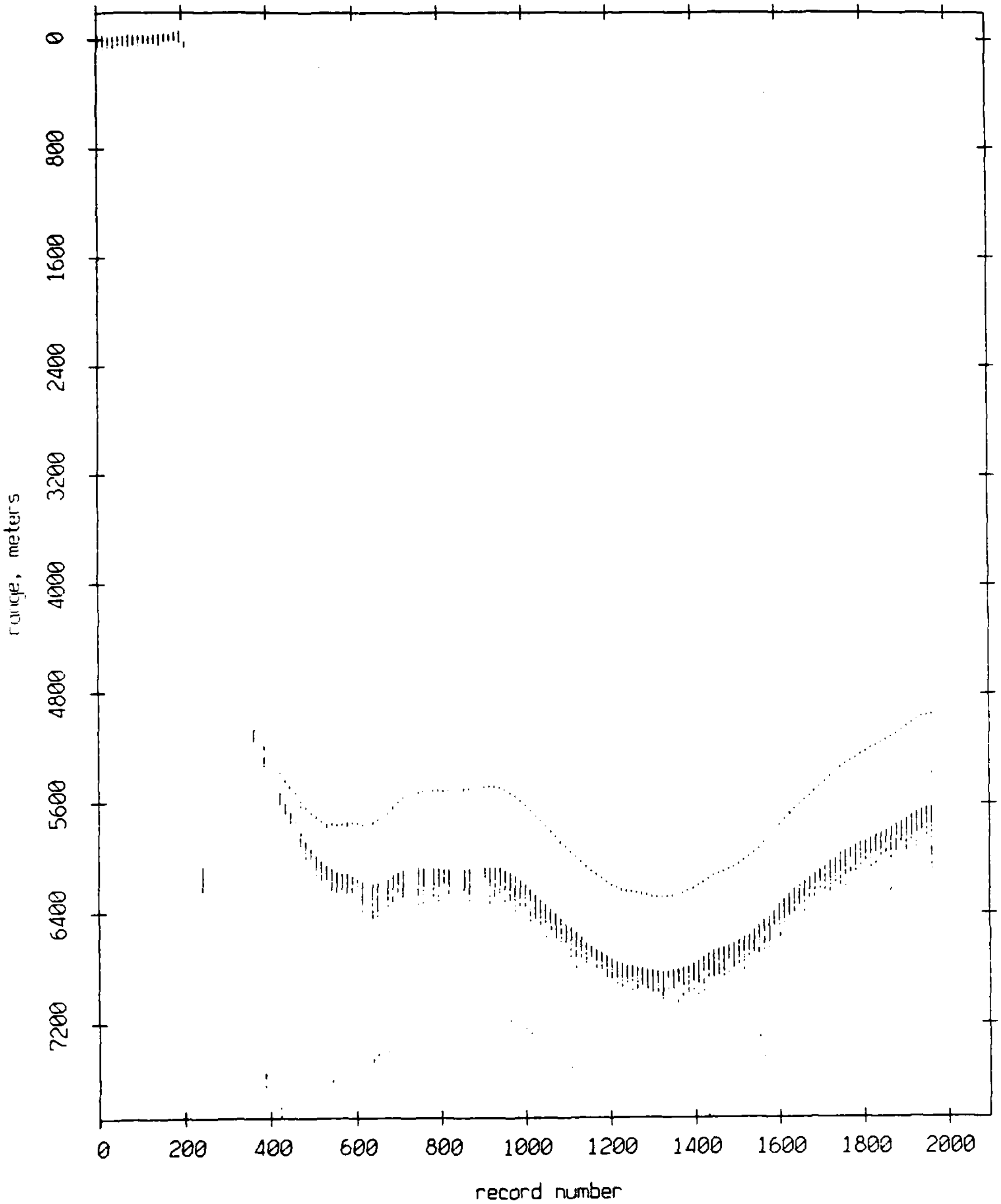
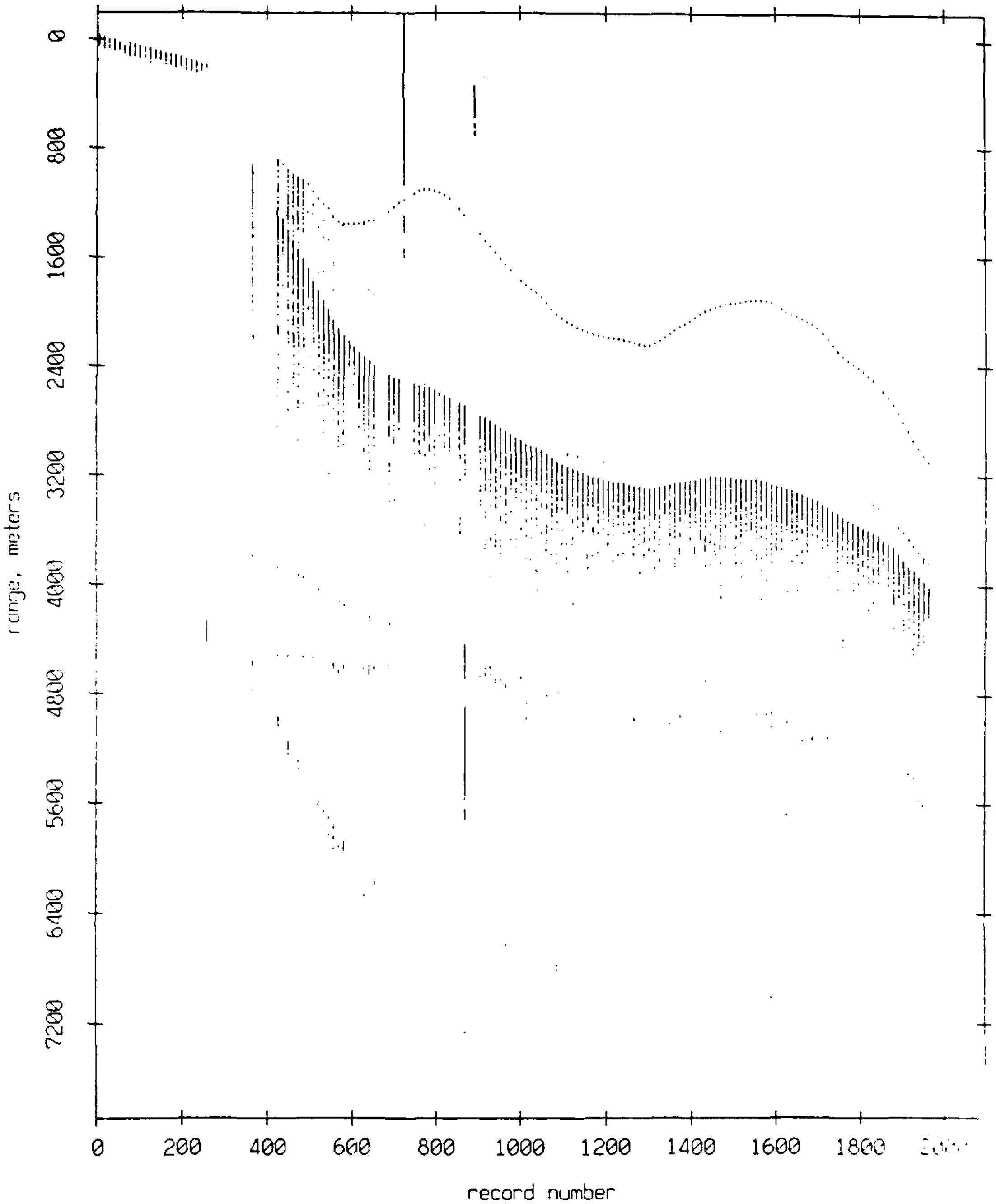
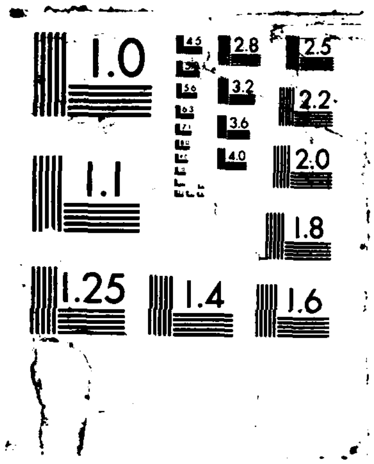


Figure IV.8c.

Float 10, 86 deployment: range from float 4



AD-A189 637 FREELY DRIFTING SHALLOW FLOAT ARRAY: SEPTEMBER 1986 2/3
TRIP REPORT(U) SCRIPPS INSTITUTION OF OCEANOGRAPHY LA
JOLLA CA MARINE PHYSIC.. R L CULVER ET AL. APR 87
UNCLASSIFIED MPL-U-13/87 N00014-82-K-0147 F/G 20/1 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

Float 10, 86 deployment: range from float 5

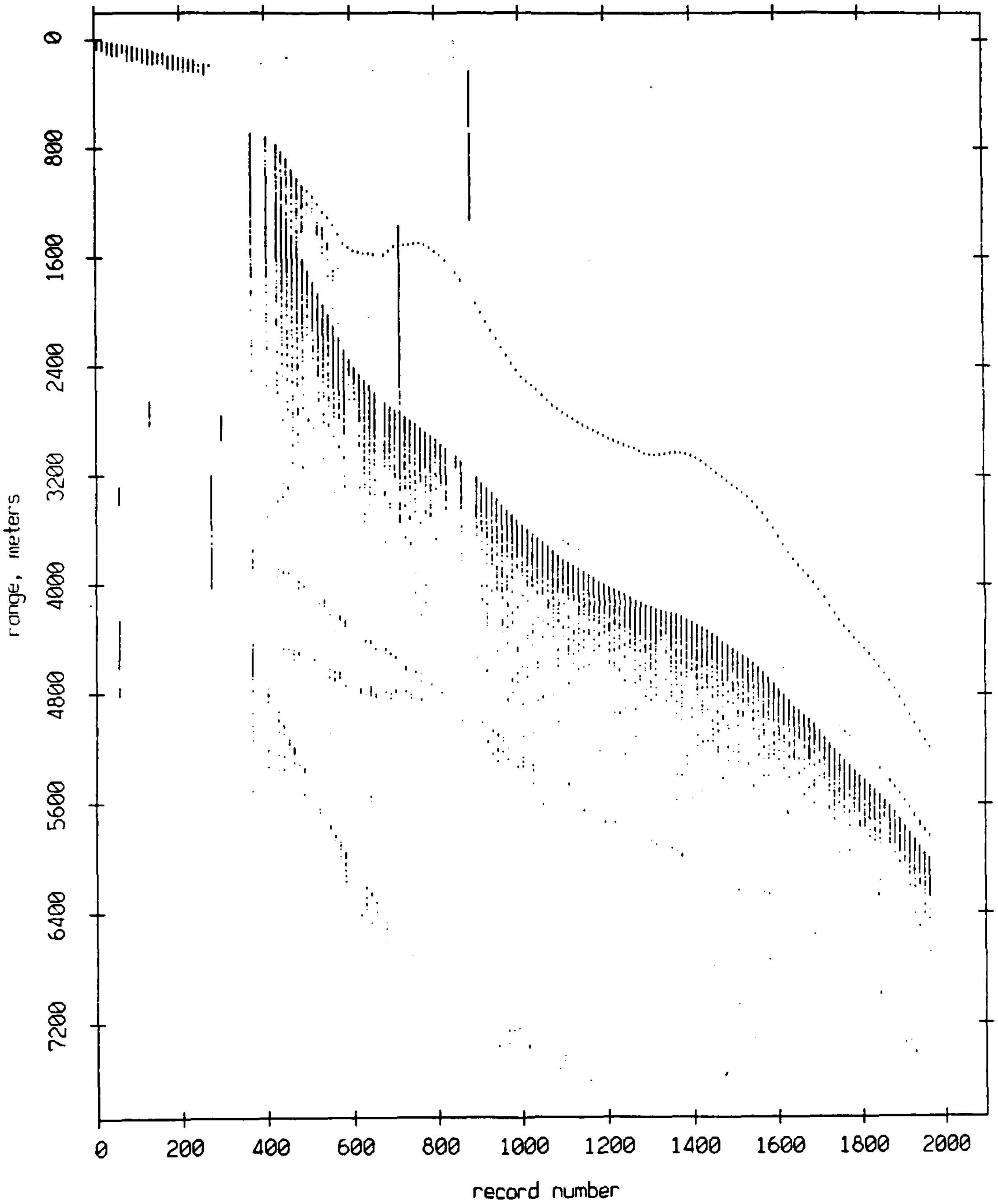


Figure IV.8f.

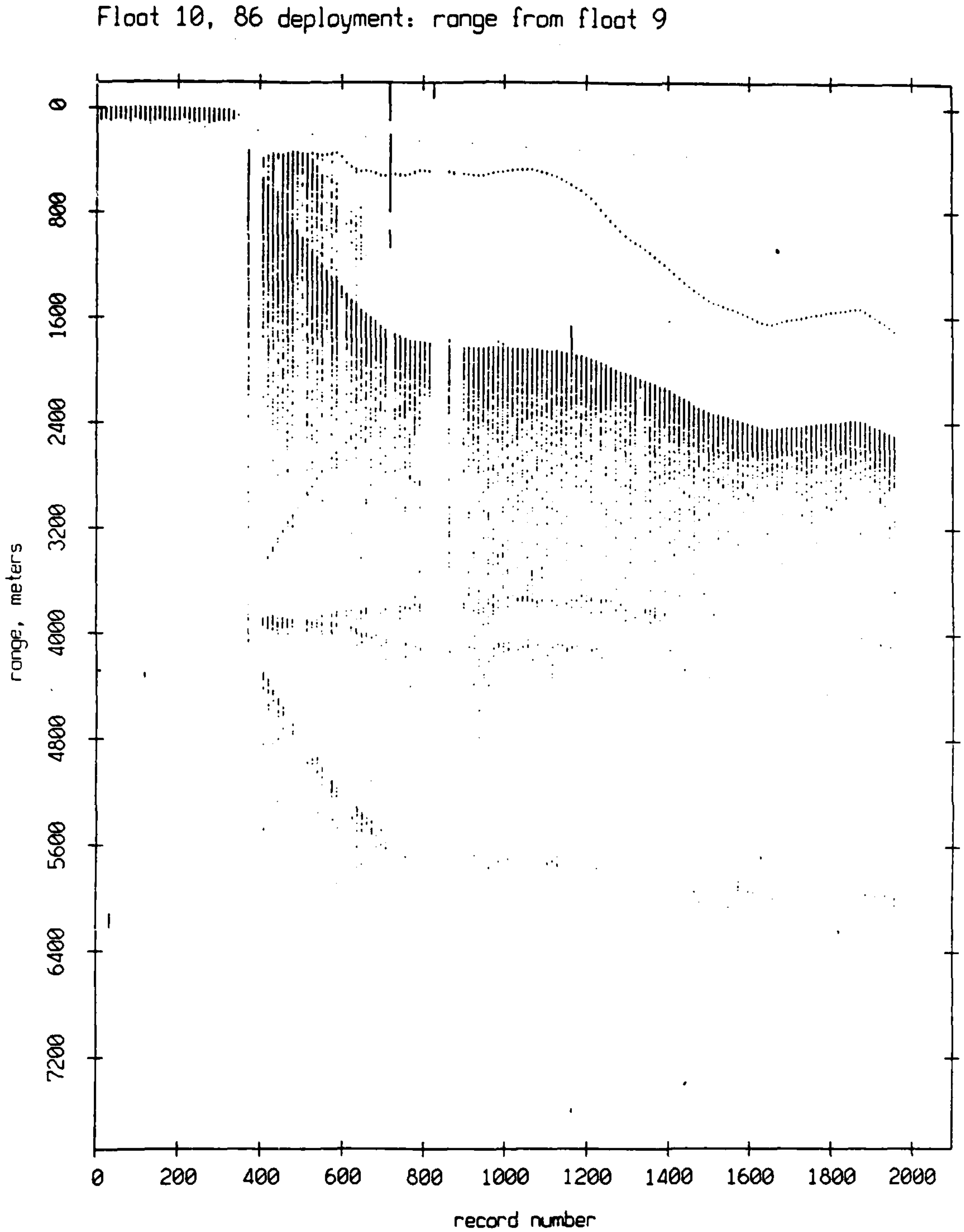

Float 10, 86 deployment: range from float 9
range, meters
0
800
1600
2400
3200
4000
4800
5600
6400
7200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure IV.8g.

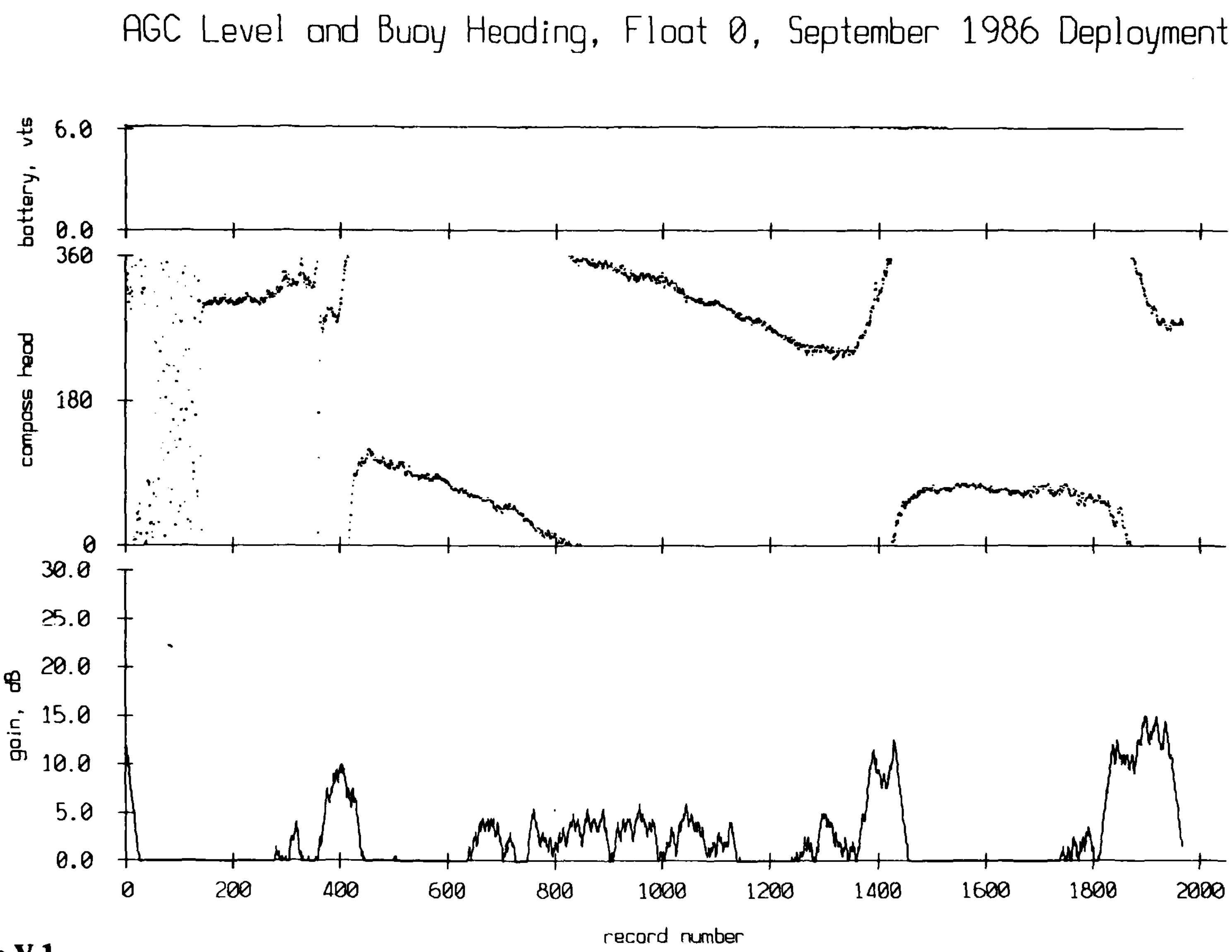

AGC Level and Buoy Heading, Float 0, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.1.

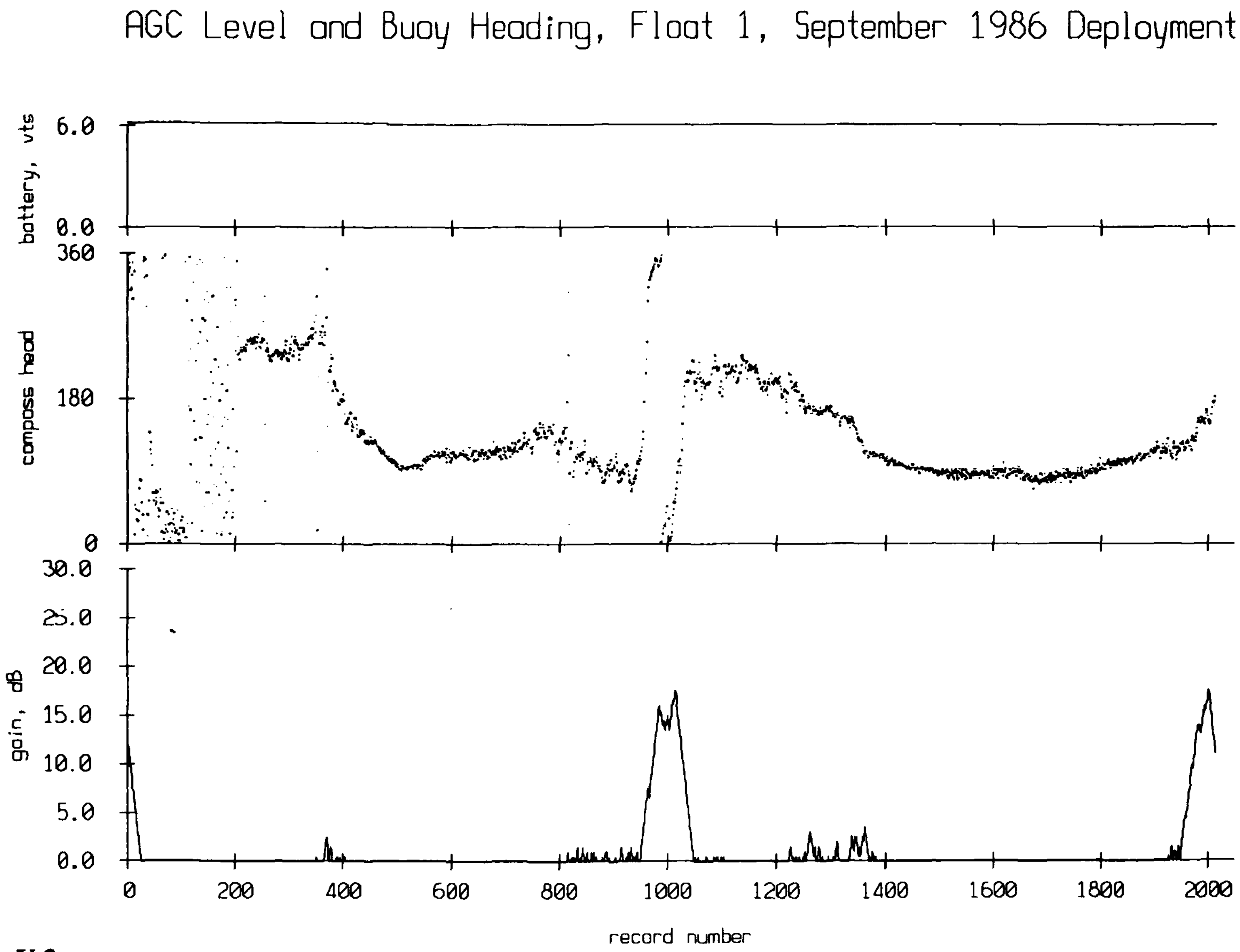

AGC Level and Buoy Heading, Float 1, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.2.

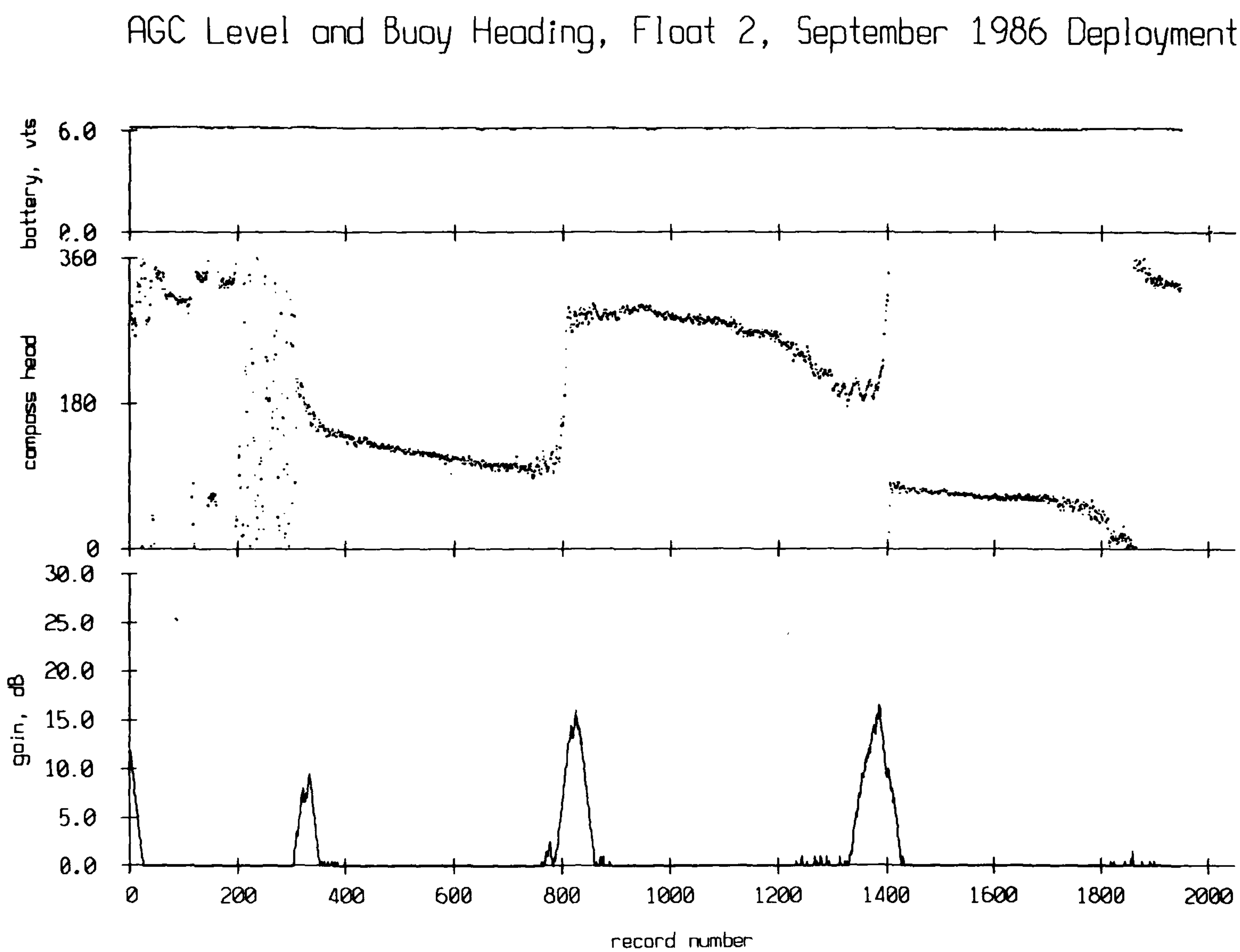

AGC Level and Buoy Heading, Float 2, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.3.

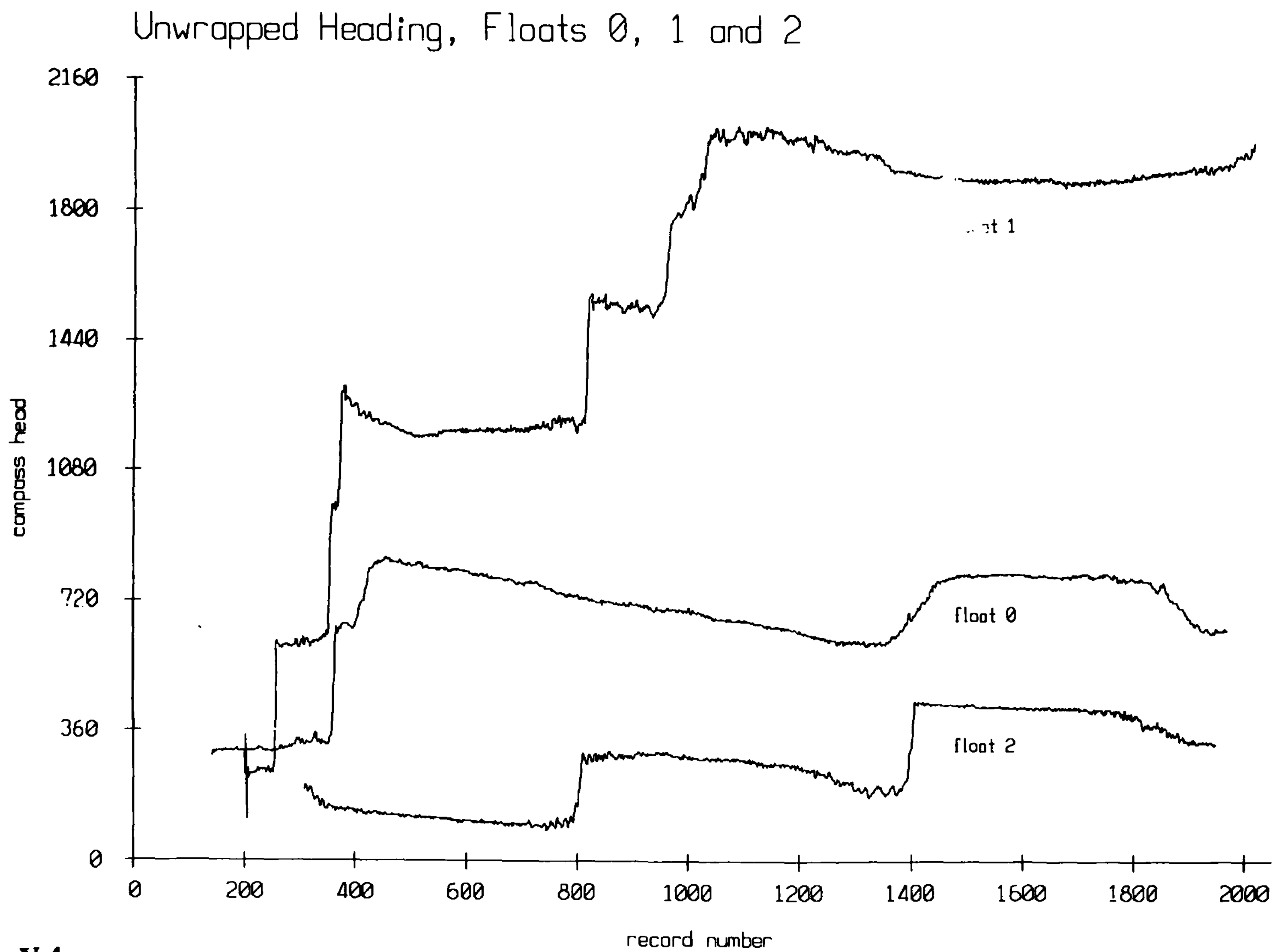

Unwrapped Heading, Floats 0, 1 and 2
compass head
2160
1800
1440
1080
720
360
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number
float 0
float 2

Figure V.4.

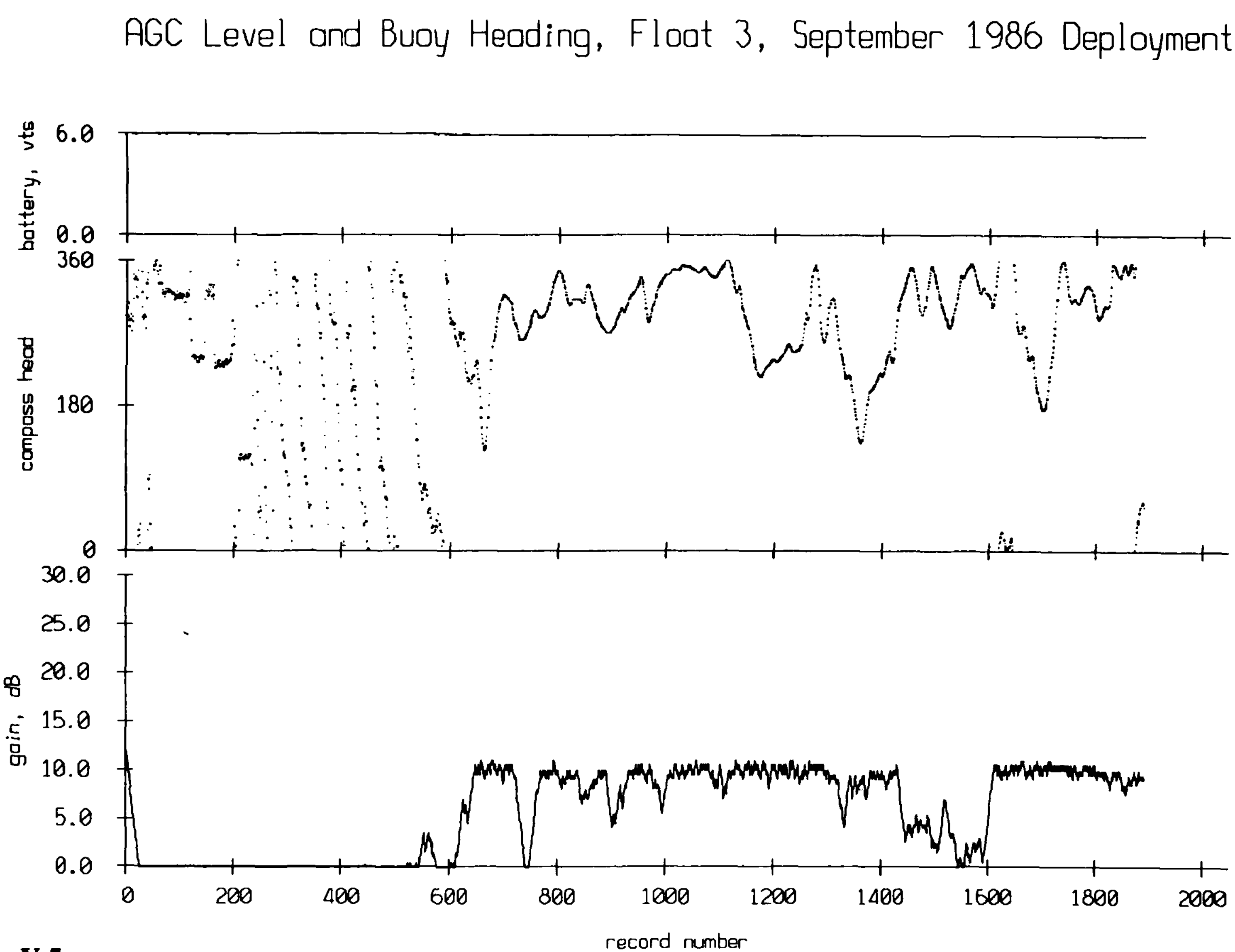

AGC Level and Buoy Heading, Float 3, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.5.

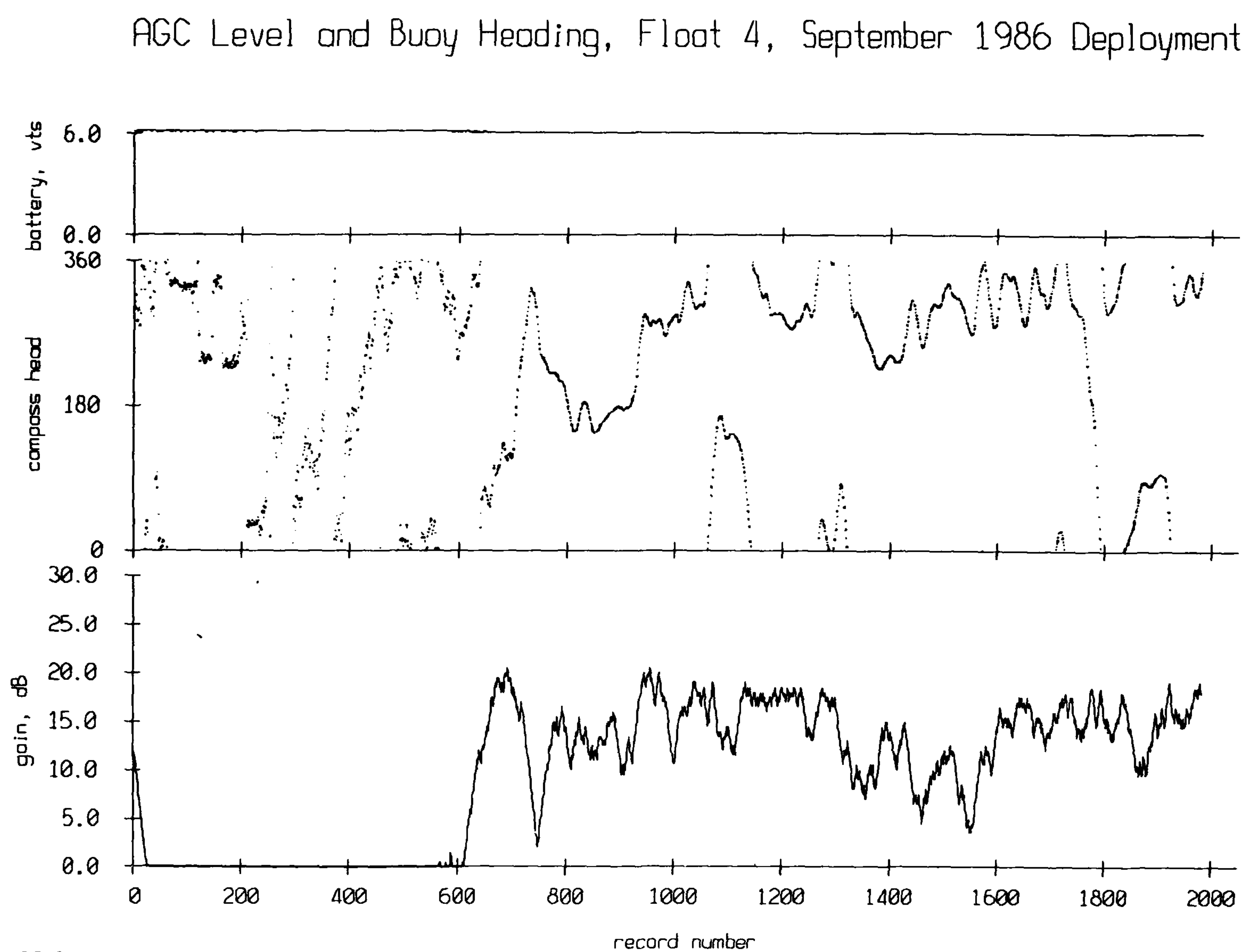

AGC Level and Buoy Heading, Float 4, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.6.

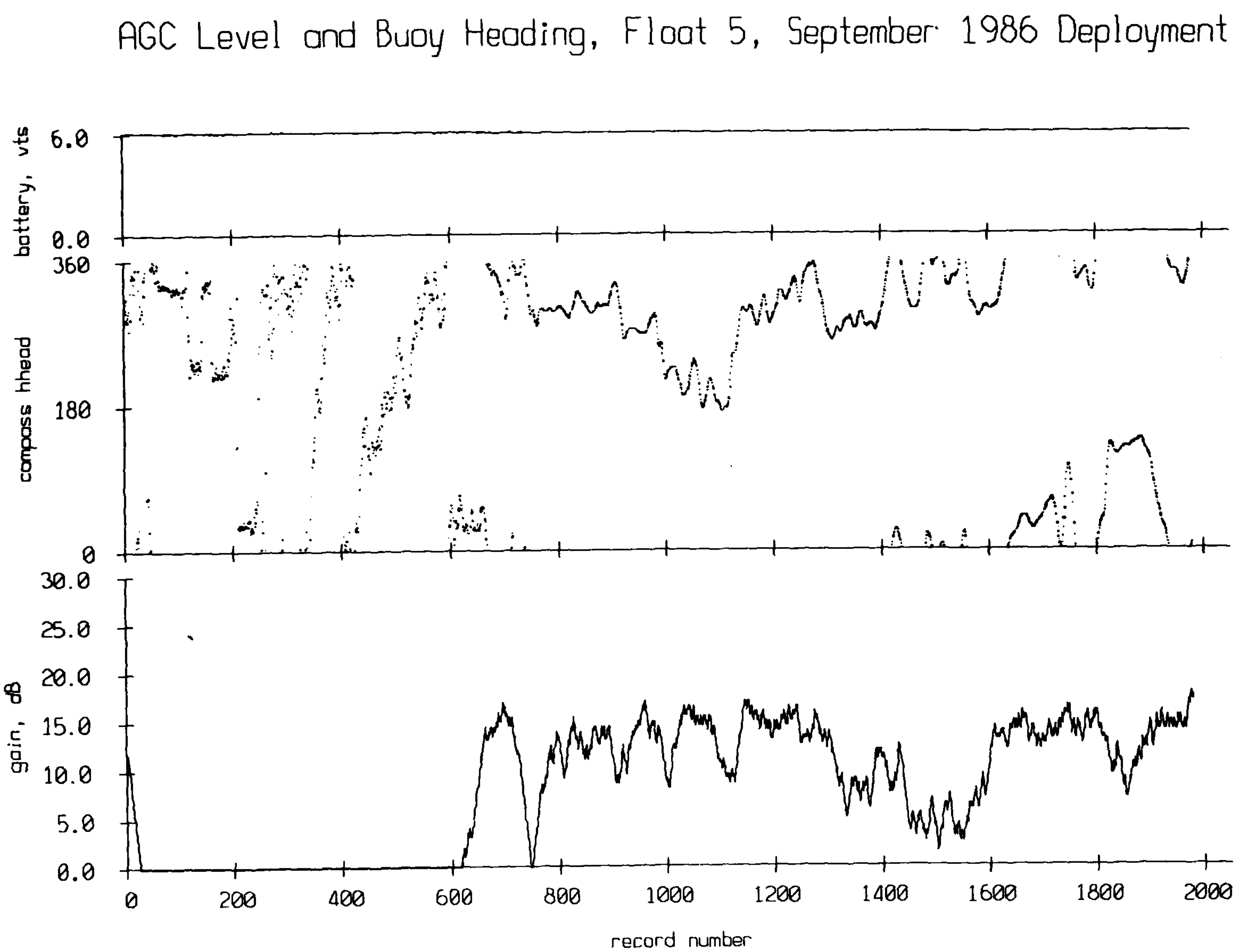

AGC Level and Buoy Heading, Float 5, September 1986 Deployment
battery, vts
6.0
0.0
compass hhead
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.7.

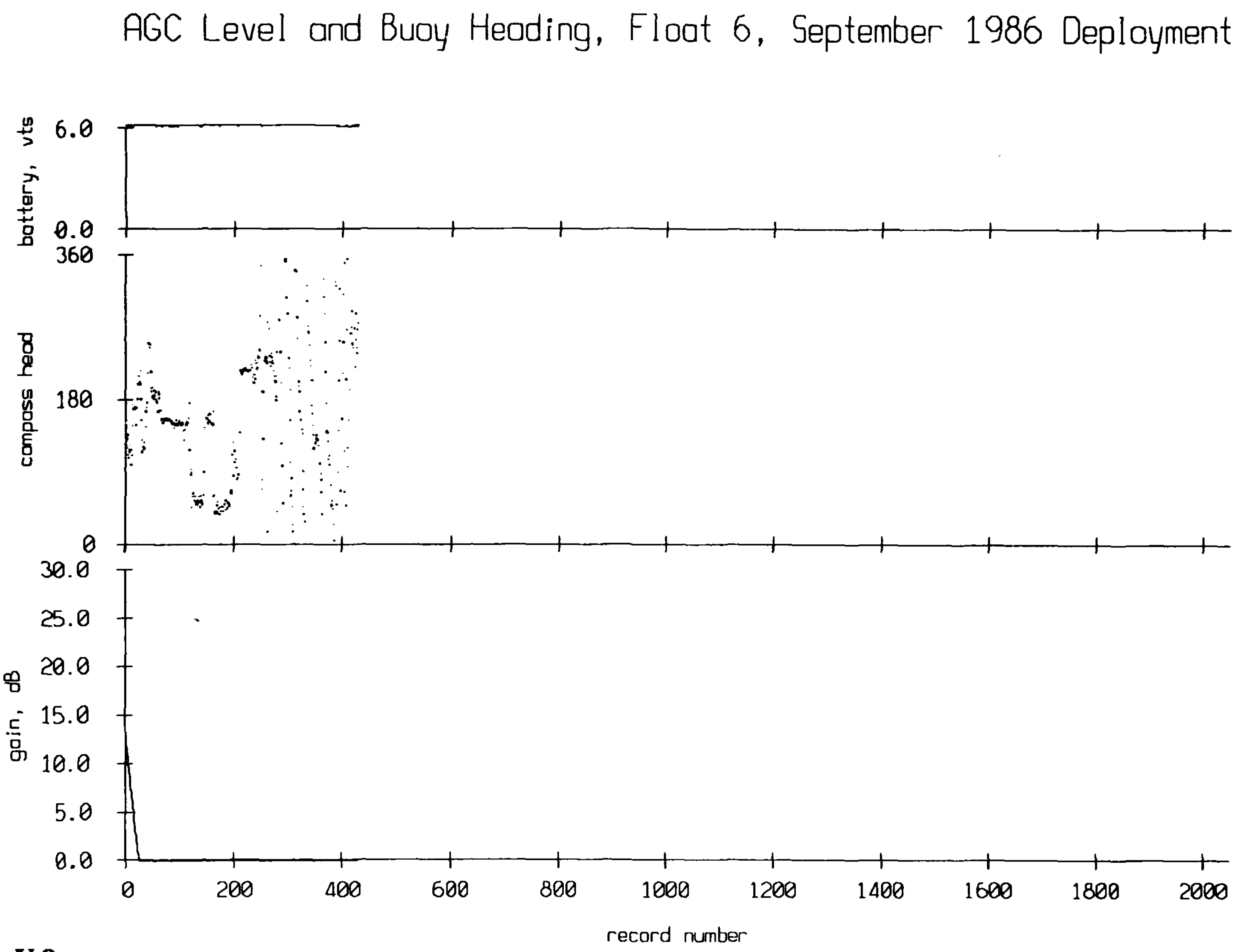

AGC Level and Buoy Heading, Float 6, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.8.

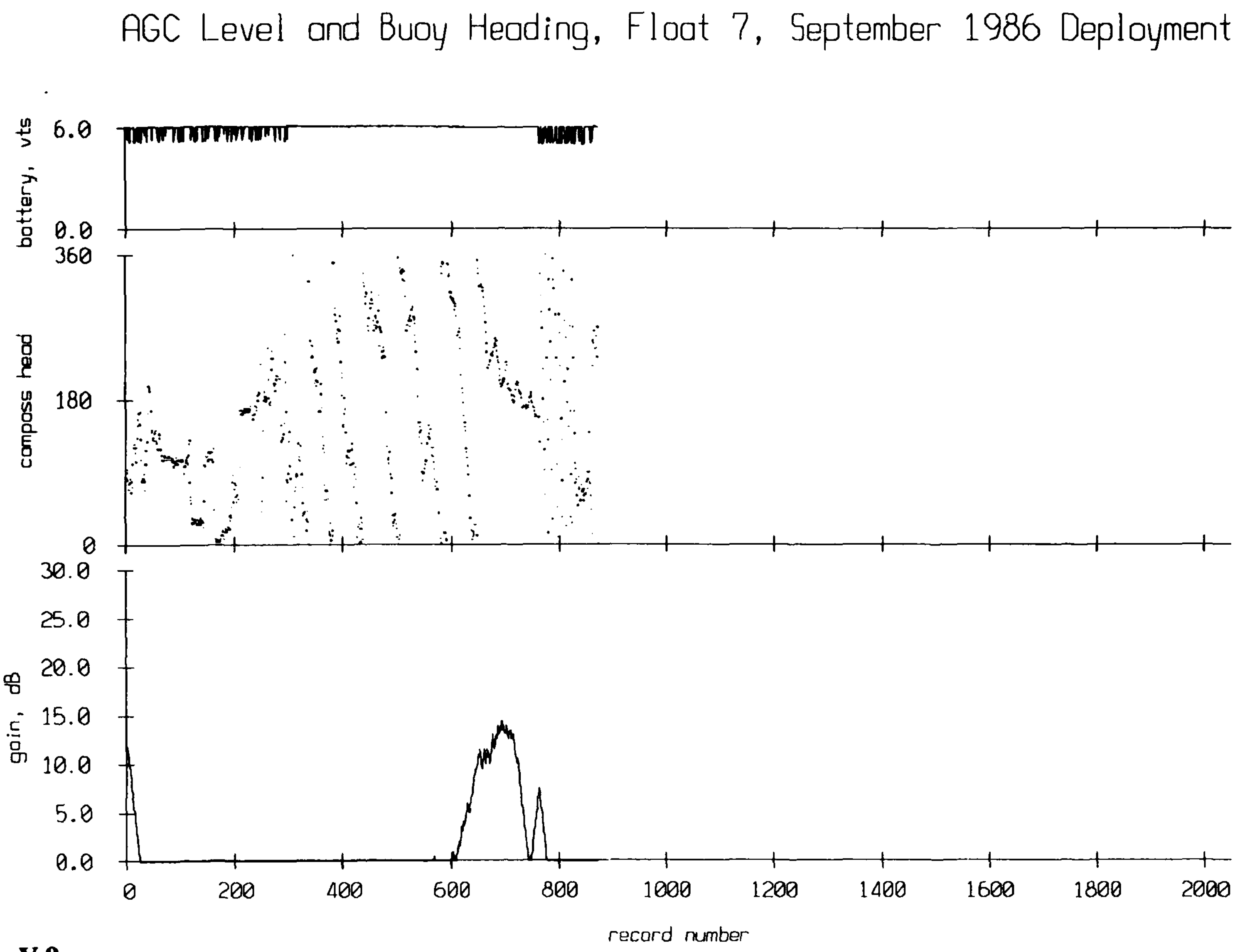

AGC Level and Buoy Heading, Float 7, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.9.

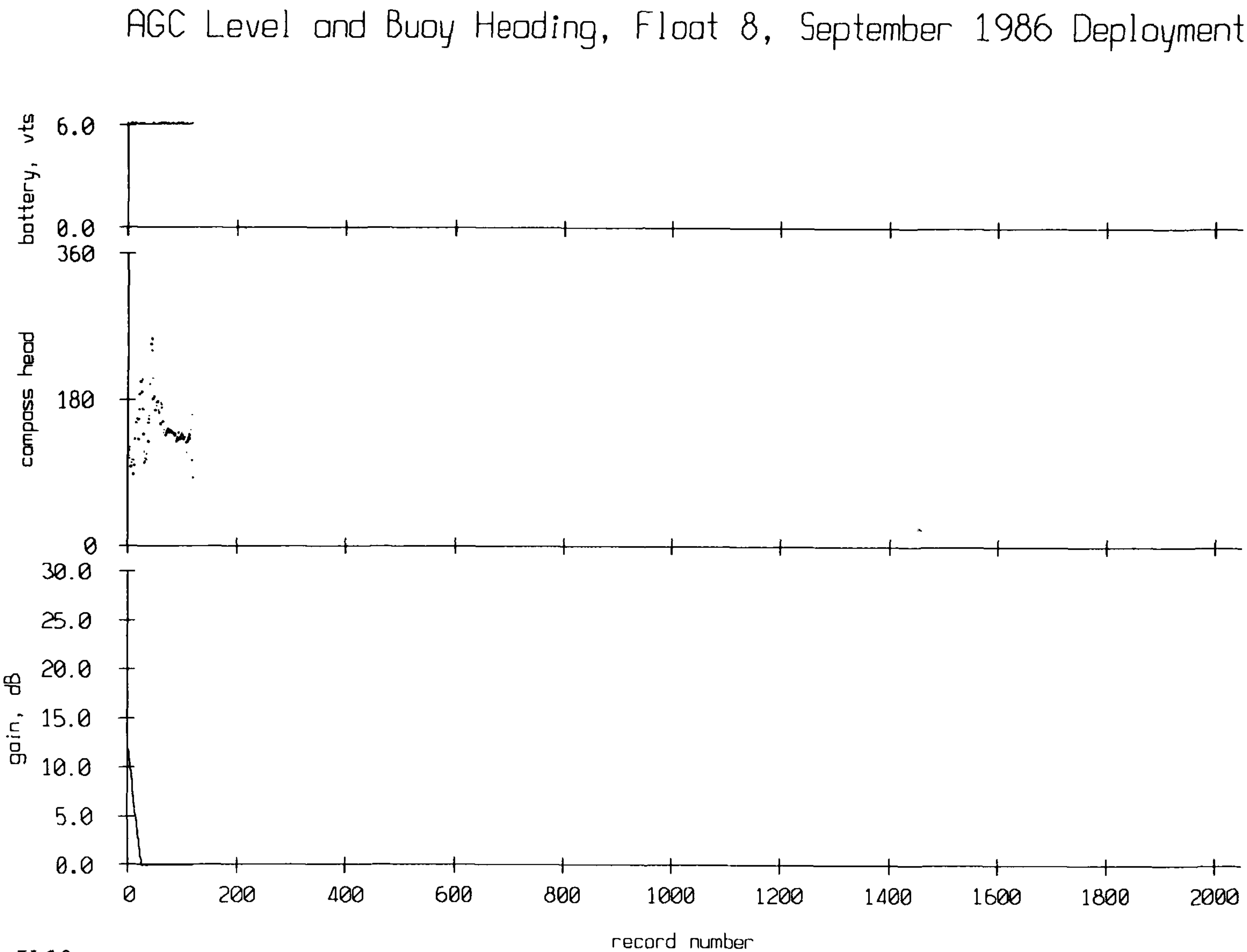

AGC Level and Buoy Heading, Float 8, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.10.

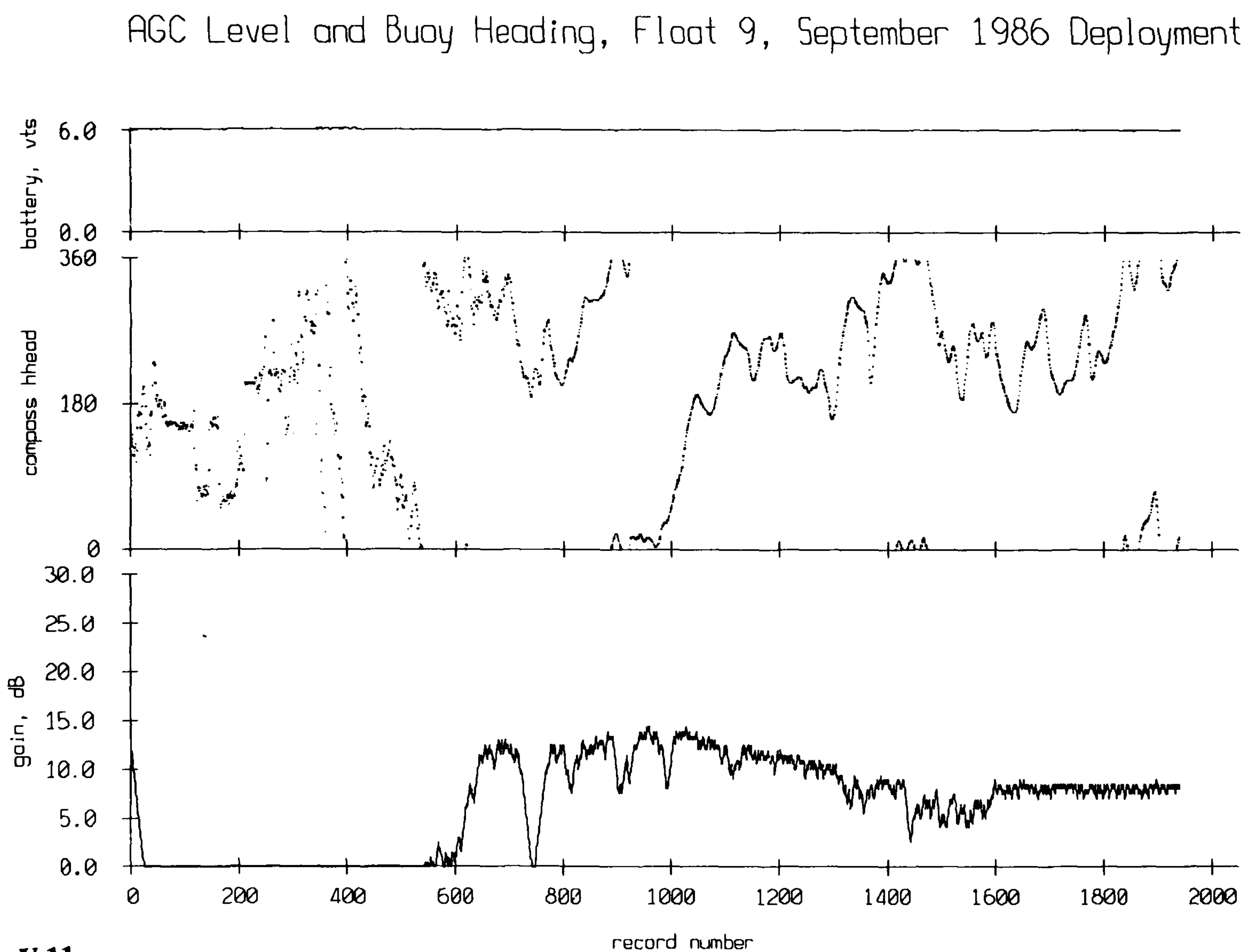

AGC Level and Buoy Heading, Float 9, September 1986 Deployment
battery, vts
6.0
0.0
compass hhead
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.11.

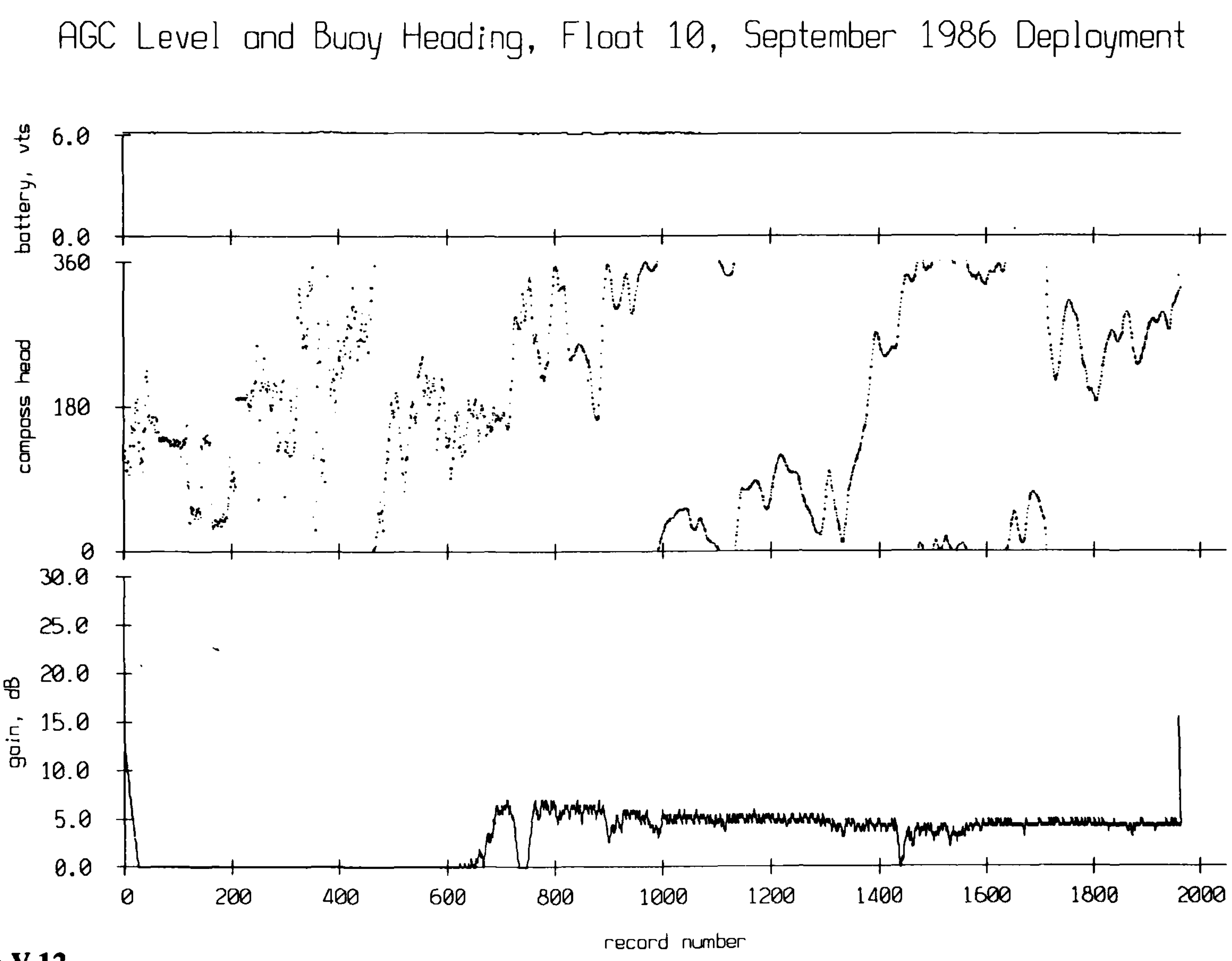

AGC Level and Buoy Heading, Float 10, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.12.

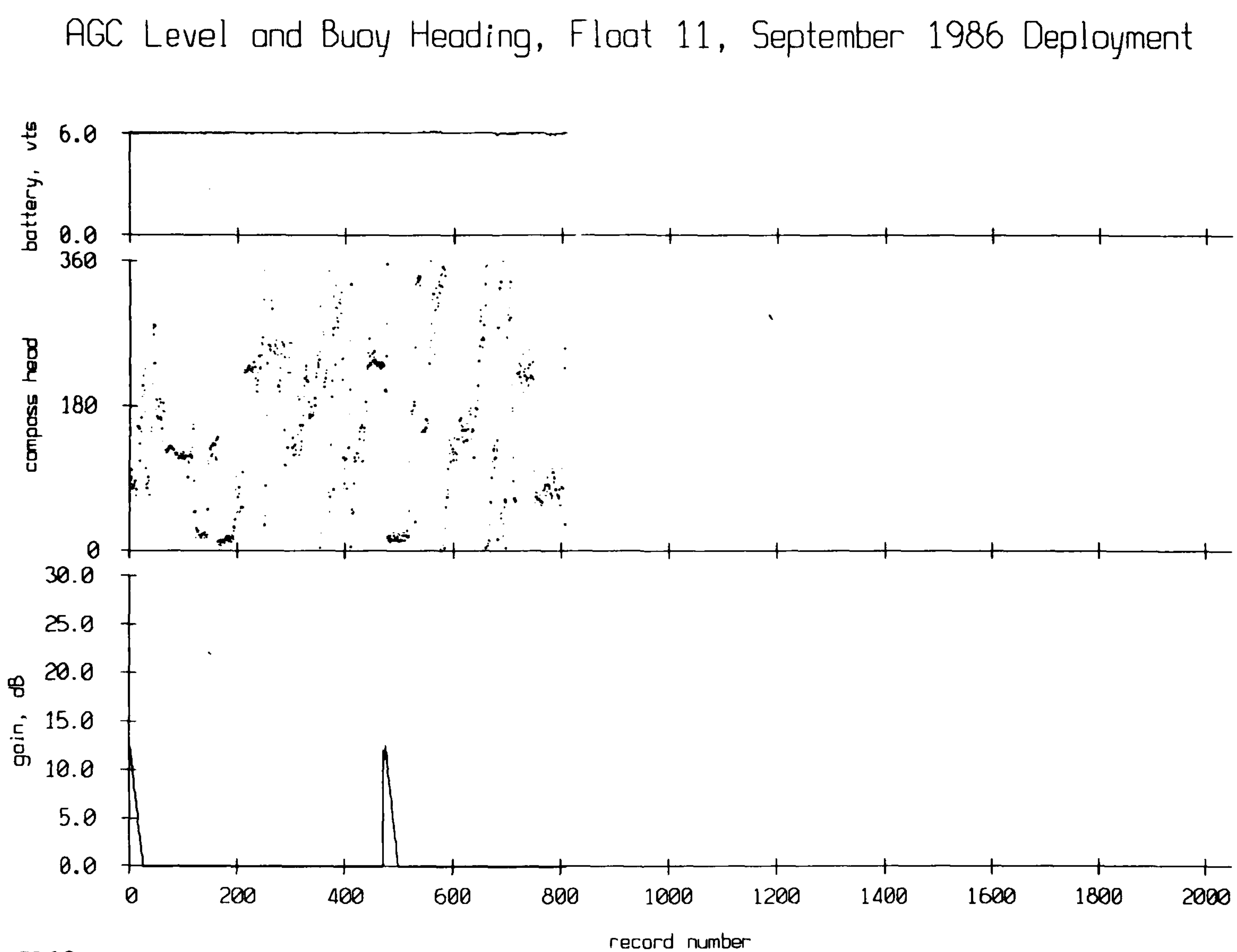
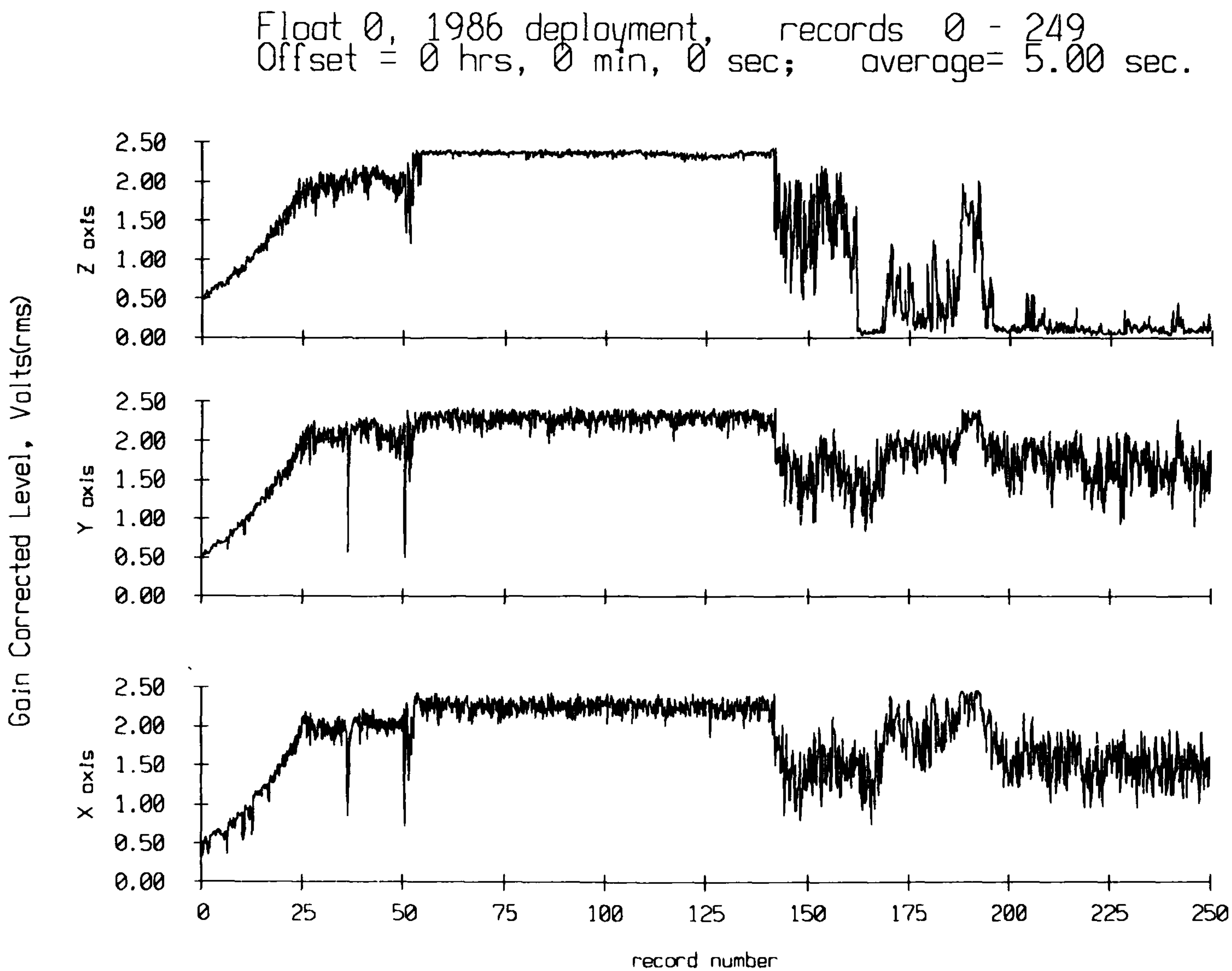

AGC Level and Buoy Heading, Float 11, September 1986 Deployment
battery, vts
6.0
0.0
compass head
360
180
0
gain, dB
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
record number

Figure V.13.



Float 0, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.1a.

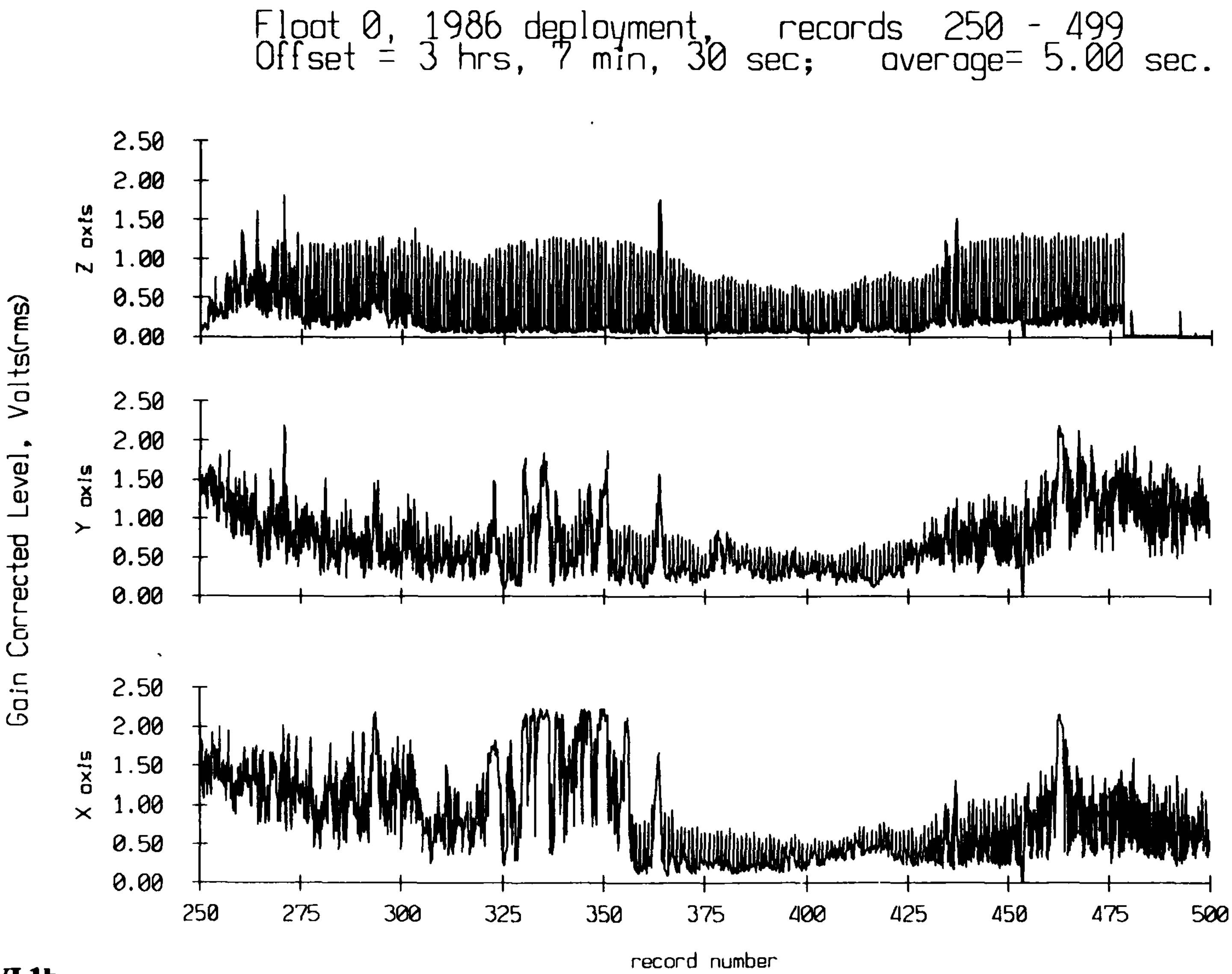

Float 0, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.1b.

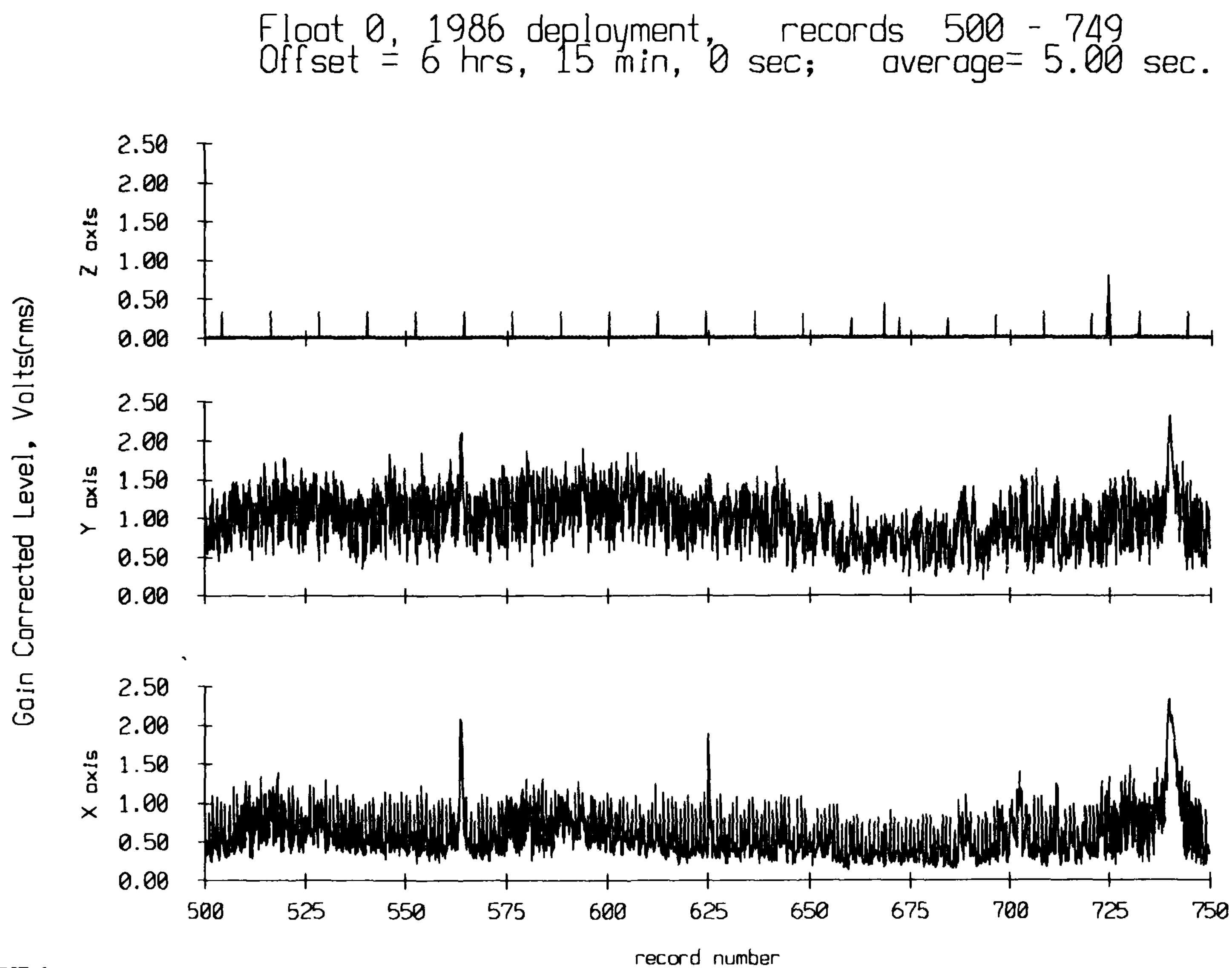
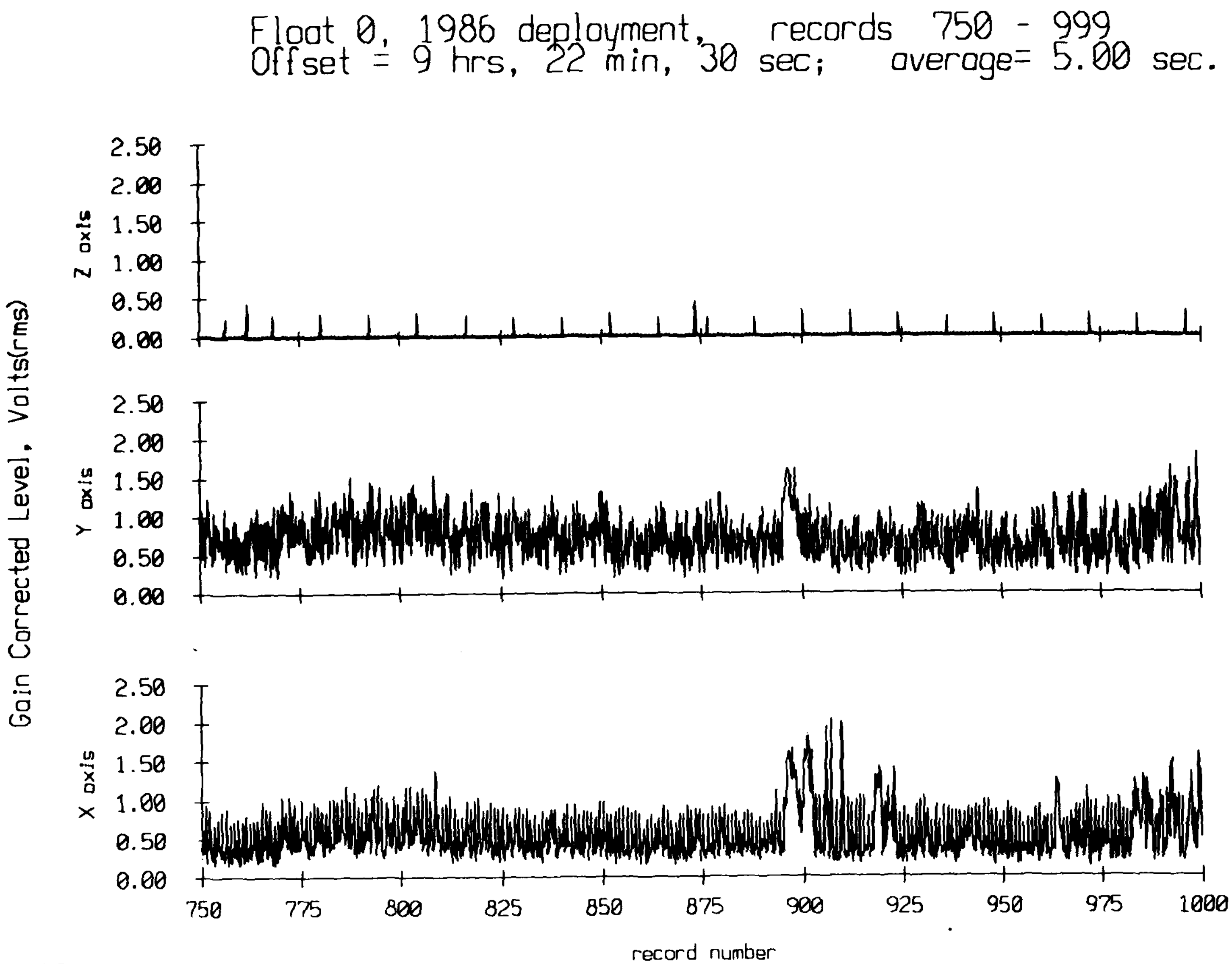

Float 0, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.1c.



Float 0, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.1d.

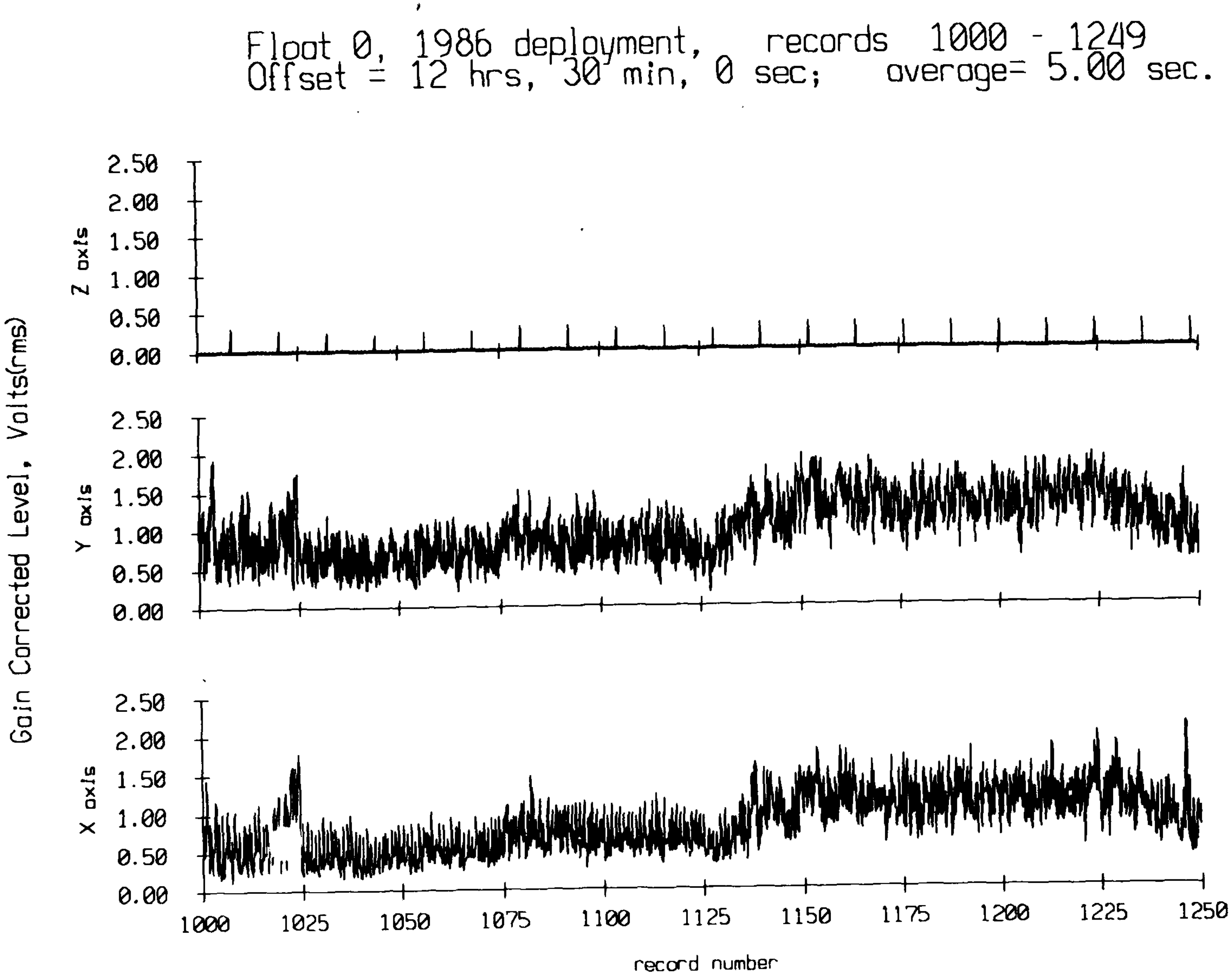

Float 0, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.1e.

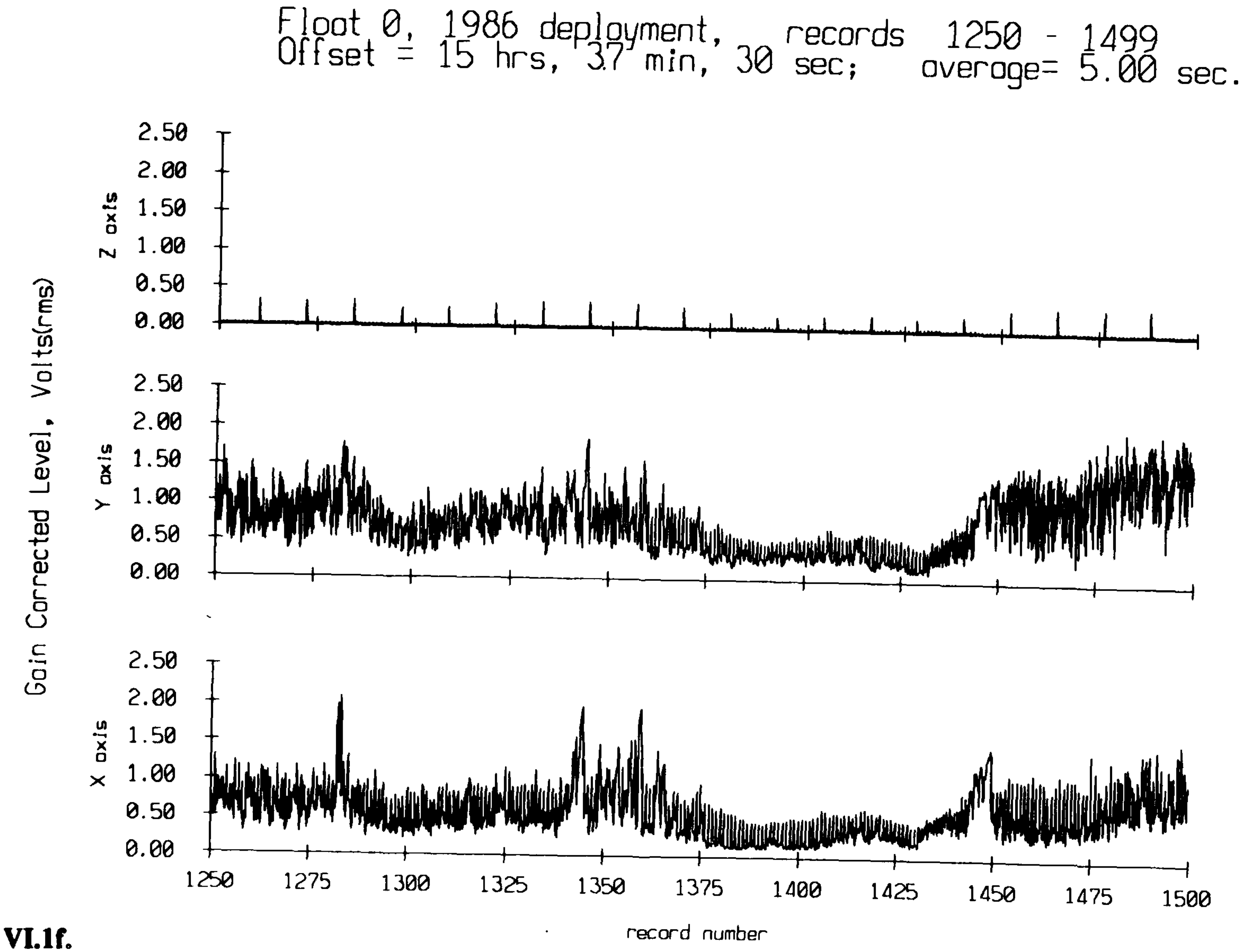

Float 0, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.1f.

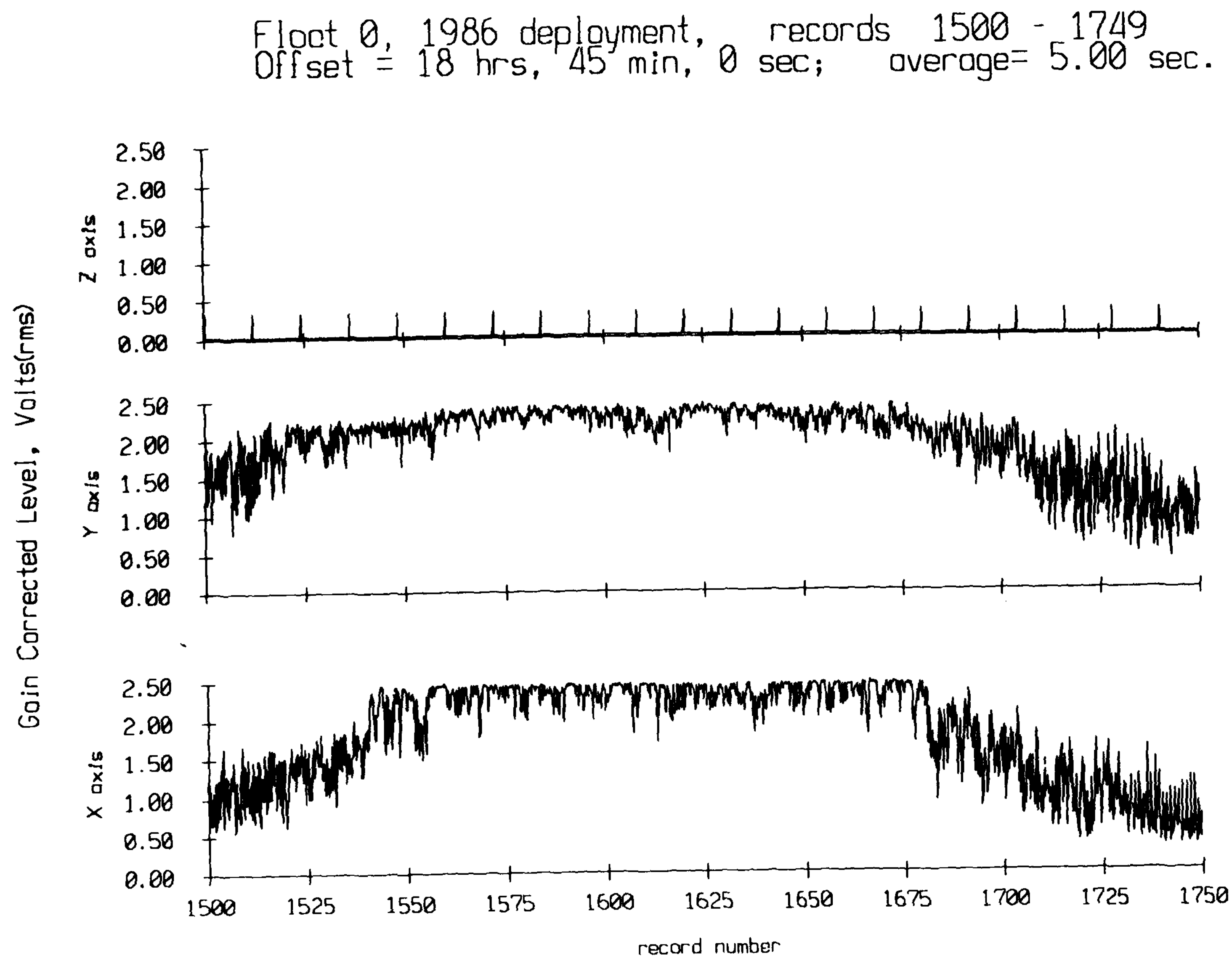

Float 0, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.1g.

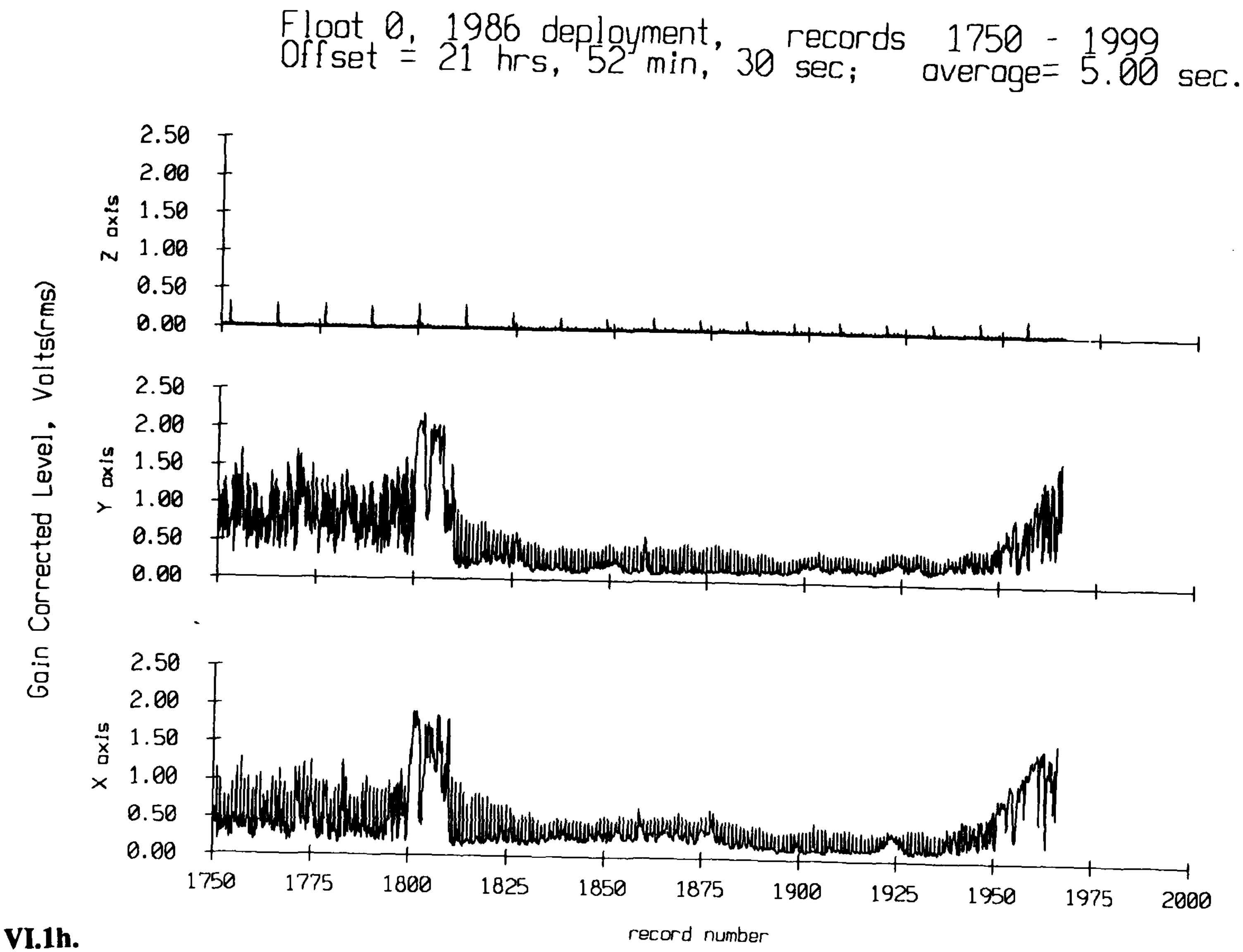

Float 0, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.1h.

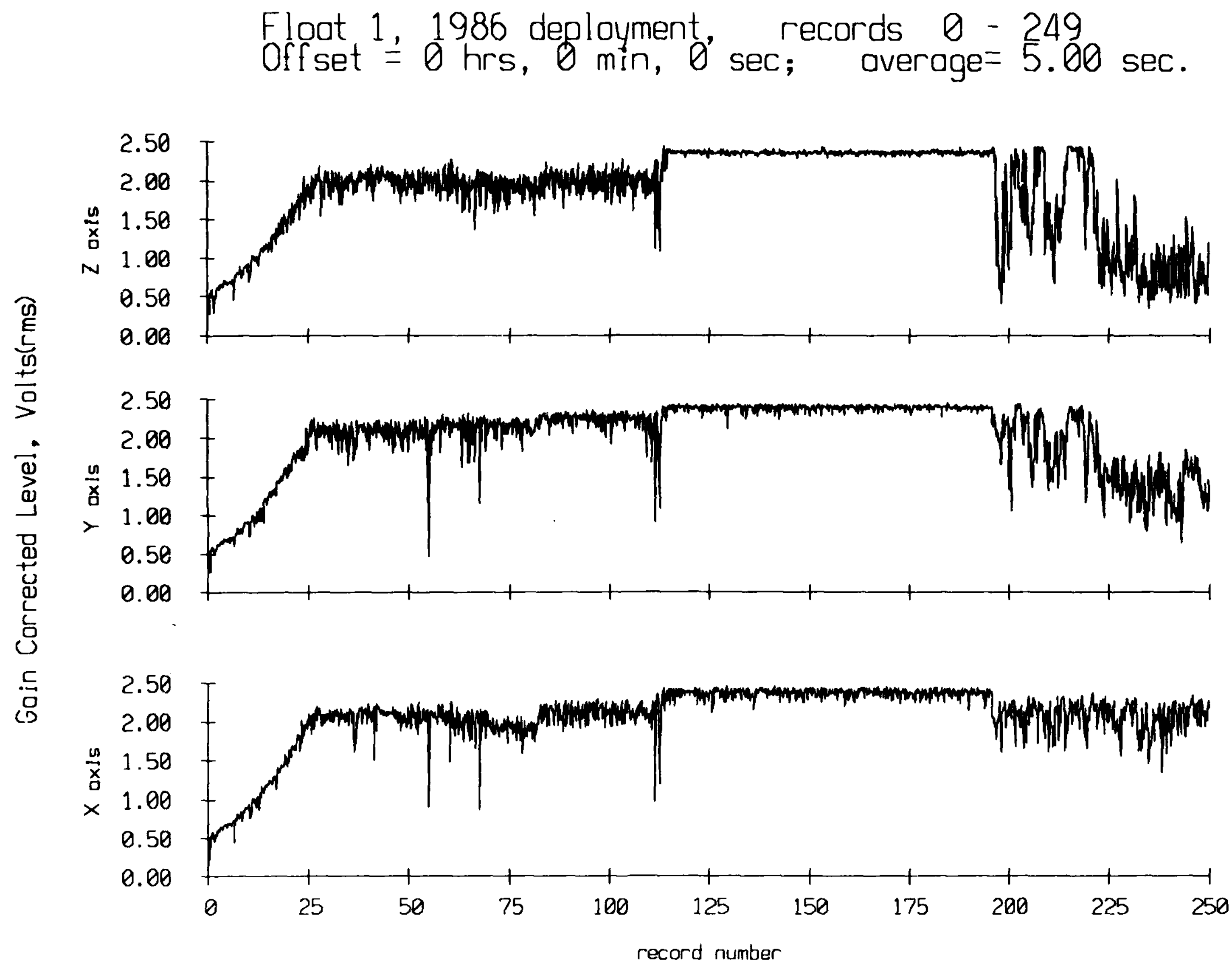

Float 1, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.2a.

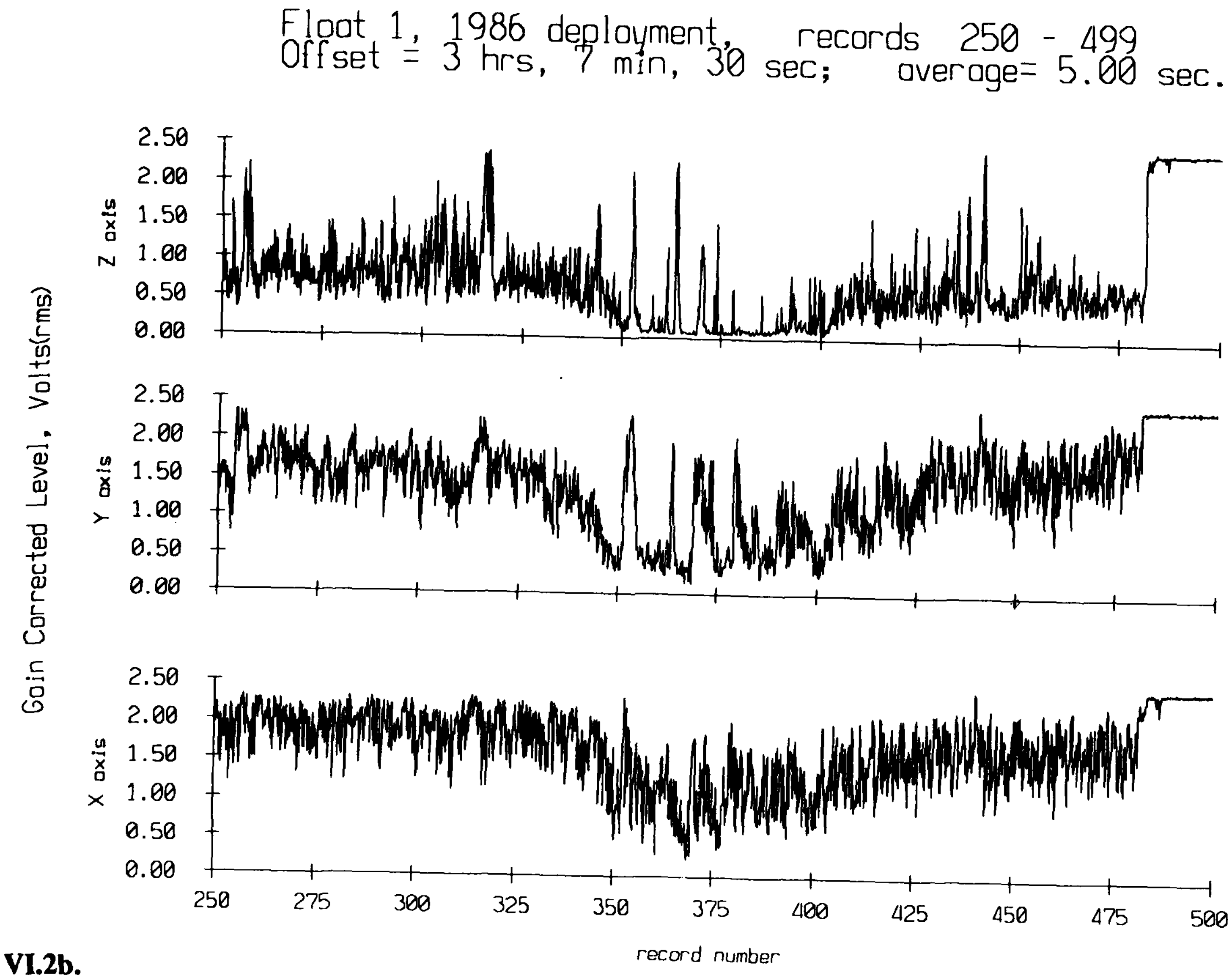

Float 1, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.2b.

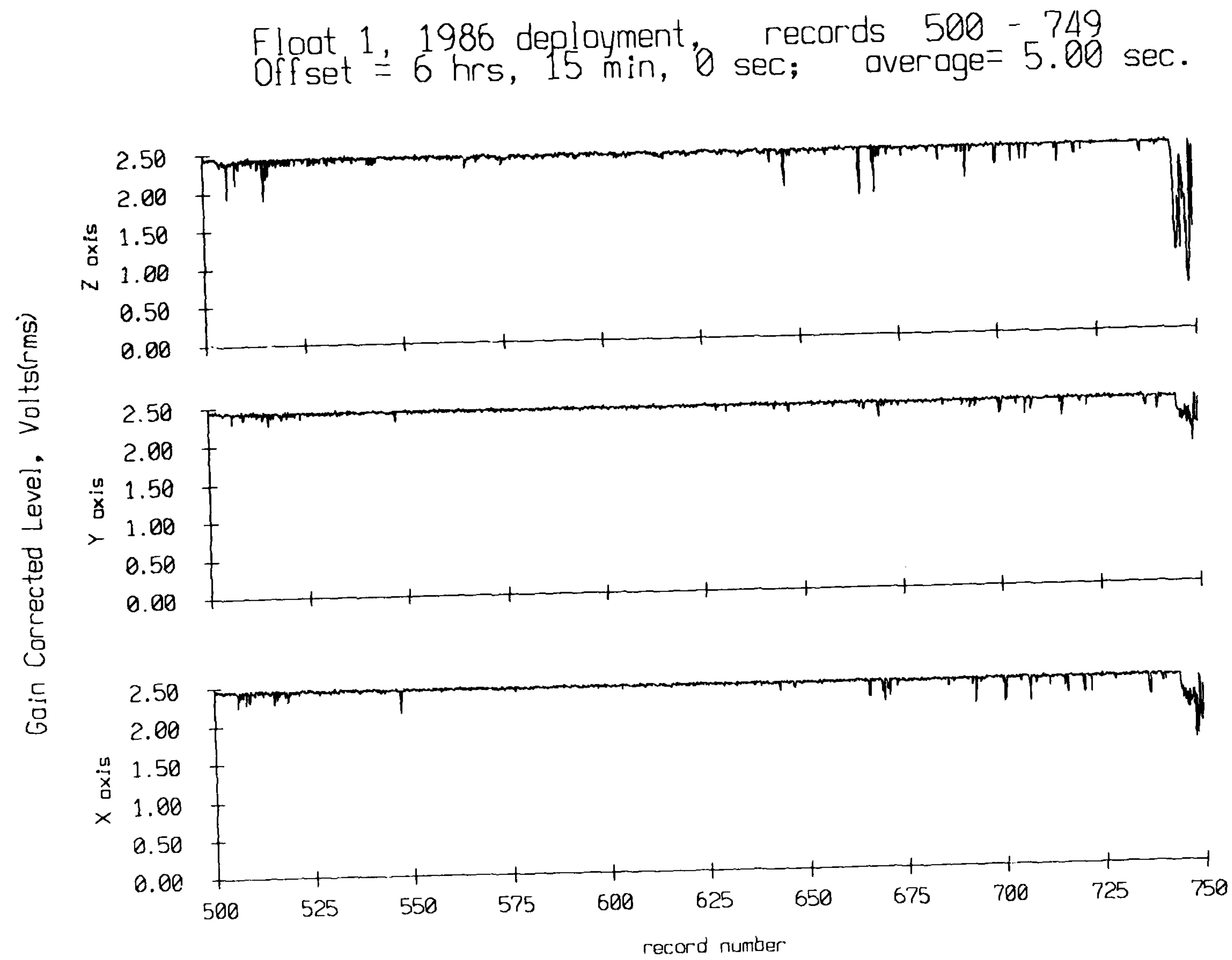

Float 1, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.2c.

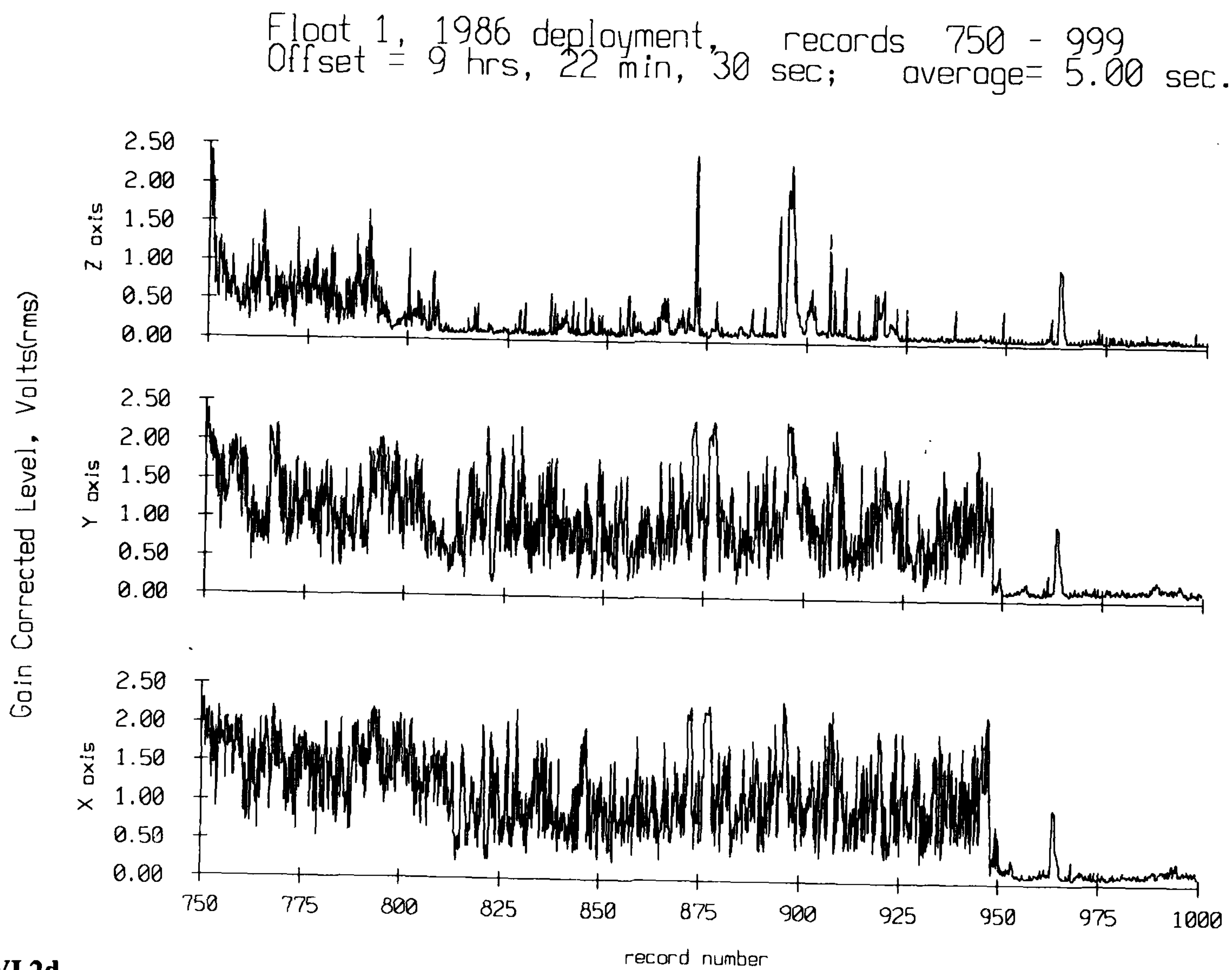

Float 1, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.2d.

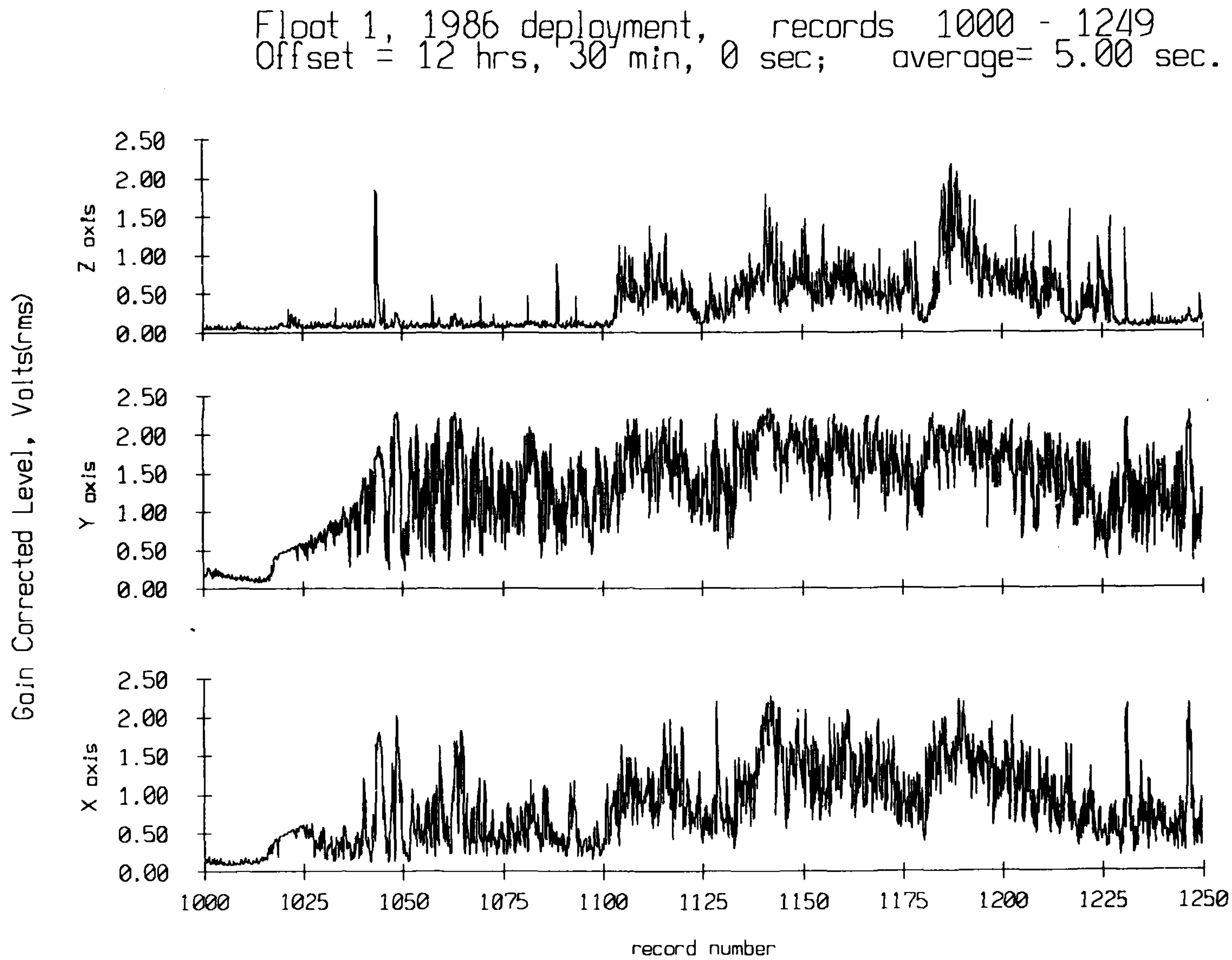
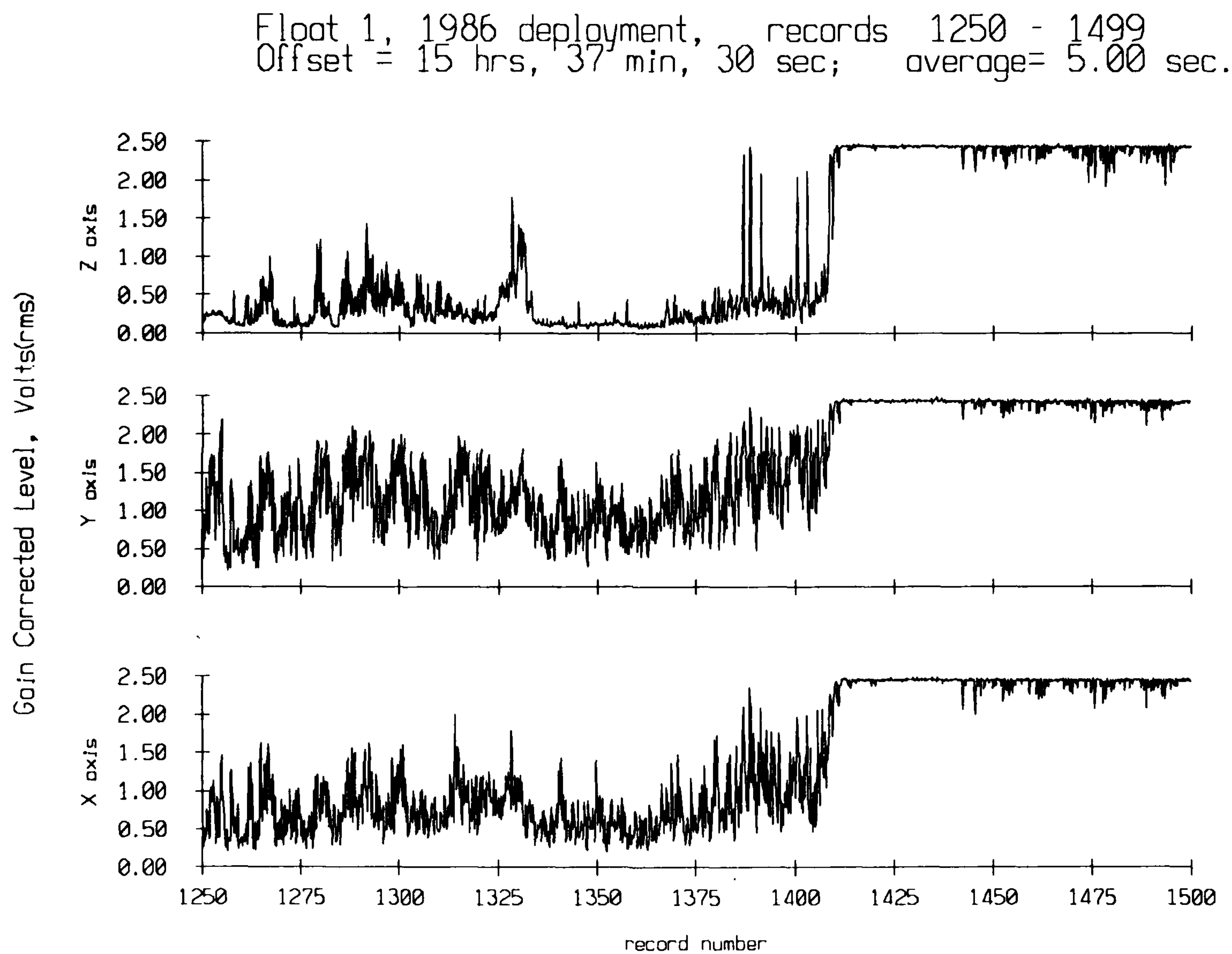

Float 1, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.2e.



Float 1, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.2f.

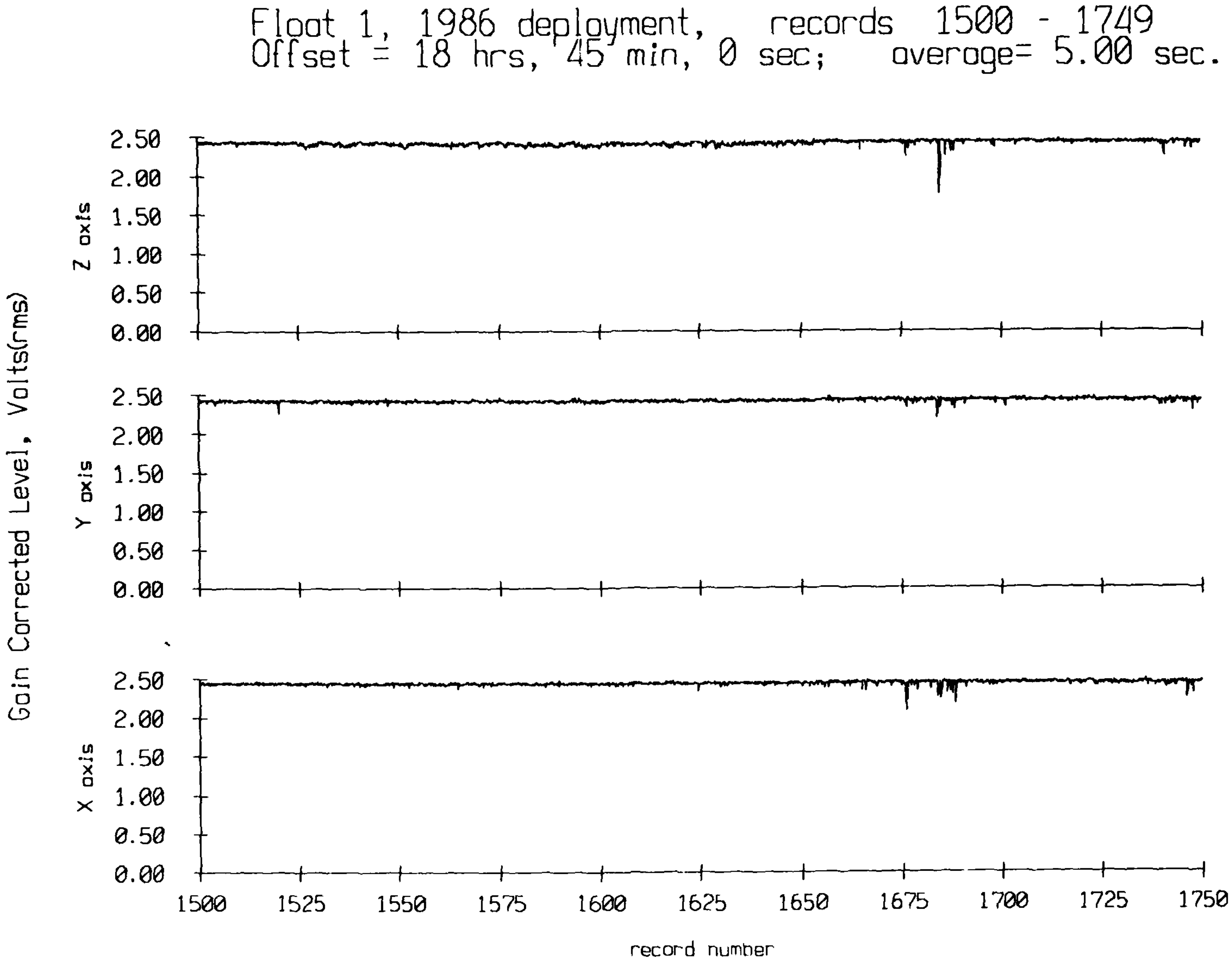

Float 1, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.2g.

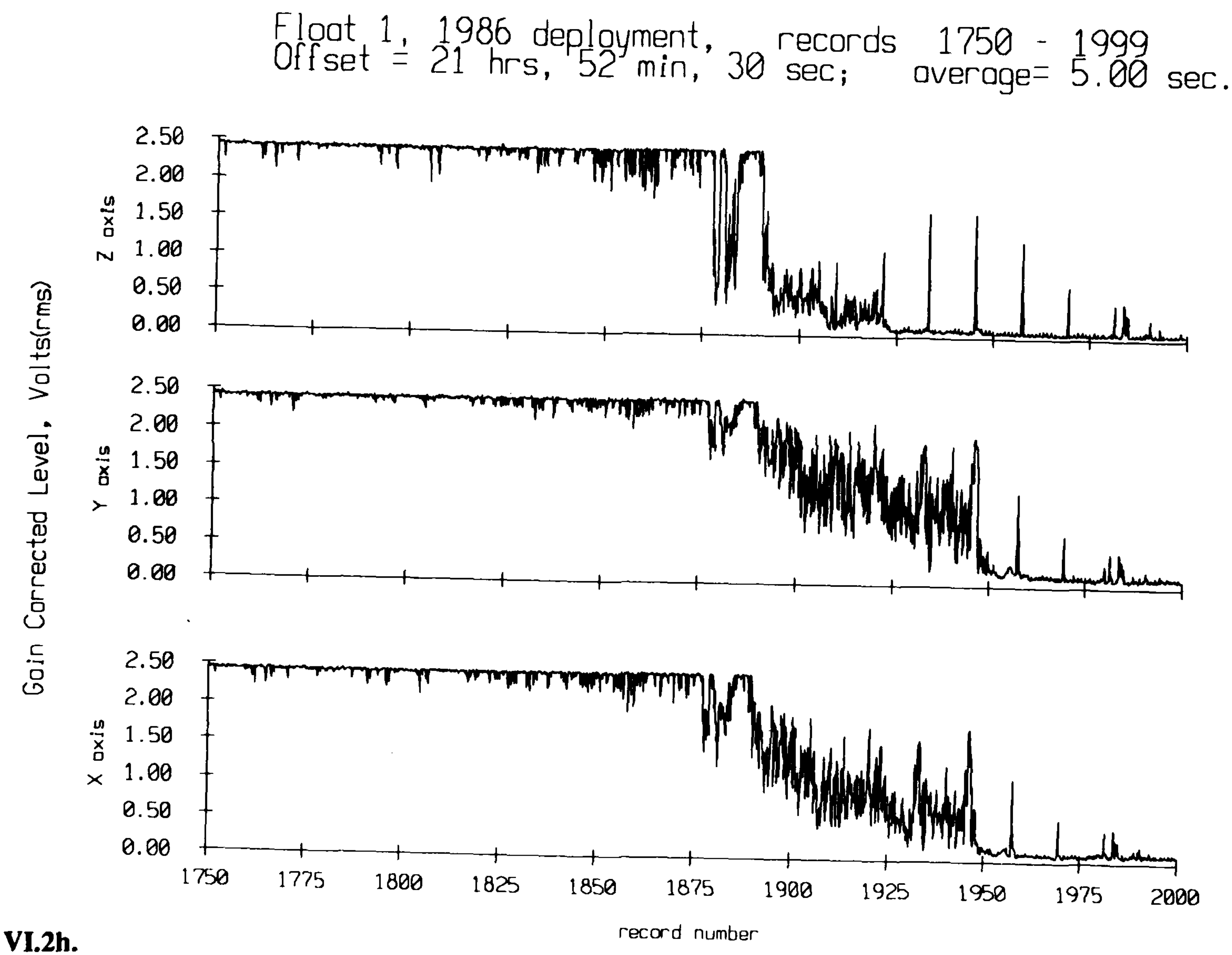

Float 1, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.2h.

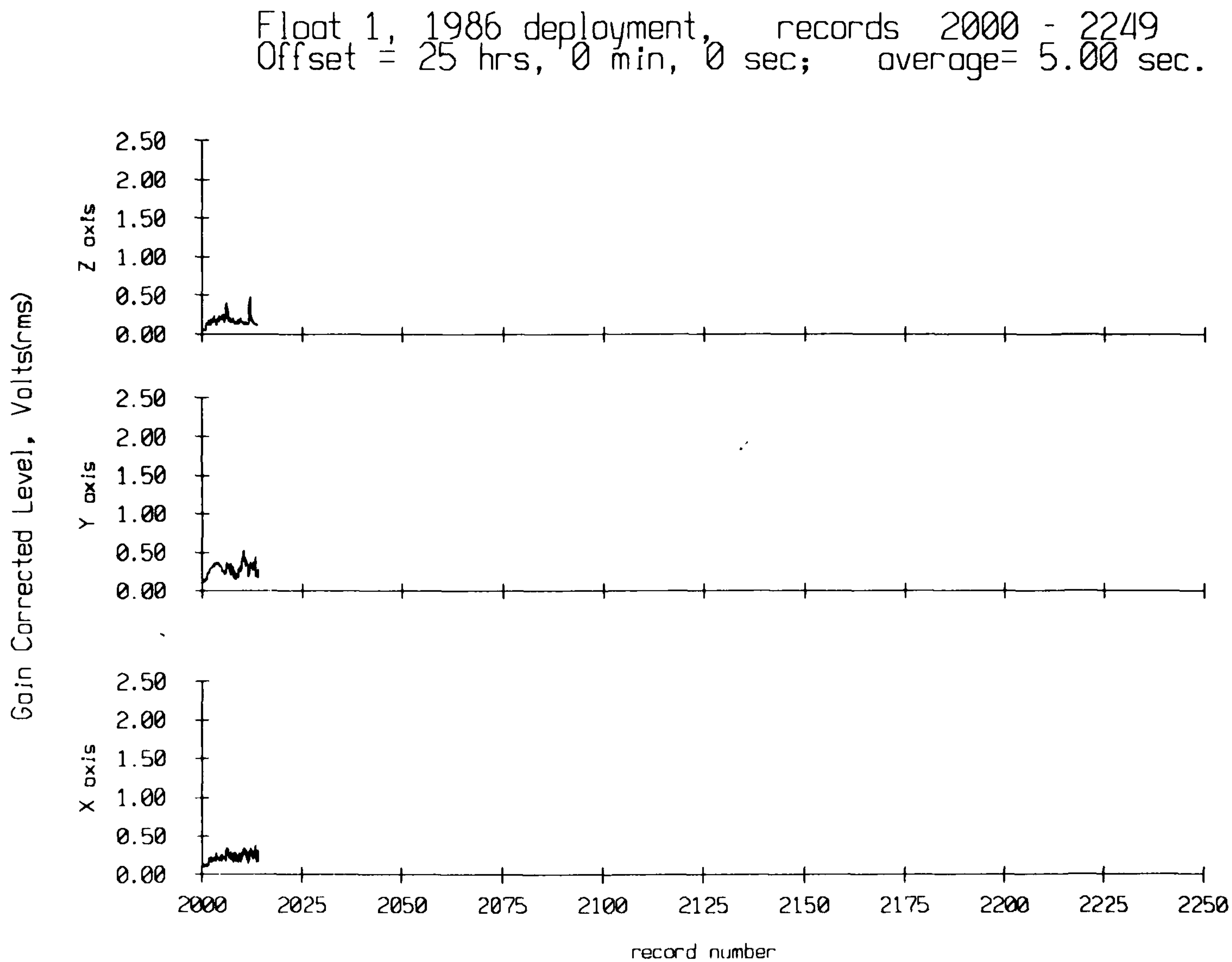
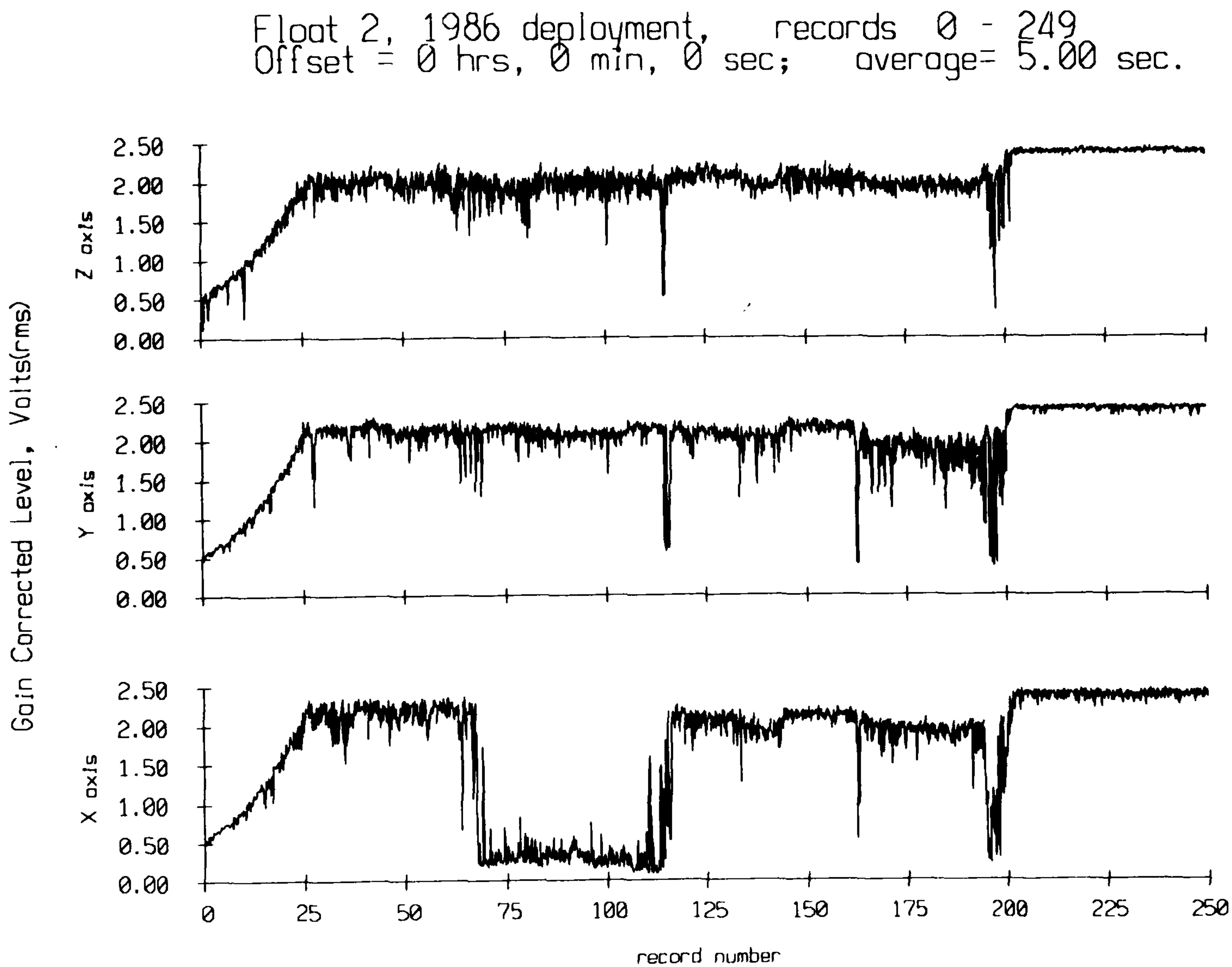

Float 1, 1986 deployment, records 2000 - 2249
Offset = 25 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
2000
2025
2050
2075
2100
2125
2150
2175
2200
2225
2250
record number

Figure VI.2i.



Float 2, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.3a.

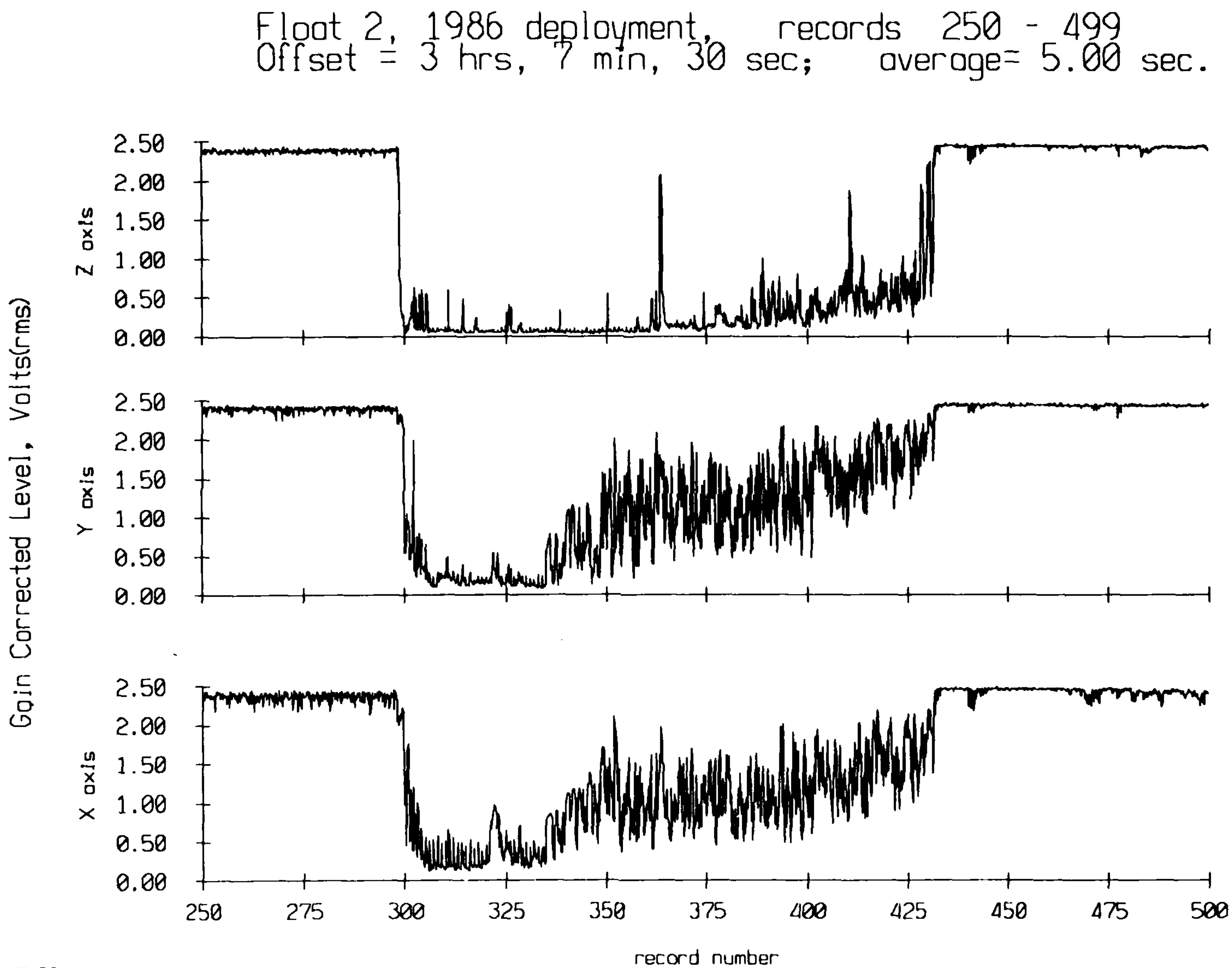
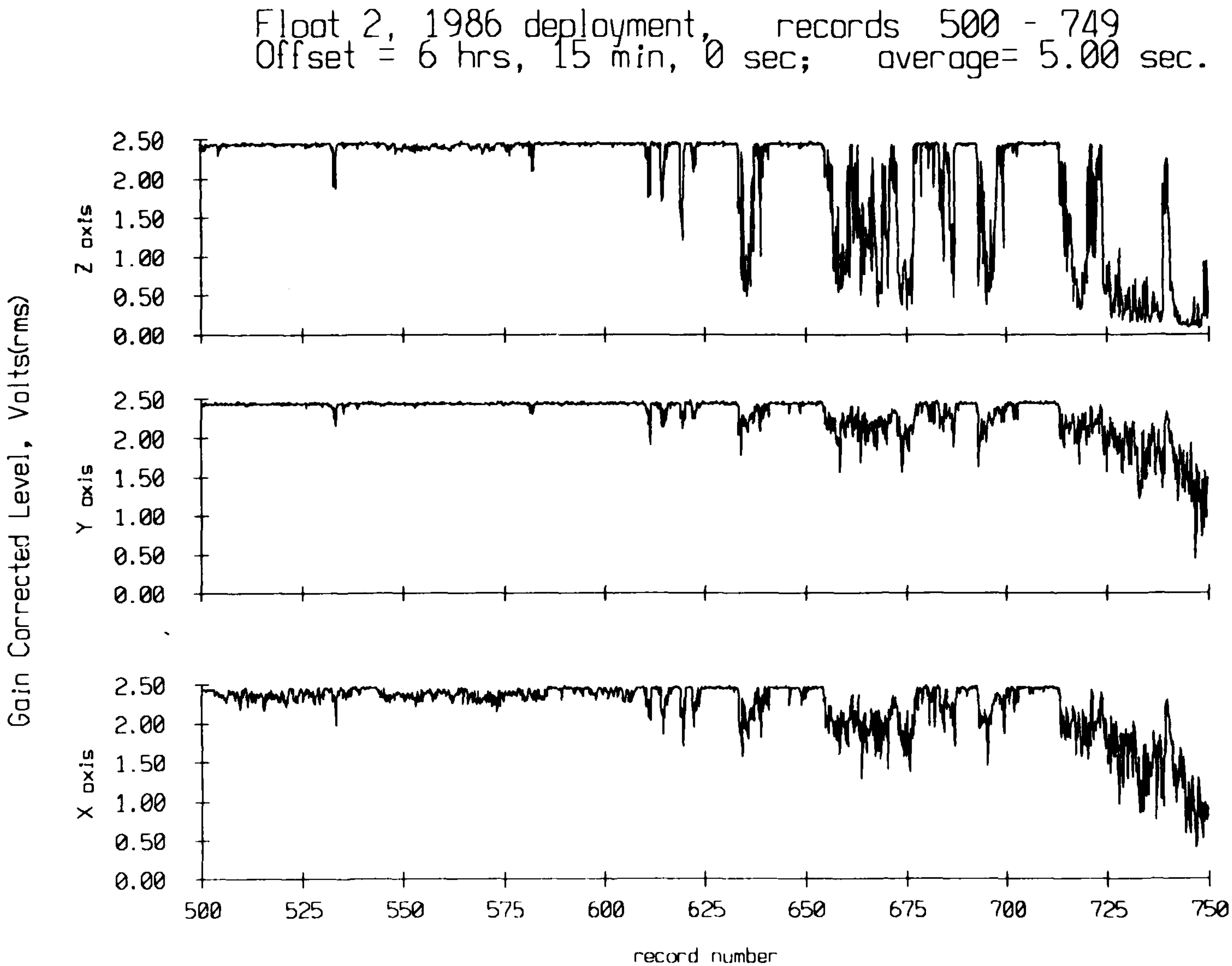
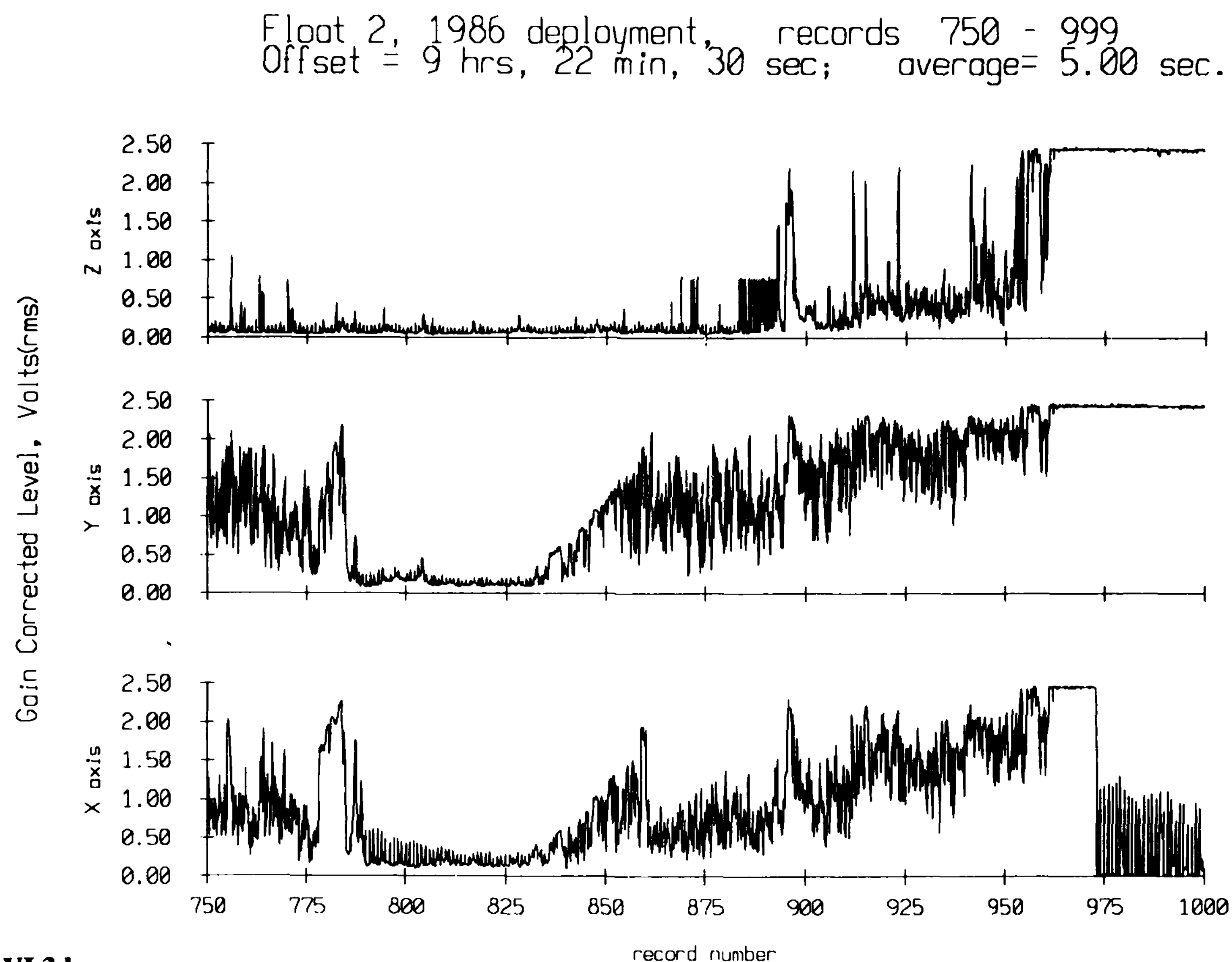

Float 2, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.3b.



Float 2, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.3c.



Float 2, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.3d.

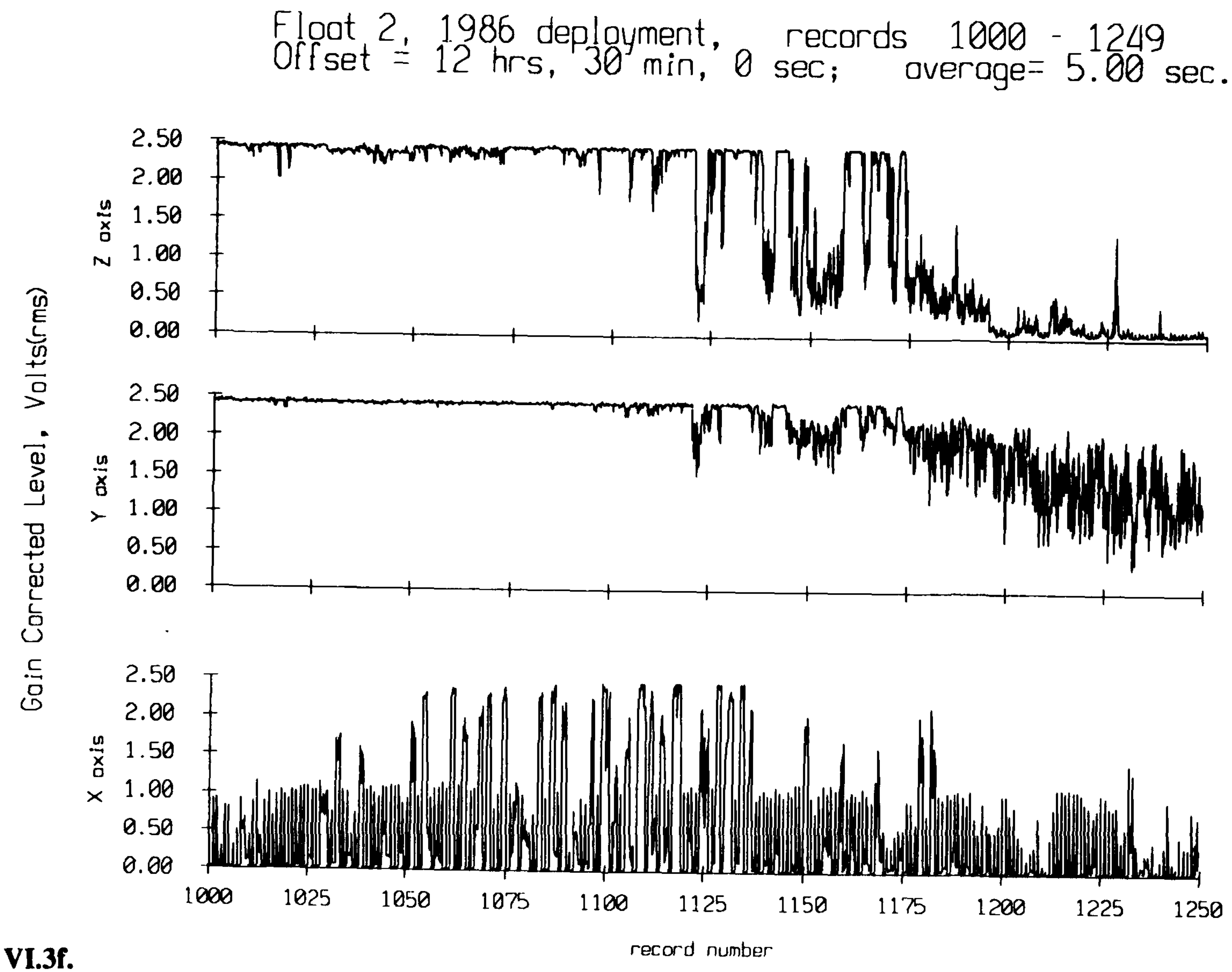
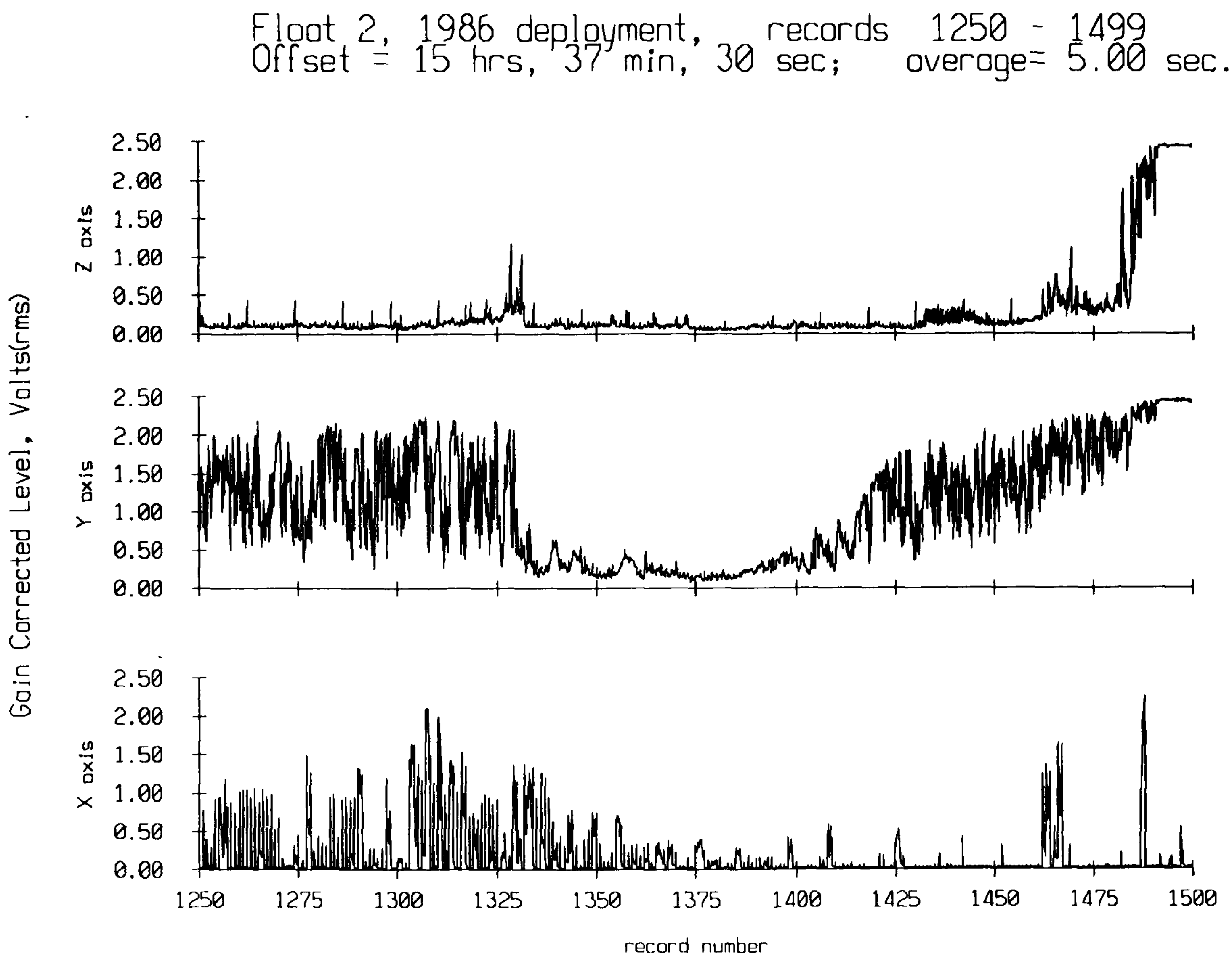

Float 2, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.3f.



Float 2, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.3g.

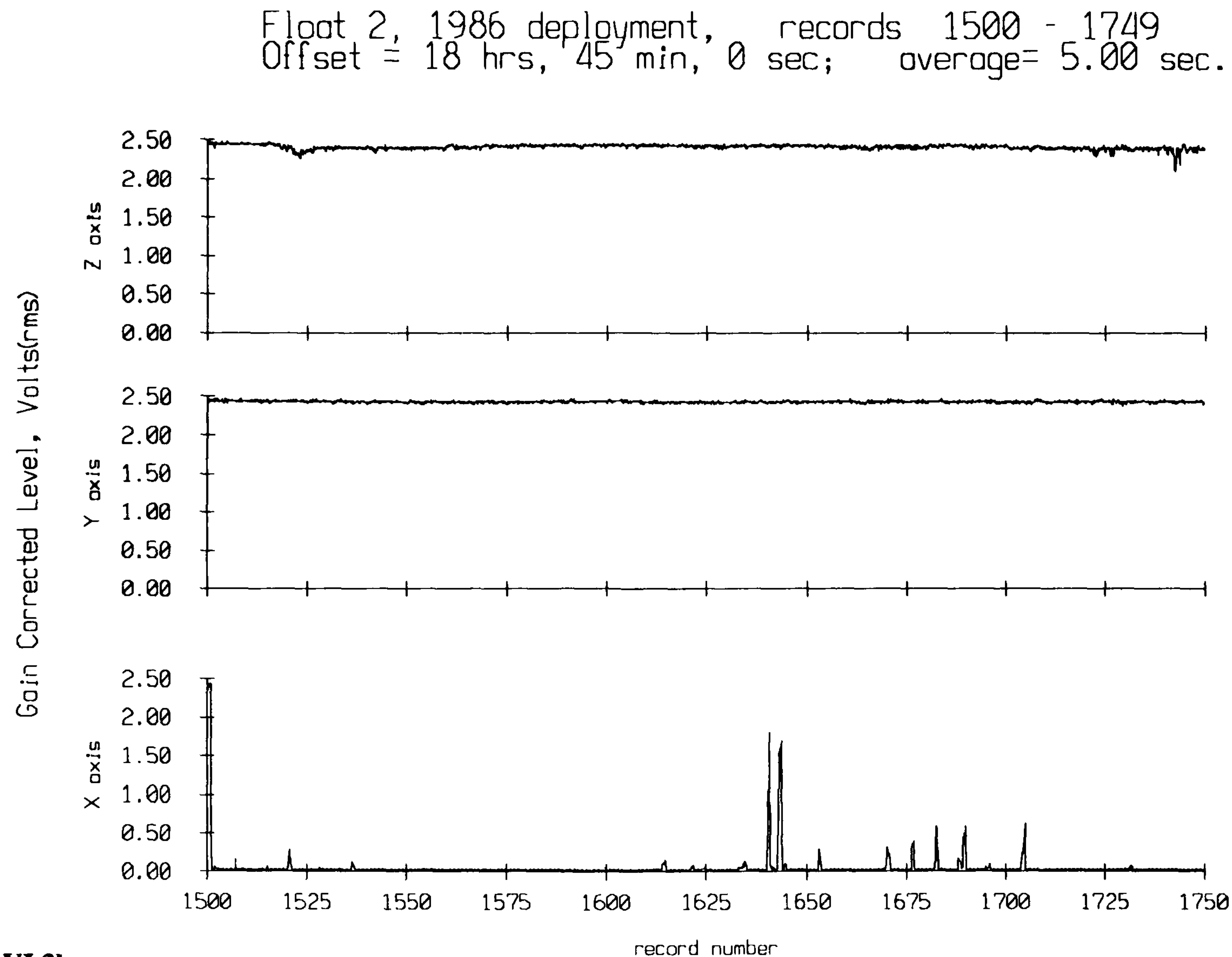

Float 2, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.3h.

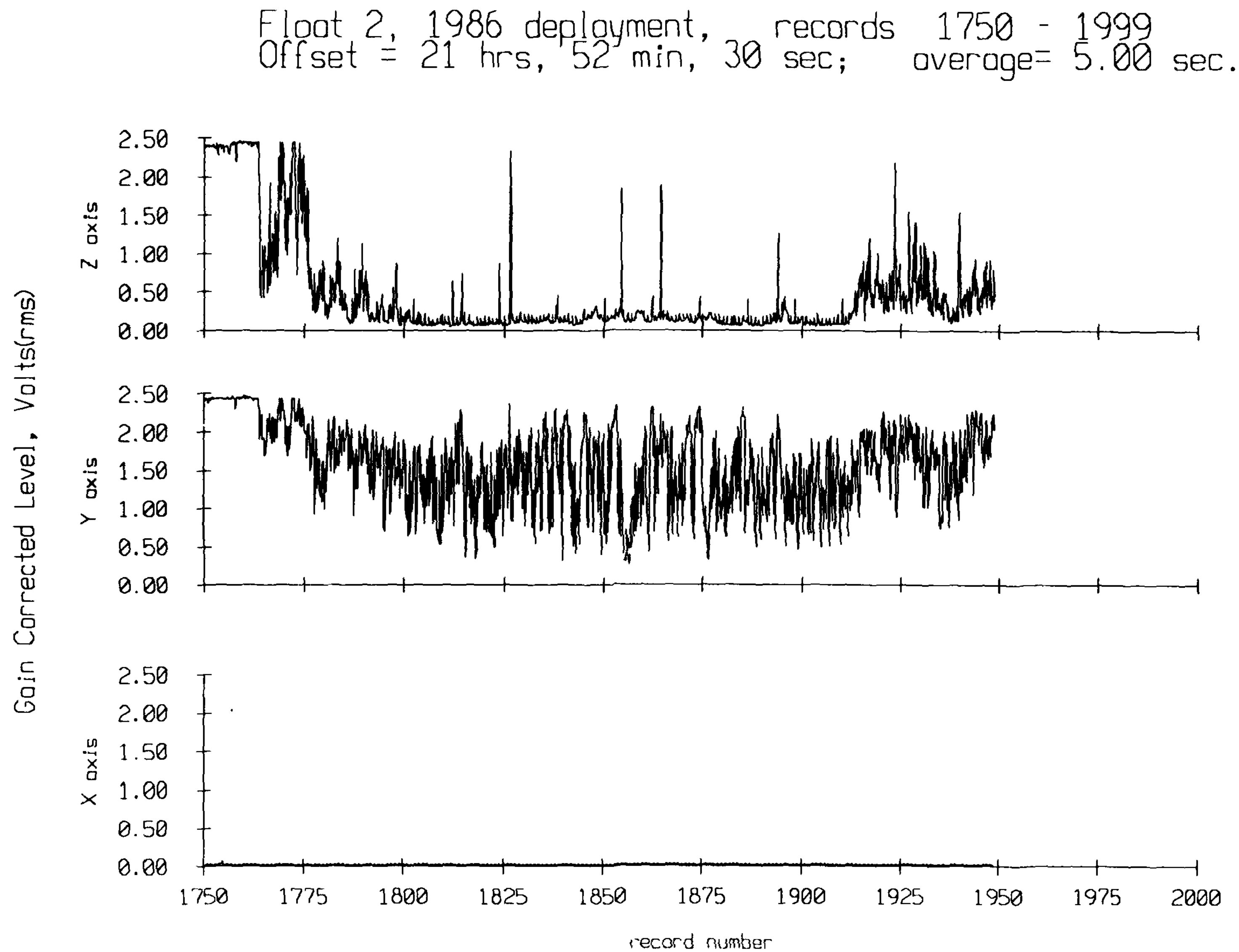

Float 2, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.3i.

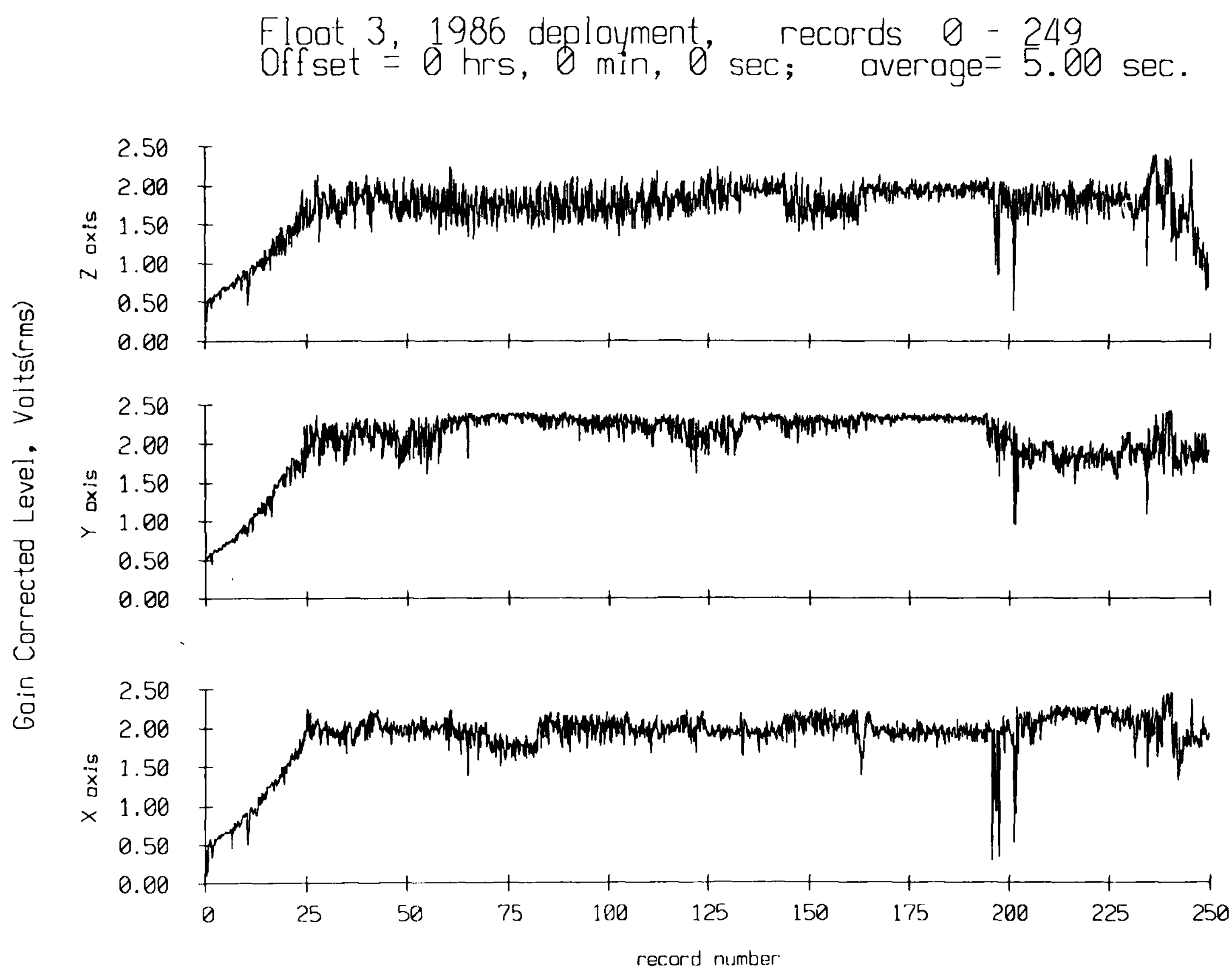
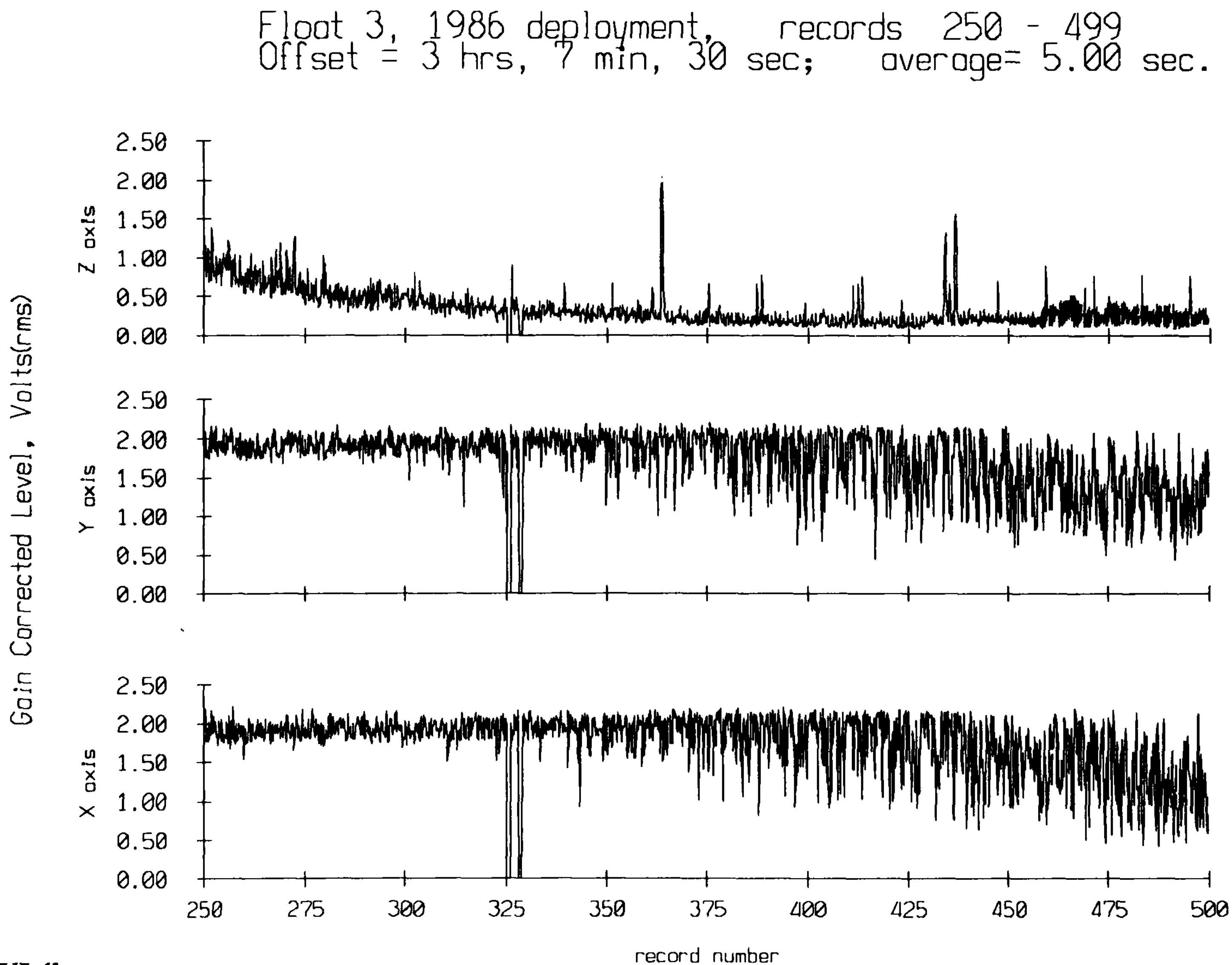
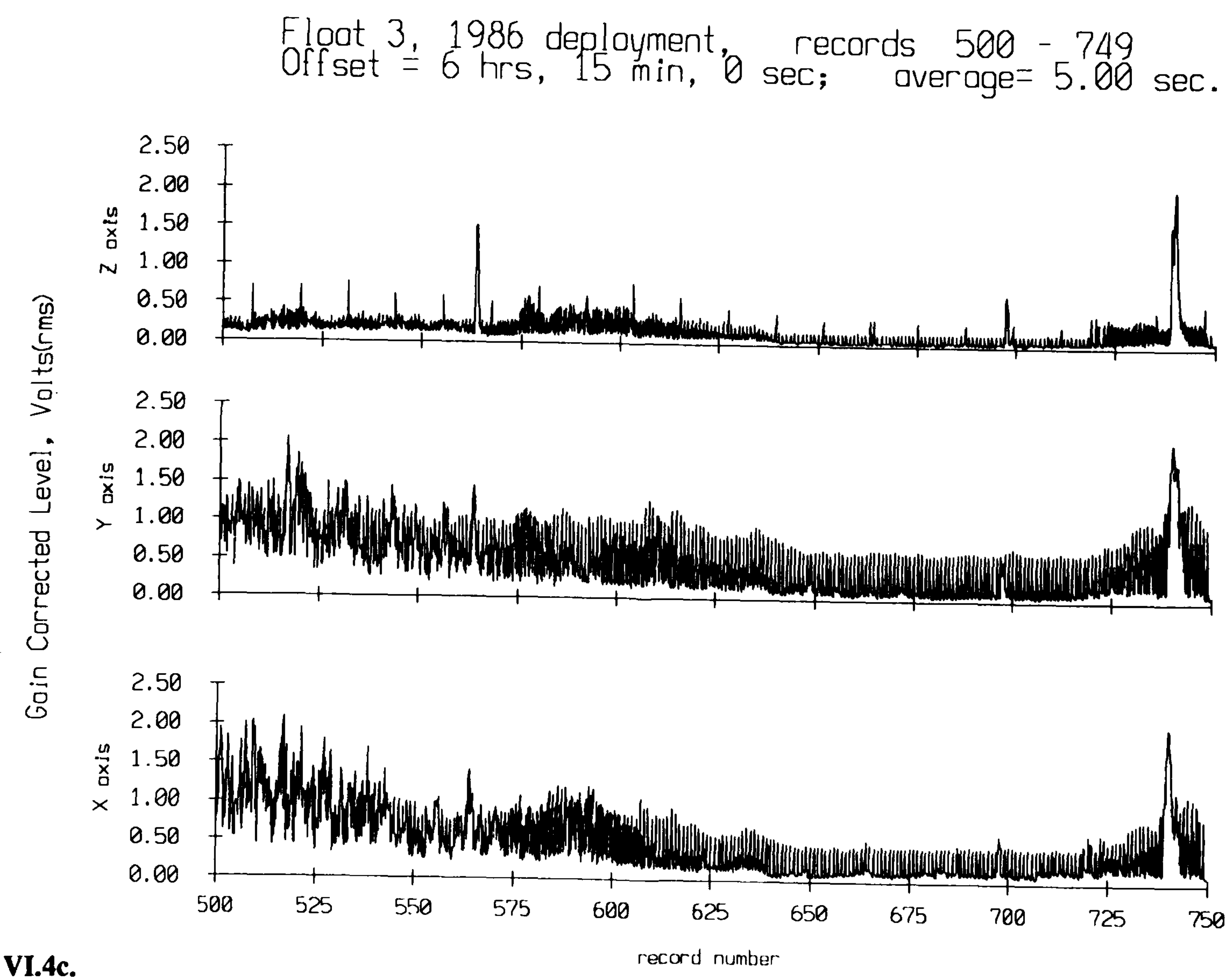

Float 3, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.4a.



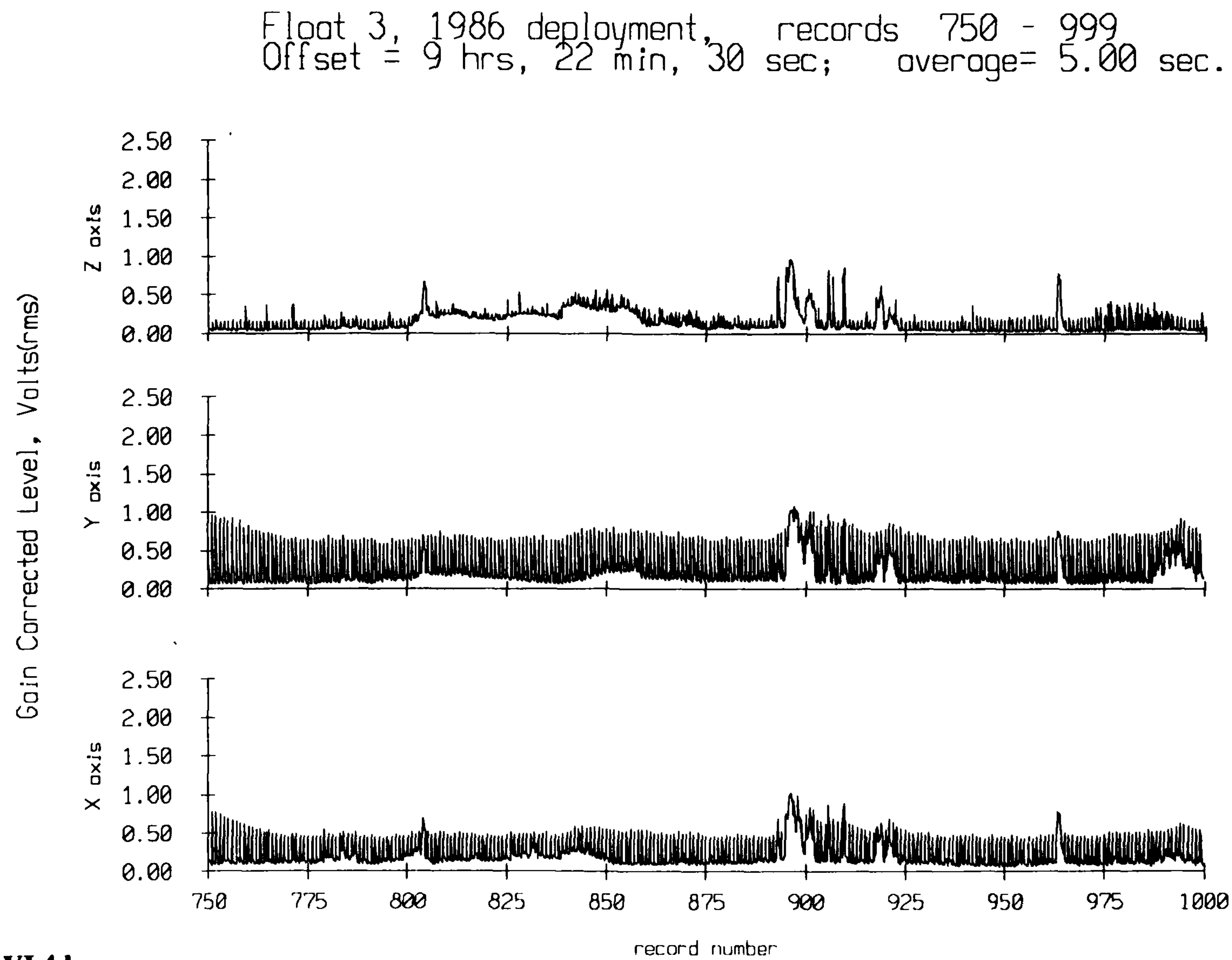
Float 3, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.4b.



Float 3, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.4c.



Float 3, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.4d.

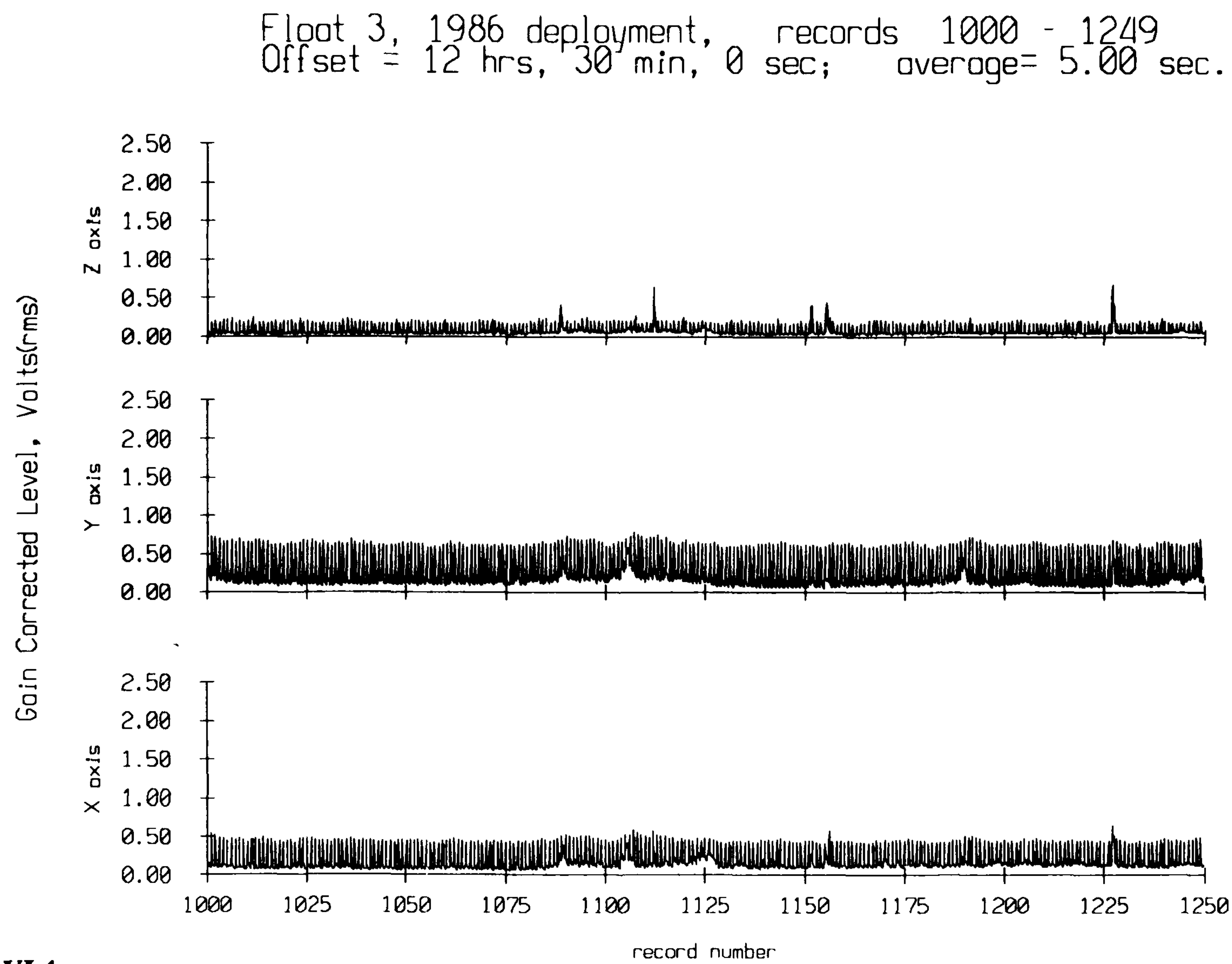

Float 3, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.4e.

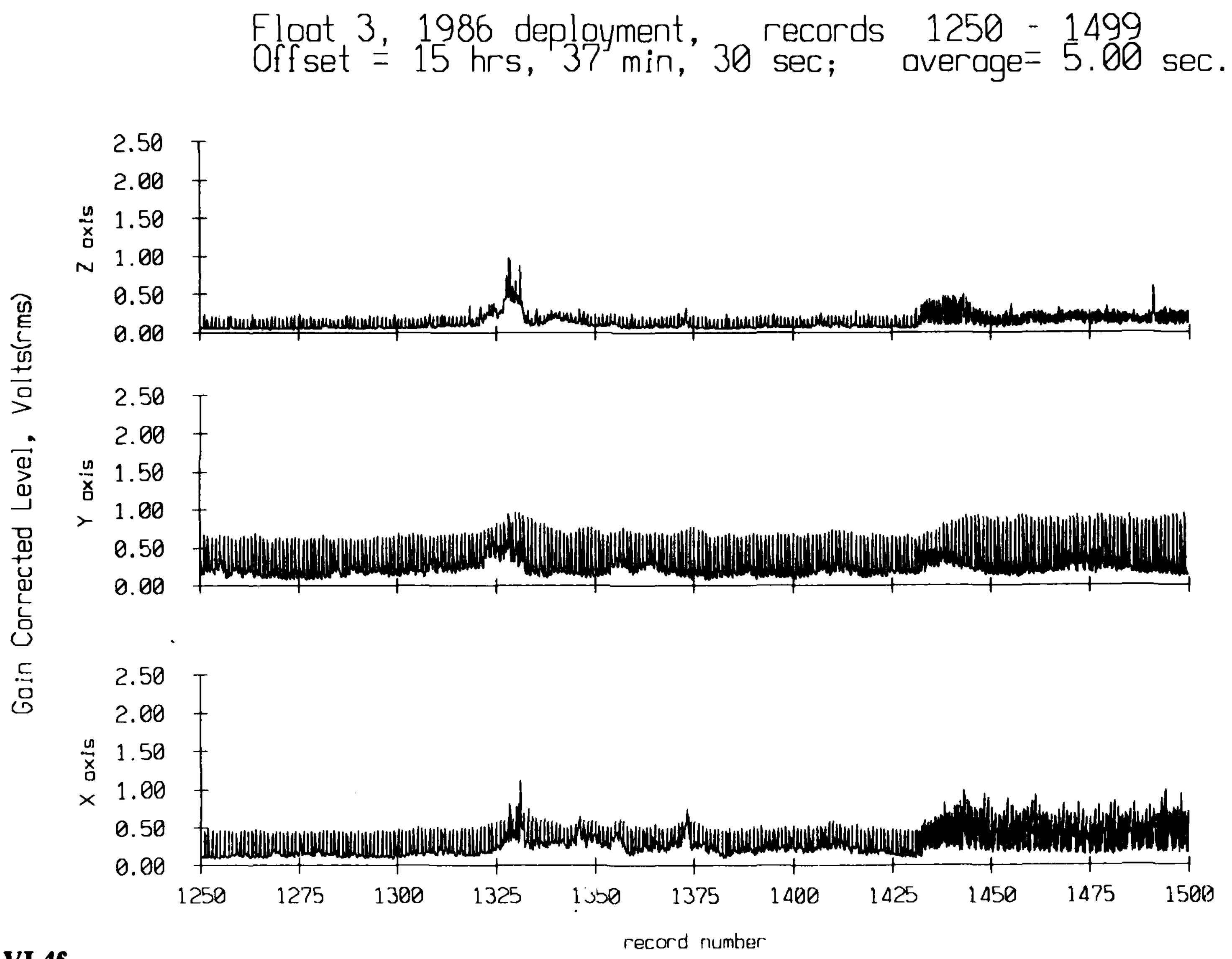
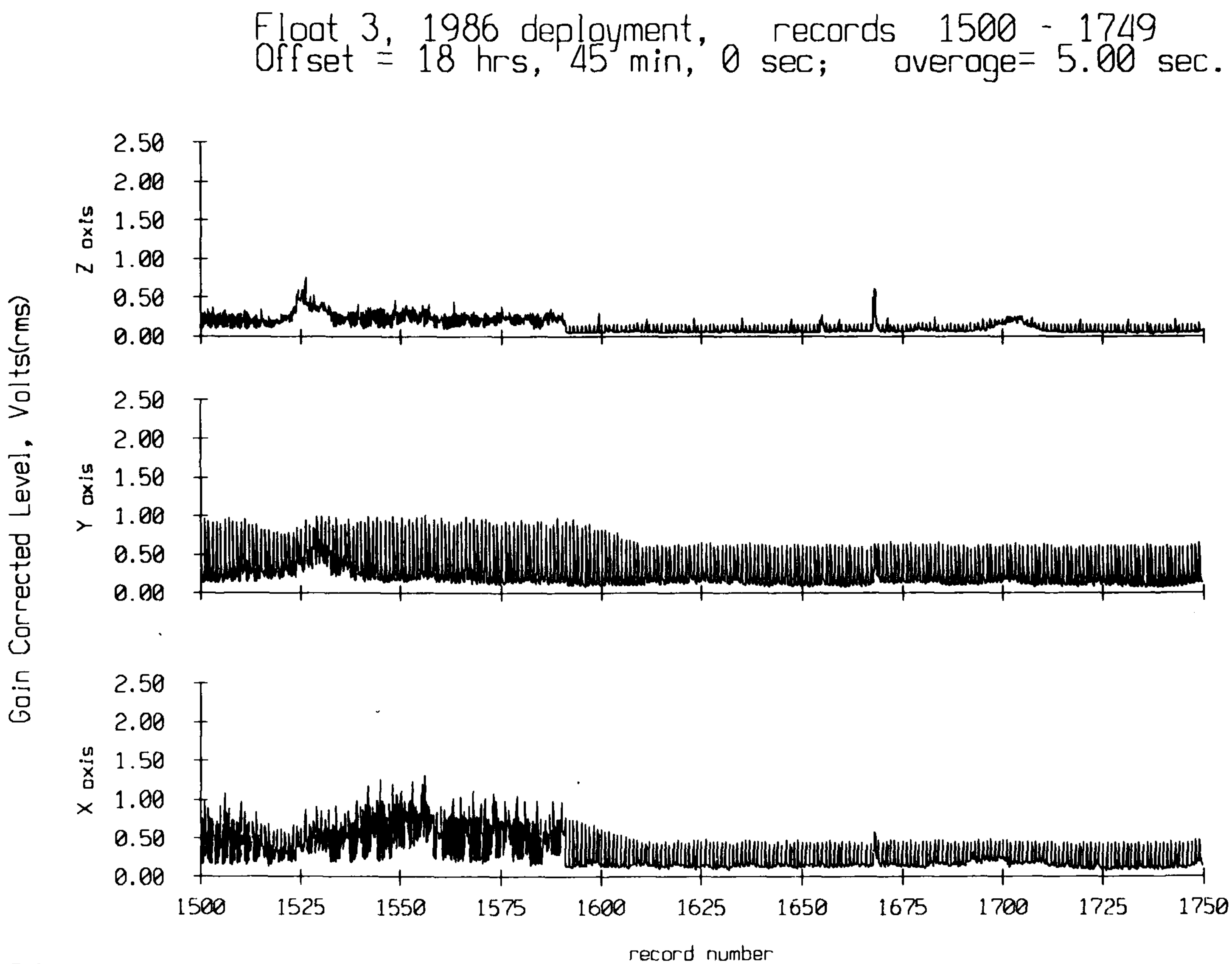

Float 3, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.4f.



Float 3, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.4g.

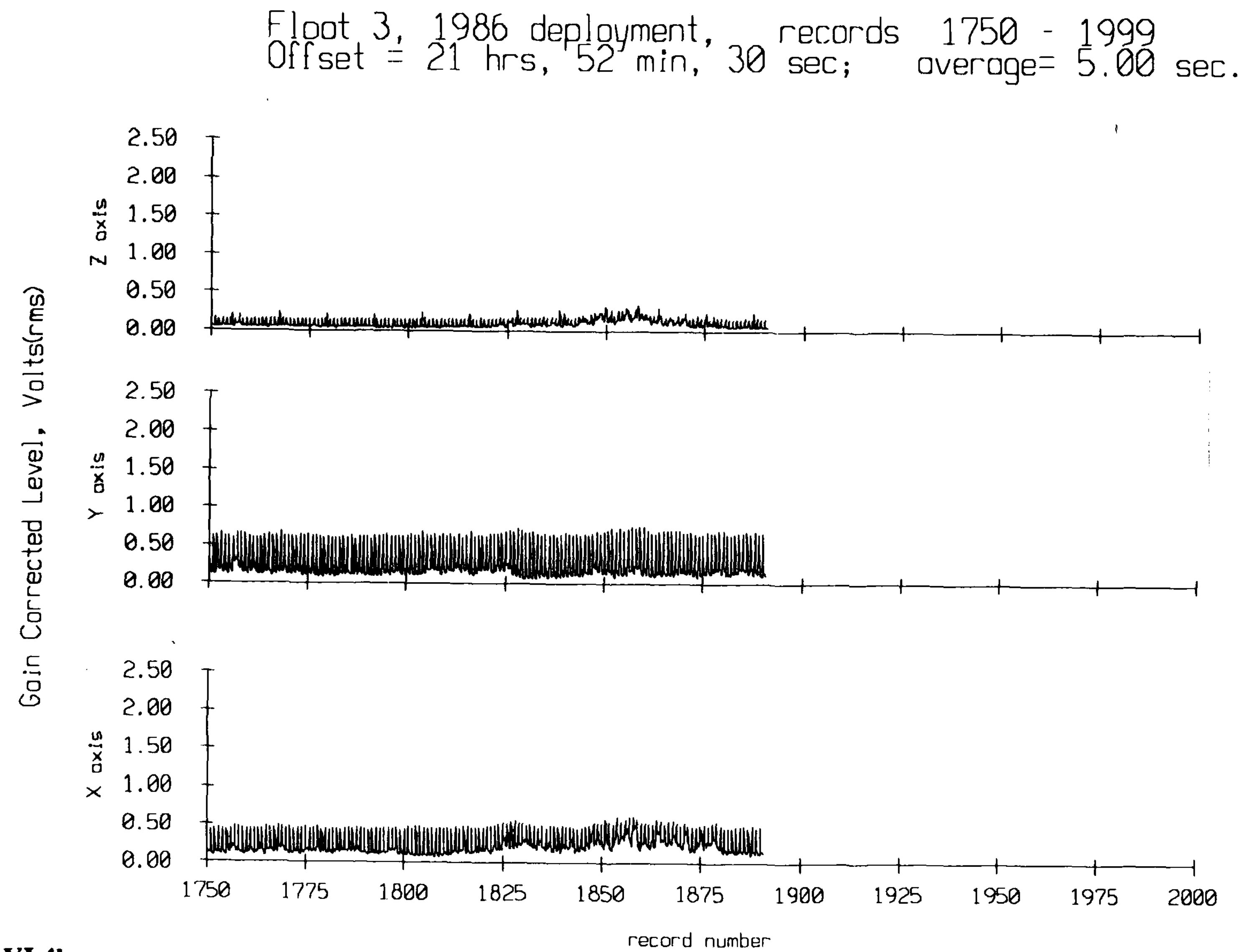
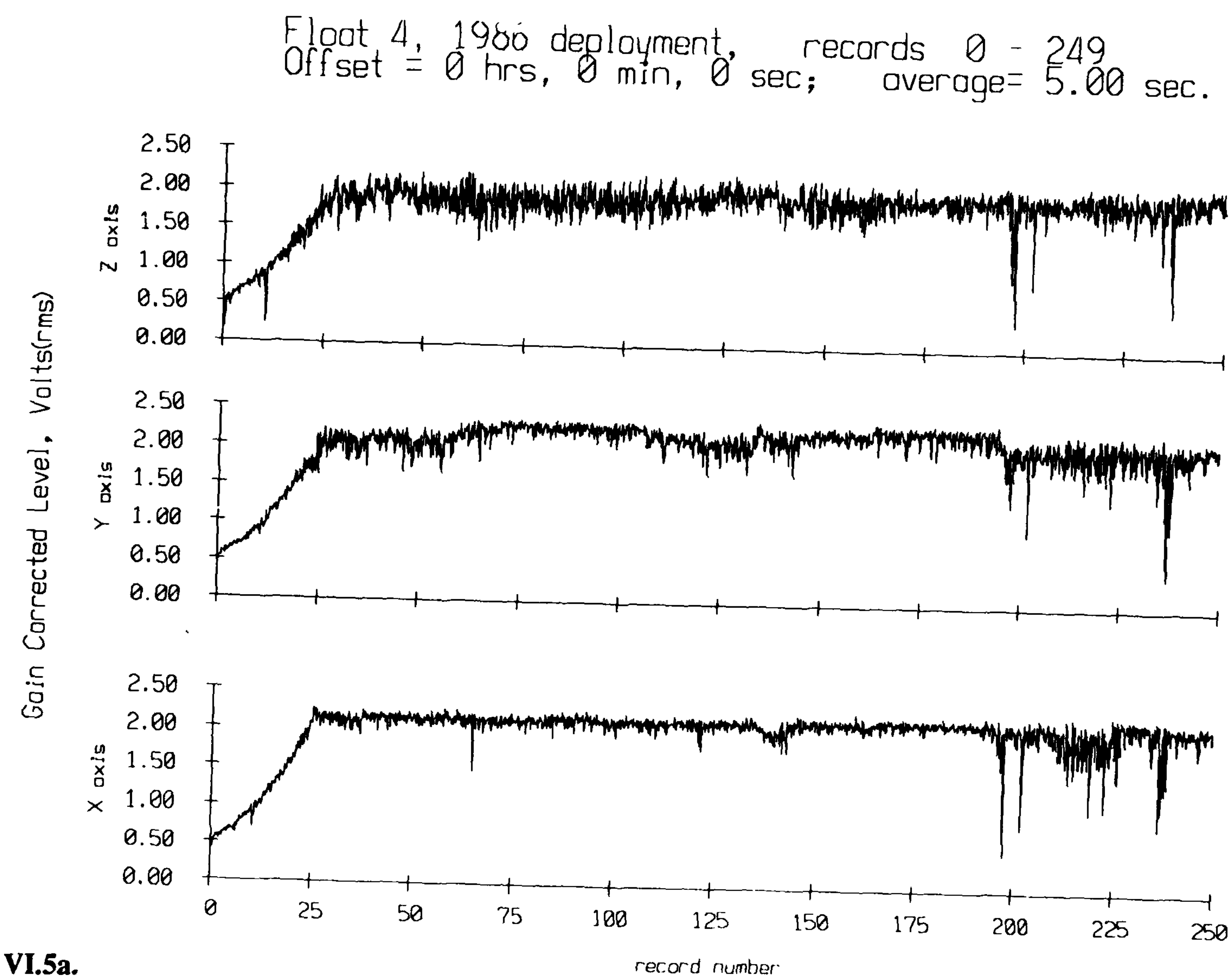

Float 3, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.4h.



Float 4, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.5a.

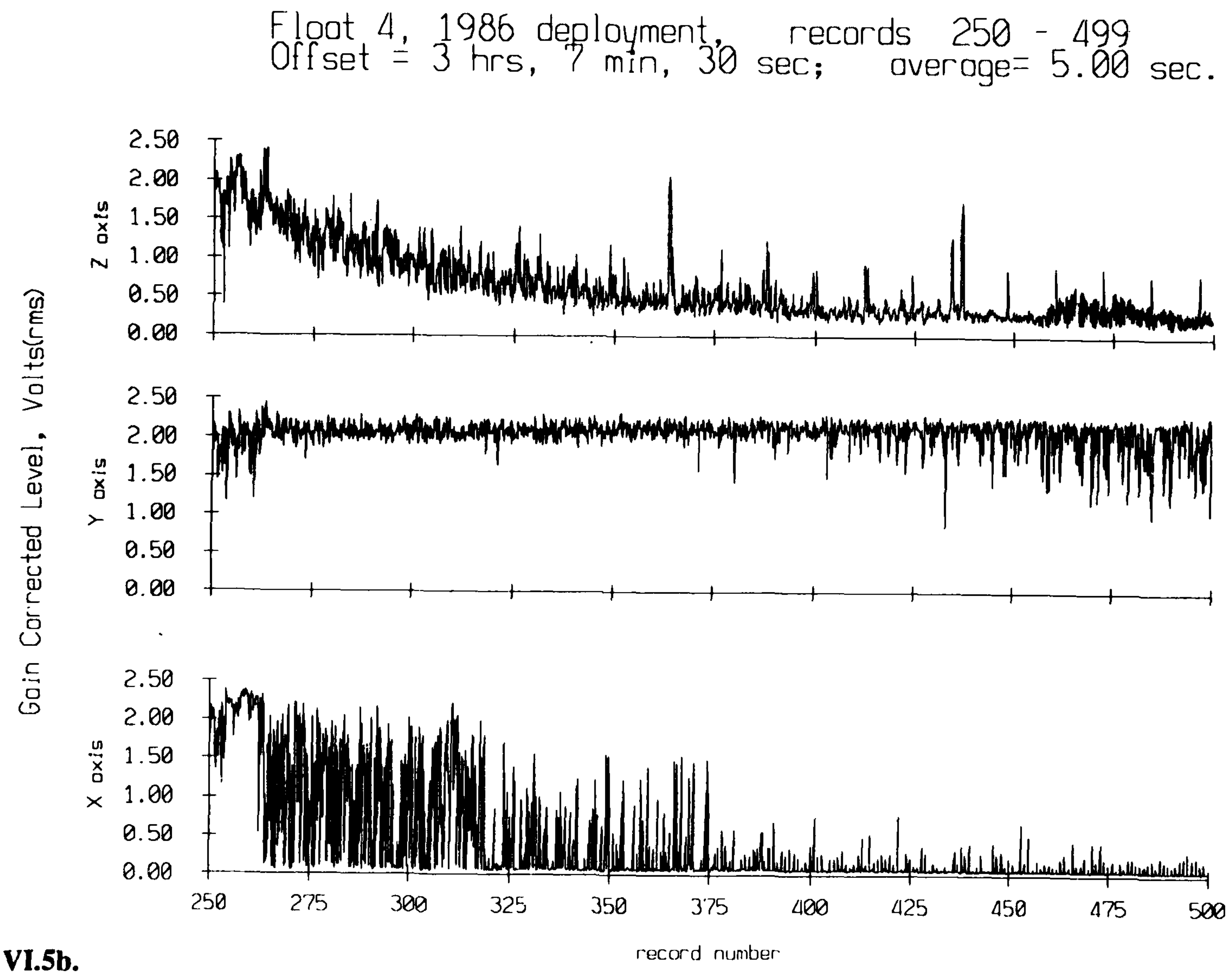

Float 4, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.5b.

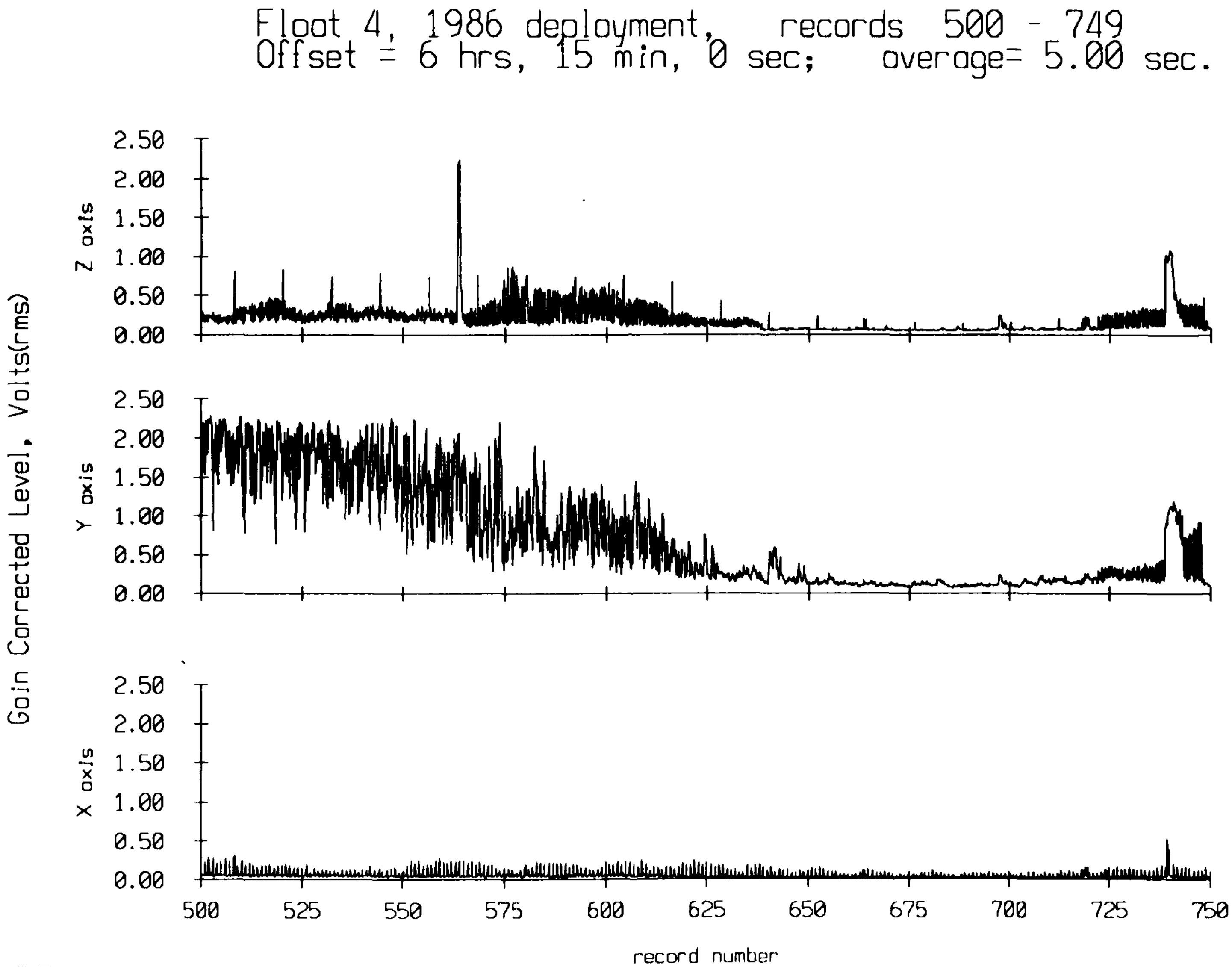
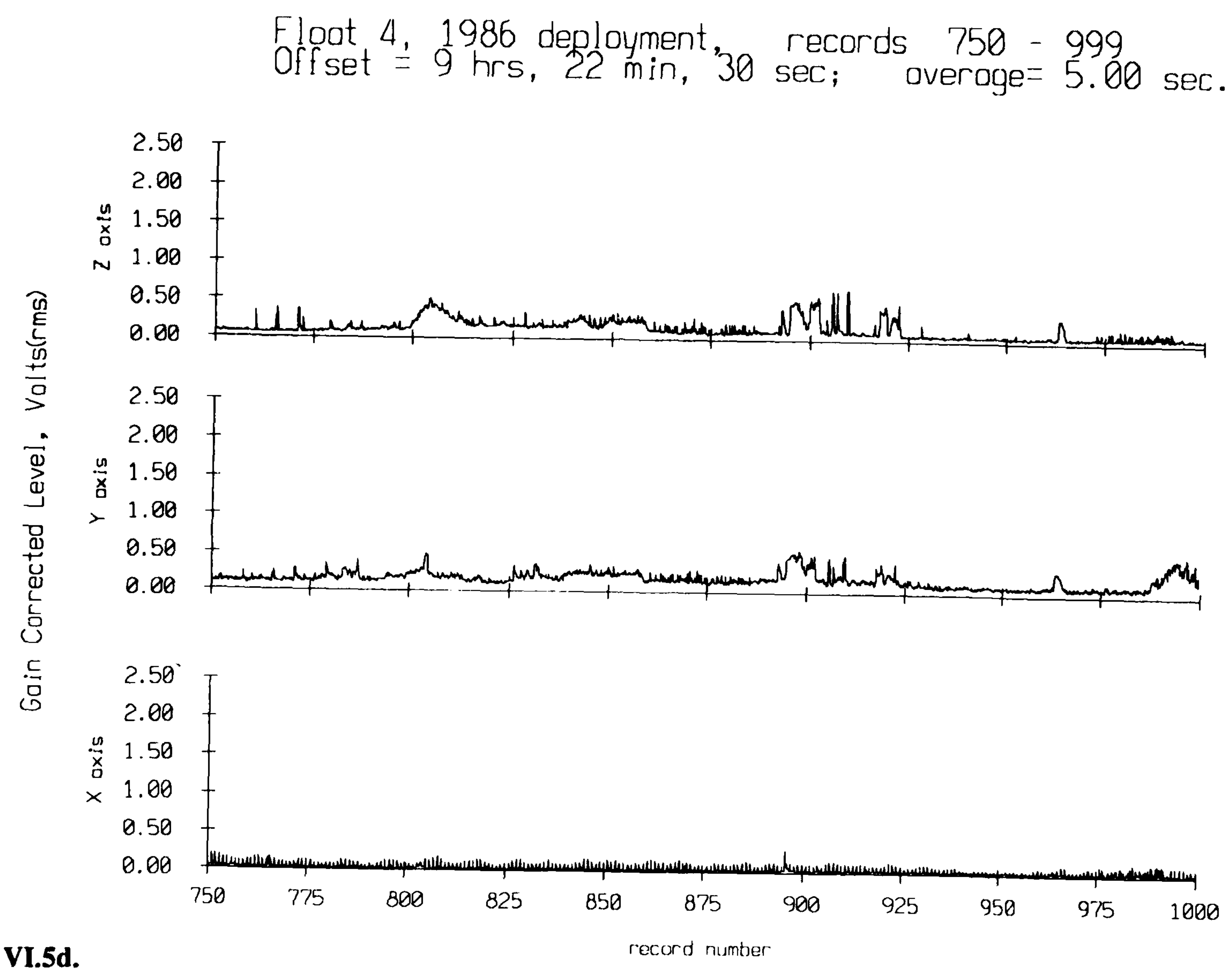
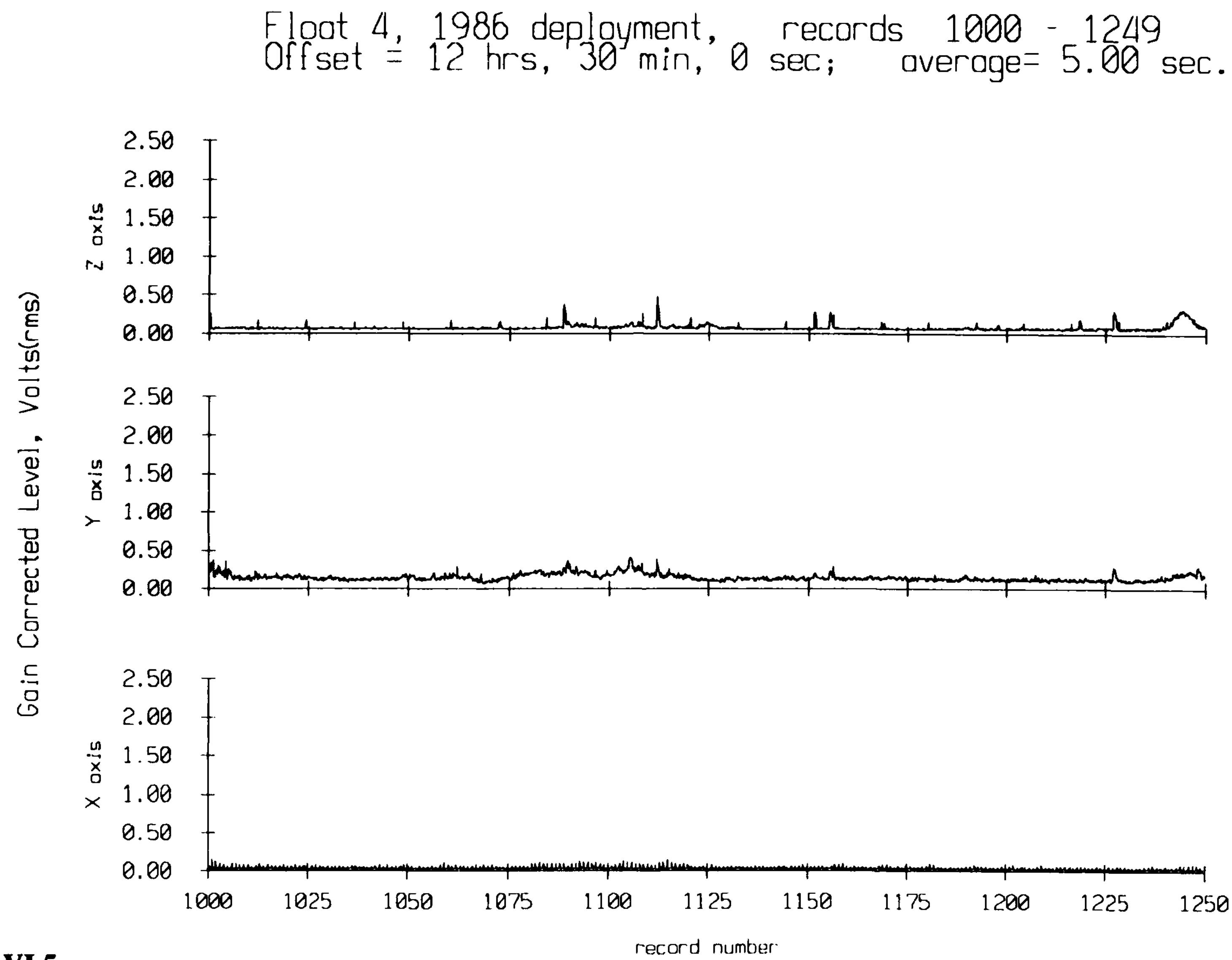

Float 4, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.5c.



Float 4, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.5d.



Float 4, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.5e.

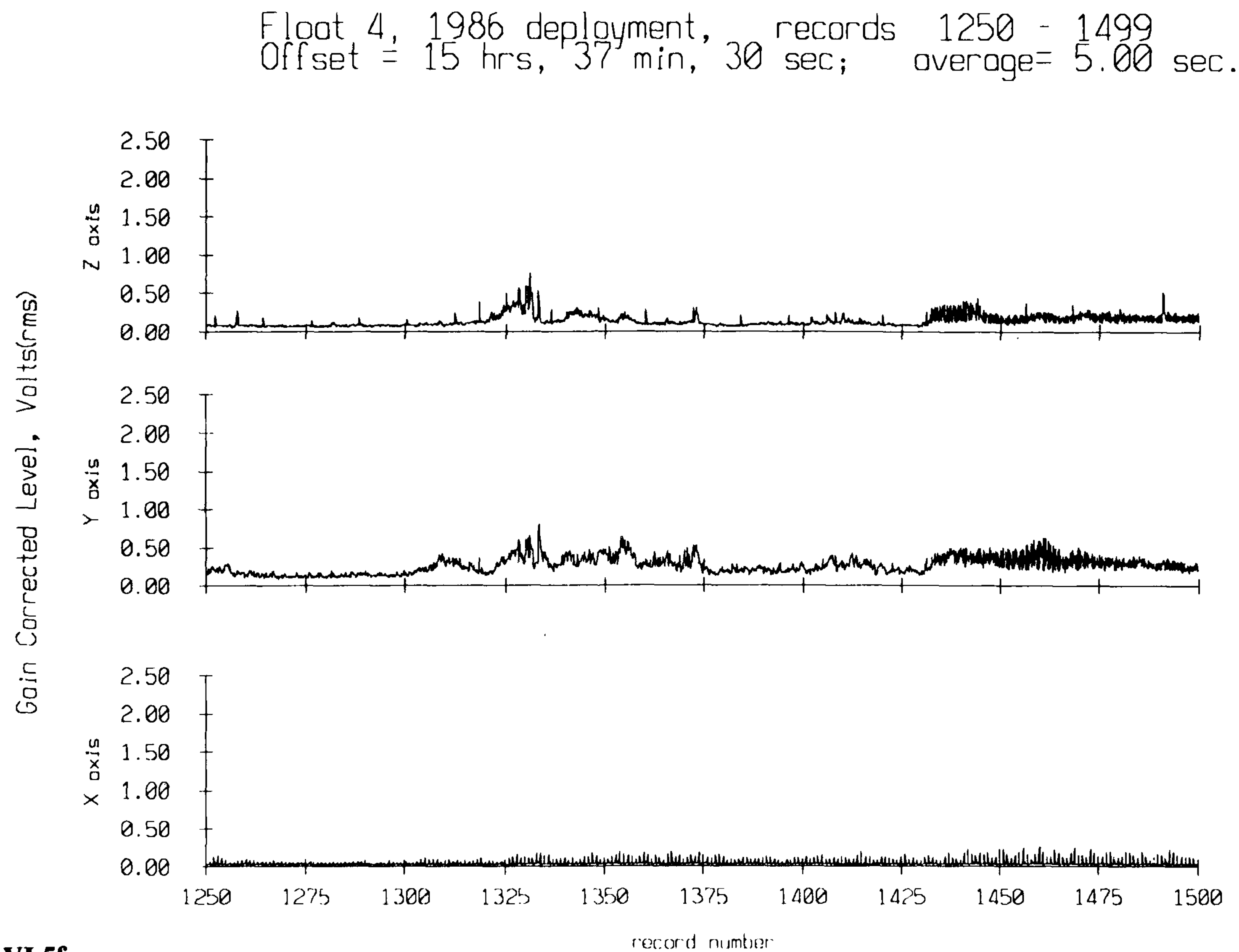

Float 4, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.5f.

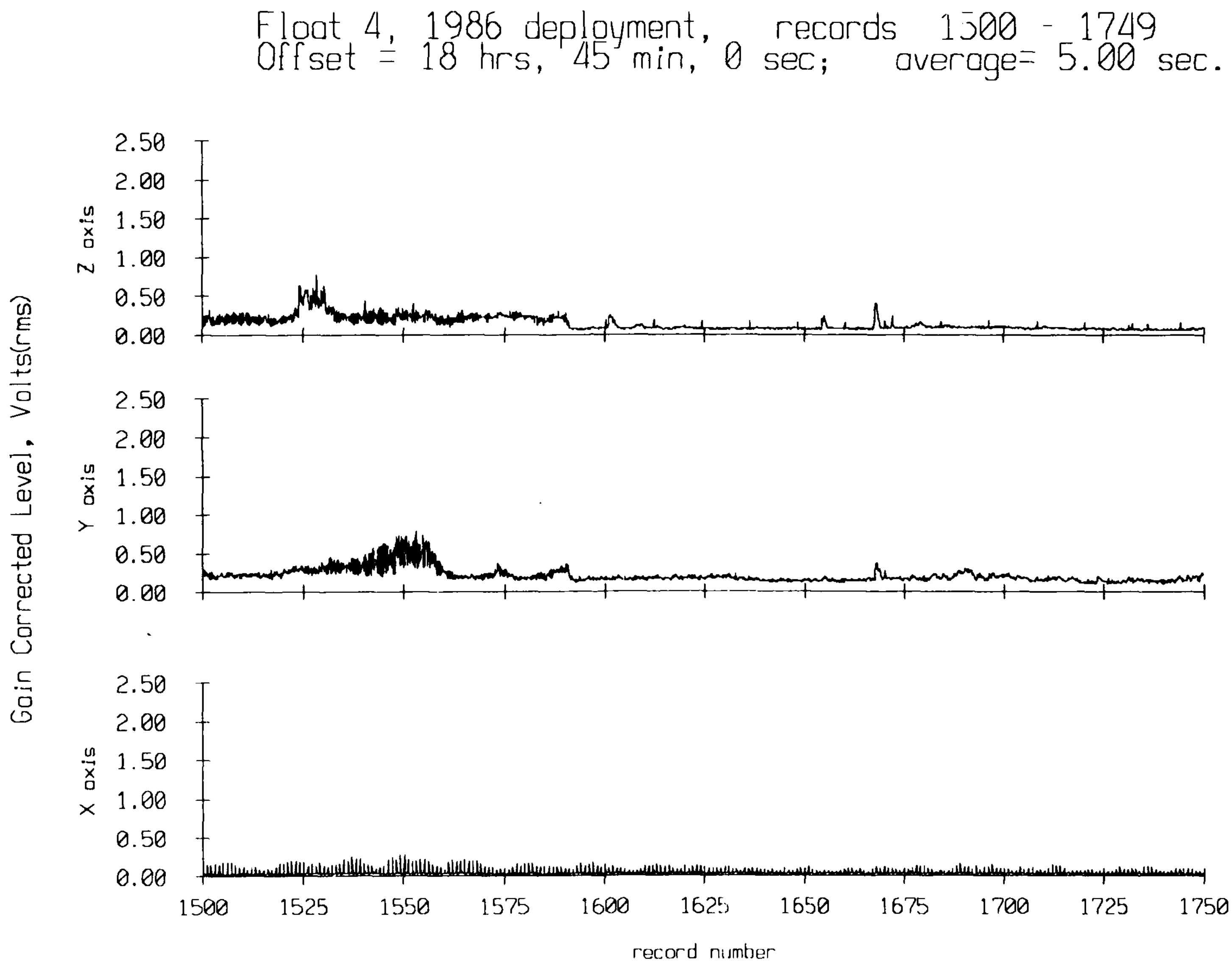

Float 4, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.5g.

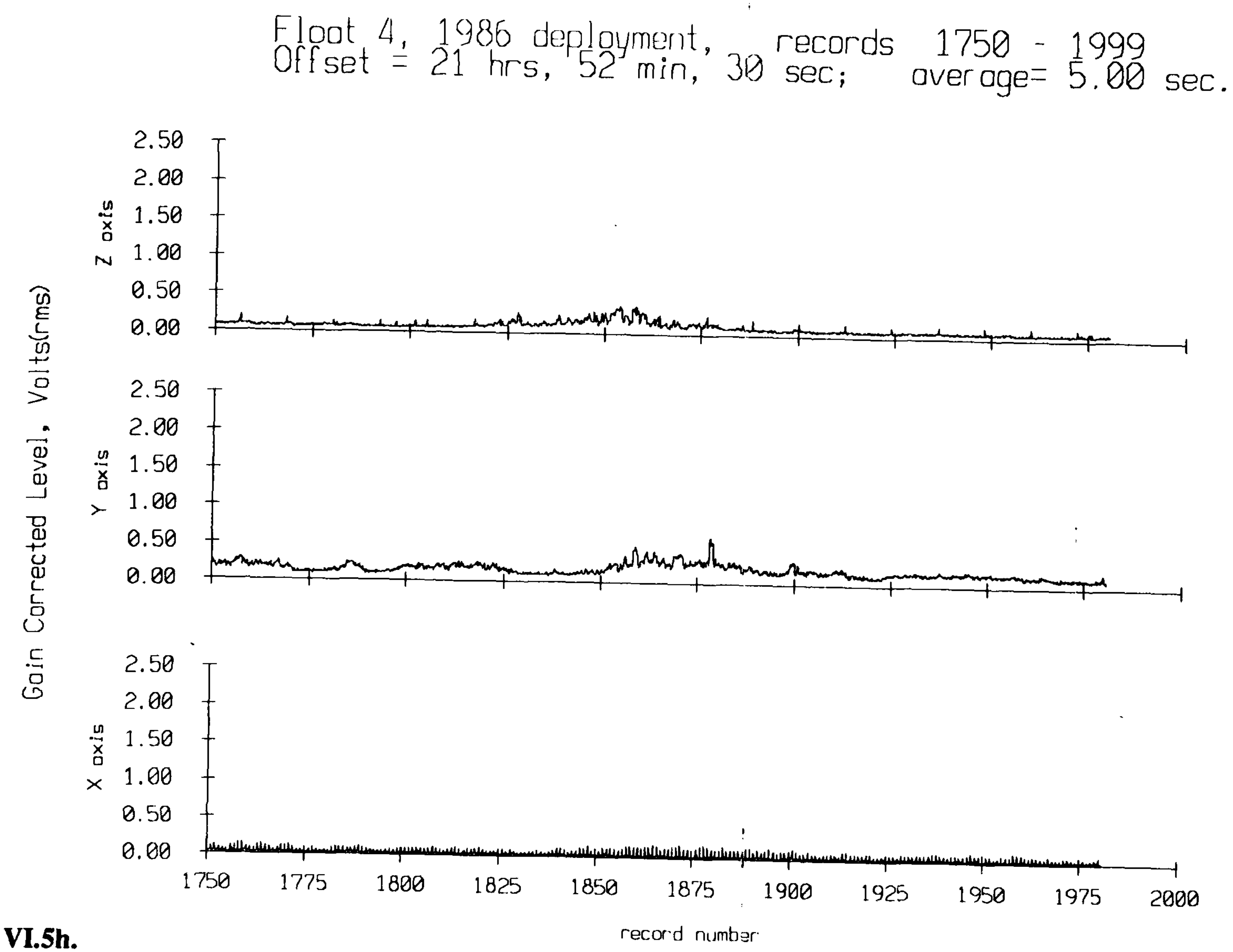
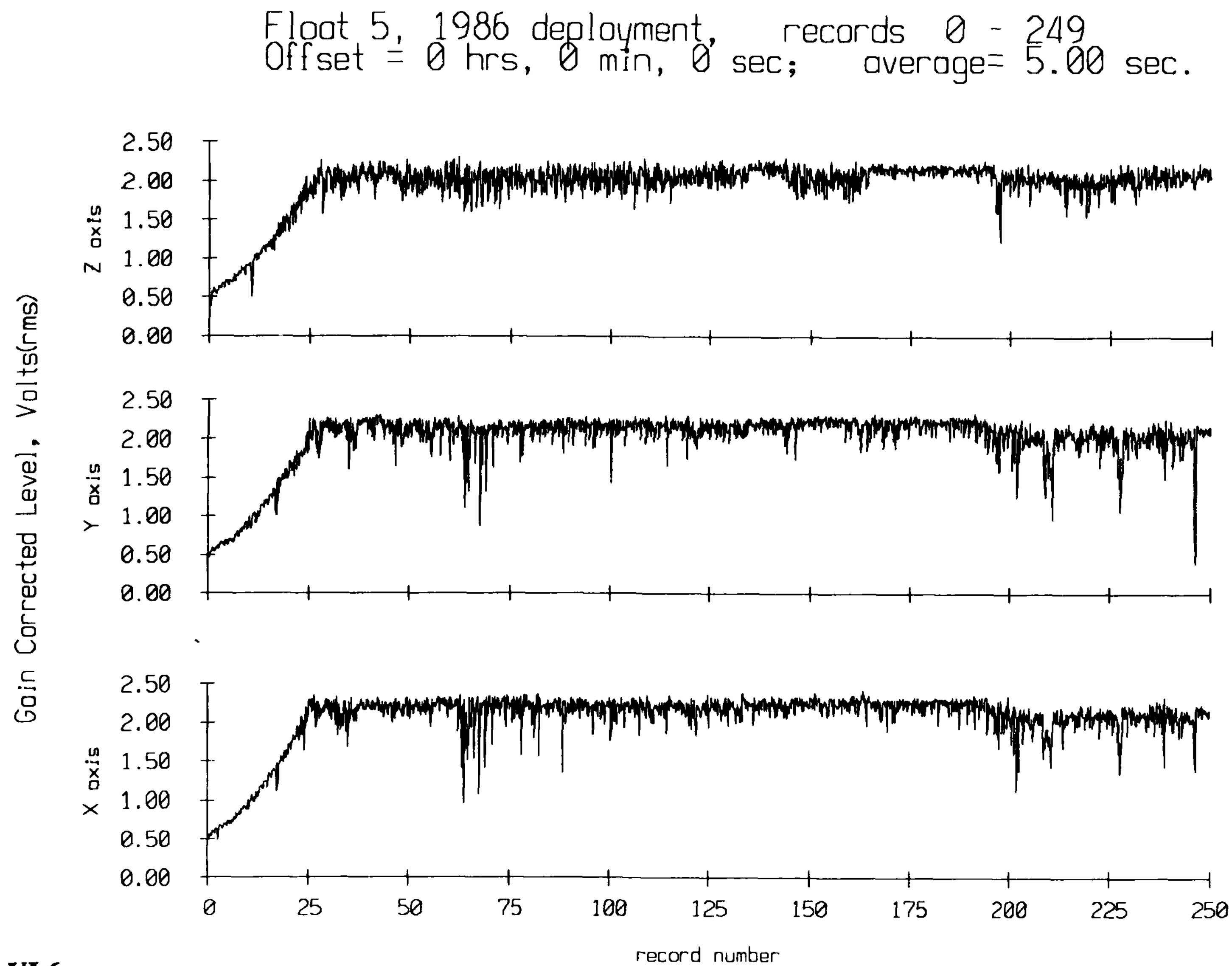
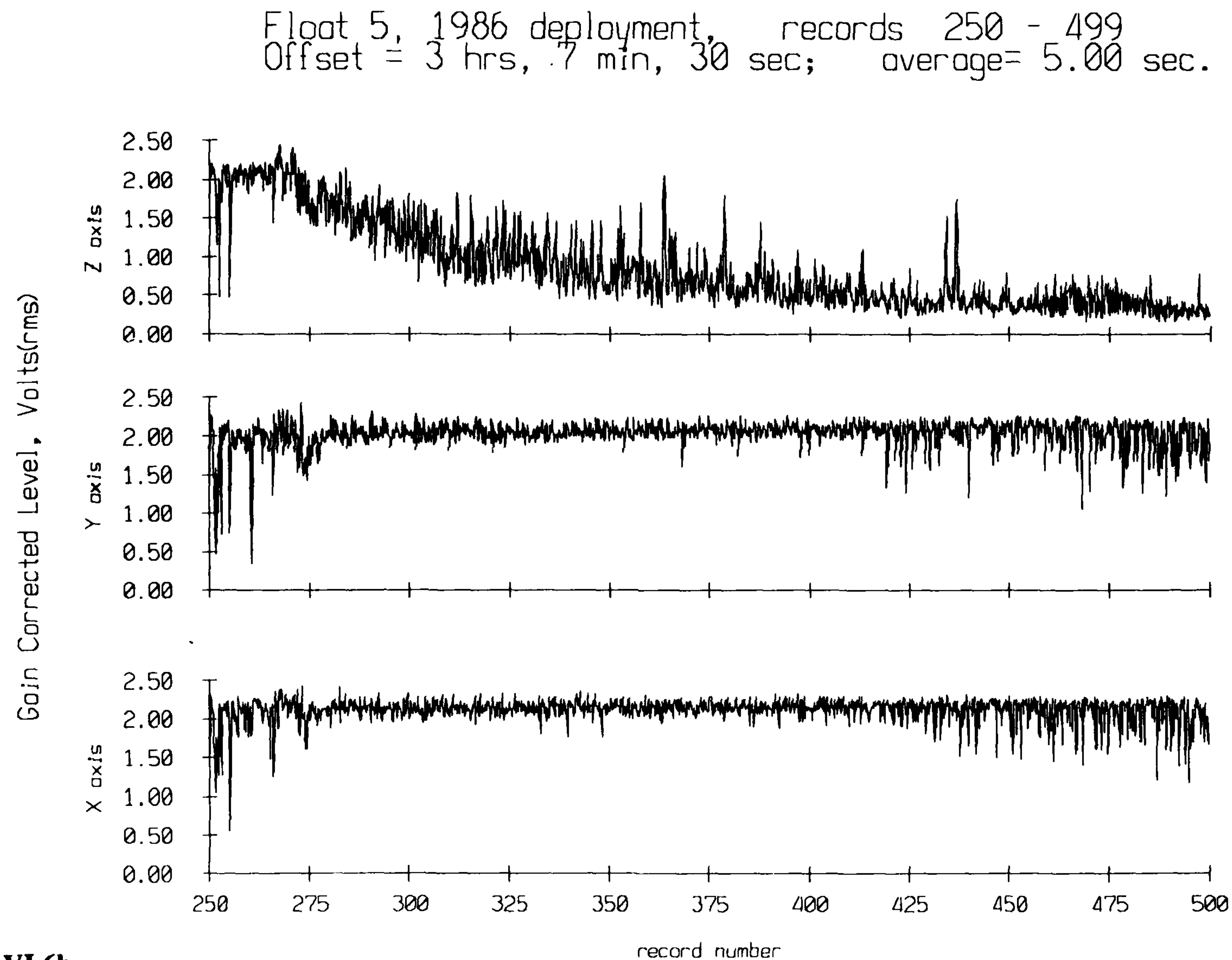

Float 4, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.5h.



Float 5, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.6a.



Float 5, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.6b.

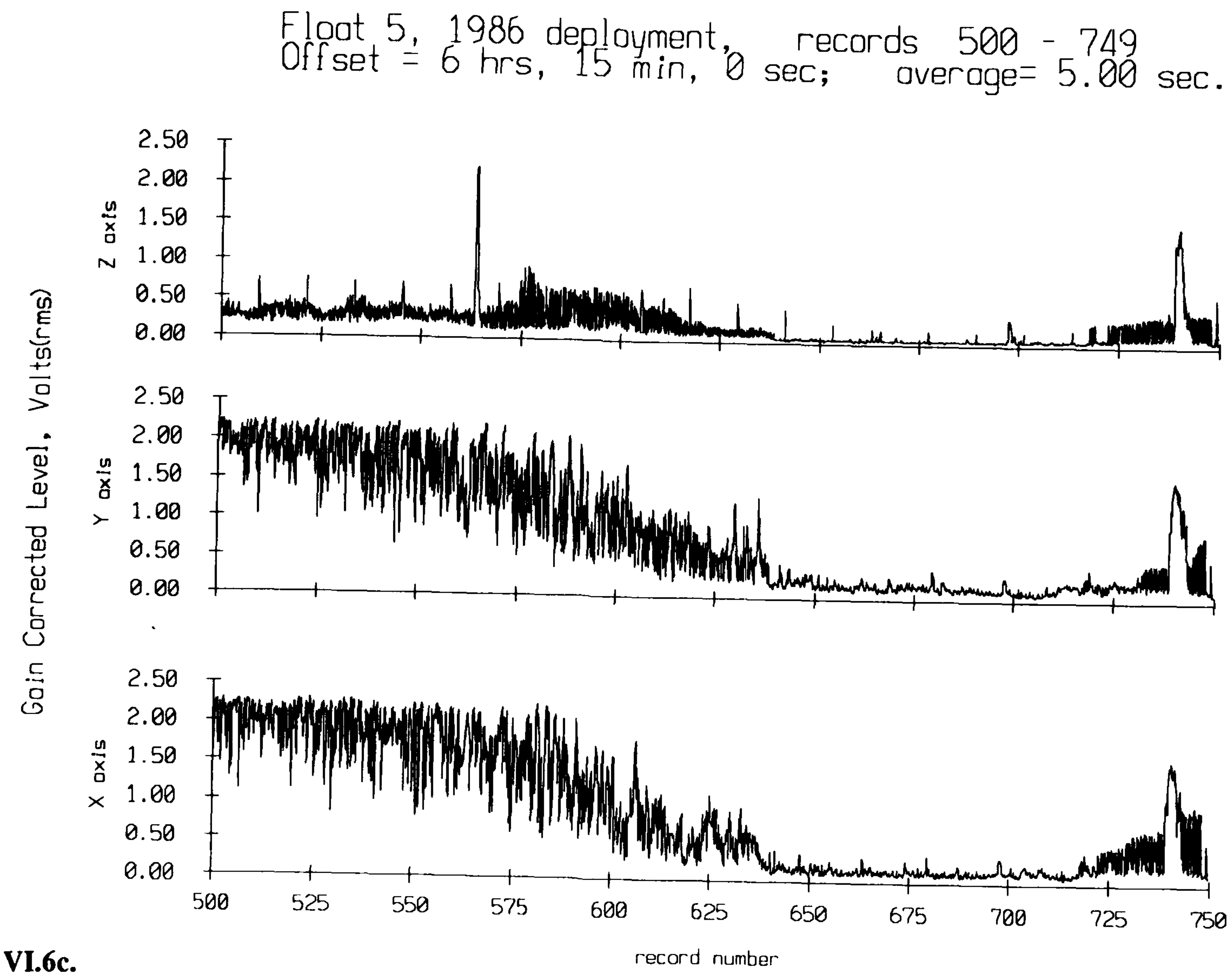
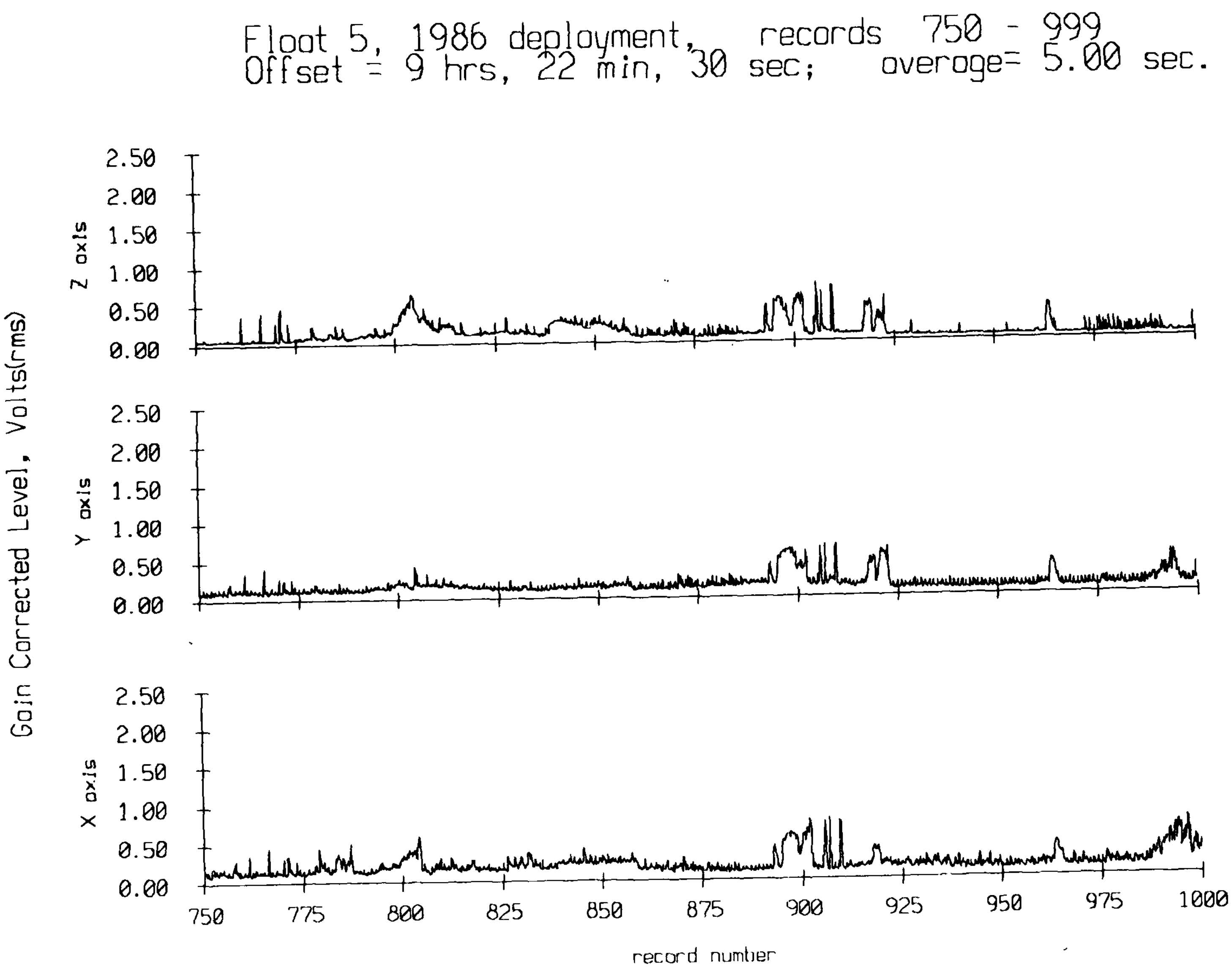

Float 5, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.6c.



Float 5, 1986 deployment, records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.6d.

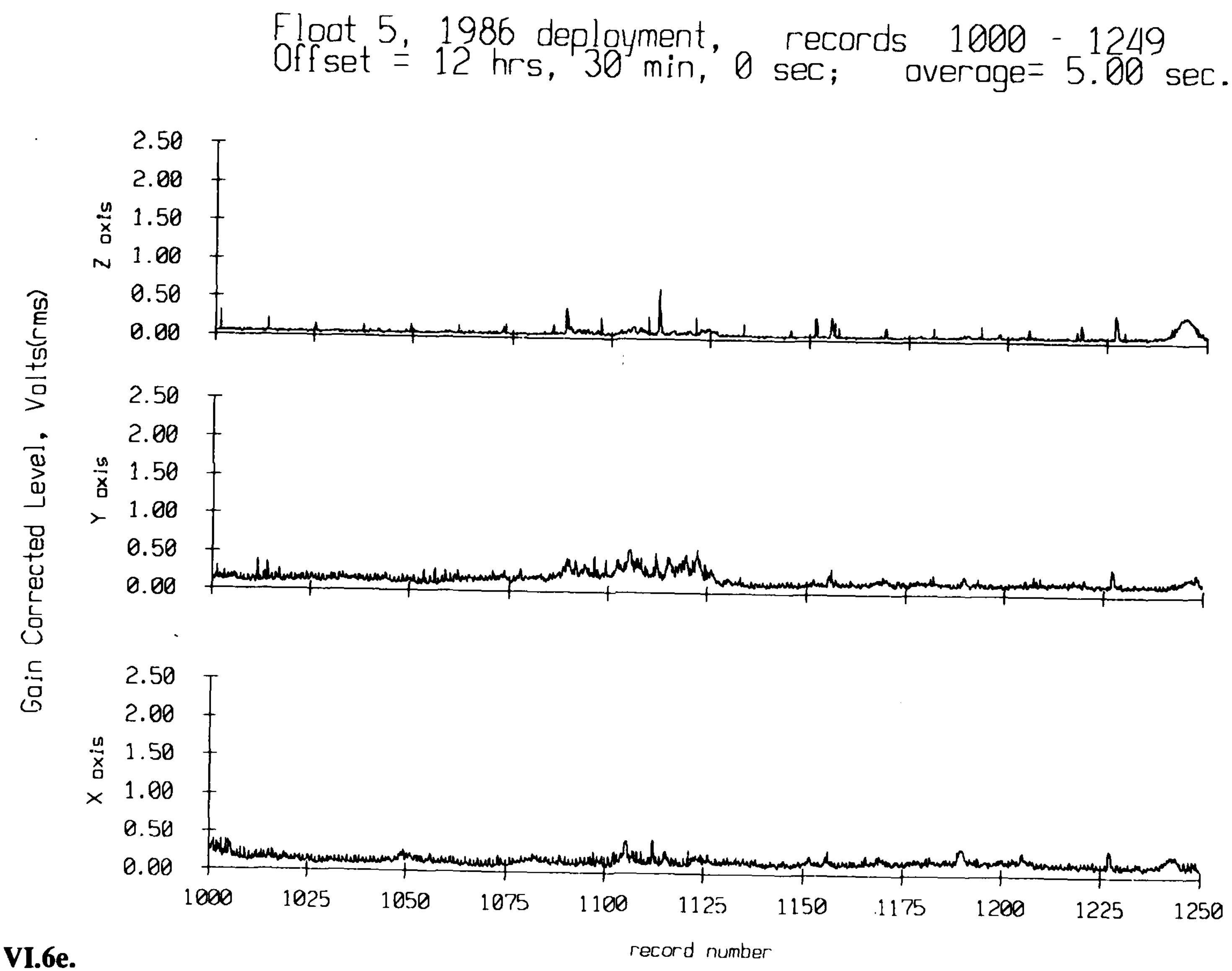
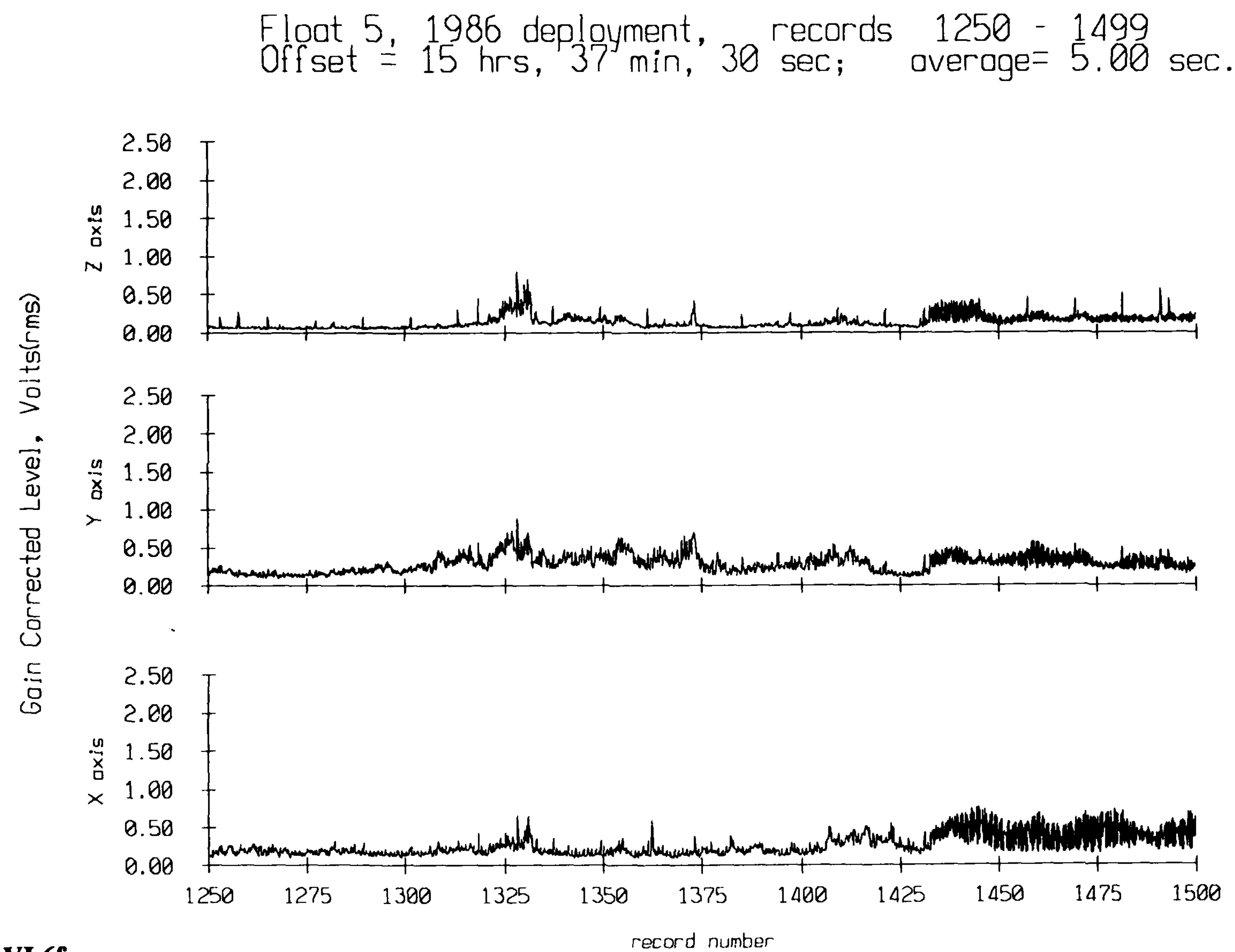

Float 5, 1986 deployment, records 1000 - 1249
Offset = 12 hrs, 30 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
record number

Figure VI.6e.



Float 5, 1986 deployment, records 1250 - 1499
Offset = 15 hrs, 37 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1250
1275
1300
1325
1350
1375
1400
1425
1450
1475
1500
record number

Figure VI.6f.

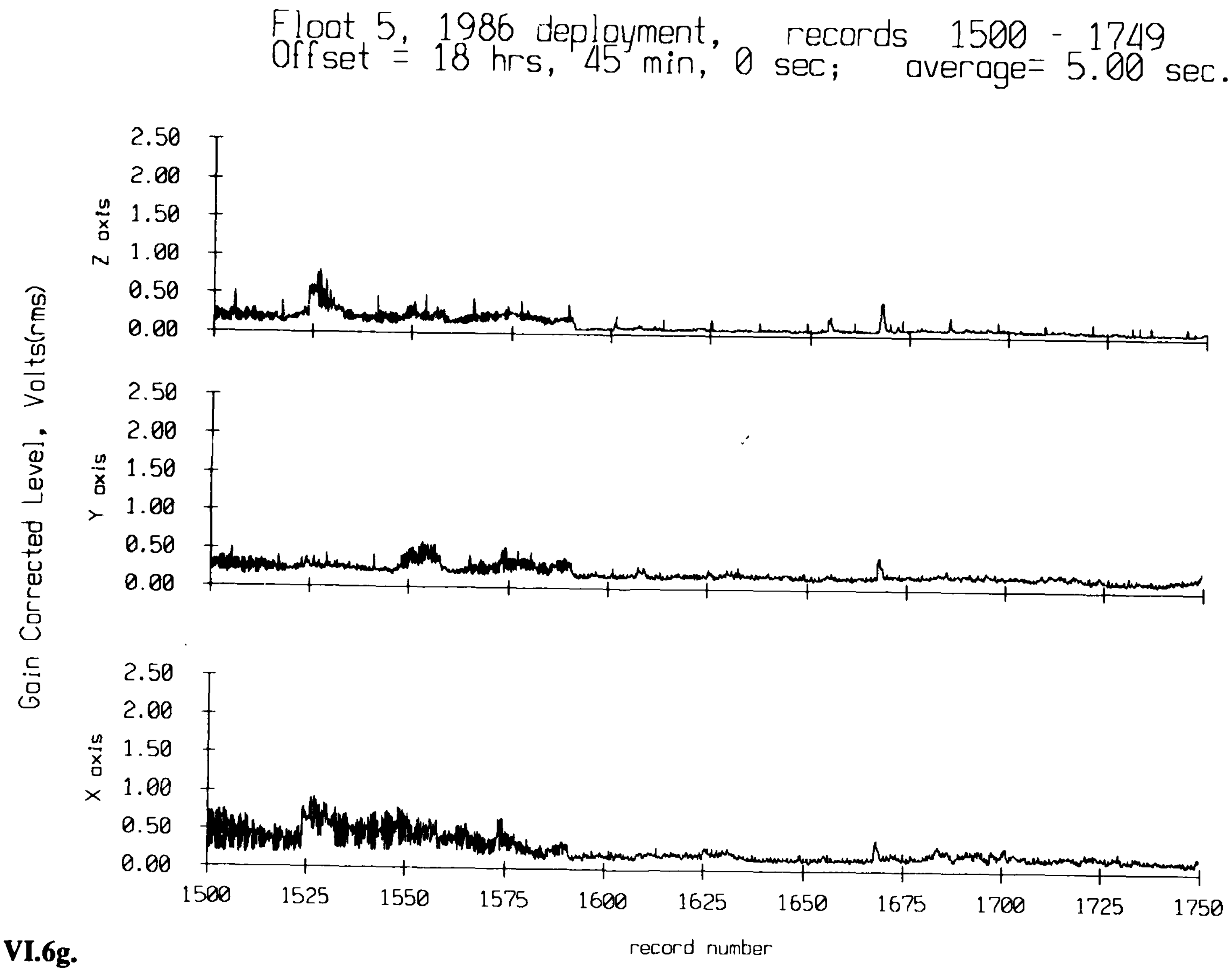

Float 5, 1986 deployment, records 1500 - 1749
Offset = 18 hrs, 45 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
record number

Figure VI.6g.

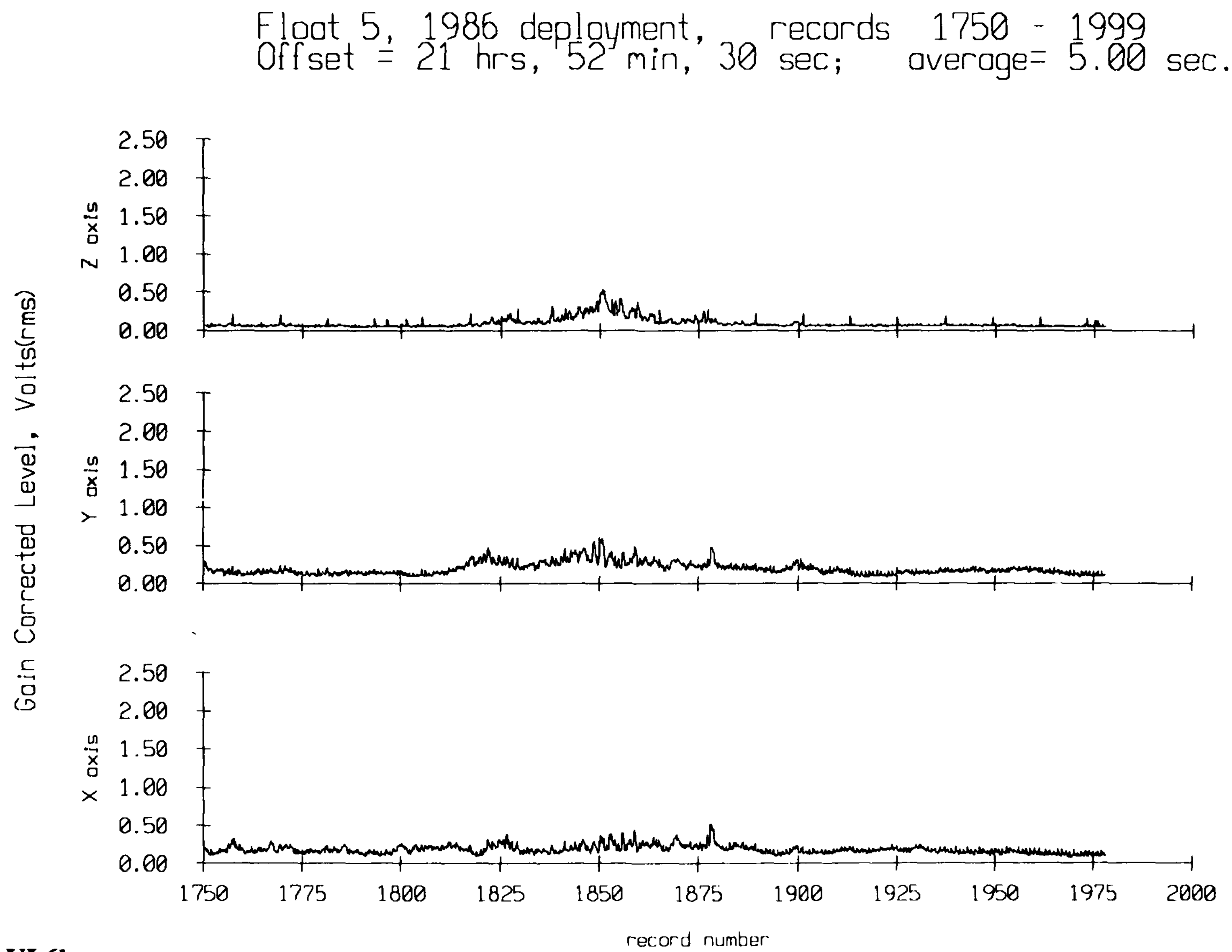

Float 5, 1986 deployment, records 1750 - 1999
Offset = 21 hrs, 52 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000
record number

Figure VI.6h.

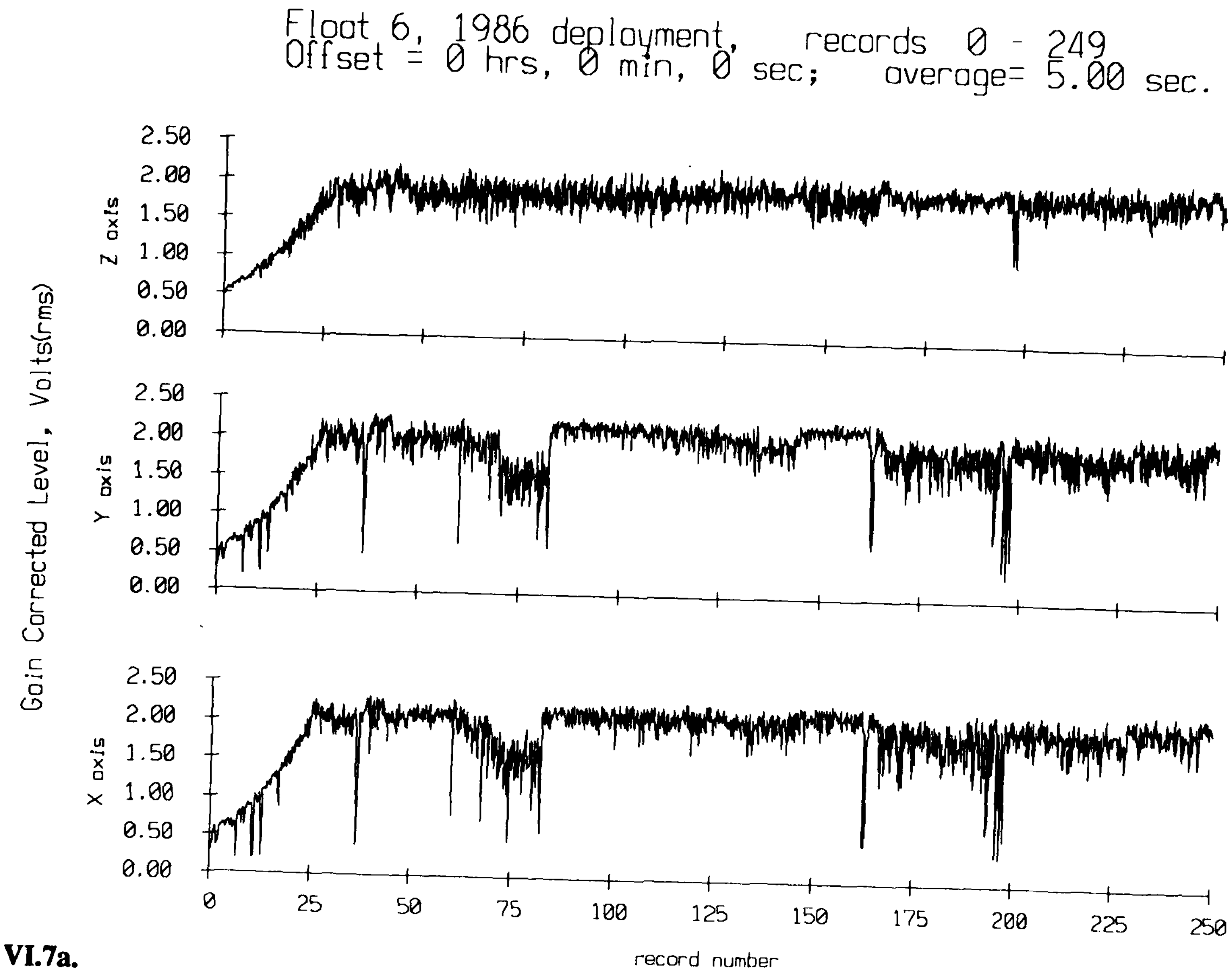
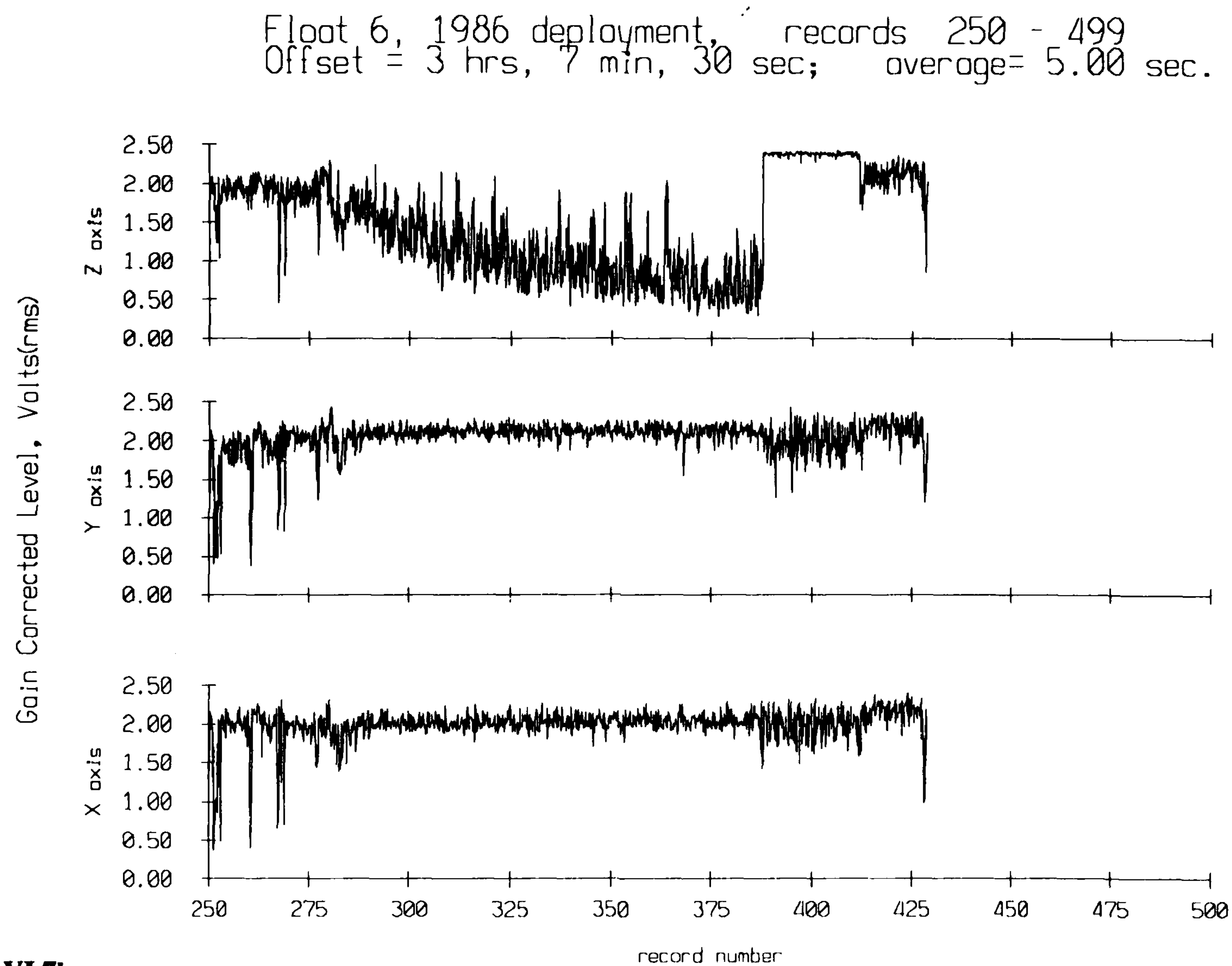

Float 6, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.7a.



Float 6, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.7b.

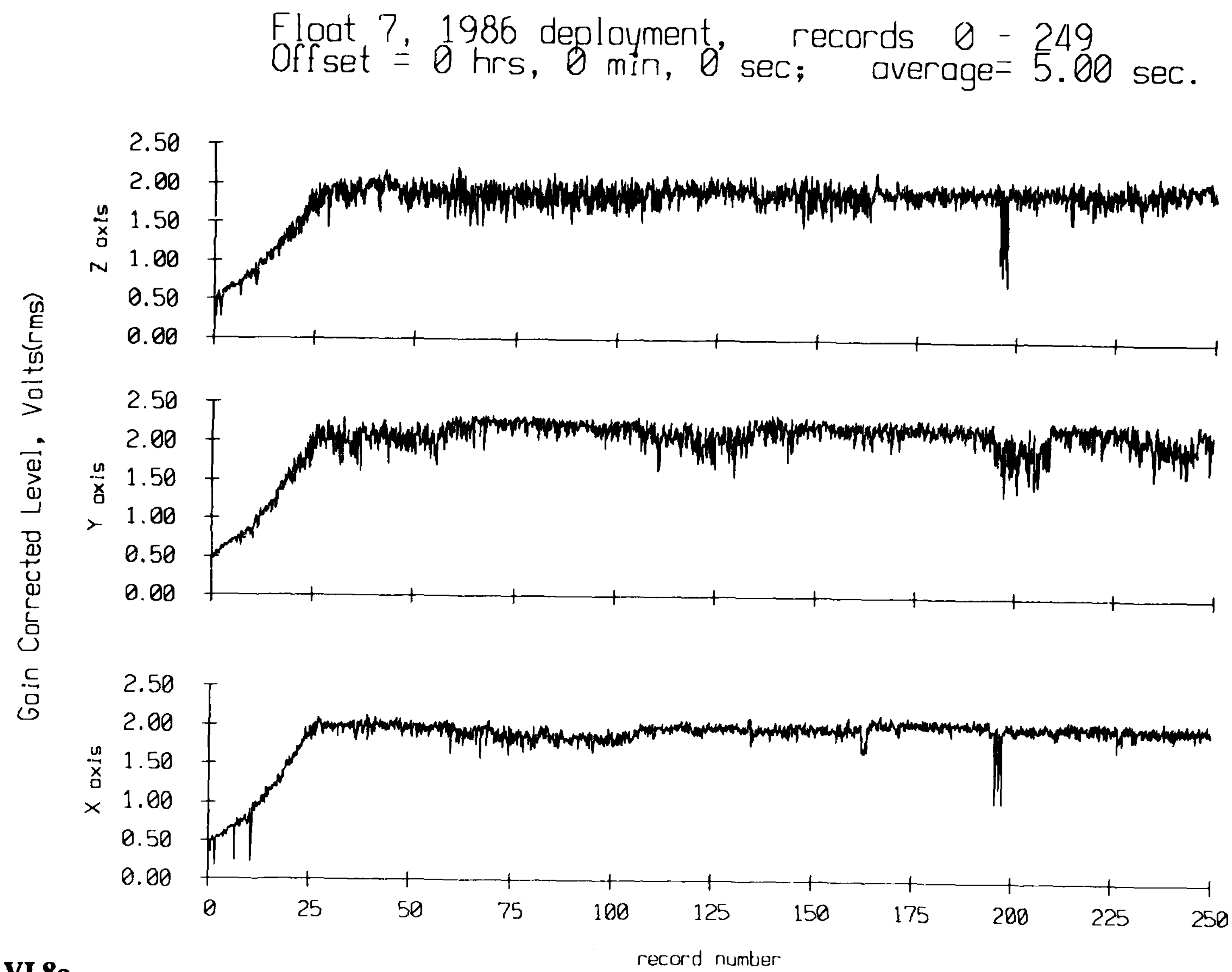

Float 7, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.8a.

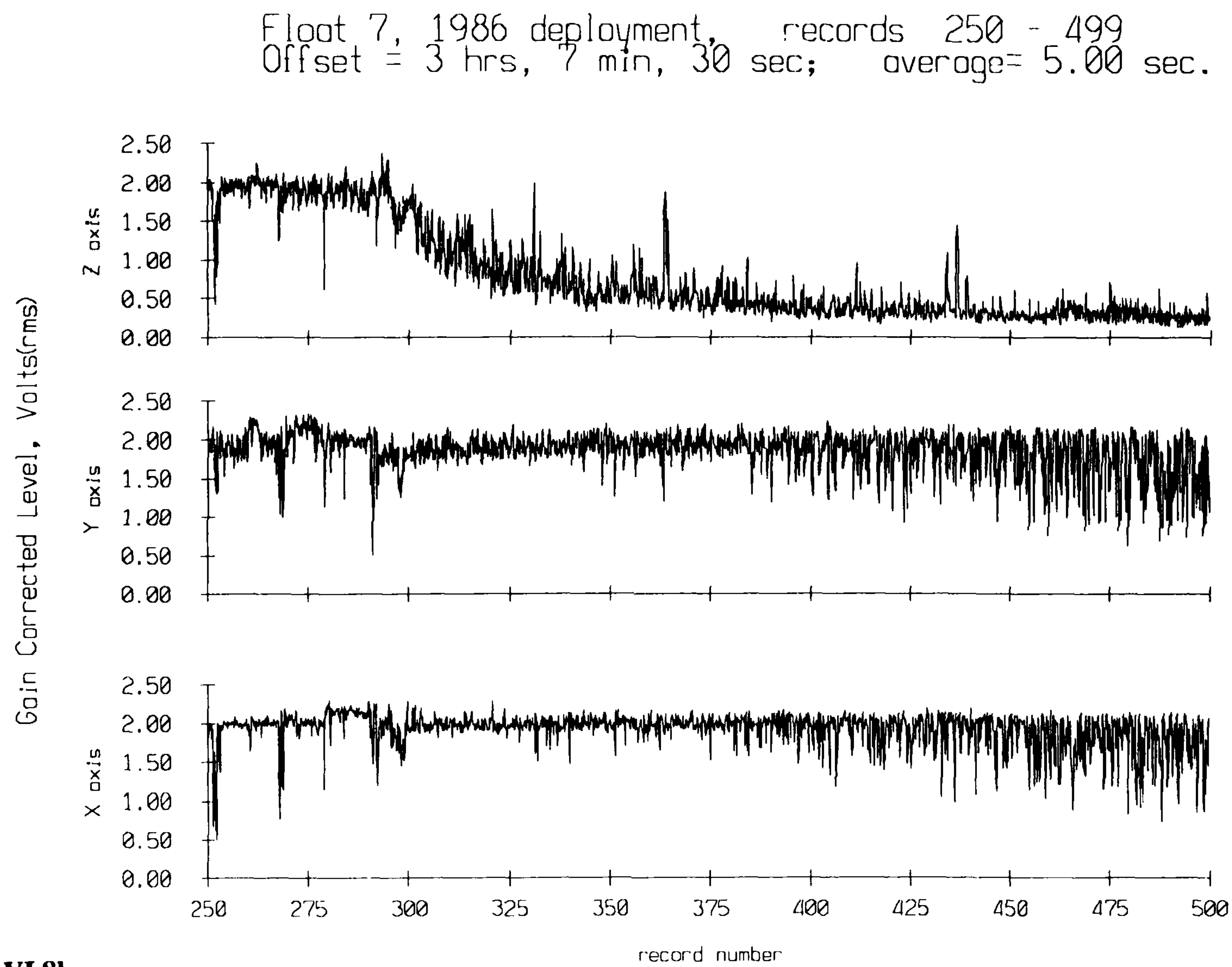

Float 7, 1986 deployment, records 250 - 499
Offset = 3 hrs, 7 min, 30 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
250
275
300
325
350
375
400
425
450
475
500
record number

Figure VI.8b.

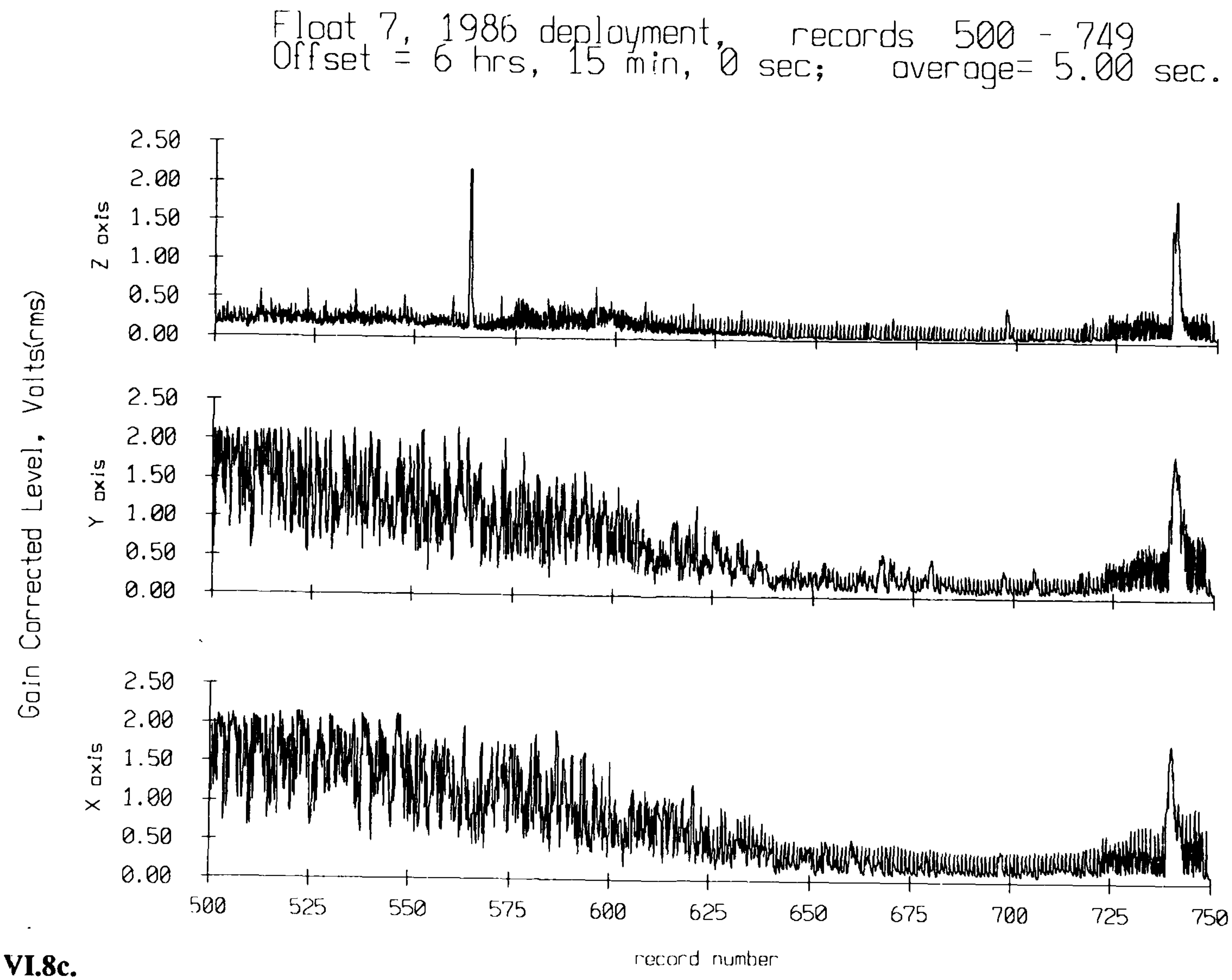

Float 7, 1986 deployment, records 500 - 749
Offset = 6 hrs, 15 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
500
525
550
575
600
625
650
675
700
725
750
record number

Figure VI.8c.

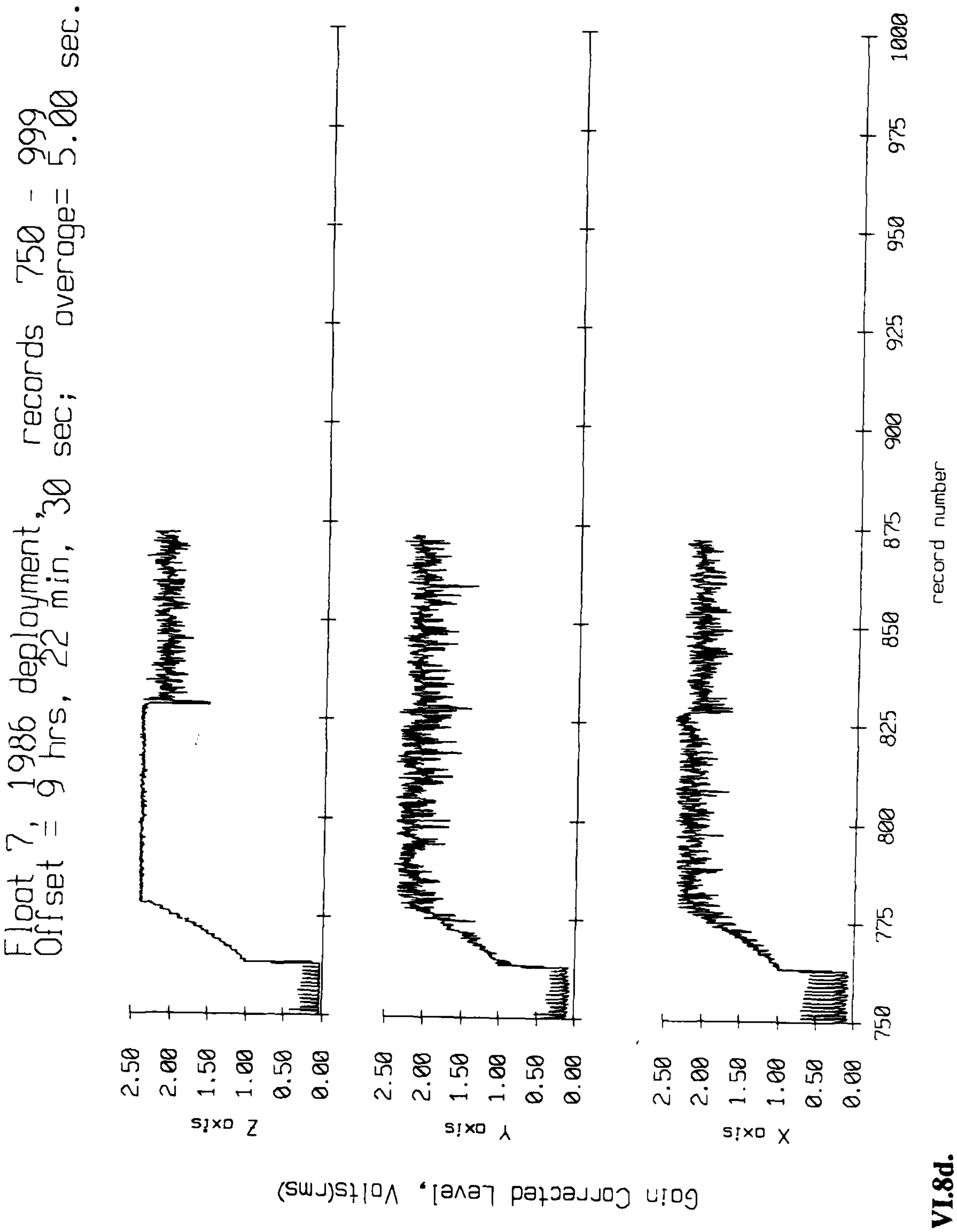

Float 7, 1986 deployment records 750 - 999
Offset = 9 hrs, 22 min, 30 sec; average= 5.00 sec.
Z axis
Y axis
X axis
Gain Corrected Level, Volts(rms)
2.50
2.00
1.50
1.00
0.50
0.00
750
775
800
825
850
875
900
925
950
975
1000
record number

Figure VI.8d.

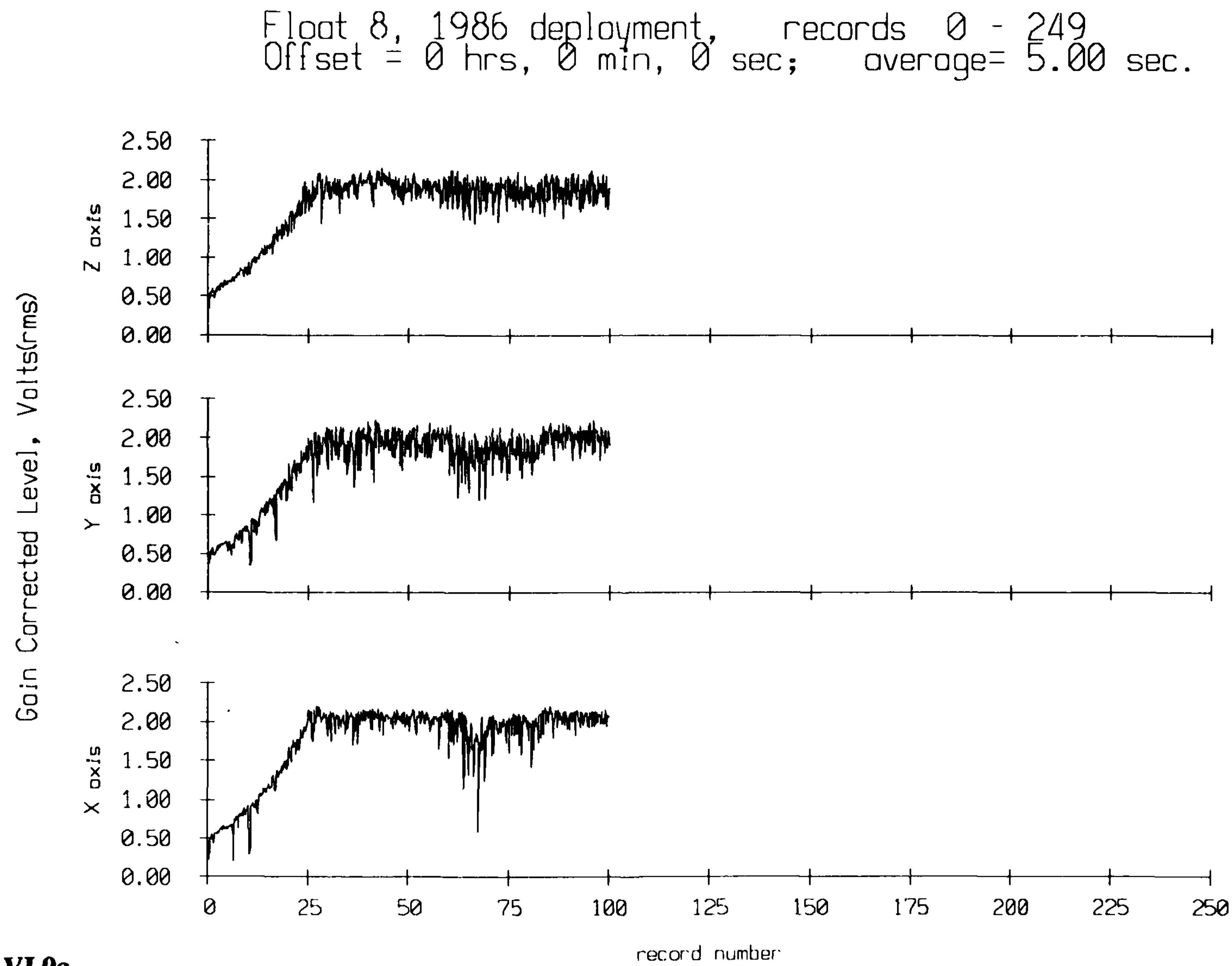

Float 8, 1986 deployment, records 0 - 249
Offset = 0 hrs, 0 min, 0 sec; average= 5.00 sec.
Gain Corrected Level, Volts(rms)
Z axis
Y axis
X axis
2.50
2.00
1.50
1.00
0.50
0.00
0
25
50
75
100
125
150
175
200
225
250
record number

Figure VI.9a.

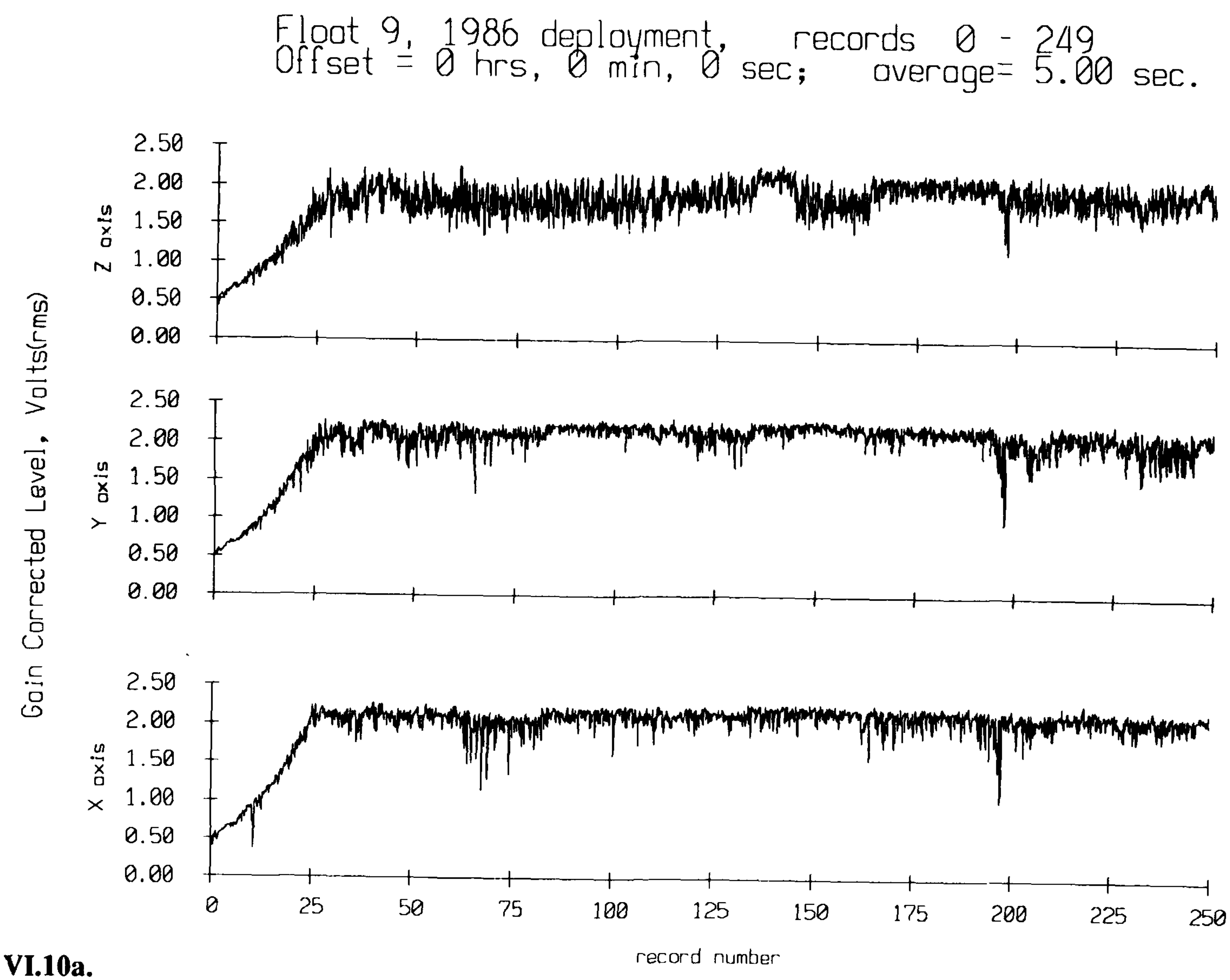


Figure VI.10a.

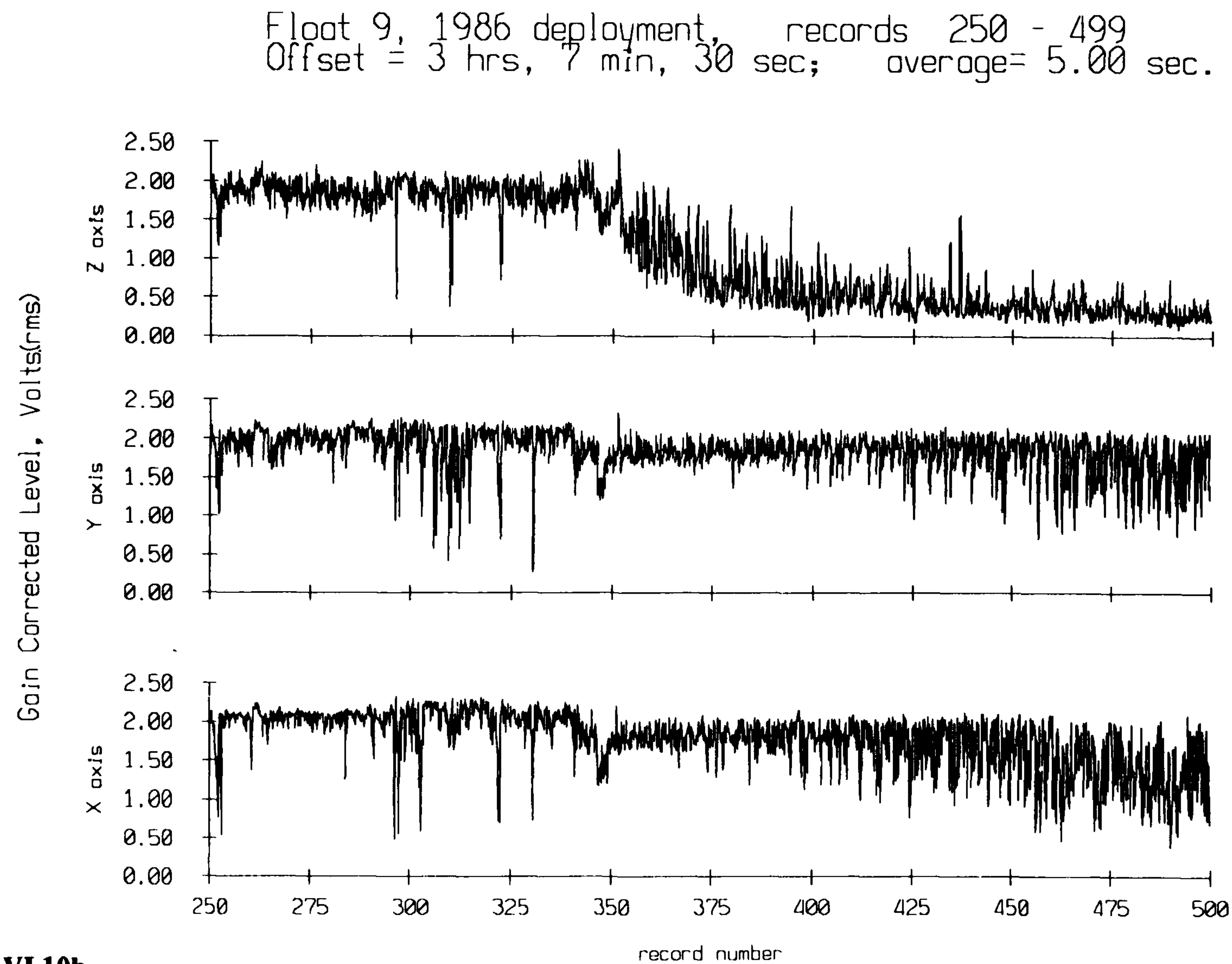


Figure VI.10b.

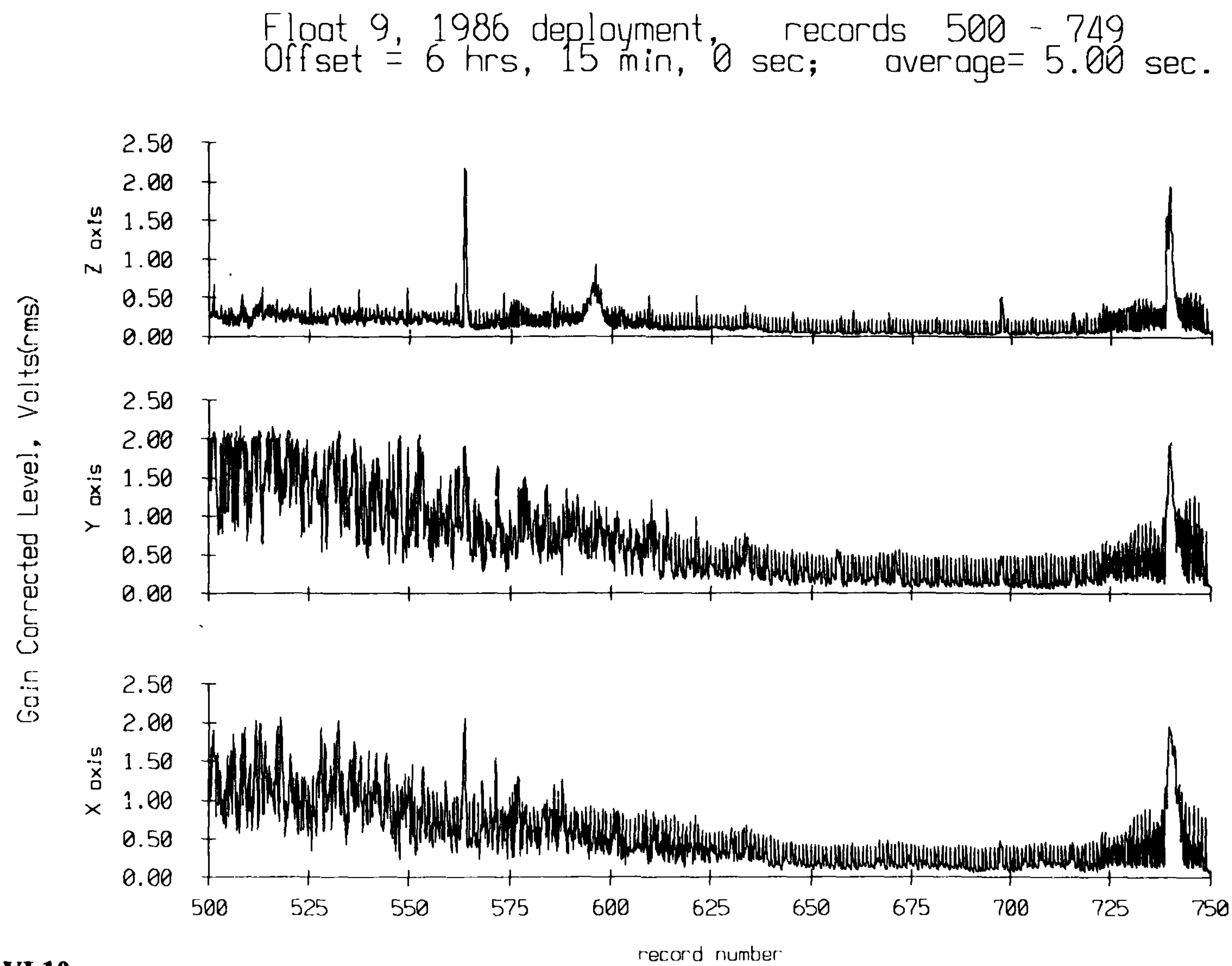


Figure VI.10c.

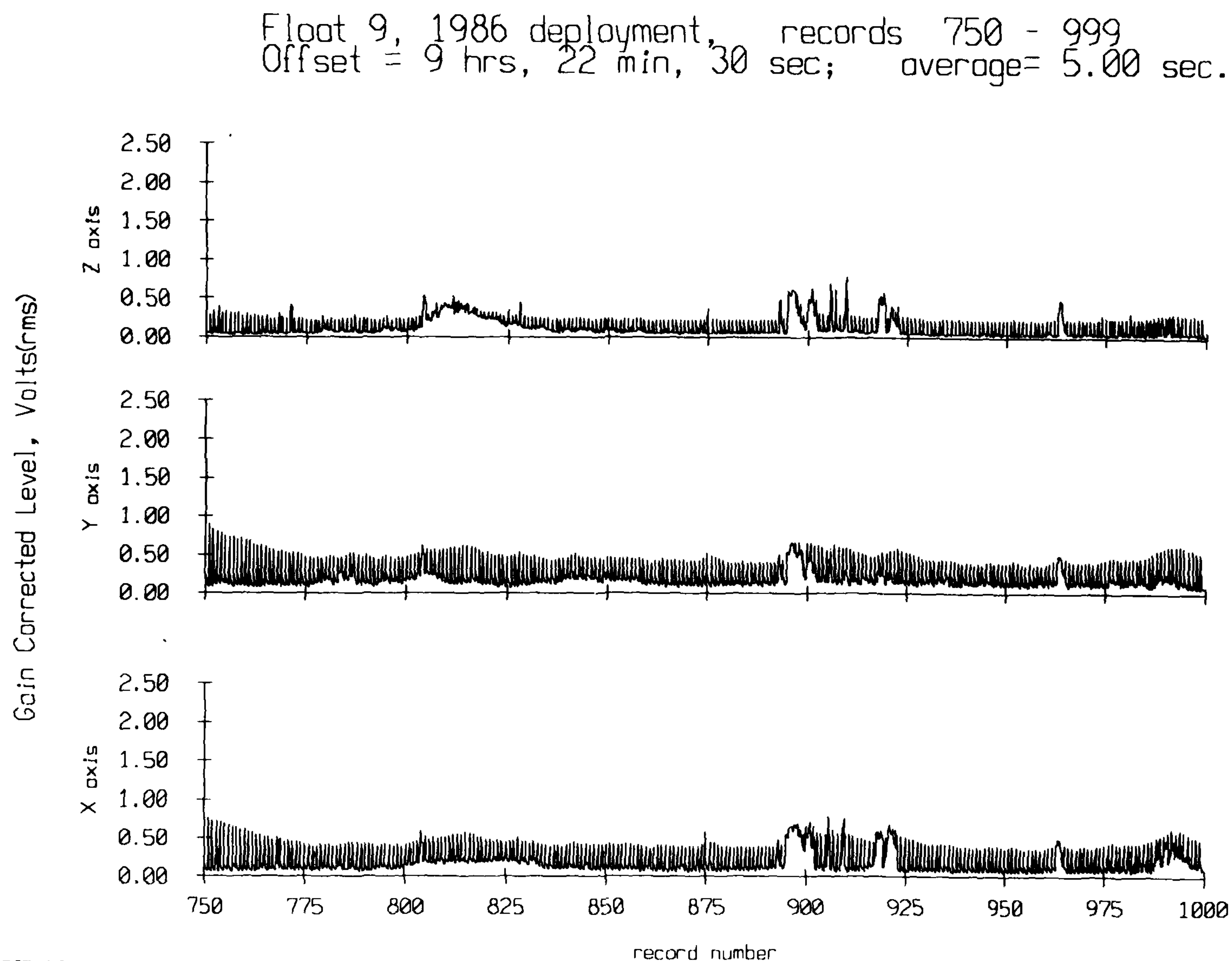


Figure VI.10d.

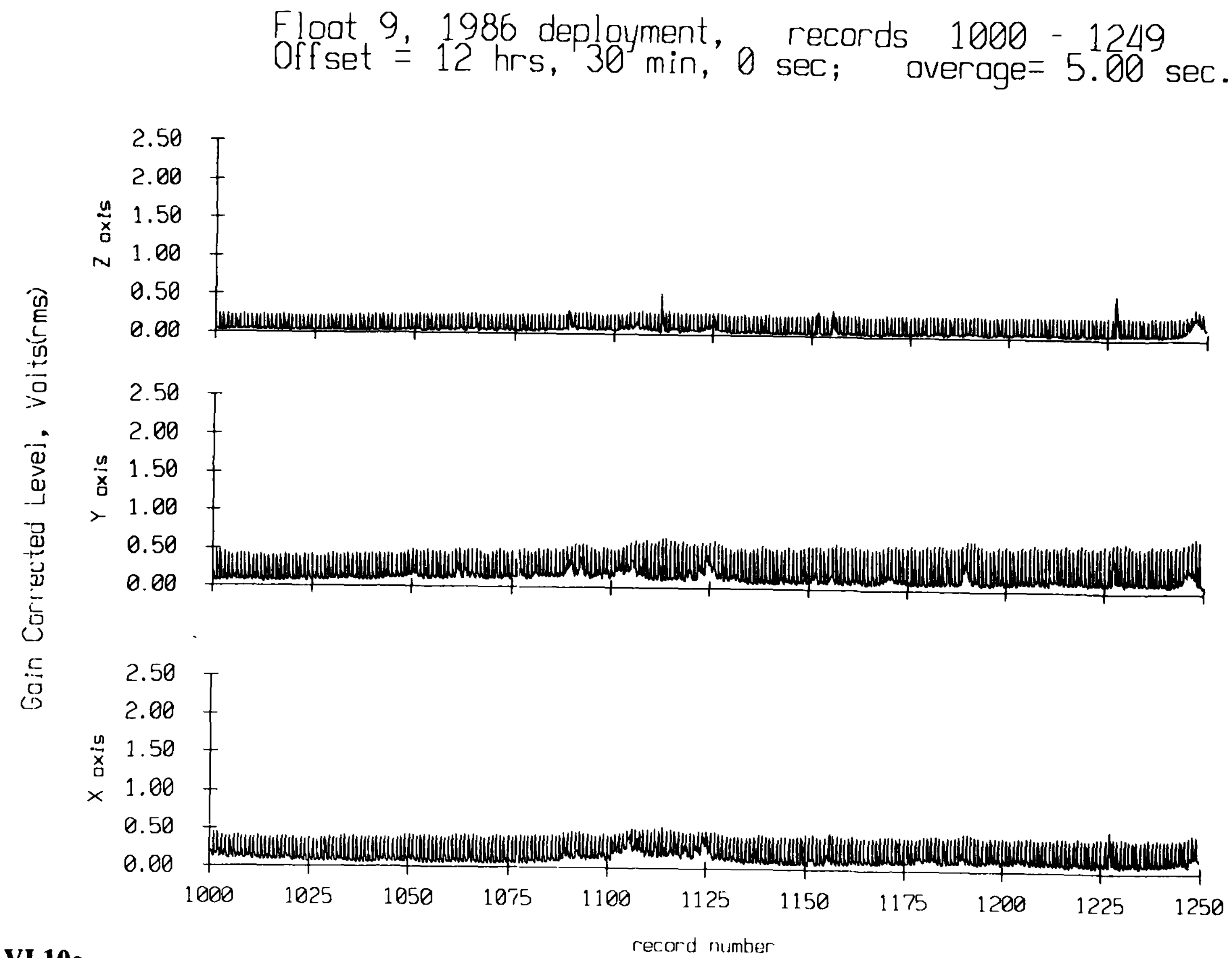


Figure VI.10e.

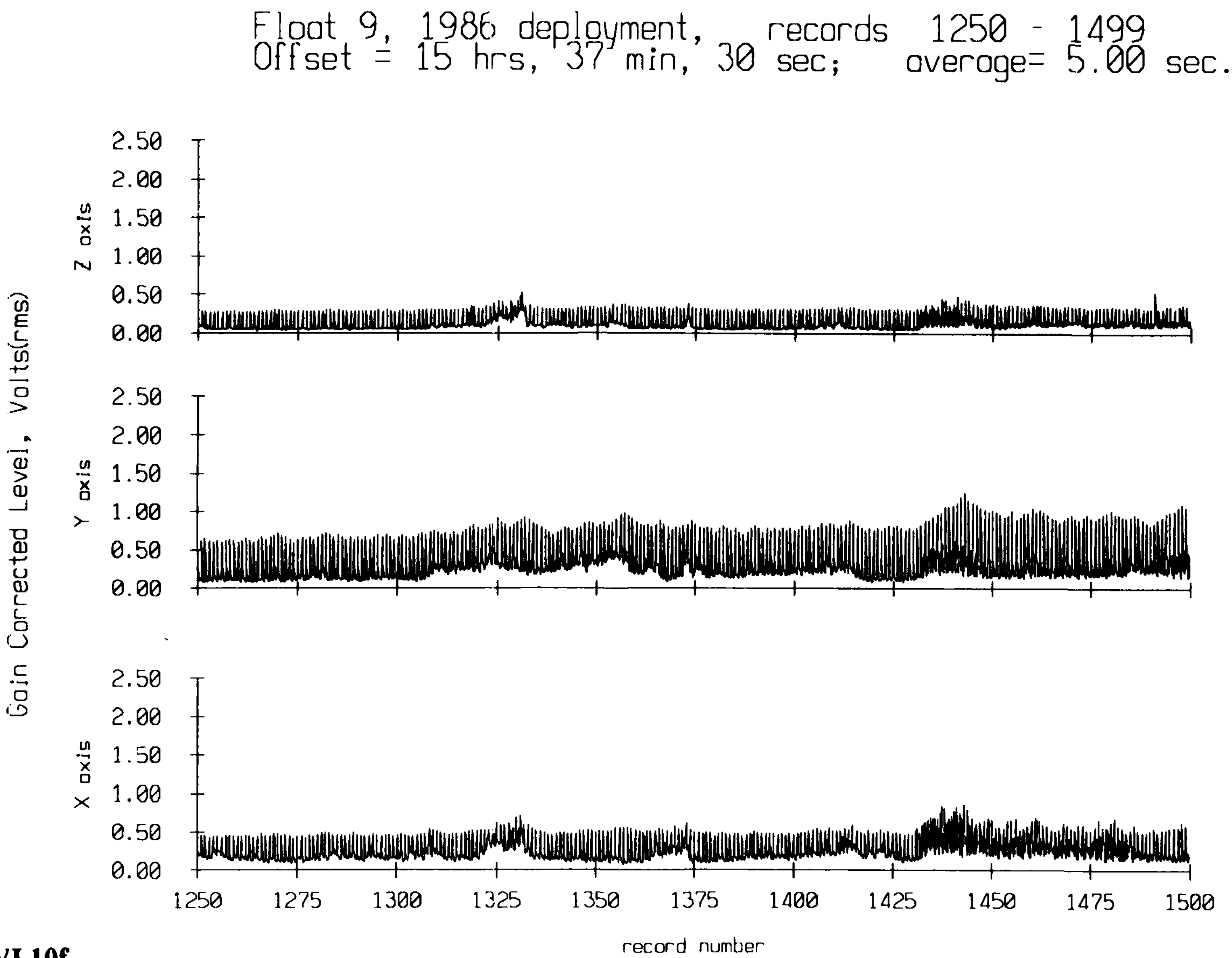


Figure VI.10f.

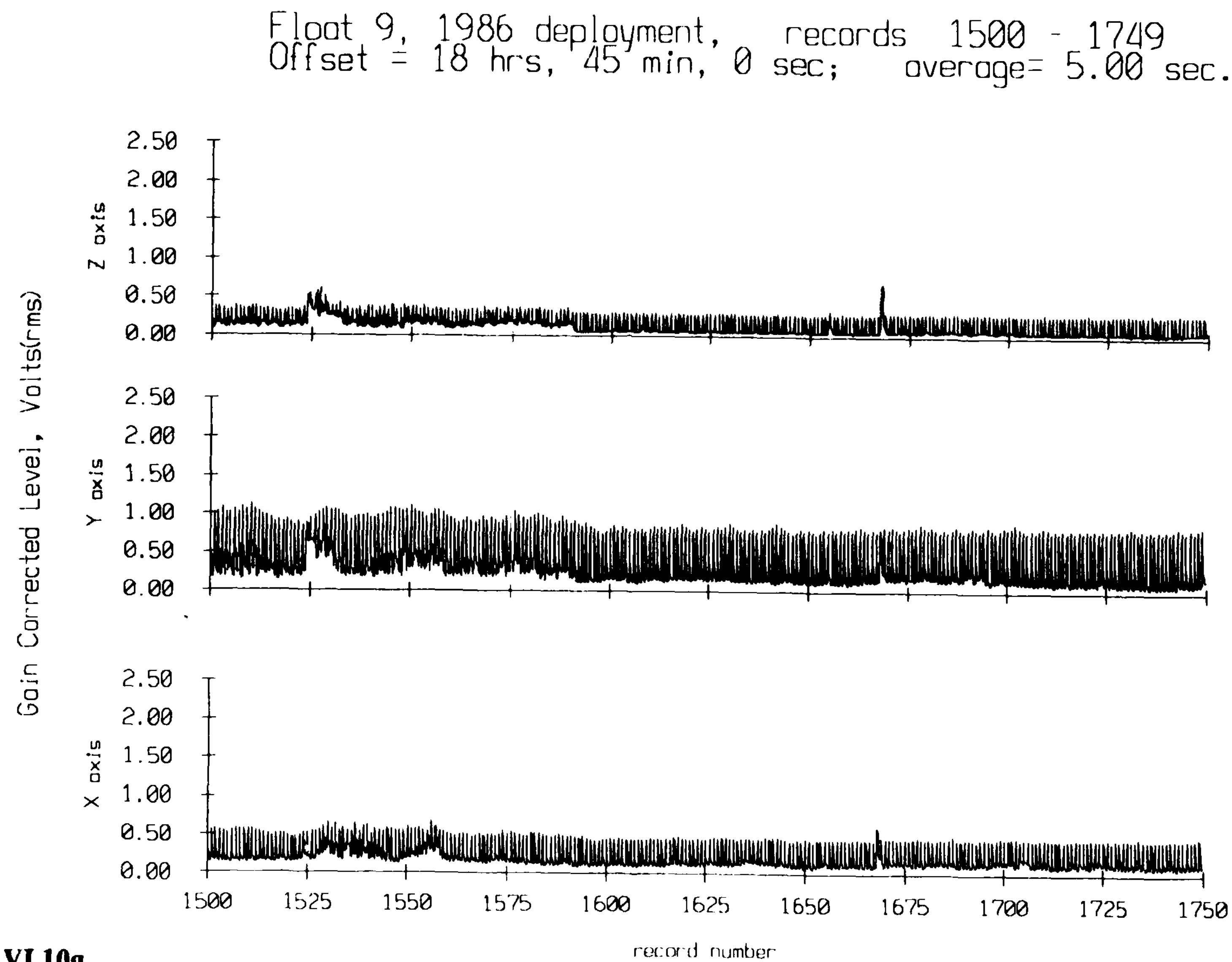


Figure VI.10g.

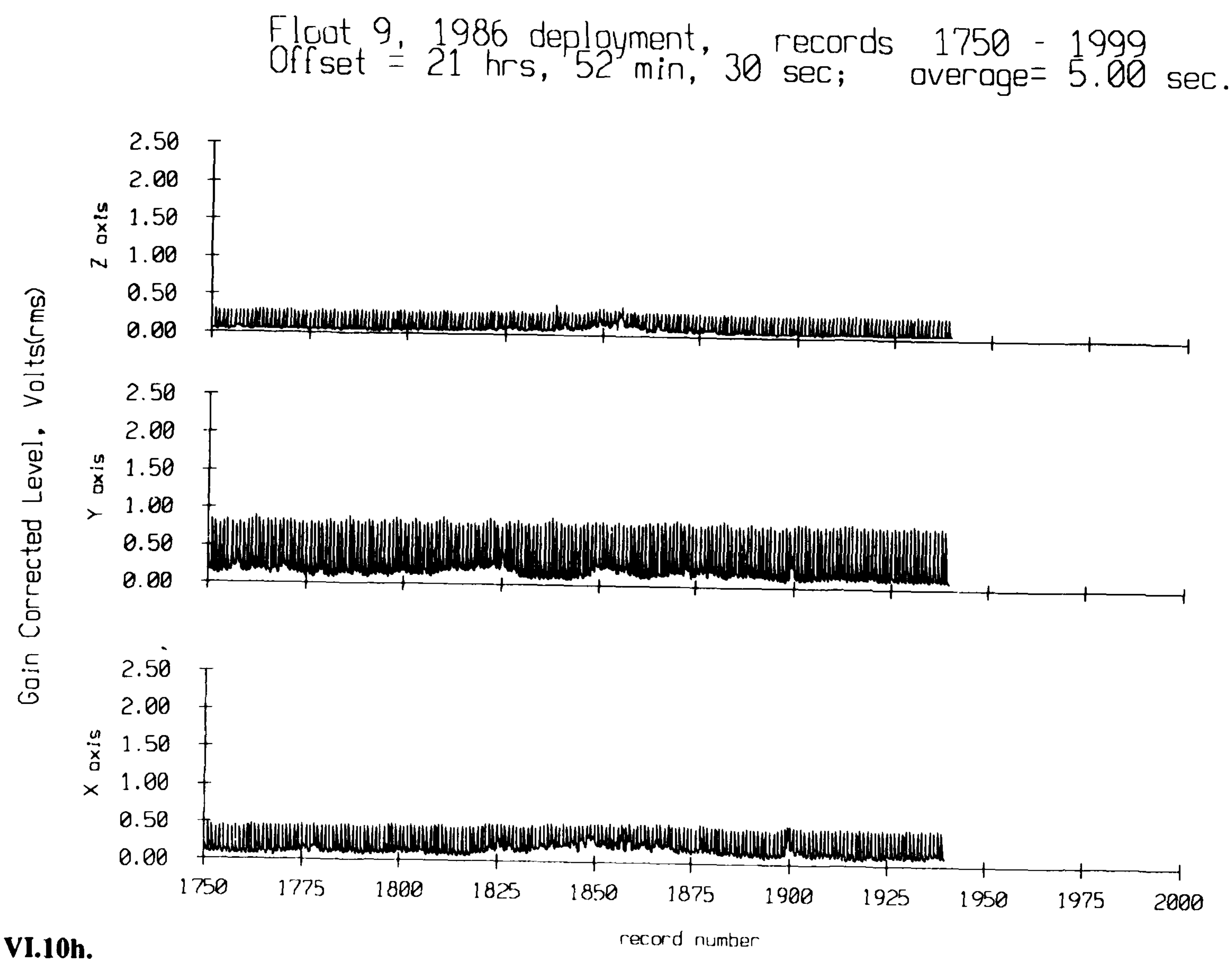


Figure VI.10h.

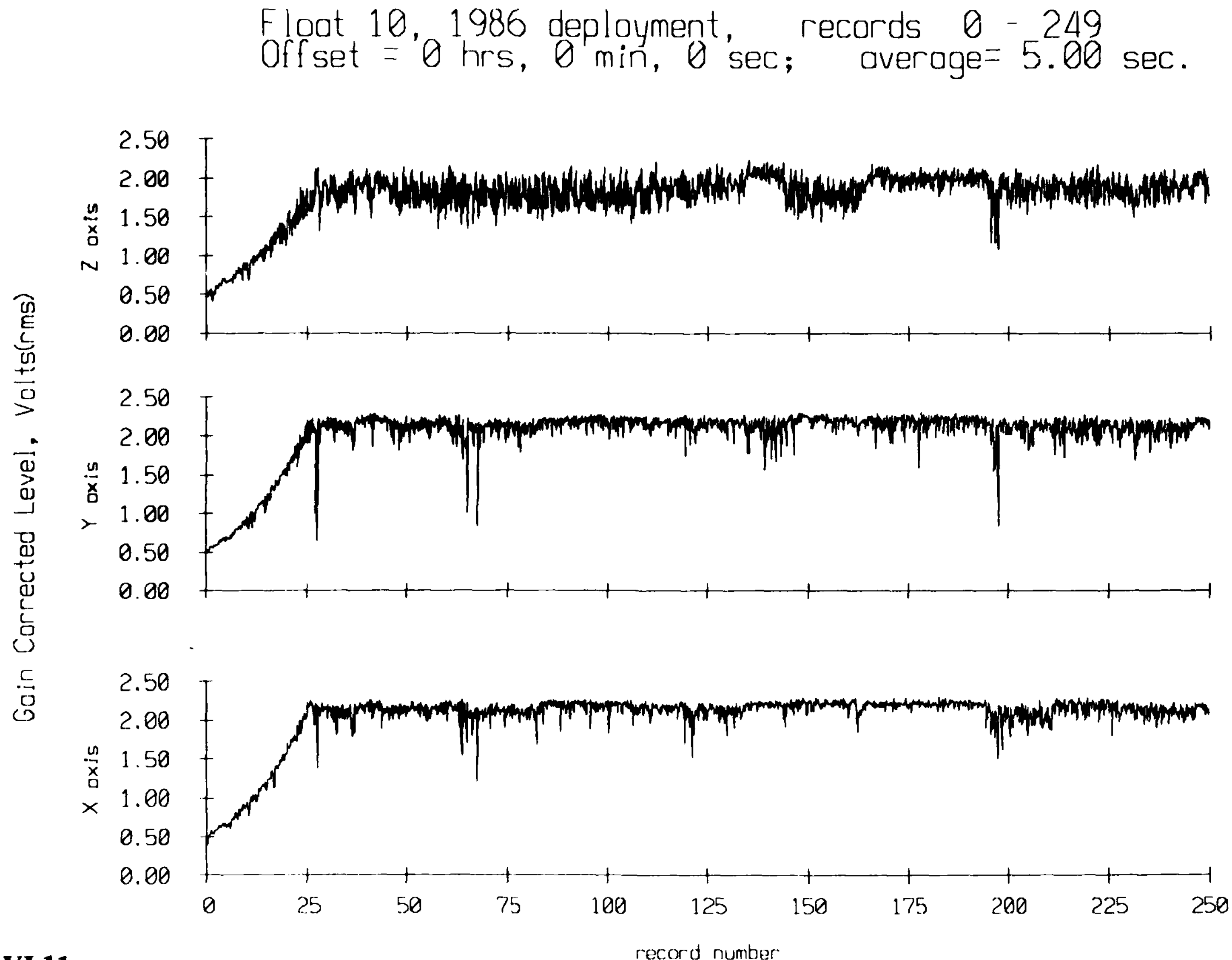


Figure VI.11a.

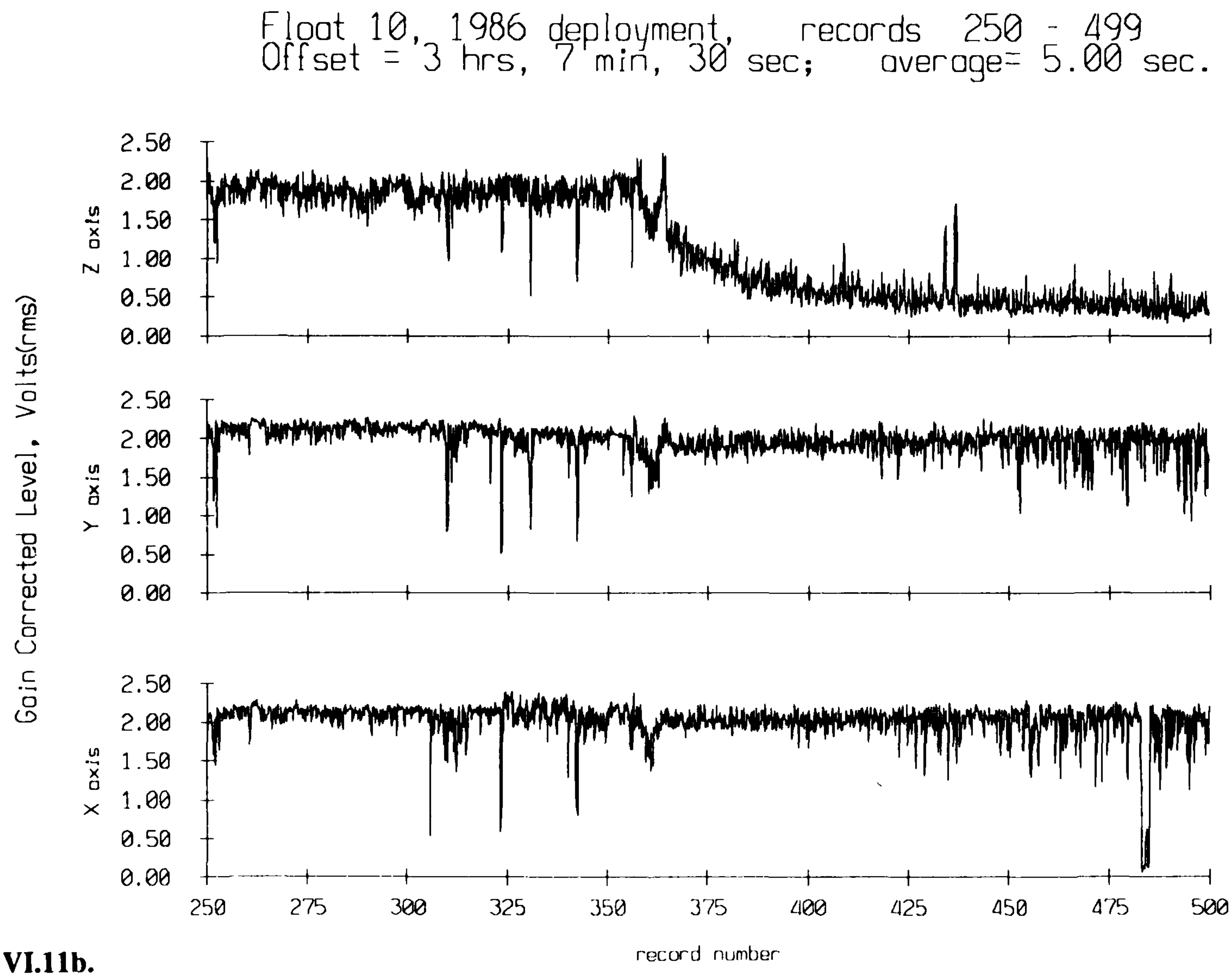


Figure VI.11b.

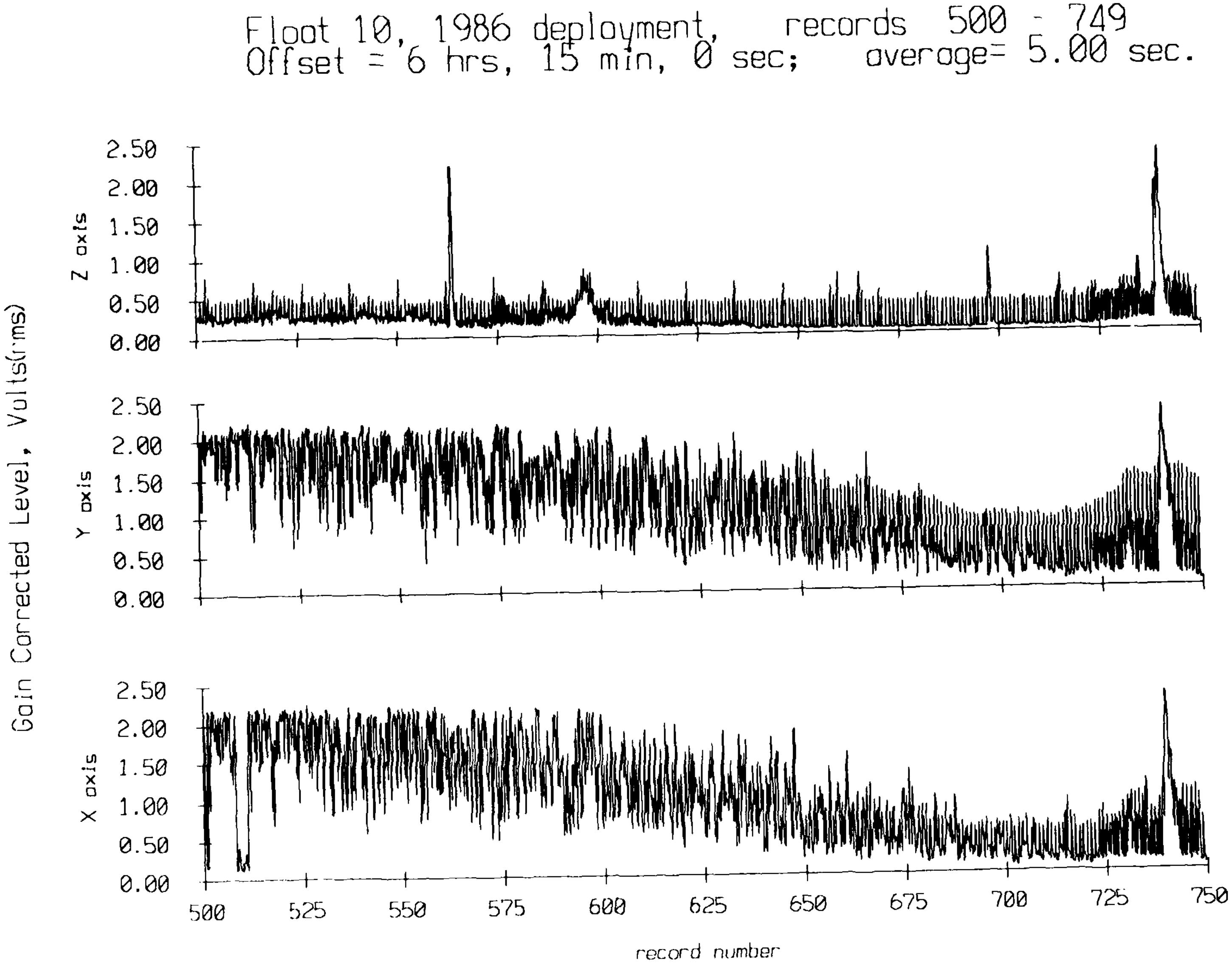


Figure VI.11c.

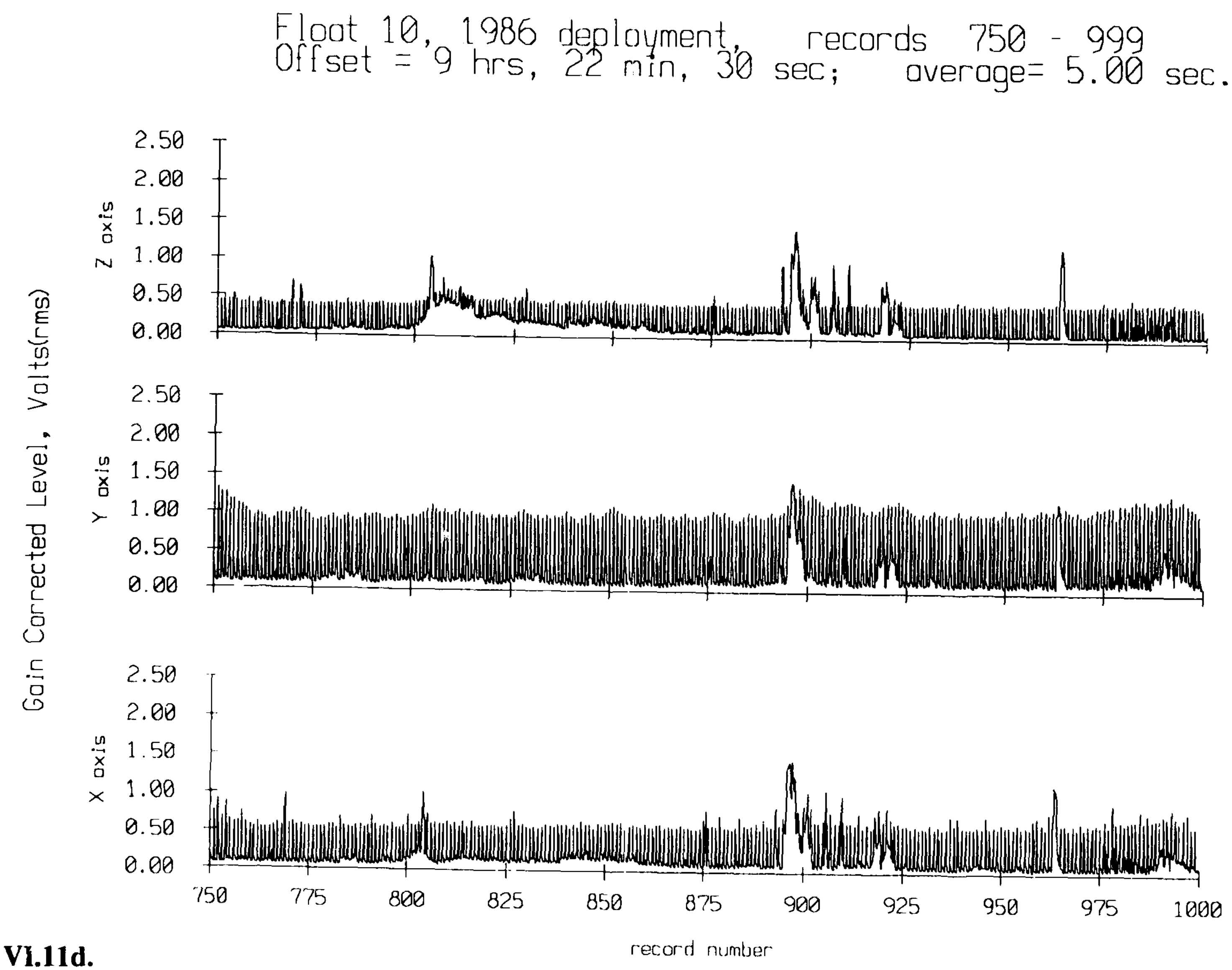


Figure VI.11d.

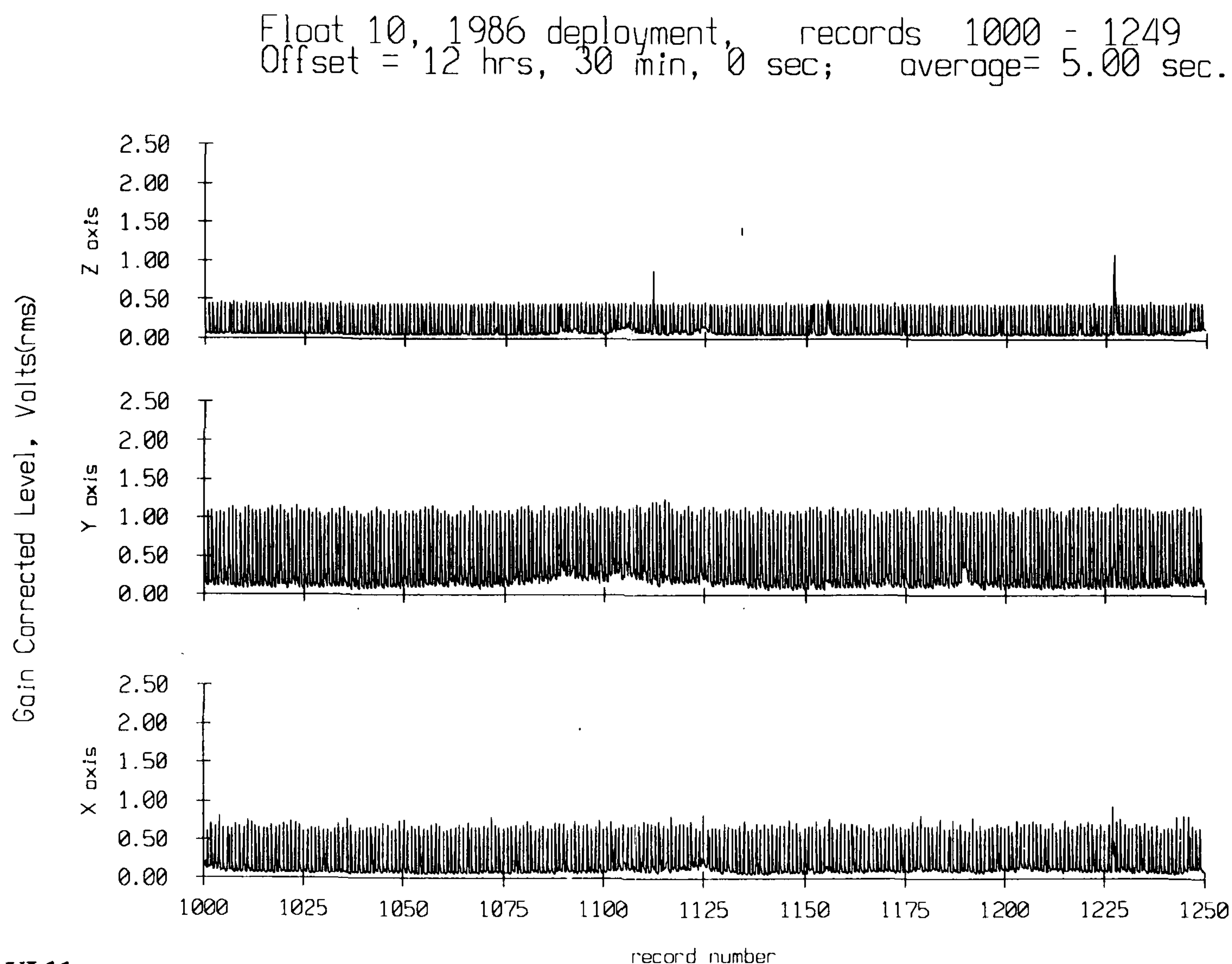


Figure VI.11e.

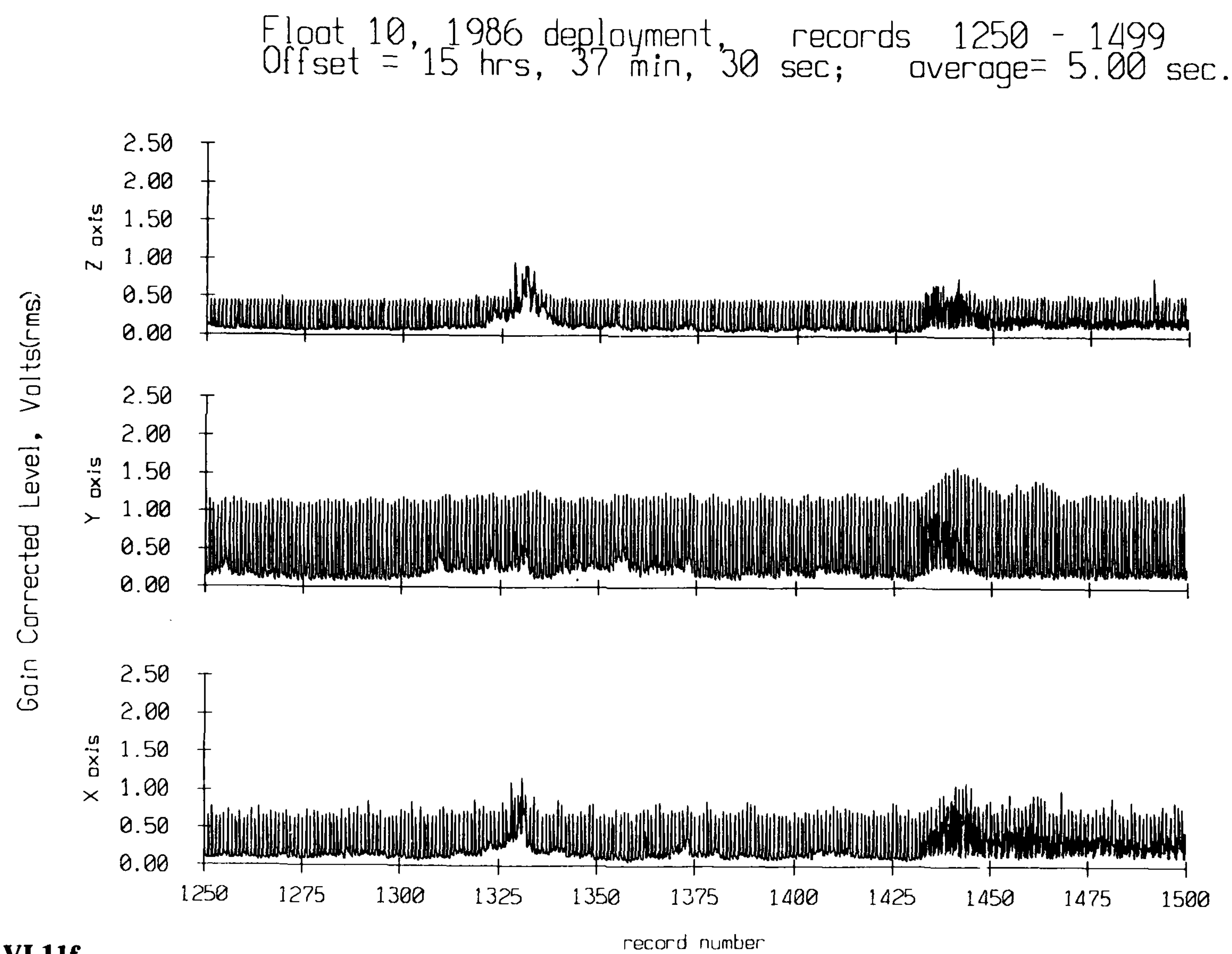


Figure VI.11f.

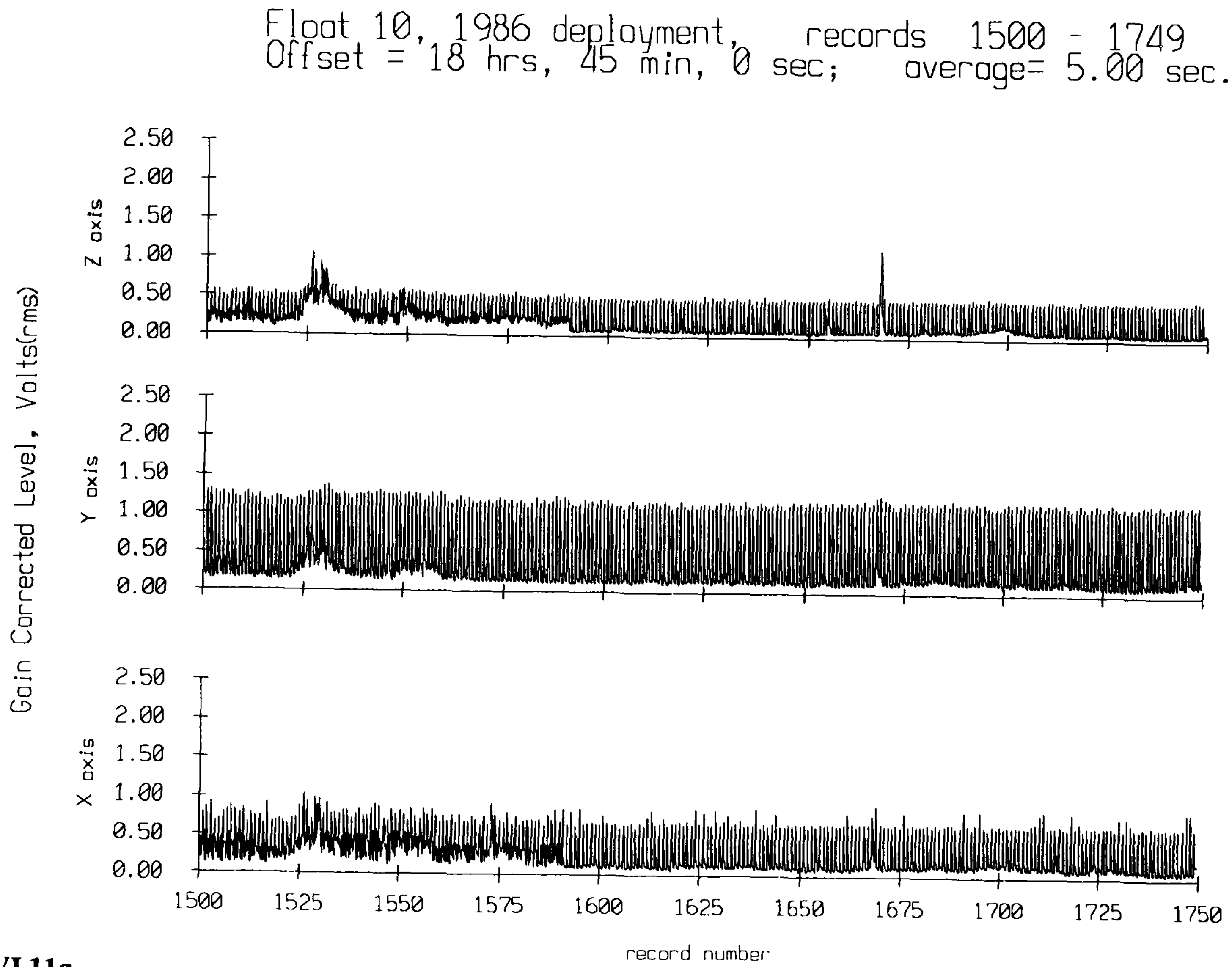


Figure VI.11g.

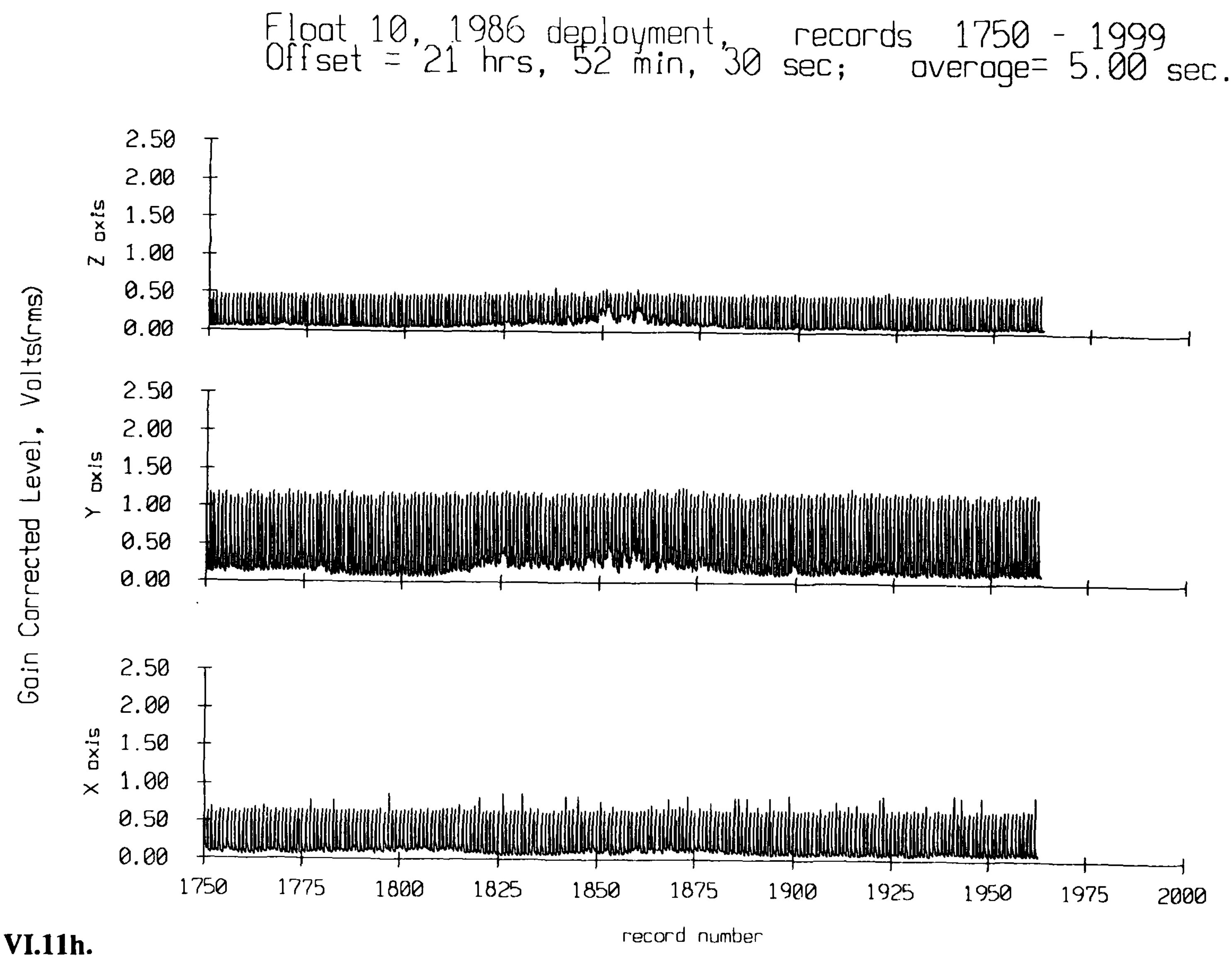


Figure VI.11h.

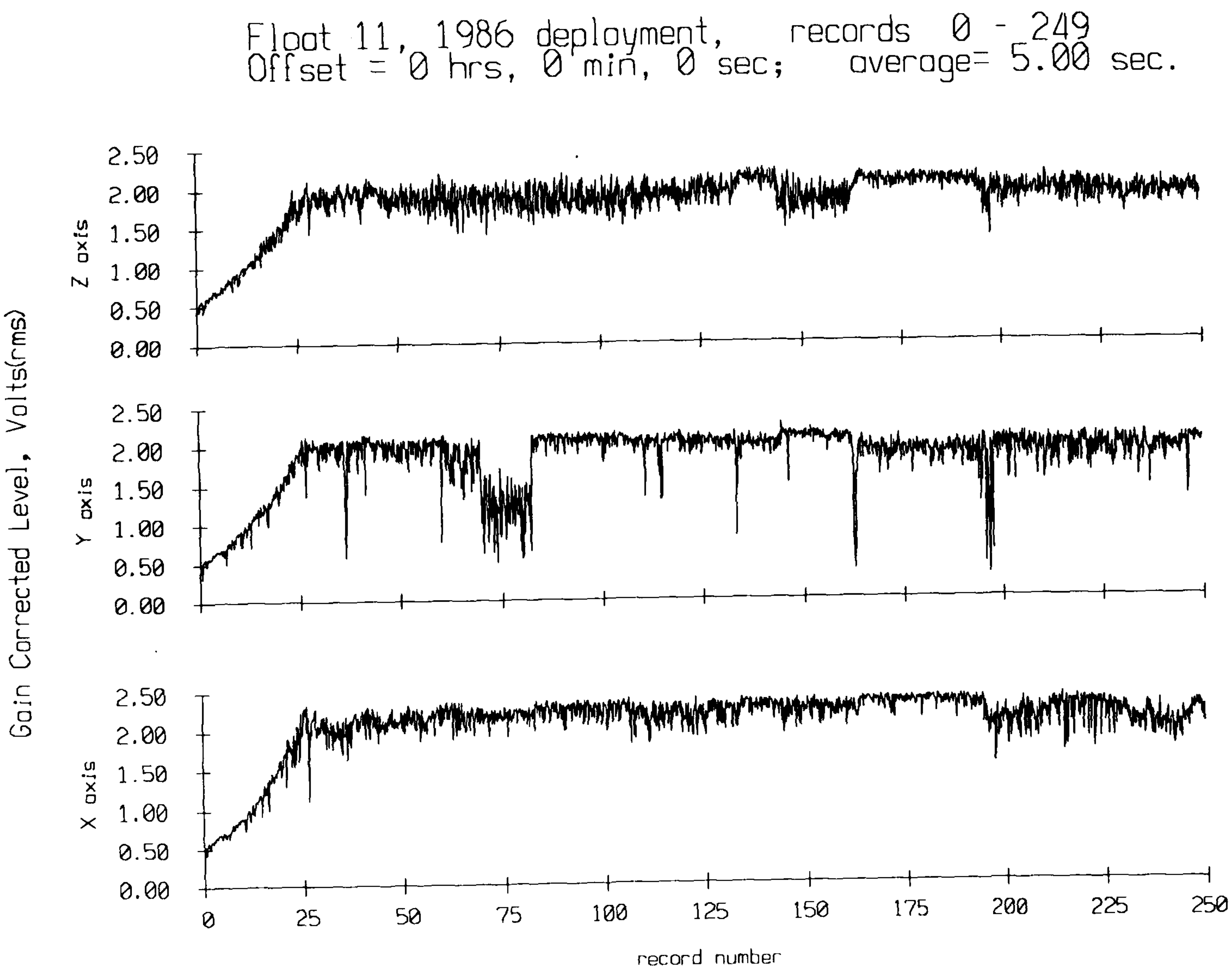


Figure VI.12a.

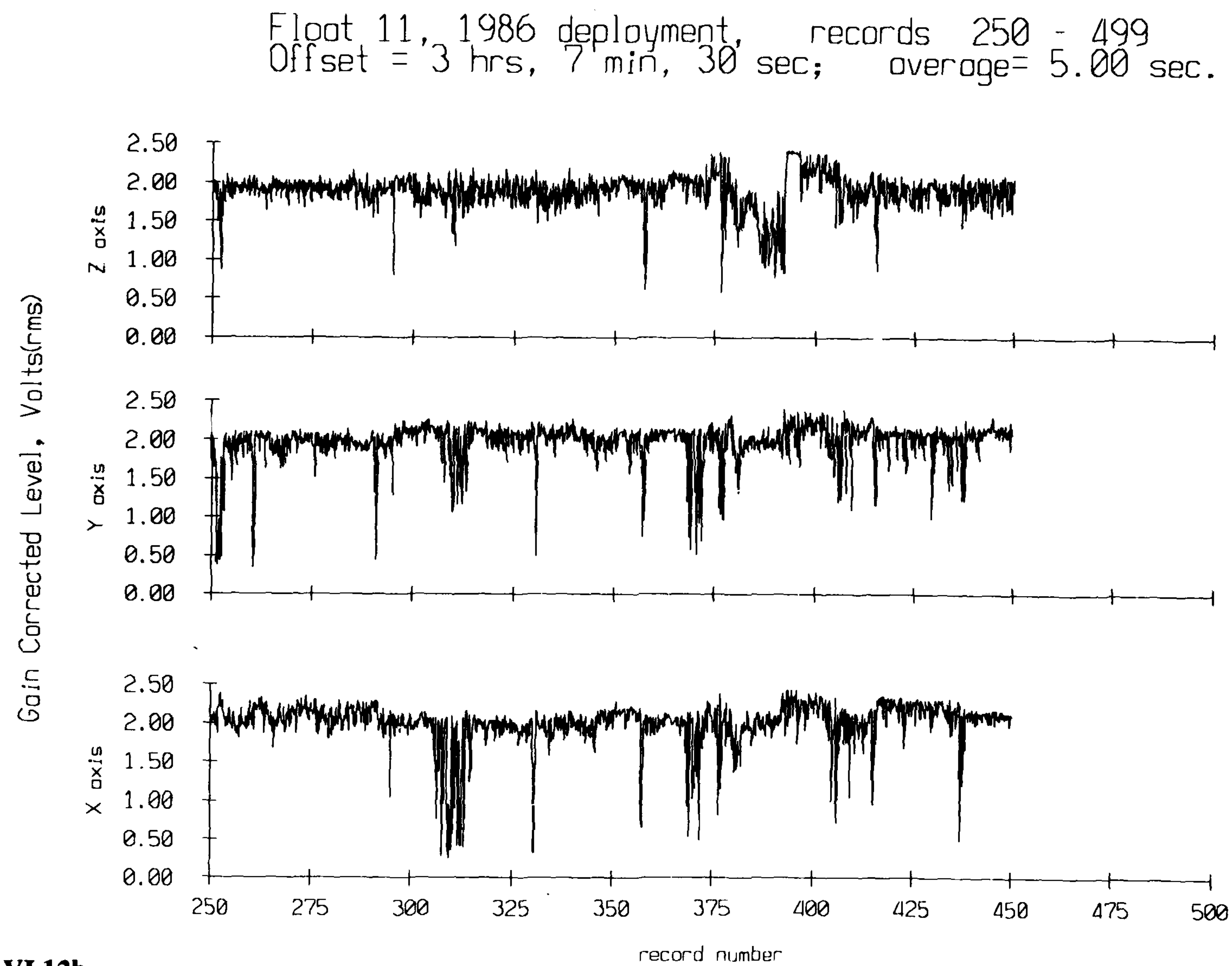


Figure VI.12b.

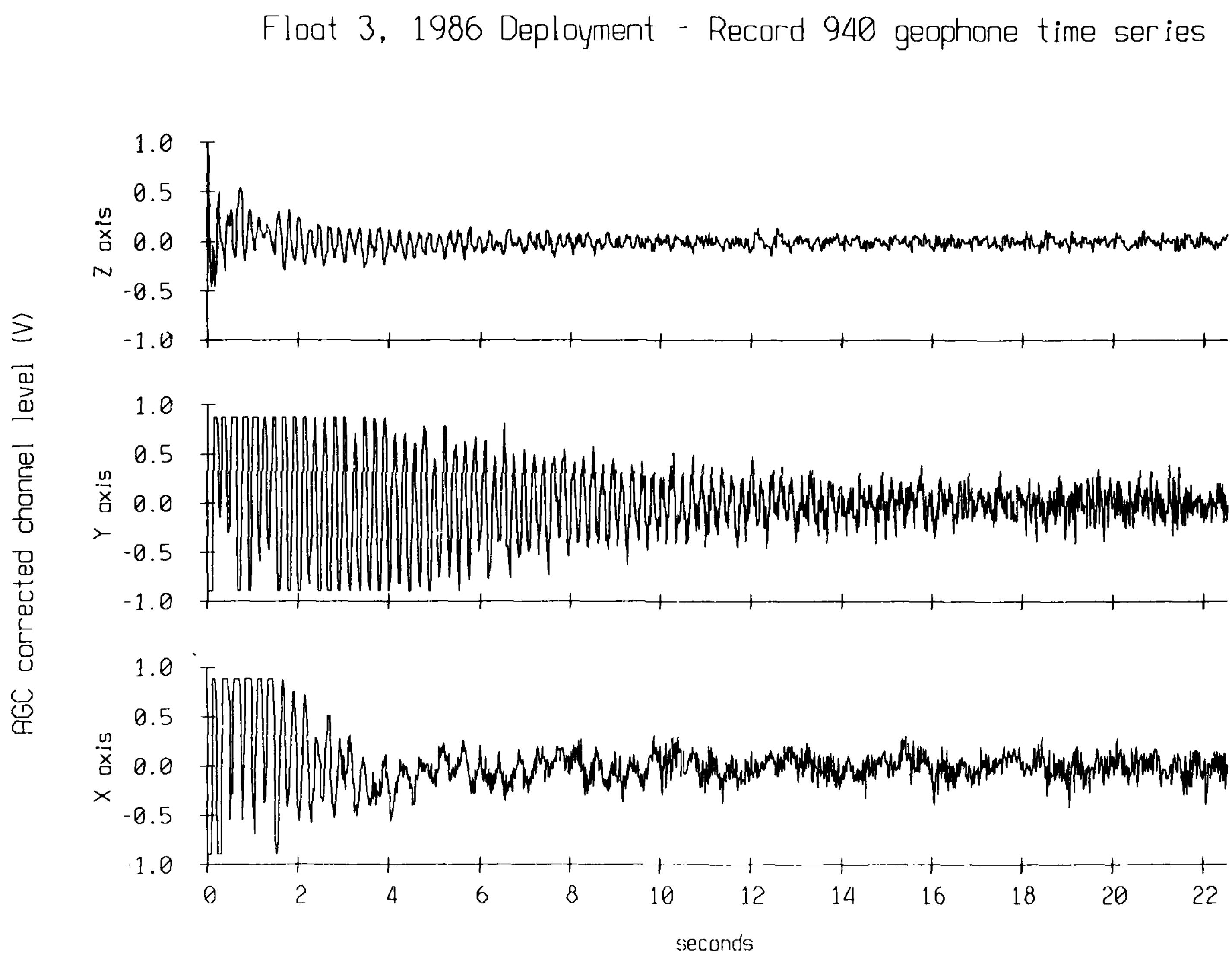


Figure VII.1a.

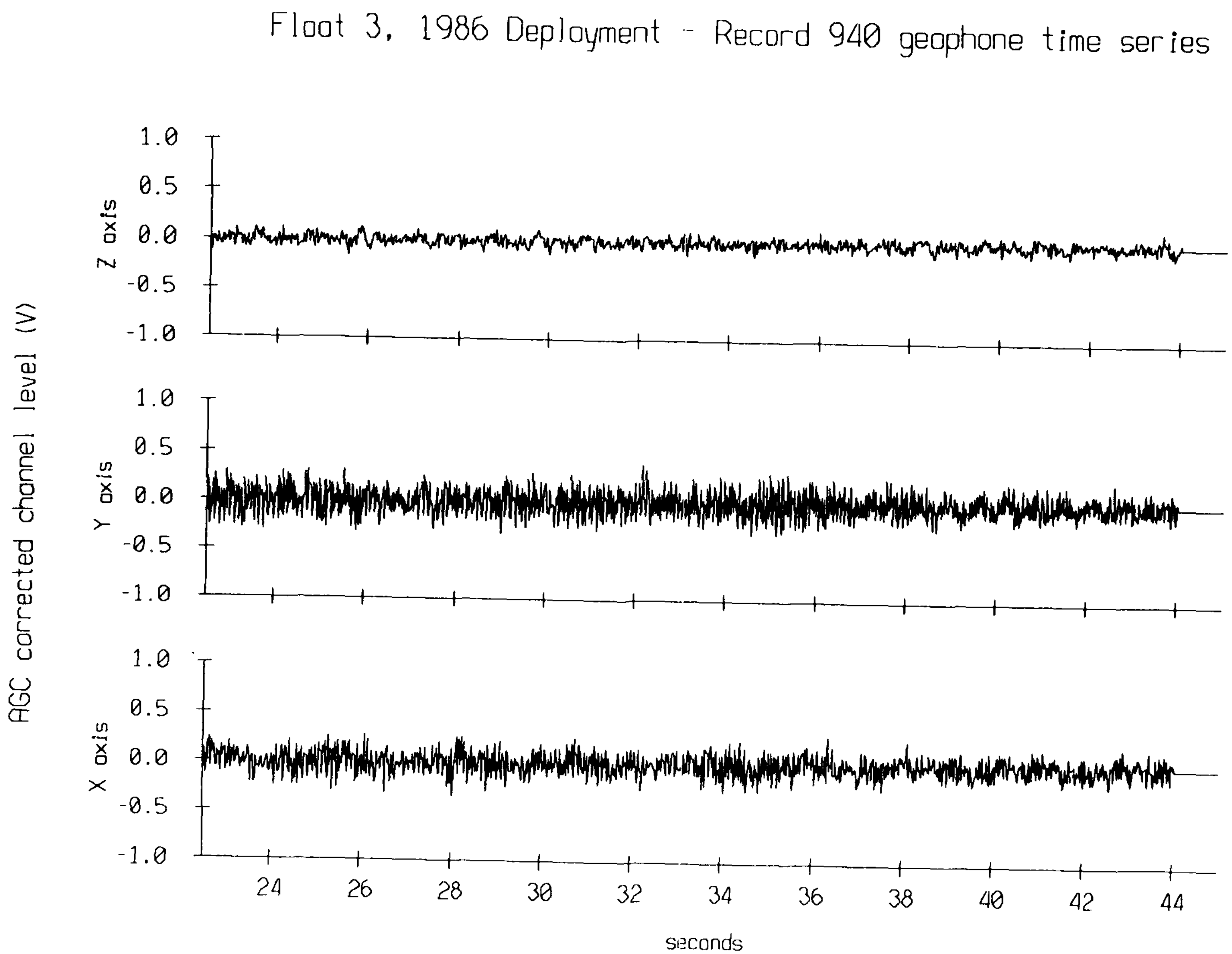


Figure VII.1b.

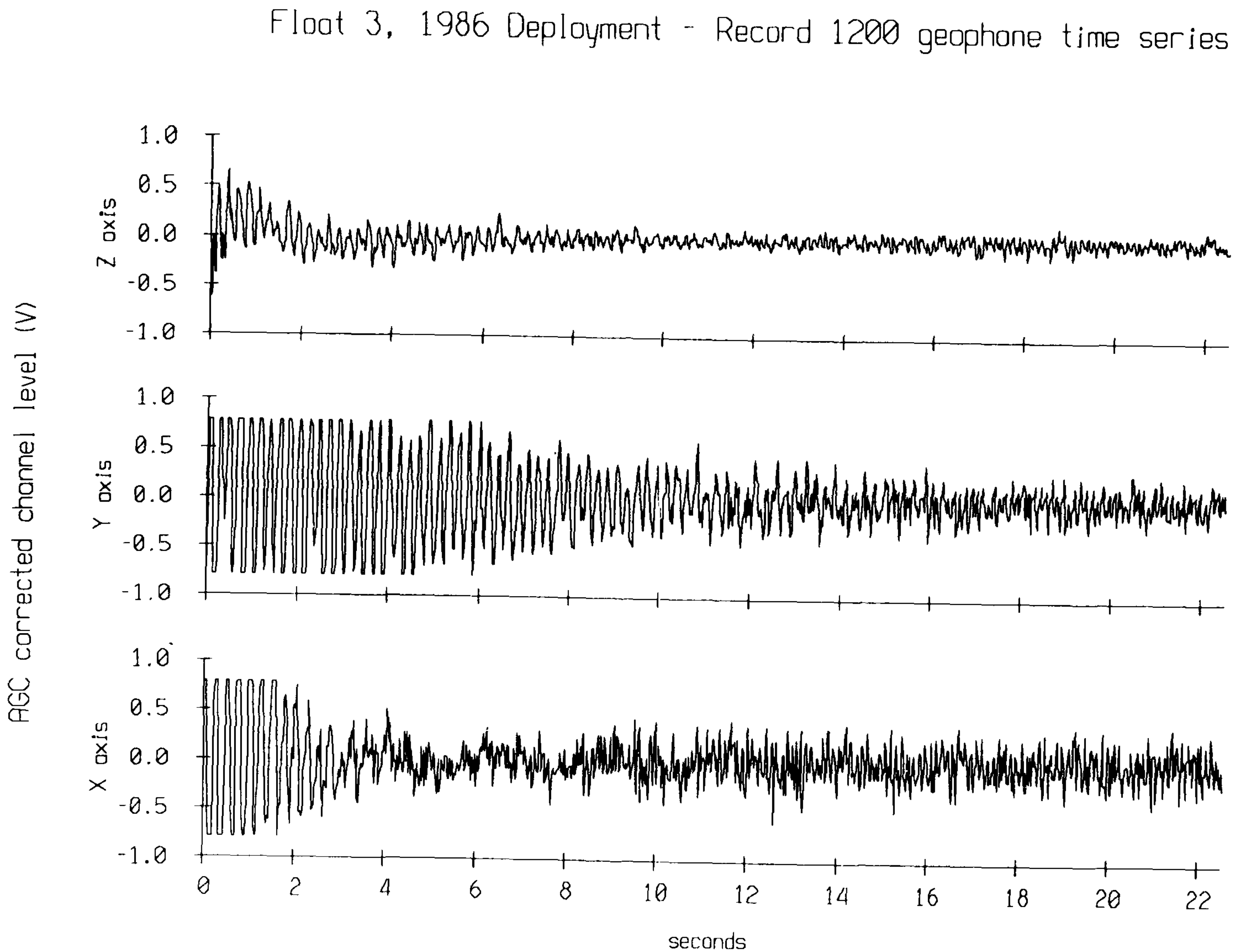


Figure VII.2a.

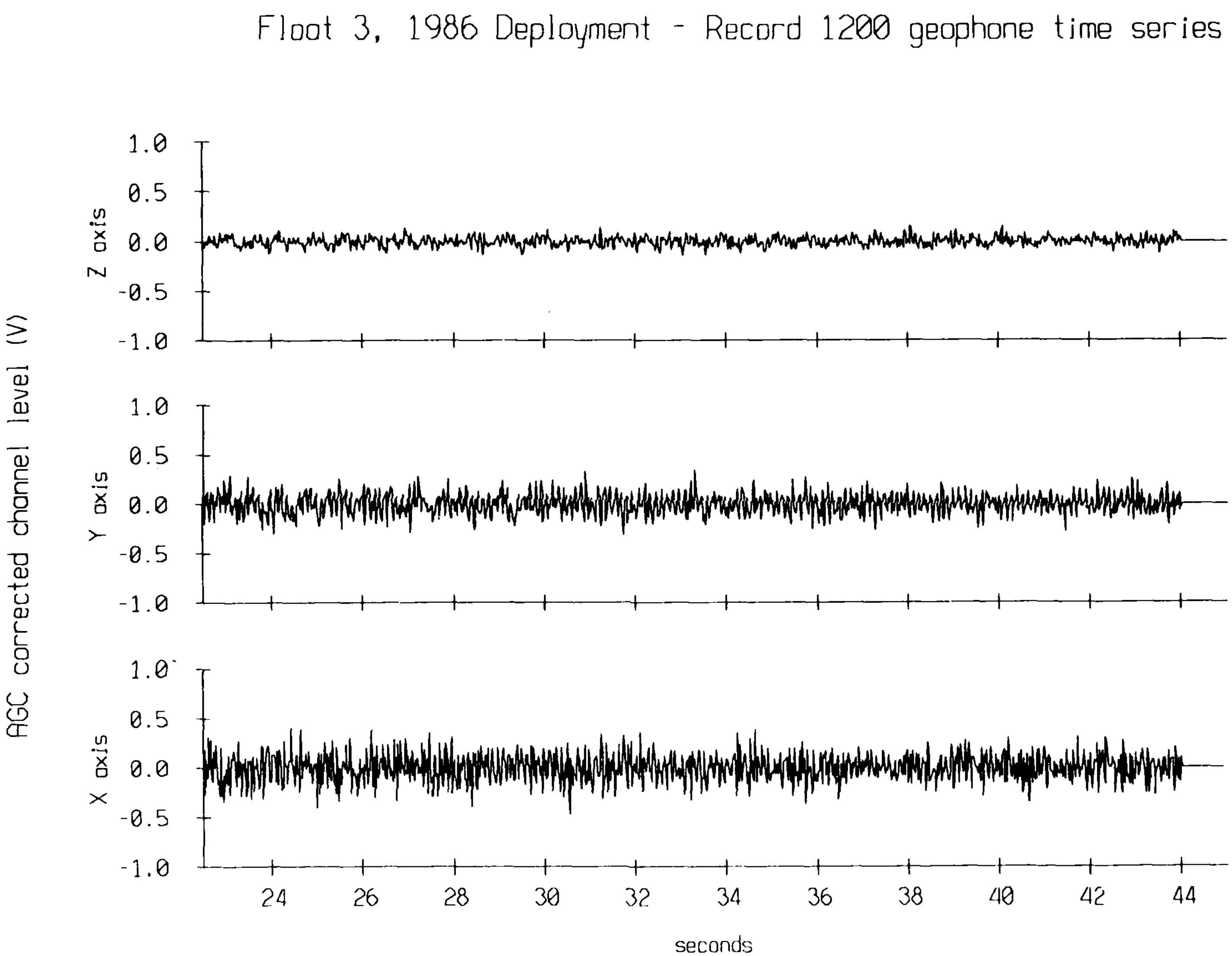


Figure VII.2b.

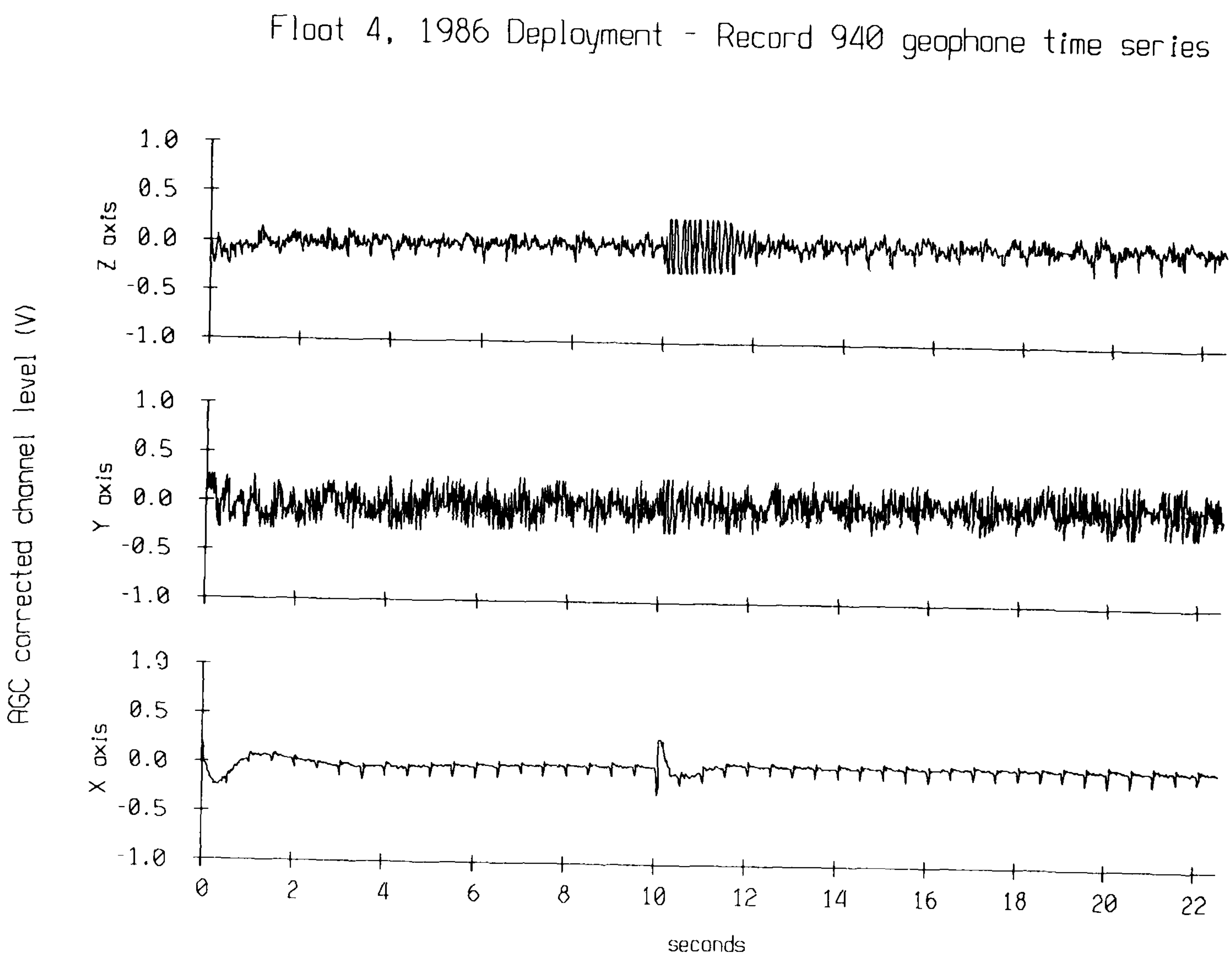


Figure VII.3a.

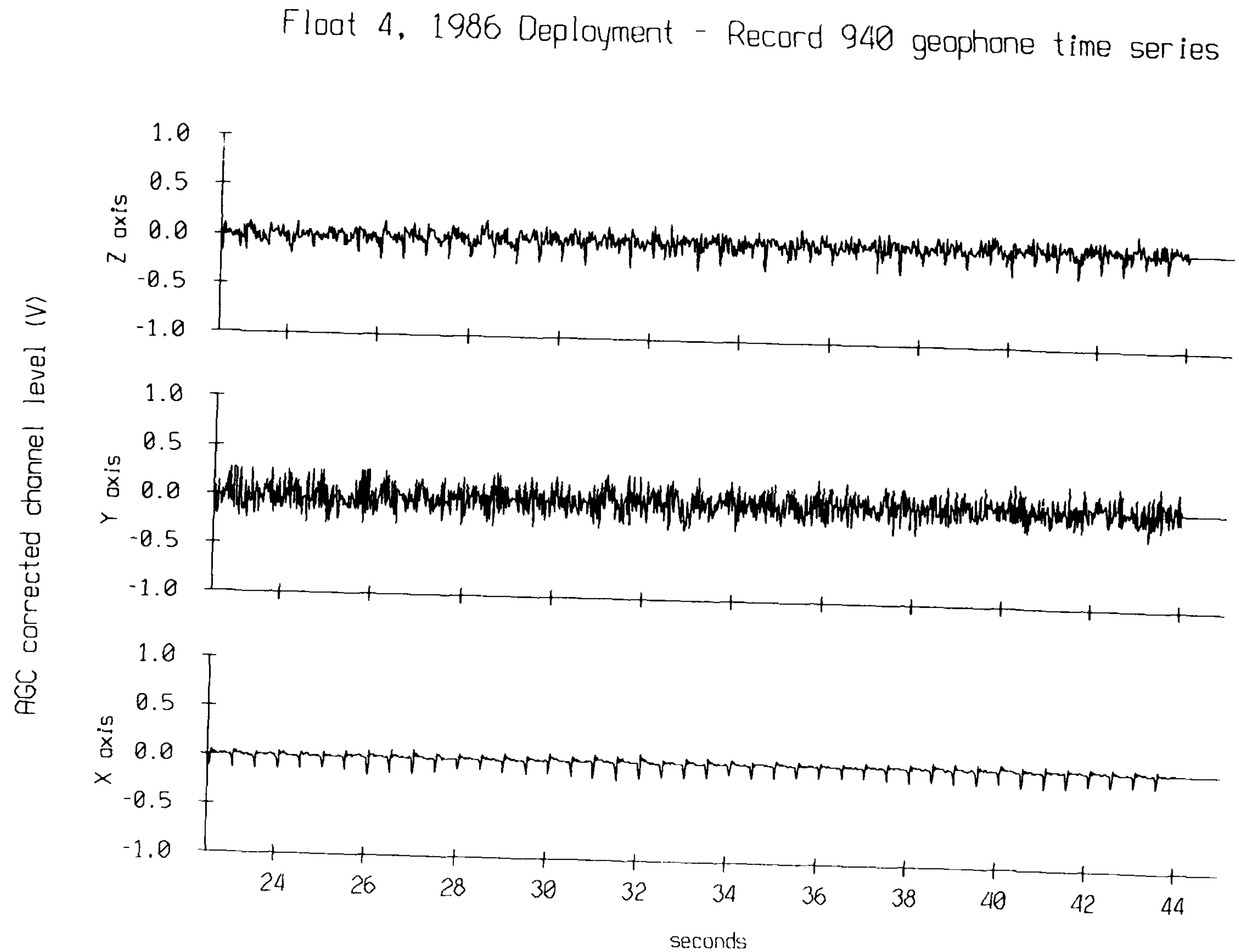
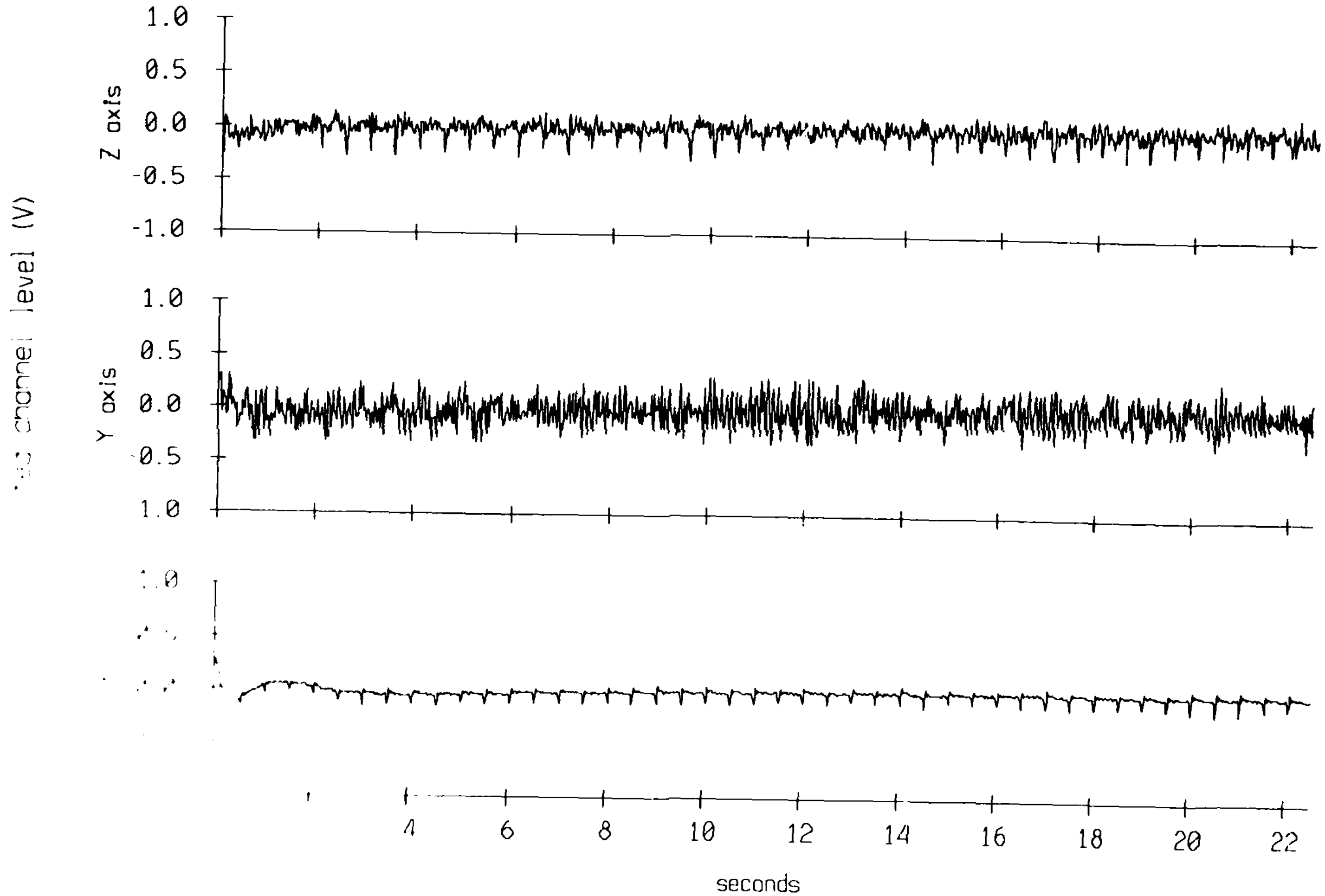


Figure VII.3b.

Float 4, 1986 Deployment - Record 1200 geophone time series



AD-A189 637 FREELY DRIFTING SWALLOW FLOAT ARRAY: SEPTEMBER 1986 TRIP REPORT(U) SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA CA MARINE PHYSIC.. R L CULVER ET AL. APR 87 3/3

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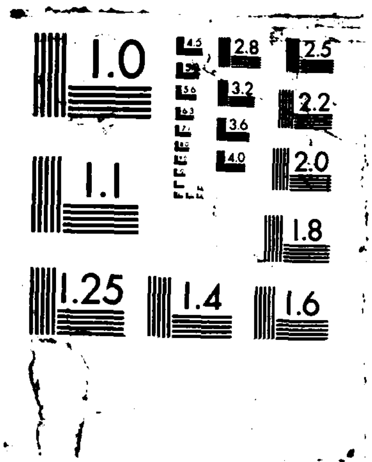
1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

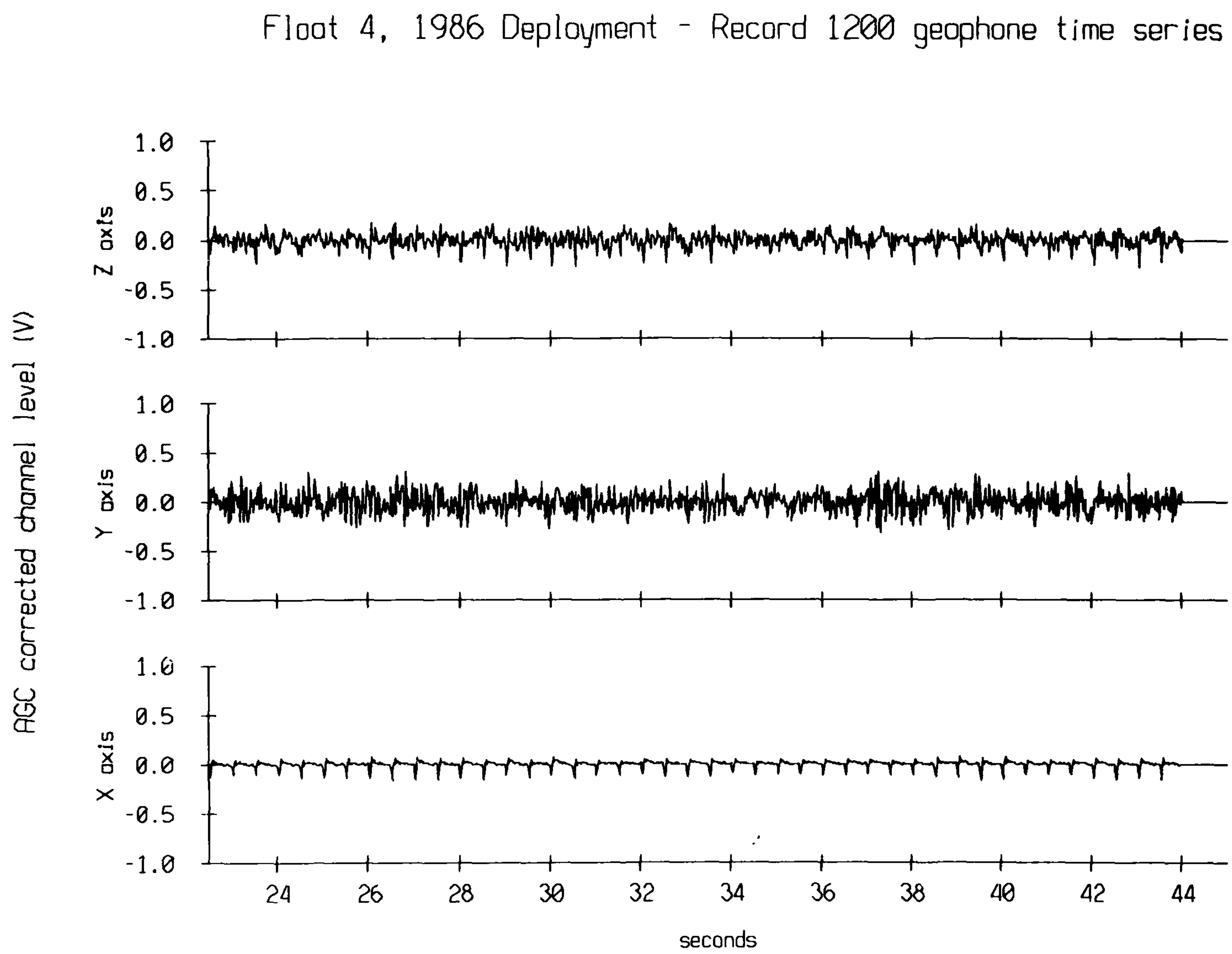

Figure VII.4b.

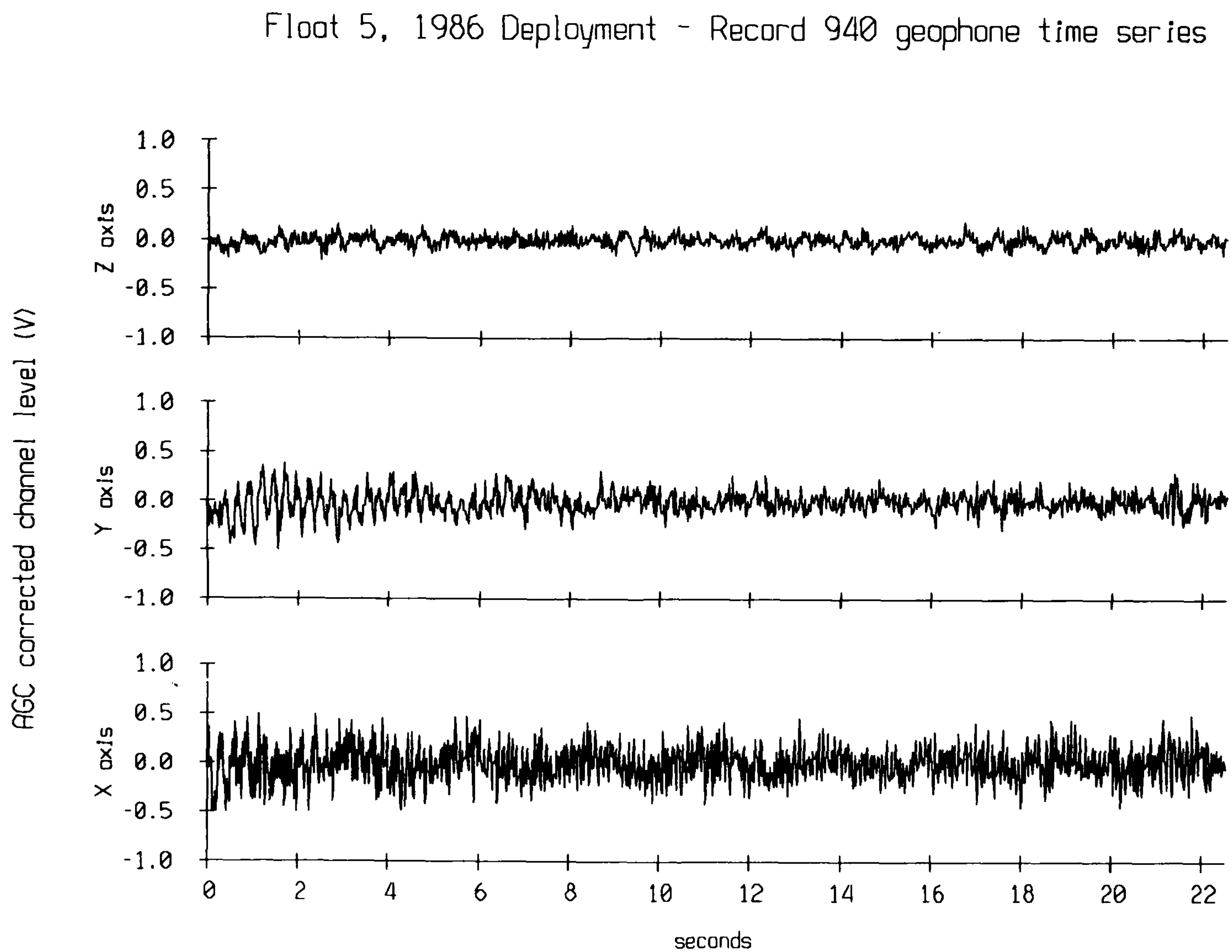

Figure VII.5a.

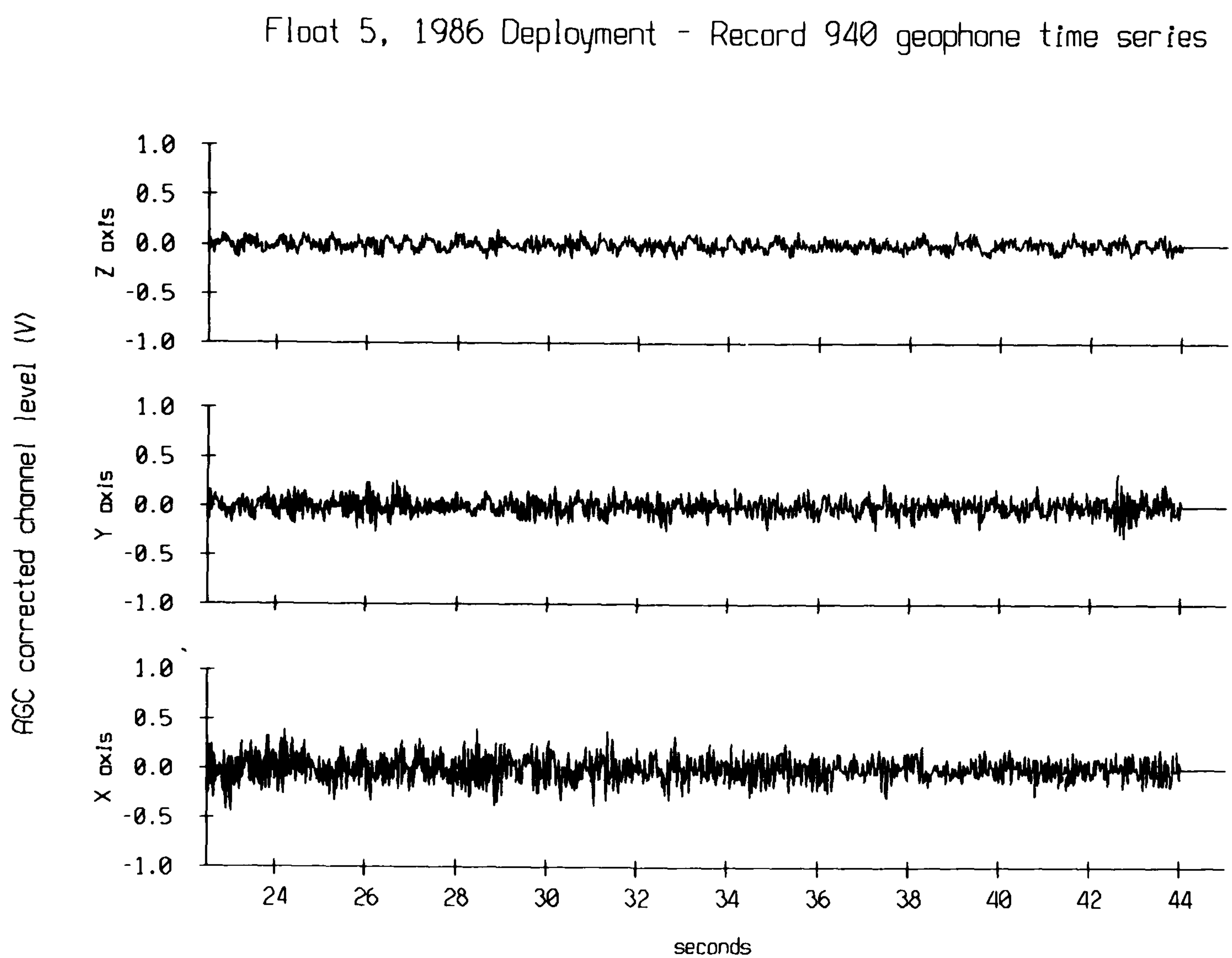

Figure VII.5b.

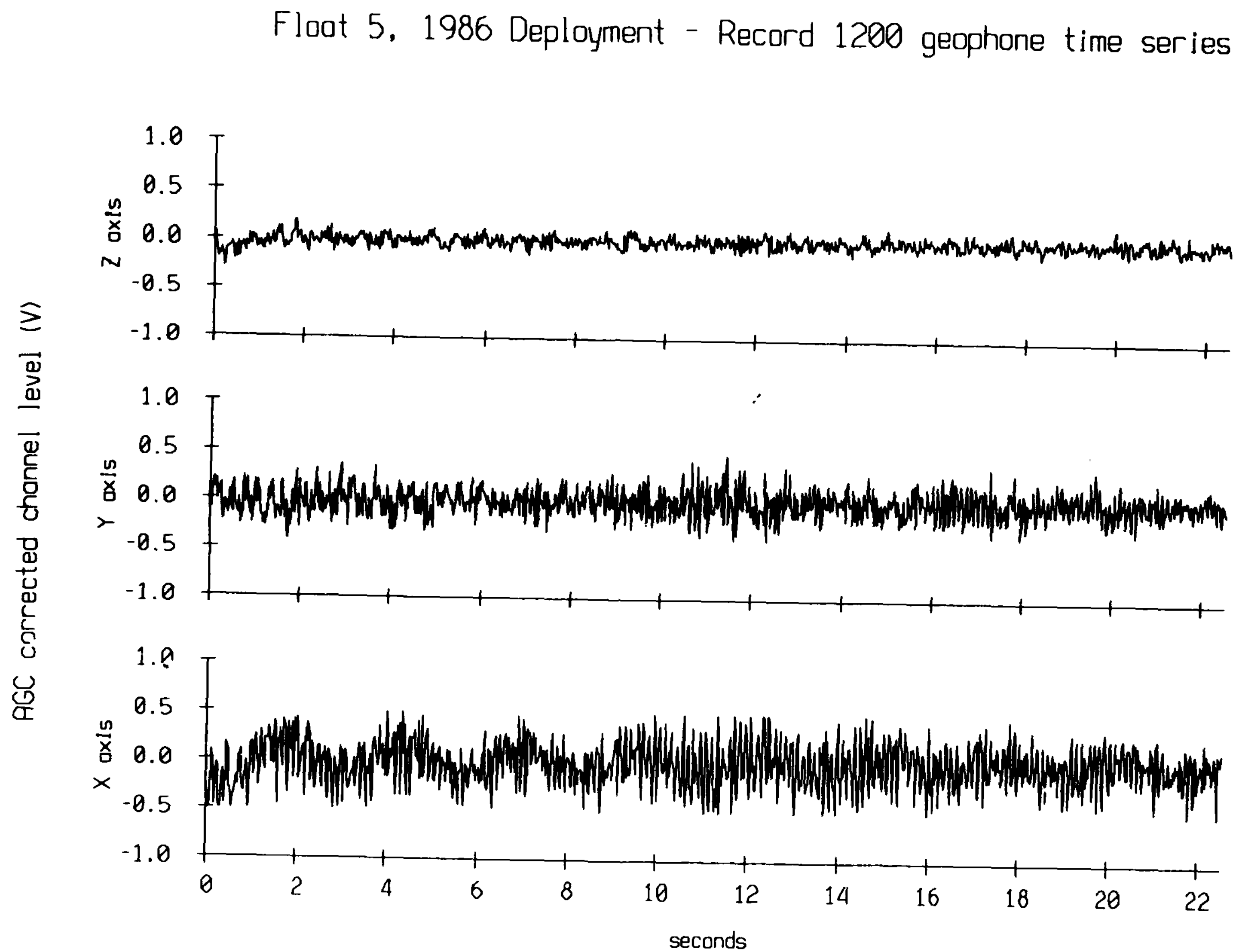

Figure VII.6a.

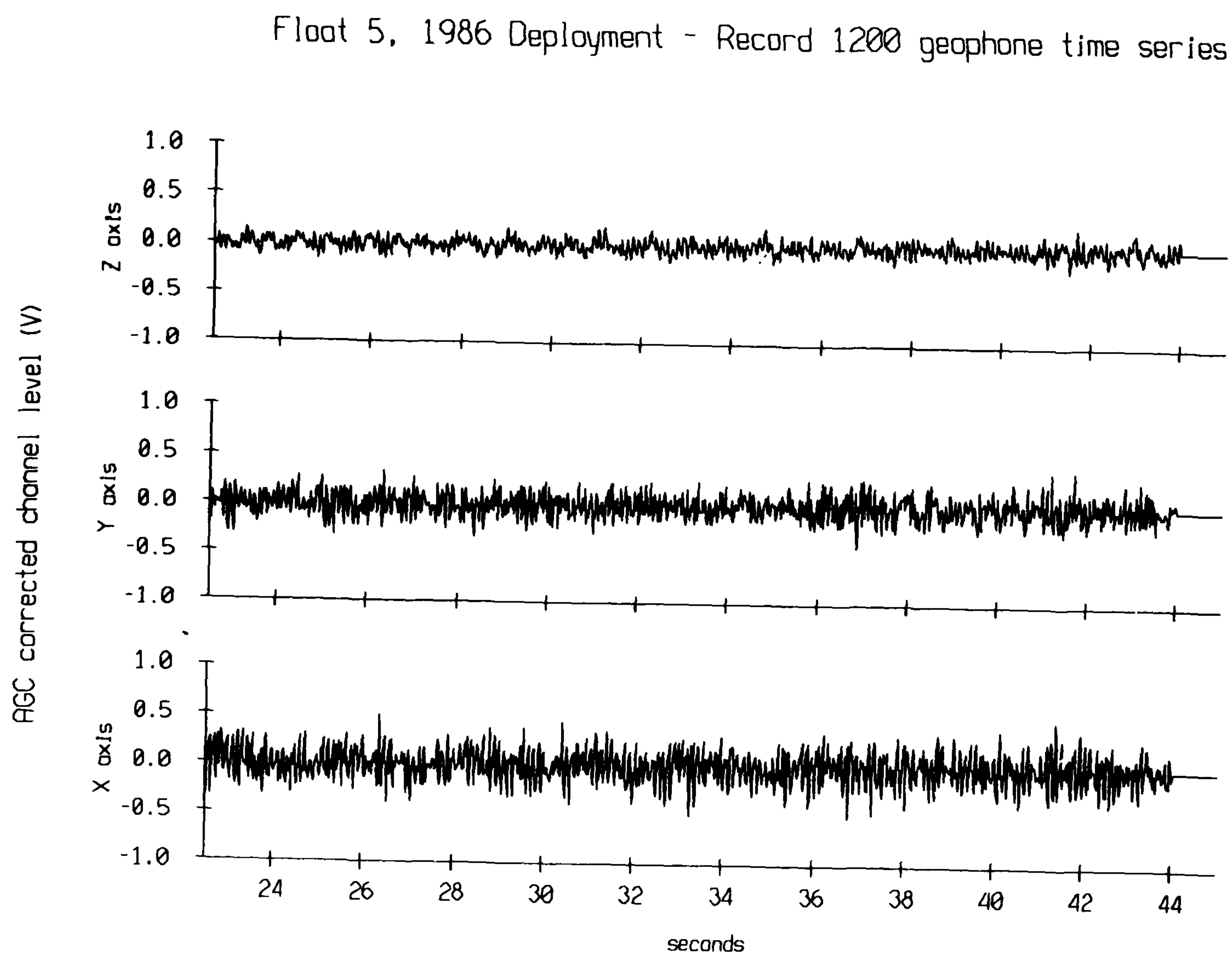

Figure VII.6b.

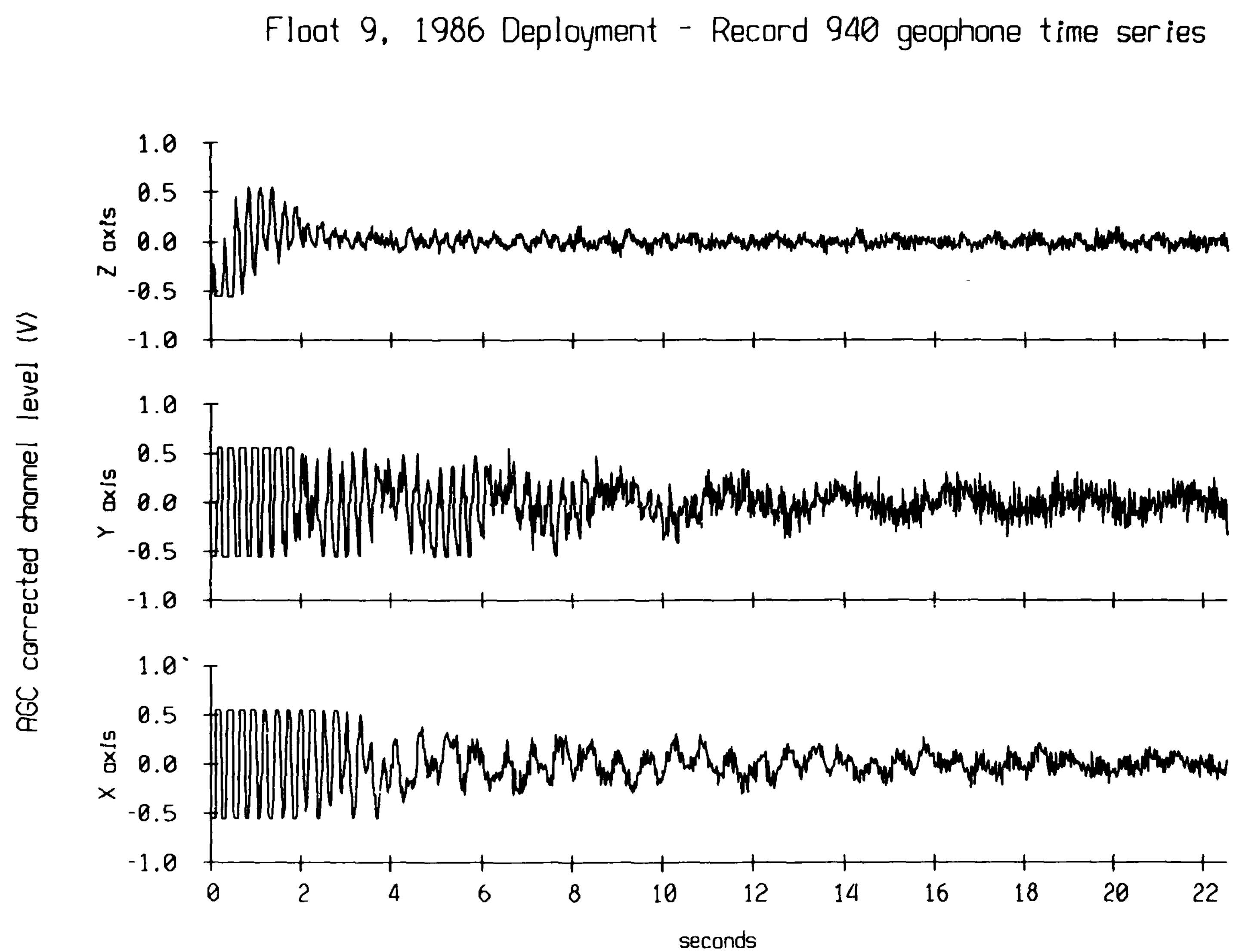

Figure VII.7a.

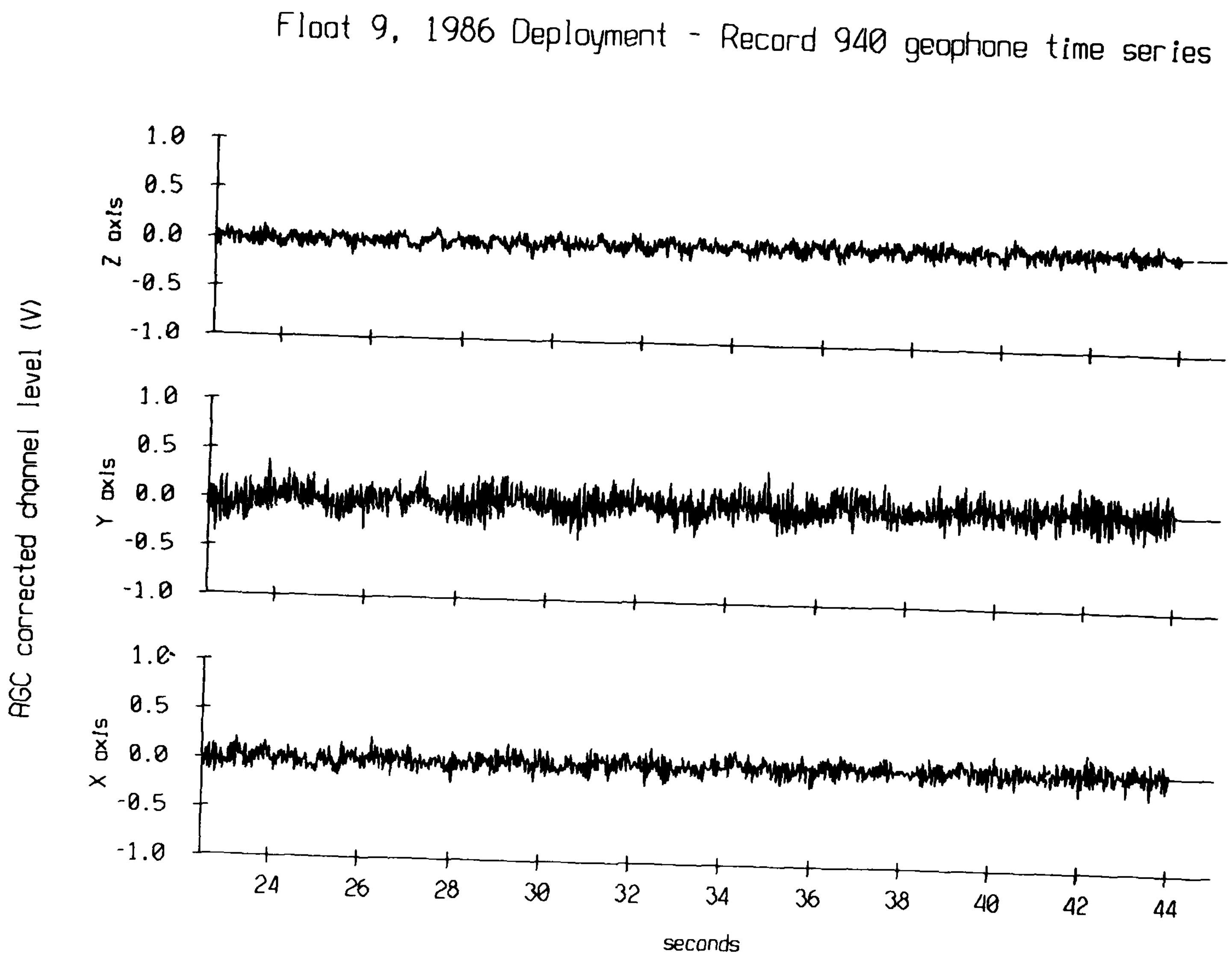

Figure VII.7b.

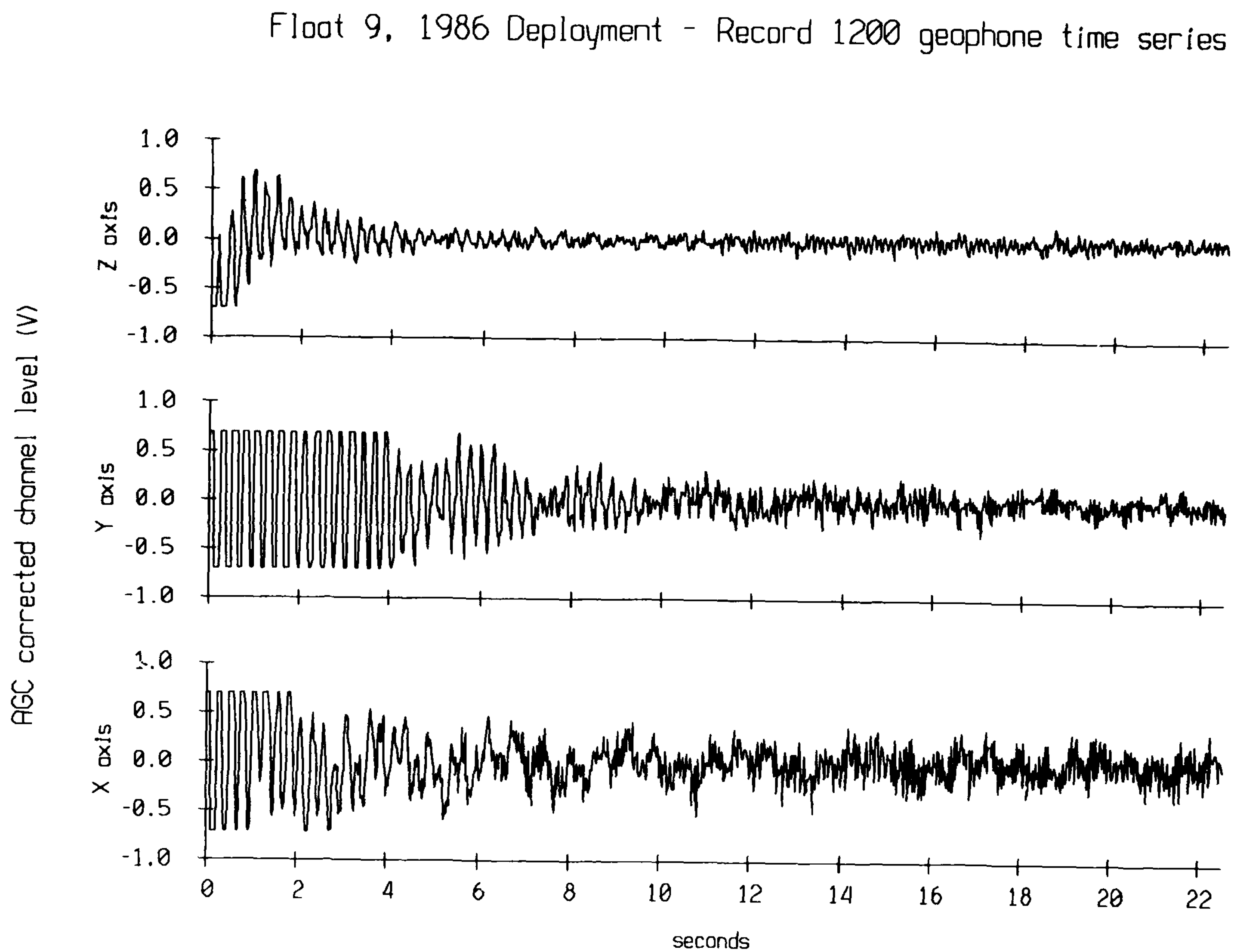

Figure VII.8a.

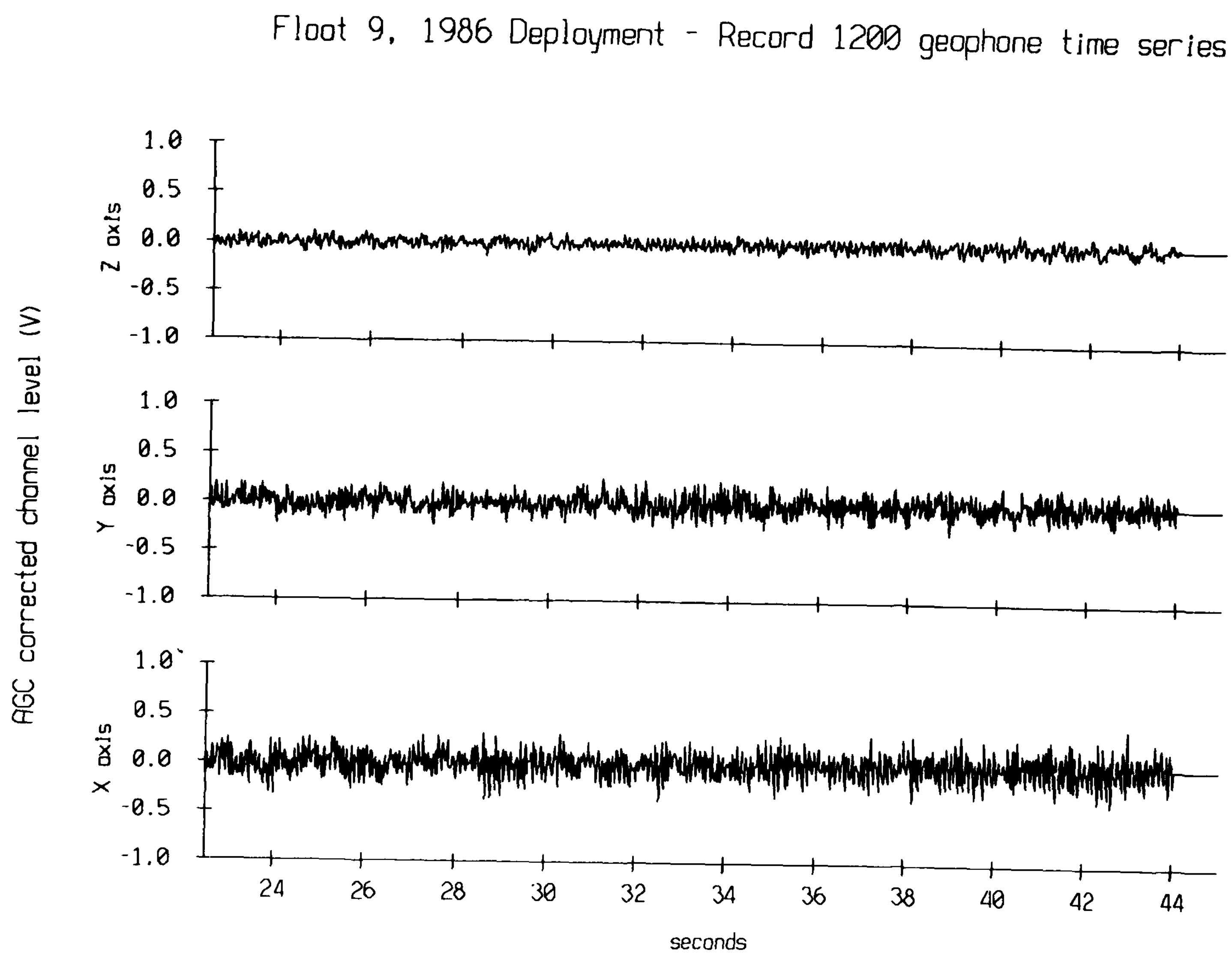

Figure VII.8b.

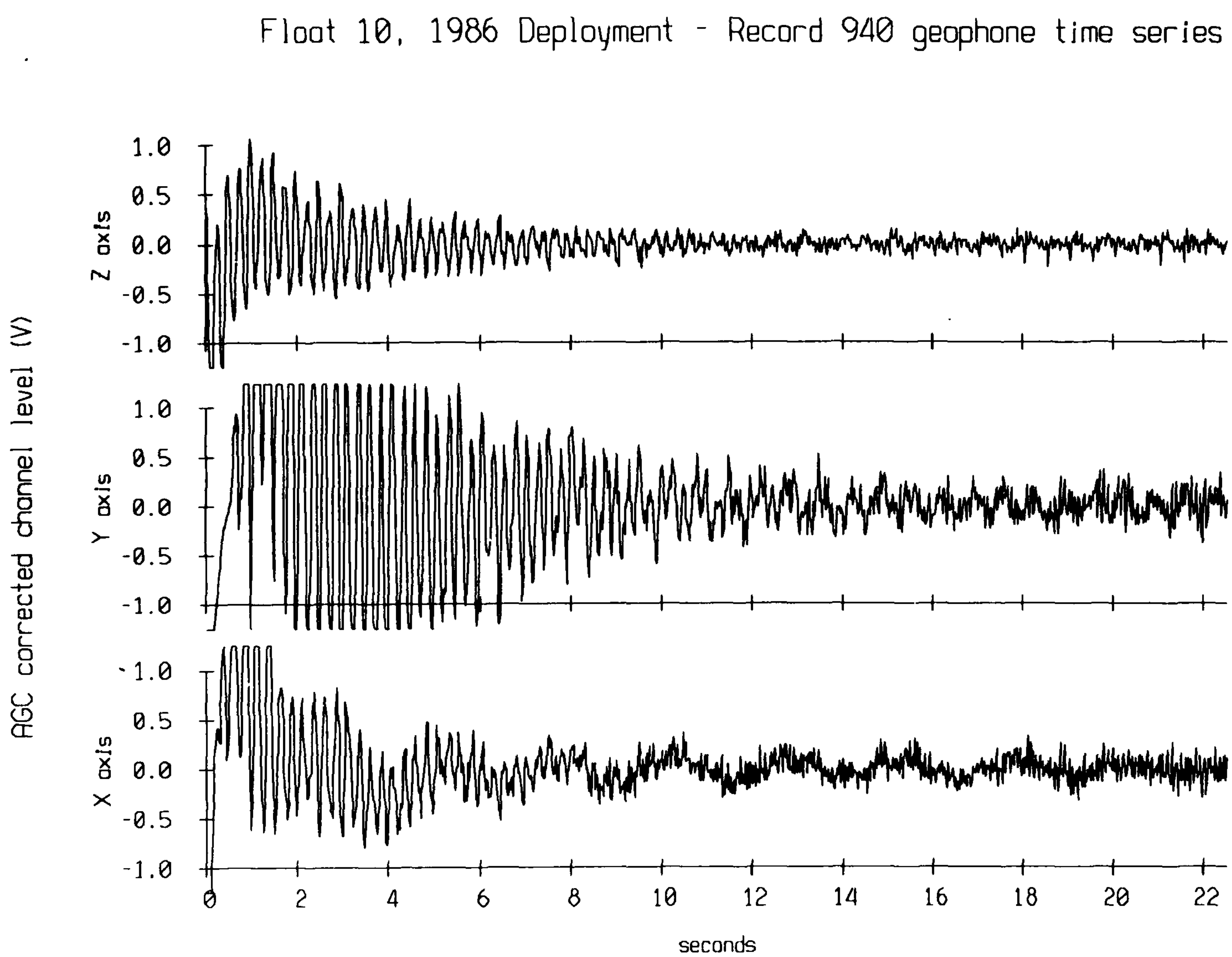

Figure VII.9a.

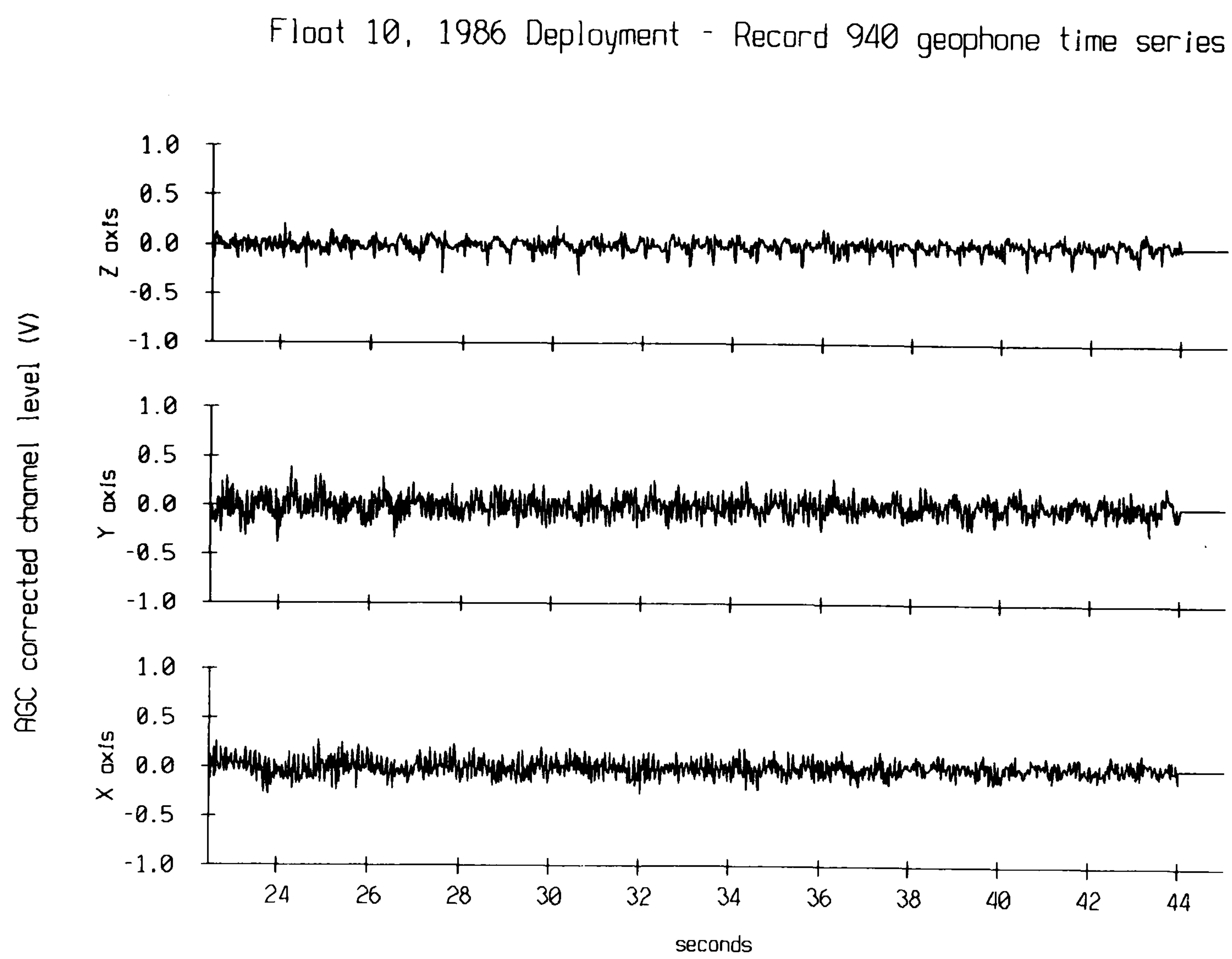

Figure VII.9b.

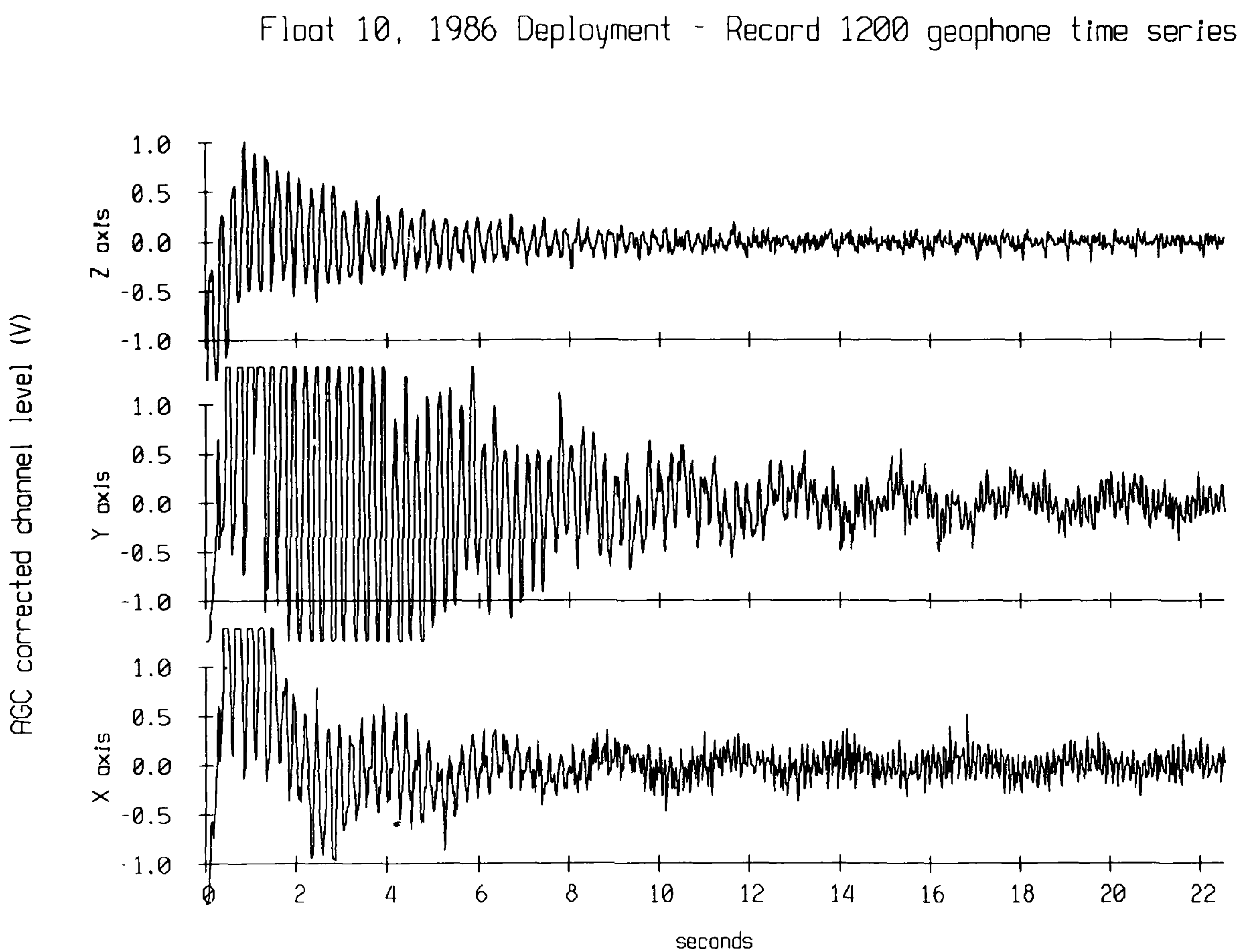

Figure VII.10a.

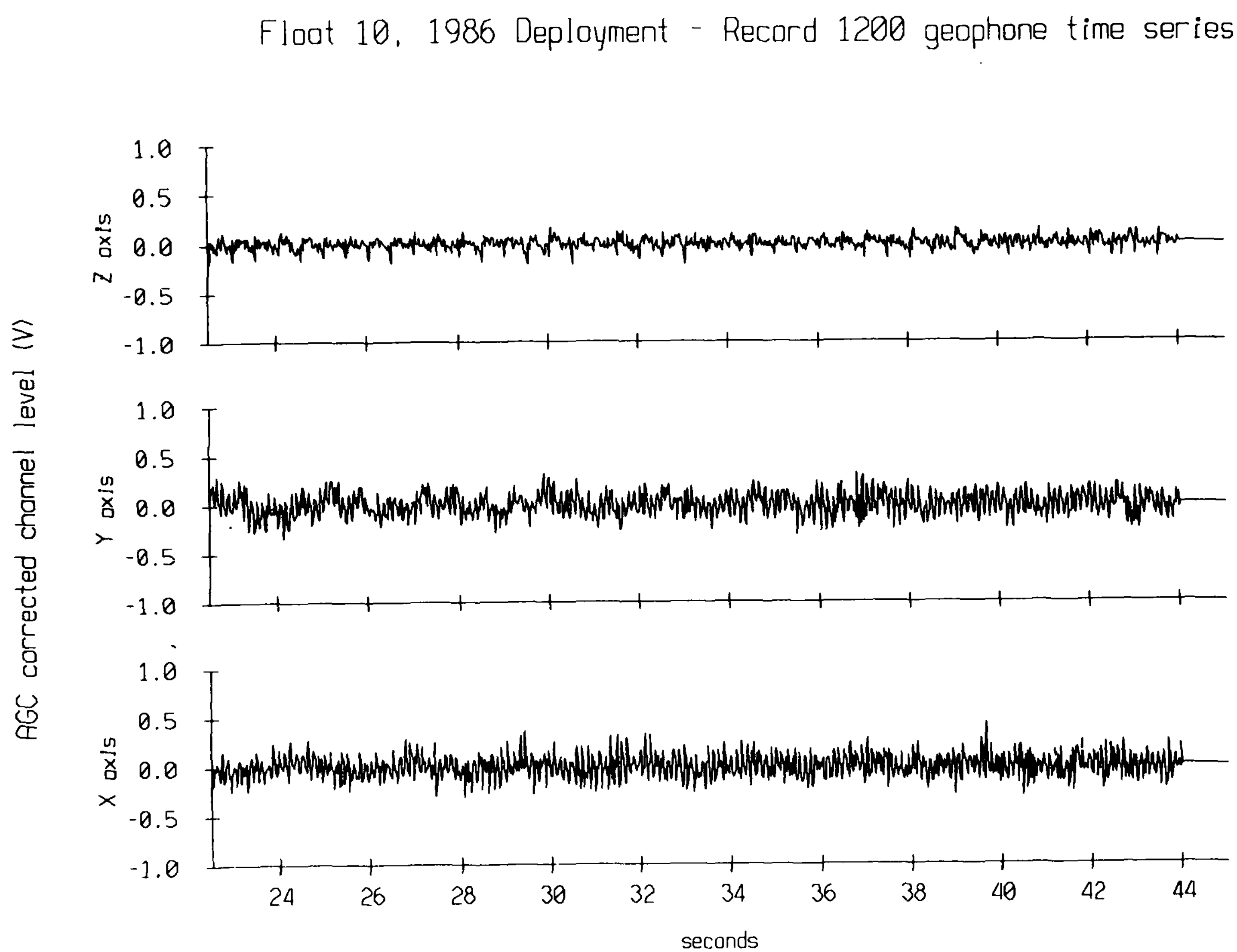

Figure VII.10b.

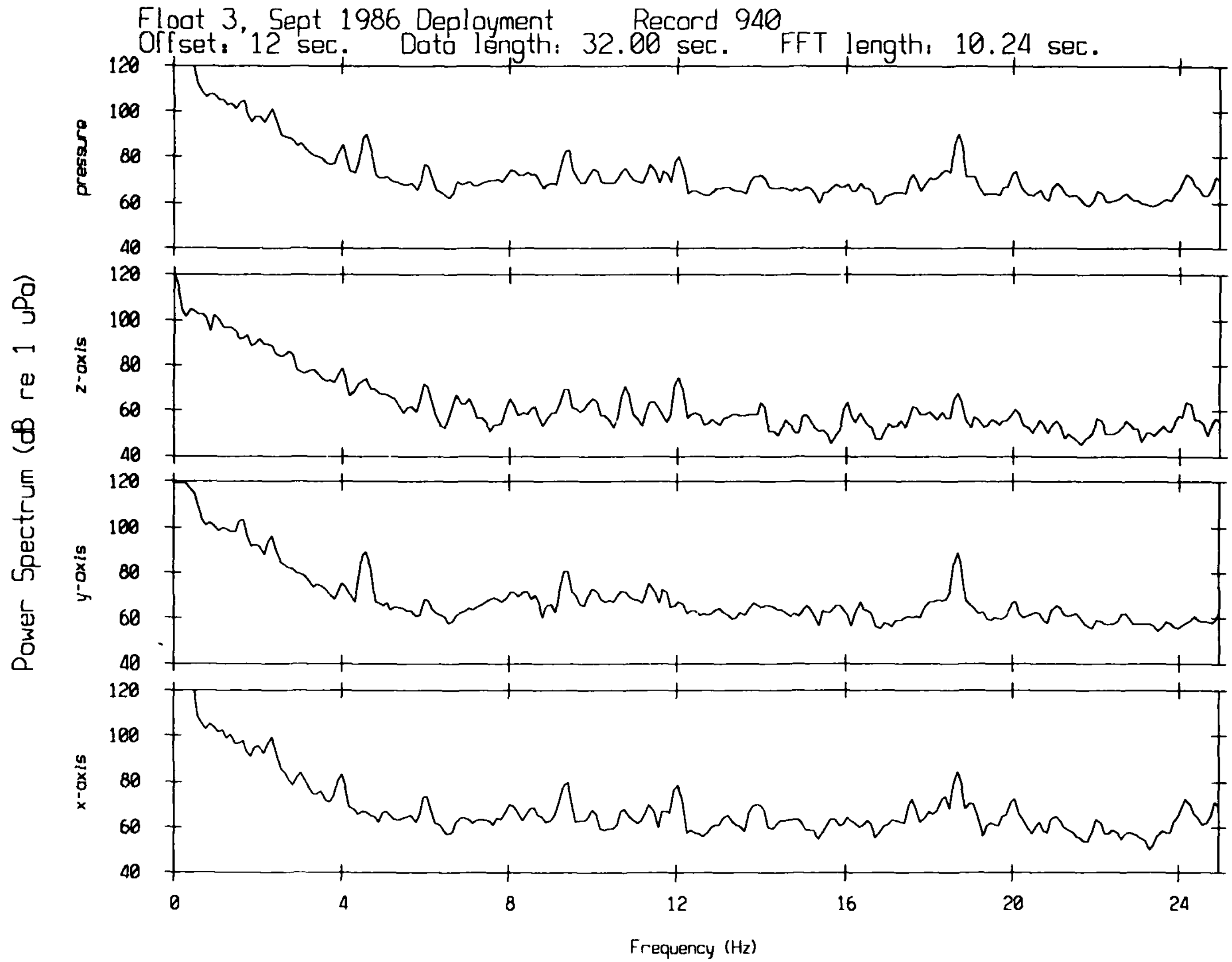

Figure VIII.1.

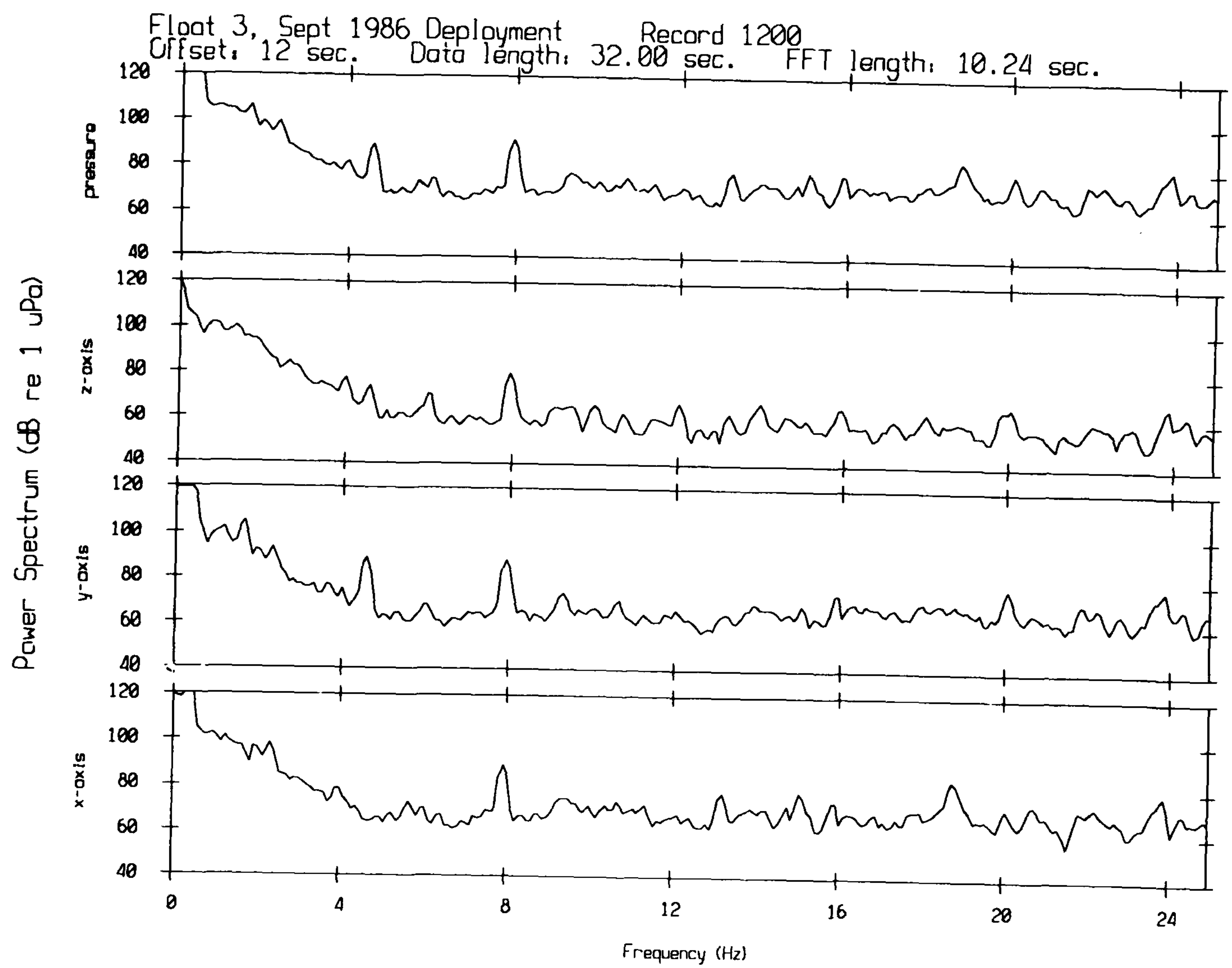

Figure VIII.2.

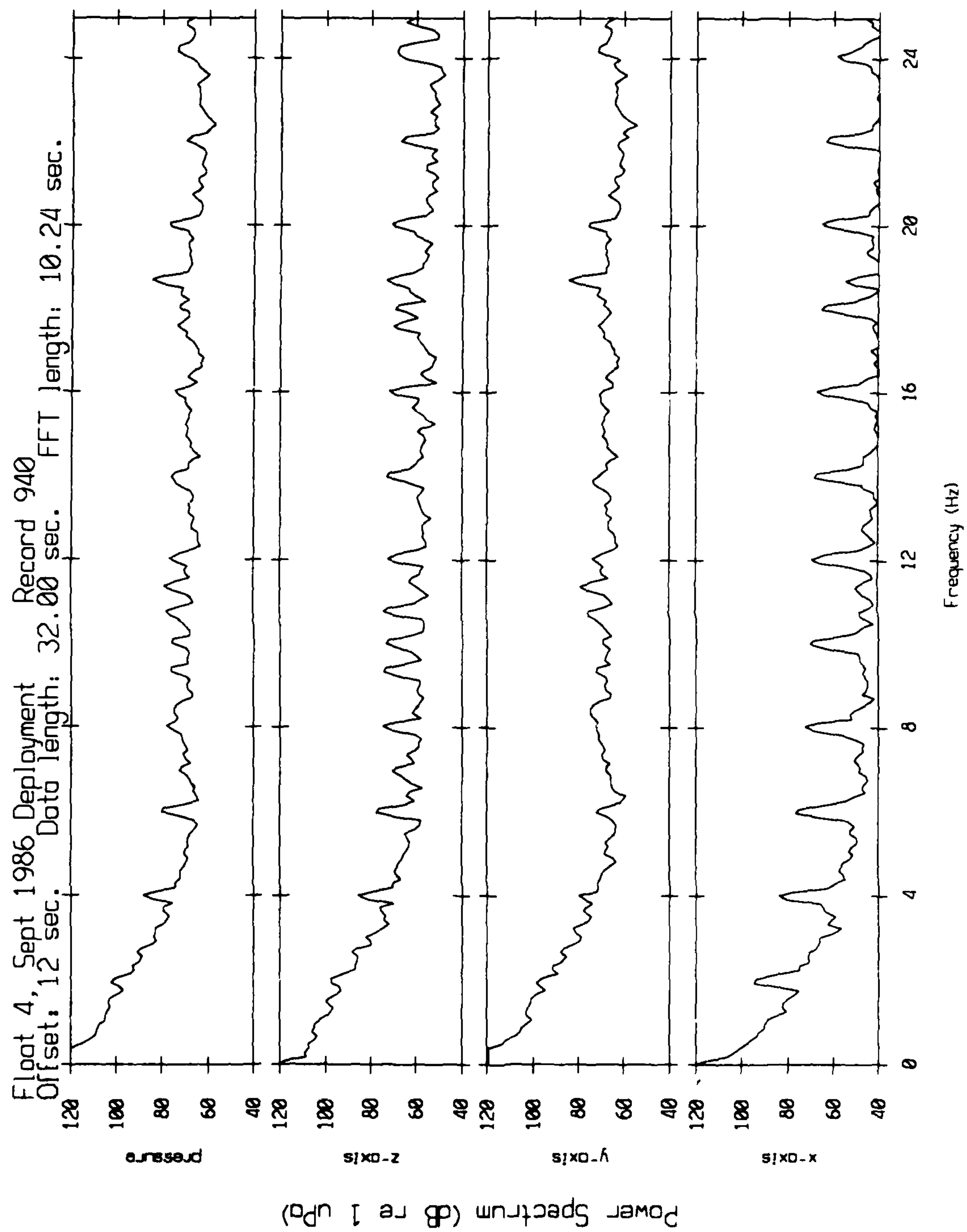

Figure VIII.3.

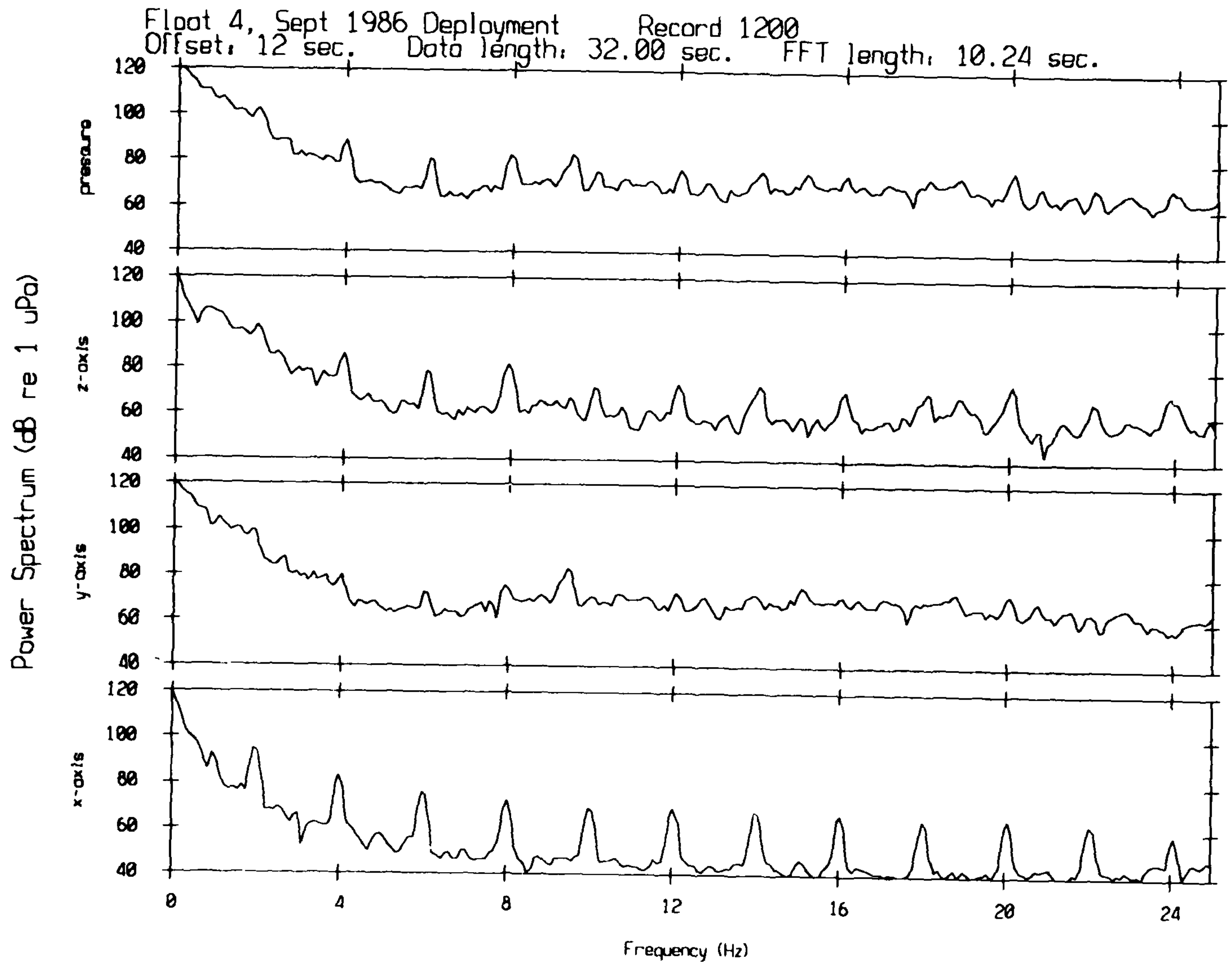

Figure VIII.4.

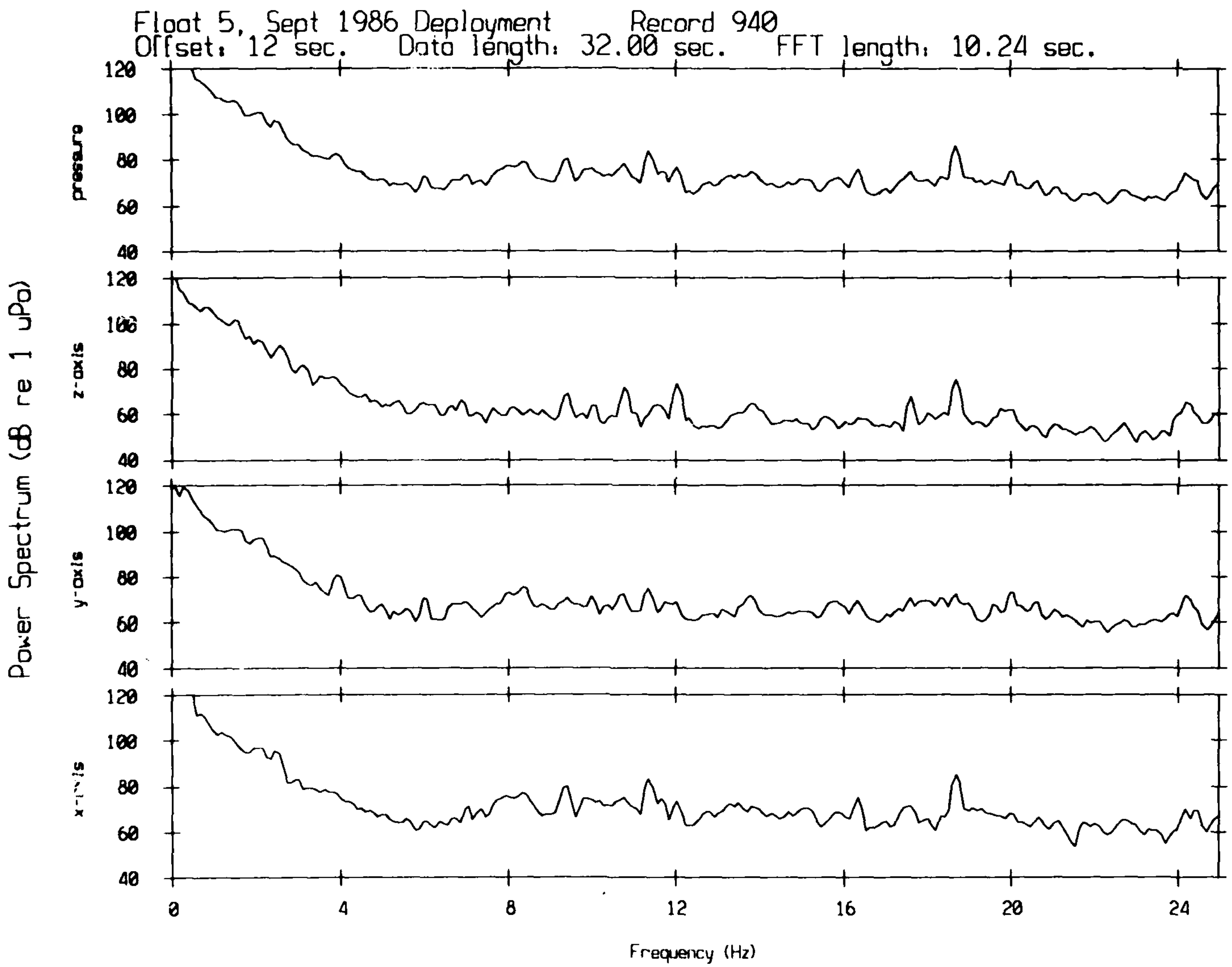

Figure VIII.5.

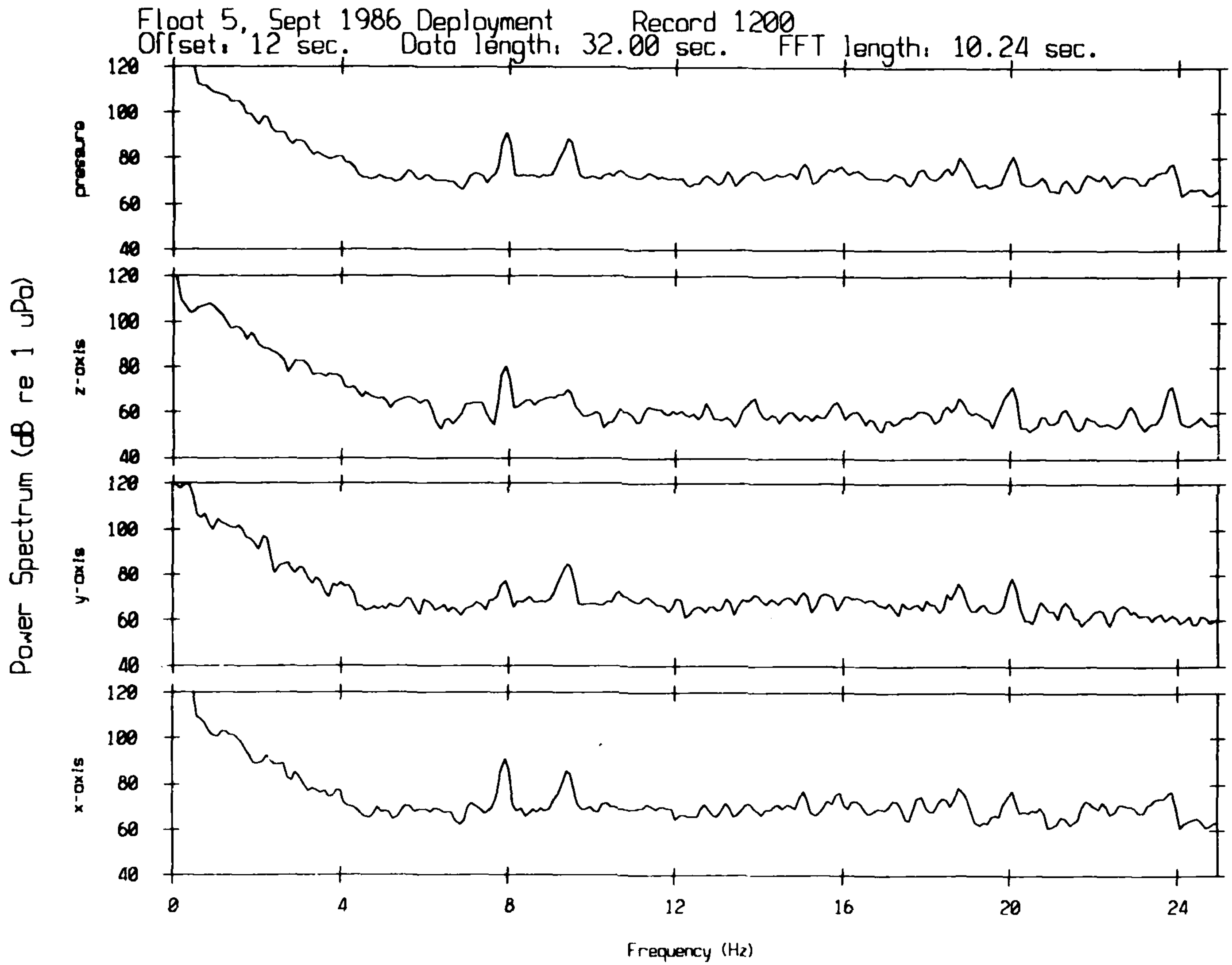

Figure VIII.6.

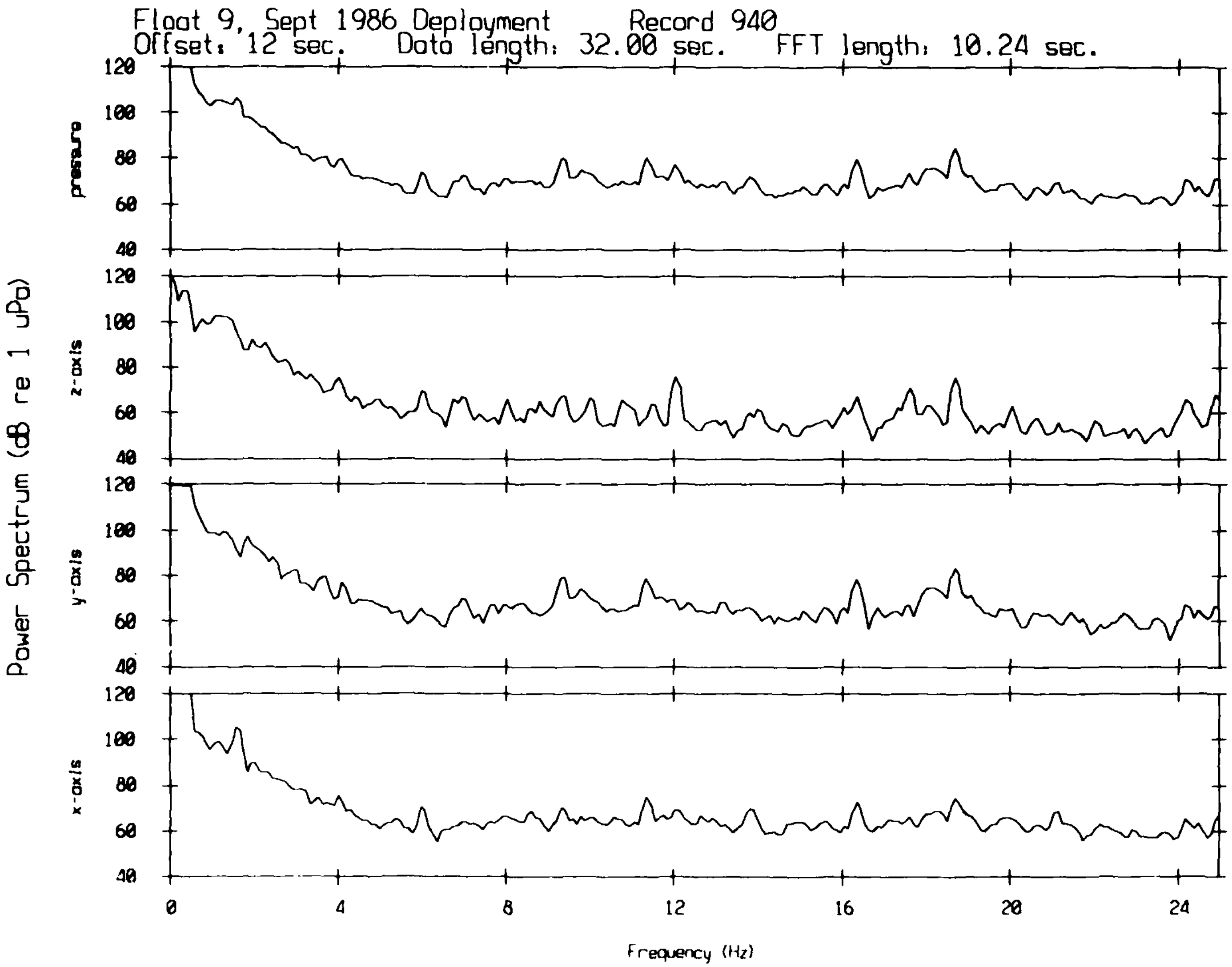

Figure VIII.7.

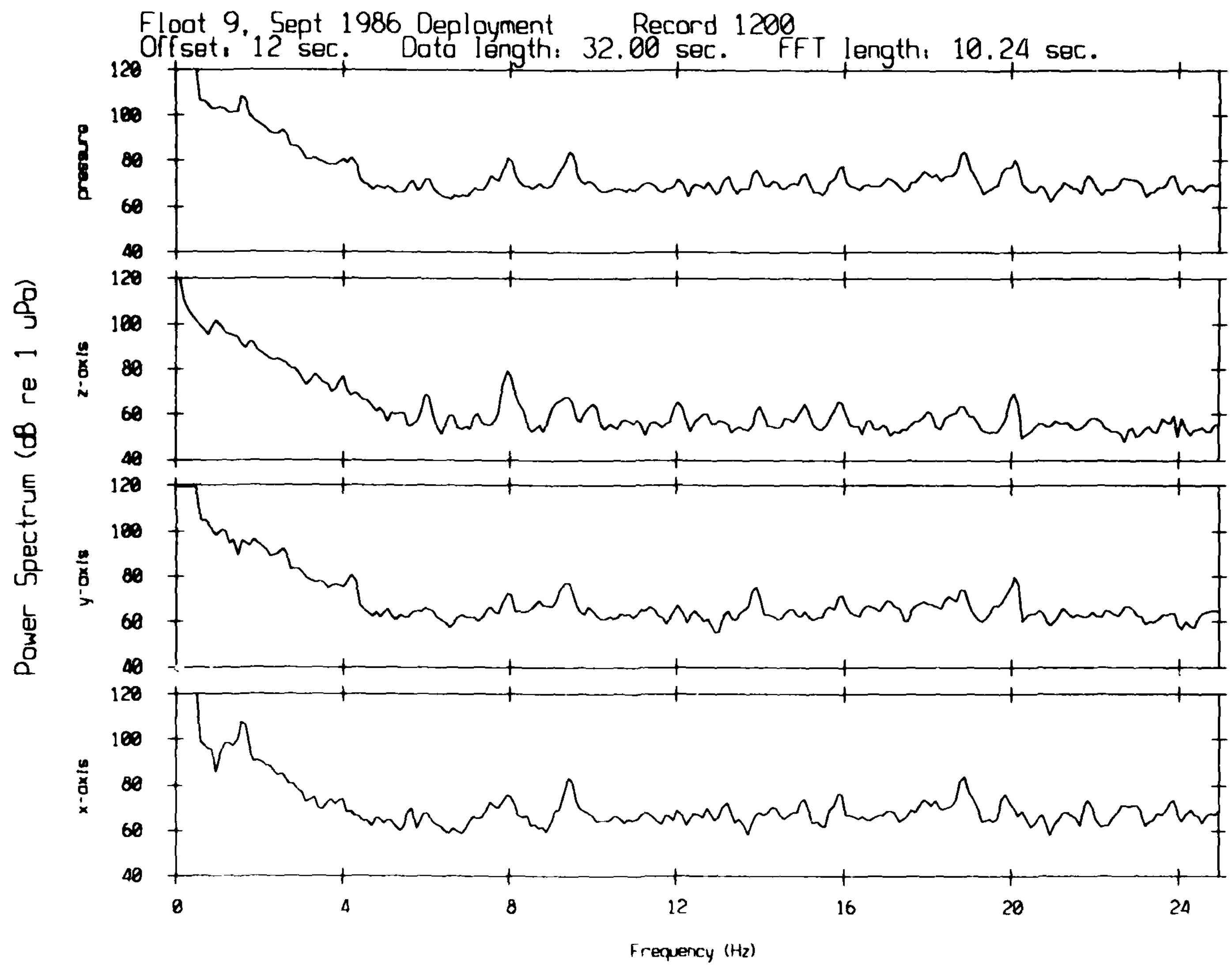

Figure VIII.8.

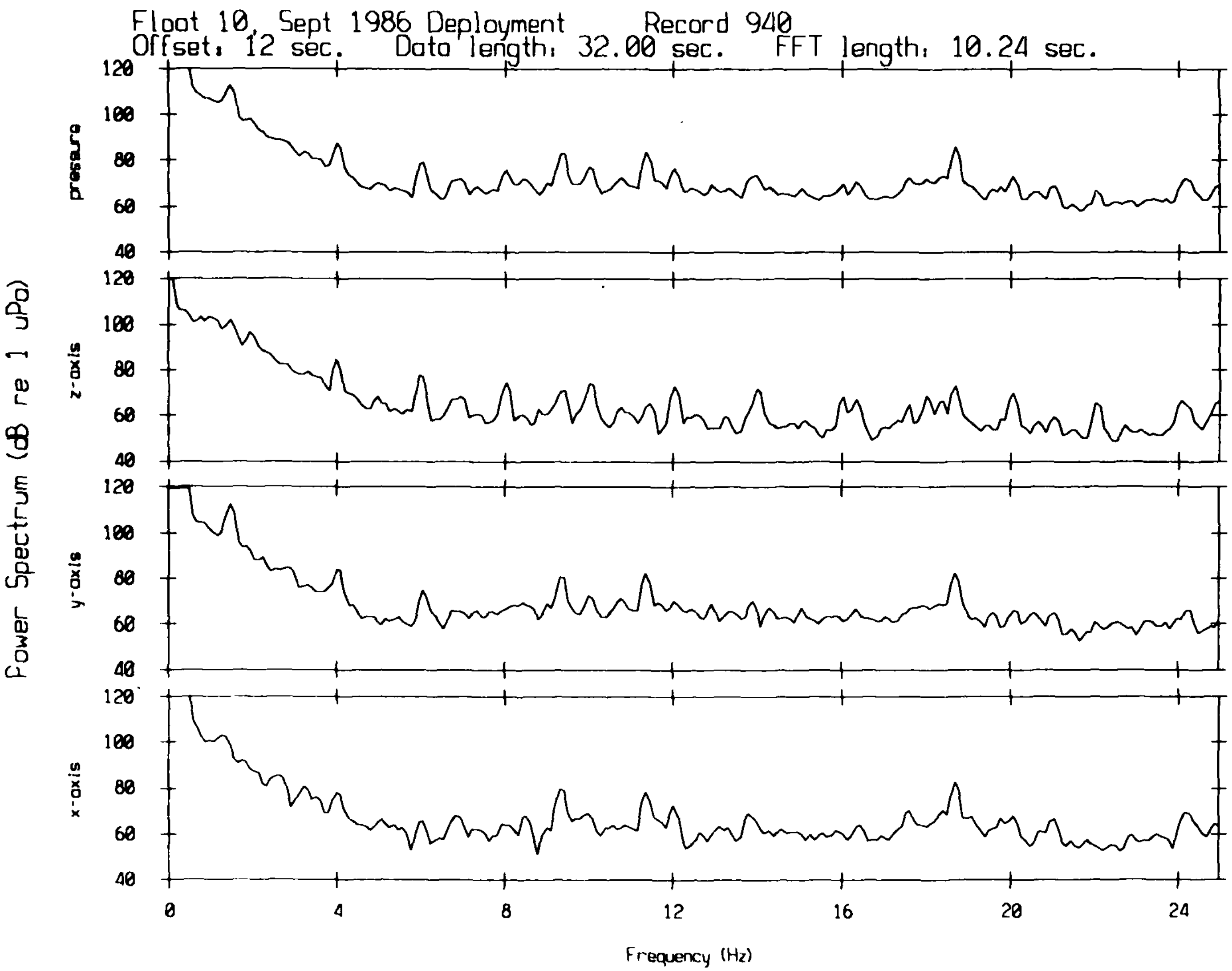

Figure VIII.9.

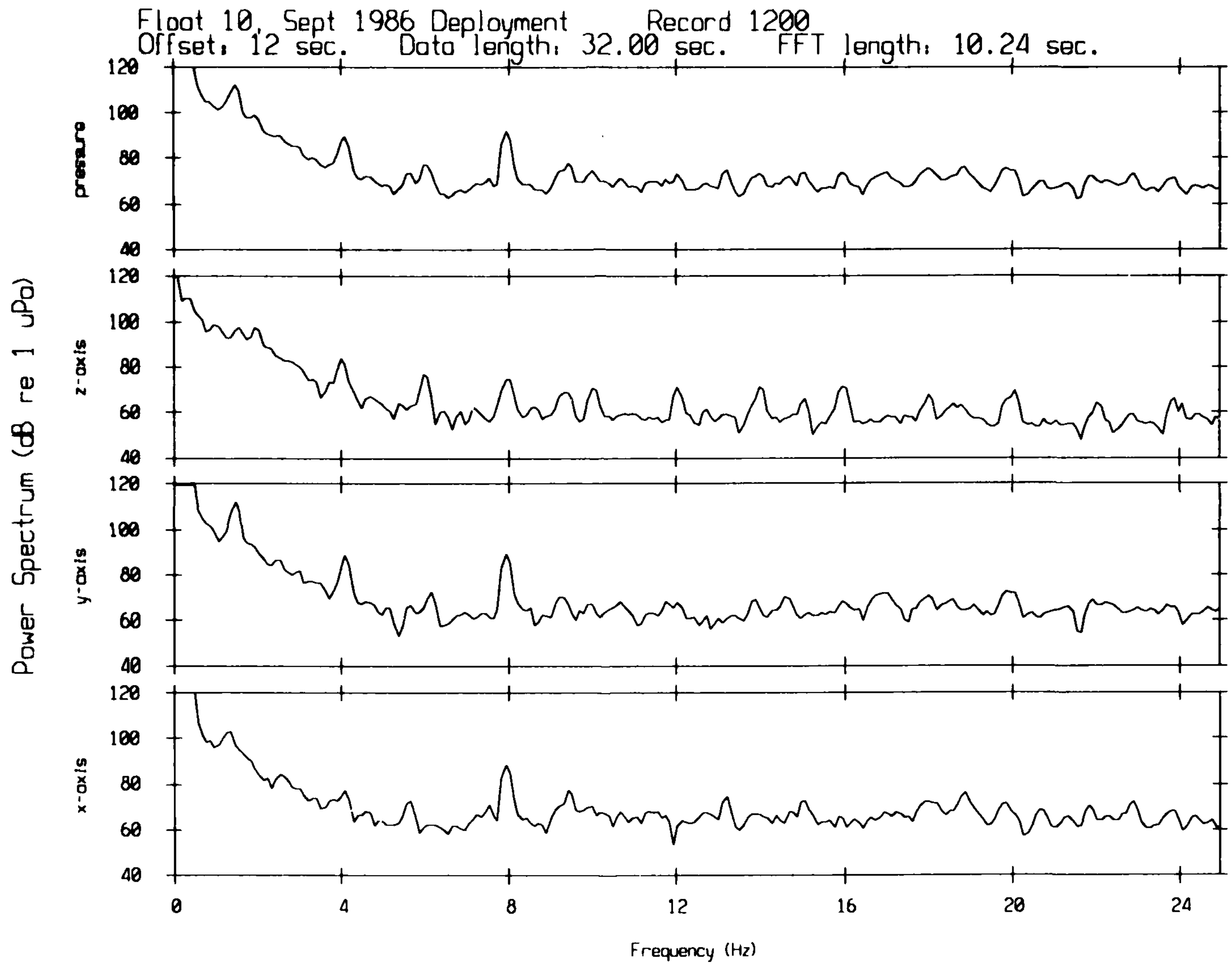

Figure VIII.10.

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