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Shipboard Acoustic Doppler Current Profiler data collected during RRS *Charles Darwin* Cruise 62a

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ABSTRACT

This report presents shipboard Acoustic Doppler Current Profiler measurements made during September 1991 aboard RRS *Charles Darwin* in a region north-east of the Faeroe Islands. The purpose of this cruise was the evaluation of sensors aboard the European Space Agency ERS-1 satellite against in-situ measurements. Here the set-up and calibration of the ADCP and also the quality of the data are discussed. Both underway and on-station data are presented separately with additional contour plots of relative acoustic backscatter and percent-good during the underway sections.

KEYWORDS

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1. INTRODUCTION

In September 1991, the James Rennell centre for Ocean Circulation led a cruise on the RRS Charles Darwin (Srokosz, 1992) primarily to take in situ measurements for an inter-comparison and calibration of data with the European Space Agency ERS-1 satellite launched in July that year. The cruise took place northeast of the Faeroes and the study area formed a triangle (see Figure 1.), such that the two longer sides coincided with ERS-1 satellite overpasses. This report presents the shipboard ADCP data collected on the cruise.

The shipboard 150kHz ADCP was set up for 64 eight-metre bins, giving a profiling range of 13 to 517 metres, an ensemble average every 2 minutes, and bottom-tracking mode enabled. This deep-water set up was used throughout the cruise because only a small portion of work was to take place in shallow waters. In retrospect, keeping bottom-tracking mode enabled was unwise as it resulted in fewer water-tracking (current measurement) pings per ensemble (because the instrument was constantly trying to re-acquire the bottom) incurring the cost of a higher standard deviation of current measurement and a general decrease in data quality.

The operation of the Data Acquisition System (DAS - version 2.48) running on the IBM PC located in the plot was generally faultless except for a crash at 21:10 on day 253, which also caused a change in the clock time on the PC. However, observations of the PC clock vs the ships clock are made regularly to account for any drift in the PC clock and so the effect of this jump in time was eliminated in the early data processing stages.

2. DATA PROCESSING

The strategy for dealing with the real-time data aboard ship was to split it into 24 hour sections and to perform preliminary processing on these files using the unix scripts *adpexec0* through *adpexec4* (Griffiths et al 1992). This processing resulted in absolute current velocities averaged over 15 minute periods. On-station data were then extracted and placed in files named after the CTD stations, and steaming data were concatenated and split up into cruise legs as depicted in Fig. 2. The naming of these legs is consistent with that in the CTD/XBT data report (Tokmakian et al, 1992). In addition to these sections which concern only the satellite comparison surveys, the presence of moorings in the North-west and Southern corners of the survey triangle resulted in a few additional trips between these positions which have been labelled legs M1 through M3.

A feature of ADCPs in general is the measurement of backscatter strength in addition to the current velocity data. This measurement is made initially in *counts* (the integer output of an Analogue to Digital converter in the receiver circuitry) but can be calibrated into dBs using a complicated theoretical formula from RDI which should then allow estimates of biomass to be made (RDI 1990). This report does not present calibrated backscatter data, instead, for each

depth-cell a mean value is calculated (over the duration of a leg) and the deviations from this mean are then contoured to form the relative amplitude plots given in this report. This simple processing is achieved with the Pstar program *adprl2* and eliminates, albeit crudely, the inevitable decrease in signal strength with depth (distance away from the transducers), and provides a qualitative feel for the vertical migration and abundance of scatterers like zooplankton.

VM-ADCP Calibration

The ADCP was calibrated using the technique described by Pollard & Read (1989) at 10 knots as this was to be the steaming speed during the scientific surveys. The calibration resulted in values of A (scaling factor) and phi (misalignment angle) which are presented in table 1 below along with previous calibration values obtained for the RRS Charles Darwin ADCP. The standard deviations for A and phi were 0.01 and 0.38 respectively. These are generally typical of the errors measured in the calibration constants for previous *RRS Charles Darwin* cruises (Hartman, 1992).

Cruise number	Date m/y	Amplitude Scaling Factor (a)	Mis-alignment angle (phi)
CD51	7 / 1990	1.0026	-0.36°
CD58	4 / 1991	0.9956	-0.68°
CD59	5 / 1991	0.9958	-1.2°
CD62	8 / 1991	1.005	0.02°
CD62a	9 / 1991	1.028	-0.763°

Table 1. RRS Charles Darwin ADCP Calibration values.

3. DATA PRESENTATION & QUALITY

The underway data are presented in Figures 3 through 11 and are in order of surveys as given in Figure 2, with a separate page for each leg (the exception being legs F and D combined on a single page). Leg E shown in Figure 11 is only part of the plot which depicts a sea-surface temperature survey, the track plot for which is given in Figure 2(d). Following these are similar plots for legs M1 through M3 (figures 12 to 14). Three different types of plot are used to convey information about the underway data. Starting from the top of the page, the first plot is relative amplitude as described in section 2, the central plot is a contour of the ADCP's own quality-measure variable percent-good, and the lower plot is a gridded vector plot of the absolute currents absve and absvn.

On-station data coincident with the CTD stations are also presented on a per-survey basis in Figures 15,16 and 17. The on-station currents shown are averages taken over the duration of the station.

The quality of data collected on the cruise was fairly typical considering the steaming speed of 10 knots and the extreme weather encountered for most of the cruise. The 25 percent-good contour was generally at about 250m depth, deepening to 400m during the calmer periods and to 450m when on-station. On occasions the conditions were so bad that almost no ADCP data were collected. ADCPs will always encounter problems under these circumstances as the bubble clouds that are generated can extend to depths of over 20 metres. The ADCP is then measuring the velocity of the bubbles in addition to that of the scatterers and the combined result is very un-homogenous. Error velocities are, therefore, large and percent-good measurements low.

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Pollard, R.T. & Read, J.F., 1989, A Method for Calibrating Shipmounted Acoustic Doppler Profilers and the limitations of Gyro Compasses., Journal of Atmospheric and Ocean Technology, 6, 859-865.

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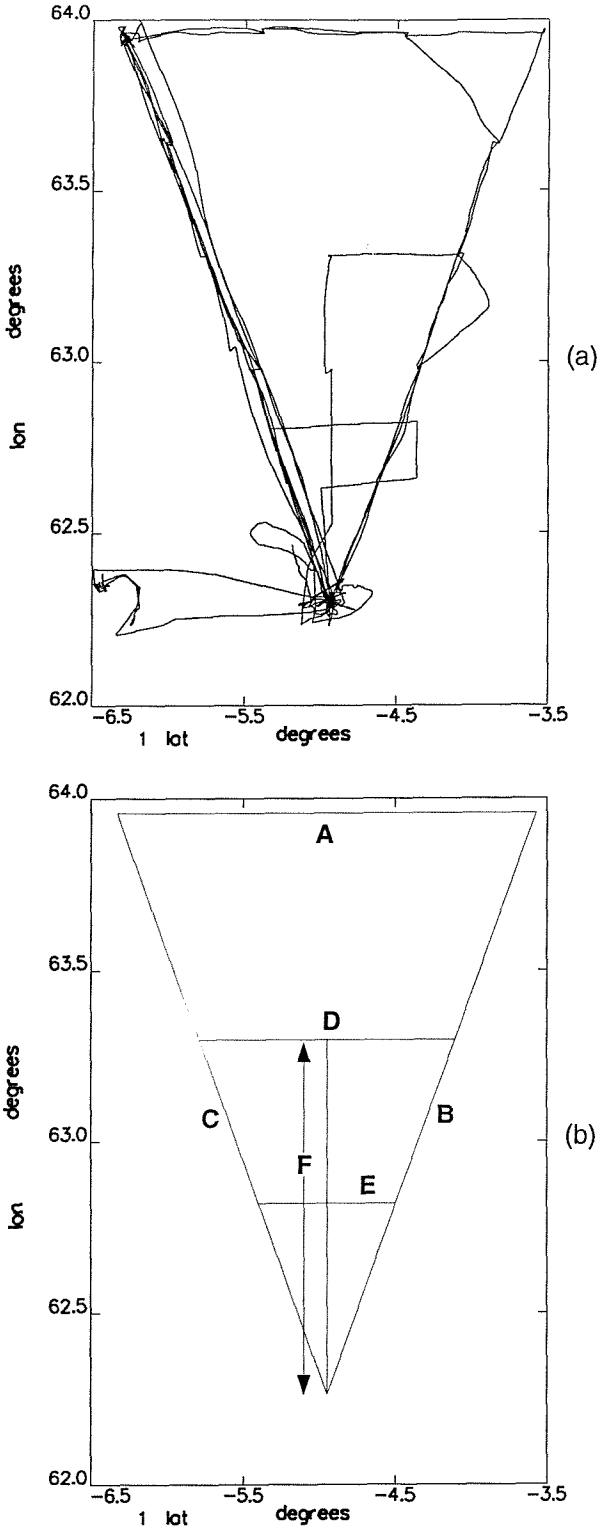

Figure 1. (a) Cruise track plot of the survey area.
(b) Schematic showing the labelling of
the survey legs (from Tokmakian et al).

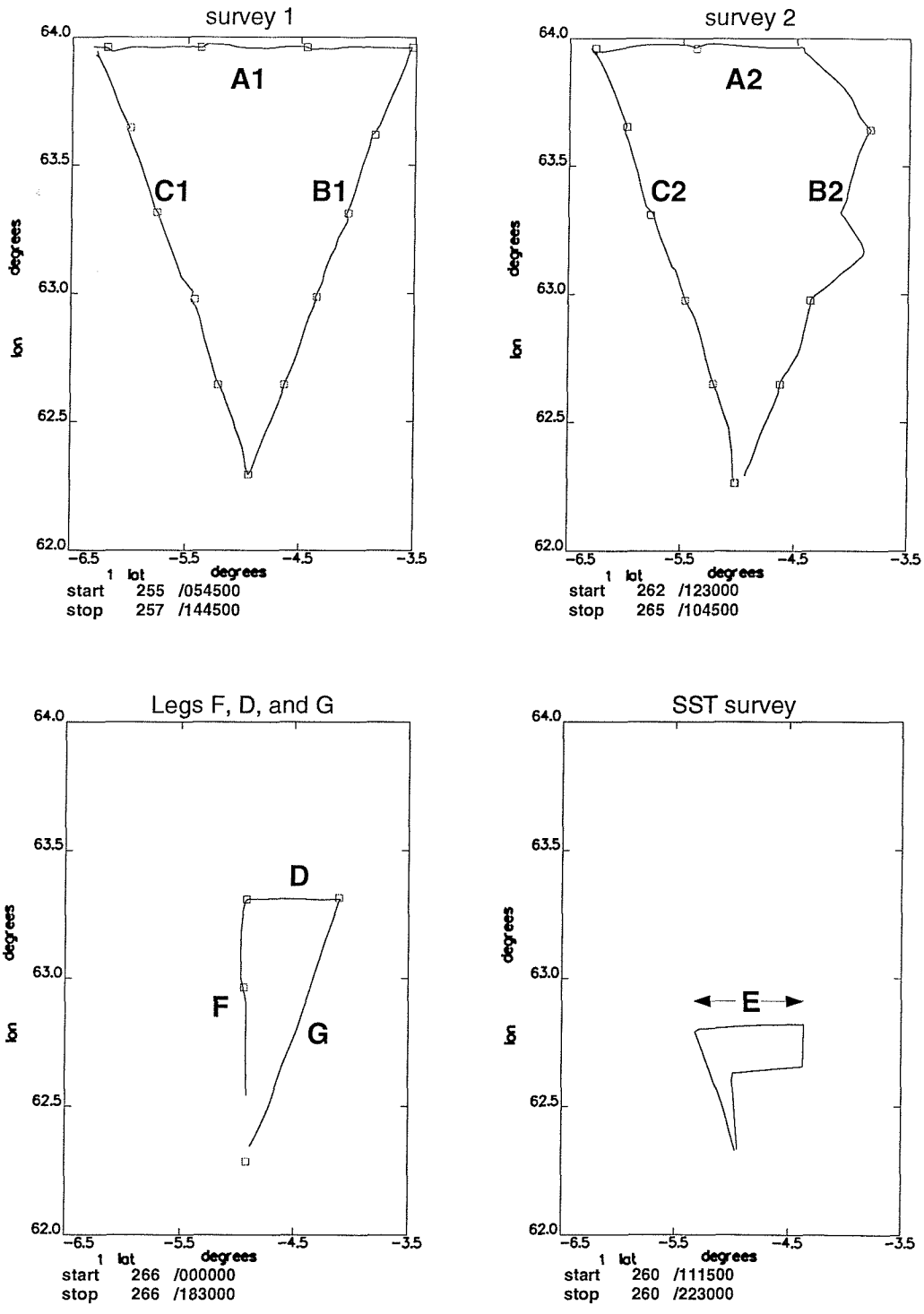

Figure 2. Broken-down labelling of legs for individual excursions within the survey area. Boxes on the track plots denote the positions of CTD stations.

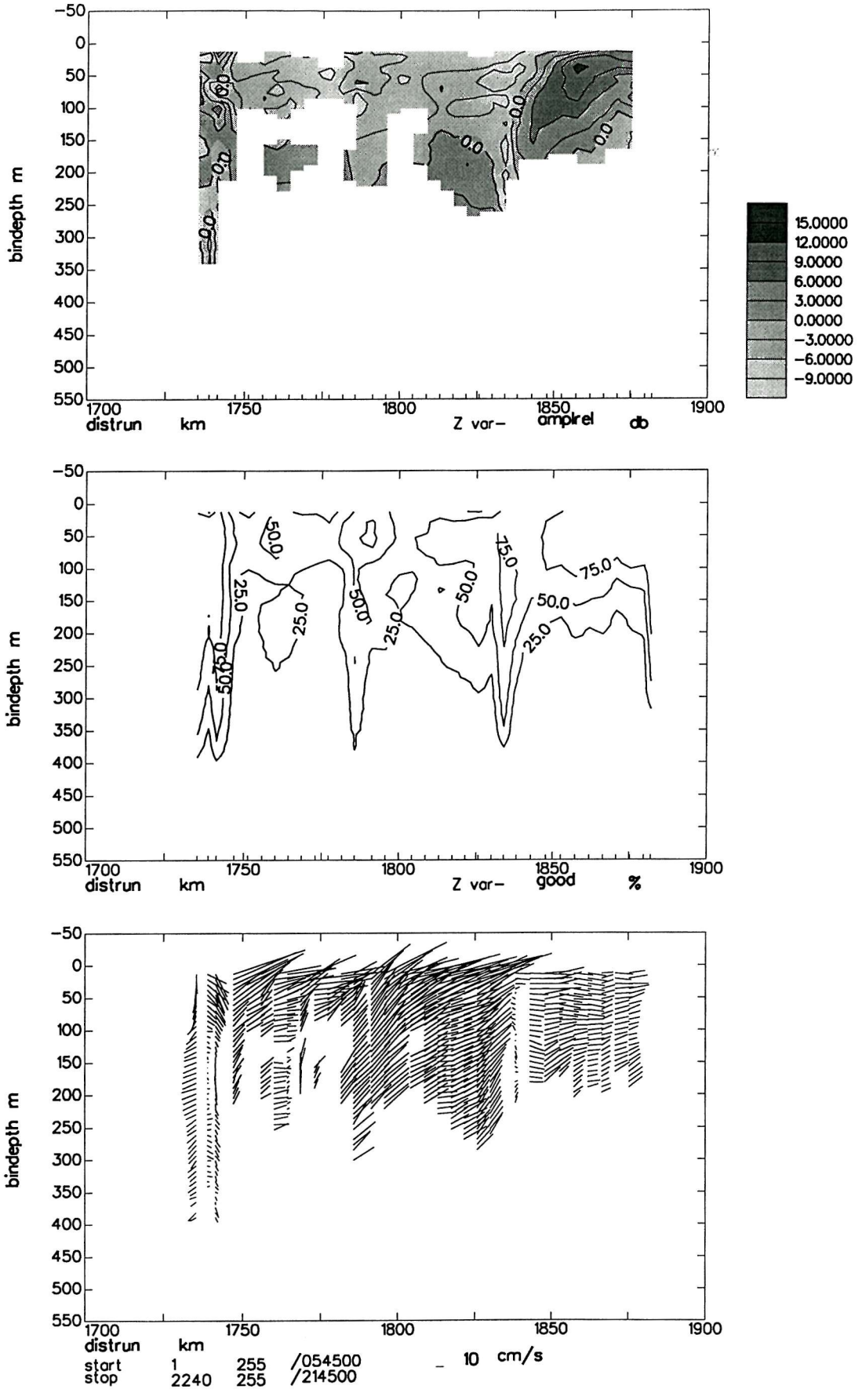

Figure 3. Underway ADCP. Section A1

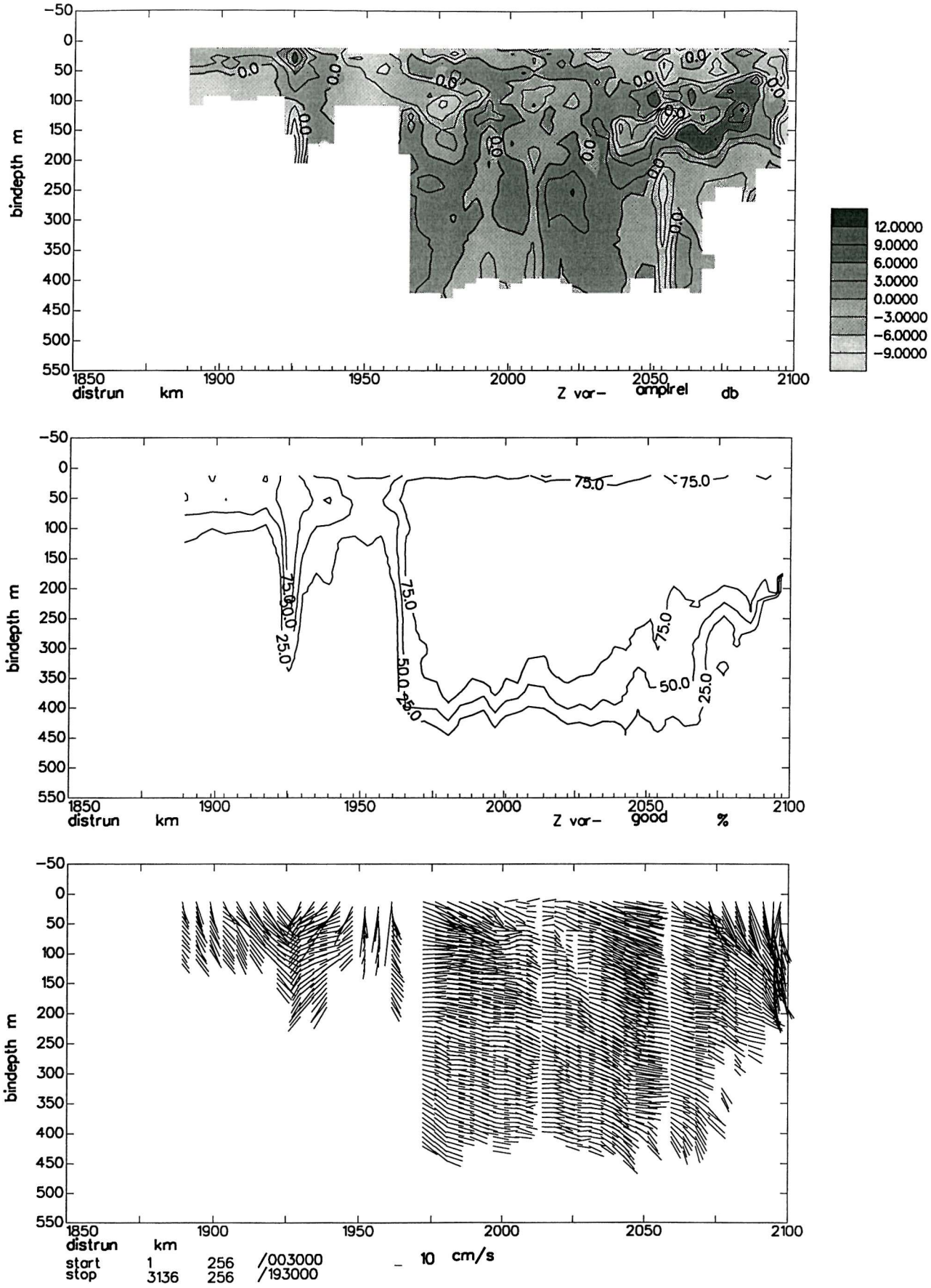

Figure 4. Underway ADCP. Section B1

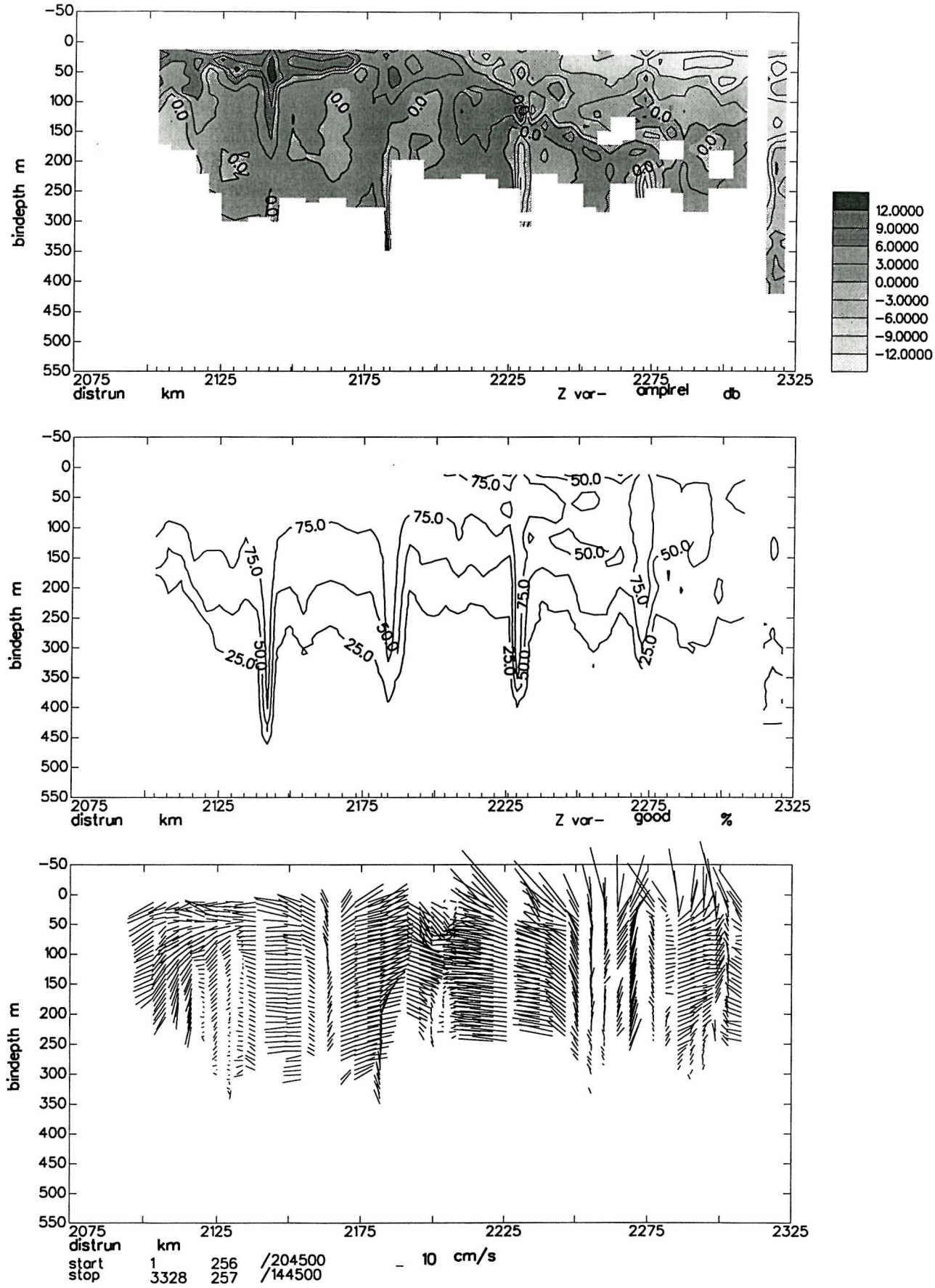

Figure 5. Underway ADCP. Section C1

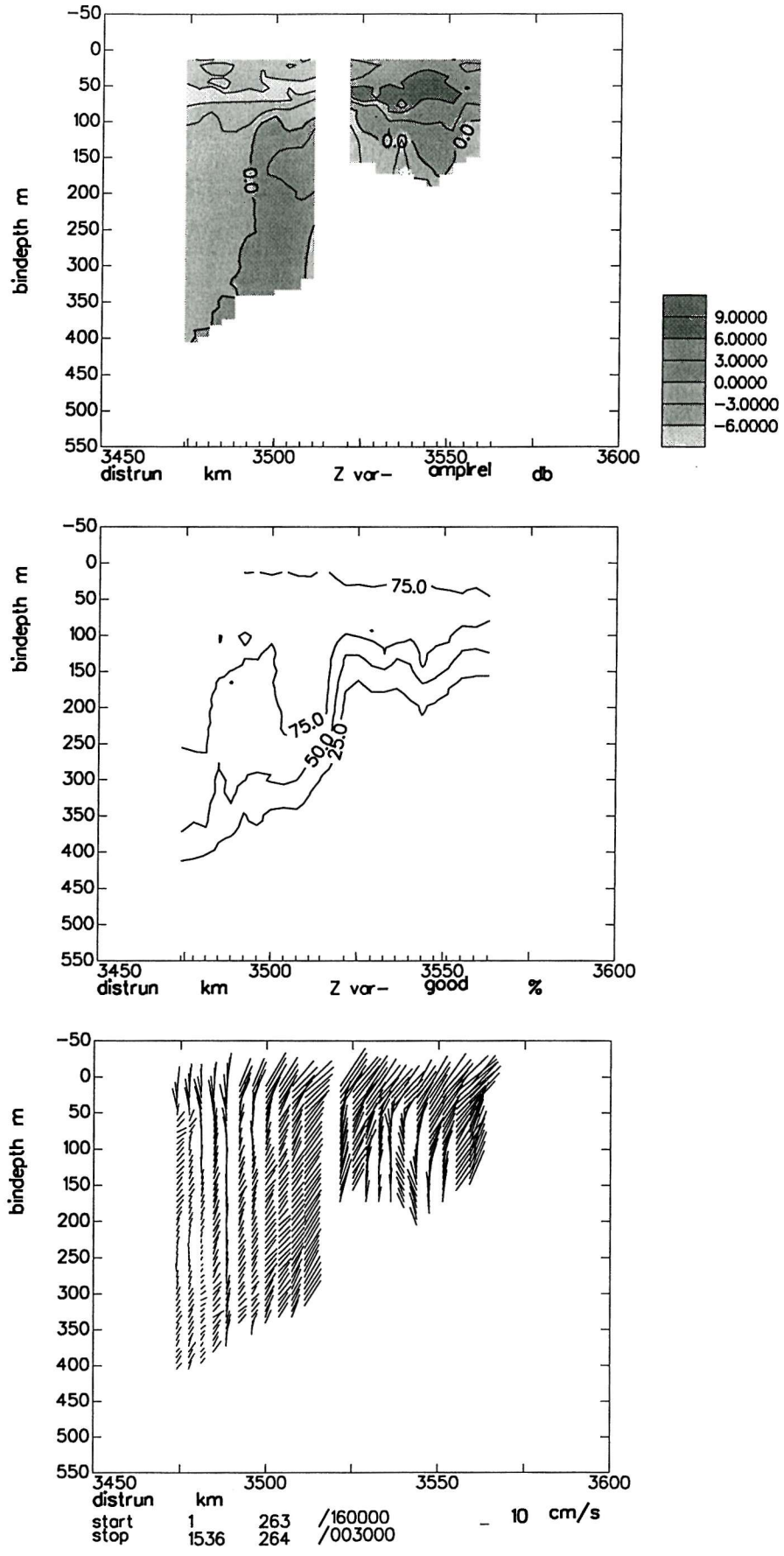

Figure 6. Underway ADCP. Section A2

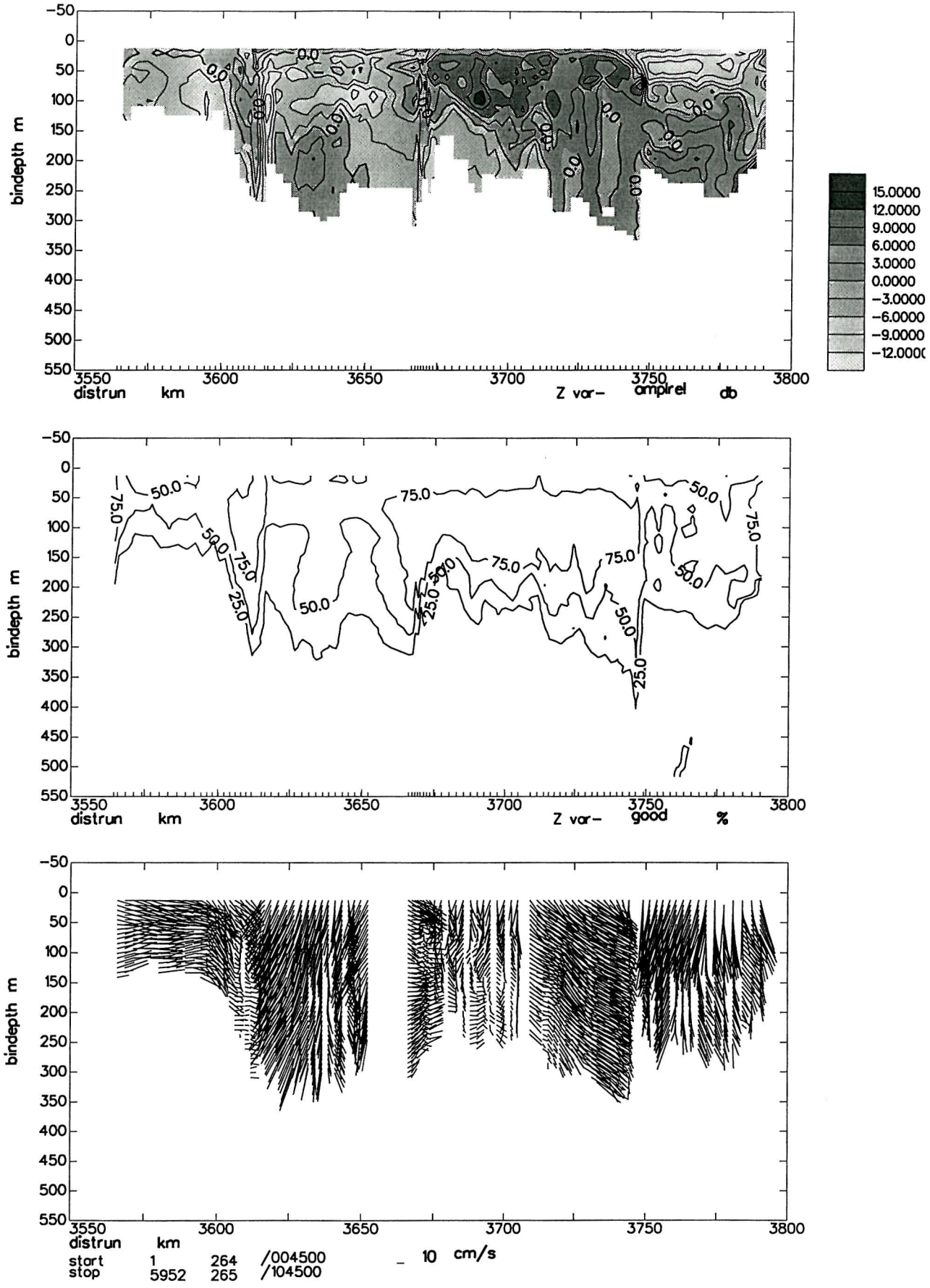

Figure 7. Underway ADCP. Section B2

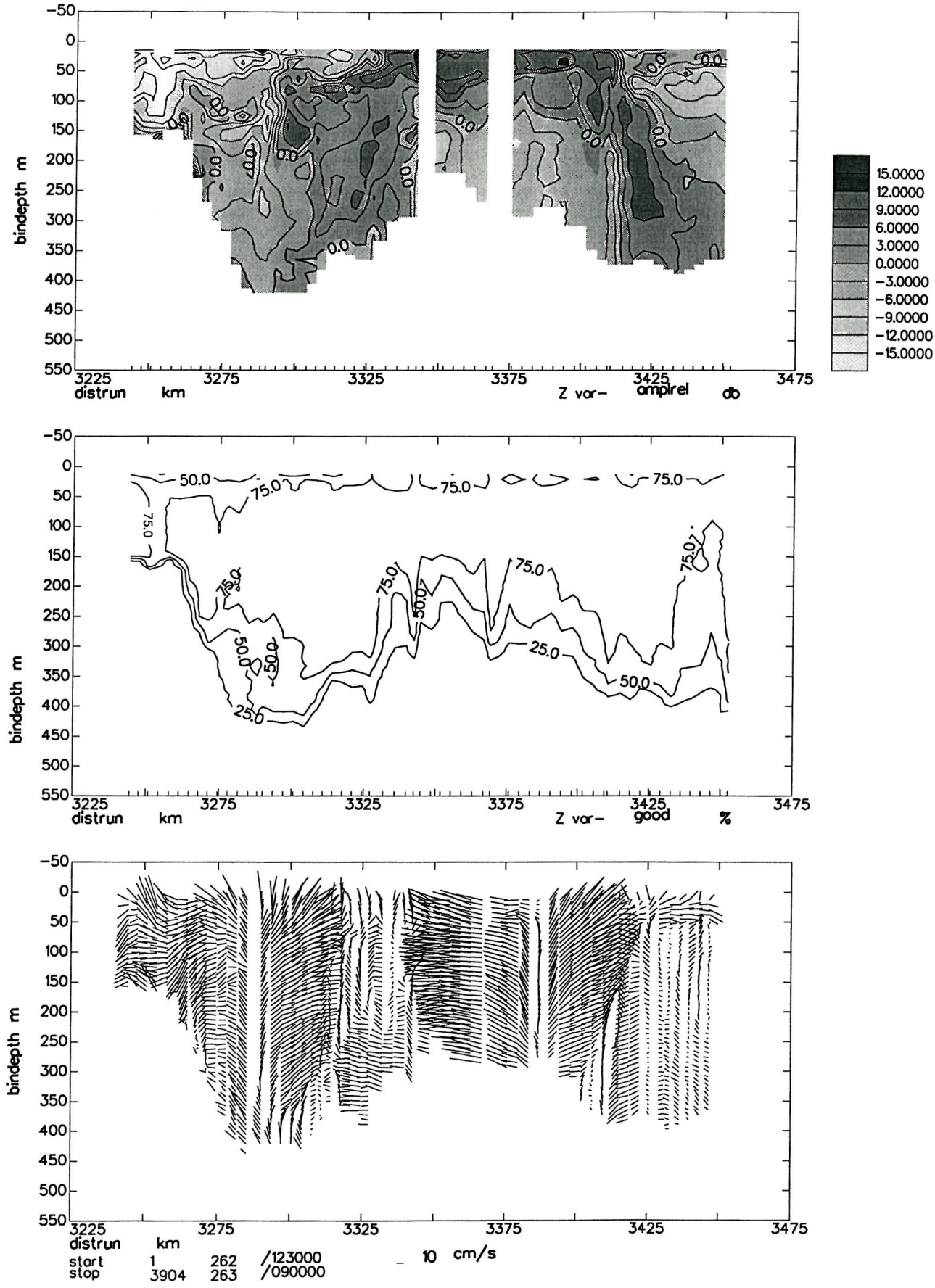

Figure 8. Underway ADCP. Section C2

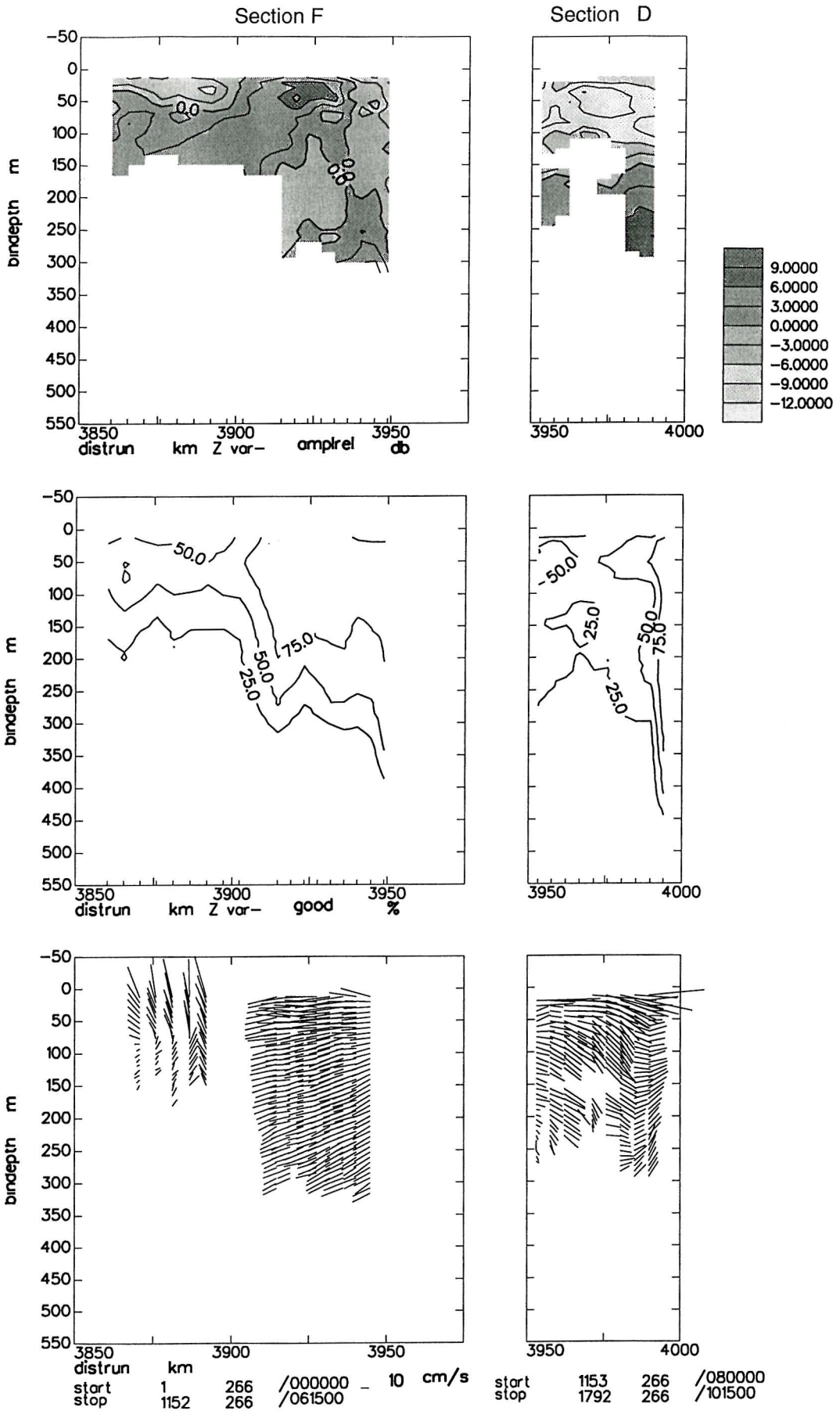

Figure 9. Underway ADCP. Sections F and D

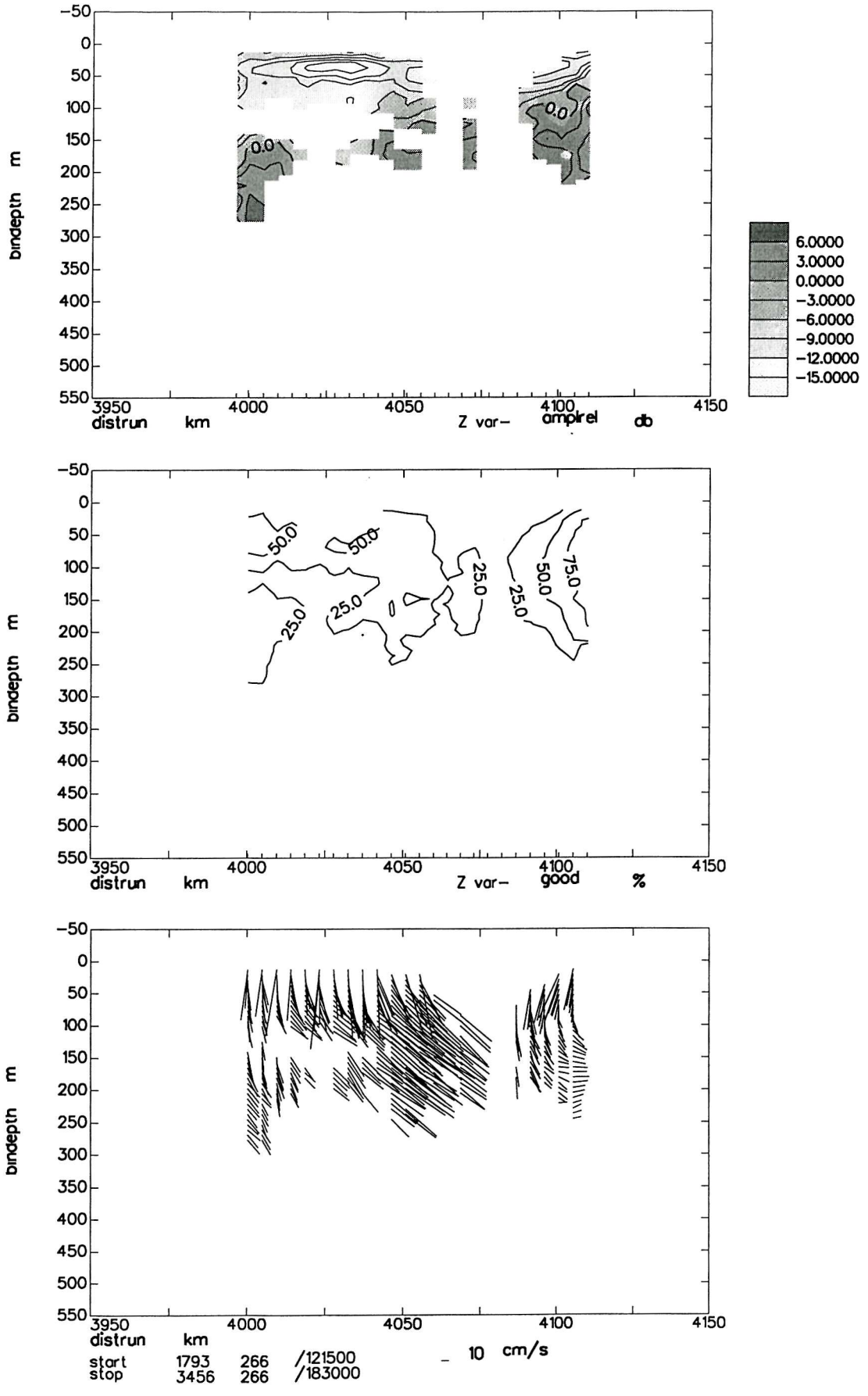

Figure 10. Underway ADCP. Section G

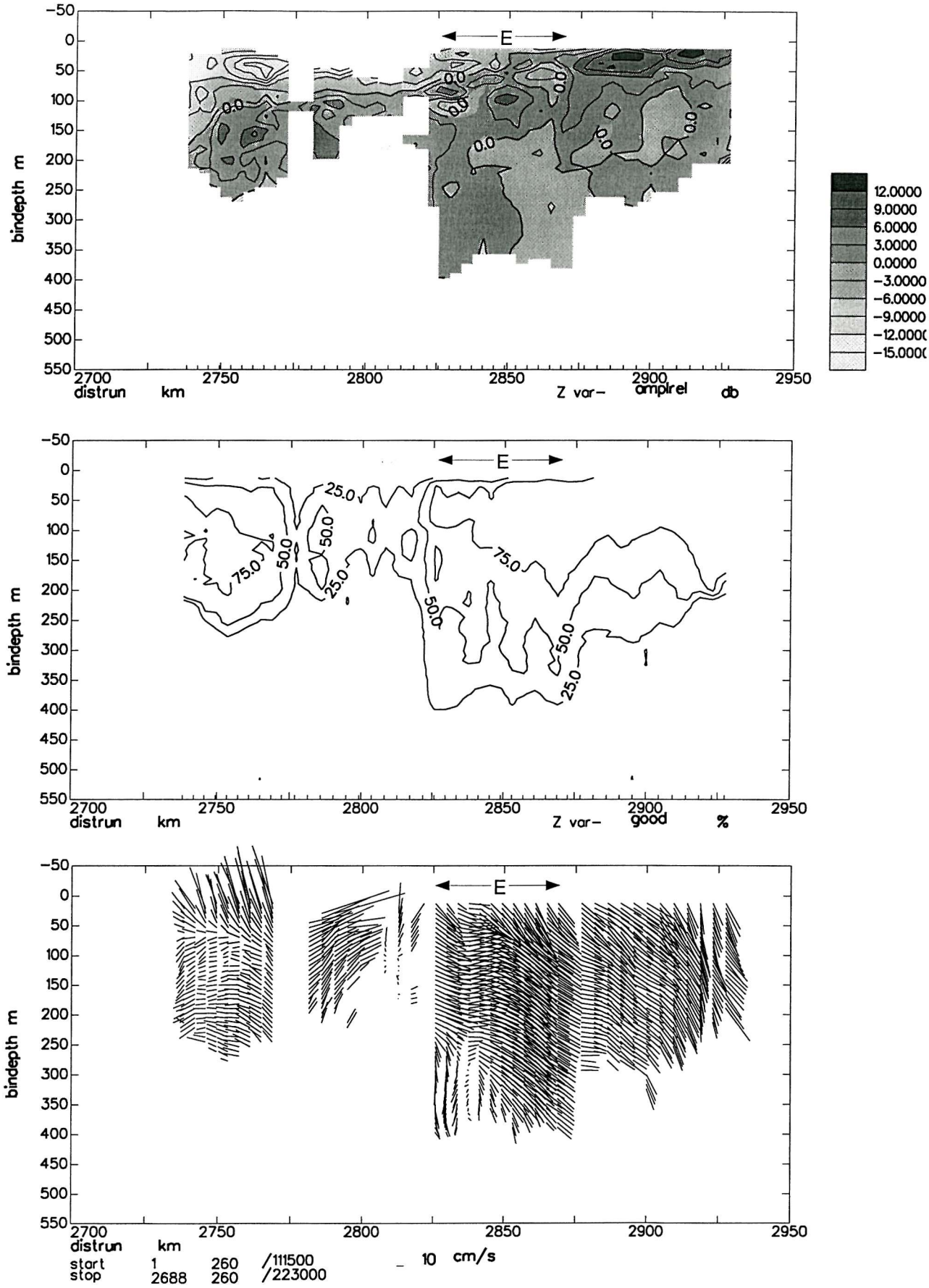

Figure 11. Underway ADCP. Sea Surface Temperature Survey (includes Section E as labelled).

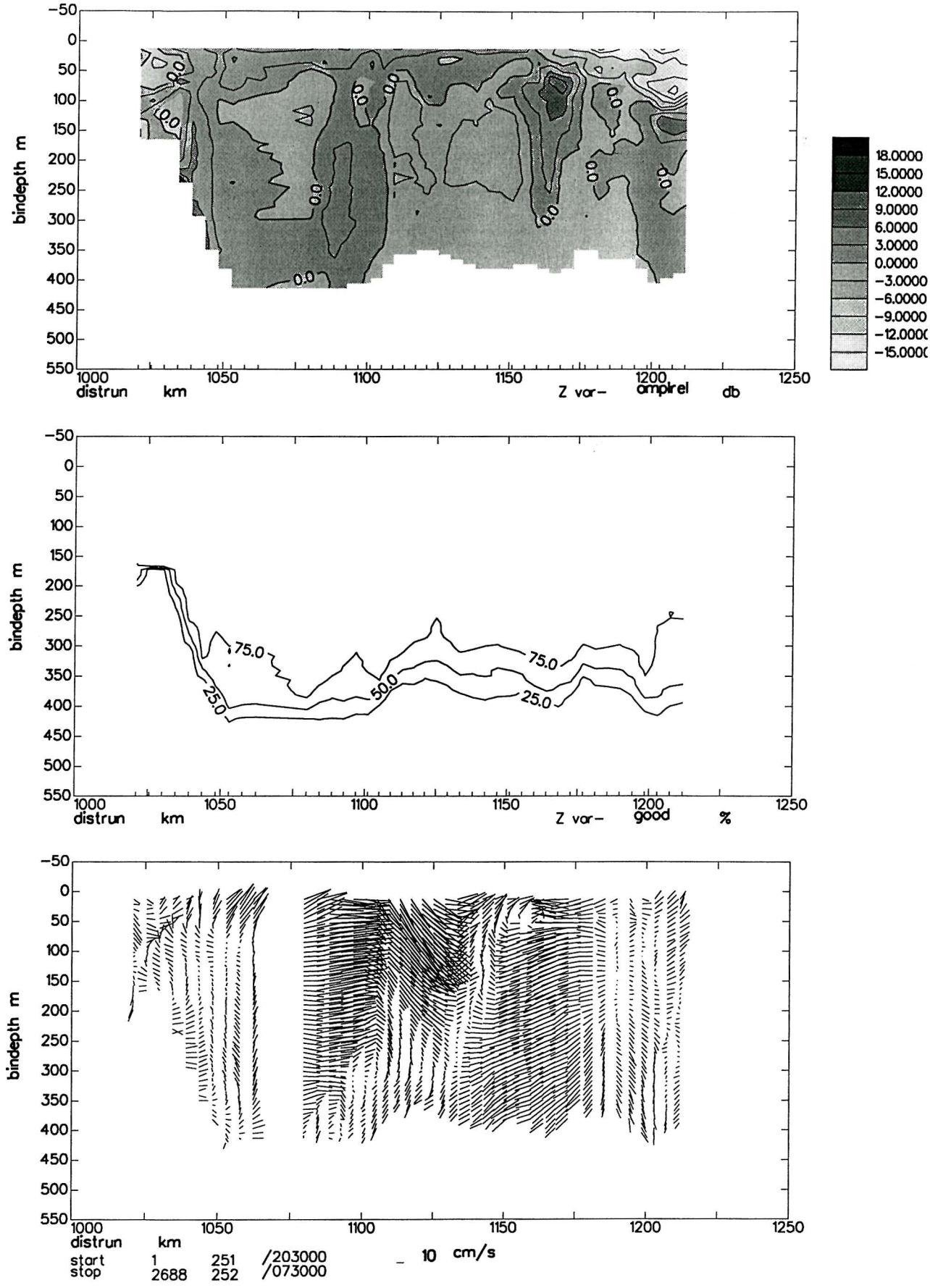

Figure 12. Underway ADCP. Section M1

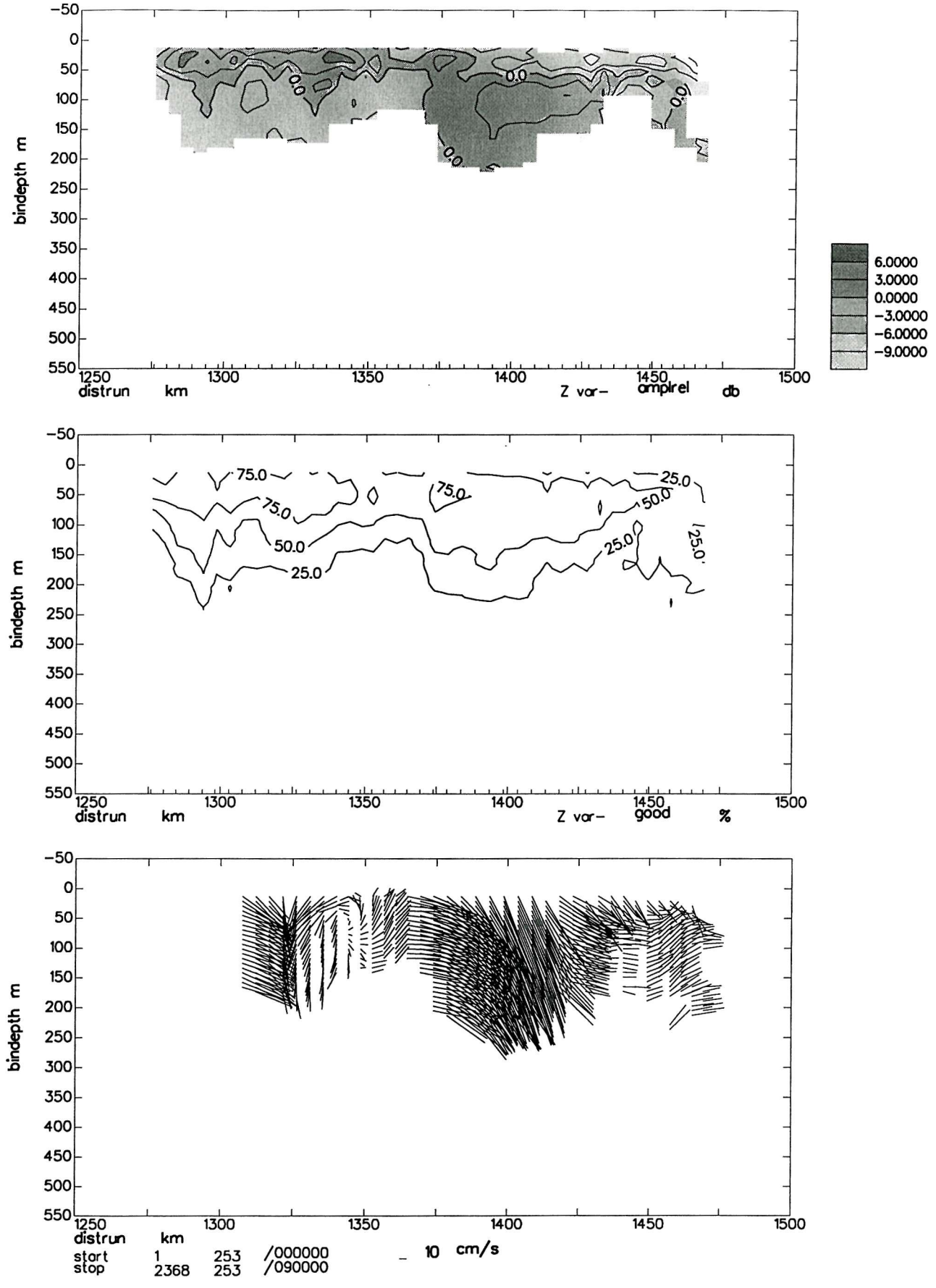

Figure 13. Underway ADCP. Section M2

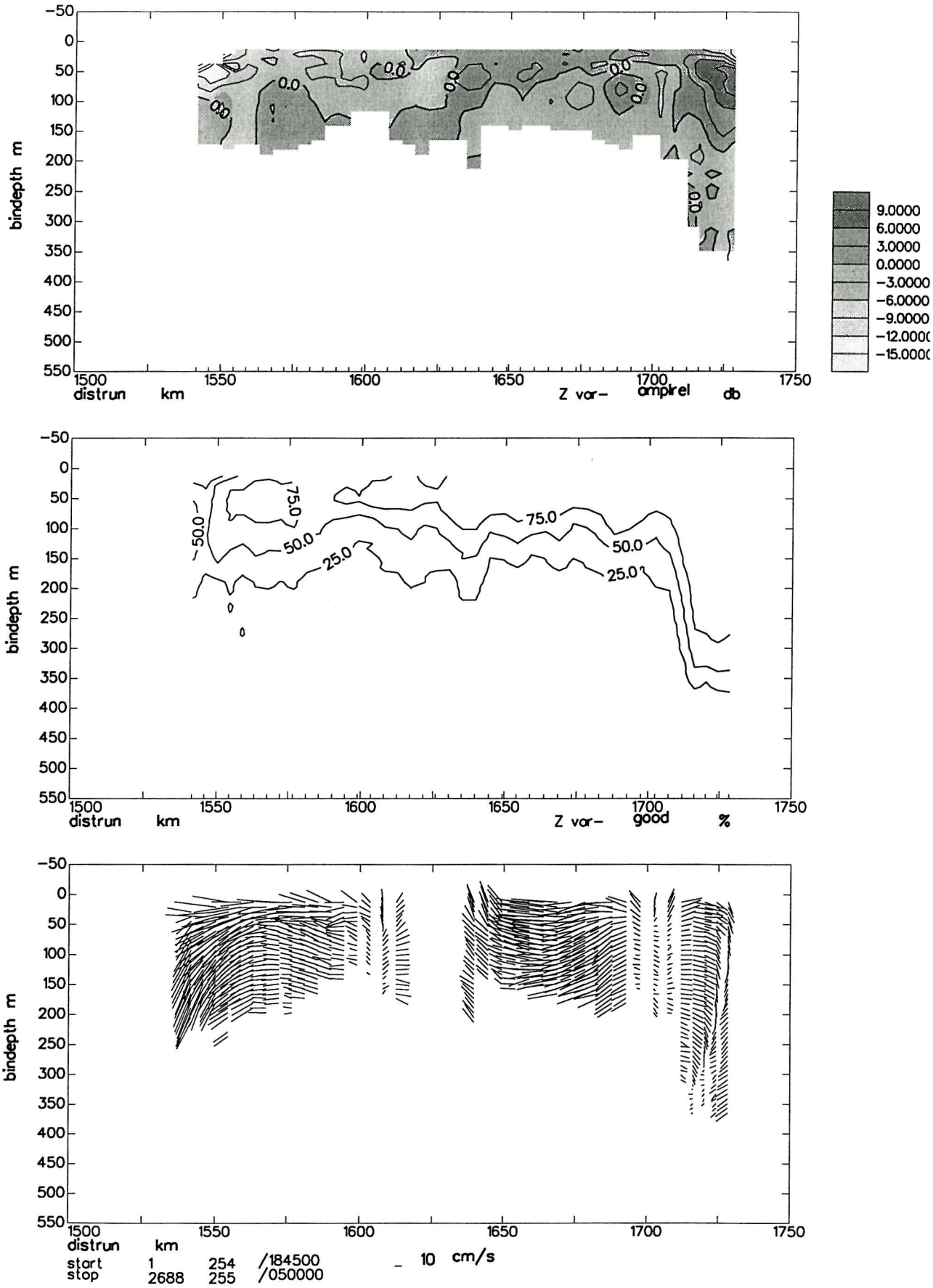

Figure 14. Underway ADCP. Section M3

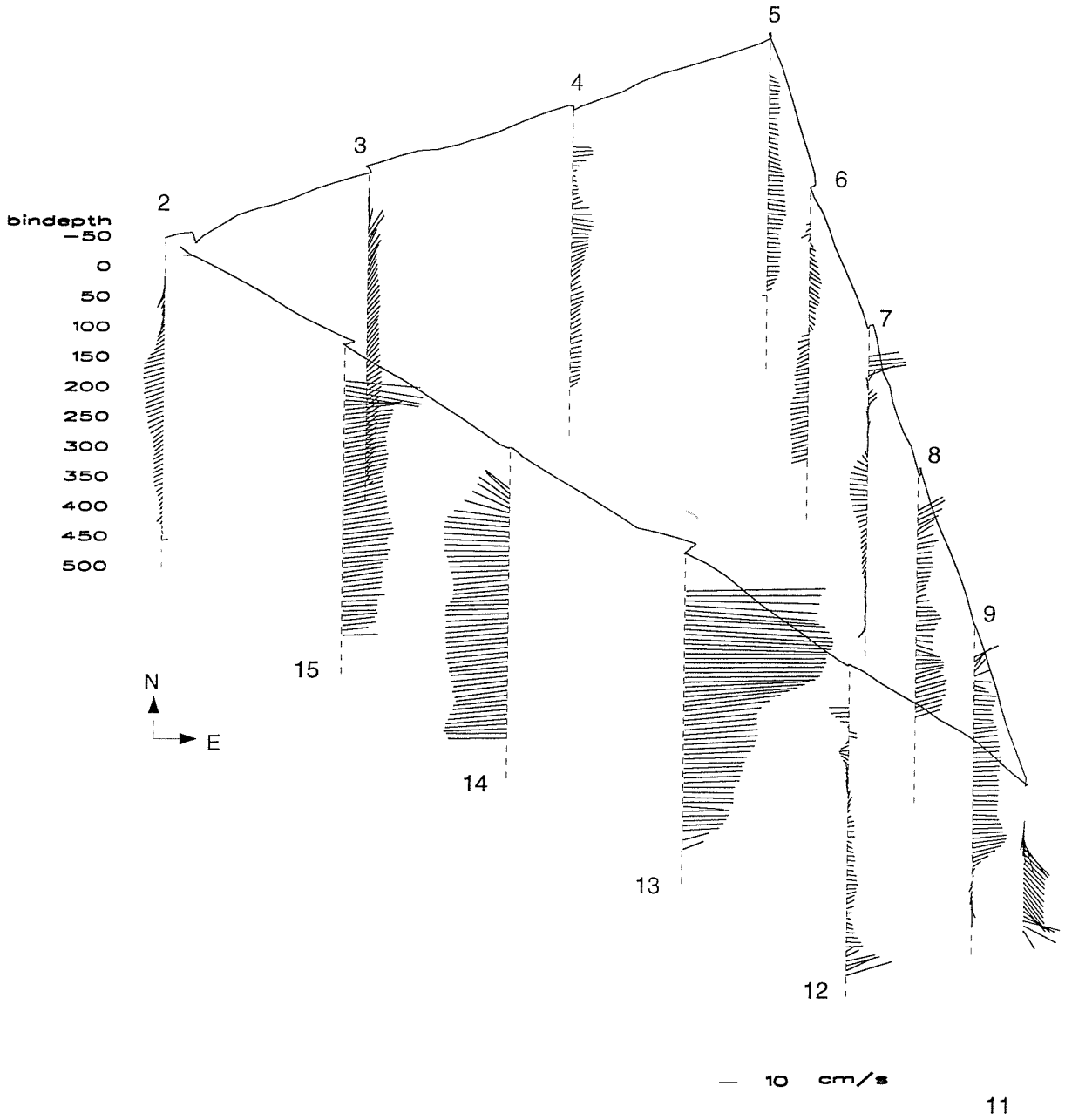

Figure 15. On-station current profiles for Survey 1.
Profile numbers represent CTD station numbers.

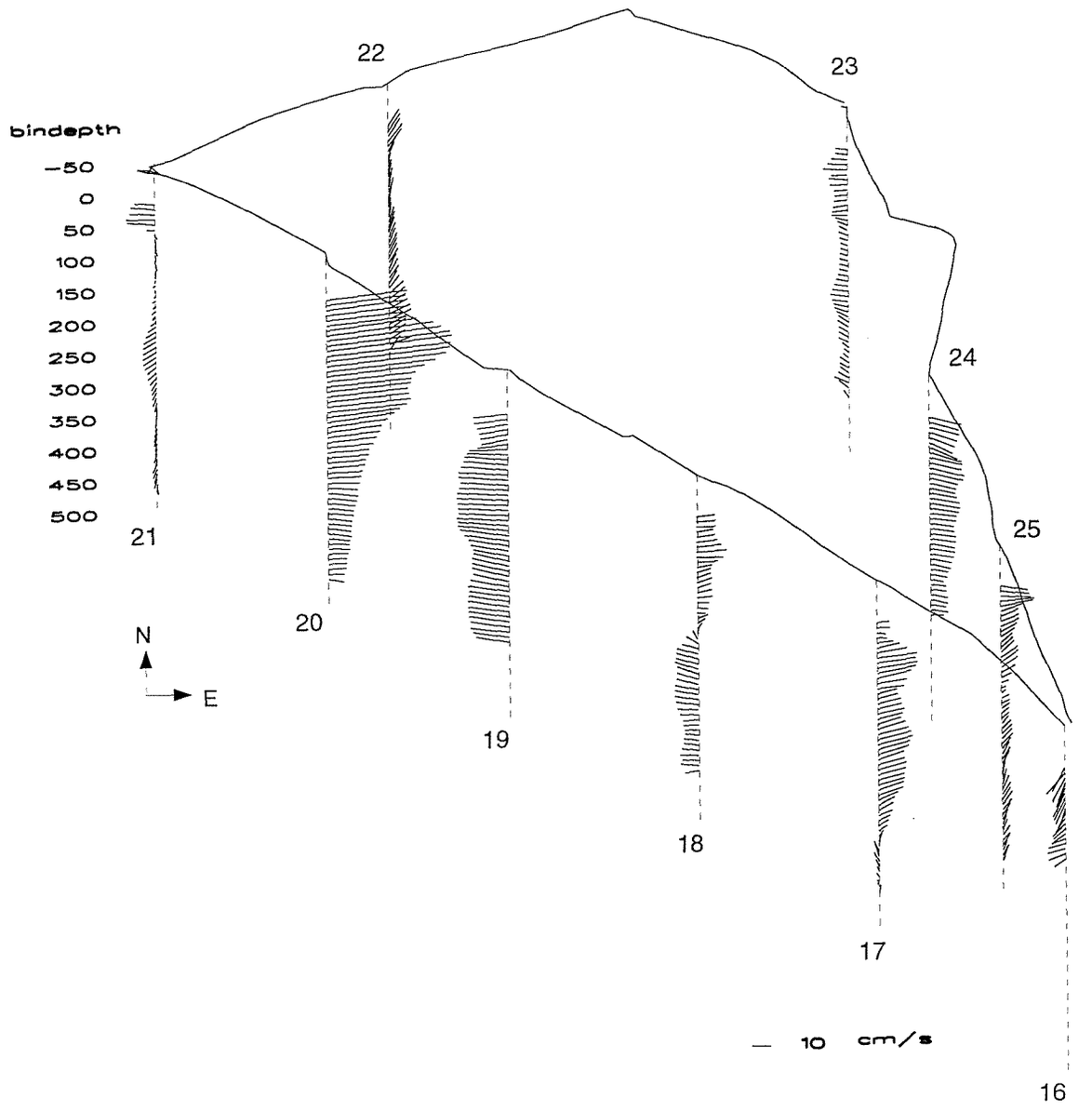

Figure 16. On-station current profiles for Survey 2.
Profile numbers represent CTD station numbers.

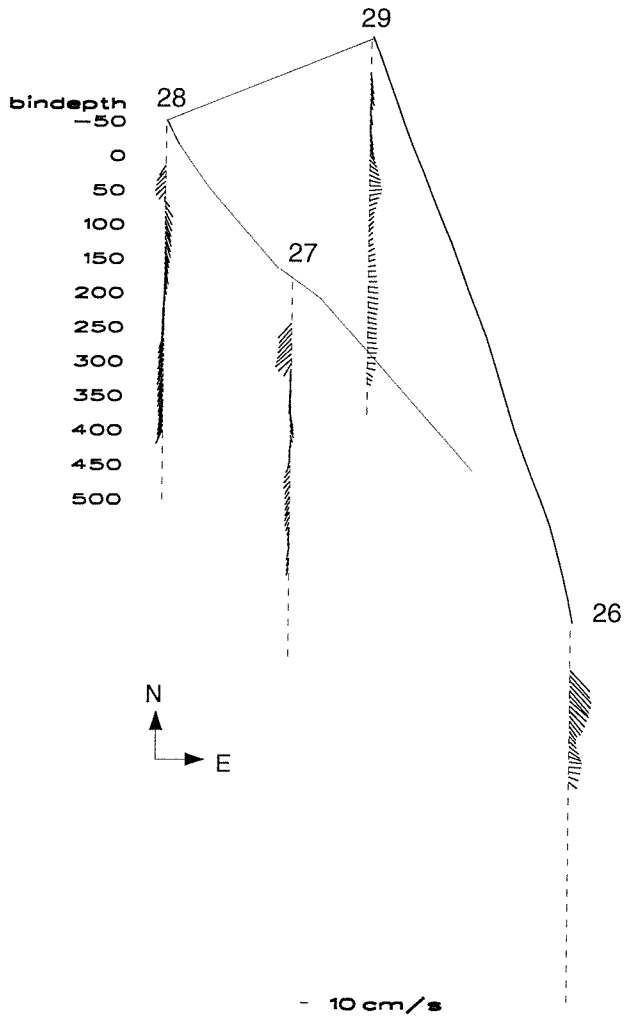

Figure 17. On-station current profiles for Legs F, D, and G. Profile numbers represent CTD station numbers.