

COVER PHOTOGRAPH: BEACH SAND CONCENTRATED FROM RHODOLITH DEBRIS

Source: Journal of Coastal Research, 28(1)

Published By: Coastal Education and Research Foundation

URL: <https://doi.org/10.2112/1551-5036-28.1.ii>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.



www.JCRonline.org

COVER PHOTOGRAPH



www.cerf-jcr.org



BEACH SAND CONCENTRATED FROM RHODOLITH DEBRIS

The extreme southeast tip of Isla Carmen in the Gulf of California features a pristine, white-sand beach under protection within the Loreto Marine Park, Baja California Sur, Mexico. Sand deposited on this 150-m long beach is highly enriched (>80%) in coarse debris derived from wave-crushed rhodoliths (unattached coralline red algae). The Pleistocene limestone deposit in the foreground also is composed of massive rhodolith debris that includes rare whole rhodoliths (concentric growth of coralline red algae in spherical mode up to several centimeters in diameter). Both the limestone formation and the modern beach are underlain by basement rocks (Miocene andesite), which crop out as a protective headland at the far end of the beach. Living rhodoliths, naturally pink in color (Rhodophyta), form a large carbonate bank covering 194 hectares (480 acres) offshore this beach. See accompanying article by Rafael Riosmena-Rodríguez et al. in the special thematic section on rhodoliths (this issue). Photo taken at low tide. (Photograph and caption by Dr. Markes E. Johnson, Department of Geosciences, Williams College, Williamstown, Massachusetts, USA).

JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences

CHEF-HERAUSGEBER

EDITOR-IN-CHIEF

RÉDACTEUR-EN-CHEF

Charles W. Finkl

Coastal Education and Research Foundation, Inc. [CERF]

Editorial Offices:

1656 Cypress Row Drive
West Palm Beach, FL
33411, U.S.A.

e-mail: cfinkl@cerf-jcr.com
(Editorial Office, West Palm Beach)
CERF/JCR Website: <http://www.CERF-JCR.org>

BOOK REVIEW EDITOR

J.A.G. Cooper
University of Ulster
Coleraine, N. Ireland

MANAGING EDITOR

Tracy Candelaria
Allen Press Publishing Services
810 E. 10th Street
Lawrence, KS 66044, U.S.A.
tcandelaria@allenpress.com

PUBLISHING MANAGER

Christopher Makowski
CERF
1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.
cmakowski@cerf-jcr.com

EDITORIAL ASSISTANT

Barbara Russell
CERF
1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.
barbara@cerf-jcr.com

MITHERAUSGEBER

Edward J. Anthony
*Coastal Geomorphology,
Beach Morphodynamics
Dunkerque, France*
Cecile Baeteman
*Holocene Coastal Dynamics,
Sea-Level Change
Brussels, Belgium*
Kenneth Banks
*Coral Reef Geomorphology,
Habitat Mapping
Plantation, Florida*
Patrick Barnard
*Coastal Geomorphology
Santa Cruz, California*
Lindino Benedet
*Oceanography, Modeling
Florianópolis, Santa Catarina, Brazil*
David M. Bush
*Coastal Geology & Hazards
Carrollton, Georgia*
Ilya V. Buynevich
*Coastal Geology
Philadelphia, Pennsylvania*
Javier A. Carrió
*Sediment Processes, Marine Geology
Valencia, Spain*
Roger Charlier
*Ocean Energies, Coastal Erosion
Brussels, Belgium*
Paolo Ciavola
*Coastal Engineering,
Sediment Transport
Ferrara, Italy*
Mark Crowell
*Coastal Zone Management,
Coastal Erosion
McLean, Virginia*
Bijan Dargahi
*Sediment Transport,
Numerical Modeling
Stockholm, Sweden*
Robert Dean
*Coastal Engineering & Processes
Gainesville, Florida*
Omar Defeo
*Sandy Beach Ecology, Invertebrates
Montevideo, Uruguay*
Reinhard Dieckman
*Coastal Engineering & Geomorphology
Arnis/Schlei, Germany*
Joseph F. Donoghue
*Coastal Morphology & Hazards
Tallahassee, Florida*
Michael S. Fenster
*Shoreline Change,
Barrier Island Morphodynamics
Richmond, Virginia*
Oscar Manuel Ferreira
*Storm Impacts,
Beach Morphodynamics
Faro, Portugal*
Chip Fletcher
*Coastal Geology
Honolulu, Hawaii*

ASSOCIATE EDITORS

Gary B. Griggs
*Coastal Engineering & Hazards
Santa Cruz, California*
Pramod Hanamgond
*Coastal Geomorphology,
Sedimentology
Belgaum, India*
Hans Hanson
*Coastal Protection,
Numerical Modeling
Lund, Sweden*
Simon Haslett
*Paleoceanography, Coastal Evolution
Wales, United Kingdom*
Michael Hilton
*Dune Geomorphology & Ecology
Dunedin, New Zealand*
Carl H. Hobbs, III
*Coastal Geology, Sand Mining
Gloucester Point, Virginia*
Wenrui Huang
*Coastal Hydrodynamics & Hazards
Tallahassee, Florida*
Michael G. Hughes
*Coastal Morphodynamics,
Shelf Processes
Canberra, ACT, Australia*
Federico I. Isla
*Sea-Level Change, Remote Sensing
Mar Del Plata, Argentina*
Derek W.T. Jackson
*Aeolian Sediment Transport,
Beach Morphodynamics
Coleraine, Northern Ireland*
Nancy L. Jackson
*Coastal Geomorphology
Newark, New Jersey*
Markes E. Johnson
*Paleoshores, Coastal Sand Dunes
Williamstown, Massachusetts*
Dieter H. Kelletat
*Coastal Geomorphology,
Sea-Level Change
Essen / Cologne, Germany*
Joseph T. Kelley
*Sea-Level Change,
Salt Marsh Ecogeomorphology
Orono, Maine*
Syed Khalil
*Coastal Geology & Geophysics
Baton Rouge, Louisiana*
Antonio H.F. Klein
*Coastal Morphodynamics & Hazards
Florianópolis, Santa Catarina, Brazil*
Vic Klemas
*Remote Sensing,
Global Environmental Change
Newark, Delaware*
Nobuhisa Kobayashi
*Coastal Engineering
Newark, Delaware*
Vladimir N. Kosmynin
*Coral Reefs, Coastal Ecology
Tallahassee, Florida*
Joseph L. Kowalski
*Estuarine Plant Ecology
Edinburg, Texas*
Michael J. Lace
*Coastal Landforms & Processes
West Branch, Iowa*
Stephen P. Leatherman
*Barrier Islands, Beach Erosion
Miami, Florida*
Charles Lemckert
*Environmental Fluid Dynamics
Queensland, Australia*
Ioannis Liritzis
*Geophysical Proxy Data
Rhodes, Greece*
Jeffrey H. List
*Shoreline Change Processes
Woods Hole, Massachusetts*
Christopher Makowski
*Coastal Benthic Ecology,
Marine Ecosystem Monitoring
West Palm Beach, Florida*
Ashish J. Mehta
*Coastal & Oceanographic Engineering
Gainesville, Florida*
Nobuo Mimura
*Global Environmental Engineering
Ibaraki, Japan*
Robert Nicholls
*Global Climate Change,
Sea-Level Change
Southampton, United Kingdom*
Karl F. Nordstrom
*Coastal Geomorphology &
Dune Processes
New Brunswick, New Jersey*
Julian Orford
*Gravel Beaches, Storm Events
Belfast, Northern Ireland, UK*
Phil D. Osborne
*Sediment Dynamics,
Beach Morphodynamics
Shoreline, Washington*
Hugh Parker
*Airborne Lidar Bathymetry
Adelaide, South Australia, Australia*
Charitha B. Pattiaratchi
*Physical Oceanography
Crawley, Western Australia, Australia*
Michael Phillips
*Coastal Geomorphology
Swansea, Wales, United Kingdom*
Orrin H. Pilkey, Jr.
*Coastal Geology
Durham, North Carolina*
Paolo A. Pirazzoli
*Sea-Level Changes
Paris, France*
Nobert P. Psuty
*Coastal Geomorphology
New Brunswick, New Jersey*
Ulrich Radtke
*Coastal Geomorphology
Duisburg-Essen, Germany*

COMITÉ DE REDACTION

Elijah W. Ramsey, III
*Coastal Image Processing
Lafayette, Louisiana*
Richard C. Raynie
*Wetland / Marsh Restoration,
Coastal Erosion
Baton Rouge, Louisiana*
Kirt Rusenko
*Sea Turtles, Dune Restoration
Boca Raton, Florida*
Andrew D. Short
*Coastal Geomorphology,
Beach Morphodynamics
Sydney, New South Wales, Australia*
Pravi Shrestha
*Coastal Engineering
Irvine, California*
Tom Spencer
*Biogeomorphology,
Wetland Morphodynamics
Cambridge, United Kingdom*
Marcel Stive
*Coastal Hydrodynamics,
Sediment Dynamics
Delft, The Netherlands*
Vallam Sundar
*Coastal Engineering
Chennai, India*
E. Robert Thieler
*Marine Geology
Woods Hole, Massachusetts*
Frank Van Der Meulen
*Coastal Zone Management,
Climate Change
Delft, The Netherlands*
Henk Jan Verhagen
*Coastal Protection & Structures
Delft, The Netherlands*
Ian J. Walker
*Coastal Dunes, Sediment Transport
Victoria, British Columbia, Canada*
Ping Wang
*Beach Morphodynamics,
Sediment Transport
Tampa, Florida*
Allan Williams
*Coastal Geology
Swansea, Wales, United Kingdom*
Harry F. Williams
*Hurricane Sedimentation,
Paleotempestology
Denton, Texas*
Colin D. Woodroffe
*Coastal Geomorphology,
Sea-Level Change
Wollongong, Australia*
Philip L. Woodworth
*Sea-Level Change
Liverpool, United Kingdom*
Donald R. Young
*Coastal Plant Ecology
Richmond, Virginia*
Robert S. Young
*Coastal Processes & Management
Cullowhee, North Carolina*

The *JOURNAL OF COASTAL RESEARCH* (ISSN 0749-0208) is the official peer-reviewed publication of The Coastal Education and Research Foundation [CERF] and is published bimonthly in January, March, May, July, September, and November. The journal is available online at www.jcronline.org and subscriptions can be placed through www.CERF-JCR.org. Publishing services are currently available through CERF, 1656 Cypress Row Drive, West Palm Beach, FL 33441. Calendar-year (2012) print and online subscription prices for the JCR are: \$115.00 for US CERF members/\$125.00 for International CERF members (\$95.00 for online only), and \$519.00 for US Institutions/\$541.00 for International Institutions (\$437.00 for online only). Additional surface charges may apply to subscribers located outside of the USA. For additional subscription information, please go to www.CERF-JCR.org. Subscriptions, changes of address, and requests for missing issues should be sent to the JCR Subscriptions Office, Allen Press, P.O. Box 7065, Lawrence, Kansas 66044 or CERF@allenpress.com. Claims for copies lost in the mail must be received within 90 days (180 days foreign) of the issue date to insure replacement at no charge. Access to the archived JCR is available through JSTOR at <http://www.jstor.org/>.

Periodicals postage paid at Lawrence, KS, and additional mailing offices. POSTMASTER: Send address changes to *Journal of Coastal Research*, Allen Press Association Management, P.O. Box 1897, Lawrence, KS 66044.

© 2012 The Coastal Education & Research Foundation [CERF].

Ⓒ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

THE COASTAL EDUCATION AND RESEARCH FOUNDATION

1656 Cypress Row Drive
West Palm Beach, FL 33411, U.S.A.

Officers of the Foundation

Founded in 1983 by: Charles W. Finkl, Sr.,
Charles W. Finkl, Jnr., Rhodes W. Fairbridge,
and Maurice L. Schwartz

President & Executive Director:

Charles W. Finkl

Senior Vice President & Assistant Director:

Christopher Makowski

Vice President:

Syed Khalil

Secretary:

Heather M. Vollmer

Executive Assistant:

Barbara Russell

Board of Directors (Trustees)

Andrew Cooper	Victor Klemas	Maurice L. Schwartz
Robert Dean	Christopher	Andrew Short
Charles W. Finkl	Makowski	Daniel J. Stanley
Gary Griggs	Michael Phillips	Marcel Stive
Jim Houston	Orrin Pilkey	Allan Williams
Robert Huff	Norb Psuty	
Joseph Kelley	Elijah W. Ramsey, III	

Patron Members

Robert Wayne	Mark Crowell	Norbert P. Psuty
Anderson	Bijan Dargahi	Giovanni Randazzo
Luis Antonio	German Flor-Blanco	Adam Weir
Buenfil-Lopez	Carl H. Hobbs, III	Robert S. Young
Gustavo Bujalesky	Timothy W. Kana	
Nicholas K. Coch	Joan Oltman-Shay	

The Coastal Education and Research Foundation [CERF] is a nonprofit corporation dedicated to the advancement of the coastal sciences. The Foundation is devoted to the multi-disciplinary study of the complex problems of the coastal zone. The purpose of CERF is to help translate and interpret coastal issues for the public and to assist professional research and public information programs. The Foundation specifically supports and encourages field and laboratory studies on a local, national, and international basis. Through the medium of scientific publications, television, and radio CERF brings accurate information to the public and coastal specialists on all aspects of coastal issues in an effort to maintain or improve the quality of shoreline resources.

Because CERF is concerned with broad environmental issues, our efforts concentrate on significant problems such as maintenance of good quality (potable) water with adequate supply, and hazards associated with potential beach erosion, flooding, and susceptibility of developed shorelines to storm surge and wave attack. By focusing attention on these potential man-made and natural hazards, it is hoped that our research efforts will help others improve the quality of life in diverse coastal areas. CERF thus aims to stimulate awareness of coastal (marine and freshwater shorelines) land and water problems; initiate and foster research and innovation to promote long-term coastal productivity; establish an educational forum for the debate of contentious coastal issues; and develop new principles and approaches for enlightened coastal management, and encourage their adoption and use.

CERF is associated with the Department of Geosciences at Florida Atlantic University (FAU) in Boca Raton, Florida, and one of the main editorial offices for the *Journal of Coastal Research* (JCR) is located at the University. This partnership provides a basis for cooperative investigation, in private and public sectors, of biophysical resources found in open and naturally protected coastal regions, estuaries, large inland bodies of water bounded by shorelines, wetlands, and other coastal environments. Multidisciplinary studies at FAU's Department of Geosciences brings together experts from various fields in remote sensing, geographic information science, spatial ecology, environmental studies, marine biology, coastal geology, geography, and coastal engineering. Scientific investigative efforts by faculty, students, and staff span a wide and diversified range of interrelated topics that are relevant to solutions of today's dynamic problems. It is hoped that these combined attempts to better understand the nature of coastal processes will help forestall what may become contentious issues of tomorrow.

□ CERF MEMBERSHIP □

Members are individuals that support the aims of the foundation through personal and group efforts or by donations. Memberships are available in different categories with privileges.

Subscription information is available online at www.cerf-jcr.org. Subscriptions office: Allen Press, Inc., P.O. Box 1897, Lawrence, KS 66044, U.S.A. CERF@allenpress.com

Editor-in-Chief

Charles W. Finkl Ph.D., CSci, CMarSci, FIMarEST, CPGS, CPSSc, PWS

Dr. Charles W. Finkl is President and Executive Director of the Coastal Education & Research Foundation [CERF], publisher of the JCR. Charlie, a founding editor of the *Journal of Coastal Research*, has served as Editor-in-Chief for the past 27 years. He is a Research Professor in the Department of Geosciences at Florida Atlantic University in Boca Raton, Florida. He received his Bachelor and Master of Science degrees from Oregon State University and the Ph.D. from the University of Western Australia. He is a member of more than 20 professional societies and has published more than 200 professional papers, books, and reports. He is a Chartered Marine Scientist (CMarSci) [Institute of Marine Engineering, Science and Technology], Certified Professional Geological Scientist (CPGS) [American Institute of Professional Geologists (AIPG)], Certified Professional Soil Scientist (CPSSc) [American Registry of Certified Professionals in Agronomy, Crops, and Soils], and a Professional Wetland Scientist (PWS) [Society of Wetland Scientists]. Charlie has field experience in parts of the USA, Caribbean area, Brazil, Honduras, Russia, South Africa, Western Europe, Australasia, and South Pacific islands. He is also the Series Editor of the Encyclopedia of Earth Sciences Series that is published by Springer (Germany). There are more than twenty-eight volumes in the Series and about twenty-five are available online. Charlie also serves on the Editorial Board of the *International Journal of Environmental Studies* (Routledge) and is an occasional peer reviewer for many other professional journals.

Charlie has interests and expertise in the general areas of surficial geology, coastal and marine geomorphology (including coastal classification), coastal/marine biophysical environments, exploration geochemistry, soils and weathering (regolith geology), coastal zone management and engineering applications or impacts on natural systems (including erosion control and shore protection), coastal hydrology including submarine freshwater and mineralized seeps, subaerial and marine structural geology, natural hazard mitigation in coastal zones, marine environments and coastal wetland protection and restoration, and remote sensing (e.g. land cover classification in coastal wetlands, advection-diffusion turbidity plumes in coastal waters, delineation of bottom types and sand resources), effluent disposal and pollution of wetlands and estuaries, water resources mapping and conservation, time series studies of wetland hydroperiod and soil moisture.

Foundation Meetings

International Coastal Symposia (ICS)

The International Coastal Symposium (ICS) was set up by Per Bruun (deceased) and Charlie Finkl, the first meeting being held in Hilton Head, South Carolina, in 1993. Since then these CERF meetings were held a second time in Hilton Head and then in Palm Beach, Florida. With the success of these meetings, CERF moved the ICS to the international scene holding meetings in conjunction with local sponsors in Australia, Brazil, Iceland, New Zealand, Northern Ireland, and Portugal. Forthcoming meetings will be held in Szczecin, Poland (11th ICS hosted by Dr. Kazimierz Furmanczyk at the University of Szczecin), and Plymouth, United Kingdom (12th ICS hosted by Dr. Gerd Masselink at the University of Plymouth). The ICS deals with all aspects of the coastal zone and attracted more than 600 delegates to the 10th ICS, organized by the Faculdade de Ciências Sociais e Humanas – UNL in Lisbon, Portugal. For more information, please visit www.cerf-jcr.org



JOURNAL OF COASTAL RESEARCH

An International Forum for the Littoral Sciences



Supporting Scientific Organizations

- **AZTI** - Tecnalia [Pasaia, Spain; www.azti.es/]
- Coastal and Hydraulics Laboratory (**CHL**), US Army Corps of Engineers® [Vicksburg, Mississippi, U.S.A.; <http://chl.erdc.usace.army.mil/>]
- Coastal and Marine Geology Program (**CMGP**), U.S. Geologic Survey (USGS) [Reston, Virginia, U.S.A.; <http://marine.usgs.gov/>]
- Coastal Research Laboratory (**CRL**), University of South Florida [Tampa, Florida, U.S.A.; <http://crl.usf.edu/>]
- Commission on Coastal System (**CCS**), International Geographical Union (**IGU**) [<http://www.igu-ccs.org/>]
- Consorzio Nazionale Interuniversitario per le Scienze del Mare (**Co.N.I.S.Ma.**) [Rome, Italy; www.conisma.it/]
- Deltares Institute [Delft, The Netherlands; <http://www.deltares.nl/en/coast-sea>]
- Department of Geosciences, Florida Atlantic University (**FAU**) [Boca Raton, Florida, U.S.A.; <http://www.geosciences.fau.edu/>]
- e-Geo Center for Geographical and Regional Planning Studies [Lisbon, Portugal; <http://e-geo.fcsh.unl.pt/>]
- Institute of Marine and Coastal Sciences (**IMCS**), Rutgers University [New Brunswick, New Jersey, U.S.A.; <http://marine.rutgers.edu/main/>]
- Louisiana Office of Coastal Protection and Restoration (**OCPR**) [Baton Rouge, Louisiana, U.S.A.; www.ocpr.louisiana.gov/]
- Royal Belgian Institute of Natural Sciences: Management Unit of the North Sea Mathematical Models (**MUMM**) [Brussels, Belgium; www.mumm.ac.be/]

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.

Advertising, Editorial, and Subscription Information

Advertising and Editorial Office: All advertising and editorial correspondence should be sent to Dr. Charles W. Finkl, Editor-in-Chief, *Journal of Coastal Research*, 1656 Cypress Row Drive, West Palm Beach, FL 33411, U.S.A. PHONE: 561.313.0926. E-MAIL: CFinkl@CERF-JCR.com.

Subscription Information: The *Journal of Coastal Research* is a bimonthly publication. Calendar-year (2012) print and online subscription prices for the JCR are: \$115.00 for US CERF members / \$125.00 for International CERF members (\$95.00 for online only), and \$519.00 for US institutions / \$541.00 for International institutions (\$437.00 for online only). Additional surface charges may apply to subscribers located outside of the USA. For additional membership and subscription forms and information, please go to www.CERF-JCR.org. To obtain a membership or subscription form by mail, please send request to *Journal of Coastal Research*, P.O. Box 7065, Lawrence, KS 66044. Back Issues and Special Issues of the JCR, when available, can be directly purchased at www.CERF-JCR.org.

The *Journal of Coastal Research* is currently surveyed in *Applied Science & Technology Abstracts*; *Applied Science & Technology Index* (H.W. Wilson); *Aquatic Sciences & Fisheries Abstracts*; *BIOBASE*; *Biological Abstracts*; *BIOSIS Previews* (Thomson); *CAB International Abstracts* (CABI); *CSA Civil Engineering Abstracts* (ProQuest); *Current Awareness in Biological Sciences* (Elsevier); *Current Contents/Agriculture, Biology, & Environmental Sciences* (Thomson); *Ecology Abstracts* (ProQuest); *Environmental Sciences & Pollution Management*; *GeoAbstracts* [Geographical Abstracts: Physical Geography; Ecological Abstracts; Geological Abstracts; *GEOBASE*] (Elsevier); *GeoRef*; *Meteorological & Geostrophysical Abstracts* (ProQuest); *Oceanic Abstracts* (ProQuest); *Oceanographic Literature Review* (Elsevier); *Physical Sciences Digest* (CSA, Ebsco); *Pollution Abstracts* (ProQuest); *Referativnyi Zhurnal*; *Science Citation Index*; *SciSearch* (Thomson); *SCOPUS*; *Water Resources Abstracts* (Bethesda); *Zoological Record* (Thomson).