Figure No. 1 and 3—Multicolored zeolitic silty clay of early Tertiary—late Cretaceous (?) age. Variations in the amount of iron-manganese oxide minerals locally exhibiting geothite structure are responsible for the various color bands. The dominant clay mineral is montmorillonite, and silt-sized sphalerite and palagonite grains are common throughout this zone. Zeolites, principally clinoptilolite, heulandite and phillipsite occur sporadically. This multicolored sediment appears to correlate with the inferred position of the seismic horizon "A" and of an apparent hiatus between Middle Tertiary and Middle Cretaceous. (fig. 1: Hole 105, Core 9, 75-100 cm below the top of Section 2; fig. 3: Hole 105, Core 9, 100-125 cm below the top of Section 2. Lower Continental Rise Hills southeast of New York, 34°53.72'N, 69°10.40'W, 5245 m).

Figure No. 2—Aptychi (Ammonoidea) from the late Jurassic (Oxfordian) red clayey limestone. (Upper specimen, Hole 105, Core 37, 34-36 cm from the top of Section 2. Lower specimen, Hole 105, Core 33, 86-88 cm from the top of Section 2).

Figure No. 4—Small fault in laminated Neocomian limestone. This lithologic unit extends from Core 17 to Core 32 (early Cretaceous to late Jurassic) and is characterized by recrystallized nannoplankton calcite and a paucity of clay minerals and plant debris. Flow and slump structures, common in the lower portion of the section, decrease toward the abrupt lithologic contact with overlying early to middle Cretaceous black clays. The lithologic boundary between the black clays and the white to gray limestones probably correlates with the top of reflector β (Beta) which appears to be Hauterivian/Valanginian in age. (Hole 105, Core 27, 100-150 cm below the top of Section 3).

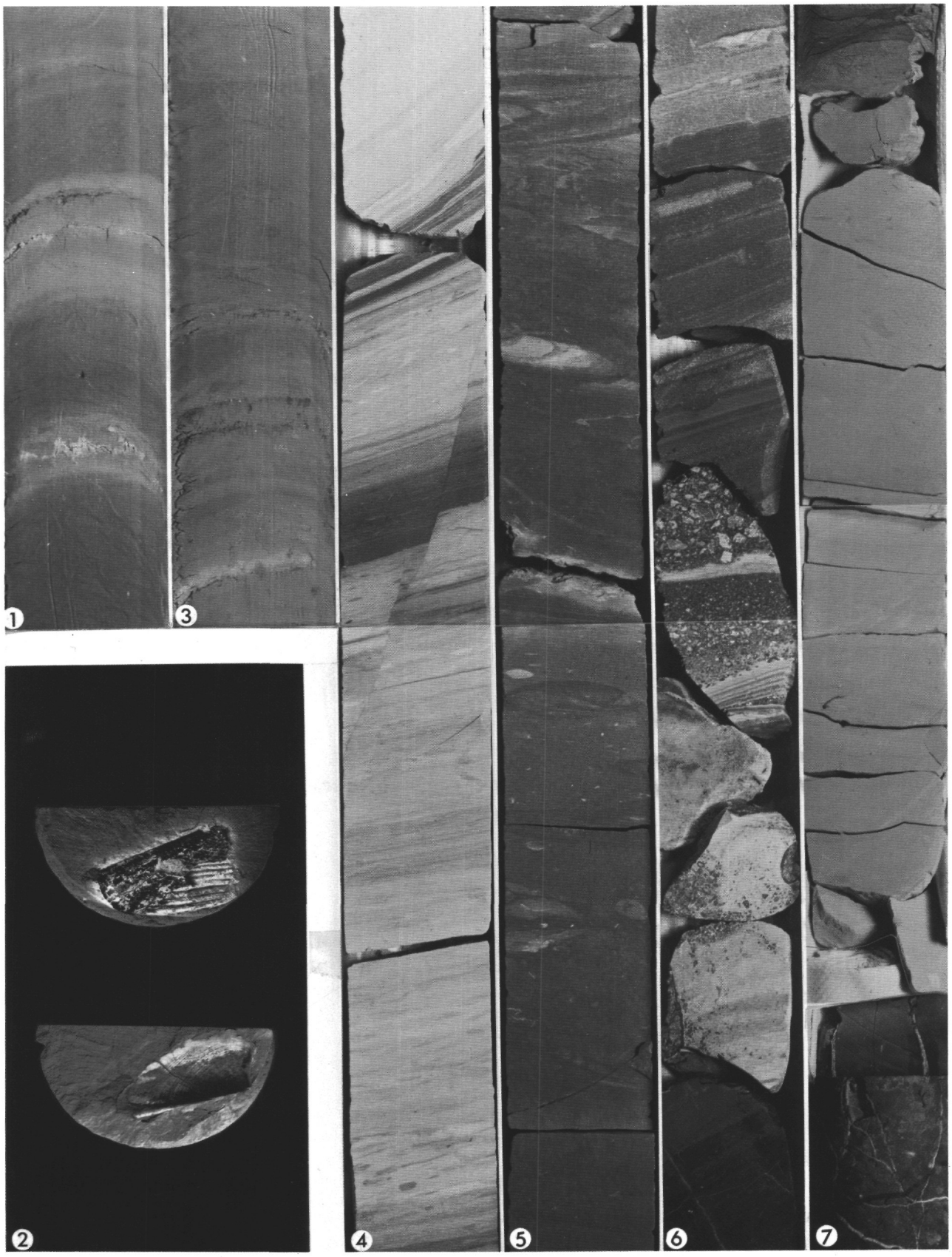
Figure No. 5—Penecontemporaneous flow deformation is commonly seen in the Kimmeridgian to Oxfordian red clayey limestone. Clasts of green palagonite occur in this red iron-oxide rich sediment that overlies the basalt basement. A vein of tiny crystals of native copper, associated with palagonite occurs near the base of this unit. Principal clay mineral is montmorillonite with lesser amounts of illite. (Hole 105, Core 34, 75-125 cm from the top of Section 4).

Figure No. 6—Basalt basement contact beneath pyroclastics and recrystallized Oxfordian limestone. The uppermost of the laminated beds show the outlines of relatively fine-grained palagonite fragments that grade downward to coarse particles, then to fine-grained particles in thin laminations; all are altered to montmorillonite. Sanidine, the high temperature potassium feldspar is abundant. Below the brightly colored zone very hard recrystallized limestones are in contact with the basalt. Except for a sample nearest the contact these limestones are composed of high magnesium calcite and contain patches of green palagonite fragments of various sizes.

The underlying basalt is highly fractured and altered; it contains numerous inclusions of hard limestone and vein fillings of fibrous calcite. Faunal assemblages suggest a gradual shallowing of the depositional environment towards the basalt contact. (Hole 105, Core 40, 25-75 cm from the top of Section 1).

Figure No. 7—Basalt basement contact beneath greenish gray Oxfordian/Callovian (?) argillaceous limestone. The homogenous limestones, the oldest sediment yet recovered by the Deep Sea Drilling Project, consist of greenish-gray calcilutite with some silty zones (calcisiltite). Laminations are usually faint or absent, burrowing is common. Plant debris (twigs and leaves) are abundant throughout the interval.

The basalt contact with the overlying sediments is very sharp and no transition zone of baked sediments is observed; the top 2 cm of basalt (sectioned in this illustration) is very glassy. Most of the basalt is massive with thin calcite-filled cracks, but some zones show many thin (1 mm) veinlets of black, glassy material and curved lamellar structures that are characteristic of pillow lavas. Fragmented specimens of coccoliths were observed in the limestone layers interbedded in the basalt. The increase in the specific diversification of the foraminiferal assemblages towards the contact with the basalt indicates a gradual shallowing of the depositional environment. (Hole 100, Core 10, 75-125 cm below the top of Section 2. Cat Gap region east of San Salvador Island, Bahamas, 24°41.28'N, 73°47.95'W, 5336 m).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Initial Reports of the Deep Sea Drilling Project

A Project Planned by and Carried Out With the Advice of the
JOINT OCEANOGRAPHIC INSTITUTIONS FOR DEEP EARTH SAMPLING (JOIDES)

Volume XI

covering Leg 11 of the cruises of the Drilling Vessel *"Glomar Challenger"*
Miami, Florida to Hoboken, New Jersey
April-June 1970

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Prepared for the
NATIONAL SCIENCE FOUNDATION
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Under Contract C-482
By the
UNIVERSITY OF CALIFORNIA
Scripps Institution of Oceanography
Prime Contractor for the Project

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Foreword

The year 1972 marks the 100th anniversary of H.M.S. CHALLENGER—after which D/V GLOMAR CHALLENGER is named. It is fitting that our century should have its counterpart to the famous ship of the 19th century, which helped establish oceanography as a science through her voyages. It is equally fitting that GLOMAR CHALLENGER should be plying the same waters one century later seeking answers to new problems concerning the history of our planet and of life on it. The fundamental advancement of our knowledge of the earth will lead to enhanced capabilities to understand its processes and to exploit its natural resources intelligently.

The Deep Sea Drilling Project is being undertaken within the context of the National Science Foundation's Ocean Sediment Coring Program. The Foundation is funding the project by means of a contract with the University of California, and the Scripps Institution of Oceanography is responsible for its management. The University has, in turn, subcontracted with Global Marine Incorporated for the services of the drilling ship, GLOMAR CHALLENGER. Scientific planning, both of the detailed itinerary and of the preliminary analyses leading to these Initial Reports, has been conducted under the auspices of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). The JOIDES consortium has convened several panels for that purpose, consisting of a large number of distinguished scientists from academic institutions, government agencies, and private industry. Altogether, the project has involved the active interest and participation of many of the Nation's best scientists and technologists. Leading scientists from abroad have participated and their countries have made contributions to the project.

The first ocean coring operations for the Deep Sea Drilling Project began on August 11, 1968. During the ensuing 18 months of drilling operations in the Atlantic and Pacific Oceans, the Gulf of Mexico, and the Caribbean Sea, the scientific objectives that had been set forth were successfully accomplished. Primarily, the age of the ocean basins and their processes of development were determined. Emphasis was placed on broad reconnaissance and on testing the involvement of the mid-oceanic rise systems in the development of the ocean basins.

As a result of the success of the Deep Sea Drilling Project, the National Science Foundation extended its contract with the University of California to encompass an additional 30 months of drilling, allowing GLOMAR CHALLENGER to continue operations throughout the oceans of the world in exploring the deep ocean floors. This extension includes a broad geographic range of operations in the Atlantic, Pacific, and Indian Oceans, and the Mediterranean, Caribbean, Bering, and Red Seas. The ultimate goal is a fundamental advancement of our knowledge of the earth.

These reports contain the results of initial studies of the recovered core material and the associated geophysical information. The contribution to knowledge has been exceedingly large and future studies of the core material over many years will contribute much more. The National Science Board in its 1971 report, "Environmental Science—Challenge for the Seventies," stressed the importance of the work of the GLOMAR CHALLENGER:

> Special mention should be made of the development of new types of deep sea drilling techniques and their use on the unique, prototype vessel, GLOMAR CHALLENGER. This facility has brought to light in only a few years information that has literally revolutionized man's understanding of the physical processes occurring in the earth's crust.

Moreover, industry should benefit greatly from the project—from the technological advances that are being made and through the information being obtained on natural resources.

H. Guyford Stever

Washington, D. C.
June 1972

Preface

Recognizing the need in the oceanographic community for scientific planning of a program to obtain deep sedimentary cores from the ocean bottoms, four of the major oceanographic institutions that had strong interests and programs in the fields of marine geology and geophysics, formed in May 1964, the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). This group, Lamont-Doherty Geological Observatory; the Institute of Marine Sciences, University of Miami; the Scripps Institution of Oceanography, University of California at San Diego; and the Woods Hole Oceanographic Institution, expressed an interest in undertaking scientific planning and guidance of the sedimentary drilling program. It was the purpose of this group to foster programs to investigate the sediments and rocks beneath the deep oceans by drilling and coring. The membership of this original group was later enlarged in 1968 when the University of Washington became a member.

Through discussions sponsored by the JOIDES organization, with support from the National Science Foundation the Lamont-Doherty Geological Observatory operated a drilling program with Dr. J. Lamar Worzel as Principal Investigator. This successful drilling effort early in the summer of 1965, on the Blake Plateau region off Jacksonville, Florida, used the drilling vessel, *Caldrill I.*

With this success in hand, planning began for a more extensive deep sea effort. This resulted in the award of a contract by the National Science Foundation to the Scripps Institution of Oceanography for an eighteen-month drilling program in the Atlantic and Pacific Oceans, termed the Deep Sea Drilling Project. Operations at sea began in August 1968.

The goal of the Deep Sea Drilling Project is to gather scientific information that will help determine the age and processes of development of the ocean basins. The primary strategy is to drill deep holes into the ocean floor, relying largely on technology developed by the petroleum industry.

Through the efforts of these five principal organizations and of the panel members which were drawn from a large cross section of leading earth scientists and associates, a scientific program was developed.

Cores recovered from deep beneath the ocean floor will provide reference material for a multitude of future studies in fields such as biostratigraphy, physical stratigraphy, and paleomagnetism, that will afford a new scope for studies of the physical and chemical aspects of sediment provenance, transportation, deposition, and diagensis. In-hole measurements, as feasible, should provide petrophysical data to permit inference of lithology of intervals from which no cores were recovered.

A report, describing the core materials and information obtained both at sea and in laboratories on shore, is published as soon as possible after the completion of each cruise. These reports are a cooperative effort of the scientists participating in the cruise and are intended primarily to be a compilation of results which, it is hoped, will be the starting point for many future new and exciting research programs. Preliminary interpretations of the data and observations taken at sea, are also included.

Following publication of each report, the core materials and data collected on the cruise will be made available to qualified scientists through the Curator of the Deep Sea Drilling Project, following policies approved by the National Science Foundation.

The advent of *Glomar Challenger,* with its deep-water drilling ability, is exceedingly timely. It has come when geophysical investigation of the oceans has matured through 20 to 30 years of vigorous growth to the point where we have some knowledge about much of the formerly unknown oceanic areas of our planet. About one million miles of traverses had been made which tell us much about the global pattern of gravity, magnetic and thermal anomalies, and about the composition, thickness and stratification of the sedimentary cover of the deep-sea and continental margin. The coverage with such data has enabled the site selection panels to pick choice locations for drilling. The knowledge gained from each hole can be extended into the surrounding area. Detailed geophysical surveys were made for most of the selected locations prior to drilling.

The earth sciences have recently matured from an empirical status to one in which substantial theories and hypotheses about major tectonic processes are flourishing. Theories about the origin of magnetic fields and magnetic reversals, about ocean floor spreading and continental drift, and about the thermal history of our planet, have led to specific predictions that could be tested best by an enlightened program of sampling of deep-sea and continental margin sediments and underlying rocks.

The members of JOIDES and the scientists from all interested organizations who have served on the various advisory panels are proud to have been of service to the Nation and believe that the information and core materials that have been obtained will be of value to students of earth sciences and all humanity for many years to come.

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Deep Sea Drilling Project
SAMPLE DISTRIBUTION POLICY

1. Requests for samples should be addressed to: Curator, Deep Sea Drilling Project; Scripps Institution of Oceanography, University of California at San Diego; La Jolla, California 92037. The requests should specify the quantities and intervals in the core required, a statement of the proposed research, the possibility of returning residue to the Curator, the estimated time required to complete and publish the results, and the availability or need of funding and availability of equipment and space foreseen for the research. Initial core description should normally serve as a basis for these sample requests. In order to ensure that early requests for highly desirable but limited samples can all be honored, distribution of samples will not be made until at least one month after the date of publication of each issue of the initial core description. The only exceptions to this policy will be for samples leading to the initial core description, or for specific instances involving ephemeral properties.

   Requests for samples from researchers in industrial laboratories will be handled in the same manner as those from academic organizations, and there will be the same obligation to publish results promptly. Requests from foreign scientists or organizations will also be considered.

2. The Deep Sea Drilling Project's Curator has the responsibility for distributing samples, controlling quality of samples, and preserving core material. He also has the responsibility for maintaining a record of requests for samples that have been processed and filled, indicating the investigator and subjects to be studied. This record will be available to investigators.

   The distribution of samples will be made directly from the two repositories at Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography, by the Curator or his designated representative.

3. The National Science Foundation will establish a Sample Distribution Panel to advise on the distribution of core material, which will be chosen in accordance with its usual practices, in a manner which will assure advice in the various disciplines leading to a complete and adequate study of the core and related materials. The Curator and the Chief Scientist of the Deep Sea Drilling Project will meet with the Panel.

4. (a) Samples up to 3 cc/meter of core length can be automatically distributed by the Curator, Deep Sea Drilling Project or his authorized representative to any qualified investigator who requests them. The Curator will refrain from making automatic distribution of any parts of the cores which appear to be in particularly high demand and any requests for these parts of the cores will be referred to the Sample Distribution Panel for review. Requests for samples from thin layers or important stratigraphic boundaries will generally require Panel review.

   (b) All requests for samples in excess of 4(a) above will be referred to the Sample Distribution Panel.

   (c) If, in the opinion of scientific investigators, certain properties they wish to study may deteriorate prior to the normal availability of the samples, such investigators may request that the normal waiting period not apply. All such requests must be approved by the Sample Distribution Panel.

5. Samples will not be provided prior to the assurance that funding for sample studies either exists or is not needed. Provision of samples will not imply any associated commitment to fund the proposed or additional research. If a sample request is dependent, either wholly or in part, or proposed funding, the Curator will provide to the organization to whom the funding proposal has been submitted any information on the availability of samples that they may request, but will wait for final assurance that the funds are available before distributing the requested samples.

6. Investigators receiving samples are charged with:

   i) the responsibility of promptly publishing worthwhile results;

   ii) acknowledging, in publications, that the National Science Foundation supplied the samples;

   iii) submitting three copies of all reprints of published results to the Deep Sea Drilling Project; Scripps Institution of Oceanography, University of California at San Diego; La Jolla, California 92037; and

   iv) notifying the Curator of any additional work done on the sample that was not

stated in the original request for which the samples were made available; and

v) returning, in good shape, remainder of samples after termination of research, if so requested by the Curator.

7. Cores will be made available at repositories for investigators to examine and specify exact samples, in such instances as this may be necessary for the scientific purposes of the sampling, subject to the limitations of 4(a), (b), (c), and 5 above, and with the specific permission of the Curator or his delegate.

8. Cores of igneous and metamorphic rocks will also remain at the repositories where they will be available for observation and description, and where selected samples may be taken for thin-section preparation and other work.

9. Within the context of sample distribution, there also falls the category of raw data and information. Examples of this information would be the magnetic tapes from the X-Ray diffraction studies, the X-Ray radiographs of the cores, and logging records. Such information would be available, after publication of the initial descriptions, to any qualified investigators, and could be reproduced by those prepared to defray the costs.

10. This policy has the approval of the National Science Foundation and is incorporated in the Program Plan for the Deep Sea Drilling Project. It is now in effect.

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