RECENT SEDIMENTS

NORTHWEST GULF OF MEXICO

Published with the aid of funds furnished jointly by the American Petroleum Institute and The American Association of Petroleum Geologists, the latter fund having been established by the New York committee for the mid-year meeting of the Association, November 1926.

RECENT SEDIMENTS, NORTHWEST GULF of MEXICO

A Symposium Summarizing the Results of Work Carried On in Project 51 of the American Petroleum Institute

1951-1958

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Published by The American Association of Petroleum Geologists
Tulsa, Oklahoma, U.S.A. 1960

Published September, 1960

Composed, Printed, and Bound by
The Collegiate Press
GEORGE BANTA COMPANY, INC.
Menasha, Wisconsin

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PREFACE[1]

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All but one of the papers that follow represent a symposium summarizing the results of work carried on in Project 51 of the American Petroleum Institute. This had as its objective during the period 1951-1958 the study of modern sediments along the northwest margin of the Gulf of Mexico. The paper by Grover E. Murray, on the other hand, was not part of the project but was contributed to us to give the geological setting for the area of investigation.

This investigation of sediments came as a result of many years of deliberation by committees of the American Petroleum Institute and The American Association of Petroleum Geologists, which finally led in 1951 to the creation of A.P.I. Project 51. Many petroleum geologists contributed toward the creation of this largest of the A.P.I. geologic projects, and others have given generously of their time in advisory capacities. Much of the background which led to the project was prepared by Shepard W. Lowman, who first conceived the idea and headed a research committee in which preliminary plans were discussed. A. Rodger Denison, Clarence L. Moody, Marcus A. Hanna, Hugh A. Bernard, and R. Dana Russell have served as chairmen of the project advisory committees and all were of great assistance. The complete membership of the committees is given in an appendix at the end of the book. A. F. Frederickson has been of considerable help to us in reviewing for the A.P.I. committee all the papers in this volume.

The project was given to the University of California and administered at the Scripps Institution of Oceanography, mostly under the University's Institute of Marine Resources, directed by Charles D. Wheelock. The writer acted as project director during the first seven years, and was assisted for several years by a Scripps Institution committee under the chairmanship of Roger Revelle. During the last year much of the administration was conducted by Tj. H. van Andel, who is now directing the project in a new field, the Gulf of California. The areal sedimentation studies have been conducted by J. C. Curray, D. G. Moore, G. A. Rusnak, P. C. Scruton, and F. P. Shepard. The work on Foraminifera has been under the direction of F. B Phleger, with considerable contributions from Frances L. Parker, Jean P. Hosmer, J. S. Bradshaw, and R. R. Lankford. Macroorganisms have been studied principally by R. H. Parker, although earlier the work included E. L. Puffer and W. K. Emerson, working under the direction of J. W. Durham. Ostracods have been investigated by F. M. Swain and Doris Malkin Curtis. Clay minerals have been studied by R. E. Grim and W. D. Johns. Heavy minerals were studied first by M. N. Bramlette and later by D. M. Poole, with final study and coordination by Tj. H. van Andel. Studies in chemistry have been conducted by G. S. Bien and E. D. Goldberg; chemistry of sedimentation by U. G. Whitehouse at Texas A. and M.; microbiology by D. E. Contois and C. H. Oppenheimer; organic productivity studies by D. E. Contois, E. F. Corcoran, E. G. Simmons, and W. H. Thomas; microfossil (including pollen) studies by L. R. Wilson, A. E. LeBlanc, and Lili Ronai; remanent magnetism by R. G. Mason; particle size distribution by D. L. Inman and T. K. Chamberlain; grain-size analyses were made by H. W. Lusk and D. M. Poole with advice from J. D. Frautschy and D. L. Inman; and roundness studies by M. A. Beal. As a special subproject, R. N. Ginsburg conducted studies of the Florida Keys and of Florida Bay. Most of the field work of the project was conducted under the direction of J. R. Curray, D. G. Moore, R. M. Norris, G. A. Rusnak, P. C. Scruton, and F. P. Shepard.

Others who have been helpful to the project in various ways include—S. A. Andrews, P. R. Bass, J. L. Baughman, Peter Benson, Joan Demond, P. L. Engel, E. G. Gilley, Donald Green, Gordon Gunter, J. W. Hedgpeth, W. G. Hewett, E. R. Hewitt, Henry Hildebrand, Norville Jackson,

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W. A. Jones, Terrance Leary, H. T. Lee, D. W. Miles, Paul Miller, R. A. Mills, E. D. Milo, J. R. Moriarty, George Nava, H. F. Nelson, H. T. Odum, Miles Padereau, Jesse Petrie, Cecil Reid, A. F. Richards, Elizabeth Sanborn, D. B. Sayner, Sandra Southworth, Percy Viosca, Jr., Daniel Welch, T. L. Wynn, and Ruth Young.

We wish to express, also, our appreciation for the outstanding editorial work accomplished by Robert H. Dott and his assistant, Norma Ridley, of the Association's headquarters staff.

Most of the results of these investigations have been published and are summarized in the papers to follow. In three papers, however, the first major publication of results outside of the progress reports is given in the present volume. For a few investigations, only A.P.I. Project 51 progress reports have been published. These reports are available in the libraries of most of the major oil companies, the U. S. Geological Survey, and the University of California at La Jolla and Los Angeles.

The northwest Gulf of Mexico was chosen by the A.P.I. research committee as the first area for investigation. There were many advantages coming from this choice. The area is one which has been undergoing slow subsidence with accompanying sedimentation during much of geological history, and a large portion of the old sediments can be demonstrated to have accumulated in very much the same environments as exist today. The Mississippi Delta provided an area of rapid, large-scale deposition. The continental shelf is unusually broad and has diverse current conditions. Large barriers extend along much of the coast. The bays vary from the highly saline Laguna Madre of the south Texas coast to the low salinity bays east of Galveston, giving a wide range of conditions for sedimentation and ecology of the faunas.

The field work was conducted for the most part from small vessels obtained along the Gulf Coast. The Texas Game and Fish Commission and Las Olas Oceanography Foundation kindly gave us the use of their boats on many trips around the Rockport area and in the northern Laguna Madre. The Louisiana Wildlife and Fisheries Commission also provided us with boats for a large part of our work in the Mississippi Delta area. A 65-foot shrimper, the *Neva J,* equipped with adequate winches, permitted us to carry on most of our continental-shelf studies under quite favorable conditions. The 40-foot shrimper *Deanna L,* loaned to us by Gulf Research and Development Company, and the 60-foot *Rosemary* were used for the early part of the work around the Mississippi Delta. The California Company gave us the use of their docking and refueling facilities. A trip over the marshes of the delta was made possible by using a marsh buggy of The California Company. On one offshore trip along the Texas coast the U. S. Fish and Wildlife vessel *Alaska* was provided for our use. Some of the work on the Laguna Madre was conducted with an air boat which allowed the traverse of very shallow water. Other work was conducted by car to areas where small boats could be rented. Flights over the work areas were provided by the Gulf Research and Development Company, Texaco, Inc., and the Pan American Petroleum Corporation.

During the course of the project we have learned the importance of certain procedures which will be mentioned because they may be of value to others undertaking similar projects. First, perhaps, is the importance of preserving all field cores. Examination in the field provides some useful data, but only the complete analyses in the laboratory yield the data necessary for establishing the characteristics of sediments in the various environments. Second is the adequate storage of cores even after they have been given laboratory study. Many requests have come to us for material long after the laboratory tests have been made. Extra material has also been needed by us for confirmation of previous analyses. Third is the importance of allotting sufficient funds to keep the laboratory work abreast of field collections. Long delays in the examination of samples may lead to the deterioration of the sediments, even when carefully preserved, or to the loss of pertinent data. Furthermore, interest in the study of samples taken many years in the past always wanes. Fourth is the need for comparing results obtained in a particular environment with information from similar environments. We found, for example, that the sediments in some of the Texas bays were quite different from those in neighboring bays. By collecting comparative samples in a considerable number of bays, we were able to understand the reasons for these differences. The broadening of the field of study has allowed us to make generalizations which would otherwise be unwise.

Diversions from time to time in the general plan of procedure have proved valuable. For example, the study of the rocky or calcareous covered offshore banks was not an original purpose of the project. It seemed unfortunate, however, not to add such a study to our exploratory trips across the continental shelves. This diversion appears to have paid large dividends as it led to our discovery of Miocene fossils on one of the banks, giving good proof of an underlying salt dome, and it has shown us the importance of the banks in providing a special source of sediment to the surrounding shelves. This case appears to be an indication of the importance of untrammelled research allowing the investigator to follow interesting side leads which would be impossible in research with more rigid goals.

Perhaps more than anything else the project has shown how important it is to use a multiple approach in diagnosing environment characteristics. In some localities which we studied, the Foraminifera serve as the best means of distinguishing the environment of deposition. Elsewhere grain size parameters are the most useful guide, and in some localities the general composition of the constituents of the coarse fraction provides the best clues. In almost all cases the best results come from combining as many techniques as possible. Much could be said in favor of a broad training for a field geologist who wishes to determine the environment in which sedimentary rocks were deposited. The importance of specialization cannot be overlooked, but this type of information needs to be coordinated by what we might call a general practitioner.

In preparing the manuscripts for this symposium the editors realized that it would be most unwise to expect all authors to have the same opinion on various phases of the investigation. Accordingly, each author has been left free to give his own opinions, which do not necessarily agree with those of the editors. However, the opportunity for a free exchange of the manuscripts among authors may have led to more accord than would have otherwise existed. Furthermore, most of the authors have been working together and discussing their problems for some years, so that many differences have been ironed out.

In order to make each paper a complete entity, it has been necessary to repeat a few illustrations, and there is such repetition of information as seemed required adequately to support conclusions.

To avoid confusion from the use of widely different terms for the same thing, we have tried to introduce some uniformity into the manuscripts. For example, we decided to use *Holocene* instead of *Recent* or *Postglacial.* This term, used widely in Europe to indicate the epoch of generally rising sea levels accompanying the melting of the last great ice caps, appears to be less confusing than either of the other two. Thus, *Recent* has a different meaning when it is not capitalized; *Postglacial* is too indefinite inasmuch as ice caps still exist and there are many indications of ice-readvances during the general waning of ice caps. In general, we have drawn the boundary between Holocene and Pleistocene at the unconformity where modern sediments overlie oxidized sediments, the latter the result of weathering during the times of glacially lowered sea level. Like all other transgressions, the time of overlap is not necessarily the same at different places, but no other satisfactory basis was found.

To avoid confusion in the nomenclature of sediment types in relation to size, we consulted with a large number of sedimentologists from various parts of the country, presenting them with several types of triangle diagrams with nomenclature attached. The one chosen by the great majority and favored by most of the staff of the project consists of a triangle with sand, silt, and clay in its apices. Where sediments have been analyzed for sand, silt, and clay content, this is easy to apply and it has been our practice to use simple terms shown in the triangle. Where no separation between silt and clay has been made, the continued use of the indefinite term "mud" is necessary (either as the adjective "muddy" or as a noun).

The scope of A.P.I. Project 51 during the first seven years has been "the study of nearshore Recent (herein called Holocene) sediments and their environments in the Northern Gulf of Mexico." The purpose of such studies has been primarily to obtain information concerning the characteristics of the sediments and their fauna which might prove helpful in identifying the environments of ancient sedimentary formations. There are two principal methods by which such results can be obtained from field samples. One

is the microscopic and laboratory investigation of the constituents, size parameters, mineralogy, and organic content of the sediment samples, tabulating these for the different environments. The other is the use of modern physical and geochemical methods, such as mass spectrometers, X-ray diffraction, polarography, and electron microscopes, to determine elements or rare minerals which may prove characteristic of the environment of deposition. Both these methods have been used in the project. To some scientists the first method has little appeal and appears to belong back in the horse and buggy era. This may well be true, but the results which we can report in this volume appear to be almost entirely from the first method. This could be interpreted as meaning, first, that there has been so little study of modern sediments that the simpler methods are likely to produce valuable results; and, second, that the physical and geochemical approach is still in the developmental stage and the investigators are still concerned with perfecting their methods, so that they have not yet had time to apply their results to many of the practical problems of sedimentation. In at least one way, on the other hand, the Gulf Coast sediment studies have received considerable benefit from geochemistry. The age determinations by carbon 14 made for us by Shell, Socony-Mobil (Magnolia), and Humble petroleum companies, and by the U. S. Geological Survey, have been of great help to our work in giving rates of deposition and in indicating the history of the rise of sea level along the Gulf Coast.

It should be emphasized that the studies of the Gulf Coast in A.P.I. Project 51 represent essentially a beginning of what can be hoped will become a vast undertaking carried on in many parts of the world. It has been gratifying to learn of the initiation of many other projects which appear to give some indication that this hope may be realized in the not-too-distant future. There has certainly been a great growth in the interest accorded sedimentation.