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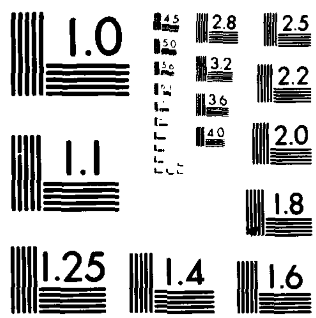

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Monterey, California

THESIS

RELATIONSHIPS BETWEEN SEA SURFACE TEMPERATURE AND NUTRIENTS IN SATELLITE DETECTED OCEANIC FRONTS

by

John Woeppel Conrad

March 1980

Thesis Advisor: Eugene D. Traganza

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Satellite IR images of the California coast off Point Sur reveal recurrent surface features which appear to be "thermal discontinuities" associated with aperiodic upwelling events. Some of these have associated "chemical fronts" and increased biological activity. Satellite IR imagery was used to locate "discontinuities" and with *in situ* monitoring the development of three features were studied. Interrelationships between sea surface temperature

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nutrients and microplanktonic biomass were investigated. Nutrient ratios, satellite imagery, wind stress data and correlations between nutrients and temperature were used to develop an estimate of "age" within a simplified upwelling "life cycle" model.

The features range in scale from tens to hundreds of kilometers. Two upwelling features exhibited very strong correlations between nutrient and temperature but a third feature had considerable nutrient variability. This suggests a considerable impact from the dynamic and biological processes. The technique of coupling satellite imagery and in situ monitoring was found to be a feasible method to provide real time inferences of the nutrient structure associated with an upwelled thermal feature.

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Relationships Between Sea Surface Temperature and Nutrients in Satellite Detected Oceanic Fronts

by

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Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1969

Submitted in partial fulfillment of the requirements for the degree of

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March 1980

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ABSTRACT

Satellite IR images of the California coast off Point Sur reveal recurrent surface features which appear to be "thermal discontinuities" associated with aperiodic upwelling events. Some of these have associated "chemical fronts" and increased biological activity. Satellite IR imagery was used to locate "discontinuities" and with in situ monitoring the development of three features were studied. Interrelationships between sea surface temperature, nutrients and microplanktonic biomass were investigated. Nutrient ratios, satellite imagery, wind stress data and correlations between nutrients and temperature were used to develop an estimate of "age" within a simplified upwelling "life cycle" model.

The features range in scale from tens to hundreds of kilometers. Two upwelling features exhibited very strong correlations between nutrient and temperature but a third feature had considerable nutrient variability. This suggests a considerable impact from the dynamic and biological processes. The technique of coupling satellite imagery and in situ monitoring was found to be a feasible method to provide real time inferences of the nutrient structure associated with an upwelled thermal feature.

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ACKNOWLEDGMENTS

This thesis is a result of ongoing research in chemical oceanography at the Naval Postgraduate School which is supported by the Office of Naval Research, Code 482, NSTL, Bay St. Louis, Mississippi. I thank the sponsors and key individuals whose assistance made this task possible, including: Dr. Eugene D. Traganza, my thesis advisor and principal investigator; Dr. Christopher N. K. Mooers, Dr. Stevens P. Tucker, Dr. Eugene C. Haderlie, Ms. Andrea McDonald of the Naval Postgraduate School, Monterey, California; Captain W. W. Reynolds and the crew of the R/V ACANIA; Mr. L. Breaker of the National Environmental Satellite Service at Redwood City, California; and Mr. A. Bakun of the National Marine Fisheries Service, Pacific Environmental Group, Monterey, California. Lastly, I thank my family for their forbearance, patience and support.

I. INTRODUCTION

In this thesis satellite thermal imagery and *in situ* automated biochemical analyses were combined to study interrelationships of sea surface temperatures, nitrate, phosphate and biological activity in oceanic fronts.

An oceanic front is a region of transition between two oceanic regimes with different characteristics (Cheney, 1976). These characteristics can be temperature, salinity, chemical or biological quantities.

In situ automated biochemical and thermal analyses of surface waters were previously accomplished by others, particularly Kelly, et al. (1975). However, they were not linked to satellite infrared imagery. Due to the marginal quality of satellite-derived results, oceanographers have largely either ignored them or have not been convinced that they could be integrated usefully with classical oceanographic observations (Legeckis, 1978). More sophisticated satellites and sensors, such as the TIROS (Television Infrared Observation Satellites) series and the Advanced Very High Resolution Radiometer (AVHRR) have made it possible to make useful inferences in areas of the ocean that are classically associated with sea surface temperature anomalies. The region of interest in this study is off the central California coast, where "oceanic fronts" and "eddies" appear to form in response to wind driven pulses of cold upwelled coastal waters. The existence of "chemical fronts" in association with these features was postulated in 1978 by Traganza (1978) and demonstrated in 1978 by Traganza et al. (1980).

Continued study of these frontal systems may be particularly relevant to the interests of the Navy in view of their potential effect on the propagation of sound energy and the capability of sensors to distinguish significant sound signals from the background noises in the ocean. Sound velocity changes across thermal fronts, coupled with changes in nutrient concentrations that lead to increased biological activity, may degrade both active and passive sonar performance through changes in sound propagation loss, increased biological reverberation levels and background noise levels.

II. THEORY

A. UPWELLING

Coastal upwelling is caused by the divergence of surface water away from the coast. Cold water rises from subsurface layers to replace this water. When the pycnocline surfaces, relatively nutrient-rich water (which has been trapped below the pycnocline due to density differences) will upwell and enrich the surface waters. In the California coastal area this water is generally derived from a depth no greater than 200 meters offshore (Fairbridge, 1966; Sverdrup, et al., 1942). In the Northern Hemisphere coastal upwelling can be caused by the northerly wind stress prevailing in spring and summer along the western continental coasts. These prevailing winds may vary seasonally off the California coast as the North Pacific subtropical high moves north during the spring and summer, then south during the autumn and winter (Bakun, 1973). Upwelling can also be caused by currents impinging on land masses (Fairbridge, 1966) or winds blowing directly away from shore.

The circulation patterns vary with the width and form of the continental shelf and slope, the wind speed, duration, fetch and latitude. The characteristics of upwelled water may vary depending on the depth from which the water came, the properties of the source water, the characteristic vertical velocity, and the residence time of the upwelled water in the euphotic zone (SCOR Working Group, 1974). The proximity of the heads of underwater canyons enhances the intensity of the upwelling, (SCOR Working Group, 1974; Codispoti, 1977; Treguer, 1977). Therefore, upwelling can vary from region to region and season to season (Codispoti et al., 1979; Barton et al., 1977).

B. SATELLITE IMAGERY

Infrared (IR) images of the sea surface temperatures were received from the TIROS-N series satellites using an Advanced Very High Resolution Radiometer (AVHRR). The measured quantity is the sea surface radiance which is converted to an equivalent blackbody temperature. Correction factors are applied to account for atmospheric attenuation and radiation from atmospheric gases.

The infrared detectors have a temperature response from approximately -113° to +47°C (Brower et al., 1976). This is displayed in gray tones on photographic film, where the darker shades represent higher temperatures. Since the ocean temperature range is considerably smaller than the detector's range it is possible, through the technique of "image enhancement," to assign the available gray shades to this narrower range. This allows finer resolution of the gray shades that represent the oceanic temperature structure and will better distinguish thermal features.

Cloud cover is often difficult to distinguish in infrared images. In this case a comparison between the visual and infrared image can often resolve the ambiguity. If not, comparison, over a period of several days will highlight sea surface temperature (SST) fronts because of the time scale difference between ocean features and cloud formations.

C. NUTRIENTS (NITROGEN AND PHOSPHORUS)

Nitrogen, as reactive dissolved inorganic nitrate, and phosphorus, as reactive dissolved inorganic phosphate, were studied. Both elements are essential components of all living cells and are present in phytoplankton in a ratio approaching 16N:1P (Redfield, 1958). As a result of decomposition and respiration nitrate and phosphate are released into deep ocean waters. These deep ocean waters also have a ratio approaching 16N:1P. This is or can be represented by the statistical-stoichiometric model developed by Richards (1965), viz.,

$$\underbrace{(CH_2O)_{106}\,(NH_3)_{16}\,H_3PO_4}_{\text{Organic Matter}} + 138\ O_2 \rightleftharpoons 106\ CO_2 + 122\ H_2O + \underbrace{16\ HNO_3 + H_3PO_4}_{\text{Nutrients}}$$

The distribution of nutrients in the ocean is dependent upon biological processes (regeneration, utilization) and physical processes (sinking and upwelling, horizontal advection, diffusion and mixing). These processes, individually or collectively, plus differences in their rates cause the concentrations to vary temporally and spatially. Therefore, the ratio of nitrate to phosphate is not very often 16:1 in ocean surface waters (Banse, 1974).

III. METHODS

A. NUTRIENTS

Surface nutrient concentrations were determined approximately every 0.6 km except for the 13 June Cruise Leg 3 when engine problems caused speed adjustments. Seawater samples were pumped from a keel intake at 2.5m to the shipboard laboratory. Nitrate and phosphate were analyzed every two minutes according to the Technicon Autoanalyzer Industrial Method 175-72-WM, 177-72-WM (Anonymous, 1973) and 100-70-WM (Anonymous, 1978). Here nitrate may include traces of *in situ* nitrite, since the nitrate is reduced to nitrite before measurements. However, according to Paulson (1972) there is little or no interference from surface nitrate in this area.

B. SATELLITE IMAGERY

The pre-cruise procedure was initiated approximately 2-3 weeks prior to the estimated departure time. Mr. Breaker of the National Environmental Satellite Service (NESS) at Redwood City, California, monitored and enhanced images from the TIROS-N satellite series. Several days prior to the cruise, the day of the cruise and sometimes during the cruise updated satellite information was passed via telephone. Information, re IR inferred thermal features, such as orientation, approximate center, size, and spatial relationship relative to prominent landmarks proved invaluable in locating features and planning sampling strategy. Additionally, the direction of a feature's general movement and large-scale changes in shape may be inferred by viewing a time sequence of images.

C. COMPUTATIONS

A linear regression analysis was performed and mean values were calculated for nitrate, phosphate and temperature using the NORLSQ library subroutine at the W. R. Church Computer Center of the Naval Postgraduate School.

Correlation coefficients for nitrate to phosphate, nitrate to temperature and phosphate to temperature were obtained utilizing the correlation coefficient equation:

$$r = \Sigma(X_i-\bar{X})(Y_i-\bar{Y})/([\Sigma(X_i-\bar{X})^2][\Sigma(Y_i-\bar{Y})^2])^{\frac{1}{2}}$$

Zero values of nitrate and phosphate occurred when taking reference baselines or calibrating standards, or when a nitrate "none detected" condition occurred due to concentrations below the sensitivity of the instrument. When grossly anomalous values occurred, the nutrient and temperature data for that time increment were not used in the calculations.

(Statistical computations for the wind stress, adenosine triphosphate (ATP), and chlorophyll biomass will be discussed in a related thesis.)

D. CHLOROPHYLL

Fluorescence was recorded continuously using a Turner Model 111 fluorometer as described by Lorenzen (1966). Discrete samples, taken every 30 minutes, were used to calibrate and convert fluorescence to chlorophyll a concentration. The discrete chlorophyll samples were analyzed using the method of Strickland and Parsons (1968). These samples were filtered through a Whatman 4.5 cm G/FC glass fiber filter. For comparison with ATP, chlorophyll concentrations were converted to carbon units (mg/l) by using the average conversion factor (100) proposed by Holm-Hansen (1969).

E. ATP

Adenosine triphosphate was sampled every 10 minutes or approximately every 3 km over most of the cruise tracks. Each 50 ml sample was filtered through a 200-μm nylon screen, then through a 0.45-μm glass filter. The method of Holm-Hansen and Karl (1976) was used for ATP analysis. For comparison with chlorophyll, ATP concentrations were converted to carbon units (mg/l) by using the average conversion factor (250) proposed by Holm-Hansen (1969).

F. TEMPERATURE

Sea surface temperature was recorded continuously from a thermistor located at approximately 2.5 m depth coincident to the sea water intake. Sea surface temperature was also measured by bucket thermometer every 20 minutes simultaneously with the release of a Sippican expendable bathythermograph probe (XBT). The bucket thermometer readings differed by a maximum of ±0.5°C with respect to the continuous samples and by a maximum of ±0.6°C with respect to the XBT temperatures. When these deviations exceeded ±0.3°C they were adjusted to the bucket thermometer readings.

In Figures 8 and 21 the XBT data are plotted as isotherms in vertical sections along the cruise tracks for the 30 April and 7 August cruises. A contour interval of 0.5°C was used.

G. WIND

Wind effects were calculated from the Fleet Numerical Oceanography Center's (FNOC) Data Base using the so-called Field By Information Blending (FIB) routine for grid position 36°N x 122°W, which is in the vicinity of the Point Sur coastal region. Computer programs developed by Mr. Andrew Bakun of the National Marine Fisheries Service (Bakun, 1973) produced an output consisting of six hour values for the wind vector, wind stress magnitude, Ekman transport vector, upwelling index (the Ekman vector component normal to the coastline) and vertical velocity (Appendix B). A minimum of 12 days of data prior to and after each cruise was selected for analysis.

IV. RESULTS

A. 30 APRIL CRUISE

Satellite IR imagery indicated a cyclonic thermal feature had developed off Pt. Sur, California, on 19 April 1979 (Plate 1). It appeared to be forming as a seaward extension of coastally upwelled water. By 29 April it appeared to have persisted as a plume-like feature with a cyclonic swirl (Plate 2). Through the use of temperature and nutrient sampling, referenced to the satellite imagery, the central area was found on the first transect and re-located on each subsequent transect (Fig. 1).

Temperature, nitrate and phosphate are plotted against elapsed distance from 36°39.1'N x 121°58.6'W (Fig. 2). The feature is evident in the gradients of nitrate, phosphate and temperature.

Correlation coefficients of $r = 0.98$ for nitrate to phosphate, $r = -0.94$ for phosphate to temperature, and $r = -0.96$ for nitrate to temperature were obtained (Table I). Nutrient ratio (N/P) and temperature when plotted against elapsed distance (Fig. 4) also exhibit a strong negative correlation with respect to each other; as is to be expected.

Based on the temperature minima and nutrient maxima the central area of the feature appeared at approximately 65 km (Leg 1), 220 km (Leg 2) and 300 km (Leg 3). The other cold water areas at approximately 165 km (Leg 2) and beyond 335 km

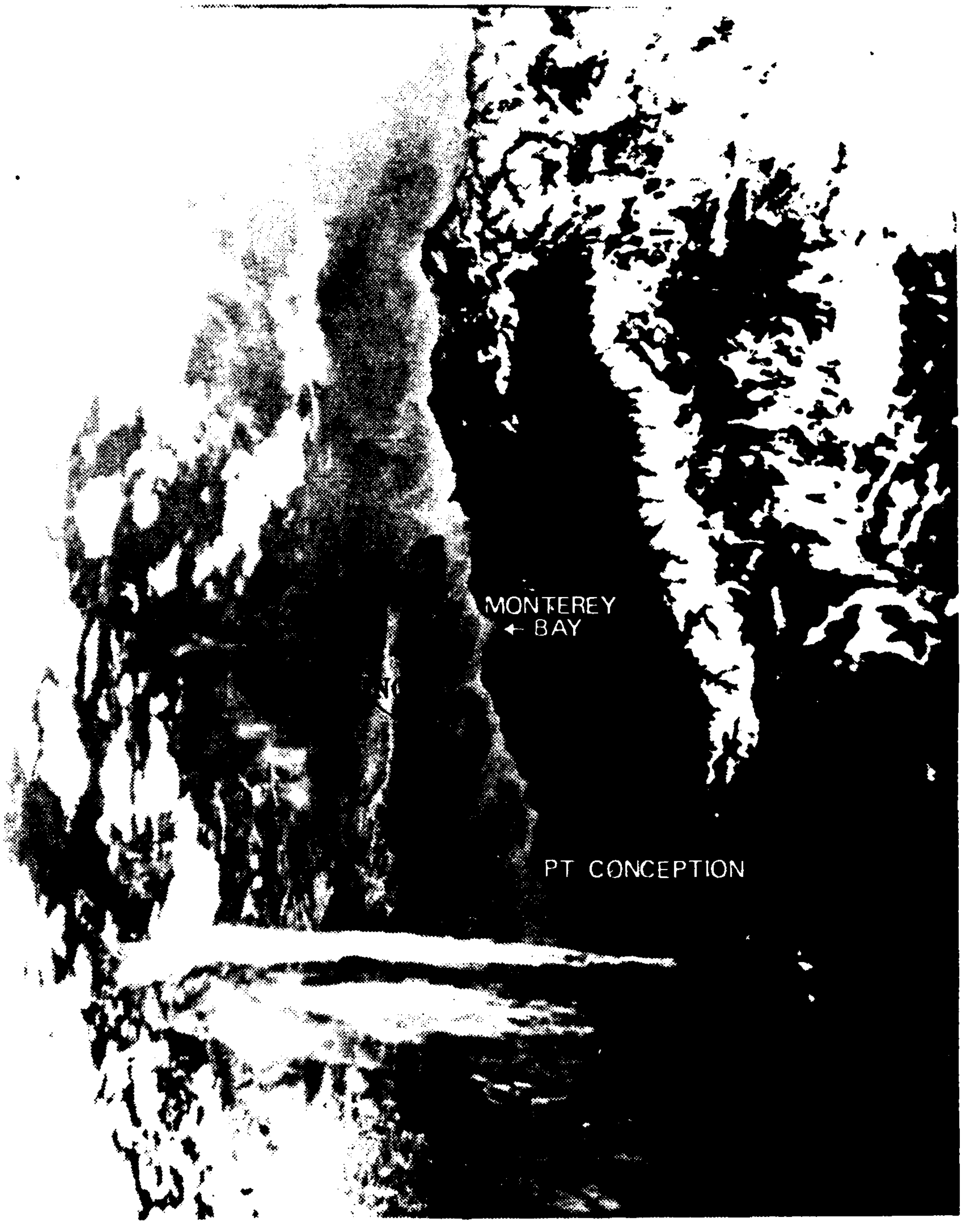

Plate 1. TIROS-N Satellite IR Image of the California Coast, 19 April 1979.

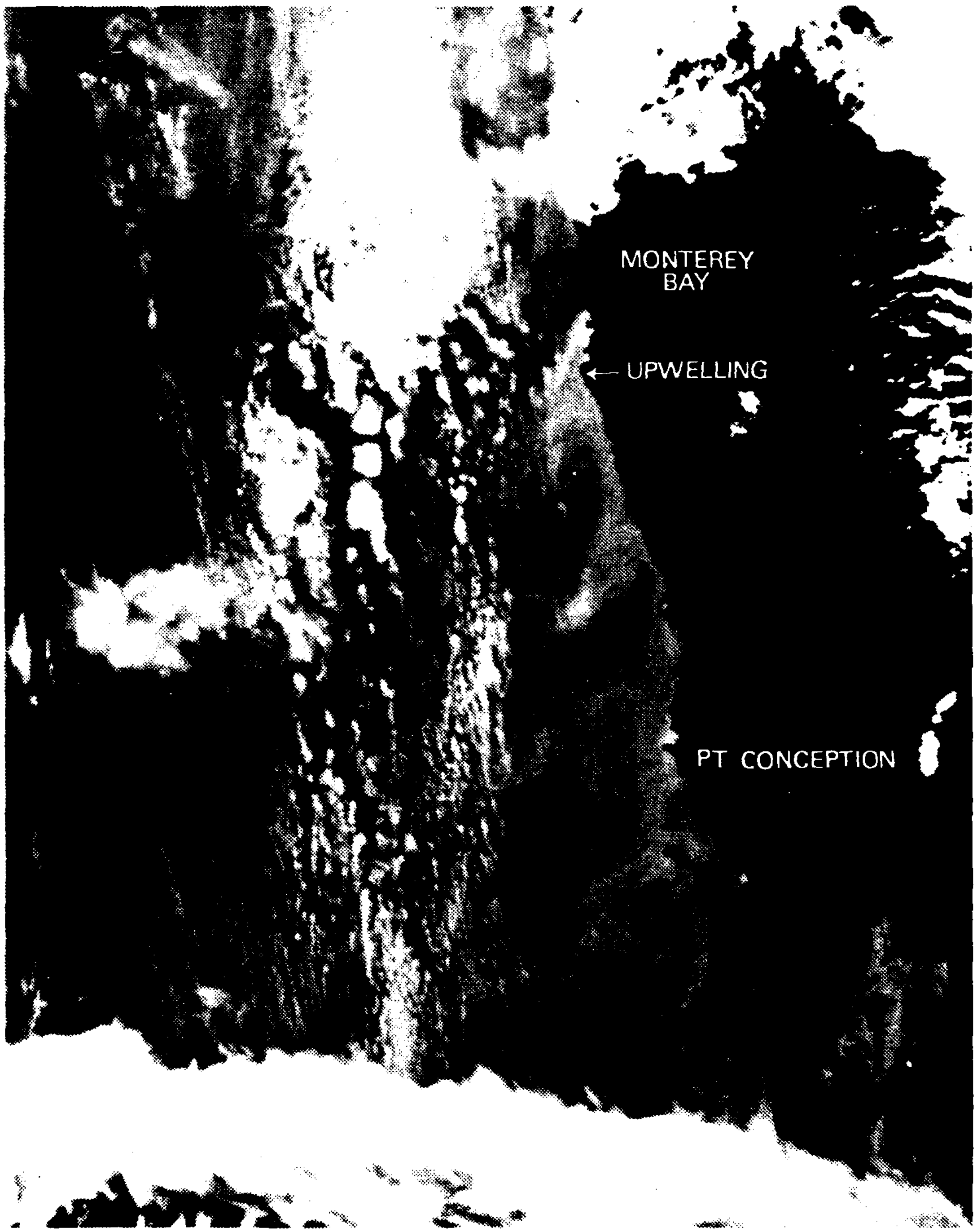

Plate 2. TIROS-N Satellite IR Image of the California Coast, 29 April 1979.

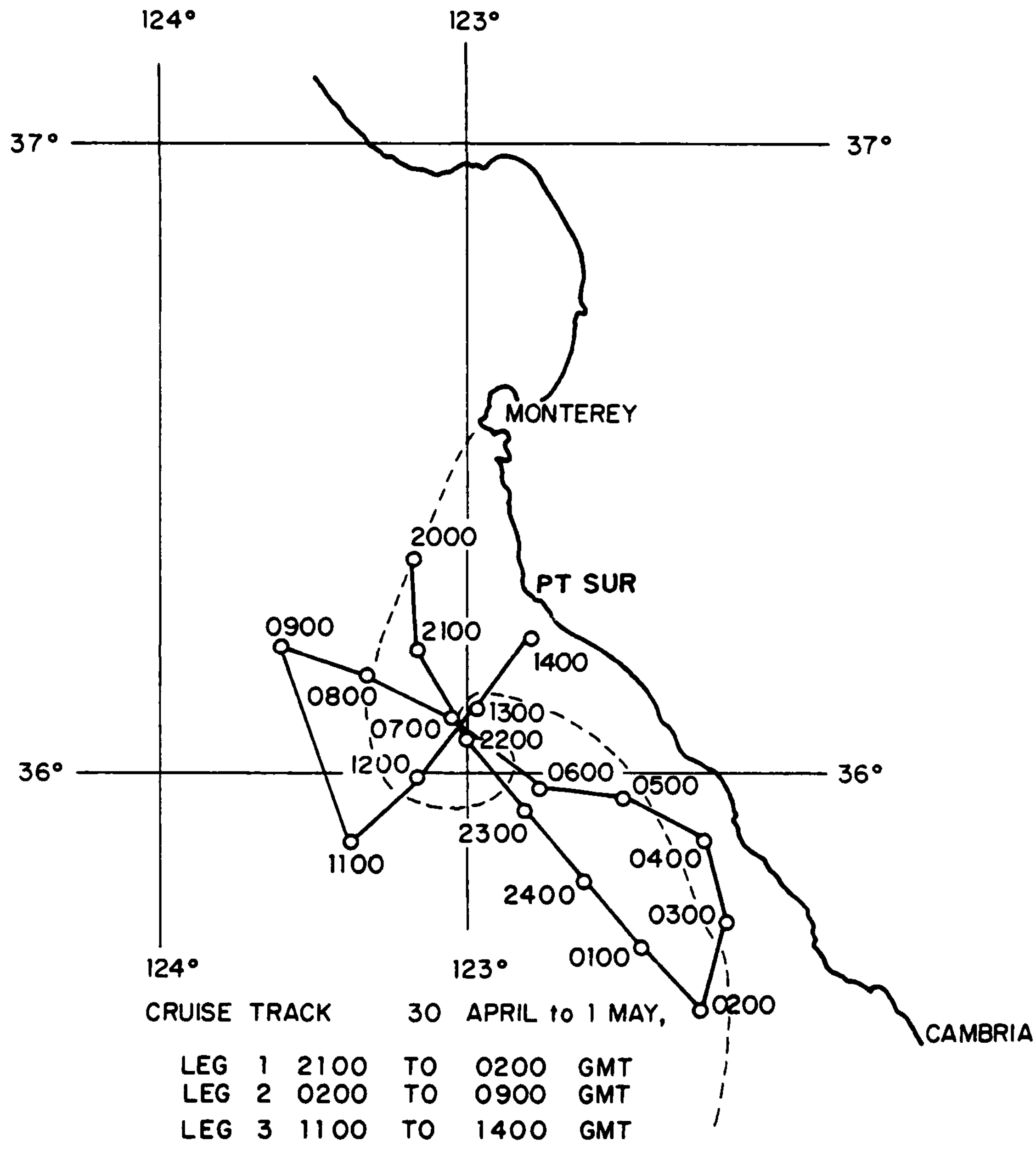

Fig. 1. Track of the 30 April Cruise (solid line) and of the Upwelling Feature (dashed line) based on Satellite IR Imagery, Sea Surface Temperature and Nutrient Data.

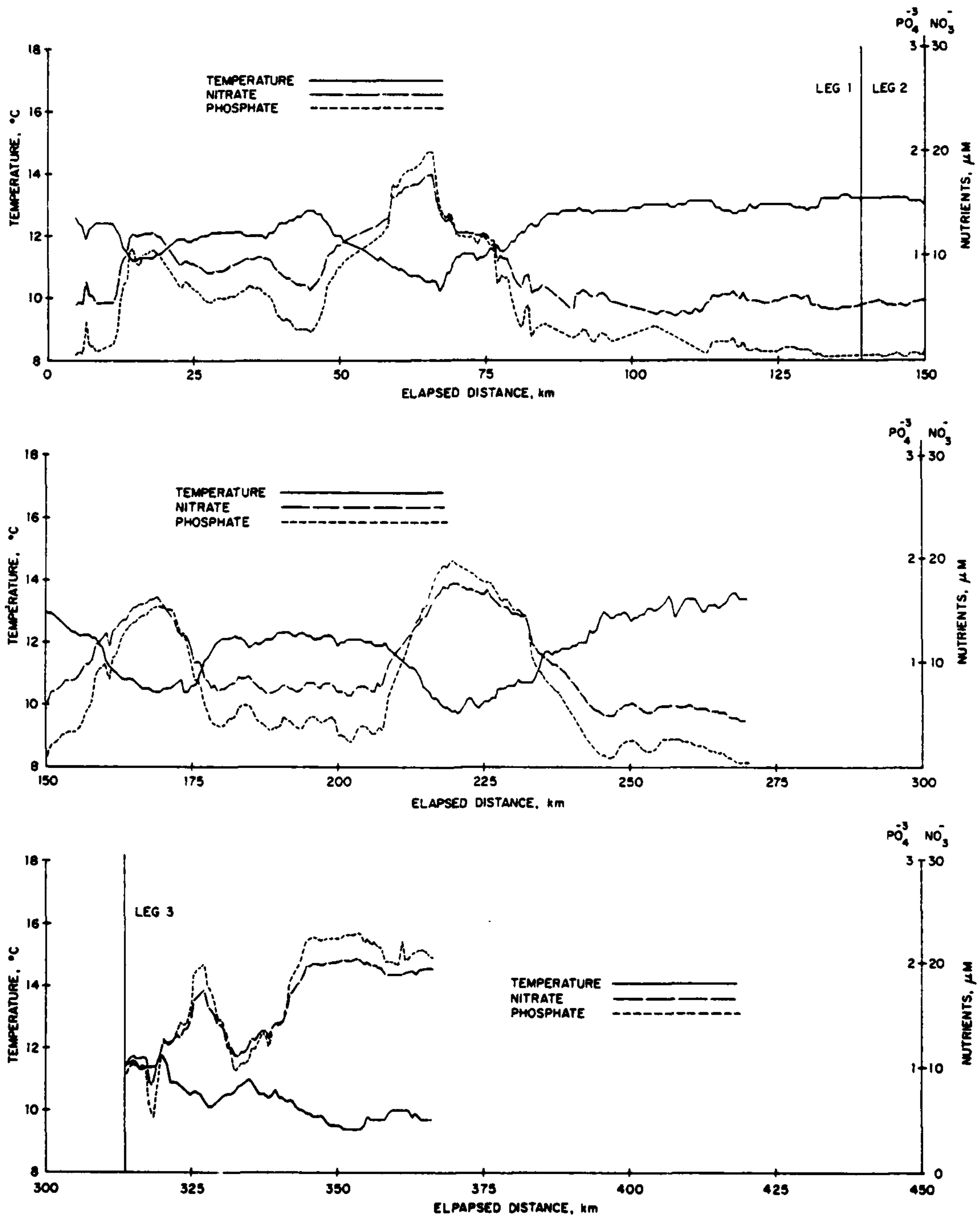

Fig. 2. Nitrate, Phosphate, and Sea Surface Temperature Versus Elapsed Distance along the Track of the 30 April Cruise. Note the tendency for inverse correlation between temperature and nutrients.

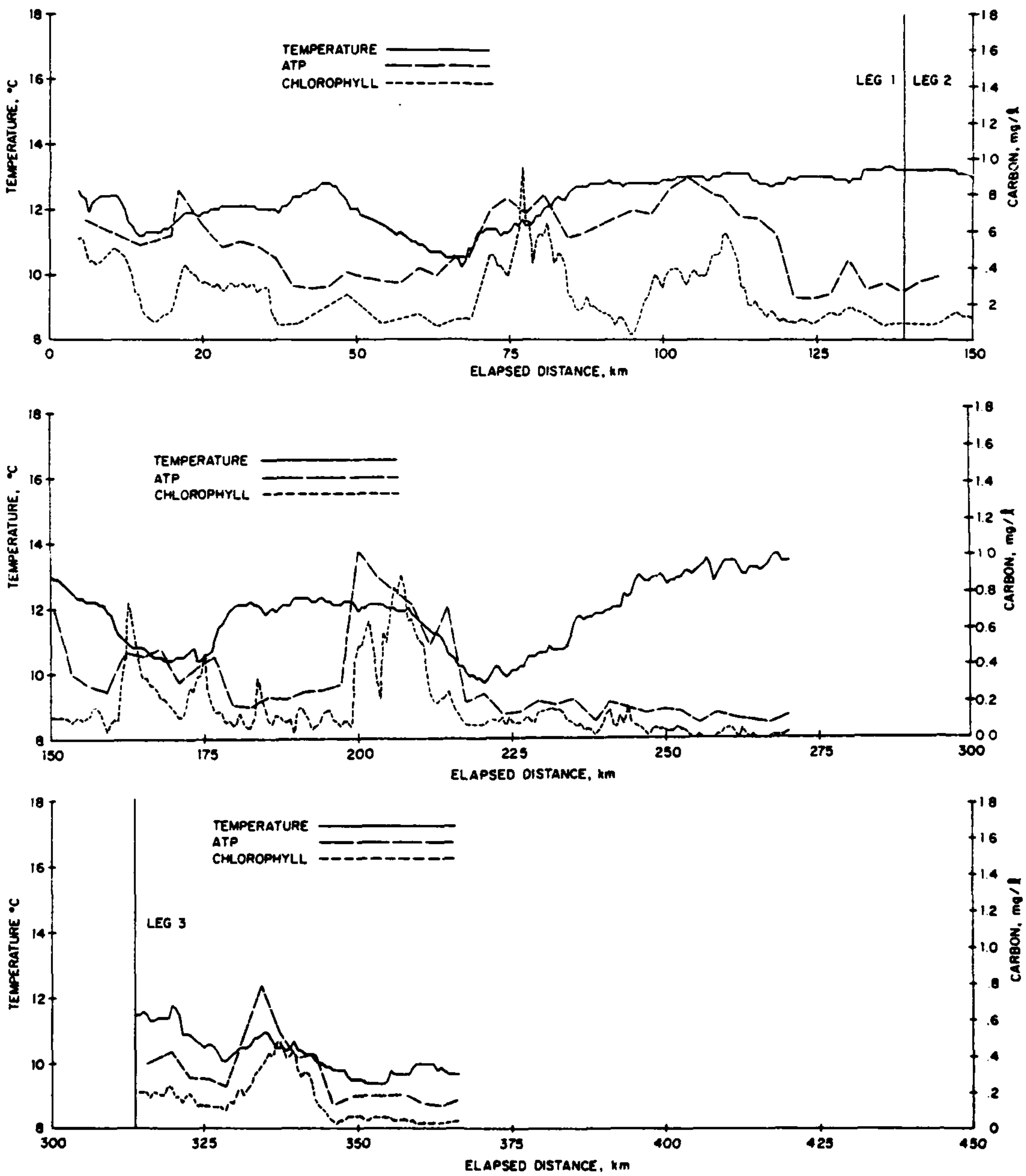

Fig. 3. ATP, Chlorophyll a, and Sea Surface Temperature Versus Elapsed Distance along the Track of the 30 April Cruise.

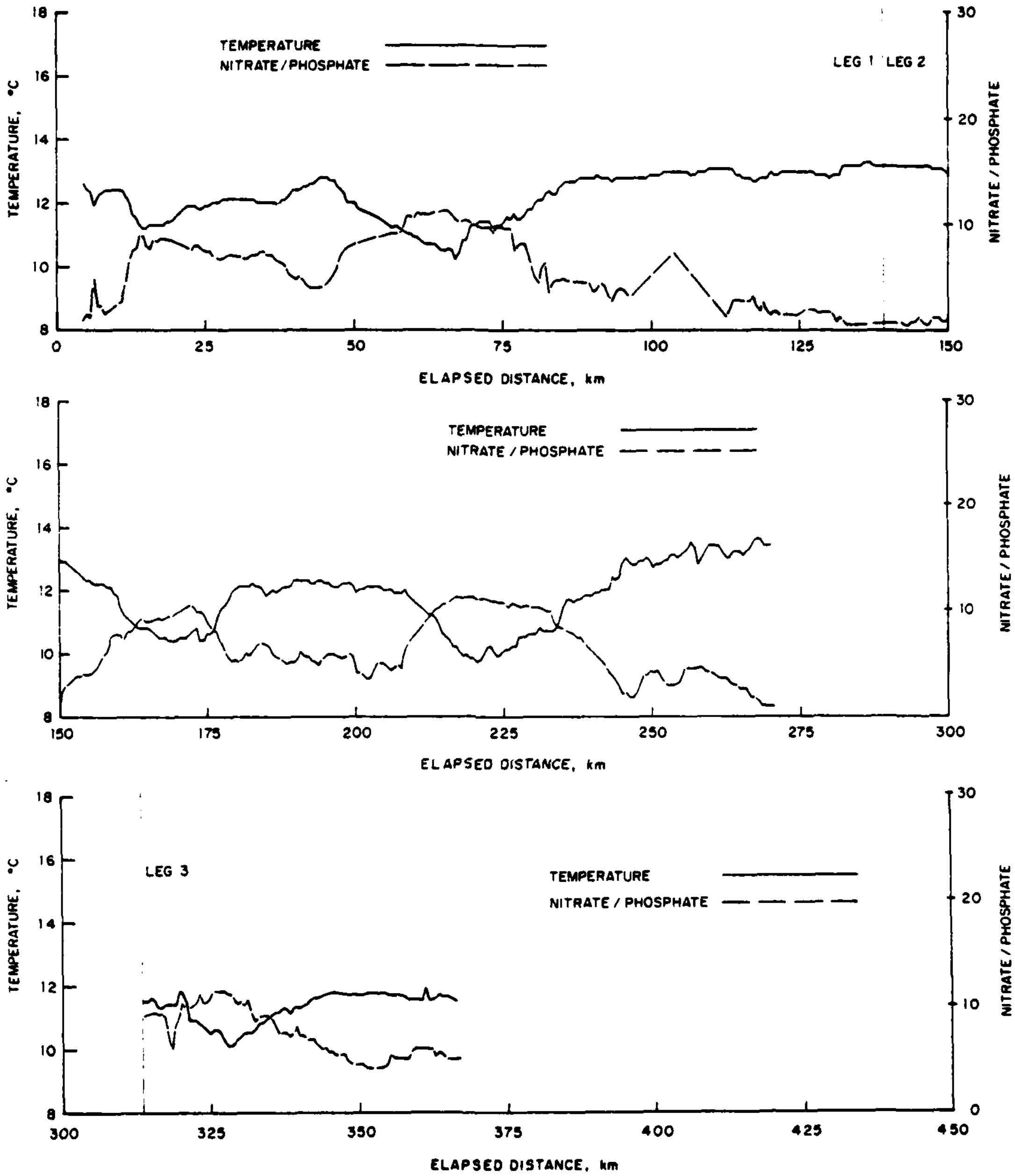

Fig. 4. Nutrient Ratio and Sea Surface Temperature Versus Elapsed Distance along the Track of the 30 April Cruise. Note the tendency for inverse correlation between temperature and nutrient ratio.

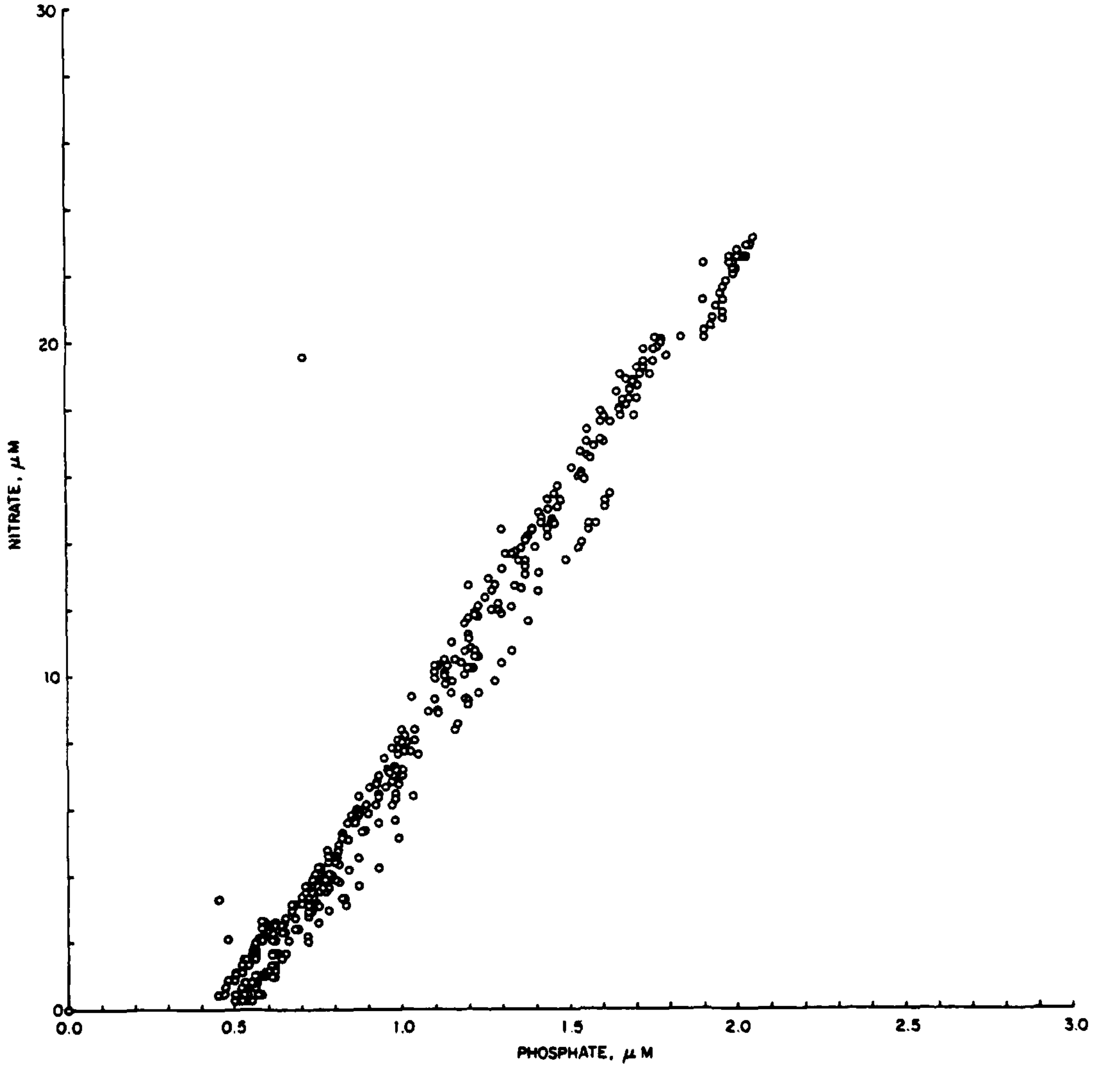

Fig. 5. Nitrate Versus Phosphate for the 30 April Cruise.

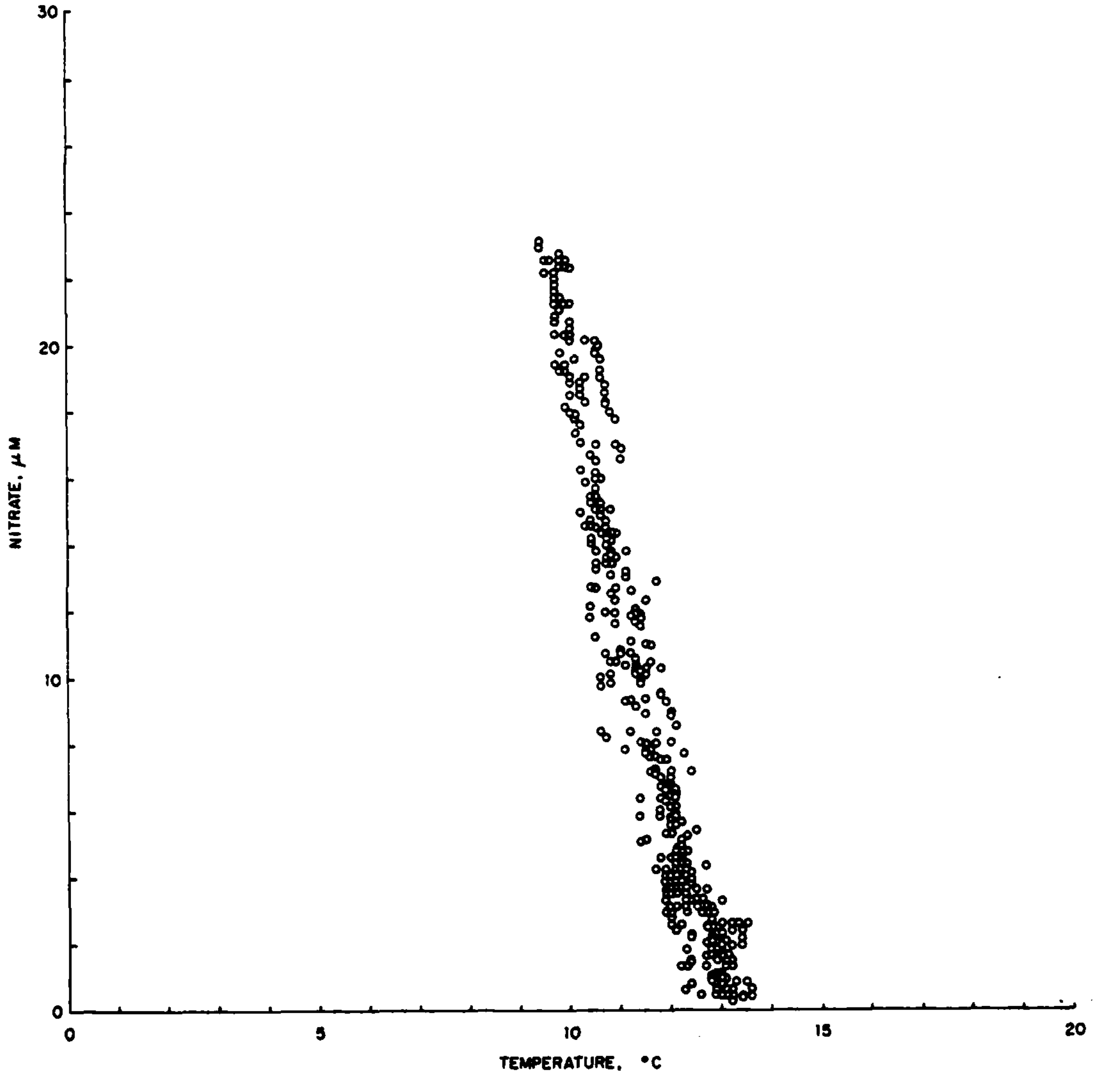

Fig. 6. Nitrate Versus Temperature for the 30 April Cruise.

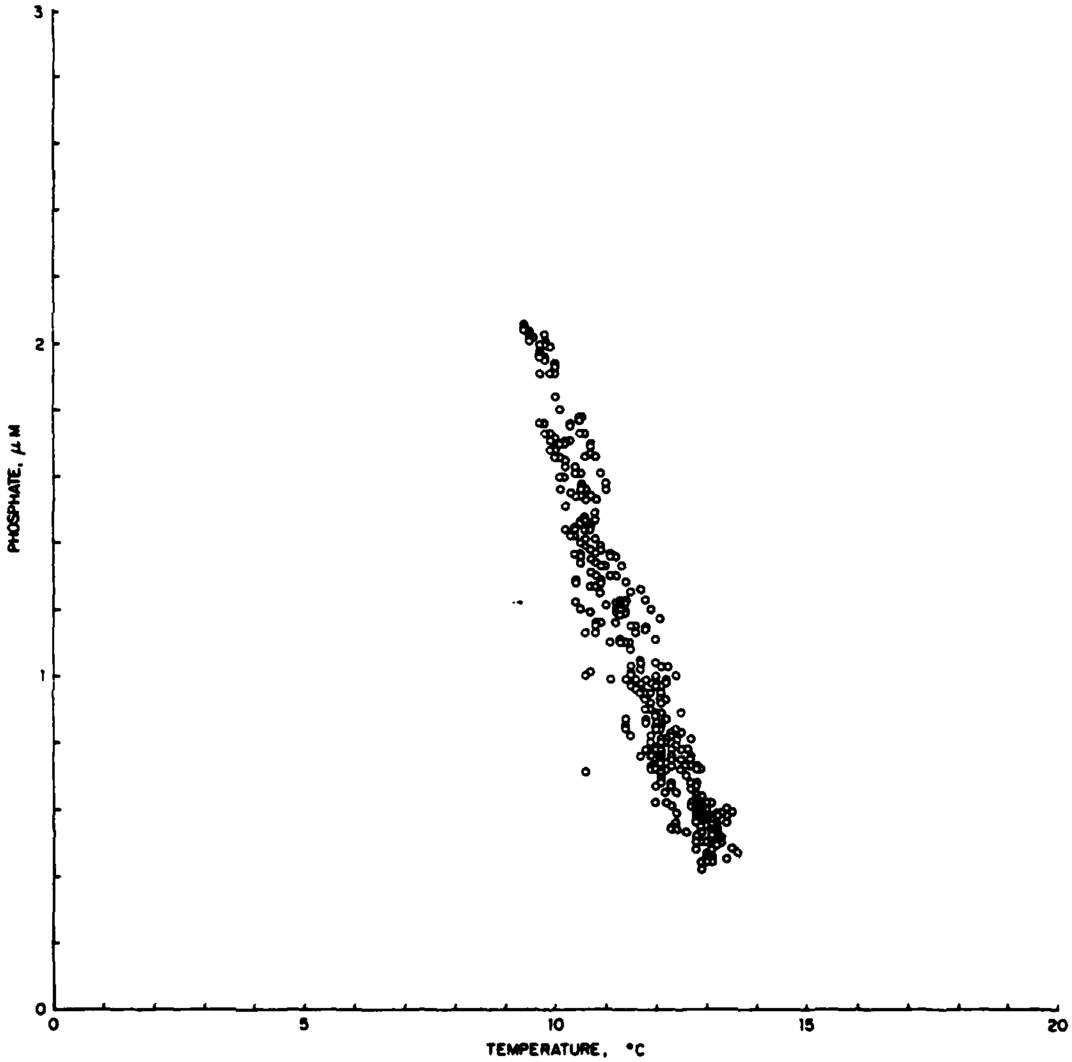

Fig. 7. Phosphate Versus Temperature for the 30 April Cruise.

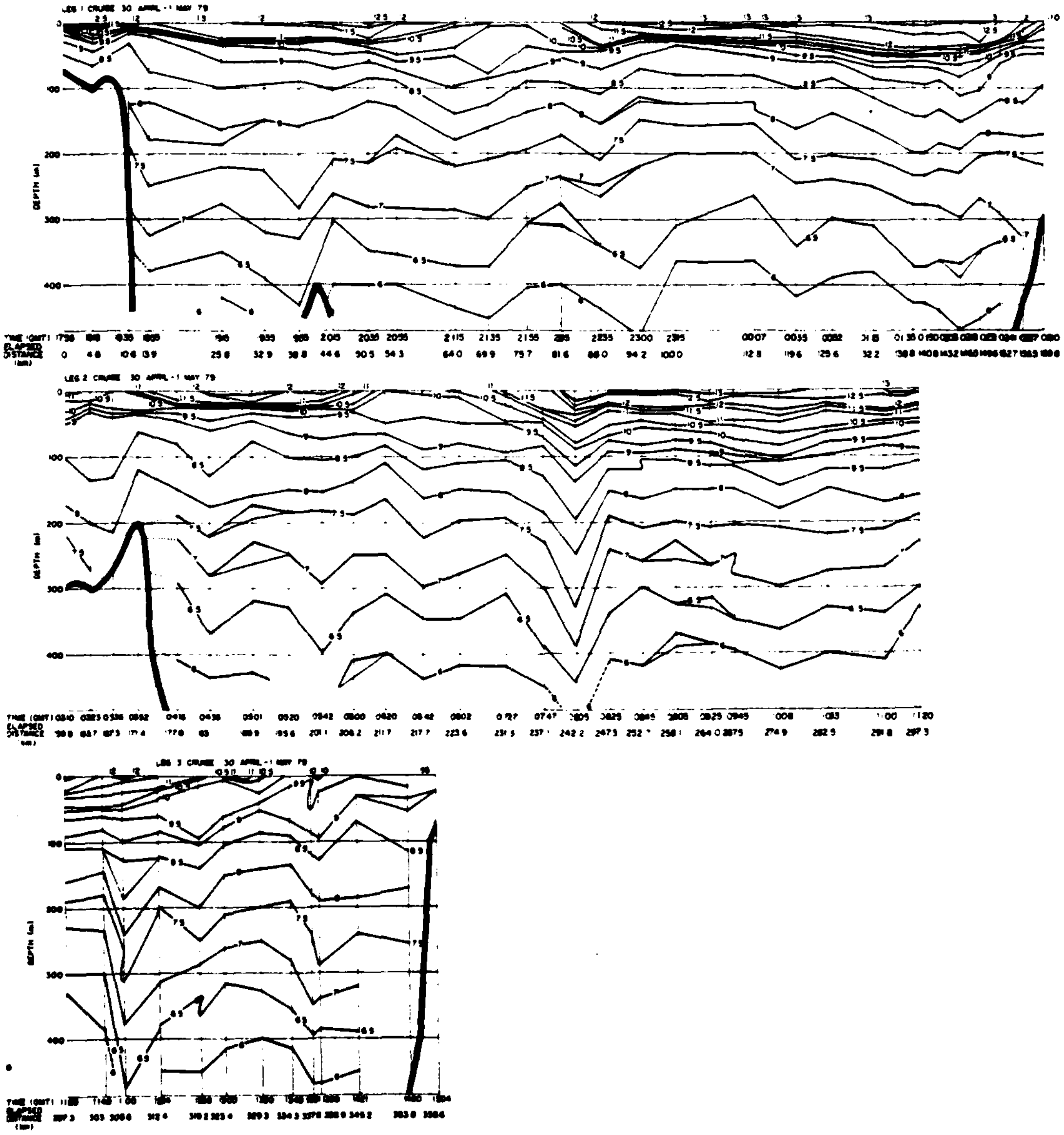

Fig. 8. Vertical Temperature Sections Along the Track of the 30 April Cruise.

(Leg 3) occurred when the ship's track extended into the near-shore upwelling region. Sharp chemical and thermal gradients or "fronts" are evident on all legs.

The linear regression analysis of nitrate versus phosphate, nitrate versus temperature and phosphate versus temperature (Figs. 5, 6, 7) yielded slopes of 15.10, -6.48 and -0.43 respectively and x-axis intercepts of 0.48 μM, 12.99°C and 14.11°C respectively (Table I).

Figure 8 gives some idea of the vertical structure of the upwelled feature. The thermal feature is evident from elapsed distance 64.0 through 81.6 km, 206.2 through 213 km and 312.4 through 323.4 km (where the 11.0°C isotherm surfaces). Coastal upwelling is evident from elapsed distance 163.7 through 171.4 km and 329.3 through 353.8 km.

B. 13 JUNE CRUISE

On 13 June 1979, Mr. Laurence Breaker (NESS, Redwood City) gave approximate coordinates and adjacent shore features of a coastal upwelling event off Point Sur, with "plume-like" characteristics (Plate 3). The ACANIA sailed south parallel to the shore until the northern and southern thermal and nutrient gradients were transected. North-south legs were to be repeated westward in a ladder-like fashion until the seaward termination of the plume was found. However, the cruise was terminated (after only ten hours) due to a clogged sampling port.

Sea surface temperature, nutrient, ATP and chlorophyll data were collected along one and one-half transects of the feature as shown in Fig. 9. The elapsed distances are from point 36°36.3'N x 121°58.7'W.

Based on the distributions of temperature, nitrate and phosphate (Fig. 10) the upwelling area was encountered at approximately 15 km along the track. Nitrate and phosphate values were high (up to 12.1 μM and 1.23 μM respectively) until the southern frontal boundary was reached. In the oceanic water, at approximately 50 km, nitrate and phosphate concentrations were low (0.55 to 3.8 μM and 0.33 to 0.65 μM, respectively). To the north, the frontal southern boundary was again encountered at approximately 60 km along the track. Throughout, there was a strong correlation ($r = 0.93$) between nitrate and phosphate, a strong inverse correlation between nitrate and temperature ($r = -0.92$) and a strong inverse correlation between temperature and phosphate ($r = -0.93$).

The chlorophyll data are unreliable after an elapsed distance of 40 km, because of excessive air injection into the sea chest during rough seas. Additionally, the XBT recorder was inoperative during this cruise.

C. 7 AUGUST CRUISE

The satellite image of 30 July 1979 (Plate 4) shows a cold water plume extending approximately 150 km southwest from Point Sur. Mr. Laurence Breaker (NESS, Redwood City)

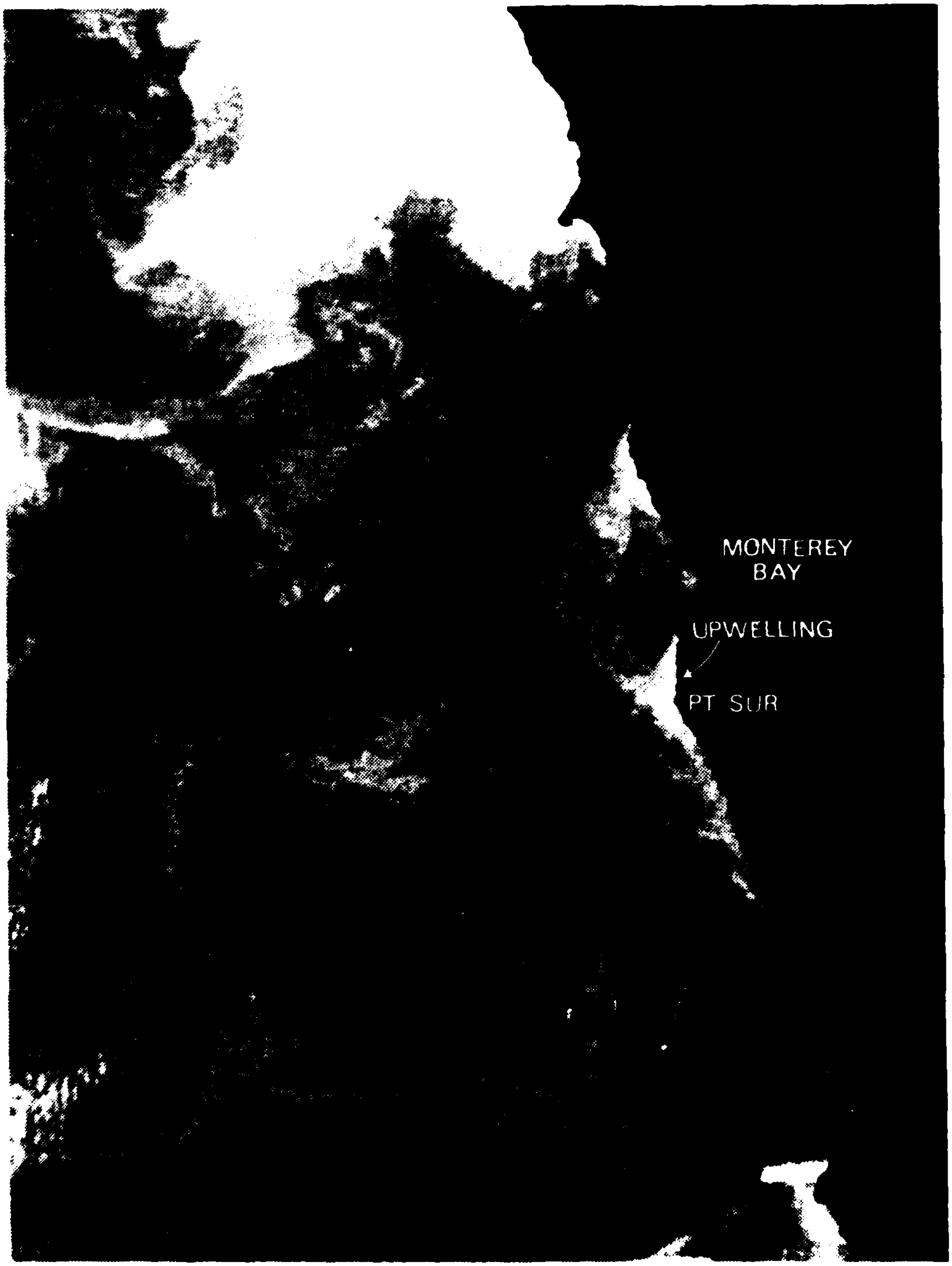

Plate 3. TIROS-N Satellite IR Image of the California Coast, 13 June 1979.

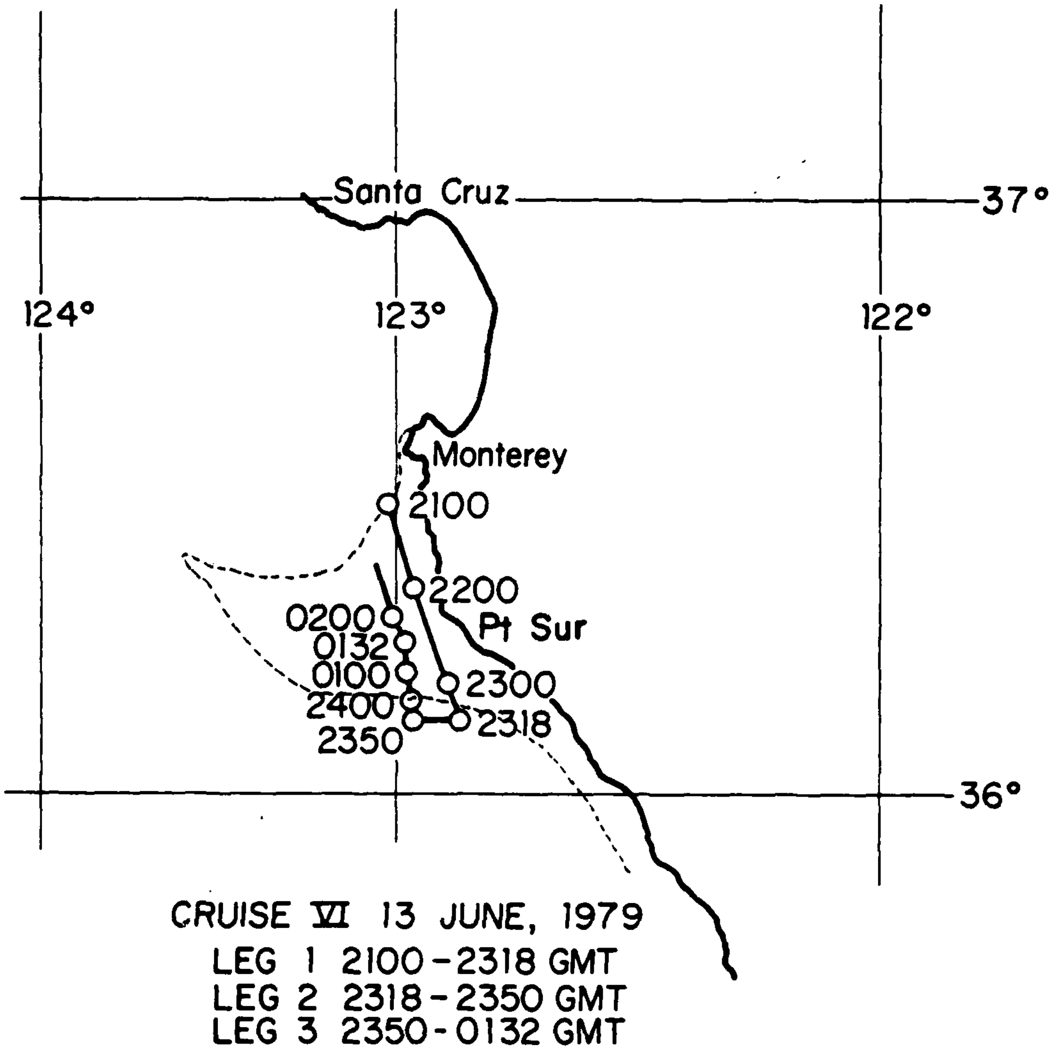

Fig. 9. Track of the 13 June Cruise (solid line) and Outline of the Upwelling Feature (dashed line) Based on Satellite Imagery, Sea Surface Temperature and Nutrient Data.

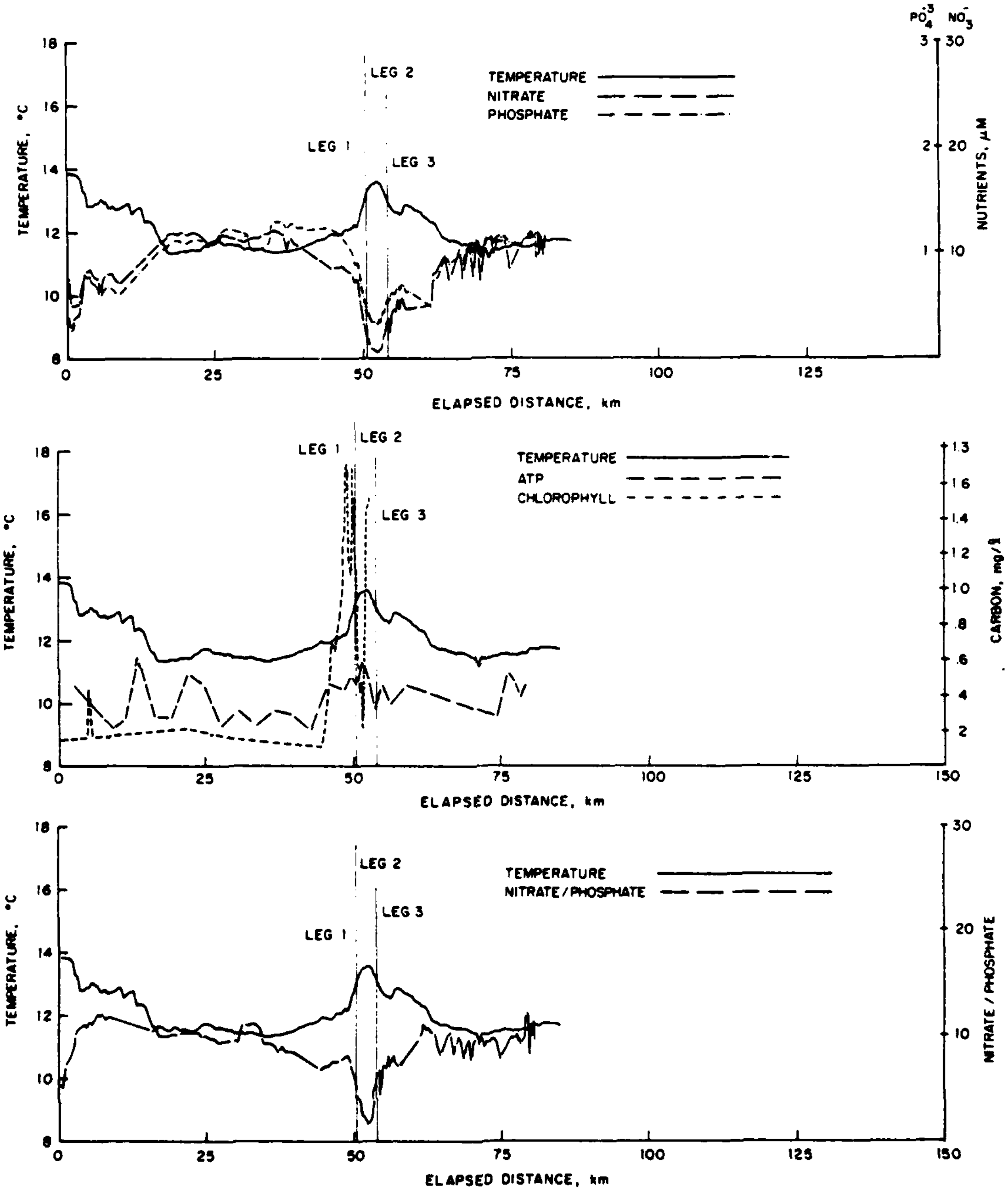

Fig. 10. Nitrate, Phosphate, Nutrient Ratio, ATP, Chlorophyll a, and Sea Surface Temperature Versus Elapsed Distance along the Track of the 13 June Cruise.

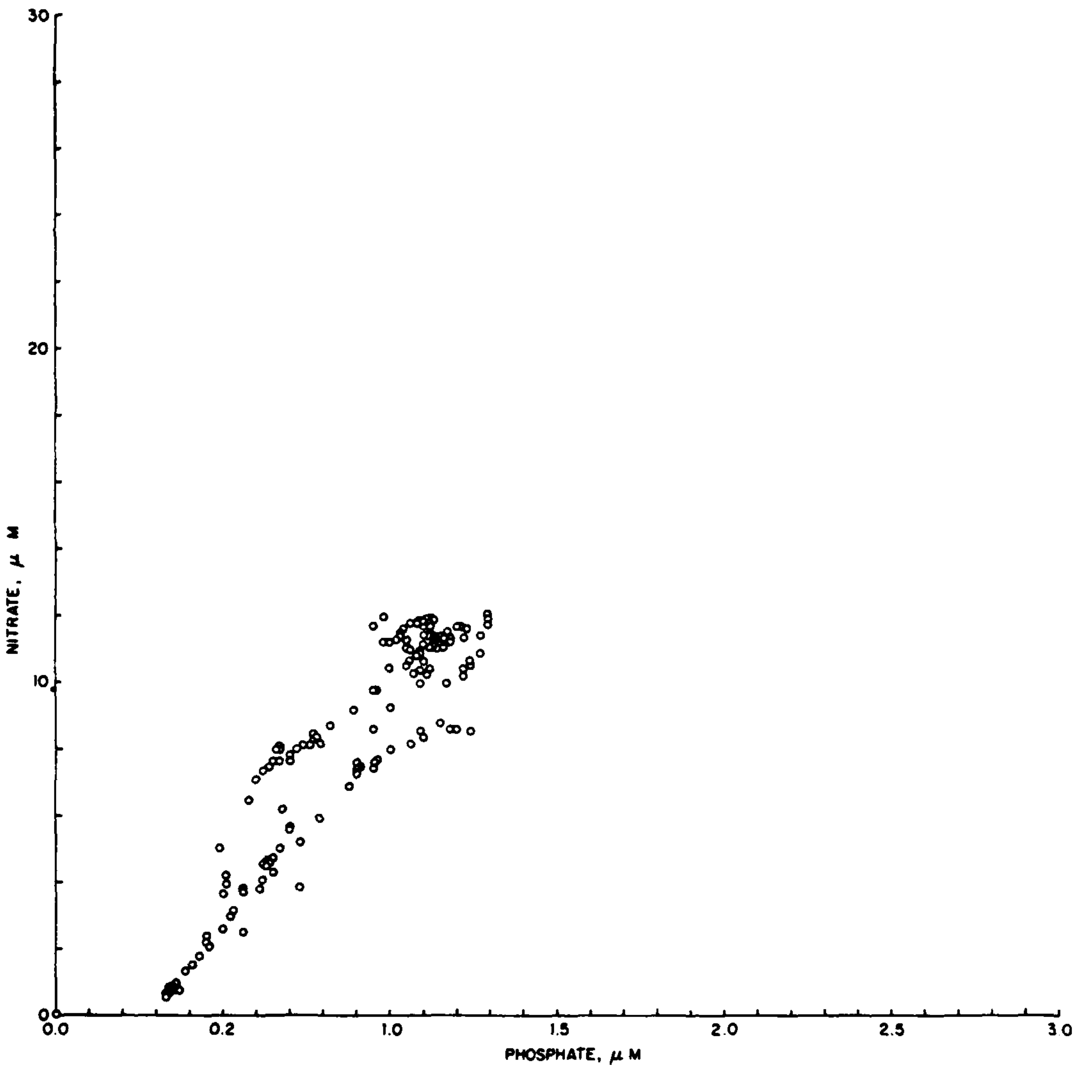

Fig. 11. Nitrate Versus Phosphate for the 13 June Cruise.

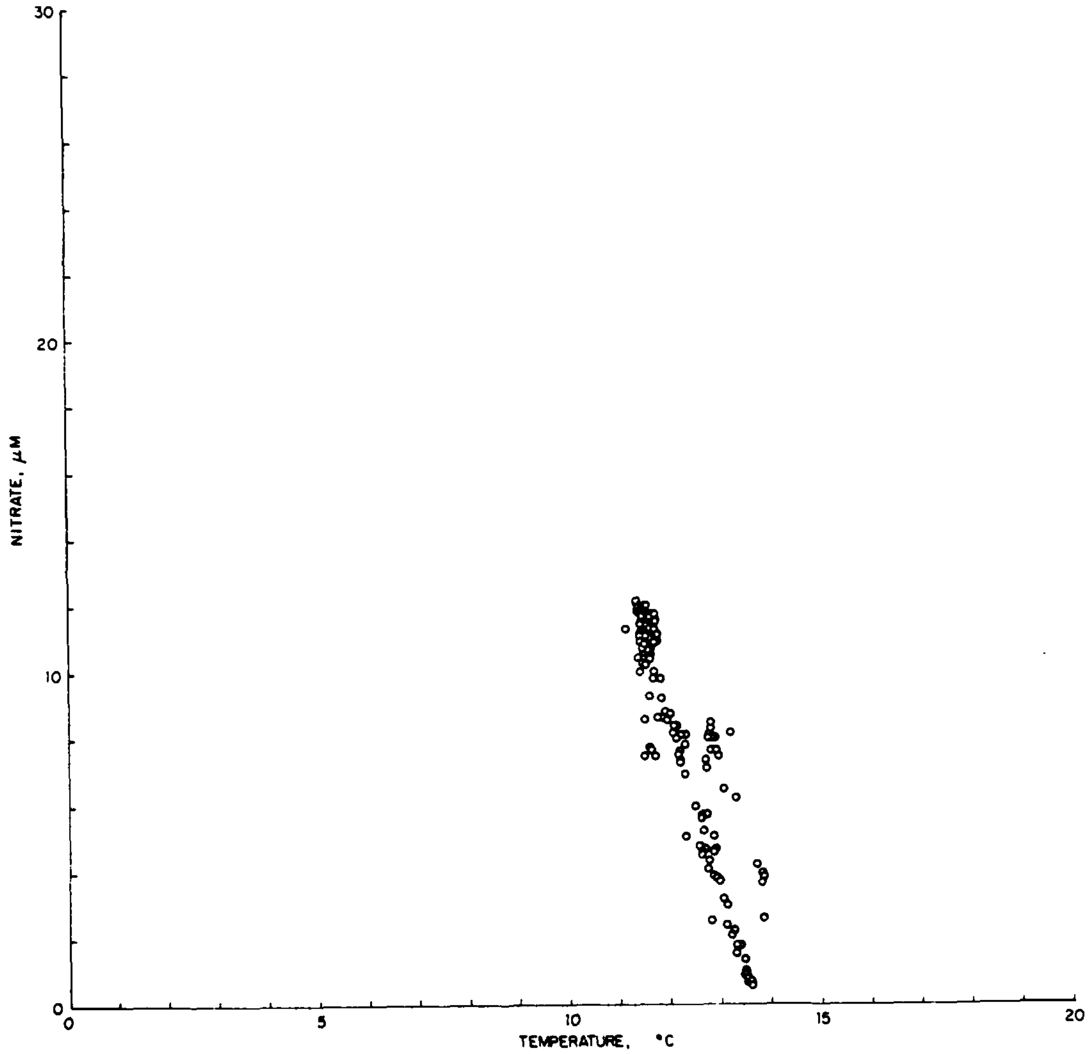

Fig. 12. Nitrate Versus Temperature for the 13 June Cruise.

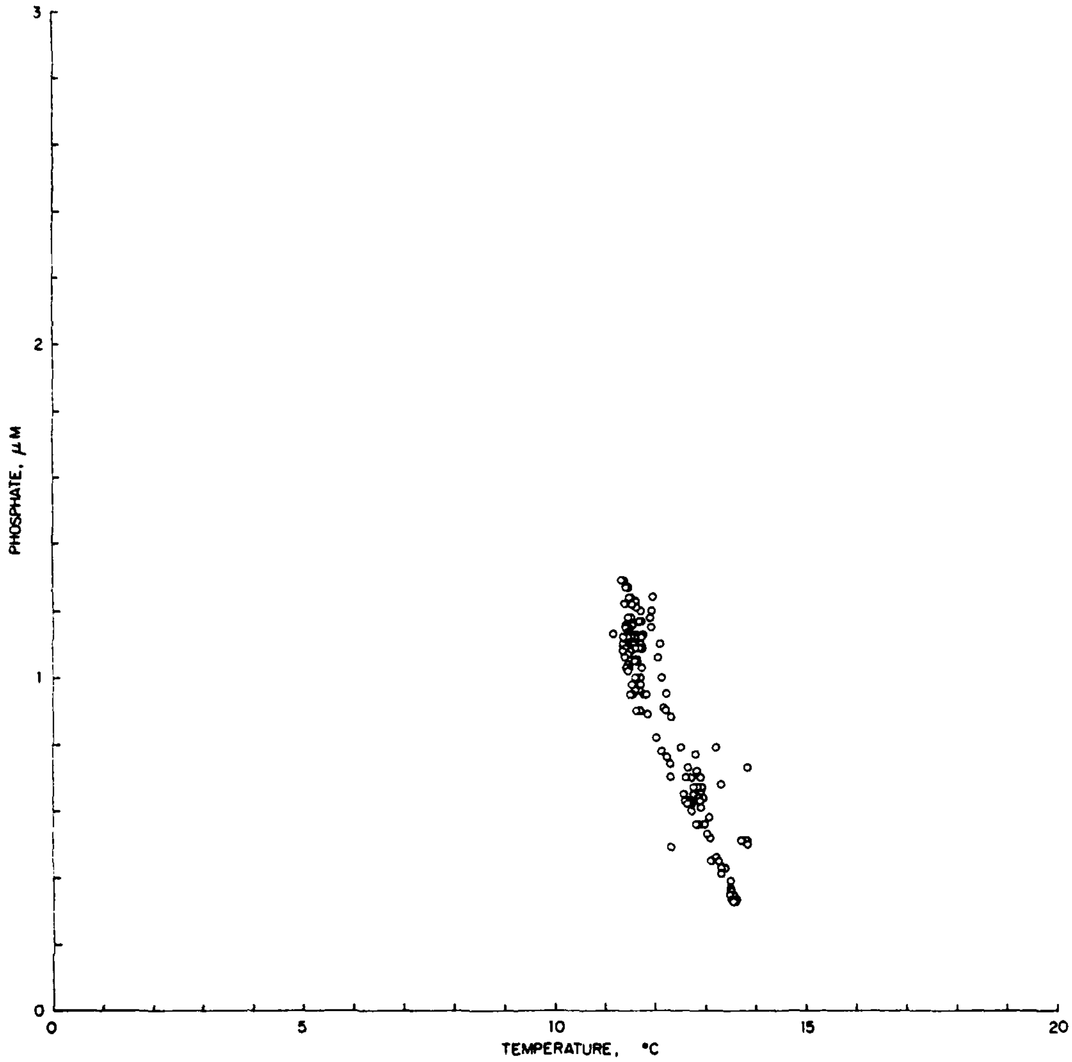

Fig. 13. Phosphate Versus Temperature for the 13 June Cruise.

reported the feature had continued to extend southwest. By 5 August 1979 the feature had extended approximately 240 km southwest of Point Sur (Plate 5). Sea surface temperatures were expected to be within approximately 14 to 15°C inside the plume and greater than 17°C outside the plume based on ship reports correlated to the satellite image by Mr. Breaker.

The cruise plan was similar to the 30 April and 13 June cruises except, in this case, the primary interest was the water near the seaward termination of the feature. The track strategy was planned to coincide with the axis of the feature; when applicable, turn south to transect its southern boundary, zigzag across its southern boundary, then run back up the axis upon return. Due to limited sampling resources, ATP sampling did not commence until the southern boundary was reached.

The cruise track is shown in Fig. 14. Legs 2 through 5 intersected the feature's southern boundary. Elapsed distances are measured from position 36°38.8'N x 121°57.5'W.

Figure 15 is the line graph of temperature, nitrate and phosphate along the cruise track. The nutrient lines are discontinuous from 160 to 200 km, 275-295 km and 325-355 km because the Autoanalyzer was secured for cleaning. When there is a phosphate line but no line for nitrate, nitrate concentrations were so low that they were below the sensitivity of the instrument. However, in all cases the frontal crossings are clearly evident in the temperature lines.

Frontal crossings occurred at approximately 260, 325, 360 and 385 km on Legs 2 through 5. The line graphs for Legs 1 and 6 are generally within a temperature range of 14 to 16°C, indicating that the ACANIA was within the plume.

The correlation coefficients were r = 0.42 for nitrate versus phosphate, r = -0.11 for nitrate versus temperature, and r = -0.39 for phosphate versus temperature. Linear regression analysis yielded slopes of 26.44, -13.63 and -0.32 and x-axis intercepts of 0.61 μM phosphate, 15.35°C and 17.56°C for Figs. 18, 19, and 20, respectively (Table I).

The thermal feature is evident in the vertical cross section of temperature (Fig. 21) and gives some idea of the vertical structure of the feature. The transition between plume water and oceanic water is located between elapsed distances 249.5 through 263.1 km, 274.8 through 285.9 km, and 305.2 through 336.0 km (where the 15.5°C isotherm rises toward the surface). The 15.5°C isotherm is 30 to 40 meters deep outside the plume and inside it rises toward the surface. The thermal patchiness, evident in the satellite IR imagery, is seen in both the temperature cross section and the surface temperature line graphs.

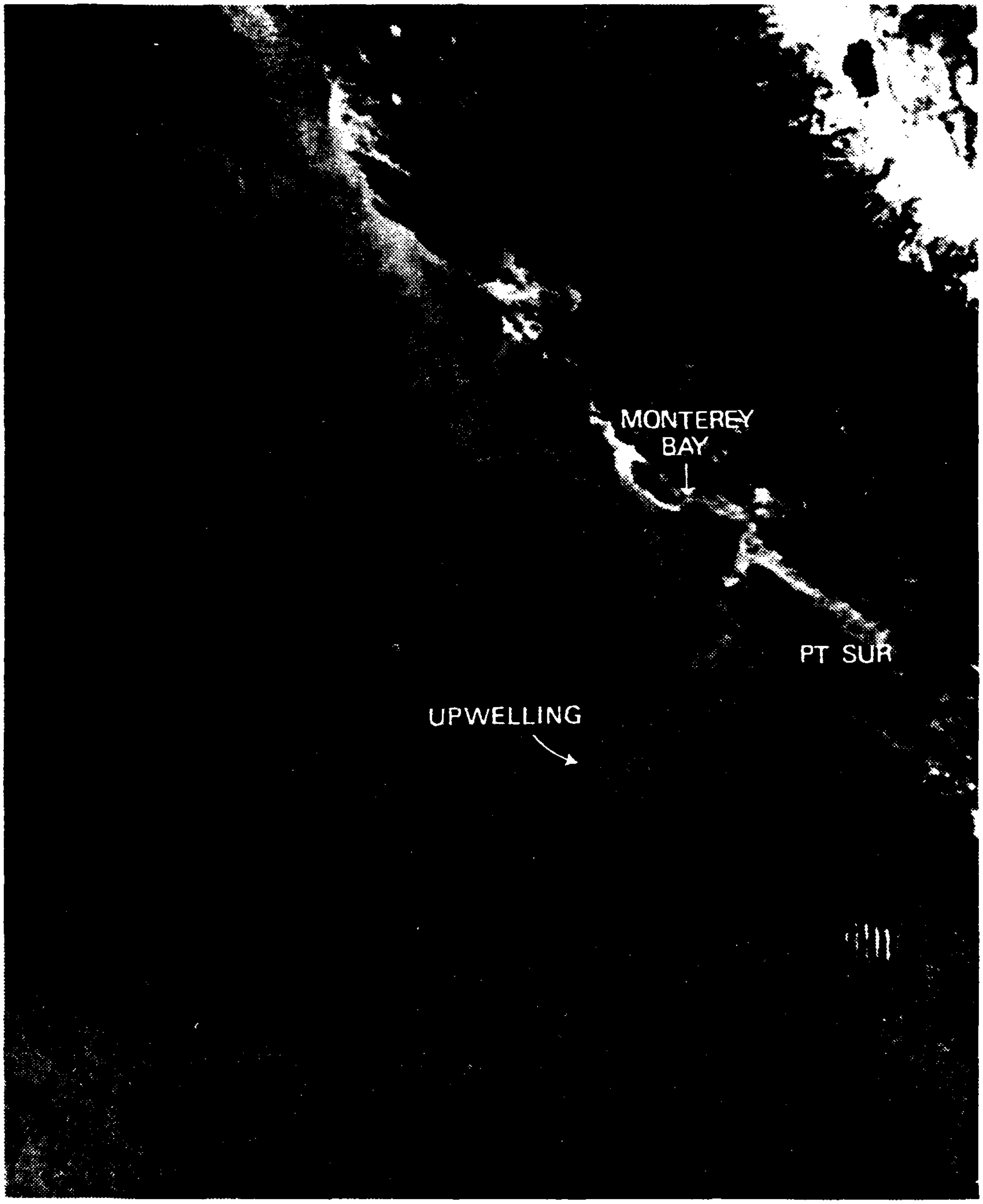

Plate 4. TIROS-N Satellite IR Image of the California Coast, 30 July 1979.

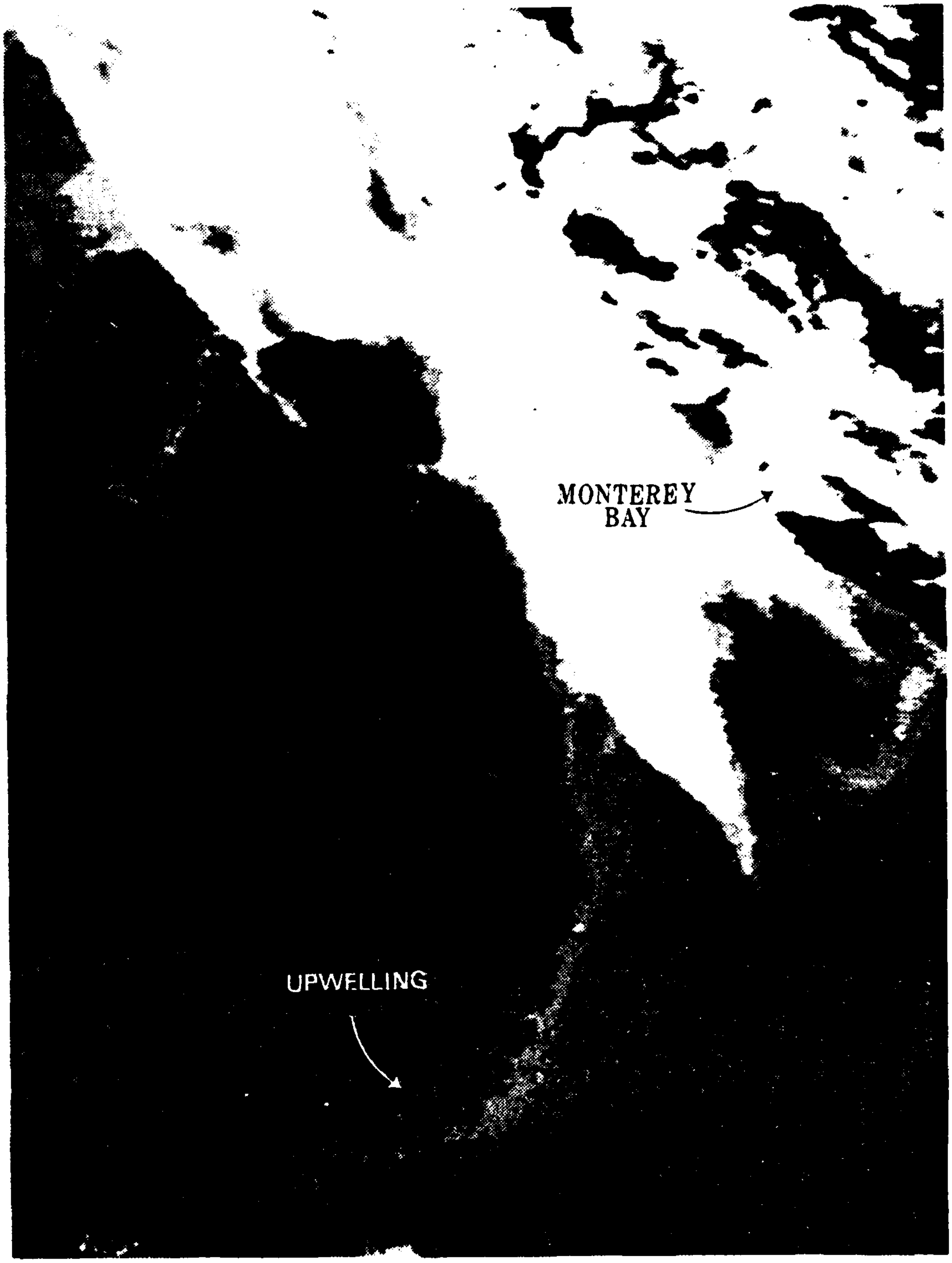

Plate 5. TIROS-N Satellite IR Image of the California Coast, 5 August 1979.

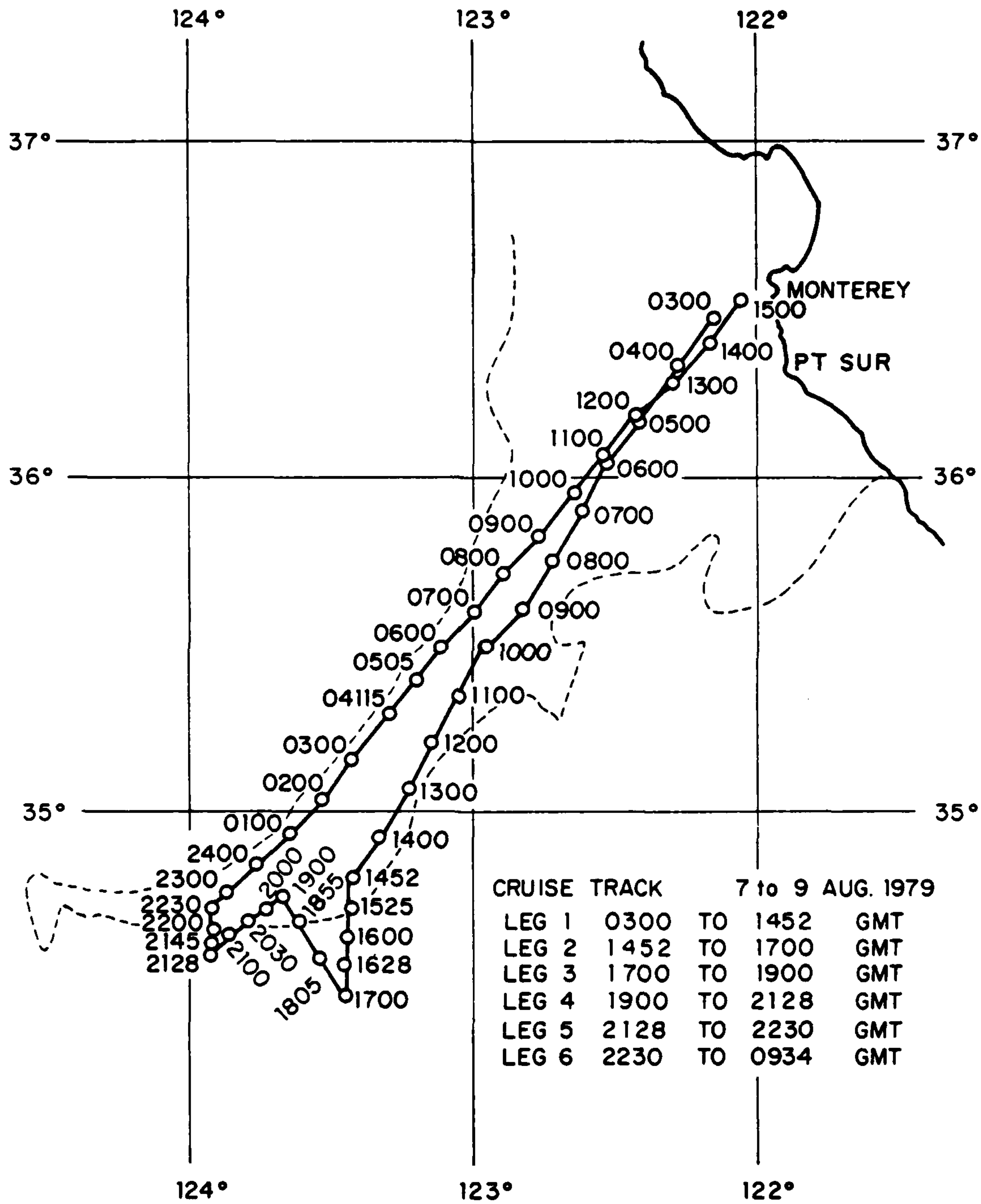

Fig. 14. Track of the 7 August Cruise (solid line) and Outline of the Upwelling Feature (dashed line) based on Satellite Imagery, Sea Surface Temperature and Nutrient Data.

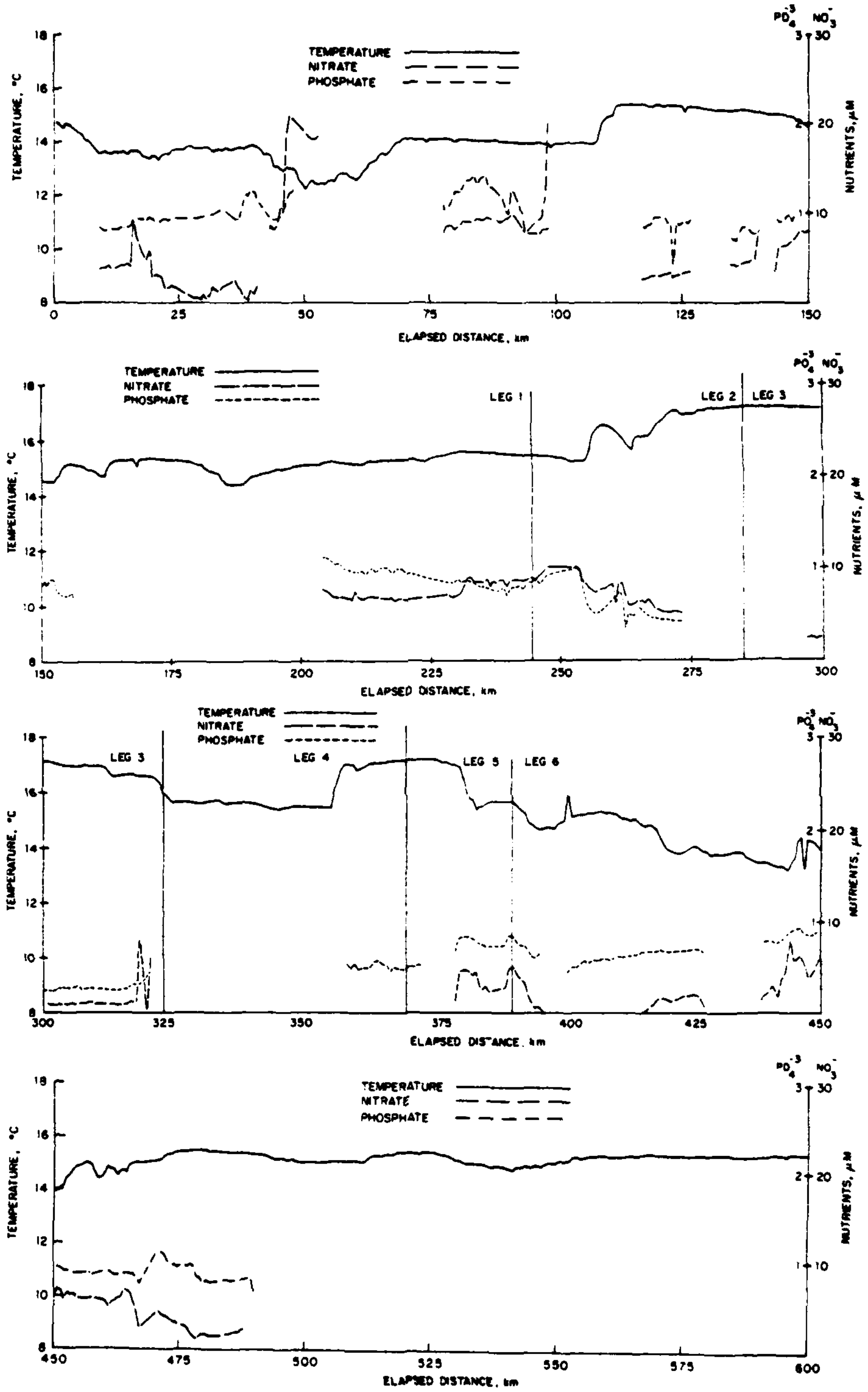

Fig. 15. Nitrate, Phosphate, and Sea Surface Temperature Versus Elapsed Distance Along the Track of the 7 August Cruise.

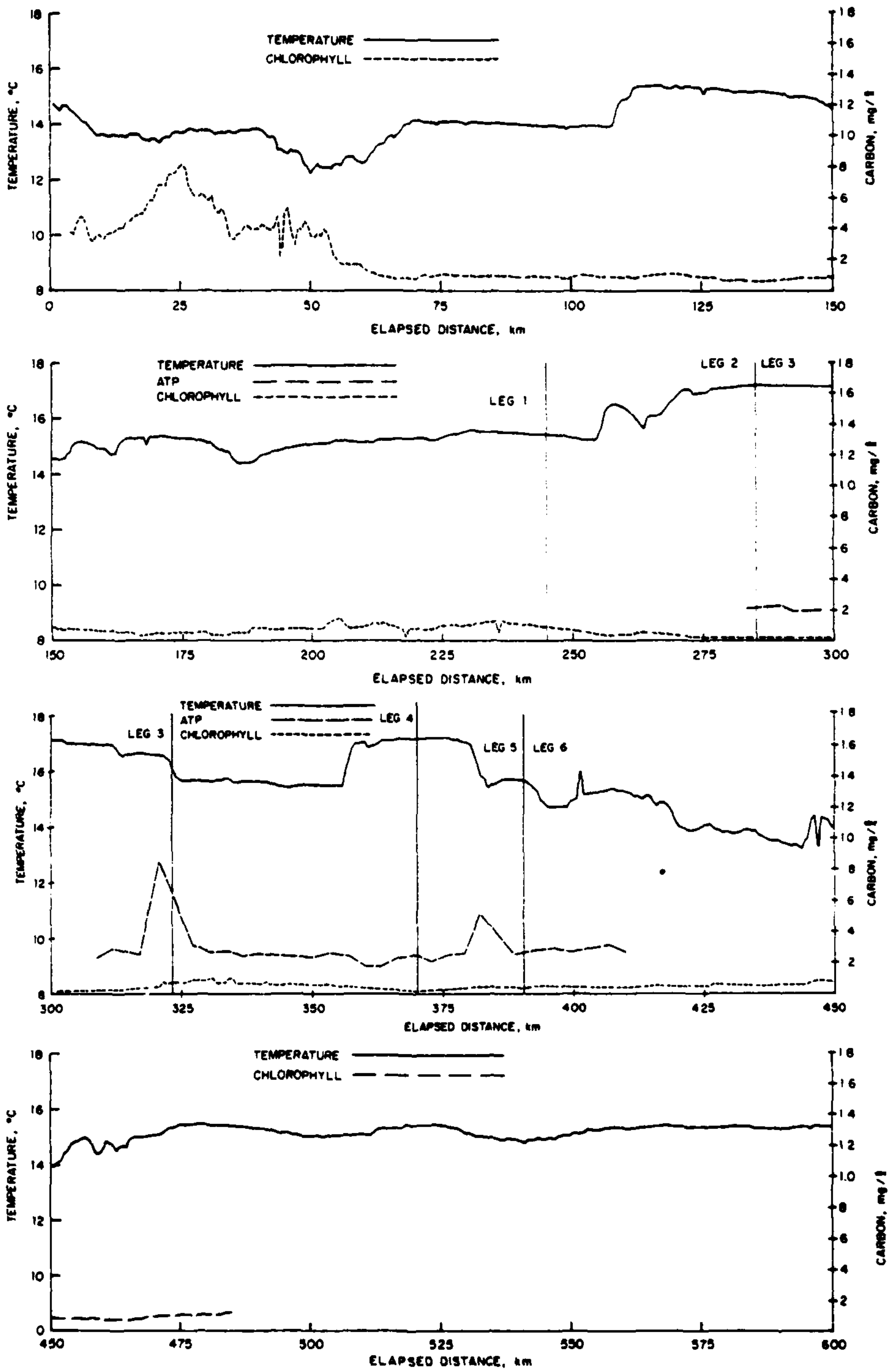

Fig. 16. ATP, Chlorophyll a, and Sea Surface Temperature Versus Elapsed Distance Along the Track of the 7 August Cruise.

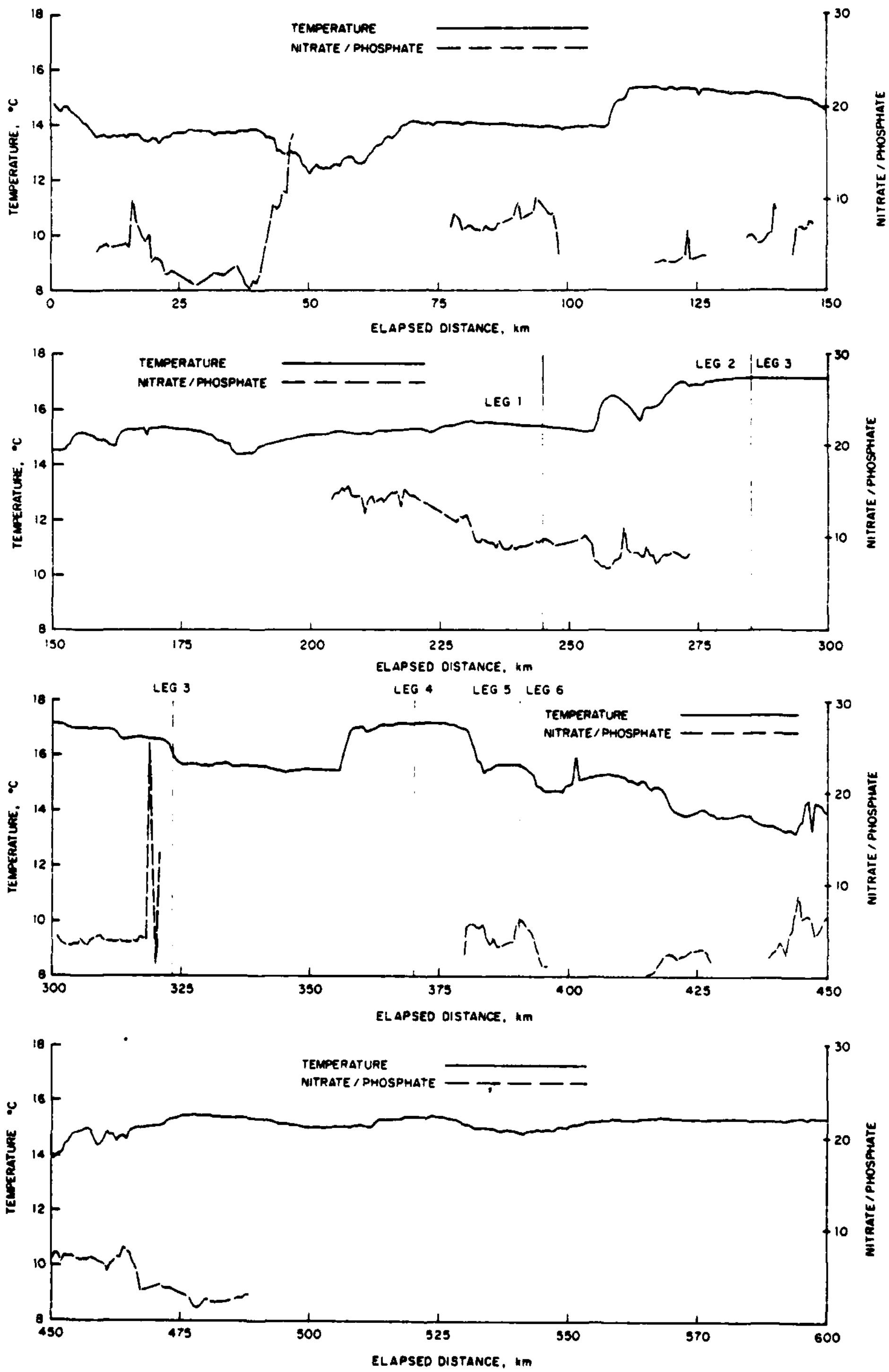

Fig. 17. Nutrient Ratio and Sea Surface Temperature Versus Elapsed Distance Along the Track of the 7 August Cruise Track.

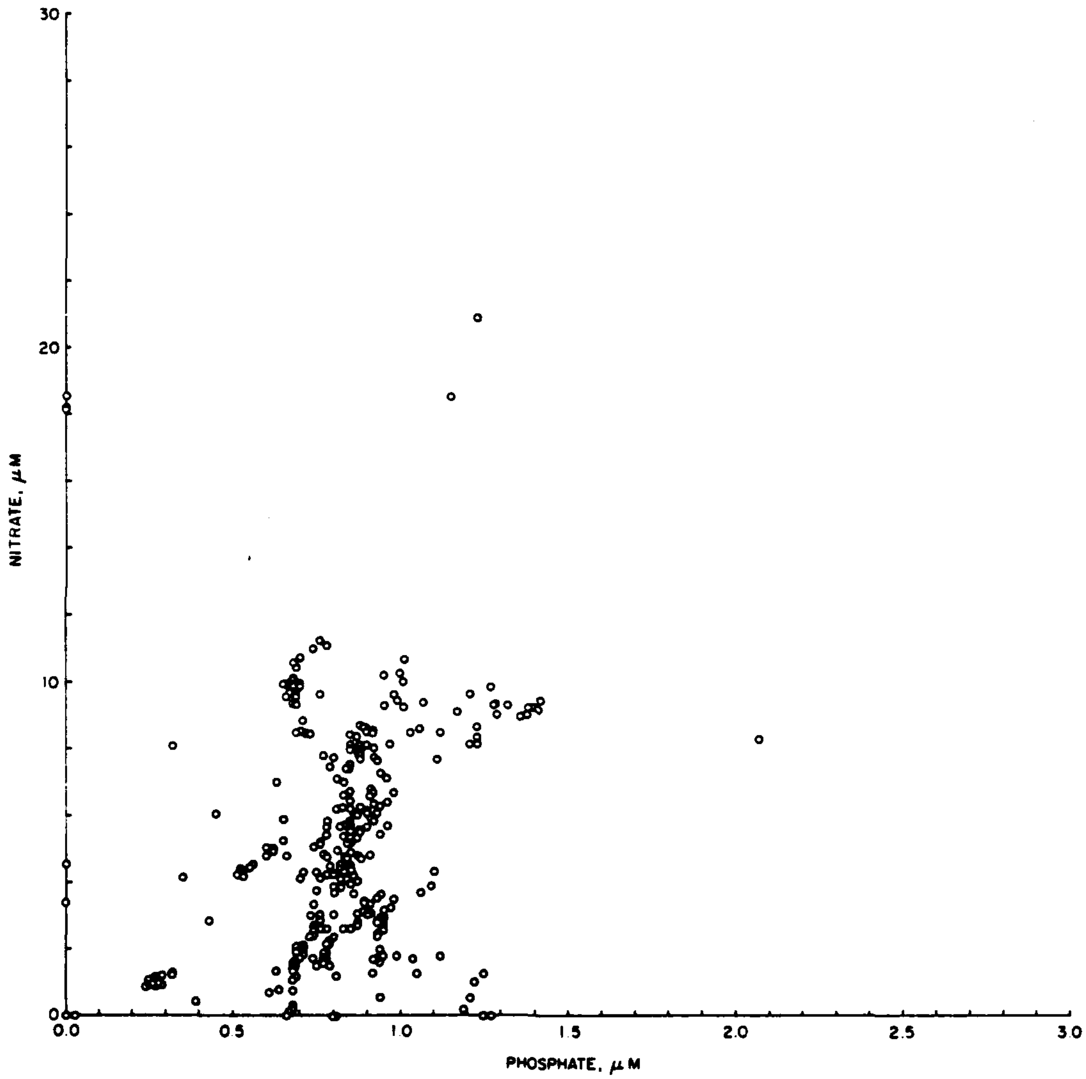

Fig. 18. Nitrate Versus Phosphate for the 7 August Cruise.

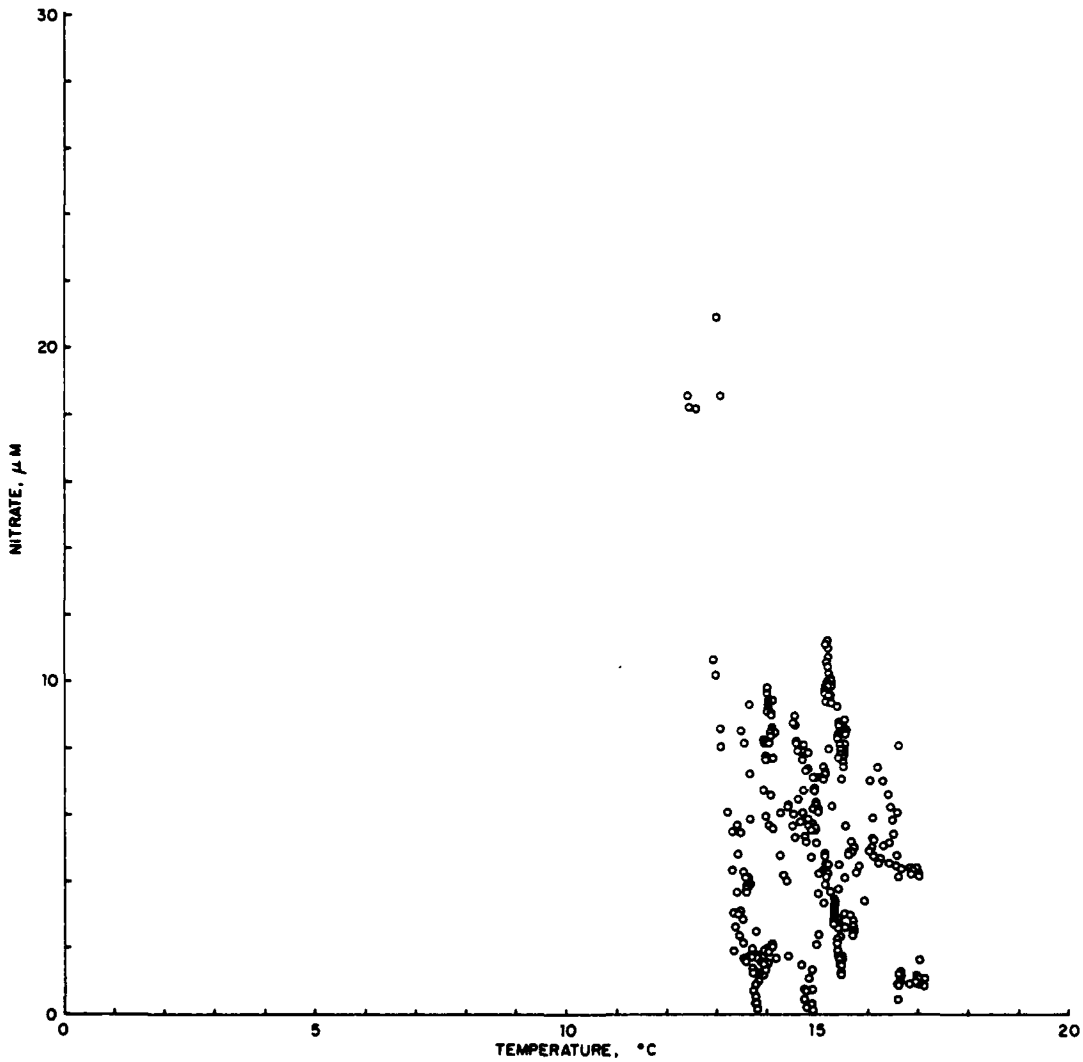

Fig. 19. Nitrate Versus Temperature for the 7 August Cruise.

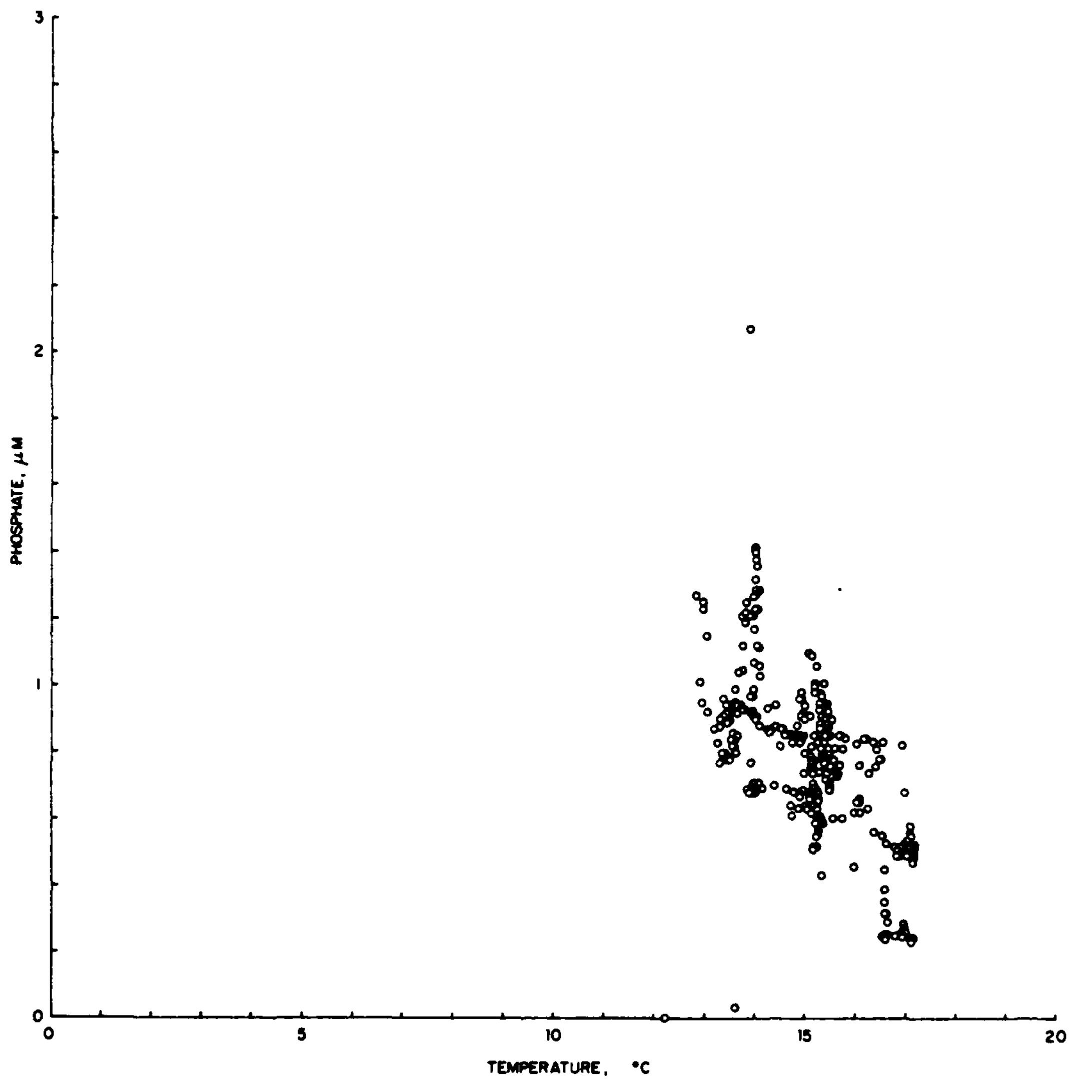

Fig. 20. Phosphate Versus Temperature for the 7 August Cruise.

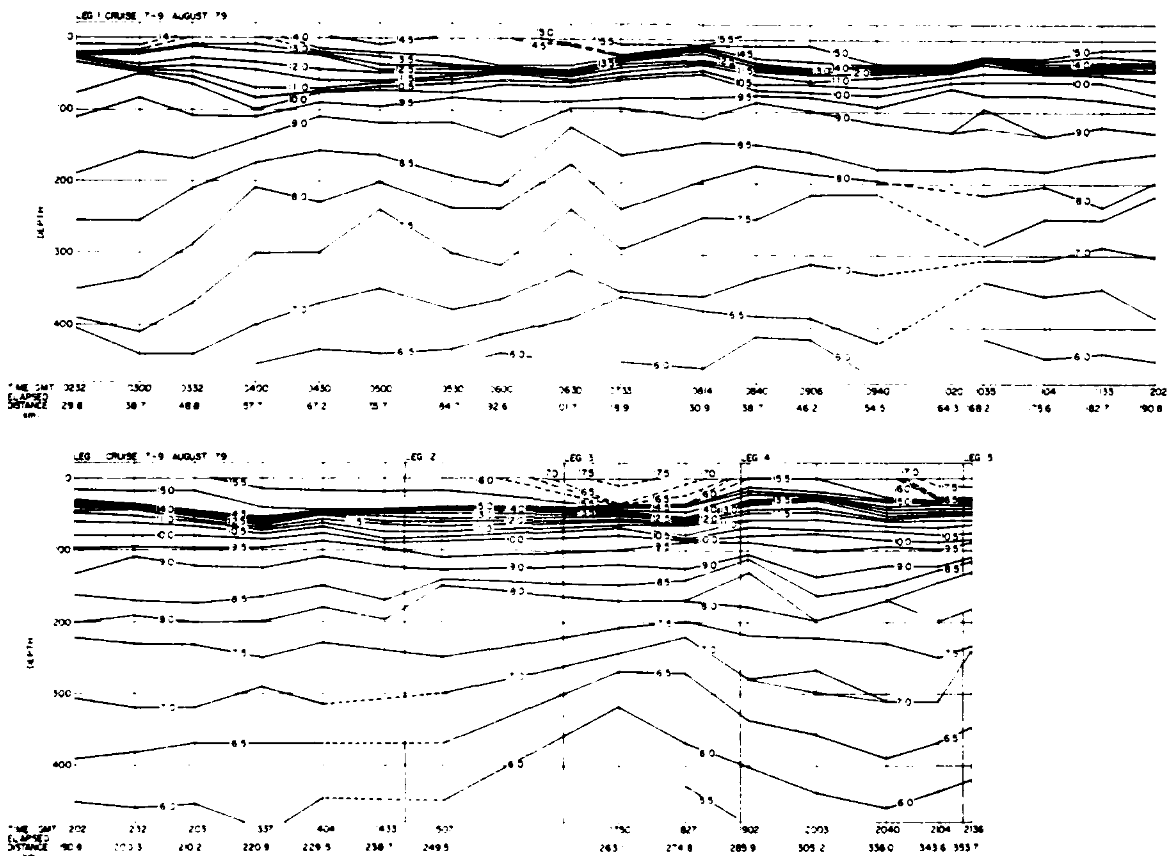

Fig. 21. Vertical Temperature Sections Along the Track of the 7 August Cruise

TABLE I

SUMMARY OF REGRESSION ANALYSES

CRUISE	$\overline{N}$ (μM)	$\overline{P}$ (μM)	$\overline{T}$ (°C)	SLOPE			"X" INTERCEPT			CORRELATION COEFFICIENTS		
				ΔN:ΔT	ΔN:ΔT	ΔN:ΔP	N:T(°C)	P:T(°C)	N:P(μM)	N:T	P:T	N:P
April 30 to May 1	8.59	1.03	11.7	-6.48	-0.43	15.1	12.99	14.11	0.48	-0.96	-0.94	0.98
June 13	8.24	0.90	12.4	-4.99	-0.39	12.88	13.79	14.43	0.26	-0.92	-0.93	0.93
August 7 to 9	5.28	0.767	15.06	-13.63	-0.32	26.44	15.35	17.56	0.61	-0.11	-0.39	0.42

TABLE II

DATA RANGES

TEMPERATURE °C	NITRATE μM	PHOSPHATE μM	RATIO N/P	ATP ng/1	CHLOROPHYLL mg/m3	ATP mgC/1	CHLOROPHYLL mgC/ℓ
30 April to 1 May Cruise							
9.4 to 13.6	0.29 to 23.11	0.45 to 2.06	0.6:1 to 11.7:1	338 to 4126	0.13 to 6.49	0.0845 to 1.0315	0.013 to 0.649
13 June Cruise							
11.1 to 13.8	0.55 to 12.10	0.33 to 1.29	1.7:1 to 12.3:1	825 to 2485	1.15 to 17.28	0.206 to 0.621	0.115 to 1.728*
7 to 9 August Cruise							
12.2 to 17.2	none detected to 20.91	0.03 to 2.07	0.0 to 15.3:1	712 to 3418	0.17 to 8.19	0.178 to 0.855	.017 to 0.819

*Data are unreliable due to air injection into the sampling water.

V. DISCUSSION

A better understanding of the "life cycle" of an upwelling event may be provided through the integration of satellite IR imagery and *in situ* sampling. This approach leads to a descriptive "phase" model of the formation and dissipation of an upwelling chemical system and some insight on the interaction of dynamic and biological processes in the system. This thesis analyzes results obtained while using this integrated technique to investigate three upwelling events.

An upwelling event, like many physical phenomena, may be described in terms of phases: initiation, growth, equilibrium, decay and dissipation. Each phase is a function of the magnitude and rate of change of the dynamic processes (mixing, advection, diffusion) and the boundary conditions (atmospheric forcing; topography and bathymetry). The chemical characteristics of any phase of an upwelling event are a function of the initial conditions (source water); the magnitude, direction, and duration of the driving function (wind stress); and the differential utilization and regeneration by biological processes.

The satellite imagery prior to all cruises show "plumes" of colder water extending from the coast near Point Sur. These features range in scale from tens of kilometers to several hundred kilometers in length. Analysis of *in situ* surface nutrient concentrations, summarized in Tables I and II, the surface winds in the area prior to and during the cruises (Appendix B), sea surface temperatures, satellite IR imagery and bathymetry strongly argue that these satellite detected thermal plumes were caused by upwelling events. That nutrient concentrations may closely follow the pattern of the satellite thermal imagery of the sea surface was shown by Traganza et al. (1980). These upwellings of cold nutrient-rich waters produce chemical and thermal fronts which appear to have associated with them increased biological activity.

The feature examined during the 30 April Cruise is postulated to be composed of recently upwelled water. Figure 2 shows very sharp chemical (up to $\frac{10.41\ \mu M\ NO_3}{4.7\ km}$) and thermal (up to 0.9°C/2.3 km) gradients. The range of nutrient ratio values are 0.6N:1P (lowest value, outside the feature) and 11.7N:1P (maximum level, inside the feature). The graph of nutrient ratio (Fig. 4) against elapsed distance along the track shows that the concentrations of high values are either within the area of the feature or the coastal upwelling. The low values of temperature (below 12°C) and the high concentrations of nitrate and phosphate (up to 12.1 μM and 1.29 μM, respectively) are all either within the feature or the coastal upwelling (Fig. 10). There are strong correlations between nitrate and phosphate ($r = 0.98$), nitrate and temperature ($r = 0.96$), and phosphate and temperature ($r = -0.94$). Analysis of the wind data prior to the cruise shows that favorable upwelling conditions occurred during the periods 9 to 20 April and 28 April to 4 May (Appendix B). All these factors, plus the lower temperatures indicated by the satellite IR imagery are taken to describe a feature of recently upwelled water in the early phases of its life cycle.

The 13 June Cruise examined a feature that is close inshore (Plate 3). Wind data (Appendix B) shows favorable upwelling conditions commenced only three days prior to cruise. The waters outside the feature are about 14°C but inside the feature temperatures fall below 12°C. All high concentrations of nutrients are within the feature, as are all high nutrient ratios. There are strong correlations between nitrate and phosphate ($r = 0.93$), nitrate and temperature ($r = -0.92$), and phosphate and temperature ($r = -0.93$) (Figs. 11, 12 and 13). This feature is recently upwelled water and is postulated to be in the early phases of the upwelling event "life cycle."

The waters examined in these two cruises still have very strong source water (thermal and nutrient) signatures. The dynamic and biological processes have not had sufficient time to change the upwelled water's initial characteristics. Along the frontal boundaries, the biological processes become evident (Figs. 3 and 10). The dynamic processes appear to have provided the necessary environment for biological acitivity.

The data from the 7 August Cruise were gathered predominantly from within the feature (Fig. 14). In comparison to the previous cruises, this resulted in a considerably smaller proportion of data points being collected outside the feature. A statistically insufficient number of samples were obtained in the low nutrient concentration, high temperature region. In comparison to the previous cruises the analysis is biased as follows: mean nutrient concentrations are high; mean temperature is low; the slopes of nitrate to phosphate, nitrate to temperature, and phosphate to temperature are too high, and the respective x-axis intercepts are too low.

The feature observed on the 7 August Cruise appears to contain upwelled water that is in various phases of the upwelling cycle. At 50 km elapsed distance water temperature was below 13°C with rapidly increasing nutrient ratios. Sampling was interrupted to clean the Autoanalyzer but concentrations were approaching levels consistent with the previous cruises (nutrient ratios above 10N:1P). This area of the feature contains water that has source water characteristics and may be assumed to be in the early phases. At 75 km elapsed distance, while still within the feature, temperature was approximately 14°C and nutrients had fallen, but not to the "outside-the-features-levels" of the previous cruises. This area might be considered to be close to equilibrium. The water was still relatively cold and nutrient-rich but no longer similar to the source water; the dynamic and biological processes apparently had started to modify it. The temperature then rose to the 15.0° to 15.5°C range and while nutrients still generally decreased with increasing temperature, they showed considerable variability. This area can be characterized as in the decay phase. The dynamic and biological processes continued to change the temperature and nutrient characteristics.

Once outside the feature, temperatures rose sharply to levels of 17.5°C and nutrients correspondingly fell. As the track moved west (Fig. 15) the nutrient levels and nutrient ratios (Fig. 17) never recovered to the levels previously encountered within the feature. In some areas, at the western most extent of the cruise, the nitrate levels are too low to be detected. In most coastal upwelling systems, nitrogen is characteristically the limiting nutrient, Dugdale et al. (1967) and Thomas, (1969). "In accordance with Liebig's law of the minimum, that constituent of the sea water present in smallest quantity relative to the requirement for growth of organisms will become the limiting factor." (Redfield, 1958). In this area, there is insufficient nitrate to sustain photosynthesis and, therefore, the biological modification of the feature is complete and low biomass concentrations are evident (Fig. 16). All that remains is for the dynamic processes to dissipate the temperature anomaly.

The wind data prior to the cruise shows a cyclical pattern of upwelling events occurring since early April.

Upwelling periods were of the order of one to three weeks and relaxation periods were of the order of two to six days (Appendix B). The average Ekman transport varied from west southwest to southwest. With such an intermittent, long range pattern of offshore transport; it is therefore possible that the feature investigated on the 7 August Cruise was in fact upwelled water of varying ages. Barton, et al. (1977) indicates that during an upwelling event coldest water will migrate to the continental shelf edge and remain there until the system relaxes. Upon return of favorable winds the upwelling will again reappear along the inner shelf. In this case, high nutrient, cold water was found at 50 km elapsed distance which is just inside the shelf break. The center of an upwelling may stop at the shelf edge, with continued favorable winds, upwelled water will continue to be transported offshore in a 20 m thick surface layer (Huyer, 1974). Patchiness or banding can result from this start/stop action between close upwelling events (Barton, et al. 1977). The satellite images (Plates 4 and 5) show some patchiness. The second image (Plate 5) shows the feature has moved 90 km further southwest and the wind data show the Ekman transport to be west southwesterly during the period between the images. Therefore the feature investigated has some of the characteristics of a wind induced upwelling plume with the oldest water at its furthest extent; still maintaining some of its temperature characteristics but due to biological action and mixing losing much of its high nutrient signature at its westernmost (oldest) edges.

In viewing the correlation values of all cruises it must be remembered "that where elements are substantially depleted by the growth of plants small unused residues of one or another element may greatly alter the ratios." (Redfield, 1958). The nutrient-to-temperature correlations will reflect the effects of heat transfer, mixing, advection, diffusion and biological utilization and regeneration. The longer the water has been on the surface, the more time the processes have to affect the correlations. This is evident on the 7 August Cruise where all correlations are poor.

In sea water the ratio of change of nitrate and phosphate, $\Delta N/\Delta P$, is representative of the uptake of these nutrients by phytoplankton at a rate of 16N:1P. The slope of the best fit line found from linear regression analysis (Table 1) represents this ratio of change. The values obtained on the 30 April Cruise (15.1:1) and 13 June Cruise (12.88:1) are close to the theoretical value of 16N:1P.

On all cruises the nutrient ratio did not equal the theoretical value of 16:1 (Redfield, 1958) most likely because the source water was not at that ratio. The ratios ranged from a low where no nitrate was detected to a high of 15.3:1. The low values perhaps were found where further biological uptake had become inhibited due to low nitrate concentration and the higher values corresponded to the upwelled water. These values are not inconsistent with the annual range for the nutrient ratio of 3:1 to 13:1 obtained in a study by Butler et al. (1979).

Finally, in areas of upwelling there exist some geographically fixed preferred positions, e.g. south of capes, where plumes of freshly upwelled water protrude offshore (Shaffere, 1976; Reid et al., 1958). The research of this thesis and that of Traganza et al. (1980), which covered one annual cycle, indicates the coastal waters off Point Sur, California, are such an area. Whether this is because of the proximity of Point Sur and/or Monterey Canyon, local bathymetry, local water circulation patterns, local wind effects, or coastally trapped topographic Rossby waves; or a combination of these factors cannot be determined from the data. However, offshore plumes consistently, albeit aperiodically, originate from this area.

VI. CONCLUSIONS

1. High resolution, enhanced satellite IR imagery can be of great value in locating and assessing feature motion when investigating upwelling events that are manifested as sea surface temperature anomalies.
2. Upwelled water may be evidenced at considerable (ca. 100 to 300 km) distances from the coast.
3. Qualitative inferences on the distribution of nutrient concentrations can be made using satellite infrared imagery if coupled with *in situ* sampling to establish nutrient versus temperature correlations.
4. Altogether, with sufficient historical upwelling data from *in situ* monitoring, a nutrient predictive model for upwelled water in the initiation, growth and equilibrium phases is conceivable in the future.
5. A predictive model of the entire upwelling cycle, in all its phases, is not yet possible. The effects of air-sea interaction, the dynamical processes, and the biological processes make any nutrient model extremely complex. The dynamic processes vary from region to region and season to season. Regeneration and utilization rates vary from organism to organism and season to season. This further compounds the task.
6. The area off Point Sur, California, consistently has offshore upwelling plumes and merits further detailed

study. Such study is continuing under the direction of Dr. Eugene Traganza supported by the Office of Naval Research, Code 482.

7. From a Naval aspect the thermal gradients in upwelled water can have a considerable impact on sound propagation. The increased biological concentrations associated with the thermochemical fronts can, depending on the species, increase the reverberation levels and background noise.

APPENDIX A

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
1604	36 39.1	121 58.6	0.0						0.0
			4.7	0.48	0.53	0.9		5.57	12.6
			5.3	0.83	0.56	1.5		5.66	12.4
			5.8	0.65	0.54	1.2	2648.0	4.94	12.3
			6.4	3.67	0.76	4.8		4.34	11.9
			7.0	1.36	0.62	2.2		4.35	12.2
			7.6	1.36	0.61	2.2		4.18	12.3
			8.2	0.83	0.55	1.5		4.29	12.4
			8.8					4.42	12.4
			9.3					4.66	12.4
			9.9					4.71	12.4
			10.5					5.04	12.4
			11.1	1.54	0.56	2.8		4.99	12.4
			11.7	2.60	0.65	4.0		4.73	12.2
			12.3	5.62	0.86	6.5		4.56	12.0
			12.8	7.21	0.96	7.5		4.03	11.6
			13.4	7.75	1.01	7.7		3.53	11.5
			14.0	10.41	1.18	8.8		2.59	11.3
			14.6	10.76	1.22	8.8	2096.0	2.49	11.2
			15.2	9.34	1.19	7.8		1.59	11.2
			15.8	9.16	1.20	7.6		1.39	11.3
1900	36 30.6	122 2.9	16.3	10.23	1.21	8.5		1.16	11.3
			16.9	10.23	1.22	8.4		1.01	11.3
			17.5	10.58	1.22	8.7		1.02	11.3
			18.1	10.58	1.23	8.6		1.23	11.3
			18.7	10.23	1.20	8.5		1.39	11.4
			19.3	10.05	1.19	8.4		1.41	11.4
			19.9				2299.0	1.61	11.5
			20.4					2.17	11.6
			21.0				3303.0	3.11	11.7
			21.6					3.48	11.8
			22.2					4.12	11.9
			22.8	6.86	0.92	7.5		3.79	11.9
			23.3	7.57	0.95	8.0		3.64	11.9
			23.9	7.57	0.95	8.0		3.49	11.8
			24.5	7.04	0.93	7.6		3.13	11.8
			25.1	6.80	0.92	7.4	2534.0	3.17	11.9
			25.7	6.68	0.90	7.4		3.16	11.9
			26.3	6.15	0.89	6.9		2.96	12.0
			26.8	5.80	0.86	6.7		2.95	12.0
			27.4	5.62	0.84	6.7		3.14	12.0
			28.0	5.62	0.84	6.7	2060.0	2.74	12.1
			28.6	5.97	0.86	6.9		2.73	12.1
			29.2	5.97	0.86	6.9		3.11	12.1
			29.8	5.97	0.86	6.9		3.10	12.1
			30.3	5.97	0.87	6.9		2.90	12.1
			30.9	6.15	0.89	6.9	2170.0	3.09	12.1
			31.5	6.15	0.92	6.7		3.08	12.1
			32.1	6.15	0.92	6.7		2.88	12.1
			32.7	6.50	0.93	7.0		3.07	12.1

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			33.3	6.68	0.95	7.0		3.05	12.1
2000	36 21.6	122 6.9	33.8	6.86	0.97	7.1	2078.0	2.67	12.0
			34.4	7.21	0.98	7.4		2.40	12.0
			35.0	7.04	0.97	7.3		2.86	12.0
			35.6	6.86	0.98	7.0		2.92	12.0
			36.2	7.04	1.00	7.0		1.58	12.0
			36.8	6.50	0.98	6.6	1823.0	1.21	12.0
			37.3	6.33	0.98	6.5		0.82	11.9
			37.9	6.15	0.97	6.3		0.84	12.1
			38.5	5.62	0.93	6.0		0.86	12.1
			39.1	4.55	0.87	5.2		0.87	12.2
			39.7	4.70	0.84	5.0	1192.0	0.88	12.4
			40.3	3.85	0.81	4.8		0.90	12.4
			40.8	4.02	0.79	5.1			12.4
			41.4	3.67	0.78	4.7			12.5
			42.0	3.14	0.75	4.2			12.5
			42.6	2.96	0.73	4.1	1146.0		12.6
			43.2	2.96	0.73	4.1			12.6
			43.8	2.96	0.73	4.1			12.7
			44.3	2.96	0.73	4.1			12.8
			44.9	2.78	0.68	4.1			12.8
			45.5	3.14	0.72	4.4	1186.0		12.8
			46.1	3.67	0.76	4.8			12.7
			46.7	4.38	0.81	5.4			12.7
			47.3	5.44	0.89	6.1			12.5
			47.9	7.21	1.00	7.2			12.4
			48.4	7.75	1.03	7.5	1508.0	2.51	12.3
			49.0	8.10	1.04	7.8			12.0
			49.6	8.90	1.11	8.0			12.0
			50.2	8.99	1.11	8.1			12.0
2100	36 12.4	122 6.6	50.8	9.52	1.15	8.3	1378.0		11.8
			54.3				1286.0	0.90	11.5
			56.6	11.86	1.30	9.1			11.2
			57.2	12.07	1.33	9.1	1246.0		11.3
			57.8	12.65	1.36	9.3			11.2
			58.3	13.04	1.37	9.5			11.1
			58.9	16.88	1.53	10.7			11.0
			59.5	16.57	1.56	10.6			11.0
			60.1	16.99	1.61	10.6	1578.0	1.46	10.9
			60.7	17.77	1.61	11.0		1.33	10.9
			61.3	18.01	1.66	10.8		1.20	10.8
			61.8	18.25	1.67	10.9		1.07	10.7
			62.4	18.31	1.69	10.8		0.94	10.7
			63.0	18.56	1.69	11.0	1413.0	0.81	10.7
			63.6	18.80	1.70	11.1		0.81	10.7
			64.2	19.23	1.73	11.1			10.6
			64.8	19.86	1.77	11.2			10.5
			65.3	20.11	1.78	11.3			10.5
			65.9	19.98	1.78	11.2	1796.0	1.11	10.5
			66.5	17.01	1.56	10.9			10.5

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			67.1	14.97	1.44	10.4			10.2
			67.7	14.05	1.37	10.3			10.4
			68.3	13.71	1.34	10.2	1837.0		10.8
2200	36 3.7	122 0.2	68.8	14.14	1.37	10.3		1.17	10.8
			69.4	13.21	1.30	10.2			11.1
			70.0	12.08	1.23	9.8			11.3
			70.6	11.92	1.22	9.8			11.5
			71.2	11.95	1.22	9.8			11.4
			71.8	11.79	1.23	9.6	2833.0	4.71	11.4
			72.3	11.82	1.22	9.7		4.71	11.4
			72.9	11.85	1.22	9.7		4.13	11.4
			73.5	11.11	1.20	9.3		4.10	11.2
			74.1	11.72	1.20	9.8		3.80	11.3
			74.7	11.96	1.22	9.8	3135.0	3.50	11.3
			75.3	11.58	1.19	9.7		4.29	11.4
			75.8	11.01	1.15	9.6		5.08	11.6
			76.4	11.03	1.15	9.6		5.88	11.5
			77.0	7.22	0.95	7.6		9.60	11.7
			77.6	8.04	1.00	8.0	2816.0	6.53	11.5
			78.2	7.86	0.97	8.1		7.54	11.5
			78.8	7.88	0.97	8.1		4.21	11.6
			79.3	6.05	0.86	7.0		5.57	11.9
			79.9	4.62	0.78	5.9		5.89	11.8
			80.5	3.59	0.73	4.9	3213.0	5.69	12.0
			81.1	3.18	0.70	4.5		6.47	12.1
			81.7	4.84	0.81	6.0		5.33	12.1
			82.3	5.27	0.82	6.4		4.22	12.3
			82.8	2.34	0.65	3.6		4.82	12.4
			83.4	2.97	0.67	4.4		4.63	12.3
			84.0	3.18	0.68	4.7		4.14	12.3
			84.6	3.40	0.72	4.7	2266.0	3.45	12.5
			85.2	3.40	0.70	4.9		2.32	12.6
			85.8	3.19	0.69	4.7		1.74	12.7
2300	35 56.2	121 53.5	86.4					1.64	12.7
			86.9				2358.0	1.35	12.7
			87.5					2.47	12.7
			88.1					1.85	12.8
			88.7					1.87	12.8
			89.3				2516.0	1.67	12.8
			89.9	2.12	0.48	4.4		1.56	12.8
			90.4	2.33	0.64	3.6		1.46	12.8
			91.0	2.54	0.64	4.0		1.35	12.9
			91.6	2.97	0.67	4.4		1.25	12.8
			92.2	2.76	0.65	4.2		0.85	12.8
			92.8	2.11	0.62	3.4		1.25	12.8
			93.4	1.67	0.61	2.7		1.18	12.7
			93.9	2.10	0.61	3.4		0.80	12.8
			94.5	2.54	0.64	4.0		0.35	12.8
			95.1	2.54	0.64	4.0	2960.0	0.32	12.8
			95.7	2.32	0.61	3.8		0.86	12.8

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			96.3	1.87	0.56	3.3		1.43	12.8
			96.9	1.87	0.56	3.3		2.14	12.8
			97.4					2.42	12.8
			98.0				2778.0	3.03	12.8
			98.6					3.64	12.8
			99.2					3.34	12.8
			99.8					3.85	12.9
			100.4					3.57	12.9
			100.9				3321.0	3.86	12.9
			101.5					3.96	12.9
			102.1					3.93	13.0
			102.7					3.78	13.0
			103.3					3.29	13.0
2400	35 49.4	121 46.2	103.9	3.31	0.45	7.4	3592.0	3.07	13.0
			104.4	0.0	0.45	0.0		3.64	13.0
			105.0	0.0	0.47	0.0		3.88	13.0
			105.6	0.0	0.47	0.0		3.51	13.0
			106.2	0.0	0.45	0.0		3.54	13.0
			106.8	0.0	0.44	0.0		3.53	12.9
			107.4	0.0	0.42	0.0		4.03	12.9
			107.9	0.0	0.44	0.0	3241.0	4.67	13.0
			108.5	0.0	0.47	0.0		4.69	13.0
			109.1	0.0	0.46	0.0		4.76	13.0
			109.7	0.0	0.44	0.0	3177.0	5.80	13.1
			110.3	0.0	0.45	0.0		5.84	13.1
			110.9	0.0	0.49	0.0		5.34	13.1
			111.4	0.0	0.46	0.0		4.85	13.1
			112.0	0.0	0.48	0.0		4.36	13.1
			112.6	0.65	0.54	1.2	2729.0	2.90	13.1
			113.2	1.01	0.56	1.8		2.88	13.1
			113.8	1.73	0.62	2.8		1.92	13.1
			114.4	1.73	0.61	2.8		1.91	12.9
			114.9	1.73	0.61	2.8		2.21	12.9
			115.5	1.73	0.63	2.7	2676.0	1.73	12.8
			116.1	1.73	0.63	2.7		1.57	12.8
			116.7	1.73	0.63	2.7		1.74	12.8
			117.3	2.09	0.66	3.2		1.55	12.7
			117.9	1.37	0.62	2.2		1.54	12.7
			118.4	1.10	0.59	1.9	2324.0	1.23	12.8
			119.0	1.73	0.65	2.7		1.04	12.8
			119.6	1.01	0.57	1.8		1.16	12.8
			120.2	0.83	0.57	1.5		0.99	13.0
			120.8	1.01	0.57	1.8		0.96	12.9
0100	35 42.4	121 38.5	121.4	1.01	0.57	1.8	945.0	0.93	12.9
			121.9	0.83	0.56	1.5		1.00	13.0
			122.5	0.83	0.55	1.5		1.16	13.0
			123.1	0.83	0.55	1.5		1.07	13.0
			123.7	0.83	0.55	1.5		0.93	13.0
			124.3	0.83	0.57	1.5	913.0	0.89	13.0
			124.9	0.83	0.57	1.5		1.02	13.0

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			125.4	1.01	0.58	1.7		1.15	13.0
			126.0	1.19	0.60	2.0		1.24	13.0
			126.6	1.19	0.60	2.0		1.41	13.0
			127.2	1.19	0.62	1.9	1023.0	1.54	13.0
			127.8	1.19	0.62	1.9		1.44	12.9
			128.4	1.01	0.61	1.7		1.34	12.9
			128.9	1.01	0.59	1.7		1.49	12.9
			129.5	1.01	0.61	1.7		1.71	12.9
			130.1	1.01	0.62	1.6	1773.0	1.77	12.8
			130.7	0.83	0.53	1.6		1.77	12.9
			131.3	0.47	0.53	0.9		1.58	12.9
			131.9	0.65	0.53	1.2		1.56	12.9
			132.4	0.47	0.50	0.9		1.46	13.2
			133.0	0.29	0.50	0.6	1121.0	1.36	13.2
			133.6	0.0	0.49	0.0		1.23	13.2
			134.2	0.0	0.49	0.0		1.11	13.2
			134.8	0.0	0.49	0.0		0.99	13.2
			135.4	0.0	0.49	0.0		0.87	13.2
			135.9	0.0	0.51	0.0	1264.0	0.75	13.3
			136.5	0.0	0.51	0.0		0.85	13.3
			137.1	0.0	0.51	0.0		0.86	13.3
			137.7	0.0	0.51	0.0		0.83	13.2
			138.3					0.90	13.2
0200	35 36.8	121 31.7	138.9				1051.0	0.92	13.2
			139.4					0.90	13.2
			140.0					0.88	13.2
			140.6					0.87	13.2
			141.2					0.85	13.2
			141.8				1297.0	0.84	13.2
			142.4	0.47	0.58	0.8		0.84	13.2
			142.9	0.29	0.55	0.5		0.85	13.2
			143.5	0.29	0.53	0.5		0.85	13.2
			144.1	0.47	0.53	0.9		0.86	13.2
			144.7	0.47	0.53	0.9	1397.0	0.97	13.2
			145.3	0.65	0.52	1.3			13.2
			145.9	0.47	0.54	0.9			13.2
			146.4	0.29	0.52	0.6			13.2
			147.0	0.29	0.52	0.6			13.2
			147.6	0.65	0.54	1.2		1.56	13.1
			148.2	0.65	0.56	1.2		1.40	13.1
			148.8	0.65	0.56	1.2		1.31	13.1
			149.4	0.47	0.57	0.8		1.34	13.1
			149.9	0.47	0.57	0.8		1.25	13.0
			150.5	1.55	0.64	2.4	2895.0	1.17	12.9
			151.1	2.09	0.72	2.9		1.18	12.9
			151.7	2.27	0.72	3.2		1.16	12.8
			152.3	2.63	0.75	3.5		1.19	12.7
			152.9	2.99	0.78	3.8		1.12	12.6
			153.4	3.17	0.83	3.8	1444.0	0.94	12.5
			154.0	3.35	0.82	4.1		1.07	12.4

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			154.6	3.35	0.83	4.0		1.20	12.3
			155.2	3.35	0.83	4.0		1.06	12.3
			155.8	3.72	0.87	4.3		1.17	12.2
0300	35 45.4	121 29.4	156.4	4.26	0.93	4.6	1175.0	1.23	12.2
			156.9	5.16	0.99	5.2		1.75	12.2
			157.5	5.70	0.98	5.8		1.79	12.2
			158.1	6.42	1.03	6.2		1.50	12.1
			158.7	8.59	1.17	7.3		1.00	12.1
			159.3	9.31	1.20	7.8	1073.0	0.45	11.9
			159.9	9.49	1.23	7.7		0.99	11.8
			160.4	9.85	1.29	7.7		1.13	11.4
			161.0	8.41	1.16	7.3		1.06	11.2
			161.6	10.39	1.30	8.0		3.18	11.1
			162.2	10.75	1.33	8.1	1914.0	4.45	11.0
			162.8	11.65	1.38	8.4		7.63	10.9
			163.4	12.56	1.41	8.9		6.49	10.8
			163.9	13.10	1.41	9.3		5.30	10.8
			164.5	13.46	1.49	9.0		4.33	10.8
			165.1	13.82	1.53	9.0	1833.0	3.49	10.8
			165.7	14.00	1.54	9.1		3.23	10.7
			166.3	14.36	1.56	9.2		2.96	10.6
			166.9	14.54	1.56	9.3		2.99	10.5
			167.5	14.54	1.58	9.2		2.69	10.5
			168.0	15.08	1.61	9.4	1990.0	2.22	10.5
			168.6	15.26	1.61	9.5		2.22	10.4
			169.2	15.44	1.63	9.5		1.97	10.4
			169.8					1.73	10.4
			170.4					1.50	10.5
			171.0				1250.0	1.20	10.5
			171.5					1.21	10.5
			172.1	14.90	1.41	10.6		1.81	10.6
			172.7	13.64	1.31	10.4		2.88	10.7
			173.3	12.56	1.27	9.9		2.69	10.8
0400	35 53.4	121 32.3	173.9	12.74	1.28	10.0	1565.0	3.35	10.4
			174.5	11.83	1.22	9.7		3.46	10.4
			175.0	10.03	1.13	8.9		4.62	10.6
			175.6	8.41	1.00	8.4		2.78	10.6
			176.2	8.23	1.01	8.1		1.95	10.7
			176.8	7.86	0.99	7.9	1819.0	1.51	11.1
			177.4	5.88	0.85	6.9		1.46	11.4
			178.0	5.16	0.82	6.3		1.51	11.5
			178.5	4.26	0.76	5.6		0.98	11.7
			179.1	4.08	0.73	5.2		1.01	11.9
			179.7	3.90	0.73	5.3	743.0	0.76	12.0
			180.3	3.90	0.75	5.2		0.77	12.1
			180.9	4.08	0.75	5.4		1.39	12.1
			181.5	4.62	0.78	5.9		0.81	12.1
			182.0	4.62	0.80	5.8		0.62	12.1
			182.6	4.98	0.81	6.1	714.0	0.64	12.2
			183.2	5.70	0.86	6.6		1.14	12.1

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE (CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			183.8	5.88	0.85	6.9		3.35	12.1
			184.4	5.88	0.85	6.9		2.31	12.0
			185.0	5.83	0.87	6.8		1.73	11.8
			185.5	5.34	0.82	6.5	919.0	0.97	11.9
			186.1	4.62	0.79	5.8		0.81	12.0
			186.7	4.26	0.76	5.6		1.33	11.9
			187.3	4.08	0.74	5.5		1.20	12.0
			187.9	3.72	0.71	5.2		1.03	12.1
			188.5	3.54	0.71	5.0	880.0	0.92	12.1
			189.0	3.72	0.72	5.2		1.09	12.1
			189.6	3.72	0.73	5.1		0.36	12.3
			190.2	4.08	0.75	5.4		1.61	12.3
			190.8	4.80	0.78	6.2		1.77	12.3
0500	35 57.7	121 41.8	191.4	4.44	0.78	5.7	1036.0	1.41	12.2
			192.0	4.26	0.75	5.7		1.05	12.3
			192.5	3.90	0.74	5.3		0.52	12.2
			193.1	3.72	0.72	5.2		0.69	12.2
			193.7	3.54	0.73	4.8		0.85	12.3
			194.3	4.08	0.76	5.4	1070.0	1.36	12.3
			194.9	4.62	0.81	5.7		1.55	12.2
			195.5	4.80	0.81	5.9		1.54	12.2
			196.0	4.80	0.81	5.9		1.01	12.1
			196.6	4.44	0.78	5.7		0.89	12.1
			197.2	4.26	0.76	5.6	1194.0	0.67	12.1
			197.8	4.44	0.80	5.5		0.95	12.2
			198.4	4.62	0.81	5.7		0.94	12.2
			199.0	4.90	0.81	5.9		0.65	12.2
			199.5	4.44	0.78	5.7		4.26	12.1
			200.1	2.99	0.72	4.2	4126.0	5.12	11.9
			200.7	2.99	0.72	4.2		5.07	12.0
			201.3	2.81	0.72	3.9		5.77	12.0
			201.9	2.45	0.69	3.6		6.50	12.1
			202.5	2.45	0.68	3.6		5.44	12.1
			203.0	3.17	0.74	4.3	3583.0	3.61	12.1
			203.6	3.90	0.77	5.1		2.16	12.1
			204.2	3.90	0.78	5.0		5.91	12.1
			204.8	3.90	0.78	5.0		5.24	12.0
			205.4	3.54	0.75	4.7		7.22	12.0
			206.0	3.17	0.73	4.3	3247.0	8.31	12.0
			206.5	3.35	0.73	4.6		7.57	11.9
			207.1	3.90	0.80	4.9		8.48	11.9
			207.7	3.54	0.77	4.6		8.36	11.9
			208.3	5.34	0.88	6.1		6.47	12.0
0600	36 1.7	121 51.8	208.9	6.78	0.99	6.8	2952.0	6.54	11.8
			209.5	7.68	1.05	7.3		5.83	11.7
			210.0					5.43	11.6
			210.6					5.21	11.5
			211.2					3.72	11.4
			211.8				2066.0	2.40	11.3
			212.4					2.01	11.2

R/V ACANIA   30 APR / 1 MAY 79   CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			213.0					1.96	11.2
			213.5	13.92	1.36	10.2		2.23	11.1
			214.1	14.36	1.39	10.3		2.19	10.9
			214.7	15.26	1.44	10.6	2904.0	2.61	10.6
			215.3	15.44	1.46	10.6		1.97	10.5
			215.9	16.70	1.54	10.8		1.54	10.4
			216.5	17.61	1.60	11.0		1.30	10.2
			217.0	18.51	1.65	11.2		0.94	10.2
			217.6	18.87	1.68	11.2	811.0	0.75	10.0
			218.2	19.41	1.73	11.2		0.74	9.9
			219.8	19.23	1.71	11.2		0.74	9.9
			219.4	19.77	1.76	11.2		0.74	9.8
			220.0	19.77	1.76	11.2		0.74	9.7
			220.5	19.41	1.76	11.0	974.0	0.74	9.7
			221.1	19.23	1.73	11.1		0.96	9.8
			221.7	19.05	1.72	11.1		1.06	10.0
			222.3	18.87	1.70	11.1		0.99	10.2
			222.9	18.69	1.71	10.9		0.90	10.2
			223.5	18.51	1.69	11.0	545.0	1.17	10.0
			224.0	18.15	1.68	10.8		0.71	9.9
			224.6	17.97	1.66	10.8		1.15	10.0
			225.2	17.79	1.66	10.7		0.89	10.1
			225.8	17.79	1.70	10.5		0.80	10.1
0700	36 5.2	122 1.6	226.4	17.61	1.63	10.8	590.0	0.83	10.2
			227.0	17.07	1.60	10.7		0.98	10.2
			227.5	16.52	1.57	10.5		1.14	10.5
			228.1	15.98	1.54	10.4		0.92	10.5
			228.7	16.16	1.54	10.5		0.81	10.5
			229.3	15.98	1.53	10.4	801.0	1.41	10.6
			229.9	15.26	1.48	10.3		1.47	10.6
			230.5	15.08	1.47	10.3		1.53	10.6
			231.0	15.08	1.47	10.3		1.59	10.8
			231.6	14.72	1.45	10.2		1.65	10.7
			232.2	14.54	1.46	10.0	740.0	1.54	10.7
			232.8	13.46	1.35	10.0		1.53	10.7
			233.4	10.75	1.19	9.0		1.36	10.7
			234.0	9.85	1.15	8.6		0.94	10.8
			234.5	9.31	1.10	8.5		0.90	11.1
			235.1	8.95	1.08	8.3	859.0	0.75	11.5
			235.7	8.41	1.04	8.1		0.62	11.7
			236.3	8.05	1.02	7.9		0.75	11.7
			236.9	7.68	0.99	7.8		0.40	11.6
			237.5	7.32	0.98	7.5		0.53	11.7
			238.0	7.14	0.96	7.4		0.45	11.7
			238.6	6.42	0.93	6.9	377.0	0.16	11.8
			239.2	5.88	0.90	6.5		0.43	11.8
			239.8					0.81	11.8
			240.4					1.29	11.9
			241.0				786.0	1.51	11.9
			241.5					0.70	12.0

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE (CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			242.1	3.17	0.67	4.7		0.65	12.0
			242.7	2.62	0.62	4.2		1.18	12.0
			243.3	2.25	0.59	3.8		0.81	12.4
0800	36 9.1	122 12.6	243.9	1.87	0.55	3.4	684.0	1.69	12.3
			244.5	1.50	0.54	2.8		0.86	12.4
			245.0	1.12	0.52	2.2		0.75	12.8
			245.6	1.11	0.50	2.2		0.64	13.0
			246.2	0.91	0.50	1.8		0.53	12.9
			246.8	0.90	0.50	1.8	564.0	0.32	12.9
			247.4	1.07	0.50	2.1		0.17	12.8
			248.0	1.63	0.56	2.9		0.53	12.9
			248.5	2.18	0.57	3.8		0.59	12.9
			249.1	2.37	0.60	3.9		0.49	13.0
			249.7	2.55	0.60	4.2	635.0	0.52	12.9
			250.3	2.54	0.62	4.1		0.37	12.7
			250.9	2.54	0.60	4.2		0.39	12.8
			251.5	2.15	0.58	3.7		0.41	12.8
			252.1	1.76	0.55	3.2		0.64	12.9
			252.6	1.55	0.53	2.9	577.0	0.45	12.9
			253.2	1.54	0.52	3.0		0.45	13.1
			253.8	1.53	0.53	2.9		0.23	13.1
			254.4	1.71	0.55	3.1			13.0
			255.0	2.10	0.58	3.6			13.1
			255.6	2.68	0.59	4.5	338.0	0.22	13.2
			256.1	2.68	0.59	4.5			13.3
			256.7	2.67	0.59	4.5			13.5
			257.3	2.67	0.59	4.5			13.3
			257.9	2.66	0.59	4.5			12.8
			258.5	2.66	0.58	4.6	562.0	0.19	13.0
			259.1	2.45	0.58	4.2		0.21	13.2
			259.6	2.45	0.58	4.2		0.48	13.4
			260.2	2.44	0.60	4.1		0.53	13.4
			260.8	2.23	0.58	3.8		0.58	13.4
0900	36 12.2	122 23.2	261.4	2.02	0.56	3.6	446.0	0.32	13.4
			262.0	2.01	0.56	3.6			13.2
			262.6	2.01	0.56	3.6		0.54	13.0
			263.1	1.79	0.56	3.2		0.24	13.0
			263.7	1.58	0.54	2.9			13.2
			264.3	1.57	0.54	2.9	396.0	0.20	13.2
			264.9	1.36	0.54	2.5			13.2
			265.5	1.35	0.52	2.6			13.1
			266.1	1.34	0.53	2.5			13.2
			266.6	0.91	0.50	1.8			13.3
			267.2	0.90	0.48	1.9	342.0	0.13	13.5
			267.8	0.68	0.47	1.4		0.15	13.6
			268.4	0.47	0.47	1.0		0.14	13.6
			269.0	0.45	0.45	1.0		0.14	13.4
			269.6	0.44	0.45	1.0		0.20	13.4
			270.1	0.42	0.45	0.9	513.0	0.32	13.4
1100	35 52.9	122 14.3	313.9	9.38	1.03	9.1		2.06	11.5

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			314.5	10.13	1.10	9.2		2.06	11.5
			315.1	10.50	1.13	9.3		2.06	11.6
			315.6	10.31	1.10	9.4	1455.0	2.06	11.5
			316.2	10.13	1.10	9.2		1.76	11.4
			316.8	10.31	1.11	9.3		2.05	11.3
			317.4	9.94	1.10	9.0		1.96	11.4
			318.0	6.42	0.87	7.4		1.87	11.4
			318.6	5.12	0.84	6.1		1.90	11.4
			319.1	8.09	0.99	8.2		2.40	11.4
			319.7	10.31	1.14	9.0	1701.0	2.27	11.8
			320.3	12.91	1.26	10.2		1.77	11.7
			320.9	12.35	1.25	9.9		1.81	11.5
			321.5	12.35	1.25	9.9		1.52	10.9
			322.1	12.72	1.28	9.9		1.81	10.9
			322.6	13.65	1.33	10.3	1155.0	1.96	10.9
			323.2	14.39	1.30	11.1		1.74	10.8
			323.8	14.21	1.38	10.3		1.36	10.7
			324.4	14.39	1.39	10.4		1.33	10.6
			325.0	15.69	1.47	10.7		1.30	10.5
			325.6	19.03	1.66	11.5	1119.0	1.28	10.6
			326.1	19.58	0.71	27.6		1.26	10.6
			326.7	19.77	1.73	11.4		1.25	10.5
			327.3	20.14	1.76	11.4		1.24	10.3
			327.9	17.92	1.60	11.2		1.23	10.1
			328.5	17.36	1.56	11.1	948.0	1.07	10.1
			329.1	16.25	1.51	10.8		1.51	10.2
			329.6	14.58	1.42	10.3		1.46	10.3
			330.2	14.76	1.42	10.4		1.91	10.4
			330.9	13.84	1.36	10.2		2.36	10.5
1200	35 59.6	122 6.0	332.0	12.72	1.20	10.6	2055.0	1.68	10.5
			332.0	11.24	1.20	9.4		2.20	10.5
			332.6	9.76	1.13	8.6		2.47	10.6
			333.2	10.13	1.13	9.0		3.00	10.8
			333.7	10.50	1.16	9.1		3.22	10.8
			334.3	10.50	1.16	9.1	3179.0	3.53	10.9
			334.9	10.87	1.21	9.0		3.82	11.0
			335.5	11.98	1.29	9.3		4.19	10.9
			336.1	11.98	1.27	9.4		4.00	10.7
			336.7	12.72	1.34	9.5		4.60	10.5
			337.2	13.46	1.37	9.8	2176.0	4.96	10.5
			337.8	13.28	1.37	9.7		4.44	10.5
			338.4	12.17	1.29	9.4		3.93	10.4
			339.0	13.84	1.40	9.9		4.05	10.5
			339.6	14.39	1.44	10.0		4.32	10.7
			340.2	14.21	1.44	9.9	1582.0	3.37	10.4
			340.7	14.58	1.45	10.1		2.96	10.4
			341.3	15.88	1.55	10.2		3.17	10.3
			341.9	18.29	1.71	10.7		3.06	10.3
			342.5	19.03	1.75	10.9		2.62	10.3
			343.1	19.58	1.80	10.9	1670.0	1.67	10.1

R/V ACANIA 30 APR / 1 MAY 79 CHEMICAL MESOSCALE(CRUISE VI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			343.7	20.14	1.84	10.9		1.[illegible]	10.0
			344.2	21.25	1.91	11.1		1.14	10.0
			344.8	22.37	1.99	11.2		0.96	9.9
			345.4	22.55	1.99	11.3		0.63	9.9
			346.0	22.74	2.01	11.3	550.0	0.47	9.8
			346.6	22.55	2.01	11.2		0.[illegible]	9.8
			347.2	22.37	2.00	11.2		0.50	9.8
			347.7	22.37	2.00	11.2		0.51	9.8
			348.3	22.55	2.02	11.2		0.70	9.6
1300	36 6.5	121 59.1	348.9	22.55	2.02	11.2	731.0	0.73	9.5
			349.5	22.55	2.03	11.1		0.72	9.5
			350.1	22.55	2.03	11.1		0.72	9.5
			350.7	22.55	2.04	11.1		0.72	9.5
			351.2	22.92	2.05	11.2		0.54	9.4
			351.8	22.92	2.04	11.2	762.0	0.54	9.4
			352.4	22.92	2.04	11.2		0.70	9.4
			353.0	22.92	2.05	11.2		0.68	9.4
			353.6	23.11	2.06	11.2		0.66	9.4
			354.2	22.92	2.04	11.2		0.64	9.4
			354.7	22.18	2.01	11.0	757.0	0.63	9.5
			355.3	22.55	2.03	11.1		0.65	9.3
			355.9	22.00	2.00	11.0		0.51	9.7
			356.5	22.18	2.00	11.1		0.53	9.7
			357.1	21.81	1.98	11.0		0.55	9.7
			357.7	21.62	1.97	11.0	776.0	0.57	9.7
			358.2	20.33	1.91	10.6		0.46	9.7
			358.8	20.33	1.91	10.6		0.54	9.9
			359.4	20.33	1.91	10.6		0.31	10.0
			360.0	20.14	1.91	10.5		0.35	10.0
			360.6	20.14	1.91	10.5	578.0	0.39	10.0
			361.2	22.33	1.91	11.7			10.0
			361.7	20.51	1.93	10.6			10.0
			362.3	20.70	1.94	10.7			10.0
			362.9	21.07	1.95	10.8			9.8
			363.5	21.25	1.91	11.1	519.0	0.37	9.9
			364.1	21.44	1.96	10.9			9.8
			364.7	21.44	1.96	10.9			9.7
			365.2	21.25	1.97	10.8			9.7
			365.8	20.88	1.97	10.6			9.7
1400	36 13.6	121 52.7	366.4	20.70	1.97	10.5	673.0	0.44	9.7

R/V ACANIA 13 JUNE 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
2000	36 36.3	121 58.7	0.4	3.83	0.73	5.2	497.0	1.53	13.8
			0.9	2.57	0.50	5.1		1.54	13.9
			1.3	3.65	0.50	7.3		1.56	13.1
			1.8	3.54	0.51	7.7		1.57	13.9
			2.2	4.19	0.51	8.2		1.59	13.7
			2.6	6.18	0.68	9.1	1828.0	1.60	13.3
			3.1	8.16	0.79	10.3		1.62	13.2
			3.5	8.27	0.77	10.7		1.63	12.[illegible]
			3.9	8.45	0.77	11.0		1.64	12.8
			4.4	7.98	0.72	11.1		1.66	12.8
			4.8	7.62	0.70	10.9		1.67	12.9
			5.3	7.62	0.67	11.4		4.40	12.9
			5.7	6.47	0.58	11.2		1.70	13.0
			6.1	7.34	0.64	11.6		1.72	12.9
			6.6	7.98	0.66	12.1		1.73	12.9
			7.0	7.98	0.67	11.9		1.74	12.8
			7.4	8.09	0.67	12.1		1.76	12.8
			7.9	7.62	0.65	11.7		1.77	12.8
			8.3	7.33	0.62	11.8		1.79	12.7
			8.8	7.08	0.60	11.8		1.80	12.7
			9.2				880.0	1.82	12.8
			9.6					1.83	12.8
			10.1					1.95	12.9
			10.5					1.86	12.9
			10.9					1.87	12.5
			11.4				1084.0	1.89	12.6
			11.8					1.90	12.7
			12.3					1.92	12.8
			12.7					1.93	12.8
			13.1					1.95	12.3
2100	36 29.2	121 57.1	13.7				2485.0	1.96	12.[illegible]
			14.2					1.97	12.[illegible]
			14.8					1.99	12.2
			15.3					2.00	11.9
			15.9	11.05	1.05	10.5		2.02	11.6
			16.5	11.27	1.05	10.7	1132.0	2.03	11.6
			17.0	11.78	1.08	10.9		2.05	11.[illegible]
			17.6	11.88	1.10	10.8		2.06	11.3
			18.1	11.88	1.12	10.6		2.07	11.3
			18.7	11.81	1.12	10.5		2.09	11.3
			19.2	11.96	1.11	10.8	1121.0	2.10	11.4
			19.8	11.88	1.09	10.9		2.12	11.4
			20.3	11.70	1.10	10.6		2.13	11.4
			20.9	11.88	1.12	10.6		2.15	11.4
			21.5	11.96	1.12	10.7		2.16	11.4
			22.0	11.88	1.13	10.5	2115.0	2.18	11.4
			22.6	11.67	1.12	10.4		2.13	11.4
			23.1	11.41	1.10	10.4		2.09	11.5
			23.7	10.98	1.06	10.4		2.05	11.6
			24.2	10.87	1.09	10.0		2.01	11.7

R/V ACANIA 13 JUNE 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			24.8	10.91	1.09	10.0	1838.0	1.97	11.7
			25.3	11.09	1.13	9.8		1.93	11.7
			25.9	11.70	1.20	9.8		1.83	11.7
			26.4	11.70	1.21	9.7		1.84	11.6
			27.0	11.63	1.23	9.5		1.80	11.6
			27.6				917.0	1.76	11.6
			28.1					1.71	11.6
			28.7					1.67	11.5
			29.2					1.63	11.5
			29.9	11.05	1.14	9.7		1.59	11.4
2200	36 20.4	121 57.1	30.4	11.23	1.18	9.5	1276.0	1.55	11.4
			31.0	11.31	1.02	11.1		1.53	11.4
			31.6	11.45	1.03	11.1		1.51	11.4
			32.2	11.41	1.03	11.1		1.49	11.4
			32.8	11.63	1.04	11.2		1.48	11.4
			33.5	11.78	1.06	11.1	916.0	1.45	11.4
			34.1	11.85	1.10	10.8		1.44	11.4
			34.7	12.10	1.29	9.4		1.42	11.3
			35.3	12.06	1.29	9.3		1.41	11.3
			35.9	11.92	1.27	9.2		1.39	11.3
			36.5	11.74	1.29	9.1	1276.0	1.37	11.4
			37.1	10.40	1.22	8.5		1.36	11.4
			37.8	11.41	1.27	9.0		1.34	11.4
			38.4	10.87	1.27	8.6		1.32	11.4
			39.0	10.66	1.24	8.6		1.30	11.5
			39.6	10.51	1.24	8.5	1175.0	1.29	11.5
			40.2	10.19	1.22	8.4		1.27	11.5
			40.8					1.25	11.6
			41.4					1.23	11.6
			42.1					1.22	11.7
			42.7				825.0	1.20	11.7
			43.3					1.18	11.8
			43.9					1.17	11.8
			44.5	8.53	1.24	6.9		1.15	11.9
			45.1	8.60	1.20	7.2		2.27	11.9
			45.7	8.60	1.18	7.3	1897.0	4.69	11.9
			46.4	8.78	1.15	7.6		7.05	11.9
			47.0	8.35	1.10	7.6		6.59	12.1
			47.6	8.13	1.06	7.7		8.11	12.0
			48.2	7.98	1.00	8.0		10.03	12.1
2300	36 11.0	121 52.6	48.4	7.62	0.95	8.0	1761.0	12.40	12.2
			48.6	7.30	0.90	8.1		13.23	12.2
			48.8	7.48	0.91	8.2		16.86	12.1
			49.0	7.26	0.90	8.1		17.23	12.2
			49.3	6.90	0.88	7.8		12.59	12.3
			49.5	5.93	0.79	7.5	2057.0	11.52	12.5
			49.7	5.20	0.73	7.1		10.88	12.6
			49.9	4.30	0.65	6.6		17.07	12.8
			50.1	3.80	0.61	6.2		14.93	12.9
			50.3	2.97	0.52	5.7		12.80	13.1

R/V ACANIA 13 JUNE 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			50.5	2.06	0.46	4.5	1857.0	11.31	13.2
			50.7	1.77	0.43	4.1		8.75	13.3
			50.9	1.77	0.43	4.1		4.90	13.4
			51.1	1.34	0.39	3.4		4.26	13.5
			51.4	0.98	0.36	2.7		4.69	13.5
			51.6	0.87	0.34	2.6	2374.0	2.13	13.5
			51.8	0.80	0.35	2.3		5.33	13.5
			52.0	0.76	0.35	2.2		5.57	13.5
			52.2	0.69	0.34	2.0		10.24	13.6
			52.4	0.55	0.33	1.7		14.72	13.6
			52.6	0.66	0.33	2.0	1927.0	14.93	13.5
			52.8	0.76	0.37	2.1		15.36	13.5
			53.0	0.87	0.35	2.5			13.4
			53.2	1.52	0.41	3.7			13.3
			53.5	2.21	0.45	4.9			13.3
			53.7	2.39	0.45	5.3	1298.0		13.1
			53.9	3.15	0.53	5.9			13.0
			54.1	3.69	0.56	6.6			13.0
			54.3	3.83	0.56	6.8			12.8
			54.5	2.50	0.56	4.5			12.8
2400	36 8.4	121 55.4	54.8	4.05	0.62	6.5	1851.0		12.7
			55.1	4.66	0.63	7.4			12.7
			55.3	4.55	0.62	7.3			12.6
			55.6	4.48	0.63	7.1			12.6
			55.9	5.67	0.70	8.1			12.6
			56.2	4.73	0.65	7.3	1421.0		12.5
			56.5	5.57	0.70	8.0			12.6
			56.7	5.71	0.70	8.2			12.7
			57.0	5.02	0.67	7.5			12.8
			57.3	4.66	0.63	7.4			12.9
			57.6	4.59	0.64	7.2			12.9
			57.8						12.8
			58.1						12.8
			58.4						12.7
			58.7						12.7
			59.0				1851.0		12.7
			59.2						12.6
			59.5						12.6
			59.8						12.6
			60.1						12.5
			60.4						12.4
			60.6						12.4
			60.9						12.4
			61.2						12.3
			61.5	5.02	0.49	10.2			12.3
			61.7	7.80	0.70	11.1			12.3
			62.0	8.09	0.74	10.9			12.3
			62.3	8.09	0.76	10.6			12.2
			62.6	8.35	0.78	10.7			12.1
			62.9	8.71	0.82	10.6			12.0

R/V ACANIA 13 JUNE 79 CHEMICAL MESOSCALE(CRUISE VII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0100	36 12.7	121 57.3	63.3	9.18	0.89	10.3			11.8
			63.7	9.79	0.95	10.3			11.9
			64.2	8.60	0.95	9.1			11.8
			64.6	7.44	0.90	8.3			11.7
			65.1						11.7
			65.5						11.7
			65.9	9.79	0.96	10.2			11.7
			66.4	10.44	1.00	10.4			11.6
			66.8	7.62	0.90	8.5			11.6
			67.3	9.25	1.00	9.3	1463.0		11.6
			67.7	10.51	1.05	10.0			11.6
			68.1	10.37	1.09	9.5			11.6
			68.6	7.70	0.96	8.0			11.6
			69.0	10.40	1.12	9.3			11.6
			69.5	10.62	1.10	9.7			11.5
			69.9	7.44	0.95	7.8			11.5
			70.4	10.26	1.07	9.6			11.4
			70.8	11.23	1.14	9.9			11.4
			71.2	11.26	1.13	10.0			11.1
			71.7	11.38	1.15	9.9			11.4
			72.1	9.97	1.09	9.1			11.4
			72.6	11.13	1.15	9.7			11.4
			73.0	11.05	1.16	9.5			11.4
			73.4	11.13	1.14	9.8			11.4
			73.9	11.16	1.15	9.7			11.5
0130	36 15.0	121 58.6	74.3	10.22	1.11	9.2	1126.0		11.5
			74.8	8.53	1.09	7.8			11.5
			75.2						11.5
			75.6						11.5
			76.1						11.5
0200	36 17.6	122 0.0	76.3				2105.0		11.5
			76.5						11.5
			76.7	10.80	1.08	10.0			11.5
			76.9						11.5
			77.1	11.05	1.12	9.9			11.5
			77.3	11.31	1.13	10.0	1901.0		11.5
			77.4	11.38	1.13	10.1			11.5
			77.6	11.41	1.12	10.2			11.5
			77.8	11.34	1.18	9.6			11.5
			78.0	11.34	1.16	9.8			11.5
0230	36 19.9	122 1.0	78.2	11.34	1.22	9.3	1577.0		11.5
			78.4						11.5
			78.6						11.6
			78.8	11.34	1.13	10.0			11.6
			79.0	11.41	1.13	10.1			11.5
			79.2	11.70	0.95	12.3	1880.0		11.5
			79.4	11.96	0.98	12.2			11.5
			79.6	10.66	1.06	10.1			11.6
			79.8	9.97	1.17	8.5			11.7
			80.0	11.49	1.03	11.2			11.7

R/V ACANIA 13 JUNE 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			80.2	11.49	1.12	10.3			11.7
			80.4	11.23	1.00	11.2			11.7
			80.6	11.23	0.98	11.5			11.7
			80.8	11.52	1.17	9.8			11.7
			80.9	11.13	1.10	10.1			11.7
0248	36 21.8	122 1.9	81.1						11.7
			81.3						11.7
			81.5						11.7
			81.7						11.8
			81.9						11.8
			82.4						11.8
			82.9						11.8
			83.4						11.8
			83.9						11.7
			84.5						11.7
			85.0						11.7

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M³	TEMP DEG C
			0.6						14.8
			1.3						14.6
			1.9						14.5
			2.5						14.6
			3.2						14.6
			3.8					3.80	14.5
			4.4					3.65	14.4
			5.1					4.13	14.2
			5.7					4.78	14.2
			6.3					4.74	14.1
			7.0					4.18	14.0
			7.6					3.41	13.8
			8.2					3.20	13.7
			8.9	3.68	0.86	4.3		3.43	13.6
			9.5	3.87	0.82	4.7		3.62	13.6
			10.1	3.89	0.80	4.9		3.37	13.6
			10.8	4.12	0.82	5.0		3.60	13.5
			11.4	3.86	0.82	4.7		3.72	13.5
			12.0	3.91	0.82	4.8		3.73	13.6
			12.7	3.93	0.82	4.8		3.56	13.6
			13.3	4.12	0.84	4.9		4.11	13.6
			13.9	4.14	0.84	4.9		3.99	13.6
			14.6	4.30	0.84	5.1		4.40	13.5
			15.2	3.96	0.85	4.7		4.49	13.6
			15.9	9.30	0.95	9.8		4.74	13.6
			16.5	7.25	0.94	7.7		4.86	13.6
			17.1	0.0	0.93	0.0		4.93	13.6
			17.8	5.46	0.94	5.8		4.95	13.4
			18.4	4.84	0.91	5.3		5.27	13.4
			19.0	5.71	0.96	5.9		5.87	13.4
0200	36 34.0	122 2.1	19.7	2.87	0.94	3.1		5.79	13.5
			20.3	3.14	0.89	3.5		6.24	13.4
			20.9	3.05	0.90	3.4		6.44	13.3
			21.6	2.89	0.93	3.1		6.85	13.5
			22.2	1.62	0.94	1.7		6.74	13.5
			22.8	1.71	0.92	1.9		7.52	13.5
			23.5	1.98	0.94	2.1		7.57	13.7
			24.1					7.65	13.7
			24.7					7.95	13.7
			25.4					8.19	13.7
			26.0					7.93	13.7
			26.6					6.90	13.8
			27.3					6.40	13.9
			27.9	0.55	0.94	0.6		6.10	13.8
			28.5	0.55	0.94	0.6		6.10	13.8
			29.2	0.37	0.0	0.0		6.26	13.8
			29.8	0.91	0.0	0.0		6.06	13.8
			30.4	0.37	0.0	0.0		5.36	13.8
			31.1	0.73	0.0	0.0		6.13	13.7
			31.7	1.80	0.99	1.8		5.32	13.6

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NURTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A NG/M3	TEMP DEG C
			32.3	1.41	0.0	0.0		5.05	13.7
			33.0	1.27	0.0	0.0		5.29	13.7
			33.6	1.73	1.04	1.7		4.85	13.7
			34.2					3.96	13.8
			34.9					3.32	13.7
			35.5					3.36	13.7
			36.1	2.52	0.93	2.7		3.66	13.8
			36.8	1.73	0.93	1.9		3.78	13.8
			37.4	1.27	1.05	1.2		4.14	13.8
			38.0	0.55	1.21	0.5		4.13	13.8
0300	36 26.7	122 9.9	38.7	0.20	1.19	0.2		3.96	13.8
			39.3	1.27	1.25	1.0		3.97	13.8
			39.9	1.02	1.22	0.8		4.02	13.6
			40.6	1.80	1.12	1.6		4.27	13.6
			41.2					4.16	13.7
			41.8					3.99	13.5
			42.5					3.94	13.5
			43.1	8.52	0.92	9.3		4.06	13.4
			43.7	8.05	0.92	8.7		4.85	13.0
			44.4	8.59	0.92	9.3		7.13	13.0
			45.0	10.20	0.95	10.7		5.03	12.9
			45.6	10.66	1.01	10.6		5.34	12.9
			46.3	18.59	1.15	16.2		3.95	13.0
			46.9	20.91	1.23	17.0		3.94	13.0
			47.6	0.0	1.25	0.0		4.02	13.0
			48.2	0.0	1.27	0.0		3.94	12.8
			48.8					4.47	12.9
			49.5					4.11	12.4
			50.1					3.53	12.2
			50.7					3.59	12.4
			51.4	18.20	0.0	0.0		3.67	12.5
			52.0	18.23	0.0	0.0		3.56	12.4
			52.6	18.59	0.0	0.0		3.96	12.4
			53.3					3.69	12.4
			53.9					2.84	12.4
			54.5					2.33	12.5
			55.2					2.01	12.5
			55.8					1.84	12.5
			56.4					1.70	12.7
			57.1					1.71	12.8
0400	36 19.2	122 17.6	57.7					1.63	12.8
			58.3					1.69	12.8
			59.0					1.70	12.6
			59.6					1.67	12.6
			60.2					1.41	12.6
			60.9					1.27	12.7
			61.5					1.17	12.9
			62.1					1.13	13.0
			62.8					1.01	13.2
			63.4					0.95	13.3

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			64.0					0.91	13.3
			64.7					0.83	13.5
			65.3					0.85	13.6
			65.9					0.80	13.5
			66.6					0.79	13.6
			67.2					0.75	13.7
			67.8					0.78	13.9
			68.3					0.80	14.0
			68.9					0.79	14.0
			69.5					0.74	14.1
			70.0					0.74	14.1
			70.6					0.82	14.1
			71.2					0.89	14.1
			71.7					0.98	14.0
			72.3					0.97	14.0
			72.9					0.93	14.0
			73.4					0.95	14.1
			74.0					0.98	14.0
			74.6					1.02	14.1
			75.1					1.03	14.1
0500	36 10.0	122 25.7	75.7					1.05	14.1
			76.2					1.05	14.1
			76.8					1.04	14.1
			77.4	7.71	1.11	6.9		0.99	14.1
			77.9	8.49	1.03	8.2		0.97	14.1
			78.5	8.62	1.06	8.1		1.04	14.1
			79.1	8.50	1.12	7.6		0.99	14.0
			79.6	8.15	1.23	6.6		0.98	14.0
			80.2	8.36	1.23	6.8		0.99	14.0
			80.8	8.67	1.23	7.0		0.99	14.1
			81.3	9.03	1.29	7.0		0.95	14.1
			81.9	8.99	1.36	6.6		0.92	14.1
			82.5	8.99	1.36	6.6		0.93	14.0
			83.0	9.03	1.38	6.5		0.97	14.0
			83.6	9.18	1.41	6.5		0.97	14.0
			84.2	9.32	1.32	7.1		0.97	14.0
			84.7	9.21	1.38	6.7		0.97	14.0
			85.3	9.24	1.40	6.6		0.97	14.0
			85.9	9.46	1.42	6.7		0.97	14.0
			86.4	9.34	1.29	7.2		0.97	14.0
			87.0	9.30	1.28	7.3		0.97	14.0
			87.6					0.96	14.0
			88.1					0.97	14.0
			89.7					0.93	14.0
			89.3	9.12	1.17	7.8		0.90	14.0
			89.8	9.40	1.07	8.8		0.90	14.0
			90.4	9.46	0.99	9.6		0.90	14.0
			90.9	9.86	1.27	7.8		0.89	14.0
			91.5	9.67	1.21	8.0		0.93	14.0
			92.1					0.95	14.0

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0600	36 2.1	122 32.0	92.6					0.96	13.9
			93.2	8.15	0.97	8.4		0.96	13.9
			93.8	7.78	0.77	10.1		0.93	13.9
			94.3					0.92	13.9
			94.9					0.93	13.9
			95.5					0.93	13.9
			96.0	7.74	0.92	8.4		0.99	13.9
			96.6	7.67	0.93	8.2		0.95	13.9
			97.2	8.17	0.97	8.4		0.95	13.9
			97.7	8.16	1.21	6.7		0.91	13.9
			98.3	8.28	2.07	4.0		0.83	13.9
			98.9					0.81	13.8
			99.4					0.79	13.9
			100.0					0.83	13.9
			100.6					0.94	13.9
			101.1					0.98	13.9
			101.7					1.03	13.9
			102.3					1.06	14.0
			102.8					1.01	13.9
			103.4					1.01	13.9
			103.9					1.02	13.9
			104.5					1.00	13.9
			105.1					0.99	13.9
			105.6					0.96	13.9
			106.2					0.95	13.9
			106.8					0.95	13.9
			107.3					0.93	13.9
			107.9					0.91	14.0
			108.5					0.92	14.4
			109.0					0.91	14.7
0700	35 54.0	122 37.7	109.6					0.89	14.3
			110.2					0.89	14.9
			110.7					0.96	14.9
			111.3					0.85	15.0
			111.9					0.85	15.3
			112.4					0.85	15.3
			113.0					0.90	15.3
			113.6					0.96	15.4
			114.1					0.96	15.4
			114.7					0.99	15.4
			115.3					1.03	15.4
			115.8					1.05	15.4
			116.4					1.05	15.4
			117.0	2.61	0.85	3.1		1.08	15.4
			117.5	2.62	0.83	3.2		1.11	15.4
			118.1	2.73	0.87	3.1		1.12	15.3
			118.6	2.85	0.87	3.3		1.13	15.3
			119.2	2.96	0.94	3.1		1.13	15.3
			119.8	2.96	0.95	3.1		1.12	15.4
			120.3	2.96	0.95	3.1		1.11	15.4

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			149.6	7.92	0.0	0.0		0.92	14.6
			150.1	8.18	0.0	0.0		0.85	14.5
			150.6	8.70	0.0	0.0		0.83	14.5
			151.1	8.25	0.0	0.0		0.74	14.5
			151.6	8.77	0.0	0.0		0.78	14.5
			152.0	8.96	0.0	0.0		0.66	14.5
			152.5	8.70	0.0	0.0		0.69	14.5
			153.0	7.66	0.0	0.0		0.72	14.7
			153.5	7.35	0.0	0.0		0.73	14.8
			154.0	7.14	0.0	0.0		0.74	14.9
			154.5	7.14	0.0	0.0		0.71	15.1
			155.0	7.09	0.0	0.0		0.68	15.1
			155.5	7.27	0.0	0.0		0.69	15.1
			155.9	7.32	0.0	0.0		0.69	15.1
			156.4					0.67	15.1
			156.9					0.67	15.1
			157.4					0.66	15.1
			157.9					0.63	15.0
			158.4					0.62	15.0
			158.9					0.62	14.9
1000	35 29.1	122 57.1	159.4					0.62	14.9
			159.8					0.62	14.9
			160.3					0.61	14.8
			160.8					0.59	14.8
			161.3					0.59	14.7
			161.8					0.60	14.7
			162.3					0.55	14.7
			162.8					0.52	14.9
			163.3					0.52	15.1
			163.8					0.50	15.2
			164.3					0.50	15.2
			164.8					0.47	15.3
			165.3					0.44	15.3
			165.8					0.43	15.3
			166.3					0.37	15.3
			166.9					0.33	15.3
			167.4					0.34	15.3
			167.9					0.35	15.3
			168.4					0.38	15.0
			168.9					0.40	15.3
			169.4					0.42	15.3
			169.9					0.43	15.3
			170.5					0.45	15.3
			171.0					0.43	15.3
			171.5					0.43	15.3
			172.0					0.44	15.3
			172.5					0.46	15.3
			173.0					0.48	15.3
			173.5					0.48	15.3
			174.1					0.49	15.3

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE (CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			120.9	3.03	0.95	3.2		1.09	15.3
			121.5	3.18	0.95	3.3		1.04	15.3
			122.0	3.17	0.89	3.6		1.02	15.4
			122.6	3.38	0.89	3.8		0.99	15.3
			123.2	2.86	0.43	6.7		0.97	15.3
			123.7	3.07	0.91	3.4		0.96	15.3
			124.3	3.07	0.87	3.5		0.94	15.3
			124.9	3.16	0.89	3.6		0.91	15.3
			125.4	3.36	0.91	3.7		0.90	15.1
			126.0	3.41	0.89	3.8		0.88	15.3
0800	35 42.0	122 44.8	126.6	3.54	0.93	3.8		0.88	15.3
			127.2					0.84	15.3
			127.9					0.80	15.3
			128.4					0.76	15.3
			129.0					0.70	15.2
			129.6					0.69	15.2
			130.3					0.70	15.2
			130.9					0.69	15.2
			131.5					0.70	15.1
			132.1					0.72	15.2
			132.7					0.70	15.2
			133.3					0.69	15.2
			133.9					0.68	15.1
			134.5	4.33	0.75	5.8		0.66	15.1
			135.1	4.33	0.71	6.1		0.65	15.2
			135.7	4.14	0.70	5.9		0.62	15.2
			136.3	4.26	0.78	5.5		0.63	15.2
			136.9	4.38	0.85	5.2		0.62	15.2
			137.5	4.54	0.85	5.3		0.64	15.2
			138.1	4.57	0.82	5.6		0.65	15.1
			138.7	4.77	0.78	6.1		0.66	15.1
			139.3	4.86	0.77	6.3		0.66	15.1
			139.9	7.46	0.79	9.4		0.69	15.1
			140.5					0.70	15.1
			141.1					0.73	15.0
			141.7					0.77	15.0
			142.3					0.77	15.0
			142.9					0.81	15.0
			143.5	3.66	0.94	3.9		0.83	15.0
			144.1	6.10	0.90	6.8		0.85	15.0
0900	35 36.4	122 49.9	144.7	6.18	0.90	6.9		0.85	15.0
			145.2	6.36	0.92	6.9		0.86	15.0
			145.7	6.41	0.96	6.7		0.83	14.9
			146.2	6.70	0.98	6.8		0.83	14.9
			146.7	6.85	0.91	7.5		0.85	14.9
			147.2	7.14	0.96	7.4		0.84	14.9
			147.6	7.40	0.0	0.0		0.83	14.8
			148.1	7.89	0.0	0.0		0.83	14.8
			148.6	8.12	0.0	0.0		0.82	14.7
			149.1	7.92	0.0	0.0		0.99	14.7

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
1100	35 20.6	123 2.7	174.6					0.49	15.3
			175.1					0.50	15.3
			175.6					0.50	15.3
			176.1					0.50	15.3
			176.6					0.48	15.3
			177.1					0.49	15.2
			177.7					0.50	15.2
			178.2					0.51	15.2
			178.6					0.50	15.2
			179.1					0.49	15.2
			179.6					0.48	15.1
			180.1					0.41	15.1
			180.5					0.37	15.1
			181.0					0.33	15.0
			181.5					0.32	14.9
			181.9					0.32	14.9
			182.4					0.32	14.9
			182.9					0.33	14.8
			183.4					0.34	14.8
			183.8					0.37	14.8
			184.3					0.45	14.8
			184.8					0.47	14.5
			185.3					0.49	14.5
			185.7					0.49	14.4
			186.4					0.50	14.4
			187.0					0.51	14.4
			187.6					0.52	14.4
			188.3					0.74	14.4
			188.9					0.86	14.4
			189.5					0.90	14.5
1200	35 12.1	123 8.1	190.2					0.79	14.6
			190.8					0.81	14.7
			191.4					0.77	14.7
			192.1					0.69	14.9
			192.7					0.69	14.8
			193.3					0.68	14.8
			194.0					0.69	14.8
			194.6					0.69	14.8
			195.2					0.72	14.9
			195.9					0.73	14.9
			196.5					0.74	14.9
			197.1					0.74	14.9
			197.8					0.73	15.0
			198.4					0.73	15.0
			199.0					0.74	15.0
			199.7					0.75	15.0
			200.3					0.75	15.0
			200.9					0.75	15.1
			201.6					0.75	15.1
			202.2					0.77	15.1

R/V ACADIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			202.8					0.99	15.1
			203.5					1.17	15.1
			204.1	11.11	0.78	14.2		1.26	15.1
			204.7	11.25	0.76	14.8		1.35	15.2
			205.4	11.02	0.74	14.9		1.43	15.2
			206.0	10.74	0.70	15.3		1.17	15.2
			206.6	10.45	0.69	15.1		0.87	15.2
			207.3	10.59	0.68	15.6		0.79	15.1
			207.9	10.05	0.69	14.6		0.79	15.1
			208.5	9.88	0.68	14.5		0.83	15.1
1300	35 3.7	123 13.7	209.2					0.84	15.1
			209.8	9.73	0.67	14.5		0.85	15.1
			210.5	9.65	0.76	12.7		0.91	15.1
			211.1	9.71	0.69	14.1		0.94	15.1
			211.7	9.76	0.67	14.6		1.09	15.1
			212.4	9.39	0.68	13.8		1.12	15.1
			213.0	9.88	0.70	14.1		1.00	15.2
			213.6	10.02	0.70	14.3		1.09	15.2
			214.3	9.59	0.69	13.9		1.04	15.2
			214.9	10.02	0.69	14.5		0.92	15.2
			215.5	10.16	0.68	14.9		0.90	15.2
			216.2	10.11	0.68	14.9		0.82	15.3
			216.8	10.02	0.67	15.0		0.77	15.3
			217.4	9.36	0.69	13.6		0.74	15.3
			218.1	9.96	0.65	15.3		0.73	15.3
			218.7	9.96	0.67	14.9		0.73	15.3
			219.3	9.91	0.68	14.6		0.73	15.3
			220.0	9.59	0.66	14.5		0.72	15.3
			220.6					0.72	15.3
			221.2					0.70	15.3
			221.9					0.69	15.3
			222.5					0.69	15.2
			223.1					0.75	15.2
			223.8					0.80	15.2
			224.4					0.91	15.2
			225.0					0.93	15.3
			225.7					0.95	15.3
			226.3					0.98	15.4
			226.9					1.09	15.4
			227.6					1.00	15.4
1400	34 55.2	123 19.4	228.2	8.50	0.72	11.8		0.93	15.4
			228.8	8.50	0.69	12.3		0.87	15.5
			229.5	8.53	0.70	12.2		0.97	15.5
			230.1	8.83	0.71	12.5		0.95	15.5
			230.7	8.45	0.73	11.6		1.01	15.5
			231.4	8.59	0.0	0.0		1.10	15.5
			232.0	8.68	0.90	9.6		1.09	15.5
			232.6	8.56	0.90	9.5		1.11	15.5
			233.3	8.45	0.85	9.9		1.18	15.5
			233.9	8.16	0.85	9.6		1.20	15.5

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			234.5	8.02	0.85	9.4		1.15	15.5
			235.2	8.02	0.85	9.4		1.24	15.5
			235.8	7.87	0.89	8.9		0.52	15.5
			236.4	7.73	0.80	9.7		1.24	15.5
			237.1	7.59	0.85	8.9		1.15	15.5
			237.7	7.44	0.85	8.8		1.09	15.5
			238.3	7.73	0.88	8.8		1.09	15.5
			239.0	7.99	0.87	9.2		1.06	15.5
			239.6	7.10	0.81	8.8		1.04	15.4
			240.2	7.87	0.87	9.0		0.97	15.4
			240.9	7.96	0.88	9.0		1.02	15.4
			241.5	8.02	0.89	9.1		1.02	15.4
			242.2	8.13	0.88	9.2		1.00	15.4
			242.8	7.73	0.0	0.0		0.95	15.4
			243.4	8.39	0.87	9.6		0.91	15.4
			244.1	8.53	0.90	9.5		0.89	15.4
1452	35 47.3	123 24.7	244.7	8.68	0.89	9.8		0.89	15.4
			245.3	8.73	0.88	9.9			15.4
			246.0	8.30	0.0	0.0			15.4
			246.6	8.82	0.0	0.0			15.4
			247.2	9.25	1.01	9.2			15.4
			247.9						15.4
			248.5						15.3
			249.1						15.3
			249.8						15.3
			250.4						15.3
			251.0						15.3
			251.7						15.2
			252.3	10.01	1.01	9.9			15.2
			252.9	10.25	1.00	10.3			15.2
			253.6	9.63	0.98	9.8			15.2
			254.2	7.97	0.85	9.4			15.2
			254.8	6.28	0.83	7.6			15.3
1525	34 41.8	123 25.5	255.5	5.67	0.78	7.3			15.5
			256.1	5.25	0.76	6.9			16.1
			256.7	5.10	0.74	6.9		0.32	16.3
			257.4	5.17	0.76	6.8		0.34	16.4
			258.0	5.44	0.78	7.0		0.35	16.5
			258.6	5.85	0.78	7.5		0.36	16.5
			259.3	6.21	0.81	7.7		0.38	16.4
			259.9	6.63	0.83	8.0		0.38	16.4
			260.5	7.01	0.63	11.1		0.40	16.3
			261.2	7.43	0.84	8.8		0.41	16.2
			261.8	7.01	0.83	8.4			16.0
			262.4	3.42	0.0	0.0		0.48	15.9
			263.1	5.06	0.60	8.4		0.49	15.7
			263.7	4.82	0.60	8.0		0.49	15.6
			264.3	4.95	0.62	8.0		0.49	16.0
			265.0	5.90	0.65	9.1		0.48	16.1
			265.6	5.28	0.65	8.1		0.45	16.1

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
1600	35 36.5	123 26.3	266.2	5.04	0.62	8.1		0.44	16.1
			266.9	4.80	0.66	7.3		0.43	16.1
			267.5	4.58	0.0	0.0		0.40	16.2
			268.1	4.56	0.56	8.1		0.38	16.4
			268.8	4.46	0.55	8.1		0.36	16.5
			269.4	4.39	0.53	8.3		0.33	16.6
			270.0	4.46	0.52	8.6		0.31	16.8
			270.7	4.36	0.52	8.4		0.28	16.9
			271.3	4.28	0.52	8.2		0.27	17.0
			271.9	4.21	0.53	7.9		0.25	17.0
			272.6	4.19	0.53	7.9		0.23	17.0
			273.2	4.24	0.51	8.3		0.23	16.8
			273.8					0.21	16.9
			274.5					0.19	16.9
			275.1					0.17	16.9
			275.7					0.18	16.9
			276.4					0.17	17.0
			277.0					0.17	17.0
			277.6					0.17	17.0
			278.3					0.17	17.1
			278.9					0.17	17.1
			279.5					0.17	17.1
			280.2					0.17	17.1
			280.8					0.17	17.1
			281.5					0.17	17.1
			282.1					0.17	17.1
			282.7						17.1
			283.4				823.0		17.1
			284.0						17.1
			284.6						17.1
1700	34 26.3	123 27.1	285.3					0.19	17.1
			285.9					0.18	17.2
			286.5					0.18	17.2
			287.2					0.19	17.2
			287.8					0.19	17.1
			288.4					0.19	17.1
			289.1					0.18	17.1
			289.7				903.0	0.18	17.1
			290.3					0.18	17.1
			291.0					0.17	17.1
			291.6					0.17	17.1
			292.2				767.0	0.17	17.1
			292.9					0.17	17.1
			293.5					0.17	17.1
			294.1					0.17	17.1
			294.8					0.17	17.1
			295.4					0.17	17.1
			296.0					0.17	17.1
			296.7					0.18	17.1
			297.3	0.0	0.24	0.0		0.17	17.1

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			297.9	0.0	0.25	0.0	788.0	0.17	17.1
			298.6	0.0	0.25	0.0		0.17	17.1
			299.2	0.0	0.23	0.0		0.17	17.1
			299.8	0.0	0.25	0.0		0.17	17.1
			300.5	0.0	0.25	0.0			17.1
			301.1	1.09	0.25	4.4		0.17	17.1
			301.7	0.87	0.24	3.6		0.17	17.1
			302.4	0.0	0.25	0.0		0.17	17.1
			303.0	0.89	0.27	3.3		0.18	17.0
			303.6	0.89	0.27	3.3		0.19	17.0
			304.3	0.99	0.28	3.5		0.17	17.0
			304.9	0.92	0.27	3.4		0.18	17.0
			305.5	1.08	0.27	4.0		0.19	17.0
1805	34 32.8	123 32.3	306.2	0.98	0.28	3.5		0.19	17.0
			306.8	0.95	0.29	3.3		0.20	17.0
			307.4	0.96	0.25	3.8		0.20	16.9
			308.1					0.21	17.0
			308.7				925.0	0.21	16.9
			309.3	1.13	0.27	4.4		0.21	16.9
			310.0	1.00	0.26	3.8		0.22	16.9
			310.6	0.98	0.26	3.8		0.26	16.9
			311.2	0.99	0.26	3.8		0.28	16.9
			311.9	0.96	0.26	3.7	1165.0	0.29	16.9
			312.5	0.93	0.25	3.7		0.29	16.6
			313.1	0.93	0.25	3.9		0.29	16.6
			313.8	0.91	0.25	3.6		0.29	16.6
			314.4	0.83	0.24	3.7		0.33	16.6
			315.0	0.89	0.25	3.6		0.34	16.6
			315.7	1.02	0.26	3.9		0.36	16.6
			316.3	0.95	0.26	3.7		0.37	16.6
			316.9	1.22	0.29	4.2	1014.0	0.38	16.7
			317.6	1.31	0.32	4.1		0.40	16.6
			318.2	1.24	0.32	3.9		0.41	16.6
			318.8	8.10	0.32	25.3		0.41	16.6
			319.5	4.16	0.35	11.9		0.44	16.6
			320.1	0.45	0.39	1.2		0.46	16.6
			320.7	6.06	0.45	13.5	3418.0	0.47	16.6
			321.4					0.77	16.5
1855	34 39.4	123 36.0	322.0					0.66	16.4
			322.6					0.66	16.4
1900	34 39.9	123 36.4	323.3					0.71	16.0
			323.9					0.72	15.8
			324.5					0.75	15.7
			325.2					0.74	15.6
			325.8					0.76	15.6
			326.4					0.83	15.7
			327.1				1256.0	0.90	15.7
			327.7					0.90	15.7
			328.4					0.86	15.6
			329.0					0.86	15.6

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			329.6					0.47	15.6
			330.3				1082.0	1.02	15.6
			330.9					1.01	15.6
			331.5					0.70	15.7
			332.2					0.69	15.7
			332.8					0.74	15.7
1931	34 43.9	123 39.4	333.4				1113.0	0.75	15.7
			334.1					1.02	15.7
			334.7					1.01	15.6
			335.3					0.69	15.6
			336.0					0.69	15.6
			336.6				983.0	0.69	15.6
			337.2					0.69	15.6
			337.9					0.63	15.6
			338.5					0.68	15.6
			339.1					0.67	15.6
			339.9				1047.0	0.67	15.6
			340.4					0.67	15.6
			341.0					0.80	15.6
			341.7					0.63	15.6
2000	34 42.2	123 42.6	342.3					0.59	15.5
			342.9					0.56	15.5
			343.6				1013.0	0.59	15.4
			344.2					0.58	15.4
			344.8					0.63	15.4
			345.5					0.63	15.4
			346.1					0.63	15.4
			346.7				981.0	0.62	15.4
			347.4					0.57	15.5
			348.0					0.61	15.5
			348.6					0.59	15.5
			349.3					0.59	15.5
			349.9				964.0	0.58	15.5
			350.5					0.58	15.5
			351.2					0.58	15.5
			351.8					0.55	15.5
			352.4					0.62	15.5
			353.1				1056.0	0.60	15.5
			353.7					0.56	15.5
			354.3					0.50	15.5
			355.0					0.49	15.5
			355.6					0.47	15.5
			356.2					0.43	16.0
			356.9				977.0	0.43	16.4
			357.5					0.40	16.6
			358.1					0.40	17.0
			358.8	0.0	0.53	0.0		0.39	17.0
			359.4	0.0	0.49	0.0		0.37	17.0
			360.0	0.0	0.54	0.0	723.0	0.36	17.0
			360.7	0.0	0.49	0.0		0.35	16.8

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
2130	34 36.3	123 51.4	361.3	0.0	0.49	0.0		0.44	16.5
			361.9	0.0	0.50	0.0		0.42	16.5
			362.6	0.0	0.50	0.0		0.31	17.0
			363.2	0.0	0.52	0.0	712.0	0.29	17.1
			363.8	0.0	0.56	0.0		0.28	17.1
			364.5	0.0	0.58	0.0		0.27	17.1
			365.1	0.0	0.55	0.0		0.27	17.1
			365.7	0.0	0.53	0.0		0.26	17.1
			366.4	0.0	0.53	0.0	931.0	0.25	17.1
			367.0	0.0	0.47	0.0		0.24	17.2
			367.6	0.0	0.50	0.0		0.23	17.2
			368.3	0.0	0.49	0.0		0.22	17.2
			369.9	0.0	0.48	0.0		0.20	17.2
			369.5	0.0	0.48	0.0	1019.0	0.19	17.2
2128	34 33.9	123 55.0	370.2	0.0	0.50	0.0		0.19	17.2
			370.8	0.0	0.51	0.0		0.18	17.2
			371.4	0.0	0.51	0.0		0.20	17.2
			372.1	0.0	0.52	0.0		0.21	17.2
			372.7	0.0	0.53	0.0	852.0	0.21	17.2
			373.3					0.23	17.2
			374.0					0.25	17.2
			374.6					0.27	17.2
			375.3					0.29	17.2
2145	34 35.5	123 54.0	375.9				1073.0	0.34	17.2
			376.5					0.33	17.1
			377.2					0.32	17.1
			377.8					0.34	17.1
			378.4					0.35	17.0
			379.1				1054.0	0.38	17.0
			379.7	1.64	0.68	2.4		0.38	17.0
2200	34 37.4	123 54.7	380.3	4.43	0.82	5.4		0.39	16.9
			381.0	4.76	0.83	5.7		0.42	16.5
			381.6	4.73	0.84	5.6		0.44	16.2
			382.2	4.47	0.84	5.3	2063.0	0.42	15.8
			382.9	4.28	0.81	5.3		0.44	15.8
			383.5	4.51	0.79	5.7		0.44	15.4
			384.1	3.05	0.76	4.0		0.47	15.5
			384.9	2.63	0.76	3.5		0.46	15.5
			385.4	3.01	0.73	4.1		0.45	15.6
			386.0	2.39	0.73	3.3		0.45	15.7
			386.7	2.43	0.74	3.3		0.45	15.7
			387.3	2.58	0.74	3.5		0.45	15.7
			387.9	2.69	0.74	3.6		0.46	15.7
			389.6	2.73	0.74	3.7	1024.0	0.44	15.7
			389.2	2.88	0.76	3.8		0.43	15.7
			389.8	4.90	0.85	5.8		0.37	15.7
2232	34 42.0	123 54.1	390.5	5.22	0.85	6.1		0.40	15.7
			391.1	4.95	0.81	6.1		0.42	15.6
			391.7	4.12	0.76	5.4		0.46	15.5
			392.4	3.77	0.75	5.0	1133.0	0.50	15.4

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			393.0	3.34	0.74	4.5		0.48	15.2
			393.6	2.11	0.69	3.1		0.53	14.9
			394.3	1.35	0.63	2.1		0.53	14.9
			394.9	0.71	0.61	1.2		0.50	14.8
			395.5	0.79	0.64	1.2		0.49	14.7
			396.2	0.46	0.0	0.0	1188.0	0.49	14.7
			396.8					0.49	14.7
			397.4						14.7
			398.1					0.45	14.7
			398.7					0.47	14.7
2300	34 44.4	123 51.6	399.3				1098.0	0.43	14.9
			400.0					0.43	14.9
			400.6					0.42	15.0
			401.2	0.0	0.46	0.0		0.42	16.0
			401.9	0.0	0.51	0.0		0.44	15.1
			402.5	0.0	0.52	0.0		0.44	15.2
			403.1	0.0	0.52	0.0		0.44	15.2
			403.8	0.0	0.55	0.0		0.45	15.2
			404.4	0.0	0.59	0.0		0.45	15.2
			405.0	0.0	0.56	0.0		0.44	15.2
			405.7	0.0	0.57	0.0		0.44	15.3
			406.3	0.0	0.59	0.0		0.44	15.3
			406.9	0.0	0.59	0.0	1276.0	0.45	15.3
			407.6	0.0	0.59	0.0		0.45	15.4
			408.2	0.0	0.61	0.0		0.45	15.3
			408.8	0.0	0.60	0.0		0.45	15.2
			409.5	0.0	0.60	0.0		0.46	15.3
			410.1	0.0	0.60	0.0	1102.0	0.46	15.3
			410.7	0.0	0.63	0.0		0.46	15.2
			411.4	0.0	0.63	0.0		0.46	15.1
			412.0	0.0	0.62	0.0		0.48	15.1
			412.6	0.0	0.63	0.0		0.49	15.0
			413.3	0.0	0.64	0.0		0.49	15.0
			413.9	0.0	0.64	0.0		0.50	15.1
			414.5	0.0	0.66	0.0		0.52	15.1
			415.2	0.14	0.67	0.2		0.54	14.9
			415.8	0.22	0.69	0.3		0.55	14.8
			416.4	0.34	0.63	0.5		0.57	14.9
			417.1	0.76	0.68	1.1		0.54	14.9
			417.7	1.09	0.68	1.6		0.54	14.8
2400	34 49.3	123 45.0	418.3	1.51	0.69	2.2		0.52	14.6
			419.0	1.77	0.70	2.5		0.53	14.4
			419.6	1.68	0.69	2.4		0.52	14.1
			420.3	1.58	0.68	2.3		0.52	14.0
			420.9	1.36	0.69	2.0		0.51	13.9
			421.5	1.53	0.68	2.2		0.52	13.9
			422.2	1.61	0.69	2.3		0.54	13.8
			422.8	1.74	0.69	2.5		0.52	13.9
			423.4	1.95	0.69	2.8		0.52	13.9
			424.1	1.99	0.70	2.8		0.52	13.9

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			424.7	2.03	0.70	2.9		0.52	14.0
			425.3	2.16	0.71	3.0		0.52	14.1
			426.0	2.07	0.71	2.9		0.52	14.1
			426.6	1.89	0.71	2.7		0.67	14.0
			427.2	1.21	0.69	1.8		0.65	13.9
			427.9					0.62	13.9
			428.5					0.62	13.8
			429.1					0.60	13.8
			429.8					0.59	13.8
			430.4					0.57	13.8
			431.0					0.57	13.8
			431.7					0.56	13.8
			432.3					0.57	13.8
			432.9					0.56	13.9
			433.6					0.55	13.9
			434.2					0.54	13.8
			434.8					0.54	13.9
			435.5					0.53	13.7
			436.1					0.53	13.6
			436.7					0.53	13.6
0100	34 55.4	123 38.1	437.4					0.54	13.5
			438.0					0.55	13.5
			438.6	1.72	0.78	2.2		0.56	13.5
			439.3	2.16	0.79	2.7		0.60	13.5
			439.9	2.38	0.80	3.0		0.60	13.4
			440.5	3.03	0.80	3.8		0.60	13.4
			441.2	2.64	0.78	3.4		0.60	13.3
			441.8	1.94	0.77	2.5		0.60	13.3
			442.4	3.69	0.80	4.6		0.60	13.4
			443.1	4.34	0.83	5.2		0.60	13.3
			443.7	6.09	0.87	7.0		0.60	13.2
			444.3	8.14	0.90	9.0		0.60	13.5
			445.0	5.87	0.92	6.4		0.73	13.6
			445.6	6.09	0.93	6.5		0.73	14.3
			446.2	6.30	0.94	6.7		0.83	14.4
			446.9	5.52	0.88	6.3		0.86	13.3
			447.5	4.04	0.87	4.6		0.83	14.2
			448.1	4.21	0.86	4.9		0.93	14.3
			448.8	4.78	0.87	5.5		0.83	14.2
			449.4	5.69	0.90	6.3		0.78	14.0
			450.0	5.96	0.91	6.5		0.73	13.9
			450.7	6.74	0.92	7.3		0.83	13.9
			451.3	6.61	0.91	7.3		0.75	14.0
			451.9	5.61	0.83	6.4		0.78	14.1
			452.6	6.26	0.88	7.1		0.78	14.4
			453.2	6.04	0.87	6.9		0.80	14.5
			453.8	6.09	0.86	7.1		0.77	14.7
			454.5	5.87	0.85	6.9		0.80	14.8
			455.1	5.69	0.85	6.7		0.83	14.8
			455.7	5.56	0.85	6.5		0.78	14.9

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM.	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0200	35 1.9	123 31.7	456.4	5.65	0.85	6.6		0.75	14.9
			457.0	5.61	0.85	6.6		0.77	15.0
			457.6	5.74	0.83	6.9		0.86	14.9
			458.3					0.83	14.6
			458.9					0.73	14.3
			459.5					0.73	14.4
			460.2	5.34	0.87	6.1		0.70	14.5
			460.8	4.73	0.83	5.4		0.70	14.8
			461.4	5.21	0.85	6.1		0.73	14.8
			462.1	5.39	0.83	6.5		0.72	14.8
			462.7	5.69	0.82	6.9		0.73	14.5
			463.3	5.92	0.85	6.8		0.75	14.6
			464.0	6.74	0.85	7.9		0.73	14.7
			464.6	6.43	0.85	7.6		0.67	14.6
			465.2	6.22	0.85	7.3		0.70	14.9
			465.9	5.17	0.84	6.2		0.73	14.9
			466.5	4.25	0.80	5.3		0.78	15.0
			467.2	2.42	0.74	3.3		0.73	15.0
			467.8					0.80	15.0
			468.4					0.86	15.0
			469.1					0.93	15.0
			469.7					0.96	15.0
			470.3					0.95	15.0
			471.0	4.34	1.10	3.9		0.99	15.1
			471.6	3.91	1.09	3.6		0.96	15.1
			472.2	3.69	1.05	3.5		0.99	15.2
			472.9	3.51	0.98	3.6		0.99	15.3
			473.5	3.25	0.97	3.4		1.00	15.3
			474.1	3.03	0.95	3.2		1.01	15.3
			474.8	2.81	0.93	3.0		1.04	15.4
0300	35 8.6	123 25.8	475.4	2.73	0.95	2.9		1.04	15.4
			476.0	2.60	0.95	2.7		1.04	15.4
			476.7	2.38	0.95	2.6		1.03	15.4
			477.3	1.81	0.95	1.9		1.01	15.4
			477.9	1.29	0.92	1.4		1.01	15.4
			478.6	1.20	0.81	1.5		1.04	15.4
			479.2	1.51	0.79	1.9		1.04	15.4
			479.8	1.72	0.74	2.3		1.07	15.4
			480.5	1.72	0.77	2.2		1.07	15.4
			481.1	1.51	0.75	2.0		1.07	15.4
			481.7					1.07	15.4
			482.4					1.07	15.4
			483.0					1.08	15.4
			483.6	1.59	0.77	2.1		1.17	15.4
			484.3	1.72	0.78	2.2		1.20	15.4
			484.9	1.72	0.77	2.2		1.20	15.4
			485.5	1.81	0.77	2.4			15.4
			486.2	1.94	0.77	2.5			15.4
			486.8	1.94	0.78	2.5			15.4
			487.4	2.16	0.78	2.8			15.4

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RELATIONSHIPS BETWEEN SEA SURFACE TEMPERATURE AND NUTRIENTS IN --ETC(U)
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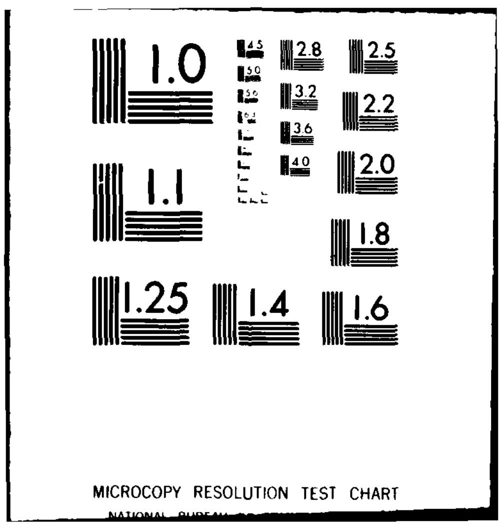
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R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NC3 UM	PO4 UM.	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			489.1	2.29	0.79	2.9			15.3
			489.7	0.0	0.80	0.0			15.3
			489.3	0.0	0.81	0.0			15.3
			490.0	0.0	0.61	0.0			15.3
			490.6						15.3
			491.2						15.3
			491.9						15.3
			492.5						15.3
			493.1						15.2
			493.9						15.1
			494.4						15.1
			495.0						15.1
			495.7						15.1
			496.3						15.1
			496.9						15.1
			497.6						15.1
			498.2						15.0
			498.8						15.0
0415	35 16.9	123 17.3	499.5						15.0
			500.1						15.0
			500.7						15.0
			501.4						15.0
			502.0						15.0
			502.6						15.0
			503.3						15.0
			503.9						15.0
			504.5						15.0
			505.2						15.0
			505.8						15.0
			506.4						15.0
			507.1						15.1
			507.7						15.0
			508.3						15.1
			509.0						15.1
			509.6						15.1
			510.2						15.1
			510.9						15.0
			511.5						15.0
			512.1						15.1
			512.8						15.3
			513.4						15.3
			514.1						15.3
			514.7						15.3
0505.	35 22.7	123 11.7	515.3						15.3
			516.0						15.3
			516.6						15.3
			517.2						15.3
			517.9						15.3
			518.5						15.4
			519.1						15.4

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			519.8						15.4
			520.4						15.4
			521.0						15.4
			521.7						15.4
			522.3						15.4
			522.9						15.4
			523.6						15.4
			524.2						15.4
			524.8						15.4
			525.5						15.4
			526.1						15.4
			526.7						15.3
			527.4						15.3
			528.0						15.3
			528.6						15.3
			529.3						15.2
			529.9						15.1
			530.5						15.1
			531.2						15.0
			531.8						15.0
0600	35 28.6	123 6.2	532.4						15.0
			533.1						15.0
			533.7						15.0
			534.3						15.0
			535.0						15.0
			535.6						14.9
			536.2						14.9
			536.9						14.9
			537.5						14.9
			538.1						14.9
			538.8						14.9
			539.4						14.9
			540.0						14.8
			540.7						14.8
			541.3						14.8
			541.9						14.9
			542.6						14.9
			543.2						14.9
			543.8						14.9
			544.5						14.9
			545.1						14.9
			545.7						15.0
			546.4						14.9
			547.0						14.9
			547.6						15.0
			548.3						15.0
			548.9						15.0
			549.5						15.0
			550.2						15.1
			550.8						15.1

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0700	35 35.0	123 0.6	551.4						15.1
			552.1						15.1
			552.7						15.2
			553.3						15.3
			554.0						15.3
			554.6						15.2
			555.2						15.2
			555.9						15.3
			556.5						15.3
			557.1						15.3
			557.8						15.3
			558.4						15.3
			559.1						15.3
			559.7						15.3
			560.3						15.3
			561.0						15.3
			561.6						15.3
			562.2						15.3
			562.9						15.3
			563.5						15.3
			564.1						15.3
			564.8						15.3
			565.4						15.3
			566.0						15.4
			566.7						15.4
			567.3						15.4
			567.9						15.4
			568.6						15.4
			569.2						15.4
			569.8						15.3
0800	35 42.6	122 53.9	570.5						15.3
			571.1						15.3
			571.7						15.3
			572.4						15.3
			573.0						15.3
			573.6						15.3
			574.3						15.3
			574.9						15.3
			575.5						15.3
			576.2						15.3
			576.8						15.3
			577.4						15.3
			578.1						15.3
			578.7						15.3
			579.3						15.3
			580.0						15.3
			580.6						15.4
			581.2						15.4
			581.9						15.4
			582.5						15.4

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM.	PO4 UM.	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			583.1						15.4
			583.8						15.4
			584.4						15.4
			585.0						15.3
			585.7						15.3
			586.3						15.3
			586.9						15.3
			587.6						15.3
			588.2						15.3
			588.8						15.3
0900	35 49.2	122 46.6	589.5						15.3
			590.1						15.3
			590.7						15.3
			591.4						15.3
			592.0						15.3
			592.6						15.3
			593.3						15.3
			593.9						15.4
			594.5						15.4
			595.2						15.4
			595.8						15.3
			596.4						15.4
			597.1						15.4
			597.7						15.4
			598.3						15.4
			599.0						15.4
			599.6						15.4
			600.2						15.4
			600.9						15.4
			601.5						15.4
			602.1						15.4
			602.8						15.4
			603.4						15.4
			604.0						15.3
			604.7						15.3
			605.3						15.2
			606.0						15.0
			606.6						14.8
			607.2						14.6
			607.9						14.4
1000	35 56.5	122 38.9	608.5						14.5
			609.1						14.5
			609.8						14.5
			610.4						14.4
			611.0						14.4
			611.7						14.4
			612.3						14.4
			612.9						14.3
			613.6						14.3
			614.2						14.3

R/V ACANIA   07 AUG / 09 AUG 79   CHEMICAL MESOSCALE(CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			614.8						14.3
			615.5						14.3
			616.1						14.3
			616.7						14.3
			617.4						14.3
			618.0						14.3
			618.6						14.3
			619.3						14.3
			619.9						14.3
			620.5						14.3
			621.2						14.2
			621.8						14.2
			622.4						14.2
			623.1						14.2
			623.7						14.2
			624.3						14.2
			625.0						14.2
			625.6						14.2
			626.2						14.1
			626.9						14.1
1100	36 3.1	122 32.2	627.5						14.1
			628.1						14.1
			628.8						14.2
			629.4						14.2
			630.0						14.2
			630.7						14.2
			631.3						14.2
			631.9						14.2
			632.6						14.2
			633.2						14.2
			633.8						14.2
			634.5						14.2
			635.1						14.2
			635.7						14.2
			636.4						14.2
			637.0						14.2
			637.6						14.1
			638.3						14.1
			638.9						14.0
			639.5						13.9
			640.2						13.9
			640.8						13.5
			641.4						12.7
			642.1						12.7
			642.7						12.7
			643.3						12.6
			644.0						12.6
			644.6						12.6
			645.2						12.7
			645.9						12.7

R/V ACANIA 07 AUG / 09 AUG 79 CHEMICAL MESOSCALE (CRUISE VIII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM.	PO4 UM.	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
1200	36 9.5	122 24.8	646.5						12.8
			647.1						12.8
			647.8						12.8
			648.4						12.8
			649.0						12.8
			649.7						12.8
			650.3						12.8
			650.9						12.9
			651.6						12.7
			652.2						12.6
			652.9						13.0
			653.5						13.5
			654.1						13.6
			654.8						13.8
			655.4						13.8
			656.0						15.8
			656.7						13.8
			657.3						13.7
			657.9						13.8
			658.6						13.8
			659.2						13.5
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			663.0						14.0
			663.6						14.0
			664.3						14.0
			664.9						13.5
1300	36 16.7	122 17.6	665.5						13.9
			666.2						13.8
			666.8						13.8
			667.4						13.8
			663.1						13.7
			668.7						13.7
			669.3						13.7
			670.0						13.6
			670.6						13.6
			671.2						13.6
			671.9						13.6
			672.5						13.6
			673.1						13.5
			673.8						13.5
			674.4						13.4
			675.0						13.4
			675.7						13.3
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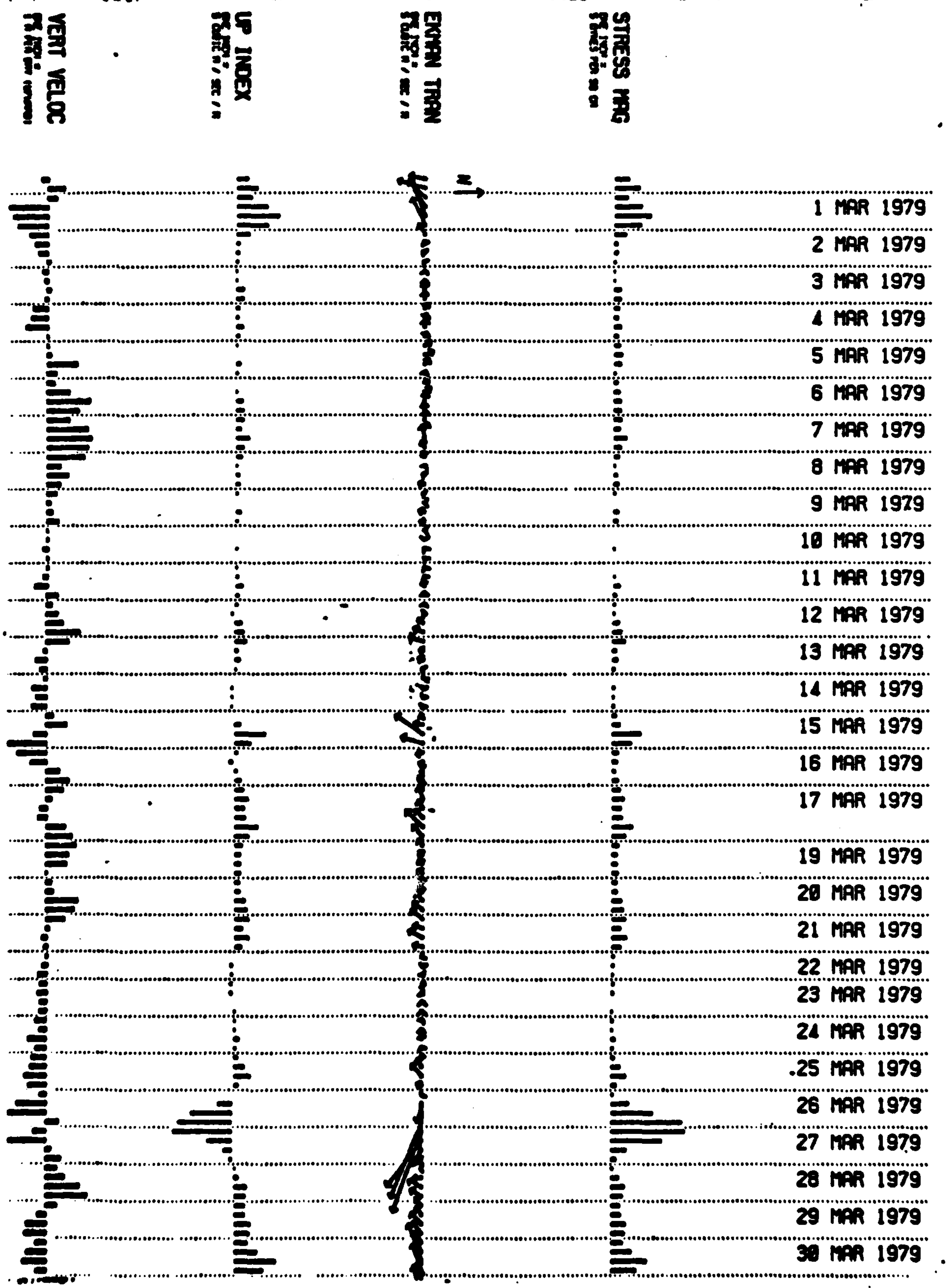
APPENDIX B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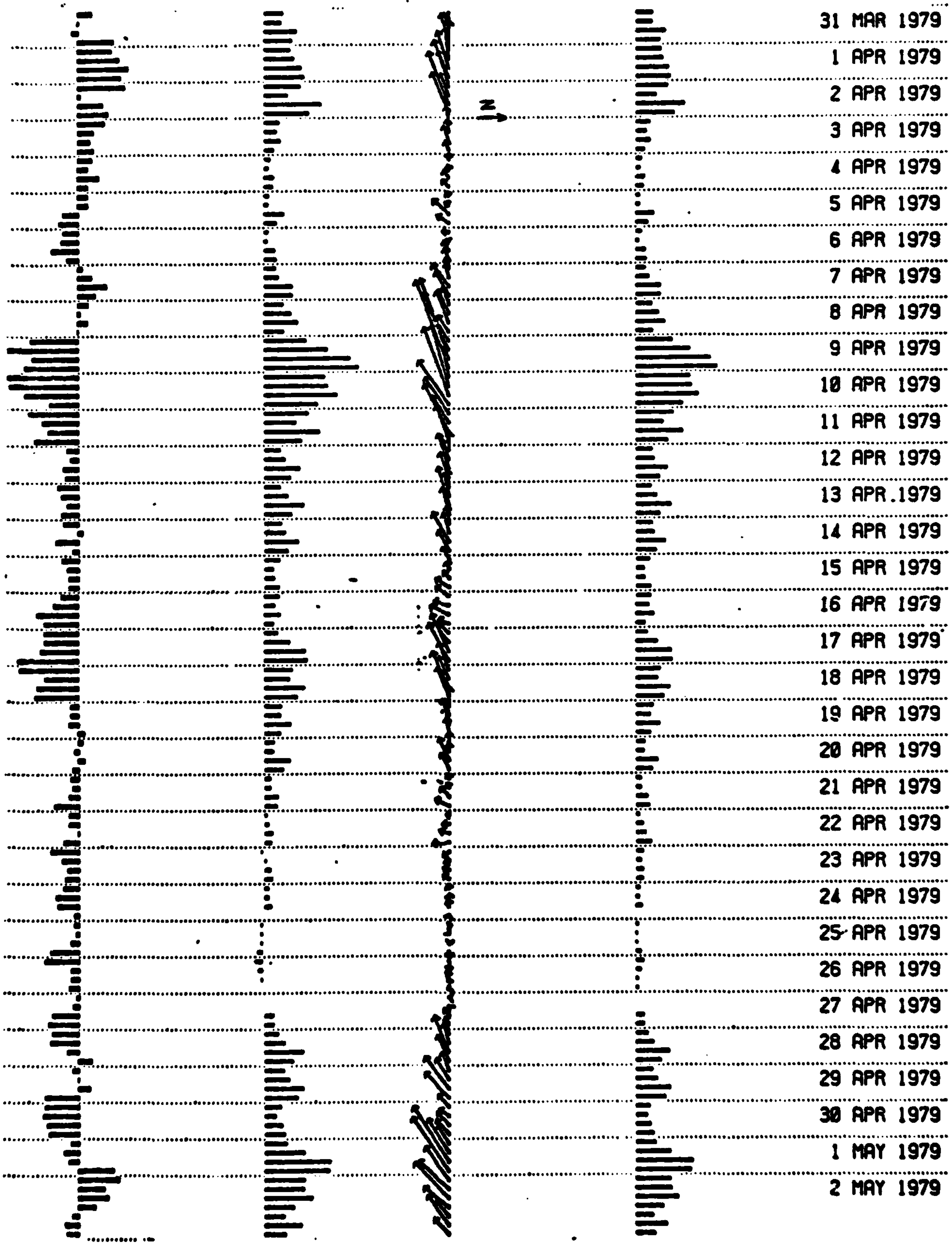
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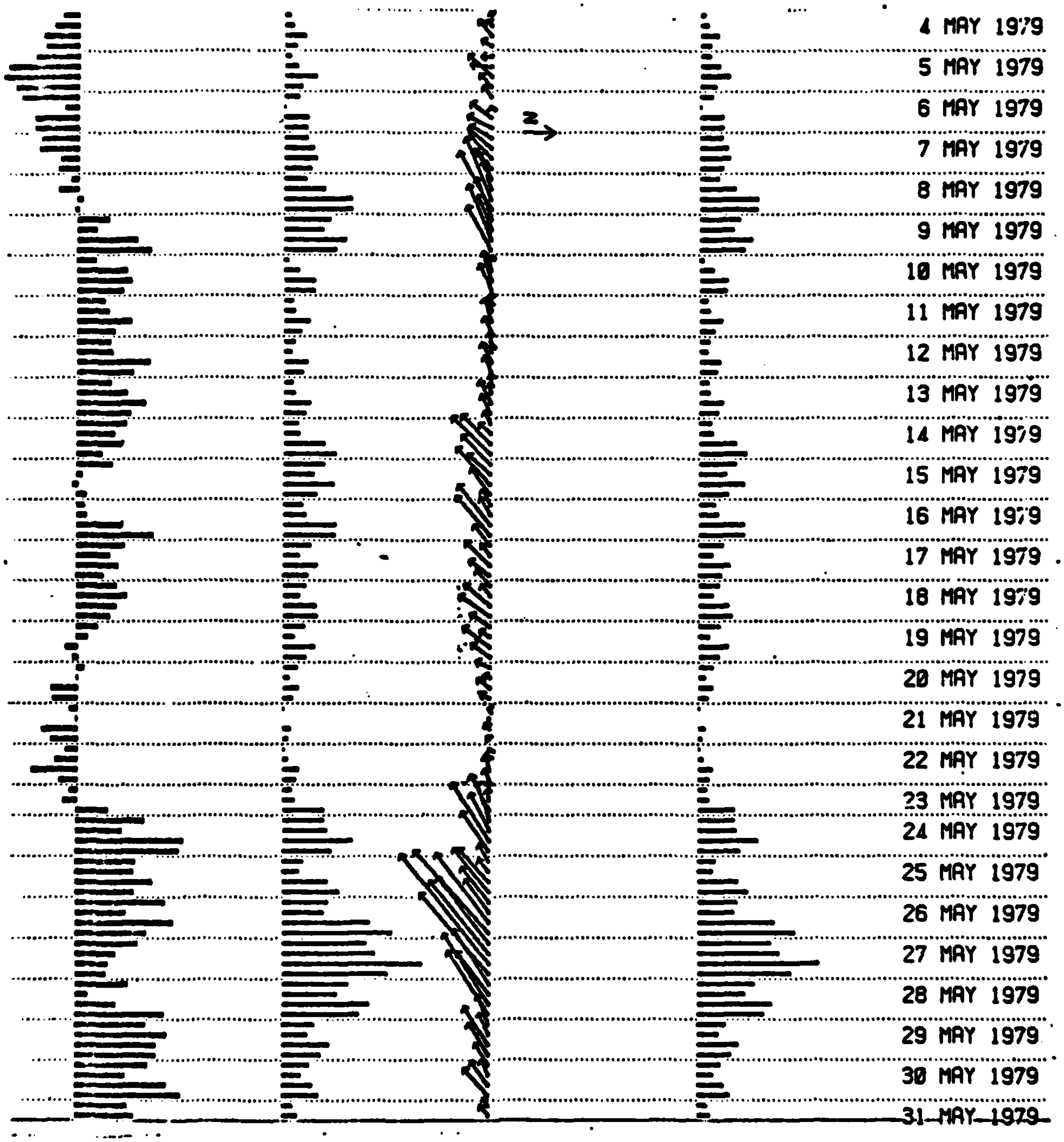
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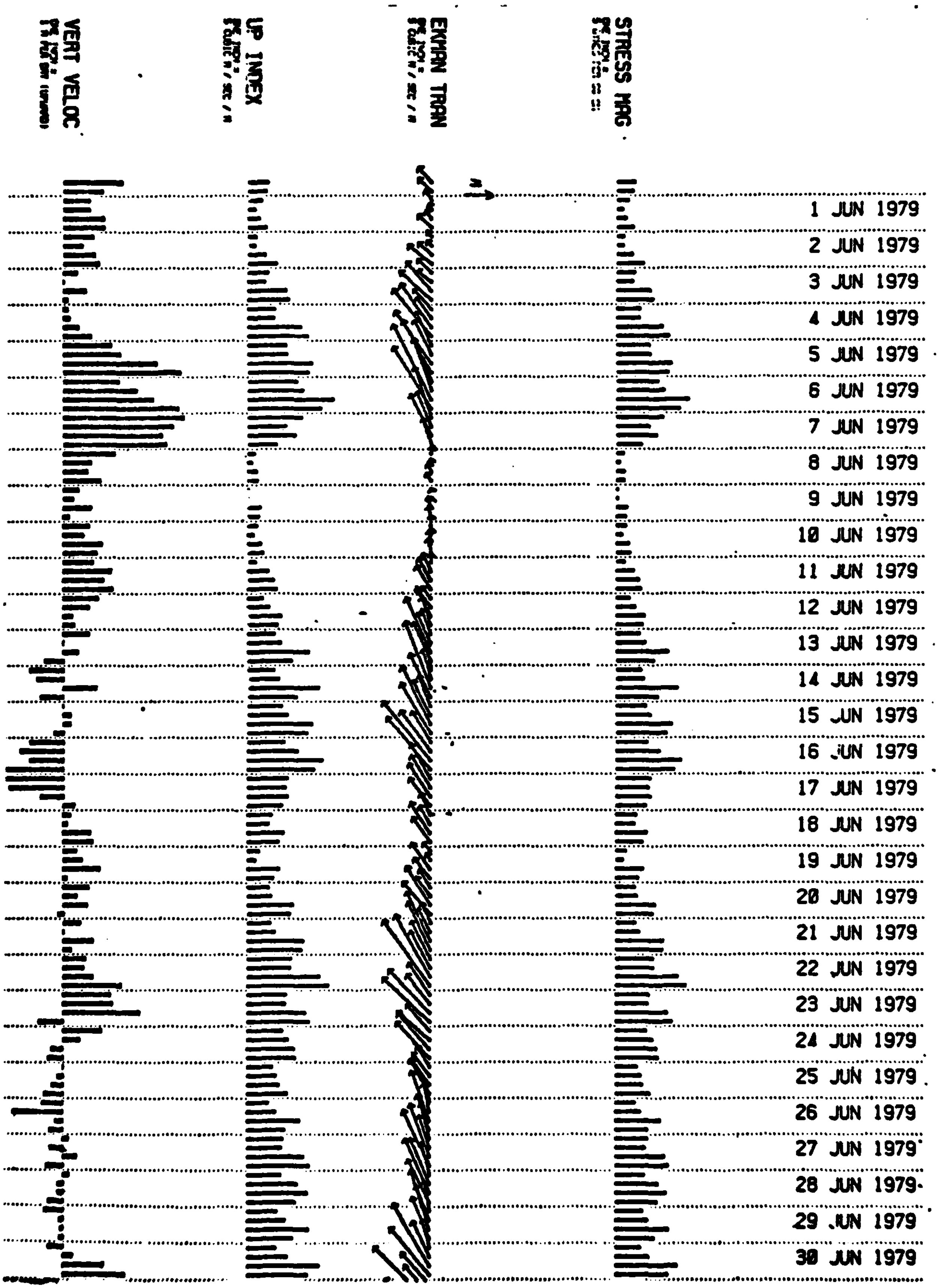

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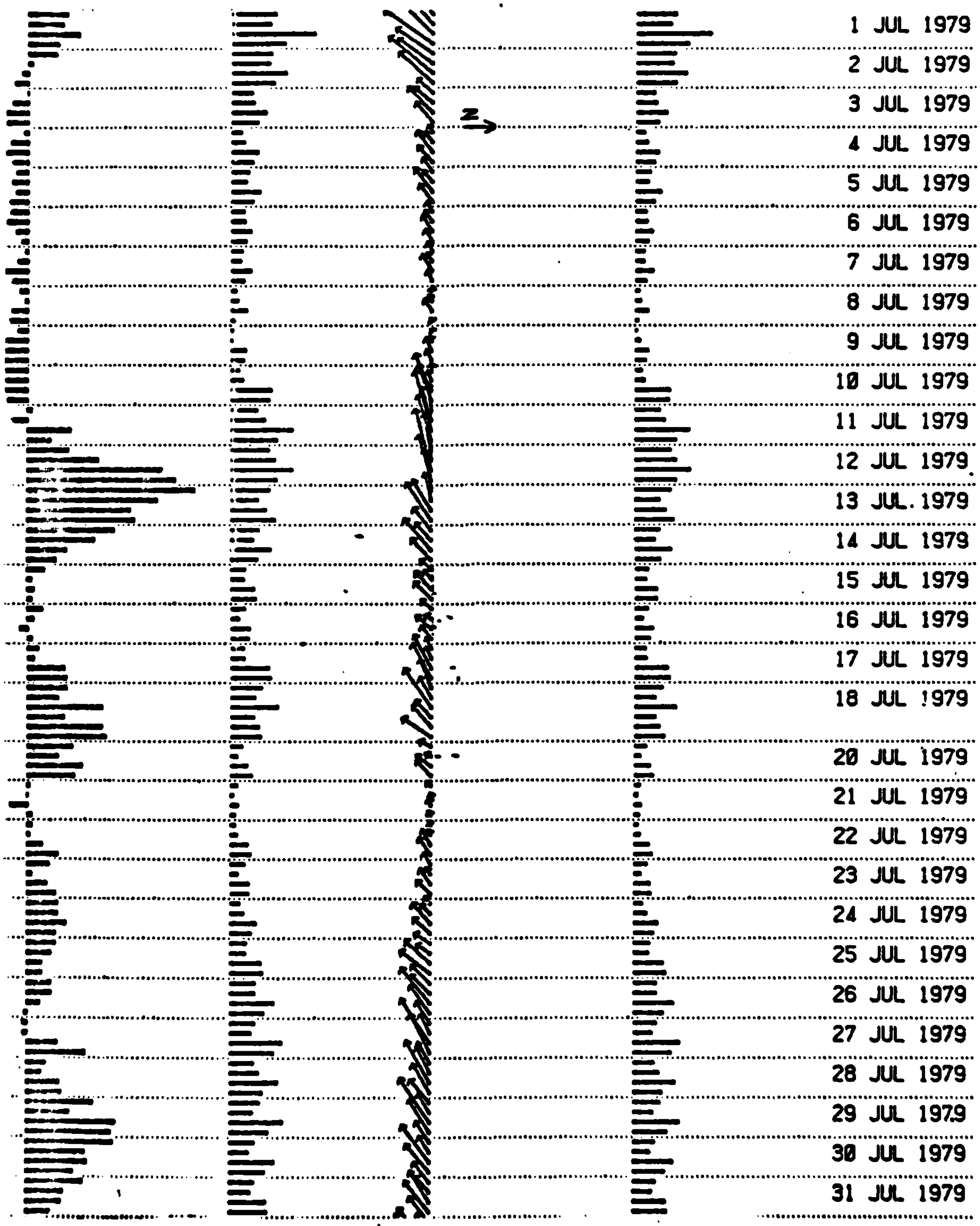
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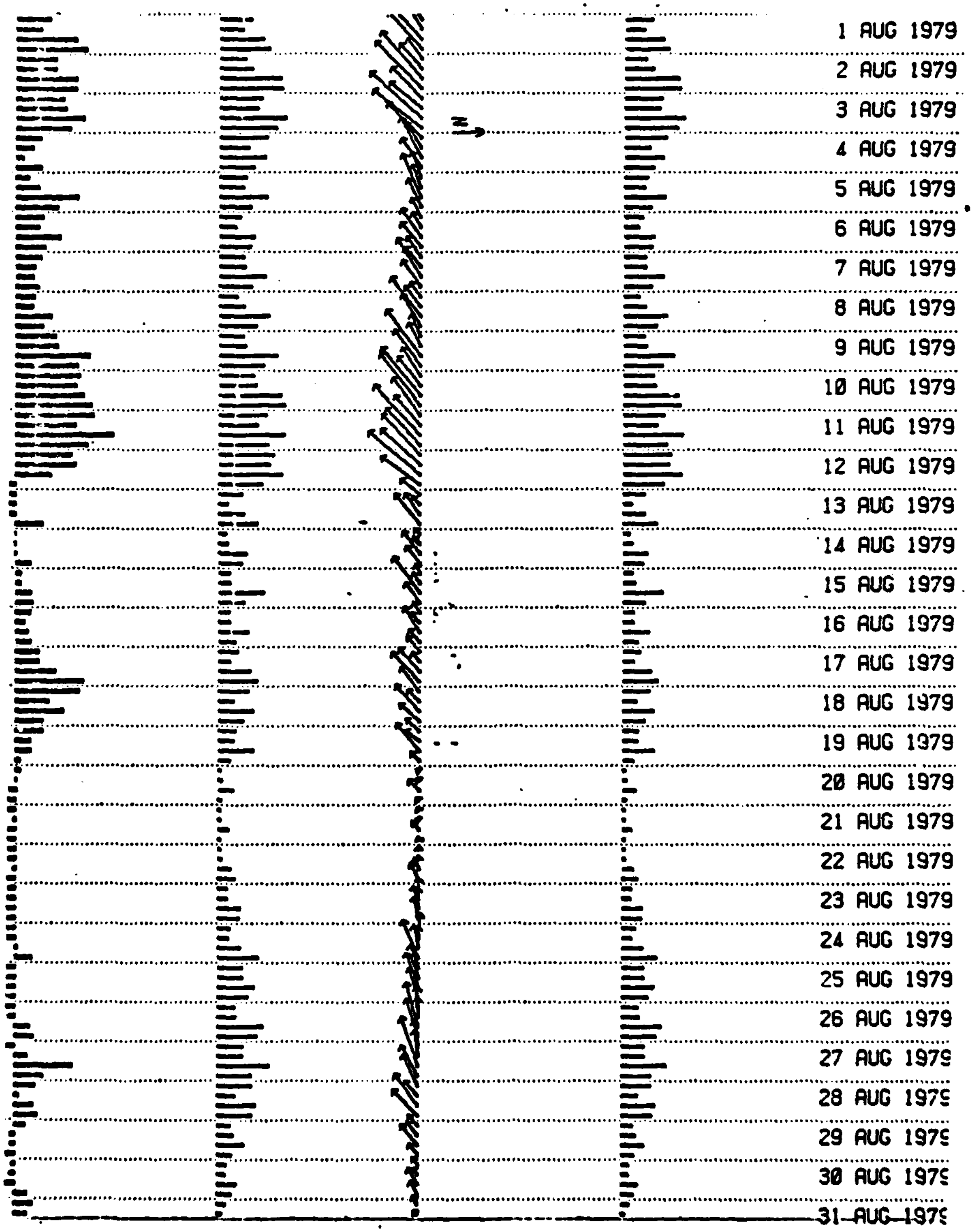

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