Estuarine Research

VOLUME 2

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VOLUME II
Geology and Engineering

Edited by

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Estuarine Research Federation

Academic Press, Inc. NEW YORK SAN FRANCISCO LONDON 1975

A Subsidiary of Harcourt Brace Jovanovich, Publishers

ACADEMIC PRESS, INC.
111 Fifth Avenue, New York, New York 10003

United Kingdom Edition published by
ACADEMIC PRESS, INC. (LONDON) LTD.
24/28 Oval Road, London NW1

Library of Congress Cataloging in Publication Data

International Estuarine Research Conference, 2d,
Myrtle Beach, S. C., 1973.
Estuarine research.

Papers presented at a conference held by the Estuarine Research Federation and cosponsored by the American Society of Limnology and Oceanography and the Estuarine and Brackish Water Sciences Association.
Bibliography: p.
Includes index.
CONTENTS: v. 1. Chemistry and biology.—v. 2. Geology and engineering.
1. Estuaries—Congresses. 2. Estuarine oceanography—Congresses. 3. Estuarine biology—Congresses I. Cronin, Lewis Eugene, (date) II Estuarine Research Federation. III. American Society of Limnology and Oceanography IV Estuarine and Brackish-water Sciences Association. V. Title.
GC96.I57 1973 551.4'609 75-29370
ISBN 0-12-197502-9 (v. 2)

PRINTED IN THE UNITED STATES OF AMERICA

Preface

These publications are the first of a biennial series planned by the Estuarine Research Federation to present new information and concepts relating to the estuaries of the world. Volumes I and II contain the papers presented in the Second International Estuarine Research Conference, held by the Federation at Myrtle Beach, South Carolina in October of 1973. The Conference was cosponsored by the American Society of Limnology and Oceanography and by the Estuarine and Brackish Water Sciences Association.

There has been a rapid and recent increase in research on estuaries, their components and processes, and their responses to human activities. The increase has followed recognition of the exceptional value of these coastal systems, awareness of the abuse many of them have received, and expanding scientific interest in these complex and highly dynamic bodies of water which link the fresh water and the seas. As the number of persons engaged in estuarine research, and of those who wish to use the product of such research increased, so, too, did the need for improved communications among and from investigators. A small Atlantic Estuarine Research Society was organized in 1947 to provide frequent, informal exchange. In later years, the New England Estuarine Society, the South Atlantic Estuarine Research Society, and the Gulf Estuarine Research Society have emerged to serve their respective regions. All of these have joined to form the Estuarine Research Federation, an umbrella organization for the constituent societies and their 1200 members, with potential for adding additional, interested organizations. The Federation conducts and publishes biennial symposia on "Recent Advances in Estuarine Research," implements estuarine research, and provides assistance on national and international policies and practices related to estuaries.

A valuable symposium on estuaries was held under multiple sponsorship in 1964 at Jekyll Island, Georgia, and produced the classic volume Estuaries edited by George Lauff and published by AAAS. That volume was comprehensive. The Federation held its First International Conference on Long Island in 1971 but publication of papers was not feasible. The Federation recognizes that total coverage is no longer feasible at any one point in time because of the expanding production of new results of research. The Executive Board has therefore de-

cided to select, for each biennial meeting, those topics in which major recent advances have indeed been achieved, design a symposium for their presentation and discussion, and arrange for publication. These are the first products. Volume I contains papers on *Chemistry*, focused on the Cycling of Elements and Estuaries; *Biology*, including sessions on the Dynamics of Food Webs, Nutrient Cycling, Zooplankton, Nekton, and Benthos; and *The Estuarine System*. Volume II provides publications on *Geology*, with collections on Estuaries with Small Tidal Ranges, Intermediate Tidal Ranges, and Large Tidal Ranges, and an additional section on Wide-Mouthed Estuaries. It also includes new materials on *Engineering*, with emphasis on Use of Vegetation in Coastal Engineering and on Estuarine Dredging Problems and Effects. The Third International Conference will be held by the Federation in October of 1975 at Galveston, Texas. The present publications are somewhat delayed in production, but rapid completion of future volumes is a foremost goal and commitment.

We wish to express exceptional appreciation to the conveners, chairman, and contributors, identified elsewhere, for the innovative and dedicated efforts they put into the creation and conduct of the Conference. Dr. Robert J. Reimold of the University of Georgia gave excellent supervision to the preparation and arrangement of all materials for camera-ready copy.

Quite special acknowledgment is given to the Office of Coastal Zone Management of the U.S. National Oceanic and Atmospheric Administration and its Director, Dr. Robert Knecht, for considerately administered financial support which made possible participation by scientists from distant laboratories and the preparation of final materials for publication.

L. Eugene Cronin
Chairman

Austin B. Williams

Jerome Williams

For the Editorial Committee

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PART I

GEOLOGY: COARSE GRAINED SEDIMENT TRANSPORT AND ACCUMULATION IN ESTUARIES

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MORPHOLOGY OF SAND ACCUMULATION IN ESTUARIES:

AN INTRODUCTION TO THE SYMPOSIUM

Miles O. Hayes[1]

ABSTRACT

The morphology of sand deposits in estuaries is determined by the interaction of a number of process variables, including: (a) tidal range, (b) tidal currents, (c) wave conditions, and (d) storm action. Of these, variations in tidal range have the broadest effect in determining large-scale differences in the morphology of sand accumulation. The papers in this symposium have, therefore, been arranged according to differences in tidal range of the areas discussed, following the classification scheme proposed by Davies (4):

I. **Coarse-grained sediment accumulation in estuaries with small tidal ranges (microtidal estuaries: tidal range (T.R.) = 0 - 2 m).**

Wave action and storm deposition are more important in this class than in any other. Galveston Bay, Texas, is an example of this type of estuary.

II. **Coarse-grained sediment accumulation in estuaries with intermediate tidal ranges (mesotidal: T.R. = 2 - 4 m).**

Tidal deltas and tidal-current-formed sand bodies increase noticeably in this class. The estuaries of New England, South Carolina, and Georgia are prototypes.

III. **Coarse-grained sediment accumulation in estuaries with large tidal ranges (macrotidal: T.R. > 4 m).**

Funnel-shaped, wide-mouthed estuaries that contain linear sand bodies are the most common types occuring in this category. Prototypes are Bristol Bay, Alaska, and the Ord River estuary, Australia.

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IV. Wide-mouthed estuaries.

This category was created in order to include in the symposium papers covering the large entrances into such major bodies of water as the Baltic Sea and Chesapeake Bay.

Much of the emphasis in these papers has been placed on estuaries in the mesotidal category, principally because these are the ones that have been studied most. Despite the fact that mesotidal estuaries show a wide range in morphological and hydrographic characteristics, the sand shoals affiliated with them are remarkably similar from place to place. For example, flood-tidal deltas usually contain the same major components, including a flood ramp, flood channels, ebb shields, ebb spits, and spillover lobes, regardless of the variations in current and wave conditions under which they occur. Similarly, the ebb-tidal deltas, although they are exposed to great variations in open-ocean-wave intensity, are strikingly consistent in morphology.

INTRODUCTION

At first view, sand deposits occurring in estuaries are extremely complicated. The morphology of these sand bodies is controlled by the interaction of numerous process parameters, including tidal-range conditions, tidal currents, wave conditions, and coastal storms. After several years of studying tidal deltas under different wave and tidal regimes, as well as studying the coastal charts of the world, I have concluded that tidal range has the principal control over the distribution and form of sand deposits affiliated with estuaries. That is, estuaries occurring in areas with small tidal ranges have a suite of sand shoals associated with them that is distinctly different from sand shoals occurring in estuaries with large tidal ranges.

Davies (4) recognized how important tidal range is to coastal morphology, and proposed the following classification of tides:

Microtidal – tidal range 0 - 2 m[2]

Mesotidal – tidal range 2 - 4 m

Macrotidal – tidal range > 4 m

The papers of the symposium have been grouped according to this classification scheme.

The importance of tidal range in controlling coastal geomorphology was first called to my attention by W. Armstrong Price, who feels that coastal-plain shorelines can be defined on the basis of whether they are wave-dominated or tide-dominated. In compiling information on shorelines of the world for the

2. In actuality, Davies' boundaries were 0-6 ft., 6-12 ft., and 12 ft. I have rounded off these numbers to the nearest whole metric unit. On the basis of study of details of coastal morphology on the coast of North America, I feel there is much justification for considering changing the mesotidal boundaries or perhaps splitting the mesotidal class into two categories; however, the boundaries proposed by Davies will be maintained in this paper.