

Africa Partnership Station: Coastal Processes

Cheryl Hapke
U.S. Geological Survey
384 Woods Hole Rd.
Woods Hole, MA 02543
phone: (508) 457-2297 fax: (508) 457-2310 email: chapke@usgs.gov

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Andrew Ashton
Woods Hole Oceanographic Institution
MS #22, 360 Woods Hole Rd.
Woods Hole, MA 02543
phone: (508) 289-3751 fax: (508) 457-2187 email: aashton@whoi.edu

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LONG-TERM GOALS

The goal of this research is to assist with the development of research capabilities of Gulf of Guinea nations and to increase the ability of these nations to predict and mitigate coastal hazards. This is being accomplished through sponsoring and developing the coastal processes research capabilities of these nations and their university systems. Initial activities are focusing on the research group within the Department of Oceanography and Fisheries of the University of Ghana (UG) in Accra, with a goal of not only increasing the capabilities of Ghana to monitor and manage their coast, but to develop UG as a center of research excellence for the Gulf of Guinea region.

OBJECTIVES

The objectives of these research activities are to provide guidance to the developing coastal processes research program at the Department of Oceanography and Fisheries, University of Ghana, Accra, Ghana. Development of this program is anticipated to aid maritime governance capabilities and social stability within Ghana. Over the short term, the goal is to assist with the development of the capabilities UG needs to assess local coastal processes and hazards and to provide technical assistance for ongoing monitoring of coastal change. Development of technological capabilities (coastal processes expertise, terrestrial surveying, bathymetric surveying, wave computation, coastal change modeling, GIS skills) is intended to lead to a self-sustaining research group at the University of Ghana that can then independently pursue other research questions and seek other party funding, both locally and internationally. In 2010, the PIs continued to serve in an advisory role by providing technical assistance associated with coastal processes research conducted by the UG (PI Wiafe), with particular emphasis on shoreline change mapping, geomorphic characterization, and development of large-scale numerical models of coastal evolution. An objective for future activities is the development of

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independently funded international-quality collaborative research between the PIs and the coastal researchers at UG.

APPROACH

This project consists of technical advising and the development of collaborations between the PIs and UG scientists. The primary means of interaction has been periodic interaction via email and telephone conversations, visits by UG researchers to Woods Hole, and yearly trips by the PIs to UG to engage directly with the researchers, students, and staff at UG. The initial visit, occurring in February 2009, was a week-long workshop at the University of Ghana in which included scientific presentations, field visits that included collection of preliminary topographic survey data, hands-on computer analysis exercises, and small-group discussions. A second visit by the PIs to Ghana in June of 2010 included a more intense field effort followed by detailed discussions regarding development of publications and discussing future project direction and needs. Additional interactions between UG and USGS included ongoing assessments of historical imagery and maps for coastal change analyses and a visit to WHOI by a UG faculty member during April of 2010.

WORK COMPLETED

Fieldwork, updates on historical data acquisition and processing, and scientific discussions were undertaken from June 20-July 1, 2010. Participants included ONR-funded researchers Andrew Ashton of the Woods Hole Oceanographic Institution (WHOI) and Cheryl Hapke of the U.S. Geological Survey (USGS) and researchers in the Department of Oceanography and Fisheries, University of Ghana (UG), Accra, Ghana, including George Wiafe, Selorm Ababio, Kwasi Appeaning Addo, and Kwame Adu Agyekum. Prior to the site visit, Cheryl Hapke (USGS) assisted with the identification and acquisition of historical maps of the Ghana coast from the U.S. National Archives in College Park MD.

Field work in June 2010 included numerous site visits (Figure 1) along the 550-km-long Ghanaian coast with the objectives of:

- Conducting regional geomorphic characterization
- Assessing present state of erosion hazard/ hazard potential
- Collecting beach sediment samples for assessment of grain size
- Engaging in field discussions of coastal processes and the impacts of shoreline-erosion mitigation measures
- Collecting ground-penetrating Radar (GPR) data in beach ridge and delta locations

Interaction continued at UG the following week, including updates by UG faculty and students on data collection, processing and analysis of regional shoreline change and local beach monitoring studies; issues and troubleshooting of existing shoreline change data; presentation of theoretical aspects of coastal evolution by Andrew Ashton (WHOI) that are likely applicable to understanding chronic erosion hazards along portions of the Volta Delta; and detailed discussion and formulation of peer-review publications that will be developed as a result of the collaborative research efforts.



Figure 1. Variable geomorphology and erosion hazards along the coastline of Ghana: (a) collecting GPR data near New Town; (b) actively eroding coastal bluffs at Old Ningo; (c) lagoonal clays (arrow) exposed in beach face at Akpabanya; (d) lagoonal clays (arrow) exposed in eroding road grade, Akplortorkor.

Ongoing collaborations were planned to apply an existing model of shoreline evolution (Ashton and Murray, 2006) to the Volta Delta coast and to finalize a systematic analysis of recent and historical data appropriate for regional change analyses (Hapke et al., 2009). Tentative plans were made to have a follow-up workshop in the winter of 2011 that would include UG participants, Hapke (USGS) and Ashton (WHOI), as well as collaborators from the University of New Hampshire (Tom Lippmann) and UNESCO-IHE (Dano Roelvink).

RESULTS

The successful fieldwork and subsequent collaborative discussions resulted in significant improvement of an understanding of the regional coastal geology and geomorphology of the Ghana coast. Ten site visits were undertaken, covering the extent of Ghana's 550 km coast, extending from Newtown at the Côte d'Ivoire-Ghana border in the west to Denu, near the eastern border of Ghana and Togo. At each site, a description of the general geomorphology was recorded (barrier beach, bluffed coast, rocky coast, river mouth etc.), along with GPS location and descriptive measurements such as beach width and height of back beach feature (dune or bluff). A sample of beach sediment was also collected at each site to examine the regional distribution of grain size and variation in composition. Ground penetrating radar (GPR) data were collected at 3 additional sites: Newtown (a region that has not previously been surveyed with GPR) and 2 locations within the extensive Volta Delta complex.

After returning from the field, the group reviewed photographs taken in the field and engaged in assessments of potential erosion problems, hazards, and how these are likely tied to the variable geomorphology, sediment sources, and wave climate along the coast. Preliminary analysis of the wave climate trends (and consequent predicted trends in alongshore transport and shoreline stability; Figure 2) were presented, with comparison made to the numerical model of shoreline change by Ashton and Murray (2006a; 2006b). Future collaboration plans involve comparing these first-order predictions of shoreline change patterns with shoreline change measurements along the Volta Delta. The UG group provided an update of the progress of the historical shoreline change analysis, an outline of a peer-review paper detailing the analysis was drafted, and a tentative schedule for completion of the analysis and paper was discussed.

The site visit and ensuing collaborations will be the focus of an invited abstract that is to be presented as part of the Nearshore Processes session at the American Geophysical Union meeting in San Francisco, CA in December 2010 (Hapke et al., 2010).

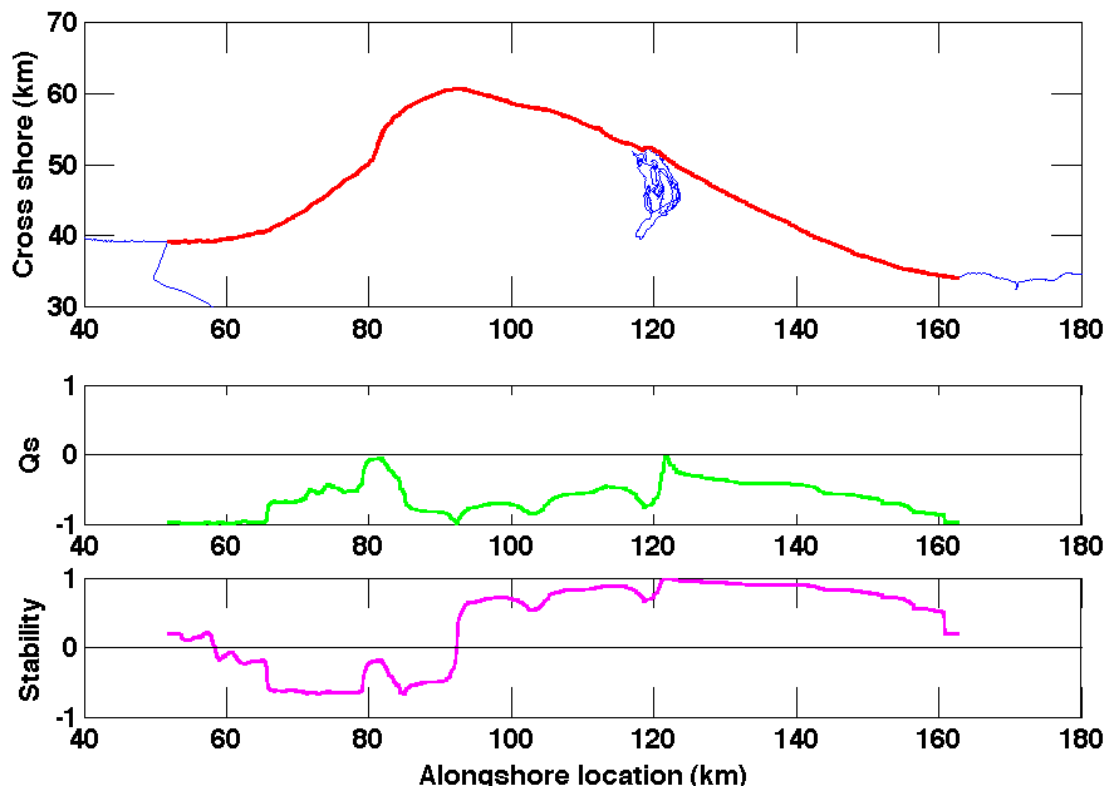


Figure 2. Trends in alongshore sediment transport (Q_s , positive to the right, looking offshore) and shoreline instability (after Ashton and Murray, 2006b) along the Volta Delta, eastern Ghana coast, using hindcast data from NOAA WaveWatch III, 1997-2005. In the east, zones of predicted shoreline instability (<0) match regions of large coastal fluctuation and increased hazard.

IMPACT/APPLICATIONS

This project addresses the overarching goal of improving maritime security in the Gulf of Guinea, and specifically in Ghana. A short-term impact will be assessment of coastal hazards along the Ghana coast and development of a research plan to increase coastal safety through hazard identification and mitigation. Research over this last year, with visits to Ghana and in the US, continued the development of scientific relationships between the PI's and African coastal researchers. Over the long term, the objective is to develop the independent research capabilities of the University of Ghana to improve the national capabilities in coastal hazards management and eventually maritime and fisheries management.

RELATED PROJECTS

Award Number: N00014-10-IP-20085; Preliminary Investigations of Erosional and Accretional Hotspots along the Ghanaian Coast (Alex Apostos, USGS).

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