

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

EDITOR-IN-CHIEF

EDITEUR-EN-CHEF

Charles W. Finkl, Jr.

Coastal Education and Research Foundation, Inc. [CERF]

Editorial Offices:

Post Office Box 210187
Royal Palm Beach, FL 33421-0187, USA

e-mail: finkl@acc.fau.edu (Boca Raton)
cfinkl@gate.net (Ft. Lauderdale)

BOOK REVIEW EDITOR

Gregory W. Stone
Louisiana State University
Baton Rouge, LA, U.S.A.

JCR PUBLICATIONS MANAGER

Karen Hickey
P.O. Box 1897, Lawrence, KS 66044
Telephone: (913) 843-1235/FAX (913) 843-1274

EDITORIAL ASSISTANT

Judy Oylar
CERF, Inc.
Royal Palm Beach, FL 33421

MITHERAUSGEBER

BIOLOGICAL SCIENCES

David Tomasko
Venice, Florida

COASTAL GEOLOGY

Richard A. Davis
St. Petersburg, Florida

ASSOCIATE EDITORS

ENGINEERING & TECHNOLOGY

Per Bruun
Hilton Head, South Carolina

COASTAL GEOLOGY

Duncan M. FitzGerald
Boston, Massachusetts

MANAGEMENT

Niels West
Kingston, Rhode Island

COASTAL PROCESSES

Joseph T. Kelley
Orono, Maine

COMITÉ DE REDACTION

MARINE GEOLOGY

Terry R. Healy
Hamilton, New Zealand

CONSULTING EDITOR

Rhodes W. Fairbridge
New York, New York

REDAKTIONSKOMMITEE

Troels Aagaard
Copenhagen, Denmark

Edward J. Anthony
Dunkerque, France

José F. Araya
Santiago, Chile

Mytheenkhan Baba
Trivandrum, India

Cecile Baeteman
Brussels, Belgium

Daniel F. Belknap
Orono, Maine

Eric C.F. Bird
Black Rock, Vic., Australia

Charles Birkeland
Mangilao, Guam

F. Vasco Costa
Lisbon, Portugal

Anthony J. Davy
Norwich, England

Clinton J. Dawes
Tampa, Florida

Robert Dean
Gainesville, Florida

Ron DeLaune
Baton Rouge, Louisiana

Reinhard Dieckmann
Bremerhaven, Germany

Richard V. Dingle
Cape Town, South Africa

Jean-Claude Dionne
Québec, Canada

Robert Dolan
Charlottesville, Virginia

Ken Dunton
Port Aransas, Texas

EDITORIAL BOARD

Lionel N. Eleuterius
Ocean Springs, Mississippi

Michael S. Fenster
Fort Worth, Texas

Donald L. Forbes
Dartmouth, Canada

Shoji Fujii
Toyama City, Japan

Cyril Galvin
Springfield, Virginia

F. Gerritsen
Hilton Head, South Carolina

Edgardo D. Gomez
Quezon City, Philippines

Gary B. Griggs
Santa Cruz, California

Bruce Hayden
Charlottesville, Virginia

David Hopley
Townsville, Qlds., Australia

Saskia Jelgersma
Bergen, The Netherlands

Paul Kaplin
Moscow, Russia

Dieter Kelletat
Essen, Germany

Joseph T. Kelley
Orono, Maine

Vic Klemas
Newark, Delaware

N. Kobayashi
Newark, Delaware

Nicholas C. Kraus
Corpus Christi, Texas

Pierre Lasserre
Paris, France

S.P. Leatherman
College Park, Maryland

Ioannis Liritzis
Athens, Greece

Jeffrey H. List
Woods Hole, Massachusetts

Miguel A. Losada
Santander, Spain

M. Anwar Maun
London, Ontario, Canada

B. Mazurkiewicz
Gdansk, Poland

C. Peter McRoy
Fairbanks, Alaska

Robert A. Morton
Austin, Texas

M.R. Nayak
Dona Paula, India

Robert Nicholls
Middlesex, U.K.

P. Nielsen
Brisbane, Qlds., Australia

Patrick Nunn
Suva, Fiji

Karl F. Nordstrom
New Brunswick, New Jersey

Randall W. Parkinson
Melbourne, Florida

Roland P. Paskoff
Le Chesnay, France

Orrin H. Pilkey, Jr.
Durham, N. Carolina

Paolo A. Pirazzoli
Paris, France

COMMISSION DE PUBLICATION

Norbert P. Psuty
New Brunswick, New Jersey

Ulrich Radtke
Köln, Germany

Michael R. Rampino
New York, New York

Bernard Salvat
Paris, France

Toru Sawaragi
Osaka, Japan

Maurice L. Schwartz
Bellingham, Washington

Andrew D. Short
Sydney, NSW, Australia

Gregory W. Stone
Baton Rouge, Louisiana

Orson van de Plassche
Amsterdam, The Netherlands

F. van der Meulen
Amsterdam, The Netherlands

Herman Th. Verstappen
Enschede, The Netherlands

H.J. Walker
Baton Rouge, Louisiana

John T. Wells
Chapel Hill, N. Carolina

Eric Wolanski
Townsville, Qlds, Australia

P.L. Woodworth
Merseyside, England

Donald R. Young
Richmond, Virginia

Robert S. Young
Burlington, Vermont

COPYRIGHT

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the Coastal Education and Research Foundation (CERF). This consent does not extend to other kinds of copying, such as copying for general distributions, for creating new collective works, or for resale.

It is a condition of publication that manuscripts submitted to this journal have not been published, nor will they be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if the article is accepted for publication. Assignment of copyright is not required, however, from authors who work for organizations which do not permit such assignment. The copyright covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microform or any other reproductions of a similar nature, and translations.

The JOURNAL OF COASTAL RESEARCH (ISSN 0749-0208) is published quarterly by the Coastal Education & Research Foundation [CERF], 810 East 10th St., Lawrence, KS 66044, USA. Subscription rates for 1997 are \$US 135.00 for institutions, \$US 65.00 for individuals and \$US 45.00 for students. Members of the Coastal Education and Research Foundation (CERF) receive the journal for \$US 55.00. All subscribers outside the USA please add \$US 10.00 for surface postage. Single back issues and parts are available at current subscription rates. Second class postage paid at Lawrence, KS. POSTMASTER: Send address changes to JOURNAL OF COASTAL RESEARCH, P.O. Box 368, Lawrence, KS 66044.

Claims for Missing Issues: No claims allowed for (1) insufficient notice of address change; (2) issues lost in mail unless claimed within (a) 90 days for USA, or (b) 120 days for other countries, from last day of month of publication; or (3) such reasons as "missing from files."

© 1997, the Coastal Education & Research Foundation [CERF]. Printed by Allen Press, Inc., Lawrence, Kansas, USA.

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

Supporting Scientific Organizations

- International Union for Quaternary Research (**INQUA**): Commission on Quaternary Shorelines, The Holocene Commission, and The Neotectonics Commission.
- International Geological Correlation Program (**IGCP**) (supported by the International Union of Geological Sciences and UNESCO): Project No. 367 — Late Quaternary Coastal Records of Rapid Change: Application to Present and Future Conditions.
- The International Geographical Union (**IGU**): Commission on the Coastal Environment.
- International Institute for Aerial Survey and Earth Sciences (**ITC**) [Enschede, The Netherlands].
- International Association for Biological Oceanography (**IABO**).
- International Association of Meiobenthologists (**IAM**).
- International Post-Graduate Training Courses on Fundamental and Applied Quaternary Geology (**IFAQ**) [Brussels, Belgium].

Aims and Scope of the Journal

Journal of Coastal Research, an International Forum for the Littoral Sciences, is dedicated to all aspects of coastal research. These include geology, biology, geomorphology (physical geography), climate, littoral oceanography, hydrography, coastal hydraulics, environmental (resource) management, engineering, and remote sensing. Although each field functions effectively within its own purview, the cross-disciplinary nature of coastal studies requires familiarity with other fields as well. Hence, the scope of topics is necessarily broad in order to address the complexity of coastal biophysical and socio-economic interactions. Because of the wide range of interrelated topics, the journal invites original contributions and manuscripts dealing with theory, methodology, techniques, and field or applied topic studies on interdisciplinary coastal issues.

The journal encourages the dissemination of knowledge and understanding of the coastal zone by promoting cooperation and communication between specialists in different disciplines. Natural scientists, for example, are encouraged to collaborate with professionals in other fields to prepare contributions relating to the coastal zone that foster increased appreciation of coastal environments and processes. By means of this journal, with its scholarly and professional papers, systematic review articles, book and symposia reviews, communications and news, and special topical issues, an international forum for the development of integrated coastal research is provided.

Subscription Information

Editorial, Advertising and Publishing Office: Dr. Charles W. Finkl, Jr., Editor-in-Chief, P.O. Box 210187, Royal Palm Beach, FL 33421, USA. Telephone and FAX: (954) 565-1051. All certified or registered mail should be sent to Dr. Charles W. Finkl, Jr., Editor-in-Chief, Journal of Coastal Research, Department of Geology, Florida Atlantic University, Boca Raton, FL 33431 USA.

Advertising and Promotion Office: Ralph DeSoignie, 1041 New Hampshire Street, Lawrence, KS 66044. Telephone: (913) 843-1235. FAX: (913) 843-1274.

Subscriptions Office: Karen Hickey, P.O. Box 1897, Lawrence, KS 66044 USA. Telephone: (913) 843-1235. FAX: (913) 843-1274.

Published Quarterly in January, April, July, and October. *Annual Subscription Rate* (1997): \$US 43.00 (Student), \$US 65.00 (Personal), \$US 135.00 (Institution). Subscribers outside of the USA please add \$US 10.00 for surface postage or \$US 50.00 for airmail postage and handling. Back issues (from Volume 3 onwards) are available at current subscription rates.

THE JOURNAL OF COASTAL RESEARCH is surveyed in *Aquatic Sciences and Fisheries Abstracts; Civil Engineering Hydraulics Abstracts; Current Awareness in Biological Sciences; Current Contents/Agriculture; Biology & Environmental Sciences; Ecology Abstracts; FLUIDEX (British Hydromechanics Research Association); Focus on: Global Change; GeoAbstracts (Geographical Abstracts: Physical Geography; Ecological Abstracts; Geological Abstracts; GEOBASE); GeoScience Contents; Institute of Scientific Information (USSR); Marine Science Contents Tables; Meteorological and Geostrophysical Abstracts; Oceanic Abstracts; Oceanographic Literature Review; Physics Abstracts; Pollution Abstracts; Selected Water Resources Abstracts (U.S. Geological Survey); Wetland Values Database (U.S. Fish & Wildlife Service); and SciSearch.*

JOURNAL OF COASTAL RESEARCH

SUBSCRIPTION INFORMATION

The **JOURNAL OF COASTAL RESEARCH** (JCR), official publication of the **Coastal Education & Research Foundation** (a non-profit corporation), acts as a basic world publication for coastal research. The journal publishes original contributions that deal with theory, methodology, techniques, and field or applied studies on inter-disciplinary topics. All aspects of coastal research are considered in the fields of biology, geology, oceanography, environmental (resource) management, engineering, and remote sensing, among others. JCR is surveyed in: *Aquatic Sciences and Fisheries Abstracts; Current Awareness in Biological Sciences; Current Contents/ Agriculture, Biology and Environmental Sciences; Ecology Abstracts; FLUIDEX (British Hydromechanics Research Association); GeoAbstracts; USSR Institute of Scientific Information; FAO Marine Science Contents Tables; Meteorological and Geostrophysical Abstracts; Oceanic Abstracts; Oceanographic Literature Review; Physics Abstracts, and Pollution Abstracts.*

JCR is published quarterly in about 1200 volume pages. ISSN No. 0749-0208.

FOUNDATION MEMBERSHIP BENEFITS

- Our scientific journal
- Participation and sharing with a distinguished international group of scholars and scientists
- Foundation newsletter
- Notices of meetings
- State-of-the-art reviews
- Reports of meetings
- Technical communications
- Book reviews
- News from affiliated societies
- Coastal calendar of events

Please enroll me as a member in the Coastal Education & Research Foundation.

My payment is enclosed for the category marked below:

1997 Volume 13, Numbers 1- 4 inclusive

- Regular membership and subscription (1 year) \$55.00/\$65.00 foreign*
- Student* membership and subscription (1 year) \$45.00/\$55.00 foreign

*Surface postage is included in the membership and subscription rates.

FOR LIBRARIES, SCHOOLS & ORGANIZATIONS

Subscriptions (when not for individual personal use)

SUBSCRIPTION (U.S.A.— LIBRARY) \$135.00

SUBSCRIPTION (OTHER COUNTRIES) \$145.00

PLEASE MAKE CHECK PAYABLE TO: CERF

NAME OF APPLICANT _____ DEGREE _____

ADDRESS FOR MAIL _____

City

State or Province

Zip Code

Country

Position or Title _____ Phone _____

*Student Status Certified by _____ Dept. Head _____

MAIL TO: 

JOURNAL OF COASTAL RESEARCH

P.O. BOX 1897

LAWRENCE, KS 66044, USA

Telephone (913) 843-1235

FAX (913) 843-1274