Research Proposal Submitted to

UNITED STATES GEOLOGICAL SURVEY
Reston, Virginia 20192

by

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

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U.S.G.S./W.H.O.I. COOPERATIVE AGREEMENT

Principal Investigator: Dr. Laurence P. Madin
5 Years Duration with Yearly Renewals
April 1, 2010 to March 31, 2015

Proposal Starting Date: April 1, 2011

Second Year Request: $3,858,031

A COOPERATIVE AGREEMENT

BETWEEN

WOODS HOLE OCEANOGRAPHIC INSTITUTION

AND

UNITED STATES GEOLOGICAL SURVEY

WOODS HOLE SCIENCE CENTER

WOODS HOLE, MA 02543

April 1, 2011–March 31, 2012
(Second Year Request)

Submitted: February 9, 2011

Abstract

Scientists at WHOI conduct a broad range of basic and applied oceanographic research in the world oceans. The USGS describes marine and coastal systems, attempts to understand the fundamental processes that create, modify and maintain them, and develops predictive models that provide understanding of natural systems, the effects of man's activities on them, and creates a capability to predict future change.

This Cooperative Agreement between the Woods Hole Oceanographic Institution (WHOI) and the Branch of Atlantic Marine Geology of the U.S. Geological Survey (USGS) provides a mechanism to support areas of joint research and support activities between the two organizations. It is based on the principles set forth in A Memorandum of Understanding (MOU), signed in 1988, which provides the foundation for long-term cooperation between WHOI and USGS for the purpose of providing information and products to guide the preservation and sustainable development of the nation's marine and coastal environment.

A list of projects proposed for CY2010-2011 may be found on pages 36-38. The projects and funding levels will be reviewed each program year by USGS and WHOI. New projects may be added, within the broad areas established here as scientific requirements change and new opportunities develop.

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INTRODUCTION

This Cooperative Agreement between the Woods Hole Oceanographic Institution (WHOI) and the Branch of Atlantic Marine Geology of the U.S. Geological Survey (USGS) provides a mechanism to support scientific and technical interactions between the two organizations. Scientists at WHOI conduct a broad range of basic and applied oceanographic research in the world oceans. The USGS describes marine and coastal systems, attempts to understand the fundamental processes that create, modify and maintain them, and develops predictive models that provide understanding of natural systems, the effects of man's activities on them, and creates a capability to predict future change. The program addresses issues of national importance in the areas of environmental quality and preservation, natural hazards and public safety, and natural resources, providing information and comprehensive understanding of marine and coastal geology for public benefit. The program will provide information and products to guide the preservation and sustainable development of the nation's marine and coastal environment.

A Memorandum of Understanding (MOU), signed in 1988, provides the foundation for long-term cooperation between WHOI and USGS. The MOU defines broad areas of joint research and support activities, documents the intent of the organizations in facilities agreements, and establishes an Advisory Board with representation from both organizations to oversee and guide cooperative efforts. This Cooperative Agreement is based upon the principles set forth in the MOU.

The scientific and technical staffs of USGS and WHOI have jointly developed the co-operative projects proposed here; they are closely coupled to the research programs of both organizations. The staff recognizes the increased productivity and creativity, which result from scientific interactions, and looks forward to implementation of the studies proposed here.

This Agreement will establish cooperative programs for 5 years. The projects and funding levels will be reviewed each fiscal year by USGS and WHOI. New projects may be added, within the broad areas established here as scientific requirements change and new opportunities develop.

PROPOSED ELEMENTS OF THE COOPERATIVE AGREEMENT

The Woods Hole Oceanographic Institution is administratively organized into 5 depart-ments (Biology, Marine Chemistry and Geochemistry, Geology and Geophysics, Applied Ocean Physics and Engineering, and Physical Oceanography), as well as Centers. Although projects are often interdisciplinary and similar research may be conducted in more than one department or Center, projects in this Cooperative Agreement are presented according to the WHOI organizational structure for administrative simplicity. This section contains a listing of the proposed Cooperative research projects, a general description of the objectives and specific statements of work for the prospective fiscal year. Budgets for the fiscal year's work are included at the end of this proposal.

I. BIOLOGY

Planned and Planned and possible investigations in biology will examine the temporal and spatial distributions and controlling factors of potentially harmful marine organisms. Studies include effects that variations in the composition and abundance of certain organisms have on coastal ecosystems, and the influence of the environment on organisms, for example, physical- or chemical-biological interactions, including impacts on economic resources and quality of life. The cooperative investigations will provide basic information on the interactions of physical, geological, chemical and biological components of coastal ecosystems.

PROJECTS

BIO-1. Marine Habitat Studies

WHOI PI: M. Carman
USGS PI: P. Valentine

Description: The USGS is conducting studies of marine habitats on the continental shelf, slope, and deep-ocean areas in the U.S. EEZ. These studies involve mapping of physical features and benthic communities, and research into the geologic, physical oceanographic and chemical processes that affect a habitat. Objectives are to (1) locate and quantify important mineral and living resources; (2) understand the processes that affect benthic habitat quality and diversity; (3) provide basic geologic and habitat maps to support a variety of management decisions; and (4) develop predictive models of habitat occurrence. Scientists at the Woods Hole Oceanographic Institution will collaborate in collecting, interpreting and using biological data in studies of marine habitats.

CY2011-12 Activities: WHOI will provide expertise on the ecology of the invasive tunicate *Didemnum vexillum* in studies that combine biological and geological approaches: (a) to determine the role of water temperature in the timing of reproduction and larval settlement of *Didemnum*; (b) to predict the spread of the species in coastal and offshore habitats; and (c) to determine the effects of *Didemnum* on shellfish aquaculture and on groundfish and scallop habitats.

BIO-2. Transport and Fate of Harmful Algal Blooms (HABs)

WHOI Co-PIs: D. Anderson and D. McGIllicuddy and others
USGS Co-PIs: R. Signell and B. Butman and others

Description: Harmful algal blooms (commonly called red tides) are a major threat to public health, fisheries, and tourism in southern New England. Of particular importance are blooms of the toxic dinoflagellate *Alexandrium fundyense* that cause paralytic shellfish poisoning (PSP), a potentially fatal syndrome associated with the consumption of shellfish that have accumulated the dinoflagellate toxins. Large sections of the Canadian and New England coastline are closed nearly every year due to PSP, and vast areas of offshore shellfish resources are closed as well.

Alexandrum fundyense has a dormant, cyst stage in its life history that plays a major role in the location and timing of bloom initiation and decline, and in the dispersal of the species to new areas. Maps of cyst abundance are now used to initialize physical-biological models of *Alexandrium* dynamics in the Gulf of Maine. These models, which were formulated in part through WHOI/USGS collaboration, match observations of water column structure and *A. fundyense* abundance very well, and are now seen as the foundation of an operational PSP

forecasting system that will be supported by NOAA's National Ocean Service in the coming years.

Despite the importance of cysts in *A. fundyense* population dynamics, shellfish toxicity, and forecasting throughout this large region, many issues related to their formation, deposition, burial, resuspension, and transport remain. For example, we can predict where cysts will form in surface waters during *A. fundyense* blooms, but have not yet modeled the transport of the cells as they fall to the sediments, nor have we simulated their fate once deposited (i.e., whether they will be resuspended, buried, or consumed, and once buried, whether they will germinate or die within the sediments). This project will carry out studies to understand the transport and fate of cysts in coastal waters.

CY2011-12 Activities: Cooperative research will be carried out to explore the transport and fate of *Alexandrium* cysts in the Gulf of Maine using the new USGS sediment transport algorithms in the Regional Ocean Modeling System (ROMS). Studies of surficial sediment dynamics as they affect *Alexandrium* cyst deposits in New England coastal sediments will be carried out. WHOI will provide opportunities to USGS scientists to participate on the GOMTOX cruises for sample collection as jointly determined. WHOI will provide expertise in cyst distribution, cell biology and behavior.

II. MARINE CHEMISTRY AND GEOCHEMISTRY

Cooperative projects in Marine Chemistry and Geochemistry will be concerned with understanding the processes, which control the distribution of chemical species in the ocean and its sediments. They will attempt to understand the extent to which the chemical environment may be altered by both natural and man-made phenomena that operate on a variety of time scales.

The cooperative projects will develop and apply a variety of chemical techniques to the study of marine geochemical processes. One emphasis will be on contaminants in the coastal ocean – their transport pathways, biogeochemical interactions and their ultimate fate. The processes will include circulation, scavenging, particle sinking, and rates of sediment mixing and accumulation.

WHOI PI's: K. Buesseler, M. Charette, P. Henderson, P. Lam, C. Lamborg, W. Martin, L. Robinson, J. Seewald, C. Reddy.

USGS PI's: M. Bothner, J. Crusius, J. Bratton, K. Kroeger, A. Schroth, K. Schanlon, J. Pohlman.

PROJECTS

MCG-1. Quantifying Submarine Groundwater Discharge and Associated Nutrients to the Coastal Zone using Natural Tracers and Seepage Meters

WHOI Co-PI's: Matthew Charette and Paul Henderson
USGS Co-PIs: J. Crusius, J. Bratton and K. Kroeger

Description: Submarine groundwater discharge (SGD) is often ignored when constructing geochemical budgets for elements in near shore environments, mainly because the volume flux is difficult to estimate (Burnett et al. 2001). However, many studies indicate that SGD may carry significant quantities of nutrients and trace metals to the ocean (Simmons, 1992; Moore, 1996; Krest et al. 2000; Montlucon and Sanudo-Wilhelmy, 2001). In the case of nutrients, SGD has

been the principal mechanism for eutrophication in many coastal embayments throughout the world (e.g. Valiela et al. 1990).

In this joint project, WHOI and USGS personnel will apply and refine various approaches for quantifying SGD including natural tracers (radium isotopes, radon) and automated seepage meters. Radium isotopes and radon have proven to be useful tracers of total SGD in many environments on both small and large scales from salt marshes (e.g. Rama and Moore, 1996; Cable et al. 1997) to the continental shelf (Moore, 1996). Samples collected will be analyzed for inorganic nutrients and trace metals to determine the load to an embayment within the watershed. Automated seepage meters have revealed the subtle connection between SGD and both sea level and aquifer recharge rates (e.g. Sholkovitz et al. 2003). These studies may be carried out in various local embayments or in other locations where basic or applied science questions related to SGD can be effectively addressed.

References cited:

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Moore, W.S. 1996. Large groundwater inputs to coastal waters revealed by 226Ra enrichments. Nature. 380: 612-614.

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Rama, and W.S. Moore. 1996. Using the radium quartet for evaluating groundwater input and water exchange in salt marshes. Geochim. Cosmochim. Acta. 60: 4645-4652.

Sholkovitz, E.R., C. Herbold, and M.A. Charette. 2003. An automated dye-dilution based seepage meter for the time-series measurement of submarine groundwater discharge, Limnol. Oceanogr.:Meth., 1, 17-29.

Simmons Jr., G. M. 1992. Importance of submarine groundwater discharge (SGWD) and seawater cycling to the material flux across sediment/water interfaces in marine environments. Mar. Ecol. Prog. Ser. 84: 173-184.

Valiela I., J. Costa, K. Foreman, J.M. Teal, B. Howes, and D. Aubrey. 1990. Transport of groundwater-borne nutrients from watersheds and their effects on coastal waters. Biogeochem. 10: 177-197.

CY2011-2012 Activities: Activities include further development (both laboratory and field testing) of a radon mapping system for detecting SGD hotspots in the coastal environment and joint development of other tools and methods as necessary to meet evolving SGD project priorities. Also included is support for measurement of nutrients, a key ancillary measurement for all SGD studies, to be conducted at the WHOI Nutrient Analytical Facility.

MCG-2. Isotope Inventories and Sedimentary Processes in Coastal Marine Areas. Improvements to the Shared Gamma Counting Facility

WHOI PI: K. Buesseler
USGS PI: M. Bothner

Description: Undisturbed sediment cores collected from marine and freshwater environments will be analyzed for 210Pb, 234Th and 137Cs by gamma spectroscopy. The

sediment depth-profiles will be used to interpret the rates of sediment mixing and accumulation at the sites sampled. The inventories of the radioisotopes will be used to identify the relative potential for depositional areas to accumulate contaminants. The data from Boston Harbor and adjacent coastal waters will have implications for predicting and monitoring changes in the distribution of contaminants in response to the continuing reduction wastes discharged through Boston's sewage treatment system. Samples from coastal and mountain lakes will be analyzed to determine the fluxes of atmospherically transported contaminants such as mercury and lead.

Similar work is proposed on sediment cores in selected locations off the Hawaiian Islands where deforestation has increased the sediment flux to coral reefs. Higher turbidity and siltation is suspected of degrading the health of the reef. A time history of sedimentation and a chemical and mineralogical characterization of the recently deposited sediments should confirm the timing and source of increased sediment flux. The chemical characterization of coastal sediments will utilize the WHOI ICP MS facility.

CY2011-2012 Activities: An additional objective of this project is to increase the capability and efficiency of the joint USGS-WHOI counting facility for gamma-emitting radioisotopes. The project will continue to replace or supplement existing systems with state-of-the-art electronics and custom software, which will be developed to increase the system's ability to accept a wide variety of sample types. Calibrations via participation in interlaboratory intercomparison studies and assessment of detector efficiency for different sample types and geometry may be conducted.

MCG-3. Trace Element and Isotopic Analyses by High-Resolution and Multi-Collector

WHOI PI: P. Lam
USGS Co-PIs: J. Crusius and A. Schroth

Description: WHOI and USGS personnel will collaborate to carry out high-precision analyses using WHOI's state of the art inductively coupled plasma mass spectrometry (ICP-MS) facilities. A variety of projects examining the fate and cycling of trace elements in coastal surface waters, groundwaters and sediments may use this instrumentation. Analyses could include element and/or stable isotope analyses of sediments, porewaters, groundwater and seawater samples.

CY2011-2012 Activities: WHOI ICP-MS instruments will be used for determination of elemental concentration and isotopic composition of a variety of water, sediment and rock samples.

MCG-4. Mercury Methylation in Bays and Coastal Ponds of Cape Cod

WHOI Co-PIs: Carl Lamborg and William Martin
USGS PI: Mike Bothner

Description: In collaboration with Mike Bothner of the USGS (Woods Hole) and Bill Martin (WHOI), I am engaged in on-going studies of the cycling of mercury (Hg) in embayments and coastal ponds on Cape Cod. This work has broad societal importance as the biogeochemical transformation of this toxic metal into the highly bioaccumulative monomethylHg (MMHg) form occurs within these aquatic systems. Thus, transformation of Hg to MMHg within such systems is the first step which can eventually lead to the accumulation of Hg in commercial fisheries and human exposure.

Similar studies are currently underway in different sorts of fresh and saltwater ecosystems, but the situation of our Cape bays and ponds is unique and of environmental importance. These

systems have direct hydrological and biological connection with the coastal ocean, and can therefore represent an importance source of Hg and MMHg to the ocean through Hg export or transport within forage fish ("bioadvection") that spawn and develop within these estuarine environments. Thus, we are systematically developing an understanding of the sources and sinks of Hg and MMHg within these bays and ponds through a combination of sediment, water, biota and atmospheric studies. In this effort, we are supported by and are making use of additional USGS projects that are/have characterized atmospheric deposition of Hg species in the region, as well as groundwater height monitoring.

Over the next several years we plan to focus our attention on a number of research themes, including:

- Hg and MMHg inputs to bays and ponds via groundwater.
- MMHg production in sediments and at the water column oxic/anoxic interface.
- Reconstructions of historic loadings to local bays and ponds.
- Relative importance of water, particulates and biota in the export of Hg and MMHg from bays and ponds.
- Range of microbiological metabolisms that give rise to net MMHg production.
- Dissolved organic carbon controls on Hg bioavailability to methylating microorganisms.
- Photochemistry of Hg(II) and MMHg and its importance as a sink for Hg from local bays and ponds.
- Sandy, tidally pumped sediments as highly effective sites for MMHg production and supply to the coastal ocean.

CY2011-2012 Activities: In the upcoming calendar year, we plan to extend our previous exploratory work by focusing on a few experiments. To this end, we will work primarily in Oyster Pond (Falmouth, MA) which contains a range of geochemical conditions and is therefore an ideal laboratory for our investigations. As time permits, we may also extend some of our investigations to nearby ponds, such as Salt Pond, which are more tidally influenced.

In particular, we will pursue seasonal measurements of Hg speciation in the water column and sediment/porewaters of Oyster Pond as well as methylation rate measurements in sediment and water using stable isotope spiking experiments. These measurements are made possible by adding one of Hg's seven stable isotopes to environmental samples, incubating these materials for a short time (1-2 days) and then assaying the amount of the added isotope that has been converted through the use of liquid or gas chromatography and inductively coupled mass spectrometry.

We will also spend some time developing innovative high resolution water column sampling equipment, which will allow a more precise description of the sharp gradients in Hg speciation, as well as other water quality parameters (oxygen, salinity, sulfide, nutrients, nitrous oxide, ammonium and dissolved organic carbon).

MCG-5. Geological and Geochemical Studies of Marine Carbonate Habitats

WHOI PI: L. Robinson
USGS PI: K. Scanlon

Description: The USGS is conducting studies of marine habitats on the continental shelf, slope, and deep-ocean areas in the U.S. EEZ and other key marine areas. These studies involve mapping of physical features and benthic communities, and research into the geologic, physical oceanographic and chemical processes that affect habitats today, in the past and in the future. Specific objectives are to (1) locate and quantify cold-water coral habitats; (2) understand the processes that affect benthic habitat quality and diversity; (3) provide basic geologic and

habitat maps to support a variety of management decisions; and (4) develop predictive models of habitat occurrence (5) assess growth rates and age distribution of cold-water coral populations (6) perform geochemical measurements on coral skeleton to reconstruct recent and past climate change (7) use integrated spatial and temporal mapping approaches to assess impacts of climate change on marine carbonate habitats and their associated fauna.

CY2011-2012 Activities: Scientists at WHOI will collaborate in collecting, interpreting and using biological, physical and chemical data in studies of marine habitats both for modern day and fossil benthic communities. WHOI will provide expertise in geochemistry, paleoceanography, and cold water coral ecosystems to support USGS habitat mapping, and database activities.

MCG-6. Biogeochemical Investigations of Gas Hydrate Systems

WHOI Co-PIs: J. Seewald and C. Reddy
USGS PI: J. Pohlman

Description: Delineating the biogeochemical cycles that create, consume and transform methane and other hydrocarbons associated with gas hydrate bearing systems requires diverse and sophisticated field sampling programs and analytical techniques. Collectively, the USGS and WHOI have the skills and infrastructure to execute complex, state-of-the-art research programs in this area. In this project, scientists from WHOI and USGS will collaborate to 1) organize and execute oceanographic expeditions in gas hydrate-bearing systems and 2) apply and develop techniques for analyzing samples collected during the field campaigns.

CY2011-2012 Activities: WHOI laboratory and analytical facilities will be used to analyze samples from ongoing and future investigations. Ongoing investigations include studies of thermokarst lakes on the North Slope Alaska that were initiated during a previous co-op with Tim Eglinton and a study of hydrocarbon degradation in seep sediments of the Barkley Canyon cold seep. Laboratory analysis for the Alaskan lake study will include carbon isotope analyses of DIC and methane from gas seeps and lakes sediment pore water in WHOI co-PI Seewald's lab. Sean Sylva will provide technical support to enable USGS PI Pohlman to process the samples. For the hydrocarbon degradation study, Robert Nelson will continue to support USGS PI Pohlman in the analysis of biomarkers and hydrocarbon degradation products previously analyzed by comprehensive GC×GC in WHOI co-PI Reddy's lab. Funds will be provided for technical support, consumables and equipment maintenance within the Department of Marine Chemistry and Geochemistry at WHOI.

III. GEOLOGY AND GEOPHYSICS

Marine geologists and geophysicists study the processes that form, deform and continuously modify the nature and physical properties of the earth's crust. Cooperative investigations will concentrate on understanding the tectonic framework and geologic processes (including rifting and subsidence) occurring at continental margins and in the adjacent ocean basins. Sedimentary processes and the structure of shelf and slope sediment sequences will receive particular emphasis. Studies will encompass analyses of present day processes (including those related to global change issues) as well as reconstructions of past changes and events. A full range of geological and geophysical tools will be used in the field and in the laboratory. Databases will be developed and sample archives maintained to the highest standards. Because earth processes are so closely dependent upon one another at all scales, research must extend from studies of large-scale basin and margin subsidence (on scales of hundreds of kilometers) to investigations of small-scale sediment transport processes on scales of centimeters and less. Direct sampling of the seabed using cores and other techniques will

provide samples for geochemical analysis and measurement of physical properties. Geophysical studies will use a range of seismological techniques, bathymetric and sidescan imaging, magnetics, gravity and heat flow.

PROJECTS

GG-1. Geological Sample Acquisition, Processing, Curation

WHOI PI: J. Broda
USGS Co-PIs: W. Winters and B. Buczkowski

Description: WHOI and USGS personnel will collaborate in the acquisition and processing of marine geological samples. In addition, the project will support a joint sea floor sample storage and curation facility, which maintains and provides access to geological collections that have been acquired over the past 25 years. Support will be provided on a continued basis, for facilities and activities that are required to gather, process, curate, and store geological samples as part of offshore scientific investigations.

CY 2011-2012 Activities:

A. Acquisition of samples for investigators will periodically require the cooperation of WHOI and USGS coring specialists and the use of joint equipment to collect other marine geological samples.

B. Processing of samples by WHOI and USGS technicians and scientists will require the use of core loggers, X-Ray Fluorescence (XRF) core analyzers, core splitters, rock saws and other equipment maintained by WHOI in spaces suitable for describing, photographing, and sub-sampling the marine geological samples.

C. Joint storage of geological samples will require the use of specialized sample storage facilities and personnel to maintain collections, provide access, and assist with sample handling.

GG-2. Examining Deepwater Corals as Paleoceanographic Archives

WHOI Co-PIs: A. Cohen and W. Thompson
USGS Co-PIs: J. Crusius and J. Bratton

Description: This project will explore the potential of deep-water corals and gorgonians as paleoceanographic archives over monthly to millennial timescales. Deep-water corals have only recently been recognized as potential recorders of past changes in deep ocean circulation, temperature and salinity, and to date few geochemical proxies ($\delta^{18}O$, $\delta^{14}C$, Mg/Ca) have been tested on a handful of specimens. The major challenge to recovery of highly resolved information is the slow growth and minute dimensions of deep water coral skeletons which do not lend themselves to traditional bulk sampling techniques. This project will continue to explore deepwater corals as archives, making use of microbeam analytical technology available at WHOI to reconstruct multi-elemental and isotopic records from North Atlantic deep water specimens at sub-seasonal resolution. Another initial focus will be to use U/Th dating techniques to obtain age estimates on both recent and fossil colonies. Our initial goal is to develop the analytical techniques required to obtain highly resolved and precise measurements of skeletal chemistry that we can confidently interpret in terms of oceanographic variables. Our longer term objective is to apply these developments to reconstruct a history of the deep ocean circulation in the North Atlantic.

CY 2011-12 Activities: None

GG-3. Operation of Ocean Bottom Seismic Instrumentation Pool in Woods Hole for the Marine Geosciences Community

WHOI PI: J. Collins
USGS PI: U. ten Brink

Description: In 1999, Woods Hole Oceanographic Institution (WHOI), the Institute of Geophysics and Planetary Geophysics (IGPP), Scripps Institution of Oceanography (SIO), University of California at San Diego (UCSD), and Lamont Doherty Earth Observatory (LDEO) of Columbia University were funded by NSF to design and construct state-of-the-art ocean-bottom seismic instrumentation for use by the broad U. S. scientific community. Simultaneous with the awarding of funds for the construction of new Ocean-Bottom Seismographs (OBS), NSF established the U.S. National Ocean-Bottom Seismic Instrumentation Pool (OBSIP) with Institutional Instrument Centers (IICs) at WHOI, SIO-IGPP, and LDEO. The OBSIP is charged by NSF with providing state-of-the-art ocean-bottom seismic instrumentation and at-sea technical assistance for the collection of marine seismic data by the U.S. scientific community (see http://www.obsip.org). In the fall of 2004, an NSF-appointed, external committee reviewed the OBSIP. On the basis of this review, the continued value of the OBSIP to the U.S. academic community was endorsed, and NSF agreed to fund the WHOI and SIO Institutional Instrument Centers through 2008. Last year, LDEO re-joined OBSIP.

The WHOI OBSIP operates two distinct types of OBS, both of which were designed and built at WHOI: a small, compact, short-period OBS, nicknamed “D2”, optimized for both active-source experiments and passive microseismicity monitoring, and a larger, broadband seismograph, BBOBS, optimized for teleseismic structural studies and earthquake-source investigations. The short-period and broadband OBS have sufficient battery and storage capacity to record continuously for durations of up to 8 months and 15 months, respectively.

Under an earlier 5-year cooperative agreement, USGS Woods Science Center funded the construction of 16 short-period “D2” OBS according to the WHOI design, and also contributed engineer/technician support for the maintenance of these OBS. Under this new cooperative agreement, we request annual support to maintain/upgrade the USGS instruments and to support WHOI OBSIP.

CY2011-12 Activities: In FY2011 engineering support is requested for maintenance of the USGS OBS and for the operation of the WHOI OBSIP facility.

We request 4.45 man-months of base-level support for electronics engineer Alan Gardner. This support is used to maintain and carry out necessary upgrades (software, new hardware) to the OBS, and to support maintenance of related infrastructure.

Particular tasks for 2011 include:

- General maintenance of the D2 fleet. These system have been heavily used over the last ~10 years, and are showing signs of wear and tear.
- Continue to upgrade OBS sub-systems. For example, we recently found a bug in our vacuum sensor boards which caused maintenance difficulties. We now have a solution but we need to implement it across our fleet.
- Inspection and possible replacement of the glass ball pressure housings used in the D2 OBS.
- Calibration and maintenance of the 4.5 Hz geophones used in the D2 OBS. We typically open the geophone pressure housings and inspect for broken wires etc. We also put all the geophones on our testing slab to ensure all components are working correctly.
- Continue testing of an intermediate-period seismometer and integrated leveling system from Nanometrics that might prove useful for long-term earthquake monitoring and hazards assessment.
- Continue testing of a new clock that promises an order-of-magnitude improvement in stability.

- Continue development of a rapid response protocol that would maximize the likelihood of shipping appropriately equipped OBS to the area of interest.

GG-4. Support for Rapid Response Experiment

WHOI PI: J. Collins
USGS PI: U. ten Brink

Description: The WHOI OBSIP group has made progress in developing a rapid response capability whereby if an earthquake or volcanic event of interest to USGS should occur then a small number of WHOI short-period OBS would be available for rapid deployment. In 2006, we carried out our first such deployment, when we successfully deployed and recovered 5 short-period OBS in the immediate vicinity of Augustine volcano in Seward Sound, Alaska.

Of course, the capability to respond rapidly to an event is dependent on OBS and manpower availability. The current informal arrangement with USGS is that if an event of interest should occur, and if WHOI has short-period OBS in house, and should technicians/engineers be available, then the WHOI OBS group would make every effort to respond to the event in a timely manner.

CY2011-12: Given WHOI's location in a region of low seismic and volcanic risk, it is likely that the rapid deployment requires air transportation of the OBS and support equipment. As it is extremely difficult to ship lithium batteries by air, we have opted to equip the rapid-response OBS with non-hazardous alkaline batteries only. We have designed a pack that allows about 4 weeks of on-bottom recording of 4 channels at 100 Hz. The WHOI short-period OBS is small, and can be deployed readily from a modest-sized vessel.

Other than OBS and manpower availability, the severest limitation in responding rapidly to an event is battery availability. The ordering, construction, and delivery of specialized battery packs can easily take a month or more. To avoid this delay, we propose to have appropriate battery packs in-house at all times. As installation of the batteries in the glass-ball pressure housings used in the WHOI OBS takes time, we further propose to pre-load the batteries in glass balls specifically designated for rapid response. Of course, all batteries have a finite shelf life, and hence the price of having batteries always available in-house is that they must be replaced annually regardless of whether or not they have been used on an OBS deployment.

The alkaline battery pack that we have designed is heavy, and hence the OBS requires additional buoyancy. We have acquired custom-molded syntactic foam to provide additional floatation for these rapid-response units.

The OBS are housed in Hardig shipping cases that can be handled reasonably easily by two people only. In 2008, in the light of the experience we gained shipping short-period OBS for the USGS-funded GEOPRICO2 experiment, we concluded that our shipping procedure was less than ideal. That experiment demonstrated that the large Hardig cases that hold the OBS are subject to very rough handling that resulted in damage to the OBS. In 2008, we rented a ULD (Unit Load Device) LD3 container (the type used to hold airline passenger's luggage) and demonstrated to our satisfaction that this container could hold securely 5 OBS (in Hardig cases). We would like to evaluate renting or purchasing an LD3 container for the purposes of transporting 5 OBS for rapid response purposes.

1.0 The Need for Dedicated Rapid-Response Instrumentation

The primary limitation of the USGS/WHOI rapid response program is that there is no guarantee that there would be OBS available should there be a need to deploy OBS in response to a large earthquake - the 30+ WHOI short-period OBS might be on the seafloor on the far side of the globe. We propose that USGS provide funding to re-activate 5 short-period systems were deactivated in order to supply components to our initial build of 25 broadband OBS. All of the 5 short-period systems that we propose to reactivate are equipped with: (i)

hard-hat enclosure; (ii) High Tech hydrophone; (iii) 3-component 4.5 Hz geophone and associated titanium pressure housing and gimbal-based leveling system; (iv) underwater cables and penetrators; and (v) 17" glass-ball pressure housing. Each system lacks: (i) Quanterra Q330 data-logger; (ii) Quanterra PB14F Baler storage device; (iii) acoustic-release board; (iv) navigation transducer for acoustic communications; (v) Seascan timebase; (vi) WHOI Auxiliary Control (AC) board; (vii) WHOI Recovery Board; and (viii) interior cabling. These systems do have 12" glass ball pressure housings for battery storage, but given OBSIP's recent experience with glass balls, we believe that these should be replaced. We propose to set these 5 OBS aside for rapid response only. We request funding for hardware costs and salary support for electronics engineer Gardner (1 month) and mechanical technician Kot (1 month) to carry out installation and testing.

2.0 Development of a Protocol for Rapid Response

We request 1 man-month support each for engineer Gardner and technician Dubois to work with Collins and ten Brink to develop a protocol for rapid response. The outcome of this effort would be a detailed inventory and budget for all of the instrumentation (acoustic deck box, deck wall-box, radio-direction finder, shipping boxes, LD3 container, as well as OBS) needed to rapidly respond to a hazardous event. We will develop a robust plan with the WHOI Shipping Dept. and a commercial shipping company to expedite air-shipment of OBS and support equipment. Working closely with Uri ten Brink and other USGS personnel, we would formalize a procedure for how a rapid response might be initiated, who would be responsible for securing a boat of opportunity to deploy the OBS, etc.

GG-5. Offshore Hazards and Tectonic Deformation Using OBS

WHOI PI: J. Collins
USGS PI: U. ten Brink

Description: This budget itemizes the costs associated with supporting a USGS earthquake monitoring experiment offshore the U.S. or Puerto Rico. Engineering and material support will be provided for preparation, deployment, and recovery of 5 OBS. Support will also be provided for clock correcting and reformatting the acquired data into SEED format. With the exceptions noted below, this budget conforms to the OBSIP guidelines used in budgeting NSF-funded OBSIP experiments.

CY2011-12 Activities: WHOI engineer Alan Gardner and technician Peter Lemmond will prepare 15 OBS for deployment offshore the Gulf of Alaska and the Bering Sea and refurbish the OBS on their return to WHOI. Gardner's salary for these activities is covered under the base-level support provided by the USGS/WHOI cooperative agreement, and hence this budget does not include any salary for him to carry out these on-shore tasks. Technician Lemmond will also participate in the cruise. The attached budget includes Dubois's and Lemmond's salary charges while at sea and all travel-related costs.

Once the data are back at WHOI, computer programmer Peter Lemmond will carry out final data processing of the acquired data. This includes applying clock corrections, re-making SEGY gathers, and archiving the data.

We request funds to purchase burn-wires for the 15 OBS that will be deployed on this experiment. The instrument modernization charge is charged per OBS, and provides funds to replace minor components such as disk drives, flashers, radios, seismometer deployment arm, hard-hats, etc.

GG-6. Electrical Studies of Sediments

WHOI PI: R. Evans
USGS PI: D. Hutchinson

Description: Electromagnetic (EM) measurements on the sea floor are proving to be underutilized indicators of key sediment properties such as porosity, thermal condition, and salinity. Information about grain size, texture, and permeability can indirectly be obtained. WHOI and USGS have a mutual interest in utilizing EM methods for research issues such as characterizing gas hydrates in deep marine environments, identifying certain contaminants in coastal sediments, and improving our understanding of salt water-fresh water interactions in the coastal zone. The objective of this collaborative research is to develop and improve field, laboratory, and modeling methods to maximize the potential use and application of EM to coastal and marine research problems.

CY 2011-2012 Activities: None.

GG-7. Multi-Disciplinary Studies of Shoreline Change

WHOI Co-PIs: R. Evans, J. Donnelly, L. Giosan, B. Raubenheimer, and A. Ashton
USGS Co-PIs: R. Thieler, W. Barnhardt, and D. Twichell

Description: More than 3 trillion dollars are currently invested in dwellings, resorts, infrastructure, and other real estate along the Atlantic and Gulf Coasts of the United States. The acceleration in sea-level rise that has been projected for the next century puts much of this coastal property in jeopardy. The Heinz Center report (THC, 2000) has predicted that in 60 years one house in four within 500 feet of the shoreline will be destroyed. Never before has coastal research been more relevant and more important to our country's future well being.

Although we know that the processes involved in coastal change are complex, most scientists agree that rising sea level, coupled with changes in storminess and depletion of sediment sources, will result in severe beach erosion and shoreline retreat. However, many of the underlying processes involved in shoreline change, such as onshore-offshore sediment exchange, the long-term impact of coastal engineering structures, and the role of coastal and offshore geologic framework on controlling erosion, remain poorly understood.

This project will couple scientists at WHOI and the USGS in a multi-disciplinary approach to studying shoreline evolution on time scales ranging from minutes to centuries. The project will combine scientific and technical expertise, and will utilize a broad suite of techniques to map and monitor the shoreline with the aim of understanding the processes that cause and control coastal change. Geophysical techniques to be used include ground-penetrating radar, seismic reflection profiling, electromagnetic and resistivity profiling, and high-resolution acoustic backscatter and swath bathymetric mapping. Groundtruthing of geophysical data will be carried out through sediment coring and sampling followed by detailed sedimentological characterization and chemical analysis using techniques and equipment at WHOI and the USGS, including the newly acquired XRF instrument at WHOI.

CY2011-2012 Activities: WHOI will develop components of a long-term, process-based model that dynamically evolves a coastal profile in response to changes in waves and sea-level elevation. Based upon sediment transport relationships, this model will uniquely accommodate out-of-equilibrium behaviors and investigate how infrequent, high-energy storms could integrate into long-term coastal behavior. Model results will be investigated to determine if it offers significantly different predictions of coastal evolution, particularly over temporal scales of decades to centuries.

WHOI will apply and modify existing models of plan-view coastline evolution to investigate potential scenarios for the Holocene evolution of the North Carolina Outer Banks coast. These scenarios include investigating the potential instabilities in a coupled barrier/cape system that could enhance the possibility for barrier collapse. The model will also be used to investigate the potential mechanisms for forming recurved and truncated beach ridges (such as those found in the vicinity of the paleo-Roanoke River) and what types of geologic controls or climatic changes (if any) could be responsible for these features.

GG-8. Mariana Forearc Crustal Structure and Law of the Sea

WHOI PI: D. Lizarralde
USGS PI: D. R. Hutchinson

Description: A scientific cruise scheduled for 2010 provides an opportunity to inform questions related to the extent of the continental shelf off of U.S. territory within the Mariana island chain. The cruise was funded to study processes of fluid cycling through this subduction system, with PIs D. Weins and D. Lizarralde. Specifically, the science program involves a seismic experiment to test the hypothesis that bending cracks within the subducting Pacific plate promote substantial serpentinization of the subducting lithospheric mantle, with that serpentinite providing a mechanism for water transport to the mantle wedge of the upper plate. The experiment consists of active- and passive-seismic components. The active-seismic component consists of three, ~300- to 400-km-long lines perpendicular to the arc, crossing the forearc, the trench, and the outer rise; a ~200-km-long line along the forearc parallel to the trench at ~4000 m water depth; and a ~200-km-long line along the outer rise parallel to the trench at ~5500 m water depth. Results from this seismic experiment may be relevant to Law of the Sea issues relating to the continental shelf.

The question of the amount of seabed to which a coastal nation is entitled is addressed in the United Nations Convention on the Law of the Sea (UNCLOS). This treaty, ratified by 153 nations and in force since 1994, specifies national obligations, rights, and jurisdiction in the oceans, and it allows nations a continental shelf out to at least 200 nautical miles or to a maritime boundary. Article 76 (A76) of the convention enables coastal nations to establish their continental shelves beyond 200 nautical miles and therefore to control, among other things, access for scientific research and the use of seabed resources that would otherwise be considered to lie beyond national jurisdiction.

One of the arc-perpendicular lines of the scheduled 2010 seismic experiment crosses the trench at a location were a seamount is subducting, near 18.5°N. The Japanese have argued that the Ogasawara Plateau and adjacent Seri seamount chain, colliding with the Bonin arc at ~26°N, represent a continuous extension of the Bonin-arc continental shelf, extending ~600 km east of the plate boundary. A somewhat similar island chain, the Dutton Ridge, is colliding with the Mariana forearc at ~20°N. Though bathymetry of the region is poor, the seamount colliding with the forearc at 18.5°N appears to be genetically related to and perhaps fully part of the Dutton Ridge, representing its southernmost extent.

The seismic data to be collected in 2010 will provide multi-channel seismic images and tomographic seismic-velocity images of the forearc crust and the crust beneath a transect where a seamount (arguably of the Dutton Ridge) is colliding with the forearc. This information may help to inform Law of the Sea questions or perhaps motivate further geophysical work in this region. These questions were not a focus of the originally proposed work, however, and targeting these questions with the new data would represent a new and distinct research effort, one that can be shared between the USGS and WHOI.

CY2011-2012 Activities: The effort in 2011/12 will focus on advanced processing, analysis, and interpretation of seismic refraction data from the Arctic Law of the Sea cruises to compare with OBS data collected during the Marianas cruise in early 2012, particularly to

determine whether the crust beneath the Canada basin of the Arctic Ocean contains an oceanic-crust signature. The collaboration will emphasize integration of the large-offset interpretations with multi-channel seismic reflection data. Travel and computer supplies will facilitate interpretation and publication of the data with Canadian collaborators on the project.

GG-9. Radiocarbon Dating Investigations

WHOI PI: W. J. Jenkins
USGS PI: E. R. Thieler

Description: WHOI and USGS personnel will cooperate in research related to high-precision radiocarbon dating by accelerator mass spectrometry. Radiocarbon analyses of bulk sediment, organic carbon, fossil carbonate, and CO2 gas fractions will be used to reconstruct geologic history and processes over the past 40,000 years in a variety of environments, including large-lake, coastal, shallow marine, and deep ocean settings. In addition to estimating the ages of horizons in core samples, the analyses will be used to measure sediment and pollutant accumulation rates, and to estimate the sources of different carbon and carbonate fractions.

CY2011-2012 Activities: WHOI will perform radiocarbon analyses of submitted samples. USGS personnel will obtain the samples for radiocarbon analysis from field samples, sediment cores, soil profiles, and other collections, and will perform the initial stages of sample preparation. Final preparation of the samples and radiocarbon analyses will be performed in the WHOI laboratories under the supervision of technical personnel and the WHOI AMS facility.

GG-10. Experimental and Theoretical Investigations of Problems in Hydrogeomechanics

WHOI Co-PIs: M. D. Behn and D. Lizarralde
USGS PI: W. F. Waite

Description: Many processes in marine geology are influenced by how fluids move through sediments and rocks. Fluid flux is identified as a major factor in faulting, tectonism, magmatism, diagensis, and hydrocarbon migration. WHOI and USGS will develop a research facility to study deformation and fluid flow from experimental and theoretical approaches. Facilities are in place at USGS to complete experiments at low stress and fluid pressure (near seafloor conditions), and WHOI has historically maintained facilities and expertise to conduct experiments at high stress and fluid pressure (deep crustal conditions). One major goal of this collaboration is acquiring a geotechnical test system that operates at a mid-level stress and fluid pressure. These “mid-level” conditions are associated with a variety of hydrogeomechanical processes, and WHOI is pursuing a new hire who’s research focuses on these processes. A second objective is developing theoretical models explaining deformation, failure, and flow properties at a range of stresses, pressures and time scales. We anticipate costs to include laboratory equipment and some salary for PIs and post-doctoral fellows. Post-doctoral fellows will also be pursued through the WHOI-USGS and Mendenhall fellowship programs.

CY 2011-12 Activities: None

GG-11. Sedimentary Records of Global Change in Continental Margin Environments

WHOI Co-PIs: L. Keigwin, D. McCorkle, D. Oppo and L. Giosan
USGS Co-PIs: R. Thieler, J. Bratton, J. Crusius and W. Barnhardt

Description: USGS and WHOI scientists share a growing interest in the high-resolution records of Holocene and last glacial maximum paleoceanography and paleoclimate that are

preserved in continental margin environments, including records from lacustrine, estuarine, continental shelf, and continental slope sediments. As the U.S. government seeks to expand our Exclusive Economic Zone beyond 200 nautical miles, to include margin features such as Blake Ridge, the continental margin settings suitable for joint USGS-WHOI investigations will likewise extend farther offshore and into deeper water. Specific examples of potential collaborations include ongoing studies of near-surface sediments of Long Island Sound and Buzzards Bay, and studies of shallow-water locations, such as the mid-shelf "Mud Patch" and Georges Bank that may influence sedimentation far offshore. In addition to time-series studies of chemical, isotopic, and paleontological records, process-oriented studies of the factors that control paleoclimate records in continental margin sediments are a likely topic for future work. For example, continuous high deposition rate environments in nearshore locations need to be understood in the context of local current regimes. In another example, one of us (LK) is working with USGS colleagues to develop proxy records for Colorado River runoff to the Gulf of California. This should lead to a better understanding of the drought history of the American southwest. Many of these studies will rely on stable isotope and radiocarbon analyses of small samples to provide an accurate chronology for the observed changes. Others may involve sedimentological characterization and chemical analysis using the new X-radiography - X-Ray Fluorescence core scanner facility at WHOI. Opportunities for student training will be utilized when possible.

CY 2011-12 Activities: None

GG-12. Studies of Seismotectonics of Continental Margins and Interactions Between Underwater Earthquakes and Tsunamis: Observations and Modeling

WHOI Co-PIs: J. Lin
USGS PI: U. ten Brink

Description: The objectives of this cooperative research program are two folds: 1) to better understand the geological processes of seismotectonic activities along continental margins and to better characterize the seismic hazard probability associated with these margins; and 2) to better understand the interactions between underwater earthquakes and resultant tsunamis. The program involves geophysical and remote sensing data collection and analysis as well as developing new understanding through quantitative geodynamics models that can incorporate realistic rheological properties of the lithosphere and illuminate elastic, visco-elastic, and plastic deformation of the lithosphere. State-of-the-art numerical algorithms are to be adopted and developed. Observations from GPS and InSAR space geodesy, together with other geological and geophysical data, will be used to constrain and invert for rheological parameters in selected margin regions and to reveal the tectonic forces driving the observed seismotectonic activities. The project will include detailed investigation of stress interaction between various active faults at the time scale of the seismic cycle in selected margin regions to better characterize seismic hazard probability. Further numerical models will explore the development of the décollement and secondary faults near the shallow seismogenic zone of active margins over geological time scales. This problem will also involve case studies of tsunamis and their links to underwater earthquakes through both observations and modeling.

CY 2011-2012 Activities: The co-PIs have been working together on investigations of seismotectonic deformation of continental margins as well as the effects of underwater earthquakes on tsunami generation processes. Activities will involve quantitative tectonic modeling to better understand processes and various interactions.

GG-13. Developing New Paleo-Environmental Proxies Using XRF scanning

WHOI Co-PIs: L. Giosan and T. Eglinton
USGS PI: J. Crusius

Description: New core logging technology - specifically the technique known as x-ray fluorescence (XRF) core scanning - now makes it possible to acquire high resolution geochemical data at a rate and sampling interval heretofore impractical using conventional methods. This opens the door to more fully characterizing sediment composition at extremely high resolution as part of paleoclimatic, sedimentologic, and paleoenvironmental studies. The XRF scanning is cost-efficient and coupled with groundtruthing via discrete sample bulk chemistry measurements allows the collection of high resolution bulk chemistry on cores at a rate several orders of magnitude faster than other techniques. The combination of XRF scanning with organic geochemical and isotopic measurements affords unprecedented means to characterize the inorganic and organic phases in sediment and develop new paleoenvironmental proxies from marine and terrestrial cores as well as from other archives such as corals and speleothems.

This project will couple scientists at WHOI and the USGS in a multidisciplinary approach to studying sedimentary archives using the expertise of Dr. John Crusius and cores collected and to be acquired in Dr. Crusius projects and as well as the WHOI XRF scanner and expertise in Dr. Liviu Giosan's lab and the equipment and expertise in organic geochemistry in Dr. Tim Eglinton's lab.

CY2011-2012 Activities: Cores collected by USGS from ombrotrophic peat bogs in Alaska are planned to be analyzed by Chris Moy, a postdoctoral investigator at USGS/WHOI. Atmospheric dust plays an important role in the global climate system by directly altering the earth's radiation budget and by influencing biogeochemical cycling in the ocean. Ombrotrophic peat records have excellent potential to reconstruct Holocene and late glacial changes in dust deposition because they have relatively high accumulation rates (~1 mm/year), are broadly distributed, can be dated using radiocarbon dating techniques, have sufficient material for a multi-proxy approach, and are relatively easy to access and sample. The XRF scanner will be used to measure the bulk chemistry in these cores to help develop proxies of dust deposition via estimates of the lithogenic fraction. The lithogenic fraction of the peats and its sources and concentration variation with time can be estimated using elements such as Si, K, Ti, Ca, Sr, Rb, Zr, and Fe. WHOI is also working on the development of a new proxy providing high resolution estimates of organic content in organic rich sediments. Estimating the performance of this proxy in peats will be of interest to both parties. In addition, if present in quantities that are measurable, more mobile elements such as Mn, S, V, Mo will be used to characterize diagenetic processes in the USGS cores whereas downcore chemical stratigraphy can be used to correlate records from cores in the same bog and pollutants such as Pb, Cu can be used to aid age models for the studied cores.

GG-14. Geophysical, Geochemical, and Modeling Studies of Groundwater in Coastal Regions

WHOI Co-PIs: D. McCorkle, M. Charette, R. Evans and A. Mulligan
USGS Co-PIs: J. Bratton and J. Crusius

Description: There is a strong and growing interest in groundwater-surface water-sea water interactions in coastal regions. This interest includes water quality problems common to many coastal areas (such as salt intrusion due to increasing pumpage of aquifers, and nutrient and pollutant release into the coastal ocean via river flow and direct groundwater discharge) as well as broader studies of land-sea fluxes of water and solutes. It also includes studies of fluid distributions and fluid flow in continental margin settings, and their impacts on coastal and margin geology. The goal of this section of the cooperative agreement is to address these

coastal groundwater topics with collaborative studies using tools from multiple disciplines. Geophysical techniques are used to image and quantify subsurface fluids on a variety of spatial scales. Geochemical approaches can characterize groundwater and surface water compositions, identify subsurface mixing processes, and estimate discharge rates. Hydrological modeling can predict fluid flow and provide a quantitative framework for geochemical and geophysical investigations. Multidisciplinary studies combining two or more of these approaches may prove to be particularly powerful, and well suited for WHOI-USGS collaborations. Local study areas with ongoing multidisciplinary work include Waquoit Bay, MA and sites on the Outer Cape. In addition, there is active interest in multidisciplinary studies that will build on existing work by USGS and WHOI scientists in a range of coastal environments, including barrier islands and back-barrier settings (Long Island, Outer Banks of North Carolina), regions with karst geology (North Carolina, Florida), and hard-rock environments (coastal Maine).

CY 2011-12 Activities: None

IV. APPLIED OCEAN PHYSICS AND ENGINEERING

The Applied Ocean Physics and Engineering (AOP&E) Department conducts fundamental research in oceanography and develops instrumentation for scientists at WHOI and the oceanographic community at large. The Cooperative Research Program over the next five years will involve basic research questions, as well as instrument development in the areas of coastal physical oceanography, sediment transport and benthic mixing processes. These research problems are motivated by an interest in the transport and fate of sediments and contaminants in the coastal environment.

PROJECTS

AOPE-1. Development, Installation, and Operation of Coastal Ocean Observing Systems

WHOI PI: K. von der Heydt
USGS Co-PIs: B. Butman, M. Martini and U. ten Brink

Description: This project will develop and demonstrate systems for measuring and retrieving oceanographic data from instruments in the coastal ocean and delivering these data in near real time. The project will develop and test strategies for transmission of data from instruments deployed beneath the surface to the surface, from the surface to shore, and to the desktop. The goal of these systems is to provide observations from distributed arrays with multiple sensors on a wide variety of spatial scales. Such observations are needed to resolve key processes, for ocean prediction, to aid in developing optimal sampling strategies (particularly for coupled physical and biological studies), and for long-term seismic monitoring.

CY2011-12 Activities: None.

AOPE-2. Sediment Transport in Coastal Ocean Systems

WHOI Co-PIs: W.R. Geyer, P. Traykovski and K. Foote
USGS Co-PIs: R. Signell, C. Sherwood, J.C. Warner, and B. Butman

Description: This project will conduct field, laboratory, and modeling studies to further our understanding of circulation and sediment transport in the coastal ocean. A long-term goal is to understand the key physical, geological, biological, and chemical processes causing sediment transport, and to assess and further develop the community sediment transport model led by the

USGS. The project will seek to understand coastal systems on a regional basis (such as the Gulf of Maine, Massachusetts Bay, southern New England, South Carolina, Palos Verdes, or the Hudson River Estuary) as well as specific processes (such as surface waves, internal waves, tidal currents, or river flow) that play a critical role in resuspension, transport and fate of particles. The sediment transport model will provide a framework for synthesis of this understanding.

Task I: Data Analysis of Sediment Transport in the Hudson River Estuary
(W.R. Geyer, C. Sherwood and J.C. Warner, Co-PIs)

CY2011-12 Activities: None

Task II: Study of Turbulence and Sediment Transport over Large Dunes on a Tidal Shoal
(W.R. Geyer, P. Traykovski, C. Sherwood and R. Signell, Co-PIs)

CY2011-12 Activities: We will the use the Measurement Array for Sensing Turbulence (MAST), a 10-m long spar with 8 sets of turbulence-measuring instruments, that provides continuous measurements of the turbulent flow between the surface and 8-m depth from a moving or anchored vessel. The instrumentation includes acoustic Doppler velocimeters (ADVs) and fast conductivity probes at each vertical position. We will also deploy a newly developed, pulse-coherent acoustic velocity profiler (PC-ADP) that will provide 1-cm resolution of the turbulence in the lower 3-m of the water column. The suspended sediment will be quantified by the intensity of acoustic backscatter. The measurements will be obtained during a 2-3 day study at Middle Ground in Vineyard Sound. Some of the measurements will be at anchor, and some will be in a slow steaming mode, in order to resolve the spatial structure of the flow at the scale of the large dunes—i.e., 1-20-m horizontal scales. We will work with our USGS collaborators to quantify the vertical structure of the turbulence and the Reynolds-averaged flow and the associated structure of suspended sediment. The analysis will focus on the wake structure behind dunes and its influence on bottom stress, turbulence and sediment transport.

Task III: Data Assimilation Modeling of Regional Coastal Circulation
(P. Traykovski, C. Sherwood, and R. Signell, Co-PIs)

CY2011-12 Activities: None

Task IV: Circulation and Wave Modeling at MVCO
(P. Traykovski, C. Sherwood and J.C. Warner, Co-PIs)

CY2011-12 Activities: The project will develop instrumentation and conduct measurements of turbulence at MVCO in order to better understand the transport of sediment and other waterborne material in the context of the general circulation of this region. The specific focus of 2011 activities will be the development of a multi-frequency bi-static pulse coherent Doppler system for USGS and integration into existing USGS boundary layer measurement instrumentation systems.

Task V: Calibration of Acoustic Backscatter Sensors
(K. Foote and C. Sherwood, Co-PIs)

CY2011-12 Activities: This project is intended to adapt and refine standard-target calibration methods for acoustic backscatter sensors (ABSs) operating at megahertz frequencies. Earlier work performed on the AQUAScat 1000 system at 1 MHz will be extended to 2.5 MHz and higher frequencies. Protocols will be worked out for systematic calibration of

this system. Laboratory demonstrations will be cited in a detailed proposal to describe how a standard-target calibration can improve ABS estimation of suspended sediment properties, the analysis of multi-frequency ABS data, and the inter-comparison of in situ data derived from other acoustic sensors.

AOPE-3. Groundwater and Nutrient Fluxes into Shallow Estuaries

WHOI Co-PIs: D.K. Ralston
USGS Co-PIs: N. Ganju, C. Sherwood, J. Warner, and B. Butman

Description: Submarine groundwater discharge provides a major source of freshwater flux into many small embayments on the Northeast coast of the US. In regions where the groundwater has been enriched in nutrients by anthropogenic inputs, groundwater nutrient fluxes can significantly alter estuarine ecosystems. Eutrophication due to excess groundwater nutrient inputs can have negative impacts on ecosystem health such as declines in sea grass beds or increases in harmful algal bloom occurrence and intensity. This project seeks to better understand the estuarine transport processes that are important for setting nutrient concentrations in these groundwater-dominated estuaries. Initially, the study will focus on two estuaries on Cape Cod where research has begun on groundwater and nutrient fluxes: West Falmouth Harbor and Nauset estuary. Both systems have been significantly altered by anthropogenic inputs of nitrogen, yet fundamental questions remain about how conditions in the estuaries depend on the groundwater fluxes, on exchange with the coastal ocean, and how conditions would respond to shifts in forcing conditions. The goal here is to use surface and groundwater models along with field observations to better understand how nutrients pass through coupled systems like these.

CY2011-12 Activities: This project will use a combination of numerical models and field observations to evaluate the role of groundwater in driving freshwater and nutrient fluxes shallow estuaries on Cape Cod. Hydrodynamic models of West Falmouth Harbor (using the Regional Ocean Modeling System, or ROMS) and Nauset estuary (using the Finite Volume Coastal Ocean Model, or FVCOM) have been already been developed and preliminarily tested against observations. In the proposed work, we will evaluate how spatial and temporal variability in groundwater discharge impacts nutrient fluxes and residence times in the estuary. We will use field observations of currents, salinity, and nutrients to evaluate and refine the models. The more complete spatial and temporal coverage of the models will be used to help interpret the field observations. Based on our analyses of the estuarine groundwater and nutrient fluxes through the estuaries, we will collect additional observations to help refine the model parameters.

V. PHYSICAL OCEANOGRAPHY

Physical Oceanography encompasses the study of processes that drive and control sea-water motions and properties over a wide range of time and spatial scale. Cooperative studies will focus on oceanographic instrumentation and on the physical processes that are active along the continental margin in the Exclusive Economic Zone and their importance to geological processes at the sea floor. A long-range objective is to develop a predictive capability for water and sediment motion. Development and analysis of measurement techniques, instrument systems and the data resulting from them will be required.

PROJECTS

PO-1. Physical Oceanographic Measurements

WHOI PI: D. Hosom
USGS PI: M. Martini

Description: Physical oceanographic studies at WHOI and the USGS seek to describe water motions and properties over a wide range of time and spatial scales and to describe the processes, which drive and control them. Cooperative studies will primarily focus on the physical processes, which occur in U. S. coastal regions, the continental margin in the Exclusive Economic Zone, and study their importance to geological processes on the seafloor. To be able to study the current and sediment transport regime in a broad range of coastal and marine environments requires instrument development, maintenance, and deployment. An important focus of cooperative research will be the development of new measurement techniques for long-term observations of currents and water properties, tests of these techniques in the field, and initiation of long-term measurements at key locations.

WHOI and USGS use the same type of oceanographic instrumentation, comparable instrument preparation and calibration, and similar data sampling techniques in studies of physical oceanography and sediment transport. WHOI and USGS maintain and share extensive facilities to manage this instrumentation. Oceanographic instrumentation will need to be modified to meet project goals that change as a function of scientific requirements.

CY 2011-2012 Activities: In CY 2011-2012 the following activity is a defined program area starting in April 2009. USGS will provide coordination and scheduling to meet the operational requirements.

A critical spatial variable required to understand the processes described above is the vector water currents. The instrument of choice is the Vector Measuring Current Meter (VMCM). These current meters must be prepared prior to deployment, and WHOI will provide this preparation.

PO-2. Oceanography of Southern New England

WHOI Co-PIs: R. Limeburner, R. Beardsley, T. Bolmer
USGS Co-PIs: B. Butman, R. Signell, J. Warner, J. Crusius

Description: This project will conduct field and modeling studies to further our understanding of circulation, sediment transport, and nutrient dynamics in the southern New England coastal ocean. This area includes Block Island Sound, Buzzards Bay, Vineyard Sound, Nantucket Sound, and the inner shelf to the south and east. The initial focus will be on Nantucket Sound, with studies designed to investigate circulation and influences of shelf water inflow (from Vineyard Sound, the Gulf of Maine, and New England shelf), Cape Cod ground water, atmospheric exchange, and sediment suspension on the heat, salt, and nutrient budgets. Using Nantucket Sound as a natural laboratory, coupled physical and biological model studies will be conducted to investigate the role of Cape Cod estuaries in the land-sea flux of fresh water, nutrients, and carbon.

CY2011-12 Activities: (See Tasks 1, 2 and 3)

Task 1: Field Studies

CY2011-12 Activities: WHOI will make moored measurements of currents, bottom pressure, and water properties in and around Nantucket Sound as part of an on-going field effort to investigate tidal, buoyancy- and wind-driven circulation and water column stratification and mixing in Nantucket Sound. With MIT and WHOI Sea Grant support, R. Limeburner and R. Beardsley plan to recover in 2010 several previously deployed WHOI physical moorings in Nantucket Sound. The planned WHOI moored array will be augmented by Jim Churchill and Geoff Cowles with Sea Grant support to obtain near-bottom measurements that would allow estimation of bottom stress and sediment transport.

Task 2: Circulation Model Studies

CY2011-12 Activities: With MIT Sea Grant support, C. Chen, R. Limeburner and R. Beardsley will conduct numerical model studies of tidal, buoyancy- and wind-driven currents in Nantucket Sound and adjacent waters, their governing dynamics, and implications for flux of freshwater, passive tracers/particles, and sediment within and through the Sound. The initial effort will focus on detailed analysis of Chen's recent high-resolution Finite-Volume Coastal Ocean Model (FVCOM) simulations and comparison with in-situ data. Based on these initial results, additional model studies will be undertaken in collaboration with Chen to investigate in more detail key processes. In particular, the new WHOI and additional USGS moored array data will be used to investigate bottom processes and tidal-driven sediment transport and compare these in-situ measurements with FVCOM simulations made using the new FVCOM sediment transport module based on the USGS sediment transport model. While of intrinsic interest, these model studies will be invaluable in planning for future field work in Nantucket Sound and surrounding waters.

Task 3: Digital Bathymetry Database Update

CY2011-12 Activities: The USGS high-resolution digital database for the Gulf of Maine/New England shelf region (original created by R. Signell) will be updated by T. Bolmer with multibeam and along-track digital bathymetry data collected since the mid-1990s by USGS, NOAA, WHOI, and other US and Canadian investigators. The initial focus will be on coastal and inner shelf regions (e.g., Nantucket Sound and adjacent waters) and Georges Bank. The resulting database will be made public via the web and have both research and applied uses, including serving as the best representation of the bottom bathymetry and coastline for use in numerical circulation and sediment transport models.

PO-3: Circulation and Sediment Transport in Coastal Regions off the U. S. Eastern Coast

WHOI PI: J. Churchill
USGS Co-PIs: B. Butman, R. Signell, J. Warner, and C. Sherwood

Task 1: Sediment Transport in Coastal Ocean Systems Resusupension of Sediments by Trawling

(J. Churchill, B. Butman and C. Sherwood)

Description: This task will develop and test models to assess the impact of sediment resuspension by bottom trawling. These models will be incorporated, as modules, into existing hydrodynamic-sediment transport models of the coastal ocean off the U.S. eastern seaboard. Parameterization of sediment resuspension by trawling over different bottom types (predominately fine-grained, mixed grained, etc.) will be accomplished using the results of recent field studies that focused on sediment mobilization by trawling. The hydrodynamic-

sediment transport models, with trawl-resuspension modules included, will be used to assess the contribution of trawling to: the overall sediment load of particular regions, the across- and along-shore transport of sediment, and the introduction of pore-water nutrient to the water column and the euphotic zone. Geographically, the focus will be on the coastal region of the Gulf of Maine and Massachusetts Bay. Data routinely acquired by the U.S. National Marine Fisheries Service (NMFS) show high levels of bottom fishing in this area (comparable to 1990's levels). The NMFS records will allow for the specification of trawl activity in space (within 10' squares) and time (weekly) over this region.

CY2011-12 Activities: Churchill will work with USGS personnel to develop and test modules to account for trawl-induced sediment resuspension and will apply the modules to assess the impact of trawling on coastal region of the Gulf of Maine and Massachusetts Bay. Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

Task 2: Circulation and Sediment Transport in the Gulf of Maine
(J. Churchill, B. Butman and R. Signell)

Description: This task will focus on properly modeling agents responsible for sediment resuspension and transport in the Gulf of Maine and Massachusetts Bay. A large scale circulation feature to be considered will be the Gulf of Maine Coastal Current (GMCC). A baroclinic flow with strong near-bottom currents, the GMCC originates in the eastern Gulf of Maine and undergoes significant lateral and vertical migrations. Its path sometimes extends offshore to the east of Jordan Basin, and at other times continues alongshore into the western Gulf of Maine and Massachusetts Bay. Using the rich existing data set from moored instruments (current meter, CTD and optical turbidity sensors), shipboard CTD/ADCP surveys and drifters, we will assess the USGS model's representation of this current's response to wind stress, changes in the upstream boundary condition and to modification of the water mass in the interior Gulf of Maine, with the focus on near-bottom currents associated with the GMCC. We will also examine the regional wave field, focusing on the Massachusetts coastal zone. We will compare the performance of the USGS ROMS model of the region with another model, FVCOM. In situations where the latter appears to perform better, we will seek to understand how the models represent the relevant processes differently and work to effect improvements in the ROMS model. This work nicely dovetails with two of Churchill's current projects. One (with J. Runge of the U. Maine and C. Chen of U. Mass) deals with circulation in the Gulf of Maine/Massachusetts Bay system. It involves extensive data analysis and use of FVCOM in diagnosing the region's dynamics and simulating the transport of larvae. The other (with A. Williams of AOPE and G. Cowles of U. Mass) is directed at measurement and modeling of the wave climate of the Massachusetts coastal zone.

CY2011-12 Activities: Churchill will work with USGS personnel in diagnosing the circulation, wave and bottom stress climate in the Gulf of Maine and in comparing the results with hydrodynamic models of the Gulf. Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

Task 3: Shelf Circulation near the Carolina Capes
(J. Churchill, B. Butman, R. Signell, and J. Warner)

Description: This task will be devoted to assessing and effecting improvement of the USGS ROMS circulation model of the shelf region off the Carolina Capes. Using data acquired in recent and ongoing field studies, we will seek to ensure that the model accounts, as well as possible, for the effects of wind, topography and the influence of the Gulf Stream on shelf circulation. We will focus on the circulation in the regions of the cape shoals and of the Hatteras Front, which extends across the shelf near Cape Hatteras and separates shelf waters of the Mid-Atlantic and South Atlantic Bights. This work will benefit from Churchill's involvement in the

Fontal Interaction Near Cape Hatteras (FINCH) project (with field work carried out in 2004/2005) and his association with Rouying He in examining the dynamic of the Hatteras shelf region via modeling and data analysis.

CY2011-12 Activities: Churchill will work with USGS personnel in diagnosing the circulation, wave and bottom stress climate near the Carolina Capes and in comparing the results with hydrodynamic models of the region.
Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

VI. EDUCATION

The Woods Hole Oceanographic Institution conducts several academic programs with long-standing national and international reputations for excellence: The MIT/WHOI Joint Program in Oceanography/Applied Ocean Science and Engineering, the WHOI Postdoctoral Scholar Program, the WHOI Summer Student Fellowship Program for undergraduates, and programs to encourage participation by minority students. These programs all are conducted with small group instruction and one-to-one advising and mentoring with a specific focus on involvement with ongoing research. WHOI also has several projects in support of engaging researchers with teachers and informal educators in the K-12 science, mathematics and technology education community.

The intellectual vitality of both WHOI and USGS are enhanced significantly by the inquiring, early-career minds brought to the organizations by these programs. Furthermore, the continuing excellence of both organizations depends upon a continual influx of new, well-trained, and highly motivated personnel to provide new perspectives for research and the application of new knowledge to national goals in science, technology and education.

PROJECTS

EDU-1. Graduate Research Assistants (GRAs)
WHOI PI: J. Yoder
USGS PI: W. Barnhardt

Description: The MIT/WHOI Joint Program in Oceanography/Applied Ocean Science and Engineering is a highly successful and unique joint degree venture between the Massachusetts Institute of Technology and the Woods Hole Oceanographic Institution. Students commute between the two institutions, taking classes and conducting research at each location. An interactive videoconferencing link facilitates the teaching of many of the classes. This videoconferencing system has capabilities to teleconference and support distance learning anywhere in the world that has a compatible system. Since its 1968 inception, the Joint Program has awarded over 800 PhD, ScD, Masters Degrees and Engineers Degrees in the combined fields of Biological Oceanography, Chemical Oceanography, Marine Geology and Geophysics, Physical Oceanography and Oceanographic Engineering. Approximately 65 to 80% of the total advising, teaching and research effort in the program takes place at WHOI.

Support in this category is for a Graduate Research Assistant in specific projects carried out jointly under this agreement between WHOI Department or Center PIs and USGS PIs. This Graduate Research Assistant is selected for admission to the MIT/WHOI Joint Program by Joint Faculty Committees from WHOI and MIT using a demanding set of academic criteria, personal statements of the applicants, and letters of reference. WHOI's Dean, with input from each department's faculty Education Coordinator, selects the Graduate Research Assistant for

support by matching the graduate student's research interests with the research to be undertaken in the USGS-WHOI Cooperative Agreement.

CY2011-12 Activities: To be determined by research conducted under the USGS-WHOI Cooperative Agreement. Budget prepared to indicate the cost of a year's support of a GRA.

EDU-2. Postdoctoral Scholars

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

Description: The Woods Hole Oceanographic Institution has conducted a Postdoctoral Scholar Program since 1960. Initially the program was meant to attract recent doctorates in science and engineering to the fields of oceanography and ocean engineering by providing them with an opportunity to be introduced to these fields of research. As graduate education in oceanography and ocean engineering expanded, the Postdoctoral Scholar Program also has attracted new PhDs in these fields, offering them an opportunity to transition from graduate studies to professional appointments in the academic, industry or government sectors.

The Postdoctoral Scholars are chosen by a Fellowship Committee, selecting the best applicants, based on their academic records, research promise, and relevance of scientific interests to those of the Institution departments. USGS personnel participate in the Fellowship Committee selection process. One candidate is chosen for the WHOI-USGS Postdoctoral Scholar appointment based on academic credentials and research interests compatible with a research topic of mutual interest to both organizations. This candidate has a mentor and office space at both USGS and WHOI. A second Postdoctoral Scholar is selected by the Fellowship Committee in any area of ocean sciences and/or ocean engineering to enhance the overall research of both WHOI and USGS.

CY2011-12 Activities: The project will provide support for (a) one Postdoctoral Scholar to be selected jointly by USGS and WHOI to address topics of mutual interest; (b) two Postdoctoral Scholars pursuing research in ocean science and/or ocean engineering; and (c) one half-time Postdoctoral Scholar appointment.

EDU-3. Diversity Initiatives

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

Part I: This Summer Student Fellow/Minority Fellow program is an important part of an effort to attract more scientists and engineers from underrepresented groups into ocean sciences and ocean engineering. Between 1978 and 2009, support was provided for 87 Minority Fellows: 36 African-Americans, 21 Hispanics, 6 Native Americans and 24 Asian/Pacific Islanders. These awards are designed to provide training and research experience in Woods Hole for students who have completed at least two semesters of undergraduate study in physical or natural science, mathematics or engineering. Fellowships may be awarded for a ten to twelve week period during the summer or for a semester during the academic year and may be renewed the following year or two years until completion of undergraduate studies. The intent is to provide long-term mentoring for students interested in graduate studies and/or career in marine sciences or ocean engineering. We propose to continue this effort with this proposal with support from USGS for two Minority Fellows each year.

Applications to the Summer Student Fellowship and USGS Minority Fellow programs will be received in the WHOI Academic Programs Office. The application review and selection process will involve a committee of WHOI and USGS personnel. As appropriate in matching

research interests with potential advisors, one or two Summer Student Fellows, supported by funds at WHOI, or one or two Minority Fellows, supported by the USGS-WHOI cooperative agreement, will be advised by USGS Scientists within the framework of the WHOI Summer Student Fellowship Program.

CY2011-12 Activities: Two Fellowships to be supported by USGS and selected according to the mechanism described above.

Part II: In 2004, the leaders of six institutions—the NOAA Northeast Fisheries Science Center (NEFSC), Woods Hole Oceanographic Institution (WHOI), the U.S. Geological Survey (USGS), Marine Biological Laboratory (MBL), Woods Hole Research Center (WHRC), and Sea Education Association (SEA)—pledged to work together to attract and retain a more diverse workforce and formed the Woods Hole Diversity Initiative (WHDI). During summer, 2009, the WHDI coordinated a new program that specifically encourages underrepresented groups, and brought 16 science students from 11 colleges to Woods Hole for a four-week course on environmental and ocean science taught by scientists from all the institutions. The Woods Hole Partnership Educational Program (PEP) is designed primarily for juniors and seniors who want to spend a summer gaining practical experience in marine and environmental science. The program consists of a four-week course followed by six-to-eight week research projects with Woods Hole scientists. In 2009, most of the funding came from NOAA and the NEFSC, although all of the WHDI institutions contributed in various ways to the program. In addition, PEP students were invited to, and many attended, the activities WHDI institutions sponsored for other summer undergraduate programs, including those sponsored by WHOI for the Summer Student Fellowship Program. Funds are requested in this proposal to help sustain the PEP program in future years

CY2011-12 Activities: Funds to support the Partner Education Program

EDU-4. Facilities for Postdoctoral Scholars, Graduate Research Assistants, and Minority Fellows

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

Description: This cooperative project will support the establishment and operation of facilties for jointly sponsored Postdoctoral Scholars, Graduate Research Assistants, and Minority Fellows. Its purpose will be to optimize the contributions of these important personnel and efforts through the provision of modest and flexible research areas and offices which are accessible to the Postdoctoral Scholars, Graduate Research Assistants, Minority Fellows and their advisors from both WHOI and USGS.

CY2011-12 Activities: None.

VII. MARINE POLICY

The Marine Policy Center (MPC) of the Woods Hole Oceanographic Institution is one of a small number of research centers in the world dedicated to the application of social scientific scholarship to coastal and marine policy issues. A principal focus of MPC researchers, and the basis for collaboration between MPC and USGS, is the role of scientific information in public policy development. An objective of MPC research is to facilitate reduction of the “policy lag” so that effective and timely policy responses can be generated to rapidly evolving scientific knowledge.

Investigators from USGS and MPC will carry forward cooperative research activities that address pressing issues of public policy concern. These issues arise from a broad range of human endeavors in the nation's coastal regions and ocean waters. They include progress in science and technology, access to and control of resources, environmental management, and risk assessment and mitigation. To be useful, this research must be based on the best available scientific information, of the sort pursued by the USGS and WHOI ocean scientists. It must also be based on the rigorous analysis of socioeconomic systems, as pursued by MPC researchers. The cooperative work carried out by USGS and MPC will integrate marine science and social scientific knowledge through multidisciplinary teams and the application of appropriate techniques from the relevant disciplines.

In the past, MPC/USGS cooperation has centered on such public policy problems as:

- deep seabed mineral resources
- management of contaminated sediments
- optimal waste disposal practices
- effects of interagency rivalry and cooperation
- the economic value and optimal provision of seabed maps and topographic information, and
- identification of critical marine geological information for ecosystem management.

Some new topics for joint research are suggested by the project described below.

PROJECTS

MPC-1. Integrating Marine Geological Science into the Policy Process

WHOI PI: H. Kite-Powell (with Associate Investigators D. Jin, P. Hoagland, and A. Mulligan)
USGS Co-PIs: D. Hutchinson and P. Valentine

Description: Information about the marine geology of coastal systems is an important and sometimes underutilized input to the policy process. We will develop tools and illustrate through applied examples the use and economic value of marine geological information, together with other scientific and social scientific knowledge, to improve the resolution of public policy issues in coastal and marine systems management. Such issues include ecosystem management, marine spatial planning and ocean zoning, hazard assessment, and response planning (including warnings, cleanup, or remediation). Examples of possible projects include:

- evaluation of mitigation strategies for sea-level rise, storm events, and subsidence;
- evaluation of mitigation strategies for beach erosion and the environmental consequences of using offshore sources for beach replenishment;
- development of coastal land-use policy tools to balance the goals of economic development and environmental protection;
- development of tools to support risk assessment of environmental hazards in offshore habitats, marine sanctuaries, and ports;
- evaluation of risks associated with wastes dumped into coastal waters;
- development of asset accounts for marine geological resources as inputs to marine spatial planning;
- examination of the economic value and ecological risk of developing coastal fresh-water resources;

- economic and environmental consequences of developing new offshore energy resources such as gas hydrates and wind, current, and wave power; and
- the use of geologic information in the siting of offshore aquaculture operations for maximum human health benefit.

In each instance, we will bring a multidisciplinary team of natural and social scientists to focus on the problems.

CY2011-12 Activities: Researchers from the WHOI Marine Policy Center (MPC) and the USGS Coastal and Marine Geology Program (CMGP) will continue to investigate the economic values generated by CMGP research programs. Researchers from both groups will discuss the feasibility of utilizing these values to assess the benefits and costs of coastal and marine geological research. Researchers from both groups also will consider undertaking more detailed analysis of previously investigated programs (Stellwagen Bank mapping; Long Island sand and gravel resources) and initiating potential new studies, such as assessing the economic implications of coastal shoreline change as a consequence of climate-induced sea-level rise.

VIII. COST CENTERS

To provide high quality and a cost-effective range of support services, WHOI has established Cost Centers. WHOI/USGS cooperative projects generally define their needs for use of these Centers on an individual project basis.

However, within the overall scope of the Cooperative Agreement, there is a need to provide the services of these Centers for use as requirements arise.

PROJECTS

CC-1. Communications and Media Relations

WHOI Co-PIs: F. Heide
USGS Co-PIs: C. Polloni, D. Blackwood, F. Lightsom, and B. Butman

Description: WHOI and USGS provide knowledge and information concerning the oceans to a broad audience, including researchers, the press, and the public. This information is distributed through a variety of media and formats, including publications, posters, conferences, press releases, and the world-wide web. Clear illustrations, descriptions, animations, and other media appropriate for the intended audience are essential for effective communication. WHOI and USGS will work cooperatively to effectively and efficiently communicate knowledge and information on results of research and on ocean issues of mutual interest.

CY2011-12 Activities: WHOI will develop illustrations, video clips, and or animations for selected projects appropriate for the web, displays, and/or publications. WHOI will expose media journalists to oceanographic issues of mutual interest and will assist in writing press releases on collaborative science projects.

CC-2. Research Vessels

WHOI PI: A. Suchy
USGS PI: D. Nichols

Description: The Woods Hole Oceanographic Institution (WHOI) and the U.S. Geological Survey (USGS) require the use of vessels to meet the goals of their research programs. The use of ships and research platforms is often shared by several researchers or projects to affect cost savings in transit time and provide synergism to multi-disciplinary projects. Cooperative vessel use means that specialized capabilities are not duplicated and efficient use of a vessel, which has transited to a remote geographical area, can be made by investigators from both organizations. WHOI and USGS also cooperate in obtaining non-traditional vessels for specialized tasks in littoral zones as well as pelagic areas. Vessels which are outfitted for surveys and sampling in the U.S. Exclusive Economic Zone will be utilized. These vessels may be equipped to provide multibeam mapping, bathymetry and backscatter information, and have heavy gear handling capabilities.

A component in the effort to provide ships necessary for the scientific efforts of USGS and WHOI is the cooperative development and utilization of non-traditional platforms. Such platforms would significantly improve the abilities to conduct surveys and research in areas which are frequently beset by harsh climatic conditions but which are not a great distance from Woods Hole. Throughout, our efforts are intended to provide the most efficient use of available platforms and utilize new technologies in ship operations to the mutual benefit of WHOI and USGS.

CY2011-12 Activities: As in past years research vessel cooperation in CY2011 will include the use of near-shore research vessels such as the *R/V Tioga* class vessel in support of near-shore research in the Gulf of Maine, Massachusetts Bay, Long Island and Vineyard Sounds, and New York Bight. For projects closer to shore, WHOI's small boat fleet, which includes the *Mytilus,* will be available.

CC-3. Research Facilities

WHOI PI: E. Charette
USGS PI: D. Nichols

Description: An integral part of the USGS cooperative mission in Woods Hole is WHOI's provision of office, laboratory, computer, and ancillary space, and other facilities support functions in support of marine research. The broad goal of this facilities support project is to form an efficient infrastructural foundation for cooperative research. This foundation will provide the necessary close proximity between co-operating WHOI and USGS researchers, and with other investigators in the Woods Hole marine research community.

The project will also provide the facilities support functions for research operations, and those necessary to modify or create new facilities, as required by the variable needs of cooperative scientific projects. In addition, the project will plan and develop new cooperative research facilities, as required.

CY2011-12 Activities: In CY2011-12, office, laboratory, computer, and ancillary space will be provided by WHOI. The Research Facilities project will provide facilities support functions for cooperative research. These functions will include general research facilities offices, cranage, welding, machine shop, electrical shop, carpentry, marine stockroom, and scientific graphic services.

CC-4. Computer Systems

WHOI PI: A. Gaylord
USGS PI: K. List

Description: The USGS and WHOI share a common reliance on scientific computation in conducting marine research. The two organizations have cooperated extensively over the years in utilizing advanced computing techniques, computer software, and computer hardware to enhance the productivity of their research activities. In satisfying their specific computer and data communications requirements, the USGS and WHOI presently share the use of a comprehensive local area network (LAN), which interconnects end-user computer systems to each other and to the Internet. This LAN provides researchers and administrators with access to local and remote databases, computer servers, computer graphics systems, electronic mail, and many other capabilities, all of which significantly enhance scientists' ability to conduct collaborative research. The LAN and the various networked computers form a common basis for sharing expertise in the design and development of applications software, for the selection and implementation of vendor software and equipment, and for the management and operation of cooperative research efforts.

It has become increasingly important to be able to control multiple aspects of access to collaborative environments so that appropriate sharing of data and computational resources can easily occur while maintaining good security against unwanted access. Towards this end, USGS and WHOI will establish "sandbox" areas to provide secure environments to facilitate differing collaborative needs. With respect to another aspect of data protection, we intend to work together on the siting and use of off-site collocation facilities.

WHOI has migrated to a VoIP phone system and USGS will be doing so over the next couple of years. WHOI will offer support and management expertise for the USGS system and make sure that the systems integrate well as the current phones systems do. Over the next five years, telecommunications will migrate to network-based multimedia communications, which will further enhance collaboration between our organizations and with others world-wide.

The Computer Systems portion of this Cooperative Agreement covers continued support and improvement of the LAN, telecommunications and related computers and computer services.

CY2011-12 Activities In addition to traditional areas of support which include Internet, remote access services and desktop services, the Computer Systems portion of the USGS/WHOI Cooperative Agreement of CY 2011-2012 will include the following categories of activity: a) continuation of upgrades to the data networking infrastructure, including security and monitoring support as well as wiring and switch upgrades, throughout the USGS facilities in order to provide uniformity throughout the Woods Hole network; b) integration of the USGS 61C phone switch into the Woods Hole community switch and installation of IP-based integrated desktop services; c) investigate the use of advanced voice, video, and collaboration techniques over the Woods Hole network; d) further development of multimedia and visualization capabilities for USGS and; e) various application specific system analysis and programming.

CC-5. High-Performance Oceanographic Modeling on Parallel Computing Clusters

WHOI Co-PIs: J. Dusenberry
USGS Co-PIs: J. Warner, R. Signell, C. Sherwood, and N. Ganju

Description: This project will test and develop high-performance atmospheric, ocean circulation, wave, and sediment transport modeling techniques on parallel computing clusters. Performance on cluster machines depends on many factors, including numerical algorithms, parallelization strategy, efficient use of cache and interconnect fabric bandwidth, as well as

compilers and compiler options. The USGS and WHOI will work together to maintain and operate existing high performance compute clusters, acquire new systems, improve systems architecture, and investigate the use of GPU computing. We will continue the development of a coupled atmospheric, surface wave, oceanic, and sediment transport modeling system that operates efficiently on the cluster components. Data will be served on OpenDap fileservers.

CY2011-2012 Activities: The USGS and WHOI will work together to maintain and expand the existing compute clusters (marlin, nemo, and peach) and fileservers (pikmin and gam). The modeling system will be tuned for parallel cluster use. We will implement software for parallel computing technology to allow multiple applications to operate simultaneously and allow efficient exchange of information in a model coupling environment. We will develop management strategies for performing model simulations. WHOI will support the existing computing cluster systems.

CC-6. Inter-disciplinary Informatics in Support of Decision Support Systems and Policy

WHOI PI: A. Gaylord and A. Maffei
USGS PI: F. Lightsom

Description: Over the next five years it is critical that organizations such as WHOI and the USGS Coastal and Marine Geology Program deploy data informatics capabilities that manage, catalog, and provide access to inter-disciplinary scientific data and results. As science support for decision-making and policy-development become more important in areas such as Coastal and Marine Spatial Planning (CMSP) and the affects of global climate change on our society, both organizations need to improve capabilities for cataloging data they hold and making these data available to stakeholders and computer models. This requires development of data informatics frameworks that include procedures, controlled vocabularies, data provenance and attribution, information lifecycle management, security and access rights, information presentation and access/catalog services that can support the inter-disciplinary application of these data. Both USGS and WHOI have common needs in these areas, so it makes sense for them to jointly develop information systems, provide training opportunities, and develop staff skills via complementary infrastructures that further both organizations' missions while also providing collaborative sharing of these data with other agencies and research organizations.

Additional support is needed for infrastructure to facilitate sharing of inter-disciplinary data so that sufficient resources can be brought to bear to solve problems without over provisioning. Furthermore, information sharing and management across disciplines and organizations is greatly facilitated by the consistent use of an iterative data informatics methodology that incorporates elements such as use-case driven development, small mixed-team interactions, analysis of team results, standardized vocabulary and ontology model development, choice and use of appropriate informatics tools, scientist/expert review of data products, leveraging of appropriate technology infrastructures, and rapid prototyping of data applications. WHOI's strong collaboration with the RPI Tetherless World Constellation inter-disciplinary science center provides USGS with project interactions and advice from experts who have demonstrated the effectiveness of such an informatics methodology. The WHOI-USGS partnership offers some unique opportunities for the two organizations to jointly examine the use of inter-disciplinary data informatics to support decision support and policy-setting efforts that are at the core of the USGS mission.

CY2011-2012 Activities: This period of activity will focus on USGS and WHOI staff working together to implement an iterative data informatics framework that will be employed to build information systems that are capable of providing improved access to data and will support inter-disciplinary research, decision-support, and policy-development applications. Peter Fox, Co-Chair of RPI's Tetherless World Constellation, will work closely with Gaylord and Maffei.

The initial iteration of the data informatics framework, developed by Fox and his colleagues at RPI, will be used as a model. The following efforts will be made in this year's work in support of this effort:

First, two additional workshops, hosted by WHOI and also RPI's Tetherless World Constellation, are planned. The "CMSP Discovery Vocabularies Workshop," previously funded by this project, was hosted by WHOI December 1-3, 2010. The workshop brought together USGS, NOAA and other stakeholders in the CMSP process. We are hopeful that this continuing series of workshops, focusing on developing consensus on a common set of practical tools and methodologies to make CSMP data more easily discoverable and accessible will be of direct benefit to the efforts being made by the National Ocean Council in the development of a data portal for CMSP data.

Second, WHOI CIS technical support will be allocated to aid in the implementation of the data informatics framework, and, also, be available to support recommended actions that might be made by inter-organizational stakeholders that attend the above-mentioned workshops. One more USGS-centric effort would be the development of an information system that satisfies use-cases representing USGS needs to make CMGP data available for Coastal Marine Spatial Planning initiatives. Scientist experts, acting as domain specialists, will work with technical support staff in the implementation of informatics tools.

Third, an undergraduate summer guest student position will be established for a student with strong computer and inter-disciplinary science interests. This student will work on implementation of the information system mentioned above.

CC-7. Data Library and Archives

WHOI PI: J. Yoder
USGS PI: N. Soderberg

Description: The WHOI Data Library and Archives (DLA) will participate in an ongoing, cooperative 5-year effort with the USGS to develop systems for the compilation, access, distribution, management, and archiving of marine science information.

Part I: Data Managing and Archives

This portion of the cooperative project provides support for the data management and archiving, including indexing and storage of data sets, storage of data sets, including film, video cassettes, logs, reports, seismic and bathymetric records. It supports cataloging, indexing and storage of atlases, maps, charts and technical reports of mutual interest to WHOI and USGS.

CY2011-12 Activities: Anticipated activities for the 2010-2011 year include reviewing data sets with the USGS Data Cataloger to determine appropriate deposition and provide ongoing access to cruise information used to enhance USGS field activity records. DLA staff will catalog and add to the Library collection Woods Hole USGS authored reports and maps. We will continue to house USGS data in appropriate climate control storage and make this data available, as needed, to USGS researchers. The manager of the Woods Hole Open Access Server (WHOAS) will continue to solicit and deposit appropriate material in the institutional repository and staff will continue to work with the USGS Data Librarian on general reference and establishing best archival practices.

Part II: Oral History Project

The WHOI Library Staff, working with the USGS Data Librarian, will assemble resources in support of an Oral History Program to document collaborative research conducted by WHOI and USGS scientists in Woods Hole, MA. Interviews will be audiotaped and/or videotaped. Videoconferencing technology will used when appropriate. The resulting interview tapes (and transcripts when available) will be transferred to stable media and archived in both the WHOI DLA as well as the USGS Data Library (Woods Hole). Information about the oral histories will be available on publicly accessible websites.

CY2011-12 Activities: Anticipated activities for the 2010-2011 year include documenting the history of the USGS in Woods Hole including collaborative projects with WHOI. The focus will be on the histories of former center chiefs as well as the research, technology and fieldwork behind major projects and initiatives. The latter will include coordinating group interviews in the Tilley Conference Room. Former Woods Hole project participants who have relocated to other branches will be interviewed using videoconferencing technology.

CC-8. Seminars and Conferences
WHOI PI: M. Tivey
USGS PI: B. Butman

Description: The USGS and WHOI will jointly co-sponsor conferences, workshops, and research seminars which address issues of mutual interest.

CY 2011-12 Activities: WHOI will host seminars, workshops, and conferences during CY2011-12 collaboration with USGS.

CC-9. Training
WHOI PI: C. Hammond
USGS PI: F. Lightsom

Description: Participation by USGS employees in the professional development opportunities offered by WHOI.

CY2011-12 Activities: None

IX. OPERATIONAL SCIENTIFIC SERVICES

Advanced Imaging and Visualization Laboratory (AIVL)

The AIVL specializes in the image system design, development, and acquisition of imagery from unique and hostile environments in support of research, science and education. The AIVL maintains a large inventory of field-ready imaging systems including specialized aerial and underwater systems for use on aircraft, submarines, remotely operated vehicles, autonomous underwater vehicles and diver operated platforms. A complete post-production facility with the ability to acquire, post-process, edit and produce films including Digital IMAX, 3D HDTV, Full Dome, 3D Full Dome and multi-spectral formats. The imaging systems are available for scientific, educational, documentary feature film projects around the world in terrestrial, aerial and underwater environments.

OS-1. Development of a Digital HDTV Time Lapse Imaging System

WHOI PI: W.N. Lange
USGS PI: B. Butman

Description: Scientists at the USGS and WHOI share a need to collect, process, access and analyze high-resolution still images of the sea floor. These images are necessary to ground-truth side scan sonar and multibeam sonar surveys, to study sea floor processes, to document biological communities, and to understand the effects of anthropogenic activities such as waste disposal. Based upon work being done at WHOI's Advanced Imaging and Visualization Laboratory we plan to use a design architecture based upon high/hyper definition imaging systems and implement them into a seafloor digital time-lapse still imaging system. This system will utilize components of other WHOI HDTV and UHDTV camera designs but will be optimized for long-term time-lapse deployments in the deep sea. In this project, WHOI will work with USGS to develop and operate new underwater systems and to develop strategies and facilities to process and archive existing and new images.

CY2011-2012 Activities: WHOI will work with the USGS to develop a bench prototype of the design for testing and evaluation and the future fabrication of a time-lapse camera system. WHOI will attempt to use wherever possible, designs from previously developed camera systems for this project. WHOI will develop and demonstrate (on the bench top) the proposed system architecture for a long-term digital time-lapse imaging system. WHOI will also work with the USGS to develop new underwater systems and strategies and facilities to process and archive existing and new images. The goal will be to develop a design that can be easily fabricated and function as the manufacturing production prototype for a new low cost time-lapse camera system for use by the USGS for sea-floor imaging and research.

OS-2. Seafloor Imaging

WHOI PI: W.N. Lange
USGS PI: B. Butman

Description: Scientists at the USGS and WHOI share a need to collect, access, process, analyze and archive high-resolution video and still images of the sea floor. These images are necessary to ground-truth sidescan sonar and multibeam sonar surveys, to study sea floor processes, to document biological communities, and to understand the effects of anthropogenic activities such as waste disposal. In most cases, these images are collected by specialized underwater systems that operate in harsh ocean conditions, often for extended periods of time. In this project, WHOI will work with USGS to develop and operate new processing systems and to develop methodologies and facilities to process and archive existing and new underwater images. Migration of legacy data especially from aging 35mm film rolls to a digital still image format is essential to maintain the quality of the data and to allow the data to be easily used by scientists.

CY2011-2012 Activities: WHOI will work with the USGS to digitize, view, and archive approximately 50 rolls of time-lapse images of the seafloor originally obtained on 35 mm film. The digitization of the 35 mm images will facilitate analysis, interpretation and distribution. WHOI will continue to refine and develop techniques for digitizing, processing, and storing images obtained by Benthos underwater 35 mm film cameras. These cameras obtain pictures on 100' rolls of 35 mm film and have been used extensively by both WHOI and USGS to collect images since the 1970's. The images on the 100' rolls cannot be viewed easily or distributed electronically. A High-Definition 35 mm Film Transfer system will automatically feed these images to a high-resolution scanner. The ability to digitize these 35 mm images will facilitate archive, distribution, and viewing, and will make the images easily available for analysis and interpretation.

BUDGETS AND BUDGET JUSTIFICATIONS

I. BIOLOGY

BUDGET

April 1, 2011–March 31, 2012

BIO-1. Marine Habitat Studies

WHOI PI: M. Carman
USGS PI: P. Valentine

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. M. CARMAN, Res Spec	1.00	1.00
C. Total Direct Labor & Benefits	**$9,611**	**$9,611**
H. Total Direct Costs	**$9,611**	**$9,611**
I. Indirect Costs		
1. Lab Costs	5,398	5,398
2. General & Administrative	2,739	2,739
Total Indirect Costs	**8,137**	**8,137**
J. Total Direct & Indirect Costs	**$17,748**	**$17,748**
L. Amount of this Request	**$17,748**	**$17,748**

WHOI 14526.01

Budget Justification:

One month's salary is requested for Mary Carman for providing expertise for the USGS-WHOI Cooperative Program Marine Habitat Studies. She will collaboratively work with Page Valentine in collecting, interpreting, and using biological data in studies of marine habitats with a focus on invasive species.

BUDGET

April 1, 2011–March 31, 2012

BIO-2. Transport and Fate of Harmful Algal Blooms (HABs)

WHOI Co-PIs: D. Anderson and D. McGIllicuddy
USGS Co-PIs: R. Signell and B. Butman

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. D. ANDERSON, Senior Sci		0.00	
2. D. MCGILLICUDDY, Senior Sci		0.00	
B. Other Personnel			
2. Other Professionals			
B. KEAFER, Res Assoc III		1.50	
K. SMITH, Res Assoc III		1.50	
C. Total Direct Labor & Benefits			**$27,816**
G. Other Direct Costs			
1. Materials and Supplies			
a. Laboratory Supplies	500		
Total Materials and Supplies		500	
Total Other Direct Costs			**500**
H. Total Direct Costs			**$28,316**
I. Indirect Costs			
1. Lab Costs		15,624	
2. General & Administrative		7,927	
Total Indirect Costs			**23,551**
J. Total Direct & Indirect Costs			**$51,867**
L. Amount of this Request			**$51,867**

WHOI 14515.01

Budget Justification

Overall project coordination for the WHOI activities will be by D. M. Anderson for cyst and sediment studies and by D. J. McGillicuddy for sediment transport modeling. Salary support for Anderson and McGillicuddy will be provided by the NOAA ECO HAB project on *Alexandrium* cyst dynamics, in which USGS investigators are also participating. Assistance in cyst collection and counting will be provided by B. A. Keafer. K. Smith will assist with numerical modeling and incorporation of sediment trap algorithms into existing *Alexandrium* population models. A modest supply budget of $500 is also requested to cover sample bottles, core tubes and other materials needed for the cyst studies.

II. MARINE CHEMISTRY AND GEOCHEMISTRY

BUDGET

April 1, 2011–March 31, 2012

MCG-1. Quantifying Submarine Groundwater Discharge and Associated Nutrients to the Coastal Zone Using Natural Tracers and Seepage Meters

WHOI Co-PI's: Matthew Charette and Paul Henderson
USGS Co-PIs: J. Crusius, J. Bratton and K. Kroeger

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . M. CHARETTE, Assoc Sci w/Ten		0.00	
2 . P. HENDERSON, Res Assoc II		0.00	
C. Total Direct Labor & Benefits			**$0**
G. Other Direct Costs			
1. Materials and Supplies			
a. Laboratory Supplies	4,124		
Total Materials and Supplies		4,124	
6. Other			
a. Nutrient Facility 882@ $19	16,758		
Total Other		16,758	
Total Other Direct Costs			**20,882**
H. Total Direct Costs			**$20,882**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$20,882**
L. Amount of this Request			**$20,882**

WHOI 14512.01

Budget Justification:

Personnel:

The PI Charette will have overall responsibility for this project. In addition, he will assist co-PI Henderson with lab supervision, data interpretation, and manuscript preparation.

Materials and Supplies:

Materials and supplies include both field and lab expendable materials such as piezometers, pumps, filters, small volume bottles and exetainers for nutrients and metals sampling, and lab reagents.

WHOI Services:

Nutrient Analytical Facility use is budgeted for the analyses of nitrate, nitrite, ammonium, phosphate, silicate, and total dissolved nitrogen in groundwater and surface water samples.

BUDGET

April 1, 2011–March 31, 2012

MCG-2. Isotope Inventories and Sedimentary Processes in Coastal Marine Areas. Improvements to the Shared Gamma Counting Facility

WHOI PI: K. Buesseler
USGS PI: M. Bothner

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . K. BUESSELER, Senior Sci		0.00	
B. Other Personnel			
2. Other Professionals			
S. MANGANINI, Res Spec		0.50	
C. Total Direct Labor & Benefits			**$5,583**
G. Other Direct Costs			
1. Materials and Supplies			
a. Laboratory Supplies			
1. consumables & electronic supplies	8,000		
2. liquid nitrogen	4,100		
Total Materials and Supplies		12,100	
6. Other			
a. Radionuclide Analytical Fac. 50@ $281	14,050		
b. Shop Services 24@ $61	1,464		
Total Other		15,514	
Total Other Direct Costs			**27,614**
H. Total Direct Costs			**$33,197**
I. Indirect Costs			
1. Lab Costs		3,136	
2. General & Administrative		1,591	
Total Indirect Costs			**4,727**
J. Total Direct & Indirect Costs			**$37,924**
L. Amount of this Request			**$37,924**

WHOI 14479.01

Budget Justification:

K. Buesseler is a PI at no cost to this proposal. He has extensive experience in radiochemical analysis. His lab space will be used to house the detectors and chemical facilities used in the cooperative study. A half a month of time is budgeted for S. Manganini to perform additional analysis. Material and supply costs are budgeted based upon our experience for the analyses outlined as part of this program. These items are broken down into miscellaneous lab and electronic supplies in support of the gamma analyses. Liquid nitrogen is used for cooling our gamma counters. Shop services are requested for machining detector housings and electronic support. A budget is also included for the Café Thorium Radioanalytical Facility. This cost center will be used for the contract analyses of natural and man-made radionuclides in sediment.

BUDGET

April 1, 2011–March 31, 2012

MCG-3. Trace Element and Isotopic Analyses by High-Resolution and Multi-Collector

WHOI PI: P. Lam
USGS Co-PIs: J. Crusius and A. Schroth

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . P. LAM, Asst Sci		0.00	
C. Total Salaries & Benefits			**$0**
G. Other Direct Costs			
6. Other			
a. ICPMS - Element (full days) 30@ $1180	35,400		
b. ICPMS - Neptune (full days) 8@ $1400	11,200		
Total Other		46,600	
Total Other Direct Costs			**46,600**
H. Total Direct Costs			**$46,600**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$46,600**
L. Amount of this Request			**$46,600**

WHOI 14484.01

Budget Justification:

ICP-MS facility: The Element rate is $1,180 per day, and 30 days of analysis is requested, and the Neptune rate is $1,400 per day, and 8 days of analysis is requested.

BUDGET

April 1, 2011–March 31, 2012

MCG-4. Mercury Methylation in Bays and Coastal Ponds of Cape Cod

WHOI Co-PIs: Carl Lamborg and William Martin
USGS PI: Mike Bothner

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . C. LAMBORG, Assoc Sci		2.00	
2 . W. MARTIN, Senior Sci		0.00	
C. Total Direct Labor & Benefits			**$23,836**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	2,500		
Total Materials and Supplies		2,500	
6. Other			
a. ICPMS - Element (full days) 7@ $1180	8,260		
Total Other		8,260	
Total Other Direct Costs			**10,760**
H. Total Direct Costs			**$34,596**
I. Indirect Costs			
1. Lab Costs		13,389	
2. General & Administrative		6,793	
Total Indirect Costs			**20,182**
J. Total Direct & Indirect Costs			**$54,778**
L. Amount of this Request			**$54,778**

WHOI 14475.01

Budget Justification:

Among the team members (Bothner, Martin and Lamborg) we already possess the sampling and analytical equipment necessary to carry out our various tasks. Thus funds are requested for Lamborg's time, as well as money for supplies and time at WHOI's ICP-MS facility.

Personnel: Lamborg will be responsible for aiding in field collections and all dissolved Hg species analyses, and sediment-phase MMHg. He has the equipment to perform sedimentary acid volatile sulfide determinations and thiol measurements, and will also be responsible for carrying out the Hg methylation incubations, the isotope measurements and the interpretation of those results.

ICP-MS Facility: Support for a total of seven days use of the WHOI Facility ThermoFinnigan Element2, magnetic sectored, single collector instrument is requested. The cost of this time is fixed by the facility at $1,180 per day.

Supplies: An amount of $2,500 is requested to cover the costs of compressed gases, reagents, isotopes and replacement cartridges for the clean water system in Lamborg's lab.

BUDGET

April 1, 2011–March 31, 2012

MCG-5. Geological and Geochemical Studies of Marine Carbonate Habitats

WHOI PI: L. Robinson
USGS PI: K. Scanlon

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . L. ROBINSON, Assoc Sci		0.00	
B. Other Personnel			
2. Other Professionals			
M. WISCH, Res Assoc II		1.00	
C. Total Direct Labor & Benefits			**$6,645**
E. Travel			
Domestic			
1. AGU Meeting WHOI to San Francisco, CA			
Airfare RT 1 Tickets @ $850	850		
Ground General 1 @ $100	100		
Lodging Hotel 1 Rooms 6 Nights @ $160	960		
Misc. Exp. Mtg. Cost 1 People @ $300	300		
Per Diem US Cont 1 People 6 Days @ $57	342		
Total		2,552	
Total Domestic Travel		2,552	
Total Travel			**2,552**
G. Other Direct Costs			
6. Other			
a. ICPMS - Element (full days) 5@ $1180	5,900		
b. NOSAMS Sample Charges	6,933		
Total Other		12,833	
Total Other Direct Costs			**12,833**
H. Total Direct Costs			**$22,030**
I. Indirect Costs			
1. Lab Costs		3,732	
2. General & Administrative		1,894	
Total Indirect Costs			**5,626**
J. Total Direct & Indirect Costs			**$27,656**
L. Amount of this Request			**$27,656**

WHOI 14465.01

Budget Justification:
Salaries: One month salary support is requested for a Research Assistant Maureen Auro (Wisch) to carry out the FY2011-12 activities.
Travel: Support is requested for one person to attend the national AGU meeting.
Other Direct Costs: Funds are requested for Element ICP-MS time for trace metal and isotopic analyses, and for NOSAMS to cover costs associated with radiocarbon dating carbonate coral skeletons.

BUDGET

April 1, 2011–March 31, 2012

MCG-6. Biogeochemical Investigations of Gas Hydrate Systems

WHOI Co-PIs: J. Seewald and C. Reddy
USGS PI: J. Pohlman

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . J. SEEWALD, Dept. Chair		0.00	
2 . C. REDDY, Senior Sci		0.00	
B. Other Personnel			
2. Other Professionals			
R. NELSON, Res Spec		0.25	
S. SYLVA, Res Assoc III		0.86	
C. Total Direct Labor & Benefits			**$9,751**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	1,993		
Total Materials and Supplies		1,993	
Total Other Direct Costs			**1,993**
H. Total Direct Costs			**$11,744**
I. Indirect Costs			
1. Lab Costs		5,477	
2. General & Administrative		2,779	
Total Indirect Costs			**8,256**
J. Total Direct & Indirect Costs			**$20,000**
L. Amount of this Request			**$20,000**

WHOI 14546.01

Budget Justification:

Funds will be provided for technical support, consumables and equipment maintenance within the Department of Marine Chemistry and Geochemistry at WHOI. Sean Sylva will provide technical support to enable USGS PI Pohlman to process the samples. For the hydrocarbon degradation study, Robert Nelson will continue to support USGS PI Pohlman in the analysis of biomarkers and hydrocarbon degradation products previously analyzed by comprehensive GC×GC in WHOI co-PI Reddy's lab.

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III. GEOLOGY & GEOPHYSICS

BUDGET

April 1, 2011–March 31, 2012

GG-1. Geological Sample Acquisition, Processing, Curation

WHOI PI: J. Broda
USGS Co-PIs: W. Winters and B. Buczkowski

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . J. BRODA, Sr Res Spec		0.50	
B. Other Personnel			
2. Other Professionals			
E. ROOSEN, Sr Res Asst I		0.75	
C. Total Direct Labor & Benefits			**$12,503**
G. Other Direct Costs			
1. Materials and Supplies			
a. Other Supplies			
1. Curatorial, core and x-ray supplies	3,766		
2. Sample racks	1,000		
Total Materials and Supplies		4,766	
6. Other			
a. Communications	50		
b. Equipment Maintenance Agreemnt	3,000		
c. Miscellaneous			
1. Sample storage	6,000		
2. Share of computer maintenance	1,000		
d. Photocopying	50		
Total Other		10,100	
Total Other Direct Costs			**14,866**
H. Total Direct Costs			**$27,369**
I. Indirect Costs			
1. Lab Costs		7,023	
2. General & Administrative		3,563	
Total Indirect Costs			**10,586**
J. Total Direct & Indirect Costs			**$37,955**
L. Amount of this Request			**$37,955**

WHOI 14521.01

Budget Justification:

A. Personnel

1. This project will be supervised by J. Broda who has responsibility for insuring that supplies, facilities, equipment, and cruises satisfy the needs of USGS projects. Many USGS researchers use WHOI facilities in coring and sampling to both design and operate existing sea floor sampling equipment.

2. Coring, sampling, photographic, and sample curation operations will be performed by Ellen Roosen.

G. Other Direct Costs

1. Material and Supplies

a1. Curatorial and core supplies include large quantities of high-impact styrene D-tubes, required to store and preserve split core sections. X-ray supplies include XRF film, u-channels and miscellaneous laboratory supplies.

a2. Sample racks are required to store and allow easy access and removal of core sections that are stored in the WHOI storage facility at McLean.

6. Other Costs

a. Funds are requested to pay for telephone, fax, and satellite transmissions to ships at sea during the planning and conducting of coring and other sampling operations.

b. Funds are requested to support computer hardware maintenance.

c1. Facilities costs related to storing thousands of USGS cores and samples are incurred annually.

c2. Funds are requested for share of computer maintenance.

d. Costs incurred for photocopying of materials related to this project are requested.

BUDGET

April 1, 2011–March 31, 2012

GG-2. Examining Deepwater Corals as Paleoceanographic Archives

WHOI Co-PIs: A. Cohen and W. Thompson
USGS Co-PIs: J. Crusius and J. Bratton

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

GG-3. Operation of Ocean Bottom Seismic Instrumentation Pool in Woods Hole for the Marine Geosciences Community

WHOI PI: J. Collins
USGS PI: U. ten Brink

	Approximate Labor Months 04/01/11 03/31/12	
A. Senior Personnel		
1 . J. COLLINS, Res Spec	0.00	
B. Other Personnel		
2. Other Professionals		
A. GARDNER, Engr II	4.45	
C. Total Direct Labor & Benefits		**$35,893**
H. Total Direct Costs		**$35,893**
I. Indirect Costs		
1. Lab Costs	20,161	
2. General & Administrative	10,230	
Total Indirect Costs		**30,391**
J. Total Direct & Indirect Costs		**$66,284**
L. Amount of this Request		**$66,284**

WHOI 14533.01

Budget Justification:

Engineering support is requested for maintenance of the USGS OBS and for the operation of the WHOI OBSIP facility.

We request 4.45 man-months of base-level support for engineer Alan Gardner. This support is used to maintain and carry out necessary upgrades (software, new hardware) to the OBS, and to support maintenance of related infrastructure. Using these funds, the technician will carry out routine maintenance of the USGS OBS and further refine our rapid response capability.

BUDGET

April 1, 2011–March 31, 2012

GG-4. Support for Rapid Response Experiment

WHOI PI: J. Collins
USGS PI: U. ten Brink

		Approximate Labor Months 04/01/11 03/31/12	
A. Senior Personnel			
1 . J. COLLINS, Res Spec		0.00	
B. Other Personnel			
2. Other Professionals			
D. DUBOIS, Sr Res Asst I		1.00	
A. GARDNER, Engr II		2.00	
D. KOT, Eng Asst III		1.00	
C. Total Direct Labor & Benefits			**$28,915**
G. Other Direct Costs			
1. Materials and Supplies			
a. Other Supplies			
1. Quanterra Q330 Data Loggers 5@ $8500	42,500		
2. Quanterra PB14F Field Balers 5@ $2200	11,000		
3. Edgetech Navigation Transsducers 5@ $1200	6,000		
4. Seascan timebases 5@ $900	4,500		
5. WHOI Aux. Controller Board 5@ $600	3,000		
6. WHOI Recovery Board 5@ $1000	5,000		
7. Baler Modification Parts 5@ $400	2,000		
8. Interior Cabling Parts 5@ $210	1,050		
9. Glass ball battery housing 5@ $800	4,000		
10. Edgetech			
a. Burnwire Acoustic Release 5@ $1500	7,500		
Total Materials and Supplies		86,550	
Total Other Direct Costs			**86,550**
H. Total Direct Costs			**$115,465**
I. Indirect Costs			
1. Lab Costs		16,241	
2. General & Administrative		8,241	
Total Indirect Costs			**24,482**
J. Total Direct & Indirect Costs			**$139,947**
L. Amount of this Request			**$139,947**

WHOI 14537.01

Budget Justification:

This budget covers the cost of two related tasks. For task 1, we request 1 man-month support for engineer Gardner and 1 man-month support for technician Dubois to work with Collins and ten Brink to develop a protocol for rapid response. The outcome of this effort would be a detailed inventory and budget for all of the instrumentation (acoustic deck box, deck wall-box, radio-direction finder, shipping boxes, LD3 container, as well as OBS) needed to rapidly respond to a hazardous event. We will develop a robust plan with the WHOI Shipping Dept. and a commercial shipping company to expedite air-shipment of OBS and support equipment. Working closely with Uri ten Brink and other USGS personnel, we would formalize a procedure for how a rapid response might be initiated, who would be responsible for securing a boat of opportunity to deploy the OBS, etc.

Task 2 is to re-activate 5 short-period OBS that were deactivated in order to supply components to our initial build of 25 broadband OBS. All of the 5 short-period systems that we propose to reactivate are equipped with: (i) hard-hat enclosure; (ii) High Tech hydrophone; (iii) 3-component 4.5 Hz geophone and associated titanium pressure housing and gimbal-based leveling system; (iv) underwater cables and penetrators; and (v) 17" glass-ball pressure housing. Each system lacks: (i) Quanterra Q330 data-logger; (ii) Quanterra PB14F Baler storage device; (iii) Edgetech acoustic-release board; (iv) navigation transducer for acoustic communications; (v) Seascan timebase; (vi) WHOI Auxiliary Control (AC) board; (vii) WHOI Recovery Board; and (viii) interior cabling. These systems do have 12" glass ball pressure housings for battery storage, but given OBSIP's recent experience with glass balls, we believe that these should be replaced. The costs of these items are listed in sections G.1.a.1–G.1.a.10 of the budget. Item G.1.a.7 (Baler modification parts) is required to modify the Field Baler so that it fits inside our glass ball pressure housing and carries an Ethernet switch. Item G.1.a.8 covers the cost of interior cabling. All of the items G.1.a.1-G.1.a.10 are for quantity 5. Installation and testing will be carried out by electronics engineer Gardner and mechanical technician Kot. We request 1 man-month support for both Kot and an additional month for Gardner.

BUDGET

April 1, 2011–March 31, 2012

GG-5. Offshore Hazards and Tectonic Deformation Using OBS

WHOI PI: J. Collins
USGS PI: U. ten Brink

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. JOHN A. COLLINS, PI	1.00	1.00
2. ALAN T. GARDNER, Engr II	0.00	0.00
B. Other Personnel		
2. Other Professionals	7.09	7.09
C. Total Direct Labor & Benefits	**$108,525**	**$108,525**
E. Travel		
1. Domestic	9,375	9,375
Total Travel	**9,375**	**9,375**
G. Other Direct Costs		
1. Materials and Supplies	43,190	43,190
6. Other	54,700	54,700
Total Other Direct Costs	**97,890**	**97,890**
H. Total Direct Costs	**$215,790**	**$215,790**
I. Indirect Costs		
1. Lab Costs	57,798	57,798
2. General & Administrative	29,325	29,325
Total Indirect Costs	**87,123**	**87,123**
J. Total Direct and Indirect Costs	**$302,913**	**$302,913**
L. Amount of this Request	**$302,913**	**$302,913**

*includes Cruise Participation
WHOI 14538.01

1-Gulf of Alaska Budget

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. COLLINS, Res Spec	0.50	0.50
2 . A. GARDNER, Engr II	0.00	0.00
B. Other Personnel		
2. Other Professionals		
D. DUBOIS, Sr Res Asst I	1.47*	1.47
P. LEMMOND, Res Assoc III	2.00*	2.00
C. Total Direct Labor & Benefits	**$52,157**	**$52,157**
E. Travel (see detail)		
1. Domestic	5,145	5,145
Total Travel	**5,145**	**5,145**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	38,595	38,595
6. Other	27,350	27,350
Total Other Direct Costs	**65,945**	**65,945**
H. Total Direct Costs	**$123,247**	**$123,247**
I. Indirect Costs		
1. Lab Costs	27,866	27,866
2. General & Administrative	14,138	14,138
Total Indirect Costs	**42,004**	**42,004**
J. Total Direct & Indirect Costs	**$165,251**	**$165,251**
L. Amount of this Request	**$165,251**	**$165,251**

* Includes Cruise Participation

WHOI 14538.01

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

Kodiak, AK (Woods Hole, MA to Kodiak, AK)

Airfare	Round Trip	2 Tickets			@1,000	2,000
Ground	Gasoline	1			@100	100
Ground	General Grnd Transport.	2			@100	200
Ground	Vehicle Rental - Weekly	1 Vehicles	1 Weeks		@425	425
Lodging	Nightly Rate (inc. Tax)	2 Rooms	5 Nights		@141	1,410
Per Diem	Other Domestic	2 People	7 Days		@64	896
Per Diem	Inside Continental US	2 People	1 Days		@57	114
					Trip Total:	5,145

Total Domestic Travel - Period 1 **5,145**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Computer Supplies		
1. Portable Disk Drives	600	600
b. Cruise Supplies		
1. Batteries	33,000	33,000
2. Anchors	2,040	2,040
3. Burnwires	1,785	1,785
4. Corrodible Links	170	170
c. Other Supplies	1,000	1,000
Total Materials and Supplies	**38,595**	**38,595**
6. Other		
a. Communications	100	100
b. Cruise Shipments	7,200	7,200
c. Miscellaneous		
1. Contingency Funds	20,000	20,000
d. Photocopying	50	50
Total Other	**27,350**	**27,350**
Total Other Direct Costs	**65,945**	**65,945**

WHOI 14538.01

2-Bering Sea Budget

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. COLLINS, Res Spec	0.50	0.50
2 . A. GARDNER, Engr II	0.00	0.00
B. Other Personnel		
2. Other Professionals		
D. DUBOIS, Sr Res Asst I	1.62*	1.62
P. LEMMOND, Res Assoc III	2.00*	2.00
C. Total Direct Labor & Benefits	**$56,368**	**$56,368**
E. Travel (see detail)		
1. Domestic	4,230	4,230
Total Travel	**4,230**	**4,230**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	4,595	4,595
6. Other	27,350	27,350
Total Other Direct Costs	**31,945**	**31,945**
H. Total Direct Costs	**$92,543**	**$92,543**
I. Indirect Costs		
1. Lab Costs	29,932	29,932
2. General & Administrative	15,187	15,187
Total Indirect Costs	**45,119**	**45,119**
J. Total Direct & Indirect Costs	**$137,662**	**$137,662**
L. Amount of this Request	**$137,662**	**$137,662**

* Includes Cruise Participation

WHOI 14538.01

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

Bering Sea Cruise (Woods Hole, MA to Unalaska, AK)

Airfare	Round Trip	2 Tickets			@1,000	2,000
Ground	Gasoline	1			@100	100
Ground	General Grnd Transport.	2			@100	200
Ground	Vehicle Rental - Weekly	1 Vehicles	1 Weeks		@400	400
Lodging	Nightly Rate (inc. Tax)	2 Rooms	3 Nights		@121	726
Per Diem	Other Domestic	2 People	5 Days		@69	690
Per Diem	Inside Continental US	2 People	1 Days		@57	114
					Trip Total:	4,230

Total Domestic Travel - Period 1 **4,230**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Computer Supplies		
1. Portable Disk Drives	600	600
b. Cruise Supplies		
1. Anchors	2,040	2,040
2. Burnwires	1,785	1,785
3. Corrodible Links	170	170
Total Materials and Supplies	**4,595**	**4,595**
6. Other		
a. Communications	100	100
b. Cruise Shipments	7,200	7,200
c. Miscellaneous		
1. Contingency Funds	20,000	20,000
d. Photocopying	50	50
Total Other	**27,350**	**27,350**
Total Other Direct Costs	**31,945**	**31,945**

WHOI 14538.01

Budget Justification:

This budget itemizes the costs associated with supporting two USGS active-source experiments, in the Gulf of Alaska and in the Bering Sea. The experiments, which will be carried out using the R/V Marcus Langseth, are currently scheduled for June and August, 2011. Costs associated with mobilization (1.5 man days per OBS split 50:50 between a senior engineer and a technician) and de-mobilization (1 man-day per OBS split 50:50 between a junior engineer and a technician) are not included here as they are deemed covered under the annual base-level support provided via the USGS/WHOI cooperative agreement. The attached budget includes no shore-side engineering or technician costs. Because of USGS' funding for OBS construction, the budget does not include the standard "drop fee" of $1,500 per short-period OBS per drop.

Justification

Collins heads the WHOI OBS group and he requests 1 man-month to oversee this project. Electronics engineer Alan Gardner and technician Dave Dubois will prepare 15 OBS for deployment in the Gulf of Alaska and in the Bering Sea. Salary costs for these activities are covered under the base-level support provided by the USGS/WHOI cooperative agreement.

Research Associate Peter Lemmond and technician David Dubois will participate in both cruises. The attached budget includes Lemmond's and Dubois' salary charges while at sea and all of their travel-related costs. Once the data are back at WHOI, computer programmer Peter Lemmond will carry out final data processing of the acquired data. This includes applying clock corrections, re-making SEGY gathers, and archiving the data in SEED format.

Travel costs are requested for Lemmond and Dubois to participate in both cruises. However, Gardner's travel costs and at-sea salary are not included in the base-level support provided by the USGS/WHOI cooperative agreement, and hence this budget does include Gardner's travel and at-sea labor costs.

We request funds to purchase batteries, anchors, and burn-wires for the 15 OBS that will be deployed on these two experiments. One battery pack, of appropriate size, will be used for both experiments. Shipping costs are: (i) to ship our 20' lab van from WHOI to San Diego, CA where it will be loaded on the R/V Marcus Langseth; and (ii) to ship the van home from a west-coast port, location to be decided.

We include a $20,000 contingency in each of the two budgets to cover unplanned costs such as those associated with extended cruise durations, additional OBS drops (hence the need for more anchors etc), or unexpected shipping charges.

WHOI 14538.01

BUDGET

April 1, 2011–March 31, 2012

GG-6. Electrical Studies of Sediments

WHOI PI: R. Evans
USGS PI: D. Hutchinson

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

GG-7. Multi-Disciplinary Studies of Shoreline Change

WHOI Co-PIs: R. Evans, J. Donnelly, L. Giosan, B. Raubenheimer, and A. Ashton
USGS Co-PIs: R. Thieler, W. Barnhardt, and D. Twichell

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
2 . A. ASHTON, Asst Sci		2.00	
C. Total Direct Labor & Benefits			**$23,118**
G. Other Direct Costs			
6. Other			
a. Communications	100		
b. Photocopying	100		
Total Other		200	
Total Other Direct Costs			**200**
H. Total Direct Costs			**$23,318**
I. Indirect Costs			
1. Lab Costs		12,985	
2. General & Administrative		6,589	
Total Indirect Costs			**19,574**
J. Total Direct & Indirect Costs			**$42,892**
L. Amount of this Request			**$42,892**

WHOI 12031.03

Budget Justification

Salary support is requested for 2 months for Co-PI Andrew Ashton. He will develop and test models of coastal evolution. Nominal funds for communications and photocopying are also requested.

BUDGET

April 1, 2011–March 31, 2012

GG-8. Mariana Forearc Crustal Structure and Law of the Sea

WHOI PI: D. Lizarralde
USGS PI: D.R. Hutchinson

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . D. LIZARRALDE, Assoc Sci w/Ten		0.00	
B. Other Personnel			
1. Postdoctoral Associates			
N. IVANOVA, Postdoc Fellow		0.00	
C. Total Direct Labor & Benefits			**$0**
E. Travel			
Domestic			
1. AGU Scientific Mtg Woods Hole, MA to San Francisco, CA			
Airfare RT 1 Tickets @ $625	625		
Ground General 1 @ $200	200		
Lodging Hotel 1 Rooms 5 Nights @ $150	750		
Misc. Exp. Mtg. Cost 1 People @ $420	420		
Per Diem US Cont 1 People 6 Days @ $57	342		
Total		2,337	
2. Menlo Park, CA Travel Woods Hole, MA to Menlo Park, CA			
Airfare RT 1 Tickets @ $475	475		
Ground Gasoline 1 @ $75	75		
Ground Veh Rent-W 1 Vehicles 1 Weeks @ $405	405		
Lodging Hotel 1 Rooms 6 Nights @ $142	852		
Per Diem US Cont 1 People 7 Days @ $57	399		
Total		2,206	
3. Halifax, NS Travel Woods Hole, MA to Halifax, NS			
Airfare RT 2 Tickets @ $1000	2,000		
Ground Veh Rent-W 2 Vehicles 1 Weeks @ $270	540		
Ground Gasoline 2 @ $75	150		
Lodging Hotel 1 Rooms 12 Nights @ $194	2,328		
Per Diem OthDom 1 People 14 Days @ $118	1,652		
Total		6,670	
Total Domestic Travel		11,213	
Total Travel			**11,213**
G. Other Direct Costs			
1. Materials and Supplies			
a. Computer Supplies			
1. Monitor	1,000		
2. Small Disk Array	1,000		
3. Supplies	1,000		
Total Materials and Supplies		3,000	
2. Publications			
a. Publication Costs	3,000		
Total Publications		3,000	
6. Other			
a. Communications	100		

(GG-8 Budget 15583.00, cont'd)

	Approximate Labor Months 04/01/11 03/31/12		
G. Other Direct Costs			
6. Other			
b. Photocopying	100		
Total Other		200	
Total Other Direct Costs			**6,200**
H. Total Direct Costs			**$17,413**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$17,413**
L. Amount of this Request			**$17,413**

WHOI 15583.00

Budget Justification

The planned 2011-2012 research activities involve analyses of seismic data acquired jointly with colleagues from the Canadian Geologic Survey. Analyses of these data will involve close collaboration with that group.

Personnel: The primary work this year will be performed by Nina Ivanova, currently a postdoctoral scholar at WHOI with Lizarralde as her advisor. We do not request salary support for either Ivanova or Lizarralde.

Travel: Funds are included for Ivanova to take two trips to Dalhousie University to work with our Canadian colleagues; one trip to Menlo Park to work with our USGS colleagues; and a trip to attend the Fall AGU 2011 meeting.

Other Direct Costs: *Materials and Supplies:* Funds for computer and other miscellaneous supplies are requested to support the seismic analysis work.

Publication Costs: Funds are included to cover page charges and other costs of scientific publication.

Other:

Communications and Photocopying: Nominal funds are requested for communications and photocopying.

BUDGET

April 1, 2011–March 31, 2012

GG-9. Radiocarbon Dating Investigations

WHOI PI: W. J. Jenkins
USGS PI: E. R. Thieler

	Approximate Labor Months 04/01/10 03/31/11		
A. Senior Personnel			
1 . W. JENKINS, Senior Sci		0.00	
C. Total Direct Labor & Benefits			**$0**
G. Other Direct Costs			
6. Other			
a. AMS Sample Charges 80@ $300	24,000		
Total Other		24,000	
Total Other Direct Costs			**24,000**
H. Total Direct Costs			**$24,000**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$24,000**
L. Amount of this Request			**$24,000**

WHOI 14550.01

Budget Justification:

AMS C-14 analysis ($24,000): The cost of analyzing organic carbon, carbonate minerals, and CO2 gas samples including C-13 analyses, at the National Ocean Sciences AMS Facility is approximately $300 each and depends on the type of sample. Up to eighty samples will be analyzed as part of this project.

BUDGET

April 1, 2011–March 31, 2012

GG-10. Experimental and Theoretical Investigations of Problems in Hydrogeomechanics

WHOI Co-PIs: M. D. Behn, D. Lizarralde
USGS PI: W. F. Waite

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

GG-11. Sedimentary Records of Global Change in Continental Margin Environments

WHOI Co-PIs: L. Keigwin, D. McCorkle, D. Oppo, and L. Giosan
USGS Co-PIs: R. Thieler, J. Bratton, J. Crusius, and W. Barnhardt

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

GG-12. Studies of Seismotectonics of Continental Margins and Interactions Between Underwater Earthquakes and Tsunamis: Observations and Modeling

WHOI PI: J. Lin
USGS PI: U. ten Brink

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . J. LIN, Senior Sci		1.00	
C. Total Direct Labor & Benefits			**$18,314**
G. Other Direct Costs			
1. Materials and Supplies			
a. Software License			
1. Computer modeling license fees	500		
Total Materials and Supplies		500	
Total Other Direct Costs			**500**
H. Total Direct Costs			**$18,814**
I. Indirect Costs			
1. Lab Costs		10,287	
2. General & Administrative		5,219	
Total Indirect Costs			**15,506**
J. Total Direct & Indirect Costs			**$34,320**
L. Amount of this Request			**$34,320**

Budget Justification

This project is for the WHOI-USGS collaborative investigation of seismotectonic deformation of continental margins, especially through quantitative tectonic modeling.

Salary support of 1.0 month is requested for WHOI PI, Jian Lin. Also requested are the costs for sharing computer modeling software license fees.

WHOI 14527.01

BUDGET

April 1, 2011–March 31, 2012

GG-13. Developing New Paleo-Environmental Proxies Using XRF scanning

WHOI Co-PIs: L. Giosan and T. Eglinton
USGS Co-PIs: J. Crusius

	Approximate Labor Months 04/01/11 03/31/12	
A. Senior Personnel		
1 . L. GIOSAN, Assoc Sci	1.00	
B. Other Personnel		
2. Other Professionals		
RESEARCH ASST I A, Res Asst I	1.00	
C. Total Direct Labor & Benefits		**$15,745**
H. Total Direct Costs		**$15,745**
I. Indirect Costs		
1. Lab Costs	8,844	
2. General & Administrative	4,488	
Total Indirect Costs		**13,332**
J. Total Direct & Indirect Costs		**$29,077**
L. Amount of this Request		**$29,077**

Budget Justification:

Personnel:

Liviu Giosan will contribute to the design of the project, interpret the results of the XRF scanning of the cores, and supervise the XRF scanning. One month salary is requested for PI Giosan. One month of time is requested for Research Assistant, TBN, who will perform XRF scanning on the USGS cores.

BUDGET

April 1, 2011–March 31, 2012

GG-14. Geophysical, Geochemical, and Modeling Studies of Groundwater in Coastal Regions

WHOI PI: D. McCorkle, M. Charette, R. Evans and A. Mulligan
USGS Co-PIs: J. Bratton and J. Crusius

No costs are anticipated in CY2011-12.

IV. APPLIED OCEAN PHYSICS AND ENGINEERING

BUDGET

April 1, 2011–March 31, 2012

AOPE-1. Development, Installation and Operation of Coastal Ocean Observing Systems

WHOI PI: K. von der Heydt
USGS Co-PIs: B. Butman, M. Martini, and U. ten Brink

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

AOPE-2. Sediment Transport in Coastal Ocean Systems

Task I: Data Analysis of Sediment Transport in the Hudson River Estuary

WHOI Co-PIs: W. R. Geyer, P. Traykovski and K. Foote
USGS Co-PIs: R. Signell, C. Sherwood. J. C. Warner and Butman

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2011–March 31, 2012

AOPE-2. Sediment Transport in Coastal Ocean Systems

Task II: Study of Turbulence and Sediment Transport over Large Dunes on a Tidal Shoal

WHOI PI: W.R. Geyer and P. Traykovski
USGS Co-PIs: C. Sherwood and R. Signell

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . W. GEYER, Senior Sci		0.20	
2 . P. TRAYKOVSKI, Assoc Sci w/Ten		0.20	
B. Other Personnel			
2. Other Professionals			
F. JAFFRE, Res Engr		0.24	
J. SISSON, Sr Res Asst II		0.69	
C. Total Direct Labor & Benefits			**$15,537**
G. Other Direct Costs			
6. Other			
a. Tioga - >12 hr day 3@ $4050	12,150		
Total Other		12,150	
Total Other Direct Costs			**12,150**
H. Total Direct Costs			**$27,687**
I. Indirect Costs			
1. Lab Costs		8,727	
2. General & Administrative		4,428	
Total Indirect Costs			**13,155**
J. Total Direct & Indirect Costs			**$40,842**
L. Amount of this Request			**$40,842**

WHOI 14508.01

Budget Justification:

Geyer will provide oversight of the project. Traykovski will implement the PC-ADP instrumentation for this application. Jaffre is in charge of the electronic components of the PC-ADP system. Sisson will handle field logistics The R/V Tioga will be used for 3 days.

BUDGET

April 1, 2010-March 31, 2011

AOPE-2. Sediment Transport in Coastal Ocean Systems

Task III: Data Assimilation Modeling of Regional Coastal Circulation

WHOI Co-PIs: P. Traykovski
USGS Co-PIs: C. Sherwood and R. Signell

No costs are anticipated in CY2011-12.

BUDGET

April 1, 2010-March 31, 2011

AOPE-2. Sediment Transport in Coastal Ocean Systems

Task IV: Circulation and Wave Modeling at MVCO

WHOI Co-PIs: P. Traykovski
USGS Co-PIs: C. Sherwood and R. Signell

	Approximate Labor Months 04/01/11 03/31/12	
A. Senior Personnel		
1 . P. TRAYKOVSKI, Assoc Sci w/Ten	0.86	
B. Other Personnel		
2. Other Professionals		
F. JAFFRE, Res Engr	1.05	
J. SISSON, Sr Res Asst II	1.05	
C. Total Direct Labor & Benefits		**$32,447**
H. Total Direct Costs		**$32,447**
I. Indirect Costs		
1. Lab Costs	18,225	
2. General & Administrative	9,247	
Total Indirect Costs		**27,472**
J. Total Direct & Indirect Costs		**$59,919**
L. Amount of this Request		**$59,919**

WHOI 15594.00

Budget Justification:

Funding is requested for Traykovski, Sisson and Jaffre to implement a multi-frequency bi-static pulse coherent Doppler system for USGS. Traykovski will be responsible for project management, design of the geometry of acoustic transducers, and post processing signal processing to de-alias the Doppler velocities using the multi-frequency information. Jaffre will be responsible for modifying existing high frequency sonar board for the unique requirements of the USGS system, tuning the circuit boards to the transducer to ensure optimal signal-to-noise ratios, and performing any necessary modifications to on-board real-time signal processing. Sisson will be responsible for mechanical integration and fabrication of transducer mounts. Parts and supplies for this project will be available from existing systems and in parallel to new funded development work on these systems.

BUDGET

April 1, 2010-March 31, 2011

AOPE-2. Sediment Transport in Coastal Ocean Systems

Task V: Calibration of Acoustic Backscatter Sensors

WHOI Co-PIs: K. Foote
USGS Co-PIs: C. Sherwood

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. K. FOOTE, Senior Sci		0.46	
C. Total Direct Labor & Benefits			**$10,200**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	1,164		
Total Materials and Supplies		1,164	
Total Other Direct Costs			**1,164**
H. Total Direct Costs			**$11,364**
I. Indirect Costs			
1. Lab Costs		5,729	
2. General & Administrative		2,907	
Total Indirect Costs			**8,636**
J. Total Direct & Indirect Costs			**$20,000**
L. Amount of this Request			**$20,000**

WHOI 14539.01

Budget Justification:

K. Foote, as Principal Investigator (PI), will collaborate with the cognizant USGS engineer to perform a standard-target calibration of a particular acoustic backscatter sensor (ABS) system used in the field, and cite the experimental results in a proposal to establish standard-target calibration protocols for ABS measurements. The ultimate aim is to improve ABS estimation of suspended sediment properties, the analysis of multi-frequency ABS data, and the inter-comparison of in situ data derived from other acoustic sensors.

BUDGET

April 1, 2011–March 31, 2012

AOPE-3. Groundwater and Nutrient Fluxes into Shallow Estuaries

WHOI Co-PIs: D.K. Ralston
USGS Co-PIs: N. Ganju, C. Sherwood, J. Warner, and B. Butman

	Approximate Labor Months 04/01/11 03/31/12	
A. Senior Personnel		
1 . D. RALSTON, Asst Sci	2.00	
2 . W. GEYER, Senior Sci	1.50	
C. Total Direct Labor & Benefits		**$51,165**
H. Total Direct Costs		**$51,165**
I. Indirect Costs		
1. Lab Costs	28,739	
2. General & Administrative	14,582	
Total Indirect Costs		**43,321**
J. Total Direct & Indirect Costs		**$94,486**
L. Amount of this Request		**$94,486**

WHOI 14541.01

Budget Justification:

Salary is requested for Ralston to lead the observations and modeling of the Nauset estuary and to collaborate with Ganju and others on the observations and modeling in West Falmouth Harbor. Salary is requested for Geyer to assist in the analysis of estuarine fluxes, exchange and residence time.

V. PHYSICAL OCEANOGRAPHY

BUDGET

April 1, 2011–March 31, 2012

PO-1. Physical Oceanographic Measurements

WHOI PI: D. Hosom
USGS PI: M. Martini

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. D. HOSOM, Prin Engr		0.00	
B. Other Personnel			
2. Other Professionals			
P. BOUCHARD, Sr Engr Asst II		2.40	
C. Total Direct Labor & Benefits			**$22,887**
G. Other Direct Costs			
1. Materials and Supplies			
a. Other Supplies			
1. Supplies for 15 VMCMs 15@ $800	12,000		
2. Miscellaneous Instrument Supplies	800		
Total Materials and Supplies		12,800	
6. Other			
a. Communications	50		
b. Photocopying	50		
c. Shop Services 82@ $61	5,002		
Total Other		5,102	
Total Other Direct Costs			**17,902**
H. Total Direct Costs			**$40,789**
I. Indirect Costs			
1. Lab Costs		12,856	
2. General & Administrative		6,523	
Total Indirect Costs			**19,379**
J. Total Direct & Indirect Costs			**$60,168**
L. Amount of this Request			**$60,168**

WHOI 14552.01

Budget Justification:

Prior to field operations, instrumentation, including VMCMs, will be prepared and tested by Paul Bouchard, who is trained in VMCMs. The work to be performed will be a standard pre-cruise preparation of electronics and components of VMCMs at 16 hours per VMCM; and refurbishment of mechanical components at eight hours for each VMCM. There is an estimated three hours per VMCM for minor repair problems. Major repairs are not included in the requested budget.

The thermistor calibration is done by the Upper Ocean Processes (UOP) Calibration Cost Center at WHOI. Batteries will be supplied by USGS. Supplies (i.e., O-rings, bearings, paint, shims, cleaning supplies, etc.) will be supplied by the UOP Group at WHOI at an estimated cost of $800 per VMCM. Shop services and charges for miscellaneous supplies reflect the cost of field preparation.

BUDGET

April 1, 2011–March 31, 2012

PO-2. Oceanography of Southern New England

Task 1: Field Studies

WHOI Co-PIs: R. Limeburner, R. Beardsley, T. Bolmer
USGS Co-PIs: B. Butman, R. Signell, J. Warner, J. Crusius

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. R. BEARDSLEY, Sci Emeritus	0.00	0.00
2. R. LIMEBURNER, Sr Res Spec	1.00	1.00
C. Total Direct Labor & Benefits	**$14,552**	**$14,552**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	1,200	1,200
2. Publications	3,000	3,000
6. Other	8,400	8,400
Total Other Direct Costs	**12,600**	**12,600**
H. Total Direct Costs	**$27,152**	**$27,152**
I. Indirect Costs		
1. Lab Costs	8,174	8,174
2. General & Administrative	4,147	4,147
Total Indirect Costs	**12,321**	**12,321**
J. Total Direct & Indirect Costs	**$39,473**	**$39,473**
L. Amount of this		**$39,473**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Computer Software	1,000	1,000
b. Other Supplies		
1. Anti-fouling paint	200	200
Total Materials and Supplies	**1,200**	**1,200**
2. Publications		
a. Page Charges	2,000	2,000
b. Publication Costs	1,000	1,000
Total Publications	**3,000**	**3,000**
6. Other		
a. Communications	200	200
b. Photocopying	100	100
c. Tioga - full day	8,100	8,100
Total Other	**8,400**	**8,400**
Total Other Direct Costs	**12,600**	**12,600**

WHOI 14553.01

Budget Justification: Task I

Funding is requested for one month's salary support for R. Limeburner, who will conduct the mooring preparation, deployment, and recovery operations and do the initial data processing and analysis with input from R. Beardsley. Beardsley anticipates spending one month on this work at no cost. Three days ship time on the R/V *Tioga* is requested for the mooring deployment and recovery operations.

Funds are also requested for software updates, antifouling bottom paint, communications and photocopying, final preparation of figures for publication and page charges for one scientific paper.

BUDGET

April 1, 2011–March 31, 2012

PO-2. Oceanography of Southern New England

Task 2: Circulation Model Studies

WHOI Co-PIs: R. Limeburner, R. Beardsley, T. Bolmer
USGS Co-PIs: B. Butman, R. Signell, J. Warner, J. Crusius

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. R. BEARDSLEY, Sci Emeritus	0.00	0.00
2. R. LIMEBURNER, Sr Res Spec	1.00	1.00
C. Total Direct Labor & Benefits	**$43,656**	**$43,656**
E. Travel (see detail)		
1. Domestic	428	428
Total Travel	**428**	**428**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	1,200	1,200
2. Publications	3,000	3,000
Total Other Direct Costs	**4,200**	**4,200**
H. Total Direct Costs	**$48,284**	**$48,284**
I. Indirect Costs		
1. Lab Costs	24,522	24,522
2. General & Administrative	12,442	12,442
Total Indirect Costs	**36,964**	**36,964**
J. Total Direct & Indirect Costs	**$85,248**	**$85,248**
L. Amount of this Request	**$85,248**	**$85,248**

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

Confer with Chen at UMass-Dartmouth (Woods Hole, MA to No. Dartmouth, MA)

Ground	Mileage	1		@200	200
Per Diem	Inside Continental US	1 People	4 Days	@57	228
				Trip Total:	428

Total Domestic Travel - Period 1 **428**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Computer Software	1,000	1,000
b. Other Supplies	200	200
Total Materials and Supplies	**1,200**	**1,200**
2. Publications		
a. Page Charges	2,000	2,000
b. Publication Costs	1,000	1,000
Total Publications	**3,000**	**3,000**
Total Other Direct Costs	**4,200**	**4,200**

Budget Justification Task II:

Funding is requested for one month's salary support for R. Limeburner, who will do the initial model analysis and model/data analysis with input from R. Beardsley. Beardsley anticipates spending two months on this work at no cost. They will work together with C. Chen (UMass-Dartmouth) on the design of new model studies, with Limeburner taking the lead in the model/data analysis.

Support is also requested to cover travel expenses for trips to UMass-Dartmouth to confer with Chen; software maintenance; final preparation of figures for publication and page charges for one scientific paper; and miscellaneous costs.

BUDGET

April 1, 2011–March 31, 2012

PO-2. Oceanography of Southern New England

Task 3: Digital Bathymetry Database Update

WHOI Co-PIs: R. Limeburner, R. Beardsley, T. Bolmer
USGS Co-PIs: B. Butman, R. Signell, J. Warner, J. Crusius

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. R. LIMEBURNER, Sr Res Spec	1.00	1.00
B. Other Personnel		
2. Other Professionals		
S. BOLMER, Info Sys Assoc II	3.00	3.00
C. Total Direct Labor & Benefits	**$41,909**	**$41,909**
E. Travel (see detail)		
1. Domestic	1,752	1,752
Total Travel	**1,752**	**1,752**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	1,500	1,500
2. Publications	1,000	1,000
6. Other	2,000	2,000
Total Other Direct Costs	**4,500**	**4,500**
H. Total Direct Costs	**$48,161**	**$48,161**
I. Indirect Costs		
1. Lab Costs	23,540	23,540
2. General & Administrative	11,944	11,944
Total Indirect Costs	**35,484**	**35,484**
J. Total Direct & Indirect Costs	**$83,645**	**$83,645**
L. Amount of this Request	**$83,645**	**$83,645**

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

Two day trips to UNH (Woods Hole, MA to Manchester, NH)

Ground	Mileage	1		@280	280
Per Diem	Inside Continental US	1 People	2 Days	@57	114
				Trip Total:	394

Visit D. Greenburg at Bedford Inst. (Boston, MA to Halifax, Nova Scotia)

Airfare	Round Trip	1 Tickets		@500	500
Ground	General Grnd Transport.	1		@250	250
Per Diem	Other Domestic	1 People	2 Days	@304	608
				Trip Total:	1,358

Total Domestic Travel - Period 1 **1,752**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Other Supplies	500	500
b. Software License	1,000	1,000
Total Materials and Supplies	**1,500**	**1,500**
2. Publications		
a. Publication Costs	1,000	1,000
Total Publications	**1,000**	**1,000**
6. Other		
a. Maintenance of Shop Equip.	2,000	2,000
Total Other	**2,000**	**2,000**
Total Other Direct Costs	**4,500**	**4,500**

WHOI 14553.01

Budget Justification Task III:

Funding is requested for three months of salary support for T. Bolmer to gather the new bathymetry data and merge these data with the original USGS data base to construct the new data base. One month of support for R. Limeburner is requested to help collect digital data for estuaries and bays that open onto Nantucket Sound, and to begin to use the new data base in regional circulation models. R. Beardsley anticipates spending one month at no cost on this work. Beardsley will help Bolmer with location of new data, design of the data base scope and website, and final documentation.

Bolmer plans to visit with L. Mayer (UNH) to acquire his regional digital data for this project, and to visit D. Greenberg (BIO) to investigate how best to utilize the BIO high-resolution digital data base in the proposed update and to ensure that the new USGS and Canadian data bases can be combined in a consistent and seamless manner. Travel costs for these trips are included, plus funds for software licenses and software and disk maintenance. Funds are also included for the maintenance of shop equipment. The new data base will be documented through a technical report, which will require support for graphic arts help.

BUDGET

April 1, 2011–March 31, 2012

PO-3. Circulation and Sediment Transport in Coastal Regions off the U. S. Eastern Coast

Task 1: Sediment Transport in Coastal Ocean Systems Resusupension of Sediments by Trawling

WHOI PI: J. Churchill
USGS Co-PIs: B. Butman and C. Sherwood

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. J. CHURCHILL, Res Spec		3.00	
C. Total Direct Labor & Benefits			**$34,544**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	200		
Total Materials and Supplies		200	
2. Publications			
a. Page Charges	1,200		
Total Publications		1,200	
6. Other			
a. Communications	50		
b. Shipping & Postage	50		
Total Other		100	
Total Other Direct Costs			**1,500**
H. Total Direct Costs			**$36,044**
I. Indirect Costs			
1. Lab Costs		19,403	
2. General & Administrative		9,845	
Total Indirect Costs			**29,248**
J. Total Direct & Indirect Costs			**$65,292**
L. Amount of this Request			**$65,292**

WHOI 14547.01

Budget Justification:

Personnel: Churchill will work with USGS personnel to develop and test modules to account for trawl-induced sediment resuspension and will apply the modules to assess the impact of trawling on coastal region of the Gulf of Maine and Massachusetts Bay.

Other Direct Costs: Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

BUDGET

April 1, 2011–March 31, 2012

PO-3. Circulation and Sediment Transport in Coastal Regions off the U. S. Eastern Coast

Task 2: Sediment Transport in the Gulf of Maine

WHOI PI: J. Churchill
USGS Co-PIs: B. Butman and R. Signell

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. J. CHURCHILL, Res Spec		3.00	
C. Total Direct Labor & Benefits			**$34,544**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	200		
Total Materials and Supplies		200	
2. Publications			
a. Page Charges	1,200		
Total Publications		1,200	
6. Other			
a. Communications	50		
b. Shipping & Postage	50		
Total Other		100	
Total Other Direct Costs			**1,500**
H. Total Direct Costs			**$36,044**
I. Indirect Costs			
1. Lab Costs		19,403	
2. General & Administrative		9,845	
Total Indirect Costs			**29,248**
J. Total Direct & Indirect Costs			**$65,292**
L. Amount of this Request			**$65,292**

WHOI 14547.01

Budget Justification:
Personnel: Churchill will work with USGS personnel in diagnosing the circulation, wave and bottom stress climate in the Gulf of Maine and in comparing the results with hydrodynamic models of the Gulf.
Other Direct Costs: Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

BUDGET

April 1, 2011–March 31, 2012

PO-3. Circulation and Sediment Transport in Coastal Regions off the U. S. Eastern Coast

Task 3: Shelf Circulation near the Carolina Capes

WHOI PI: J. Churchill
USGS Co-PIs: B. Butman, R. Signell and J. Warner

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1. J. CHURCHILL, Res Spec		3.50	
C. Total Direct Labor & Benefits			**$40,303**
G. Other Direct Costs			
1. Materials and Supplies			
a. Supplies	200		
Total Materials and Supplies		200	
2. Publications			
a. Page Charges	1,200		
Total Publications		1,200	
6. Other			
a. Communications	50		
b. Shipping & Postage	50		
Total Other		100	
Total Other Direct Costs			**1,500**
H. Total Direct Costs			**$41,803**
I. Indirect Costs			
1. Lab Costs		22,638	
2. General & Administrative		11,486	
Total Indirect Costs			**34,124**
J. Total Direct & Indirect Costs			**$75,927**
L. Amount of this Request			**$75,927**

WHOI 14547.01

Budget Justification:

Personnel: Churchill will work with USGS personnel in diagnosing the circulation, wave and bottom stress climate near the Carolina Capes and in comparing the results with hydrodynamic models of the region.
Other Direct Costs: Funds are requested to cover the cost of supplies (computer disks, printer materials, etc.), communications and postage and page charges.

VI. EDUCATION

BUDGET

April 1, 2011–March 31, 2012

EDU-1. Graduate Research Assistants (GRAs)

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. YODER, VP Academics	0.00	0.00
B. Other Personnel		
3. Graduate Students		
JOINT PROGRAM STUDENT	12.00	12.00
C. Total Salaries & Benefits	**$29,724**	**$29,724**
G. Other Direct Costs (see detail)		
6. Other	22,250	22,250
Total Other Direct Costs	**22,250**	**22,250**
H. Total Direct Costs	**$51,974**	**$51,974**
I. Indirect Costs		
1. Lab Costs	8,350	8,350
2. General & Administrative	8,472	8,472
Total Indirect Costs	**16,822**	**16,822**
J. Total Direct & Indirect Costs	**$68,796**	**$68,796**
L. Amount of this Request	**$68,796**	**$68,796**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
6. Other		
a. Tuition (JPS)	22,250	22,250
Total Other	**22,250**	**22,250**
Total Other Direct Costs	**22,250**	**22,250**

Budget Justification CY2011:
To be determined by research conducted under the USGS-WHOI Cooperative Agreement. Budget prepared to indicate the cost of a year's support of a GRA.

BUDGET

April 1, 2011–March 31, 2012

EDU-2. Postdoctoral Scholars

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. YODER, VP Academics	0.00	0.00
C. Total Direct Labor & Benefits	**$0**	**$0**
E. Travel (see detail)		
1. Domestic	7,500	7,500
Total Travel	**7,500**	**7,500**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	18,000	18,000
6. Other	354,540	354,540
Total Other Direct Costs	**372,540**	**372,540**
H. Total Direct Costs	**$380,040**	**$380,040**
I. Indirect Costs		
1. Lab Costs	0	0
2. General & Administrative	0	0
Total Indirect Costs	**0**	**0**
J. Total Direct & Indirect Costs	**$380,040**	**$380,040**
L. Amount of this Request	**$380,040**	**$380,040**

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

Graduate Institution to/from WHOI (Graduate Institution to WHOI)

Airfare	Round Trip	3 Tickets	@2,500	7,500	
			Trip Total:	7,500	
Total Domestic Travel - Period 1					**7,500**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Laboratory Supplies		
1. Research supplies	18,000	18,000
Total Materials and Supplies	**18,000**	**18,000**
6. Other		
a. Insurance		
1. Health insurance	40,392	40,392
b. Miscellaneous		
1. Dental coverage	2,508	2,508
c. Post doc-scholarship		
1. Stipend for three 18mo appts	255,360	255,360
2. Stipend for one 12mo appt	56,280	56,280
Total Other	**354,540**	**354,540**
Total Other Direct Costs	**372,540**	**372,540**

Budget Justification CY2011:
The project will provide support for (a) one Postdoctoral Scholar to be selected jointly by USGS and WHOI to address topics of mutual interest; (b) two Postdoctoral Scholars pursuing research in ocean science and/or ocean engineering; and (c) one Postdoctoral Scholar appointment continuation.

WHOI 14419.01

BUDGET

April 1, 2011–March 31, 2012

EDU-3. Diversity Initiatives

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. YODER, VP Academics	0.00	0.00
C. Total Salaries & Benefits	**$0**	**$0**
F. Participant Costs		
1. Stipend	11,712	11,712
2. Travel Allowance	2,200	2,200
3. Subsistence Allowance	3,600	3,600
Total Participant Costs	**17,512**	**17,512**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	200	200
6. Other	20,000	20,000
Total Other Direct Costs	**20,200**	**20,200**
H. Total Direct Costs	**$37,712**	**$37,712**
I. Indirect Costs		
1. Lab Costs	0	0
2. General & Administrative	0	0
Total Indirect Costs	**0**	**0**
J. Total Direct & Indirect Costs	**$37,712**	**$37,712**
L. Amount of this Request	**$37,712**	**$37,712**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Laboratory Supplies	200	200
Total Materials and Supplies	**200**	**200**
6. Other		
a. Miscellaneous		
1. PEP Program costs	15,000	15,000
2. Support for WH Diversity Initiative	5,000	5,000
Total Other	**20,000**	**20,000**
Total Other Direct Costs	**20,200**	**20,200**

Budget Justification:
a. Two Summer Fellowships to be supported by USGS;
b. Funds to support the Partner Education Program and the Woods Hole Diversity Initiative.

BUDGET

April 1, 2011–March 31, 2012

EDU-4. Facilities for Postdoctoral Scholars, Graduate Research Assistants, and Minority Fellows

WHOI PI: J. Yoder
USGS PI: W. Barnhardt

No costs are anticipated in CY2011-12.

VII. MARINE POLICY

BUDGET

April 1, 2011–March 31, 2012

MPC-1. Integrating Marine Geological Science into the Policy Process

WHOI PI: H. Kite-Powell (with Associate Investigators D. Jin, P. Hoagland, and A. Mulligan)
USGS Co-PIs: D. Hutchinson and P. Valentine

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . H. KITE-POWELL, Res Spec	1.30	1.30
2 . P. HOAGLAND III, Sr Res Spec	1.30	1.30
3 . D. JIN, Senior Sci	1.30	1.30
4 . A. MULLIGAN, Assoc Sci	1.30	1.30
C. Total Salaries & Benefits	**$71,360**	**$71,360**
E. Travel (see detail)		
1. Domestic	2,508	2,508
Total Travel	**2,508**	**2,508**
H. Total Direct Costs	**$73,868**	**$73,868**
I. Indirect Costs		
1. Lab Costs	40,904	40,904
2. General & Administrative	21,166	21,166
Total Indirect Costs	**62,070**	**62,070**
J. Total Direct & Indirect Costs	**$135,938**	**$135,938**
L. Amount of this Request	**$135,938**	**$135,938**

Travel Detail

Period 1 04/01/11 - 03/31/12

1. Domestic

AGU-San Francisco (Woods Hole to San Francisco)

Airfare	Round Trip	2 Tickets		@450	900	
Ground	General Grnd Transport.	2		@50	100	
Lodging	Nightly Rate (inc. Tax)	2 Rooms	2 Nights	@120	480	
Misc. Exp.	Meeting Registration	2 People		@400	800	
Per Diem	Inside Continental US	2 People	2 Days	@57	228	
				Trip Total:	2,508	

Total Domestic Travel - Period 1 **2,508**

WHOI 14525.01

Budget Justification:

Requested funding will be used to cover salary support (1.3 months each in CY 2011 for Drs. Kite-Powell, Hoagland, Jin, and Mulligan) for additional data collection, model specification, and model simulation related to ongoing studies, as well as on the new topic of shoreline change as a consequence of climate-induced sea-level rise. The total cost of salaries and fringe benefits associated with these efforts is $71,360..

We also request a total of $2508 for travel-related expenses for two members of the research team to present research results at the 2011 American Geophysical Union fall meetings in San Francisco.

In addition to these project direct costs, we request total indirect costs of $62,070, for a total funding request of $135,938.

VIII. COST CENTERS

BUDGET

April 1, 2011–March 31, 2012

CC-1. Communications and Media Relations

WHOI Co-PIs: F. Heidi and J. Doucette
USGS Co-PIs: C. Polloni, D. Blackwood, F. Lightsom and B. Butman

		04/01/11 03/31/12	
C. Total Direct Labor & Benefits			**$0**
G. Other Direct Costs			
2. Publications			
a. Graphics shop services 275@ $79	21,725		
Total Publications		21,725	
6. Other			
a. Other Outside Services	7,500		
b. Photocopying	500		
c. Shipping & Postage	250		
Total Other		8,250	
Total Other Direct Costs			**29,975**
H. Total Direct Costs			**$29,975**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$29,975**
L. Amount of this Request			**$29,975**

WHOI 14582.01

Budget Justification:

This is a cooperative effort to inform the public of joint scientific and engineering activities. The costs include 275 hours of Graphic Services time to create illustrations, animations or video segments for various outlets including print, web, cell phones, or social media. An additional $7.5k was budgeted for outside services as may be required to produce and distribute these pieces. Small amounts were also budgeted for duplicating and shipping.

BUDGET

April 1, 2011–March 31, 2012

CC-2. Research Vessels

WHOI PI: A. Suchy
USGS PI: D. Nichols

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . A. SUCHY, Dir Ship Ops		0.00	
B. Other Personnel			
2. Other Professionals			
ENGINRING ASST III A, Eng Asst III		1.00 *	
C. Total Direct Labor & Benefits			**$14,896**
G. Other Direct Costs			
6. Other			
a. Miscellaneous			
1. Marine Engineering Services	25,000		
b. Small Boats Use			
1. e.g. WHOI Mytilus (10 Days) 10@ $515	5,150		
c. Tioga - full day 15@ $2700	40,500		
d. Vessel Charters 5@ $22470	112,350		
Total Other		183,000	
Total Other Direct Costs			**183,000**
H. Total Direct Costs			**$197,896**
I. Indirect Costs			
1. Lab Costs		7,214	
2. General & Administrative		3,661	
Total Indirect Costs			**10,875**
J. Total Direct & Indirect Costs			**$208,771**
L. Amount of this Request			**$208,771**

Budget Justification

USGS researchers will continue their studies along the U.S. east coast with deployment of moored arrays, geophysical and geochemical instrumentation. Marine engineering services have been included to assist USGS researchers with any ship preparations or with any at sea needed to meet the specific requirements of the researcher. An ocean class vessel and the shipboard technical group are budgeted to support work in Massachusetts Bay, the New York Bight, and the Hudson Canyon system.
WHOI's small boat fleet (e.g. Mytilus) is also included to assist the USGS researches on projects not requiring the use of the larger research vessels.

*Includes Cruise Participation

BUDGET

April 1, 2011–March 31, 2012

CC-3. Research Facilities

WHOI PI: D. Derosier
USGS PI: D. Nichols

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . D. DEROSIER, Dir Fac		0.00	
C. Total Direct Labor & Benefits			**$0**
G. Other Direct Costs			
1. Materials and Supplies			
a. Other Supplies	5,000		
b. Stockroom Supplies	5,000		
Total Materials and Supplies		10,000	
6. Other			
a. Miscellaneous			
1. Fork lift 10@ $58	580		
2. 20-ton Crane 4@ $80	320		
3. 40-ton Crane 4@ $100	400		
4. Occupancy of Crawford & Gosnold Labs	446,865		
5. Shop Projects	14,500		
6. Facilities Buildout	100,000		
Total Other		562,665	
Total Other Direct Costs			**572,665**
H. Total Direct Costs			**$572,665**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$572,665**
L. Amount of this Request			**$572,665**

WHOI 15589.00

Budget Justification:

The shop services and materials, stockroom, and cranage charges shown are an estimation of the anticipated use of these WHOI facilities in support of research activities based upon such use in previous years and anticipating the level of research activities in fiscal year 2009.

The Research Facilities Build Out will provide a contingency of available funds to quickly address changing infrastructure needs driven by new USGS science initiatives within Crawford or Gosnold.

Occupancy of Crawford and Gosnold Laboratories provides the basic physical facilities for USGS researchers in support of marine research.

Occupancy of Crawford and Gosnold Laboratories		
Occupancy Space Charge (19,260 square feet)		$325,771
Escalable Costs		
Maintenance	$28,716	
Custodial Services	$57,763	
Security Services	$14,802	
Management	$19,813	$121,094
		$446,865

The costs subject to escalation have been increased 2.90% in the occupancy charge reflecting the April 2009 to April 2010 change in the CPI-W.

BUDGET

April 1, 2011–March 31, 2012

CC-4. Computer Systems

WHOI PI: A. Gaylord
USGS PI: K. List

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . A. GAYLORD, CIS Dir	0.50	0.50
B. Other Personnel		
2. Other Professionals		
S. TYNAN, TELECOM COORDIN	0.25	0.25
5. Admin Professionals		
W. HUNTINGTON	0.80	0.80
6. Other		
H. HOSKINS, NETWORK GRP LDR	0.80	0.80
C. Total Direct Labor & Benefits	**$28,030**	**$28,030**
D. Permanent Equipment		
1. Collaborative Computing Equipment	10,000	10,000
2. Integrated Video, Voice, Data Over IP	10,000	10,000
3. Network Equipment	40,000	40,000
4. Network Security & Intrusion Detection	10,000	10,000
5. Scientific Visualization Equipment	10,000	10,000
6. Telephone Equipment	10,000	10,000
Total Permanent Equipment	**90,000**	**90,000**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	3,000	3,000
4. Computer Svc	40,740	40,740
6. Other	64,110	64,110
Total Other Direct Costs	**107,850**	**107,850**
H. Total Direct Costs	**$225,880**	**$225,880**
I. Indirect Costs		
1. Lab Costs	15,746	15,746
2. General & Administrative	7,989	7,989
Total Indirect Costs	**23,735**	**23,735**
J. Total Direct & Indirect Costs	**$249,615**	**$249,615**
L. Amount of this Request	**$249,615**	**$249,615**

WHOI 14520.01

Equipment Detail

1. Collaborative Computing Equipment

Desc:
Total Cost: 10,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	10,000

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2. Integrated Video, Voice, Data Over IP

Desc:
Total Cost: 10,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	10,000

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3. Network Equipment

Desc:
Total Cost: 40,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	40,000

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4. Network Security & Intrusion Detection

Desc:
Total Cost: 10,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	10,000

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5. Scientific Visualization Equipment

Desc:
Total Cost: 10,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	10,000

CC-4. Computer Systems
ARTHUR S GAYLORD (USGS)
Apr 1, 2011 to Mar 31, 2012

Equipment Detail

6. Telephone Equipment

Desc:
Total Cost: 10,000

Period Detail:

Period	Qty	Amount
04/01/11 - 03/31/12	1	10,000

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Supplies		
1. Miscellaneous Cables, Etc.	3,000	3,000
Total Materials and Supplies	**3,000**	**3,000**
4. Computer Svc		
a. Application Programming Suppt	6,790	6,790
b. Network/Telecomm Support	27,160	27,160
c. Security Support	6,790	6,790
Total Computer Svc	**40,740**	**40,740**
6. Other		
a. Communications	200	200
b. Duplicating	100	100
c. Other Outside Services		
1. Adv. Networking & Security Suppt.	10,000	10,000
2. Internet Services	33,000	33,000
d. Repairs & Maintenance		
1. Software Maint.	1,000	1,000
2. Maint. on Cisco Switches	7,000	7,000
3. Nortel PBX Maintenance	6,000	6,000
4. Lucent Technologies Maintenance	6,000	6,000
e. Shipping & Postage	200	200
f. Shop Services	610	610
Total Other	**64,110**	**64,110**
Total Other Direct Costs	**107,850**	**107,850**

Budget Justification:

Personnel: The Director of CIS, Arthur Gaylord, will provide direction of overall efforts. Hartley Hoskins, Network Group Leader, will be performing data network and video network design, and Sandra Tynan, Telecommunications Coordinator, will be working with USGS staff to maintain and extend the USGS phone switch, which is located in WHOI's Clark Lab. Wendy Huntington, Center Administrator, will provide administrative services including budget analysis, purchase order preparation and manpower tracking.

Equipment: Telephone equipment will be added to the USGS 61C telephone switch to more closely integrate the voice communications systems of the Woods Hole area scientific institutions and to introduce Voice over IP telephony. The networking equipment will consist of upgrades to the current router and the addition of support for power over Ethernet ports in preparation for a VoIP phone system. Both LANs and the global Internet can now support digitized video and voice communication, as well as data networking. Equipment and software programs to explore the use of these techniques, both to enhance interpersonal collaboration locally and remotely, will be obtained. Equipment and associated software to maintain network security to the Internet, including firewalls and intrusion detection systems will be upgraded. Computing equipment needed to supported secure collaborative research environments will be purchased and installed.

Materials: Miscellaneous cables, tools, and supplies for the maintenance of the network, the maintenance of voice and video systems, and general computing support are included in this budget item.

Shop Services: Miscellaneous carpentry/electric/graphics services.

Outside Services: The allowance for advanced networking and security support provides for architectural and technical assistance in maintaining the USGS section of the Woods Hole LAN to uniformity with the accepted practices for network operations and network security.

Communications: The allowance for long distance phone calls in support of this project.

Shipping and Postage: Miscellaneous shipping and postage costs.

WHOI 14520.01

BUDGET

April 1, 2011–March 31, 2012

CC-5. High-Performance Oceanographic Modeling on Parallel ComputingClusters

WHOI PI: J. Dusenberry
USGS Co-PIs: J. Warner, R. Signell, C. Sherwood, and N. Ganju

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . J. DUSENBERRY, Info Sys Assoc III	0.00	0.00
C. Total Salaries & Benefits	**$0**	**$0**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	150,000	150,000
4. Computer Svc	10,010	10,010
Total Other Direct Costs	**160,010**	**160,010**
H. Total Direct Costs	**$160,010**	**$160,010**
I. Indirect Costs		
1. Lab Costs	0	0
2. General & Administrative	0	0
Total Indirect Costs	**0**	**0**
J. Total Direct & Indirect Costs	**$160,010**	**$160,010**
L. Amount of this Request	**$160,010**	**$160,010**

WHOI 14517.01

Budget Justification:

Funds that are being requested will be used to provide continued CIS support for cluster maintenance for three high-performance computers and associated systems including the existing file server pikmin, the 72 processor cluster marlin, the 196 processor cluster nemo, and the new 196 processor cluster peach. Also, the OpenDap fileservers will be maintained under this agreement, which provide access for large files of model output. Funds requested will also be used for applications support for USGS users of the above systems.

BUDGET

April 1, 2011–March 31, 2012

CC-6. Inter-disciplinary Informatics in Support of Decision Support Systems and Policy

WHOI Co-PIs: A. Gaylord and A. Maffei
USGS PI: F. Lightsom

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . A. GAYLORD, CIS Dir	1.00	1.00
2 . A. MAFFEI, Sr Info Spec	0.00	0.00
B. Other Personnel		
2. Other Professionals		
ASSOC SCI W/TEN A, Assoc Sci w/Ten	0.00	0.00
5. Admin Professionals		
W. HUNTINGTON	1.00	1.00
P. WHITE	3.00	3.00
C. Total Direct Labor & Benefits	**$47,018**	**$47,018**
G. Other Direct Costs (see detail)		
4. Computer Svc	57,400	57,400
6. Other	81,190	81,190
Total Other Direct Costs	**138,590**	**138,590**
H. Total Direct Costs	**$185,608**	**$185,608**
I. Indirect Costs		
1. Lab Costs	26,411	26,411
2. General & Administrative	13,400	13,400
Total Indirect Costs	**39,811**	**39,811**
J. Total Direct & Indirect Costs	**$225,419**	**$225,419**
L. Amount of this Request	**$225,419**	**$225,419**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
4. Computer Svc		
a. Application Programming Suppt	31,920	31,920
b. Maffei Salary Support	25,480	25,480
Total Computer Svc	**57,400**	**57,400**
6. Other		
a. Duplicating	550	550
b. Guest Student Stipend	3,780	3,780
c. Guest Student Subsistence	1,860	1,860
d. Other Outside Services		
1. Seminar Speakers	5,000	5,000
2. Conference Hosting Expenses	70,000	70,000
Total Other	**81,190**	**81,190**
Total Other Direct Costs	**138,590**	**138,590**

Budget Justification:

Personnel: The Director of CIS, Arthur Gaylord, and Sr. Information Systems Specialist, Andrew Maffei, will co-direct the effort. Wendy Huntington, Center Administrator, will provide administrative services including conference organization, budget analysis, purchase order preparation and manpower tracking. Patricia White will provide continuing support for the workshop efforts, helping with report editing, website maintenance, and other support activities.

Computer Services - Technical Assistance: Andrew Maffei and one TBA programmer will work together with corresponding USGS staff to survey informatics-related information (use-cases, needs, expertise) about existing USGS research programs. This information will be merged into a database that includes similar information for existing WHOI research program efforts. They will also work together with USGS staff to prepare a plan to implement a software suite of useful data inter-operability tools for use by research programs in both organizations that support decision-support and policy-development application needs in areas such a Coastal Marine Spatial Planning and the affects of global climate change on society. It is expected that these efforts will be synergistic with other CMSP-related efforts that are identified as part of the workshops that include other stakeholders.

Duplicating: - Copying of seminar announcements.

Guest Student Housing and Stipend – These funds will be used to sponsor a guest student via WHOI's guest student program. A stipend of $45/day and housing expenses at $155/week will be provided. WHOI housing will be provided if available.

Outside Services - Seminar Speakers: USGS and WHOI will jointly sponsor two workshops on CMSP-related topics relevant to the application of informatics for inter-disciplinary science applications. These workshops will be lead by one or more external experts in the fields.

Conference Hosting Services: Estimated expenses for holding two 2-day conferences in Woods Hole. These costs will be primarily for transportation, lodging, meals, refreshments, space charges and personnel support.

BUDGET

April 1, 2011–March 31, 2012

CC-7. Data Library and Archives

WHOI PI: J. Yoder
USGS PI: N. Soderburg

Part I: Data Managing and Archives

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. J. YODER, VP Academics	0.00	0.00
B. Other Personnel		
2. Other Professionals		
L. RAYMOND, Info Sys Assoc III	0.60	0.60
C. Total Direct Labor & Benefits	**$5,691**	**$5,691**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	225	225
Total Other Direct Costs	**225**	**225**
H. Total Direct Costs	**$5,916**	**$5,916**
I. Indirect Costs		
1. Lab Costs	3,197	3,197
2. General & Administrative	1,622	1,622
Total Indirect Costs	**4,819**	**4,819**
J. Total Direct & Indirect Costs	**$10,735**	**$10,735**
L. Amount of this Request	**$10,735**	**$10,735**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Other Supplies	225	225
Total Materials and Supplies	**225**	**225**
Total Other Direct Costs	**225**	**225**

Budget Justification CY2011:
This project provides support for data management and archiving, including indexing and storage of data sets, including film, video cassettes, logs, reports, seismic and bathymetric records. It supports cataloging, indexing and storage of atlases, maps, charts and technical reports of mutual interest to WHOI and USGS.

BUDGET

April 1, 2011–March 31, 2012

CC-7. Data Library and Archives

WHOI PI: J. Yoder
USGS PI: N. Soderburg

Part II: Oral History Project

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1. J. YODER, VP Academics	0.00	0.00
C. Total Salaries & Benefits	**$0**	**$0**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	1,200	1,200
6. Other	8,000	8,000
Total Other Direct Costs	**9,200**	**9,200**
H. Total Direct Costs	**$9,200**	**$9,200**
I. Indirect Costs		
1. Lab Costs	0	0
2. General & Administrative	0	0
Total Indirect Costs	**0**	**0**
J. Total Direct & Indirect Costs	**$9,200**	**$9,200**
L. Amount of this Request	**$9,200**	**$9,200**

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Other Supplies	1,200	1,200
Total Materials and Supplies	**1,200**	**1,200**
6. Other		
a. Honoraria		
1. Interviews	4,000	4,000
b. Other Outside Services		
1. Transcriptions	4,000	4,000
Total Other	**8,000**	**8,000**
Total Other Direct Costs	**9,200**	**9,200**

Budget Justification:
Anticipated activities for the 2011-2012 year include documenting the history of the USGS in Woods Hole including collaborative projects with WHOI. This wil be particularly significant because of the upcoming 50th anniversary of the founding of the Center. The focus will be on the histories of former center chiefs as well as the research, technology and fieldwork behind major projects and initiatives. The latter will include coordinating group interviews in the Tilley Conference Room when appropriate. Former Woods Hole project participant who have relocated to other branches will be interviewed using videoconferencing technology.

BUDGET

April 1, 2011–March 31, 2012

CC-8. Seminars and Conferences

WHOI PI: M.A. Tivey
USGS PI: B. Butman

	Approximate Labor Months 04/01/11 03/31/12		
A. Senior Personnel			
1 . M. TIVEY, Sr Sci		0.00	
C. Total Direct Labor & Benefits			**$0**
E. Travel			
Domestic			
1. Travel to Woods Hole for Participants various locations to Woods Hole			
Ground General 1 @ $1500	1,500		
Total		1,500	
Total Domestic Travel		1,500	
Total Travel			**1,500**
G. Other Direct Costs			
1. Materials and Supplies			
a. Other Supplies			
1. Seminar/conference supplies	900		
2. Stockroom supplies	250		
3. Display materials	250		
Total Materials and Supplies		1,400	
6. Other			
a. Communications	1,000		
b. Miscellaneous			
1. Facilities Preparation	1,500		
c. Photocopying	500		
d. Shipping & Postage	100		
Total Other		3,100	
Total Other Direct Costs			**4,500**
H. Total Direct Costs			**$6,000**
I. Indirect Costs			
1. Lab Costs		0	
2. General & Administrative		0	
Total Indirect Costs			**0**
J. Total Direct & Indirect Costs			**$6,000**
L. Amount of this Request			**$6,000**

WHOI 14519.01

Budget Justification:

The USGS and WHOI will jointly co-sponsor conferences, workshops and research seminars that address issues of mutual interest. Funds are requested for the purpose of providing travel to a small number of participants external to the USGS and WHOI who will participate in these activities. Seminar conference supplies and display materials will be required in support of these meetings, and hence a small amount of funds for this purpose are included in the budget. Other Direct Costs also include funds for preparation and setup of the facilities to be used for the meetings, as well as modest costs for communications and photocopying.

BUDGET

April 1, 2011–March 31, 2012

CC-9. Training

WHOI PI: C. Hammond
USGS PI: J. Lightsom

No costs are anticipated in CY2011-12.

IX. OPERATIONAL SCIENTIFIC SERVICES

Advanced Imaging and Visualization Laboratory (AIVL)

BUDGET

April 1, 2011–March 31, 2012

OS-1. Development of a Digital HDTV Time Lapse Imaging System

WHOI PI: W.N. Lange
USGS PI: B. Butman

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . W. LANGE, Res Spec	0.89	0.89
B. Other Personnel		
2. Other Professionals		
K. WANNOP, Sr Eng Asst I	0.26	0.26
C. Total Direct Labor & Benefits	**$10,769**	**$10,769**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	5,279	5,279
Total Other Direct Costs	**5,279**	**5,279**
H. Total Direct Costs	**$16,048**	**$16,048**
I. Indirect Costs		
1. Lab Costs	6,049	6,049
2. General & Administrative	3,069	3,069
Total Indirect Costs	**9,118**	**9,118**
J. Total Direct & Indirect Costs	**$25,166**	**$25,166**
L. Amount of this Request	**$25,166**	**$25,166**

OS-1. Development of a Digital HDTV Time Lapse Imaging
WILLIAM N LANGE (USGS)
Apr 1, 2011 to Mar 31, 2012
BUDGET

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Other Supplies		
1. Removeable media printing supplies	2,500	2,500
2. Cables and Connectors	2,779	2,779
Total Materials and Supplies	**5,279**	**5,279**
Total Other Direct Costs	**5,279**	**5,279**

WHOI 14478.01

Budget Justification:

William Lange will be performing the majority of the work on this project with the assistance of a Senior Engineering Assistant (Wannop) on the design and prototyping of the underwater time-lapse camera system.

The tasks to be undertaken include the development of an imaging system Design, suitable for fabrication, under future funding, of a prototype of a high-resolution digital underwater time-lapse imaging system suitable for use by the USGS in their sea floor imaging research projects.

Additional costs in the proposed budget are for printing supplies and miscellaneous cables and connectors.

BUDGET

April 1, 2011–March 31, 2012

OS-2. Seafloor Imaging

WHOI PI: W.N. Lange
USGS PI: B. Butman

	Approximate Labor Months 04/01/11 03/31/12	Total
A. Senior Personnel		
1 . W. LANGE, Res Spec	1.37	1.37
B. Other Personnel		
2. Other Professionals		
C. LUMPING, Engr II	0.39	0.39
C. Total Direct Labor & Benefits	**$16,591**	**$16,591**
G. Other Direct Costs (see detail)		
1. Materials and Supplies	6,316	6,316
6. Other	38,487	38,487
Total Other Direct Costs	**44,803**	**44,803**
H. Total Direct Costs	**$61,394**	**$61,394**
I. Indirect Costs		
1. Lab Costs	9,319	9,319
2. General & Administrative	4,728	4,728
Total Indirect Costs	**14,047**	**14,047**
J. Total Direct & Indirect Costs	**$75,441**	**$75,441**
L. Amount of this Request	**$75,441**	**$75,441**

OS-2. Seafloor Imaging
WILLIAM N LANGE (USGS)
Apr 1, 2011 to Mar 31, 2012
BUDGET

Other Direct Costs - Detail

	04/01/11 03/31/12	Total
G. Other Direct Costs		
1. Materials and Supplies		
a. Other Supplies		
1. Removeable Media and Film	6,316	6,316
C **Total Materials and Supplies**	**6,316**	**6,316**
6. Other		
a. Outside Services		
1. Engineering Svc - Film Tech	35,986	35,986
b. Shop Services	2,501	2,501
Total Other	**38,487**	**38,487**
Total Other Direct Costs	**44,803**	**44,803**

Budget Justification:

William Lange will be performing the majority of the work on this project with assistance of a Mechanical Engineer (Lumping) and by outside services familiar with the handling of 35mm film.

The tasks to be undertaken include the continued refinement and development of techniques and methodologies for the processing of the USGS 35mm data sets. WHOI will evaluate other higher spatial resolution imagers for potential use by the USGS for circumstances where high spatial or color resolution is desired. WHOI will work towards making the transfer system more efficient for the uses proposed by the USGS.

Additional costs in the proposed budget are outside services, in particular outside engineering services for the system upgrade and modification effort. Costs for the processing and color correction of the imagery is also included under outside services. Funds are requested under supplies for removable media and data storage system supplies.

WHOI 14492.01