

## Geologic Landscape and Coastal Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earth Surface Dynamics	12,327	+745	+2,450	15,522	+3,195
National Cooperative Geologic Mapping	19,781	+457	+7,500	27,738	+7,957
<b>Coastal and Marine Geology</b>	<b>33,327</b>	<b>+602</b>	<b>0</b>	<b>33,929</b>	<b>+602</b>
Total Requirements \$000	65,435	+1,804	+9,950	77,189	+11,754

### Coastal and Marine Geology

#### Current Program Highlights

The USGS Coastal and Marine Geology Program (CMGP) provides geologic information critical to the management of the Nation's coastal and marine environments. Research in CMGP currently addresses four main themes: 1) environmental quality and human health, 2) natural hazards and public safety, 3) natural resources, and 4) technology and information. Dealing with and resolving national issues, such as coastal erosion, coastal pollution, loss of wetlands, and sea level rise, requires the credible and objective science data, information, and understanding being provided by the USGS. The CMGP follows a 5-year plan of research based on prioritization of national issues and meeting customer needs. This plan is flexible and includes interdisciplinary studies that are producing information and products used by Federal, State, and local agencies and the public. Such products provide the authoritative, credible, objective scientific basis for regulating, managing, and protecting the Nation's coastal and marine resources.

In FY 2001 as several current coastal and marine geology studies come to completion and results are disseminated to user groups, funds will be used to begin or augment high priority studies in three topics: Effects of Coastal Storms, Sediment-hosted Pollution in the Lower Mississippi River, and Coral Reefs. All three of these issues are vitally important to the Nation and reliable scientific data and information from USGS studies are needed to address these issues.

**Environmental Quality and Human Health** -- These studies address topics such as pollution and waste disposal, wetlands loss, characterization of coastal and offshore biological habitats and marine sanctuaries and reserves, and environmental change. Results from these efforts provide an understanding of geologic processes needed to predict natural and human-related variability and to evaluate the influence of human activities on coastal regions, estuaries and offshore regions. Federal and state agencies and private groups routinely use the regional broad-based and long-term science information produced by this USGS work to make land-management decisions.

**Natural Hazards and Public Safety** -- These studies provide geologic information for understanding and predicting coastal erosion and other storm effects on the shoreline, for identifying and evaluating offshore earthquake and tsunami hazard potentials, and for evaluating submarine landslide hazards.

**Natural Resources** -- These studies provide information on the location, distribution, quantity, and quality of fresh water, minerals, and energy resources in coastal and marine environments, and the potential impacts of extraction. Understanding the geologic conditions and processes which form energy and mineral deposits is important because modern marine environments are the analog for older deposits being recovered on land. Such information can increase production and safeguard the environment.

**Technology and Information** -- These studies provide base-line products characterizing the form and composition of the Nation's coasts and seafloor through systematic reconnaissance-level surveys and production of maps of the U.S. coast and offshore Exclusive Economic Zone. These scientific maps and information are used for assessment and management of the sea floor and provide a foundation for investigations of environmental-, hazard-, and resource-related issues in coastal and offshore areas. The USGS also addresses the management and transfer of marine geologic information and products.

### **Recent Accomplishments**

**Geologic Framework and Processes of Coral Reef Systems** -- Coral reefs, critical ecosystems in the U.S., island territories, and in many tropical developing-nations, are in dramatic decline because of a combination of natural and man-made factors. The USGS, in cooperation with other Federal agencies, has begun studies to assess changes caused by natural and man-made factors by mapping the location and evaluating the health of coral reefs, discerning the impact of sedimentation, including airborne dust and diseases, and wave energy on reef processes. In April 1999 USGS scientists began field studies of coral reefs along the south coast of Molokai'i in the Hawaiian Islands. These studies are mapping the complex reef system around the Hawaiian Islands to determine how land-derived sediment and other factors affect the health of the reefs. The project is employing both traditional and innovative data-collection and mapping methods such as state-of-the-art laser imaging.

Additional studies are being conducted, using satellite imagery and salinity surveys, from Florida Bay and the Florida Keys on reefs in several DOI and NOAA parks: Biscayne National Park, the Florida Keys National Marine Sanctuary, and Dry Tortugas National Park. Results are showing that net ground-water flow and contaminants are being transported from Florida Bay toward the reefs at higher rates than previously thought.

These projects are providing reef managers a better understanding of the controls and processes that influence coral reefs, regional diversity, distribution and productivity.

The USGS is also contributing to the newly formed Coral Reef Task Force by taking a lead in preparing action plans detailing the additional scientific studies and mapping necessary to protect and preserve coral reefs.

**Geology and Processes of the Lake Pontchartrain Basin, Louisiana** -- One of the largest and most important estuaries of the Gulf Coast region, the Lake Pontchartrain Basin, is adjacent to New Orleans, a city of 1.5 million people. The effects of the area's rapid development over the past 50 years, combined with natural processes, have resulted in significant loss of critical wetland habitats and environmental degradation. To better understand the Basin's origin and the processes driving its evolutionary development and degradation, a multidisciplinary study is underway, in close collaboration with Louisiana state institutions and other Federal agencies.

Six primary tasks are being addressed: geologic framework, historic shoreline and wetland change, lakebed sediment characterization, critical processes, circulation modeling, and information transfer/education outreach. Such baseline information is being used by state and local managers to protect and restore the Lake Pontchartrain Basin.

**Sediment and Pollutant Movement Offshore Los Angeles** -- The coastal ocean off the Los Angeles metropolitan area, like many regions of the US, receives surface runoff, sewage, and industrial waste drainage. Recent surveys have shown that more than 95 percent of Santa Monica Bay, west of Los Angeles, has contaminants at concentrations exceeding levels at which biological effects begin to occur. The USGS, in collaboration with the City of Los Angeles and the Southern California Coastal Water Research Project, is conducting a study of the sediments on the floor of Santa Monica Bay to determine the severity of present contamination conditions and how levels of contamination have changed in recent times.

The USGS obtained a set of sediment samples going back over the last 100 years. These samples were tested for geologic properties, pesticides, toxicity, and other contaminants. Analyses show that, although surface sediment in the Bay is still contaminated, contamination levels have decreased over the past 50 years. Overall, conditions of sediment contamination in the Bay seem to be improving. In addition, sediment data are being combined with monitoring of ocean currents to better understand how sediment and contaminants move around the Bay. This information is having immediate benefits to state and local agencies involved with cleaning up and managing the southern California coastal region.

**Long Island Sound Contamination and Habitats** -- USGS studies, conducted in cooperation with the Connecticut Department of Environmental Protection, have defined the seafloor processes, ocean circulation patterns, and contaminated sediment distributions in the large, urbanized Long Island Sound estuary. This data provides a comprehensive regional understanding of the long-term fate and transport pathways of human toxins and wastes introduced into Long Island Sound. Results show that contaminants are widely dispersed across the Sound. Seafloor environments, the proximity to pollutant sources, and the type and mixing of bottom sediments influence the contaminant distribution. Knowledge of the variability of contaminants and seafloor conditions is essential to Federal, State, and local environmental managers for predicting where contaminants and wastes affect the seafloor biologic habitats and determining where additional studies are needed.

**Understanding the Chesapeake Bay Ecosystem** -- USGS scientists are working with EPA, state agencies, universities, and marine laboratories in the Chesapeake region to put an understanding of the Bay's ecosystem into a historical context. Studying written records and working back in time with information from sediment cores, investigators are starting to see how the Bay has responded to rising sea level and changing climate over past decades and centuries. These data are being matched and compared with other archived information of the past including tree ring records and sediment cores from East coast lakes and the Atlantic Ocean.

USGS studies have also confirmed that an asteroid impact in the geologic past is largely responsible for the origin of the Bay and the buried crater continues to affect ground water flow conditions in the Norfolk region around the mouth of the Bay. USGS studies of geologic conditions and processes is providing critical understanding of pollution in Chesapeake Bay and other estuaries.

This information on the history and evolution of Chesapeake Bay is being used to assess scenarios for the future of the ecosystem and to optimize management strategies of Chesapeake Bay Program partners to reduce negative human impacts to the ecosystem. In 1999, field investigations were performed including imaging of underwater sediment layers and sediment coring in the main Bay, tributaries, and marshes. Analyses of the sea-level change record are underway. Preliminary results show that sea level is rising much faster than the world-wide average, which has grave implications for increasing coastal erosion along developed coastal regions around the Bay.

**Mapping the Effects of El Niño Storms Along the Pacific Coast** -- As part of its response to El Niño generated storms and coastal response, the USGS and its Federal partners collected airborne laser baseline topographic survey data (LIDAR) along 1200 km of the U.S. Pacific coast. The primary purpose of these investigations is to document beach and coastal bluff changes as a result of severe El Niño induced winter storms.

Additional studies, in cooperation with State, local, and university researchers, further established the timing and process mechanisms of coastal change at a number of detailed study sites along the West Coast. Coastal monitoring data, which includes oceanographic measurements, beach profiling and aerial photography, is being used by state and local agencies to plan ahead for future storm events in order to reduce the costs and threats posed by extreme climate events.

**Earthquake and Tsunami Hazards of the Pacific Northwest Coastal Region** -- A complementary mix of geologic investigations by the USGS is being used to improve the scientific understanding of onshore and offshore earthquake fault structures and potential slope instabilities associated with the tectonic deformation of coastal Washington. The results of these USGS studies are being used to update regional fault maps of the Puget Sound region and the Washington-Oregon coastal zone. Additionally, the data provide new and useful information to FEMA and state agencies on the potential magnitude and reoccurrence rates of local earthquakes and tsunamis and the impact of these events on human activities in the Seattle-Tacoma urban corridor.

**Coastal Landslides in the Great Lakes Region** -- Coastal and offshore geological studies conducted by the USGS, in cooperation with the National Park Service, have shown that major landslides along the floor of Lake Michigan have caused rapid and catastrophic shoreline loss in historic times at Sleeping Bear Dunes National Lakeshore that threaten life and property. These slides, over a period of centuries, have disrupted the beach and parts of the lakefloor. Onshore studies discovered underlying geology that predisposes the area to landslides, and documented beach loss and ground pressures. Interpretations of these findings are helping to understand the cause of repeated slides. Results of underwater surveys and onshore monitoring are helping the USGS and the NPS evaluate the landslide hazard potential in the Park and may have application to other coastal cliff regions.

**Southwest Washington Coastal Erosion** -- For the past several thousand years, the beaches of southwest Washington and northwest Oregon accumulated sand, growing seaward and creating broad coastal plains and sand dune fields. During the last century, accelerated accretion of the beaches, associated with jetty construction at tidal inlets, has led to the belief that the coast was stable and favorable for development. In the past few decades, however, beach growth has slowed, and in several areas has reversed to erosion, causing loss of land and property damage. Scientists from the USGS, the state of Washington, local agencies, and

the university community are conducting a comprehensive, regional study of sediment supply, coastal processes, and shoreline change in the Columbia River coastal region.

Scientists are learning that the position of the shoreline changes over many time scales, caused by many complex factors, including seasonal fluctuations of up to 100 m during winter, reorientation of the shoreline during El Niño storm events, and infrequent but catastrophic tsunami waves following earthquakes. All of these shoreline events are superimposed on longer-term trends of either accretion or erosion. This information, provided in reports and at workshops, is aiding State and Federal agencies that are responsible for managing coastal activities, as well as local government officials responsible for long-term planning of coastal development and protection.

**Sand Resources Offshore Long Island to Mitigate Coastal Erosion** -- Significant and widespread coastal erosion from storms is occurring along the barrier-islands of the south shore of Long Island, New York. The economic importance of this area is substantial. Approximately \$2.8 billion worth of real estate, coupled with a \$1.5 billion annual tourist industry, is dependent on the region's recreational beaches that are undergoing rapid erosion. The USGS, in cooperation with the U.S. Army Corps of Engineers, is producing geologic maps of the sea floor along the south shore of Long Island that are being used in efforts to mitigate the erosion.

This project is determining regional-scale sand resource availability for planned beach-nourishment programs and investigating the role that inner-shelf morphology and geologic framework play in the evolution of this coastal region. Information collected is being used by the Corps of Engineers to assess sand resource potential and evaluate the possible impact that extraction of this resource might have on adjacent beaches.

**Geologic Framework and Processes Shaping the Deep-water Gulf of Mexico** -- The continental slope offshore Texas and Louisiana is one of the few remaining regions for oil and gas exploration within the U. S. Exclusive Economic Zone. The USGS is conducting research in cooperation with academic institutions to map the near-surface geology to better understand the processes that have shaped this geologically dynamic area. A regional mapping effort is providing information on the geometry and sediment composition of modern slope deposits and the distribution and timing of submarine landslides.

These studies are providing Federal agencies and the oil and gas industry with critical information on the impacts of oil and gas extraction in the deep Gulf of Mexico. The hazards being identified and mapped influence the siting of oil and gas platforms and pipeline routes. The detailed understanding of the geometry and composition of modern sedimentary deposits provides industry with analogs to more deeply buried ancient deposits that presently are drilling targets; information needed for oil and gas exploration and recovery studies.

**Geologic Mapping of Coastal and Near shore Seafloor Habitats** -- Accurate base maps are a prerequisite for every geographically based scientific study. Detailed knowledge about seabed habitats does not exist for much of the Nation's coastal regions, yet seabed geology is the basic framework for the development of habitats and associated biological resources. The USGS, in cooperation with the University of New Brunswick and using private sector ocean-surveying firms, has begun the systematic mapping of large portions of the near shore U.S. continental margin. This effort is producing accurate, high-resolution base maps and imagery for geologic and biologic studies by the USGS and other agencies. The EPA, U.S. Army Corps of Engineers, and NOAA, among others have joined with the USGS to support this mapping. The data is being used for activities as diverse as regulating marine disposal sites,

decisions concerning the removal of navigation hazards, and management of the Nation's Marine Sanctuaries.

In 1998 and 1999, the USGS mapped parts of the continental margin off South Carolina, greater Los Angeles and San Diego, selected areas around the Hawaiian Islands, including the Humpback Whale Marine Sanctuary; Flower Garden Bank; Stellwagen Bank; parts of Monterey National Marine Sanctuary; parts of the New York Bight, including the Hudson Shelf Valley; Gulf of Maine; and central San Francisco Bay. In addition, the USGS brought marine mapping technology onto the continent, successfully mapping the complex bottom of Lake Tahoe to address a variety of environmental issues associated with the Lake. The coastal maps and related research on biological habitats have identified bottom types that are deemed essential for the successful reproduction and survival of important fishery species and have documented the alteration of "essential fish habitat" by fishing practices. Maps of both active and historical disposal sites have documented the dispersal patterns and the effects of the materials on the environment, and the status of toxic sites that have been capped in an effort to prevent further contamination of the seabed.

These results are providing a basis for further research and for the development of regulatory policies by State and Federal managers. For instance, the maps are used by the EPA and the USACE to manage offshore disposal sites; and by NOAA, the regional Fisheries Management Councils, and the fishing industry to identify "essential fish habitat" and to regulate fishing grounds. Future marine mapping will continue adjacent to the major population centers on the East and West coasts and possibly the Great Lakes.