1. INTRODUCTION[1]

Shipboard Scientific Party[2]

PROLOGUE

Leg 138 of the Ocean Drilling Program left Balboa, Panama, 5 May 1991, with 31 scientists representing nine countries, including scientists from the U.S.S.R. on their first cruise as new members of the Ocean Drilling Program. The original plan developed for Leg 138 called for drilling nine sites along two north-south transects that were centered at 95°W and 110°W. To assure the recovery of a complete section with the advanced hydraulic piston (APC) coring system, all sites along the 95°W transect were to be double-cored, and sites along the 110°W transect were to be triple-APC-cored. Because of the efficiency of the ship's drilling crew and the favorable weather conditions during Leg 138, a total of 11 sites were drilled; all except three were triple-APC-cored. In addition, two sites (849 and 851) were double-XCB-cored in the section beyond the APC system. More than 5538 m of sediment was recovered, setting a new DSDP/ODP record for core recovery.

As with all ODP cruises designed to examine high-resolution paleoceanographic problems, the main objectives of Leg 138 (outlined in this chapter), for the most part, will be addressed by the detailed post-cruise studies necessary for assessing the wealth of paleoceanographic data found in the recovered cores. Leg 138 differed from previous paleoceanographic legs, however, in that a concerted effort went into the development of a shipboard program designed (1) to monitor, in near real-time, core-to-core continuity and thus ensure the recovery of as complete a section as possible; and (2) to provide a shipboard high-resolution stratigraphic framework. Both objectives were achieved beyond our expectations.

The process of documenting the recovery of the sediment section at each site is given in the "Composite Depth" sections of each site chapter (this volume). Here, we describe the use of three independent data sets (GRAPE density, magnetic susceptibility, and color reflectance), collected continuously for essentially every core recovered during the leg, to construct a composite sedimentary section that was based on the overlapping APC and XCB sections recovered at each site.

In Chapter 6 (this volume), we describe the process of integrating biostratigraphic and paleomagnetic stratigraphies with composite records of sediment density to construct a detailed stratigraphic framework. Compared with other legs designed for paleoceanographic studies within the tropical ocean, we increased our resolution of sedimentation rates by almost a factor of 10. This stratigraphic framework (combined with detailed composite sections) forms the essential foundation for future high-resolution paleoceanographic studies of Leg 138 material. A brief summary of the execution of our research plan and some highlights of the results are presented in Chapter 20 (this volume).

INTRODUCTION

With the transition from the Deep Sea Drilling Project (DSDP) to the Ocean Drilling Program (ODP) came a change in the nature of scientific ocean drilling. As drilling technology, analytical techniques, and mathematical and conceptual models evolved, the regional and reconnaissance-oriented drilling of DSDP gave way to the global, problem-oriented drilling of ODP. Through input from its advisory panels and international workshops, ODP has defined and prioritized a series of key scientific questions to be addressed by ocean drilling; for each of these, a series of globally distributed drilling targets has been chosen.

Foremost among the high-priority issues identified by ODP has been the question of the evolution of changes in global climate during the late Cenozoic. A global experiment aimed at producing high-resolution paleoclimatic records from tropical oceans around the world was designed to address this question. Leg 138 is the fifth ODP expedition in this experiment. During previous legs, scientists sampled the equatorial Atlantic Ocean (Leg 108), the Peru Current (Leg 112), the western tropical Indian Ocean (Leg 117), and the western equatorial Pacific Ocean (Leg 130). Building on the experience gained during these earlier cruises, the Leg 138 scientific program was carefully designed to maximize the chances of recovering complete, high-resolution paleoclimatic records of the eastern equatorial Pacific Ocean. In this chapter, we look briefly at previous work in this area, discuss the general tectonic and oceanographic setting of Leg 138, and present the scientific goals and objectives of the leg; site-specific discussions can be found in individual site chapters.

Scientific Background

The most continuous record of the history of ocean chemistry (and thus climate) is preserved through a number of proxies in the deep-sea sediments that are most sensitive to changes in oceanic conditions, namely, the biogenous material found in areas of high productivity that are far removed from direct continental influence. The sedimentary record that has accumulated beneath the divergence-driven upwelling system of the eastern equatorial Pacific Ocean, a region shown to be responsible for as much as 50% of the global "new" production (Chavez and Barber, 1987), has long been recognized for its importance in paleoceanographic studies and thus has been the subject of numerous previous DSDP and piston coring expeditions.

Beginning with the pioneering work of the Swedish Deep Sea Expedition and the development of the piston corer (Kullenberg, 1947), it became apparent that the sediments of the equatorial Pacific Ocean contained a record of paleoclimatic cycles. Studies of these and other piston cores led to formulation of the concepts of the lysocline and the calcite compensation depth (CCD) and to an understanding of their paleoceanographic implications (Arrhenius, 1952; Bramlette, 1961; Peterson, 1966; Berger, 1971). As these concepts developed, so did the resolution and precision of equatorial Pacific Ocean stratigraphy, aided significantly by calibration to the paleomagnetic time scale (e.g., Hays et al., 1969) and the development of stable isotope stratigraphies (e.g., Shackleton and Opdyke, 1973). Concomitant with this expansion of our knowledge of equatorial Pacific Ocean sedimentation was the development of the ideas of seafloor spreading and plate tectonics, which provided a unifying framework within which to place paleoceanographic studies.

Early DSDP legs (5, 8, 9, and 16) extended our general understanding of equatorial Pacific Ocean sedimentation processes, demonstrating that the sediments in this region record the interplay among tectonism, climate, oceanic circulation, and biological productivity. From this evolved the concept of "plate stratigraphy" (Berger, 1973; Winterer, 1973; Berger and Winterer, 1974), which explains the first-order features of the distribution of Cenozoic sediments in the

[1] Mayer, L., Pisias, N., Janecek, T., et al., 1992. *Proc. ODP, Init. Repts.,* 138: College Station, TX (Ocean Drilling Program).
[2] Shipboard Scientific Party is as given in list of participants preceding the contents.

equatorial Pacific Ocean as the result of their northwestward migration and passage through the high-productivity equatorial divergence zone. These early drilling results were synthesized by van Andel et al. (1975), who clearly demonstrated the rich paleoceanographic potential of the equatorial Pacific Ocean, a potential constrained only by the discontinuous nature of early DSDP coring technology.

While these early DSDP expeditions served to establish the overall sedimentological framework of the central equatorial Pacific Ocean, it was not until the development of the hydraulic piston corer (HPC) that the dream of extending high-resolution paleoceanographic studies beyond the reach of standard piston cores became a reality. Three later DSDP legs took the HPC to the equatorial Pacific (68, 69, and 85). While during Legs 68 and 69, shipboard scientific parties each drilled only a single test HPC site in the equatorial Pacific, during Leg 85, scientists drilled a north-south transect of HPC sites (573, 574, and 575) at about 136°W and a single site at about 112°W. These cruises documented major changes in the accumulation and distribution of biogenic sediment, reflecting both changes in the production of biogenic constituents as well as important changes in the dissolution and regeneration of these components. These changes can be linked to major reorganizations of the oceanic circulation system that, in turn, can be tied to major climatic and tectonic events that occurred over the past 40 m. y. (Mayer, Theyer, et al., 1985; Mayer et al., 1986; Theyer et al., 1989).

As multivariate studies of the DSDP hydraulic piston cores began to reveal the nature of the complex oceanic, tectonic, and atmospheric interactions at these times of major oceanographic upheaval, we found ourselves frustrated with our inability to resolve in these DSDP cores the oceanic response at time scales nearer those of modern oceanographic and climatic processes. Most of the previous DSDP/HPC cores from the equatorial Pacific Ocean are from relatively deep regions where low accumulation rates and severe carbonate dissolution have resulted in a record punctuated by hiatuses (Mayer, Theyer, et al., 1985). In addition, detailed studies revealed that HPC cores often miss a small amount of the section between successive cores and thus cannot, unless carefully duplicated and offset, produce a continuous section (Ruddiman et al., 1984).

Armed with this knowledge, with advanced coring technology, with an array of real-time core property sensors, as well as new and more sophisticated models and analytical techniques, we embarked on Leg 138 in an attempt to recover continuous high-resolution sections that will allow us to address the question of oceanic variability at time scales of thousands of years. The scientific goals of Leg 138 represent a significant step beyond the framework of large-scale, long-term geologic change.

Regional Setting

Oceanographic Setting

The general distribution of surface currents in the eastern equatorial Pacific Ocean is illustrated in Figure 1. To a large extent, this circulation pattern reflects the tropical atmospheric circulation and the effects of the change in the sign of the Coriolis force across the equator. A fundamental feature of this circulation pattern is the asymmetry of surface currents north and south of the equator. This asymmetry reflects the general position of the Intertropical Convergence Zone (ITCZ), which marks the convergence between the northeast and southeast trade winds. In the present-day climate system, the position of the ITCZ is essentially always north of the equator in the eastern equatorial Pacific Ocean. This northerly position combined with the change in sign of the Coriolis force at the equator result in the classical picture of surface convergence and divergence (Fig. 2). Along the equator, divergence results in a depression of the topography and a pressure gradient that is balanced by geostrophic flow to the west, both north and south of the equator. This flow is the South Equatorial Current (SEC). Both the Peru Current, which transports colder waters from high latitudes into the equatorial current system, and the eastward-flowing subsurface Equatorial Undercurrent provide source waters for the SEC.

Seasonal variations in the equatorial current system reflect the seasonal movement of the ITCZ and the seasonal change in the strength of the trade-wind systems. The strength of the SEC reflects changes in the strength of the Southern Hemisphere trade winds. Wyrtki (1965) described three patterns of circulation that reflect the movement of the ITCZ. During August to December, the ITCZ is in its most northerly position, at about 10°N; the southeast trade winds are at their strongest; the SEC is at its strongest, and the North Equatorial Countercurrent (NECC) is fully developed. As the NECC flows eastward, it turns in a cyclonic cell around the feature known as the Costa Rica Dome and is a major contributor of water flowing into the North Equatorial Current (NEC) south of 20°N. The California Current turns away from the American coast at about 25°N and contributes water only to the NEC north of about 20°N. This circulation pattern may be the most stable pattern associated with a northerly position of the ITCZ.

During February to April, the ITCZ is at its most southerly position, the southeast trade winds are weakened, and the northeast trade winds are strongest. During this period, the NECC does not develop because of the increased intensity and southerly position of the ITCZ. The SEC is much weakened because of the decrease in the southeast trade winds. The California Current, strengthened during this interval, penetrates to about 3°N and is the major contributor of waters in the NEC. Within the Panama Basin and the Gulf of Tehuantepec, two large gyres form. A cyclonic gyre flows around the region of the Costa Rica Dome (at about 8°N, 86°W), and an anticyclonic gyre in the Panama Basin is centered at about 5°N and 88°W.

During May to July, the ITCZ returns to its northerly position. During this interval, however, the California Current is strong as the NECC begins to develop and strengthen. Unlike the period from August to December, the NECC turns northward and contributes waters to the Costa Rica Coastal Current, which flows along the Central American coast. This pattern, according to Wyrtki (1965), is less stable than the first pattern mentioned.

The asymmetry found in the distribution of surface currents in the equatorial Pacific Ocean is also seen in the response of these currents to large-scale climate events. Observations of changes in sea level across the equator during El Niño events clearly demonstrate that while El Niño along the equator is characterized by a weakening of the surface circulation, off the equator in the NECC and NEC, El Niño is associated with a marked increase in circulation (Wyrtki, 1974). Empirical orthogonal function analysis of sea-level records from the central and eastern equatorial Pacific Ocean further confirms the asymmetry of the equatorial circulation (Baumgartner and Christensen, 1985). Baumgartner and Christensen (1985) suggested that equatorial circulation can be viewed as two closed cells: the circulation made up of the South Pacific gyre, including the SEC and Peru Current, and the cell that includes the NEC and NECC systems. Change in the strength of divergence along the equator and between the NEC and NECC are seen in the out-of-phase response of organic carbon production and flux to the deep sea, as observed in sediment-trap experiments (Pisias et al., 1986; Dymond and Collier, 1988).

Tectonic Setting

An understanding of the tectonic setting of Leg 138 sites is required to place each site into its geographic and oceanographic settings during the Neogene. Sites drilled during Leg 138 are located on three lithospheric plates of the eastern Pacific: the Cocos, Nazca, and Pacific plates.

The sites of the western transect (Sites 848 through 854) presently are on the Pacific Plate. Sites 848, 849, 850, 851, 853, and 854 are thought to have formed at the present East Pacific Rise, while Site

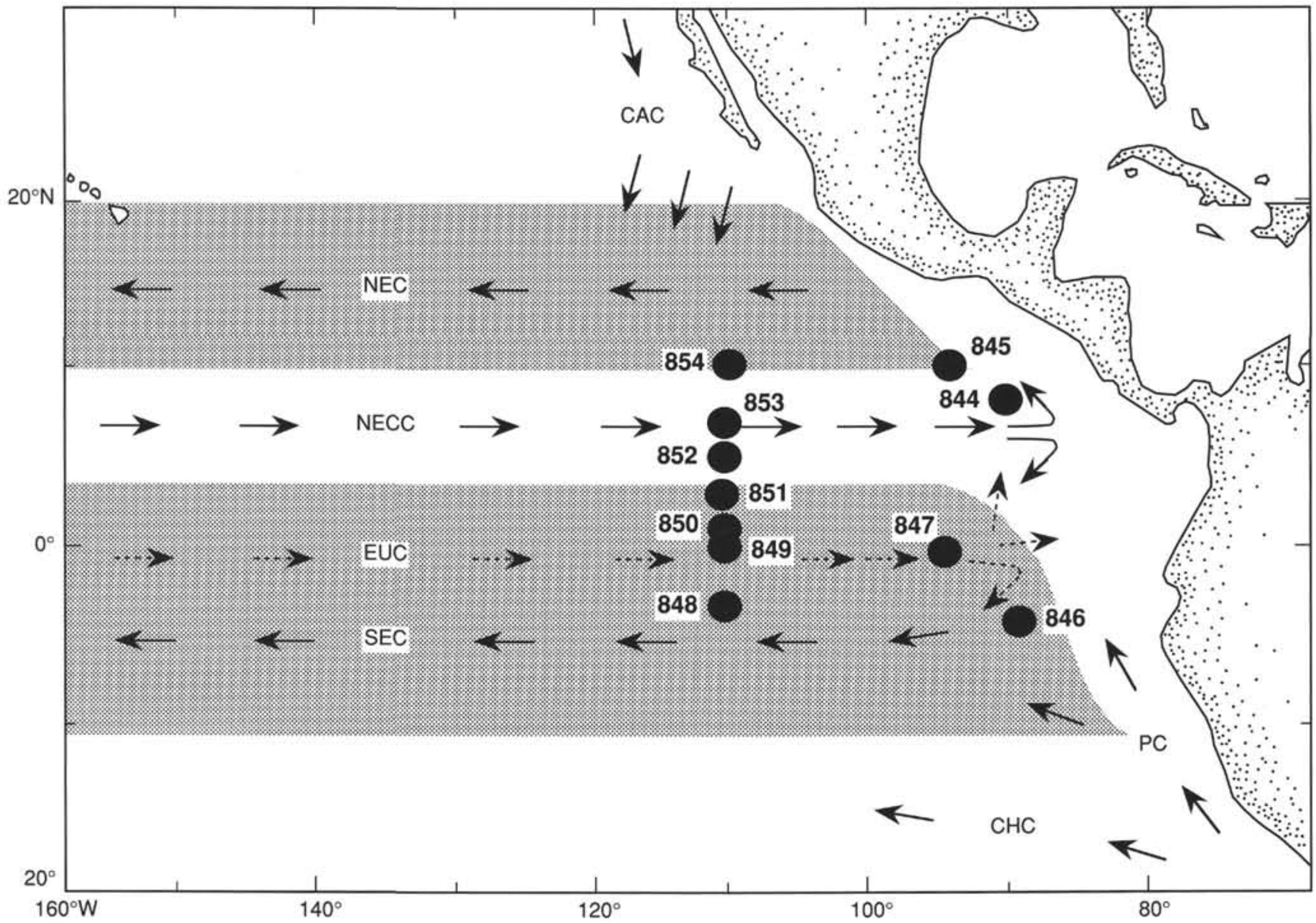

Figure 1. Generalized circulation system of the eastern equatorial Pacific. Surface current = solid arrows, subsurface current = dashed arrows: CAC = California Current; NEC = North Equatorial Current; NECC = North Equatorial Countercurrent; EUC = Equatorial Undercurrent; SEC = South Equatorial Current; PC = Peru Current; and CHC = Chile Current. Shaded areas illustrate general latitudinal extent of SEC and NEC.

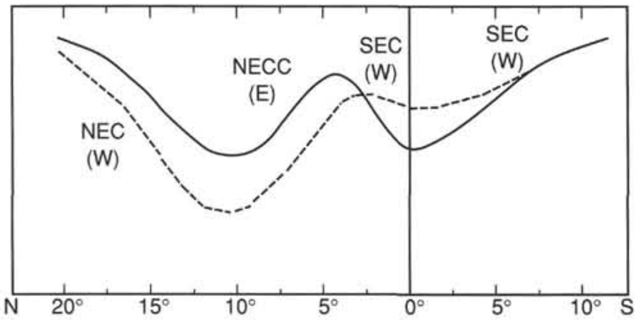

Figure 2. Schematic section of dynamic topography of the sea surface from 20°N to 10°S in the central Pacific, showing location of convergences (ridges) and divergences (troughs) in relation to current systems and the direction of flow (east–west). Solid line indicates topographic configuration during weakened eastward flow in the NECC and strong westward flow in the SEC (anti-El Niño conditions). Dashed line shows topography associated with strengthened eastward flow in the NECC and weakened westward flow in the SEC (El Niño conditions). Modified from Baumgartner and Christensen (1985).

852 is near a proposed fossil spreading center that became inactive from 10 to 11 Ma (Mammerickx and Klitgord, 1982; van Andel et al., 1975). Backtracking of all sites in the western transect (Fig. 3) is constrained by the hot-spot reference frame for the Pacific Plate, at least for the last 10 to 11 m.y.

The sites in the eastern transect are located on two oceanic plates. Sites 844 and 845 are on the Cocos Plate, while Sites 846 and 847 are located on the Nazca Plate. Site 846 is situated on crust formed at the Galapagos Spreading Center and is located on the southern limb of the Carnegie Ridge. Site 847 is located near the boundary between crust formed along the Galapagos Spreading Center that separates the Nazca and Cocos plates and the East Pacific Rise, which marks the boundary between the Nazca and Pacific plates. The absolute backtrack of these sites is constrained both by the Pacific-Nazca Plate poles of rotation (which can be referenced to the Pacific absolute pole based on the Hawaiian and other Pacific trends) and also by the Galapagos hot-spot trace reflected in the Carnegie Ridge. The resulting backtrack paths of these sites suggest that they have been near their present latitudinal position for their entire history. Thus, these sites provide important reference sections for equatorial circulation history.

The sites on the Cocos Plate (844 and 845) have the least-understood backtrack paths (see van Andel et al., 1975). The position of Site 844 suggests that it formed on the East Pacific Rise, while its basement age (see "Site 844" chapter, this volume) is consistent with the tectonic reconstruction of Hey et al. (1977). The site can be backtracked on the basis of the relative motion between the Cocos and Pacific plates. This rotation seems to have been stable for at least the last 12 m.y. (Mammerickx and Klitgord, 1982).

Site 845 is located in a region where magnetic anomalies can be mapped (showing a lineated pattern trending northwest/southeast), but cannot be correlated to the marine magnetic anomaly sequence (Mammerickx and Klitgord, 1982). The trend of these anomalies is more westward than those produced at the East Pacific Rise. Site 845 is located just east of the Berlanga Rise, which has been interpreted as a fossil spreading center. Both assuming a constant spreading from the present East Pacific Rise (taken at 71 mm/yr; Hey et al., 1977) or using subsidence estimates based on present basement depth and assuming a depth of the ridge crest at 2700 m produce similar estimates of basement age of about 15 Ma for this site. Drilling at Site 845 provided a test of this hypothesis and will shed light on the age of this part of the Cocos Plate.

Goals

While public awareness of the critical role of the ocean in problems of global change has been a relatively recent phenomenon, the paleoceanographic community has long been cognizant of its importance. Over the last 10 yr, paleoceanographers have directed much effort to documenting the nature of oceanographic change on time scales of a few thousands to a few tens of thousands of years—time scales much closer to the mixing and residence times of many important components of the ocean climate system. Unfortunately, these efforts have been limited to a select number of high-quality standard piston cores and thus have focused on only the last few glacial cycles. The fundamental goal of Leg 138 will be to attempt to apply this high-resolution approach to paleoclimatic studies of the long time series recoverable only with ocean drilling. In doing so, we hope to extend greatly our understanding of the history of Cenozoic sedimentation, paleoceanography, and climate.

Scientific Objectives

The primary objective of the Leg 138 transects will be to provide information about the response to changes in global climate during the Neogene. The evolution of Earth's climate during this interval was marked by a number of global and local events. During the early Neogene, open circulation between the tropical Pacific and Atlantic oceans was possible through the Panamanian seaway. How this interocean exchange affected oceanic circulation in the eastern Pacific

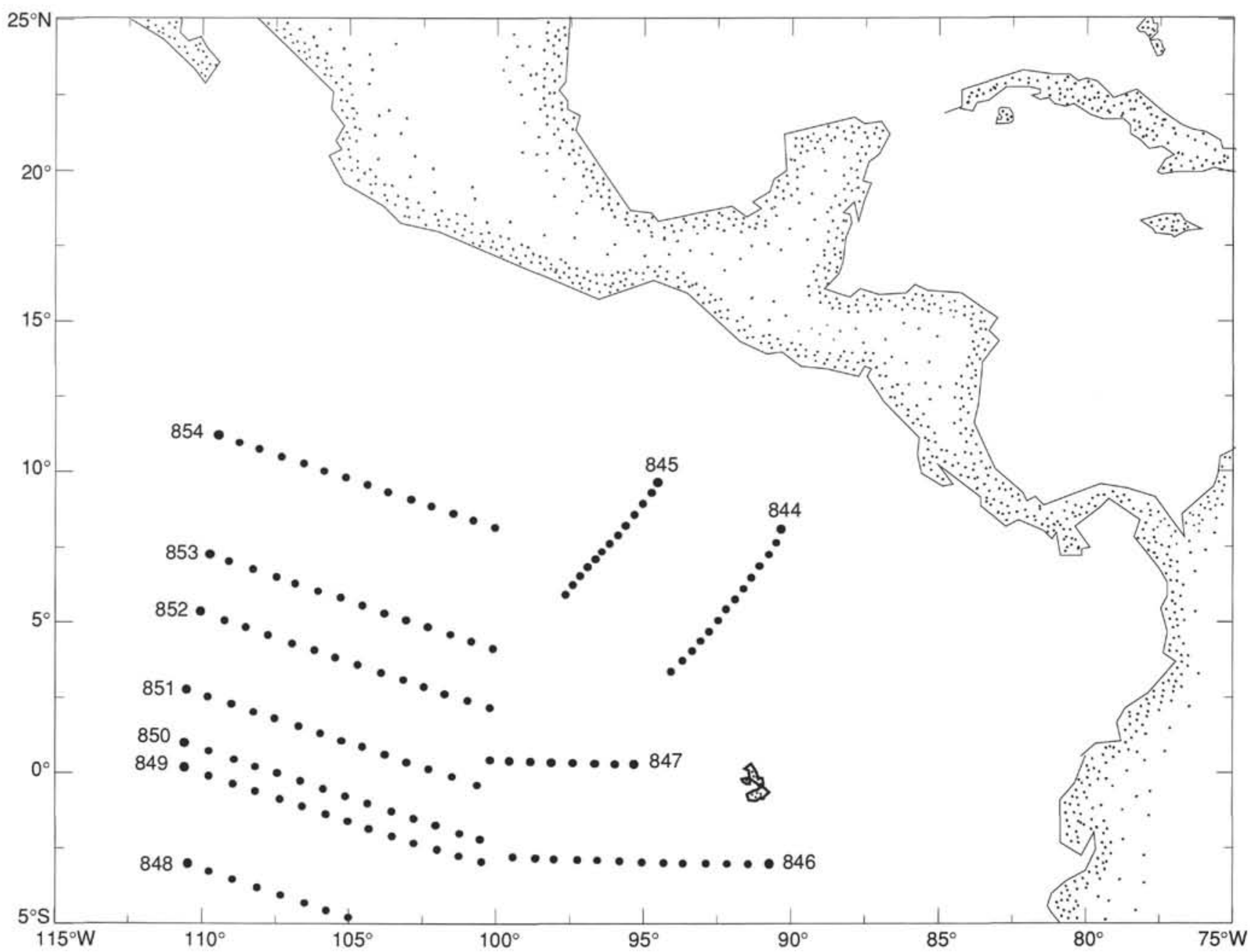

Figure 3. Backtrack paths for Leg 138 sites, in 1-m.y. increments. Data from van Andel et al. (1975) and Duncan and Clague (1985).

Ocean is not well known. Recent numerical modeling results indicate little oceanic response in the Pacific Ocean to this tectonic event (Maier-Reimer et al., 1990), but the model does not include coupled atmospheric circulation. Studies of regional sedimentation rates of the equatorial Pacific Ocean demonstrated significant redistribution of sediment accumulation rates during the latest Miocene and early Pliocene and suggest a marked change in oceanic production (Pisias and Prell, 1985a, 1985b; van Andel et al., 1975). However, how this change in sedimentation is related to changing ocean circulation as yet is undefined. The drilling transects of Leg 138 will provide the necessary paleoceanographic observations that combined with more sophisticated modeling efforts should produce significant new insights into this paleoceanographic question.

During the Pliocene, significant increases in Northern Hemisphere glaciations occurred. Isotopic evidence indicates that at 2.4 Ma, the first major advance of Northern Hemisphere glaciers occurred (Shackleton et al., 1984). This event in the Northern Hemisphere should have had a profound effect on the symmetry of Earth's thermal gradient, which would be reflected in atmospheric circulation patterns (Flohn, 1981).

Atmospheric circulation is an important aspect of global climate. Yet, because direct evidence for changes in zonal wind strength is rarely preserved in sedimentary deposits, past variations in zonal wind intensity have been poorly understood. Temporal changes in the intensity of atmospheric circulation are reflected in the size distribution of small eolian particles transported in equilibrium with the winds. Eolian particles isolated from pelagic sediments recovered during drilling of Leg 138 provide us with an opportunity to investigate the nature and variability of late Neogene atmospheric circulation intensity in both the Northern and Southern hemispheres. Comparing these records will enable us to better understand the response and development of hemispheric asymmetry in atmospheric circulation intensity as Earth evolved from unipolar to bipolar glaciation.

Specific paleoceanographic questions to be addressed include the following:

1. How did Pacific equatorial circulation evolve through the late Cenozoic as a response to increased global glaciation?
2. Are oceanographic changes hemispherically symmetrical or asymmetrical?
3. What was the nature of the circulation system during the late Miocene when open communication with the Atlantic occurred through the Panamanian seaway?
4. What was the nature of oceanographic variability during the late Miocene and Pliocene and how does this compare to the Pleistocene (i.e., do the changing boundary conditions modify the sensitivity of the system)?
5. What was the nature of circulation during the Pliocene after the closure of Panama but before the onset of Pleistocene glaciation in the Northern Hemisphere?
6. How do oceanographic changes affect productivity in the equatorial Pacific surface waters?
7. How are paleoceanographic changes expressed in the physical, acoustic, and color properties of the sediment? Can the high-resolution seismic record be a useful paleoceanographic tool?

The answers to these questions will provide important clues needed to understand the cause and nature of oceanographic and climatic variability. The last million years of Earth's history are characterized by large changes in Northern Hemisphere ice cover. These changes have been linked to changes in solar radiation—the Milankovitch Hypothesis. The identification of the response of the oceans and atmosphere is complicated by the presence of both large ice-volume changes and changing external (insolation) forcing. Examination of the ocean system at times before major Northern Hemisphere ice sheets (Question 5) provides the means of determining the effects of external forcing and changes in boundary conditions resulting from changes in ice volume. Comparison of the variability and nature of oceanographic conditions during the late Miocene and Pliocene (Question 4) provides information about the sensitivity of the climate system to changes in major oceanic boundary conditions.

Studying the tropical climate systems in the Pacific, Indian, and Atlantic oceans will be critical to understanding of changes in global climate. The Leg 138 equatorial Pacific transects provide an important late Cenozoic complement to transects drilled in the equatorial Atlantic, western equatorial Pacific, and the Indian Ocean monsoon region. Samples from the Pacific transects will ensure that one can compare these four tropical areas.

Other Scientific Objectives

Although high-resolution paleoceanographic studies were the primary objective of Leg 138, several important scientific questions have been addressed by paleomagnetic, geochemical, and physical properties of the drilled sections. The overall objectives of these studies have been outlined here (this chapter). Specific results of each site are provided as summaries in individual site chapters (this volume).

Paleomagnetic Studies

Paleomagnetic studies of Leg 138 sediments have three primary objectives. Our first objective is to provide magnetostratigraphic age control for cored Neogene sedimentary sequences. In particular, the Miocene interval lacks well-calibrated biostratigraphic datums, and thus an accurate, detailed geochronology can be achieved only with paleomagnetic age control. Although much scientific effort has been directed at establishing high-quality magnetostratigraphic records from deep-sea sediments, no continuous Miocene record from a low-latitude environment currently exists. The absence of such a record may be partly explained by difficulty in retrieving complete sections that show both good paleomagnetic behavior and good microfossil preservation (particularly in calcareous groups). This task is further complicated because the Miocene is a period of high reversal frequency, which makes identifying polarity zones particularly problematic, especially in regions having low sedimentation rates.

Our second objective is to examine the geomagnetic field in the Pliocene and Pleistocene record. These studies require high-resolution sequences with stable remanence and sedimentation rates that exceed 10 m/m.y. Sediments that meet these criteria will be sampled for studying (1) variations in the intensity of the geomagnetic field, (2) behavior of the field during polarity reversals, (3) average properties of the paleomagnetic field during times of stable polarity, and (4) the record of excursions and subchrons during the Pliocene and Pleistocene and characteristics of these features in the eastern equatorial Pacific Ocean.

And for our last paleomagnetic objective, we will examine rock magnetic properties of the sediments in association with sedimentologic, geochemical, and paleoenvironmental studies to assess factors that control the susceptibility, remanence intensity, and magnetic stability of these sediments.

Geochemical Studies

Investigation of geochemical parameters in the sediments recovered during Leg 138 include (1) inorganic chemistry of interstitial waters, (2) evolution of thermogenic gases, (3) distribution of calcium carbonate, and (4) character and isotopic composition of organic carbon. These studies focus on the geochemical fabric of the sedimentary record, established by variations in the biogeochemical flux of material to the sediment. The influence of diagenetic and metamorphic processes in the sediment column as well as diffusive overprinting driven by the alteration of basement rocks also will be examined.

Four main objectives are associated with the analysis of interstitial waters from Leg 138: (1) to establish the diagenetic state of the sedimentary section; (2) to determine the extent of recrystallization at these sites and the parameters controlling this process; (3) to examine the effects of basalt alteration on the overlying sediment column; and (4) to identify off-axis convection cells within the top layer of altered crust.

Geochemical studies of the carbonaceous fraction of the sediments will establish the mass accumulation of calcium carbonate and the nature of organic carbon deposited through time. These studies make it possible (1) to reconstruct accumulation rates of biogenic sedimentary components since the middle Miocene; (2) to break down the organic carbon fraction into contributions from production in the water column and detrital influx from terrestrial sources; and (3) to establish oceanic paleotemperatures based on alkenone unsaturation indexes to clarify the pattern of sea-surface temperatures during the Neogene.

Measurements of gases will allow us (1) to study the degree of fractionation accompanying the consumption of organic matter during diagenesis; (2) to examine the effects of varying sediment thickness and proximity of the basement on gas evolution; and (3) to identify a threshold for generation of thermogenic gas.

Drilling Strategy

The sedimentary response to equatorial Pacific circulation is illustrated in Figures 4 and 5. On longer geologic time scales, the combination of the northward motion of the Pacific Plate and enhanced surface production has resulted in the "equatorial bulge" of biogenic sediments (Fig. 4). On shorter time scales, sediment accumulation indicates marked gradients in response to surface divergence. In Figure 5, the mass accumulation of organic carbon (Isern, 1991) has been plotted vs. latitude. Near the equator, the flux of carbon exhibits a sharp gradient, as expected from the marked gradient in surface ocean processes within the equatorial region (Chavez and Barber, 1987; Isern, 1991).

Thus, to examine the sedimentary history of this region, two north-south transects were drilled across the Equatorial Current system. The western transect (six sites centered at about 110°W) crosses the Equatorial Pacific Current system where it has been fully developed and removed from influences of eastern boundary currents. As such, the transect represents the easternmost (and highest productivity) end-member of an oceanwide study of equatorial sedimentation (Legs 85 and 130). This north-south transect will add a new dimension to the study of this current system and permits a detailed look at the development of the Equatorial Current system in response to changes in global climate. The western sites also are sufficiently removed from sources of fluvial continental sediments that the mineral fraction within the sediments should represent only eolian depositional processes. Thus, these sites provide not only an important record of oceanographic processes, but also direct records of atmospheric circulation, which is the dominant factor controlling surface ocean circulation of this region.

The eastern transect (four sites centered around 95°W) was designed to look at the interaction of the Equatorial Current system with the Peru Current and the eastern boundary of the Pacific Ocean. In addition, the sedimentary environment along the eastern transect represents an important end-member of pelagic sedimentation within the region. Of particular interest is the continuity of the seismic sequences identified in the central and western Pacific Ocean into this region of more siliceous and terrigenous clay sedimentation. Many of the chemical/physical relationships defined for sediments in the central and western Pacific can be tested further and refined from results of eastern transect studies. These relationships are essential for

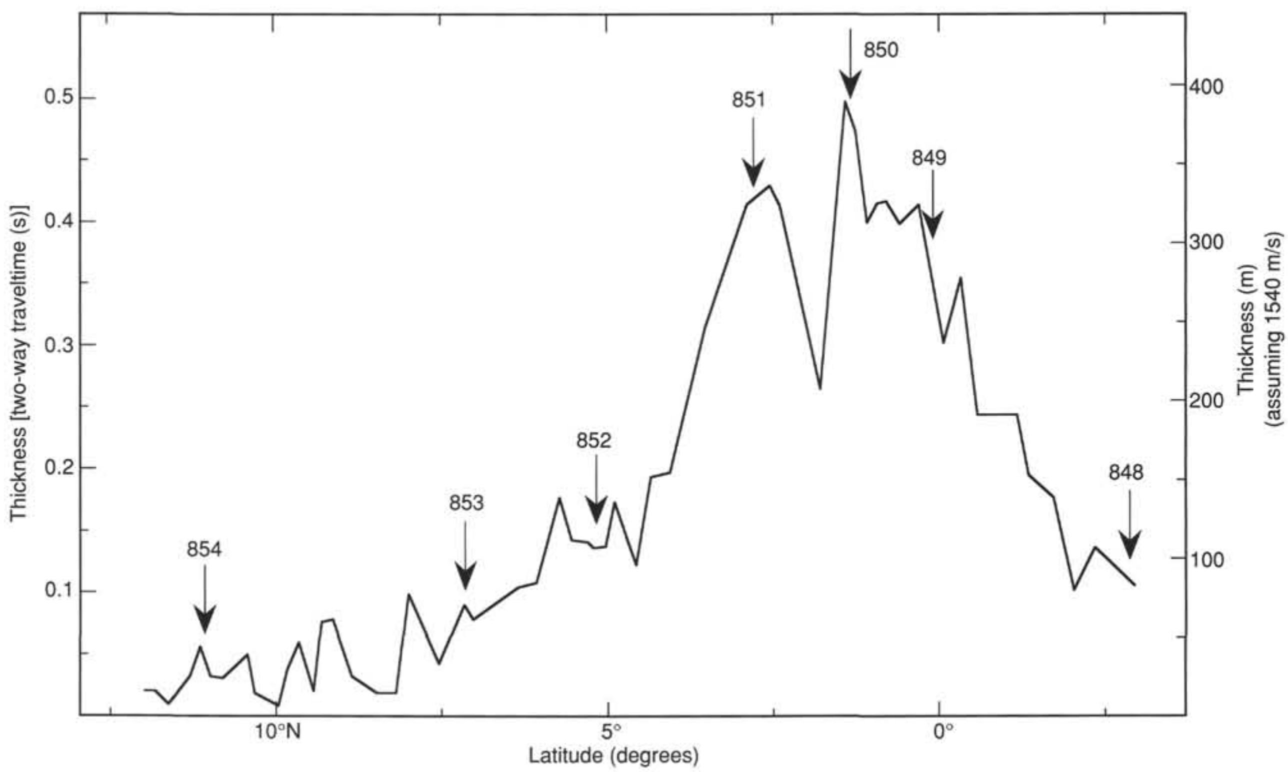

Figure 4. Sediment thickness along the 110°W transect, based on seismic records collected during the Venture 1 cruise of the *Thomas Washington* in September 1989. Approximate location of Leg 138 drill sites from the western transect are shown for reference.

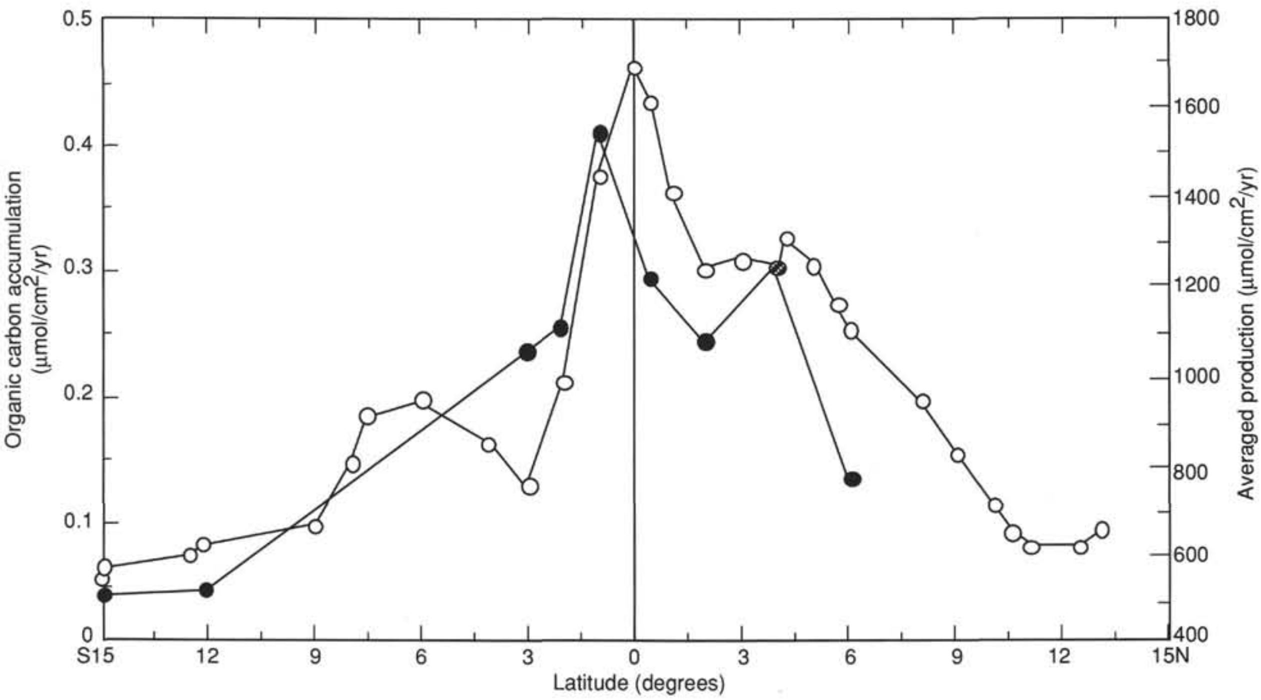

Figure 5. Mass accumulation rates of organic carbon in surface sediments along a north–south transect at 133°W in the central Pacific (solid circles) and averaged surface water production (open circles). Note overall increase in production and organic carbon burial across the equatorial region and the sharp increase directly associated with the on-equator divergence and small increase at the secondary divergence north of the equator (from Isern, 1991).

interpreting seismic data sets, which then can be used to map large-scale sediment distributions in the Pacific.

DATA ON CD-ROM

Many of the data collected during Leg 138 and referenced in this volume are contained on a CD-ROM. A list of these data are found in Part 1, page xv and in Part 2, page iv.

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