

# New Integrated Data Management System for Ridge2000 and MARGINS Research

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The initiation of dedicated databases for the U.S. National Science Foundation (NSF)-supported Ridge2000 and MARGINS programs provides the opportunity to develop a data management system capable of handling the primary data types of marine geoscience research.

Ridge2000 and MARGINS are broad initiatives focused on fundamental problems of crustal creation, evolution, and destruction along the world's tectonic plate boundaries. These programs involve the collection of a wide range of geophysical data types, as well as rock, fluid, and biological samples, and time series data.

An effective data management scheme is essential for the success of the Ridge2000 and MARGINS programs, to facilitate integration of the broad suite of studies carried out within each area of focused investigation. Data management for these programs needs to handle diverse and multi-resolution data types, as well as serve a user community composed of specialist and non-specialist researchers.

To help meet these goals, an integrated data management system is being developed which will provide cataloging and easy retrieval for all data collected as part of these programs ([www.marine-geo.org](http://www.marine-geo.org)). Data access will be provided by linking to relevant existing national data repositories where possible, rather than duplicating data holdings (e.g., National Oceanic and Atmospheric Administration (NOAA), Incorporated Research Institutions for Seismology (IRIS), and University NAVSTAR Corporation (UNAVCO)).

In addition to the metadata, the primary data sets that will be hosted locally include key environmental data of broad relevance (e.g., bathymetry and topography), high priority derived data products, and data types for which no Web-accessible digital repository currently exists.

The data system follows recommendations of recent workshop reports [Smith *et al.*, 2001; Shipley *et al.*, 2000], as well as database requirements defined in Ridge2000 and MARGINS program documents. The data system builds upon the Antarctic Multibeam Bathymetry and Geophysical Data Synthesis (AntarcticMBS) and Ridge Multibeam Bathymetry Synthesis (RidgeMBS) and metadata developments for the U.S. Coast Guard icebreaker *Healy*. It will be fully integrated with the Processed Seismic Data Center at the

University of Texas Institute for Geophysics (UTIG) and the rock geochemical database PetDB (Petrological Database of the Ocean Floor) [Lehnert *et al.*, 2000].

An oversight committee has been established to coordinate activities for all of these projects and ensure ongoing community input to the evolution of these databases. As the system evolves, new technologies in database connectivity will be adopted to enhance the global scope and broaden disciplinary content, and in data visualization to expand options for data exploration.

The ultimate aim of this effort is to develop an easy-to-use and content-rich resource to facilitate marine geoscience research throughout the global ocean.

## Database Structure and Tools

The backbone of the data system is a cruise metadata catalog, which provides basic cruise information, geophysical and sample data inventories, and relevant metadata. The data system uses an open-source relational database server (PostgreSQL®), and a metadata schema based on the NASA Directory Interchange Format (DIF), which is extended to accommodate the more complex structure of marine geoscience data.

The database can be accessed via a simple text-based search page using keywords (e.g., principle investigator, cruise name, dates, ship), geographic bounds, or data type (Figure 1). The design of the search page facilitates easy retrieval of specific cruise metadata and the data they describe.

Cruises and data sets are linked to NSF project awards and to published references as they become available. Bathymetry, navigation, and underway geophysical data within the Ridge2000 and MARGINS focus sites, as well as from elsewhere within the global ocean, are currently online. Standardized forms for capturing basic cruise information for field programs have been tested by expedition scientists and are now available for downloading. Principle investigators of MARGINS and Ridge2000 programs are currently required to submit cruise metadata. Requirements for routine metadata submission will be expanded to the broader spectrum of NSF-funded marine geology and geophysics programs.

All data contributed to the data system are incorporated with access restrictions until explicit permission for data release is provided by the investigator, normally under the timetable specified in published NSF data sharing requirements and program data policies. To encourage collaboration and proper

acknowledgment of data originators, a user registration system will be adopted similar to that in place for the Processed Seismic Data Center at UTIG.

With this system, investigators can choose to be notified when users download data sets that they contributed. It is hoped that using this scheme will encourage a greater contribution of derived data products. These often represent significant intellectual investments to produce and are typically of most value to the broader community of researchers. A Lightweight Directory Access Protocol (LDAP) server will be implemented to manage this user registration system, and provide authentication for access to proprietary data for data contributors and users of the database.

## Data Visualization

Easy-to-use interactive tools that permit co-located data to be readily displayed and searched by the non-specialist user are needed to facilitate the increasingly multidisciplinary needs of marine geoscience research.

GeoMapApp ([www.geomapapp.org](http://www.geomapapp.org)) is the primary data visualization tool currently integrated with the database. GeoMapApp is a Java™ application, which permits dynamic exploration of data from a map interface and provides the capability to generate custom grids and maps (Figure 2).

The application is fully integrated with a multi-resolution gridded topography database, which incorporates the total holdings of the RidgeMBS and AntarcticMBS as well as data now being added from continental margins. The Smith and Sandwell [1997] predicted topography, International Bathymetric Chart of the Arctic Ocean (IBCAO) [Jakobsson *et al.*, 2002], and BEDMAP [Lythe *et al.*, 2000] compilations are included as the regional background maps in areas without multibeam coverage.

Land topography data from the NASA Space Shuttle Radar Topography Mission (SRTM) [Farr and Kobrick, 2000] can also be viewed, and are currently available for most of the world's continental regions (90-m spatial resolution). The combined data set provides the capability to zoom and pan on a seamless land/oceanic topography database up to a grid resolution of ~100 m.

Other data sets that can be accessed include the seafloor age compilation of Müller *et al.* [1997], earthquake locations from the International Seismological Center, and the ocean seismicity data set of the NOAA Pacific Marine Environmental Laboratory. GeoMapApp also enables a user to access PetDB with the capability to view, select, and download geochemical data within a map view of interest.

Access to all of these data types is available through the same map browser as the digital elevation data, which allows the user to explore diverse global data sets and generate custom maps from a single interface.

## Future Plans

A major focus over the coming year is to develop direct interoperability with a number

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<b>Marine Geoscience Data Management System</b>	Applications	Get Data	Partners	Explore Further
	<a href="#">GeoMapApp</a> <a href="#">Data Link</a> <a href="#">Create Maps &amp; Grids</a>	<a href="#">Antarctic Bathymetry MARGINS</a> <a href="#">Ridge 2000</a> <a href="#">Ridge Bathymetry</a> <a href="#">Seismic Reflection</a>	<a href="#">PetDB</a> <a href="#">ODP Borehole</a> <a href="#">LDEO Core Repository</a> <a href="#">UTIG Seis Reflection</a>	<a href="#">Related Links</a> <a href="#">Contribute Cruise Info</a> <a href="#">Meetings &amp; Reports</a> <a href="#">Acknowledgements</a> <a href="#">Site Statistics &amp; Holdings</a>

**Ridge 2000 Data Portal**

This page provides access to cruise information and data collected during Ridge 2000 funded projects. Learn more about this web site by browsing the [What's New](#) page, and reading other [Project Related Documents](#).

Use [GeoMapApp](#) to view the global topography database, create and download custom maps and grids as well as multibeam ping files. With [GeoMapApp](#) you can also view and explore trackline gravity and magnetics data, geochemical data from [PetDB](#), seismicity, and seismic reflection profiles.

Use [Data Link](#) to search for a cruise or data type of interest by keyword or geographic region.

Use [Create Maps and Grids](#) to generate a quick bathymetry map or grid for a region of interest.



Study Sites	<b>Endeavour Segment (Juan de Fuca Ridge)</b> <a href="#">Science Plan</a> <a href="#">Search Data Catalog</a> <a href="#">Create Map/Grid</a> <a href="#">Deployed Instruments</a> <a href="#">Survey Targets</a>	<b>Lau Basin (Valu Fa Ridge)</b> <a href="#">Science Plan</a> <a href="#">Search Data Catalog</a> <a href="#">Create Map/Grid</a> <a href="#">Deployed Instruments</a> <a href="#">Survey Targets</a>	<b>8°-11°N Segment (East Pacific Rise)</b> <a href="#">Science Plan</a> <a href="#">Search Data Catalog</a> <a href="#">Create Map/Grid</a> <a href="#">Deployed Instruments</a> <a href="#">Survey Targets</a>
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<b>Platform:</b> (all) <input type="button" value="v"/> <b>Operator:</b> (all) <input type="button" value="v"/> <b>Funding Agency:</b> (all) <input type="button" value="v"/> <b>Funding Initiative:</b> NSF-Ridge2000 <input type="button" value="v"/> <b>Investigator:</b> (all) <input type="button" value="v"/> <b>Institution:</b> (all) <input type="button" value="v"/> <b>Port Stop:</b> (all) <input type="button" value="v"/> <b>Start Date:</b> 1950 01 01 <b>End Date:</b> 2020 01 01 <b>Region:</b> North 11 West                      East -106                      -102 South 8.5 <b>Focus/Study Site:</b> EPR 8-11 N <input type="button" value="v"/>	<table border="1"> <thead> <tr> <th></th> <th>Track</th> <th>Grid</th> <th>Image</th> </tr> </thead> <tbody> <tr><td>Gravity</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Magnetics</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Sidescan</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Bathymetry</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Echosounder</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Multibeam</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Subbottom</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Seismics</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• MCS</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• SCS</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• OBS</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Samples</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Rock</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Biology</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>• Fluid</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>CTD/TSG</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>Expendable Probe</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>ADCP</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> <tr><td>(all)</td><td><input type="radio"/></td><td><input type="radio"/></td><td><input type="radio"/></td></tr> </tbody> </table>		Track	Grid	Image	Gravity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Magnetics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sidescan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Bathymetry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Echosounder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Multibeam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Subbottom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Seismics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• MCS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• SCS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• OBS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Samples	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Rock	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Biology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	• Fluid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	CTD/TSG	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Expendable Probe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	ADCP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	(all)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Fig. 1. (A) Entry Web page for the Ridge2000 database. (B) Search page showing keyword search options. Original color image appears at back of this volume.

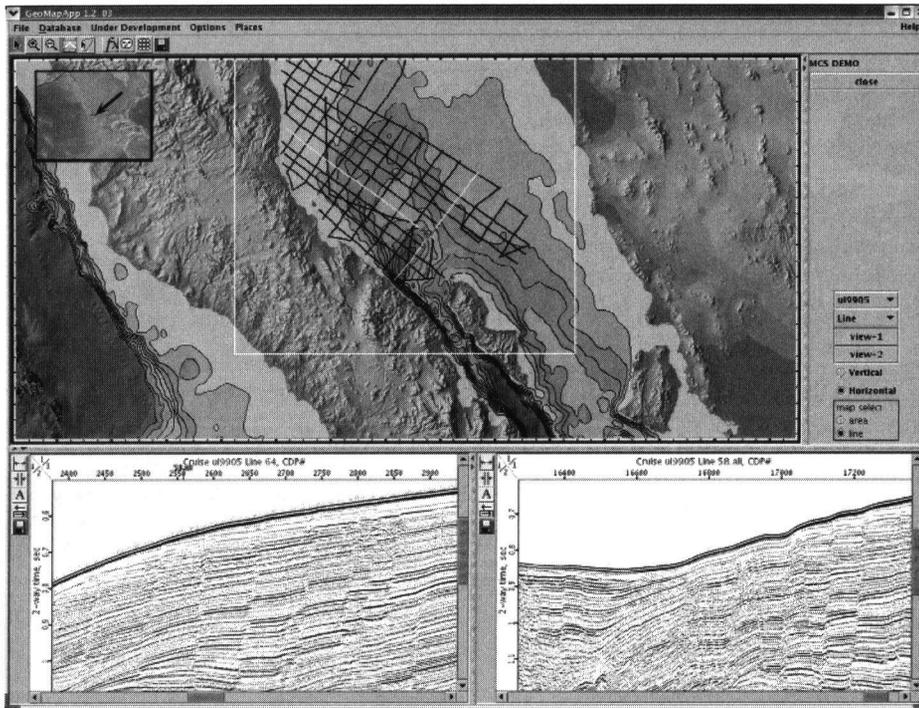


Fig. 2. Example of the GeoMapApp interface showing the Gulf of California Focus Site for the MARGINS program. Bathymetry data are integrated with Space Shuttle Radar Topography Mission land topography data, and can be custom colored and contoured. High-resolution multi-channel seismic data are available for this area and can be displayed and explored. Original color image appears at back of this volume.

of complementary databases, including the underway geophysical and multibeam databases at the National Geophysical Data Center (NGDC), the U.S. National Deep Submergence Facility at the Woods Hole Oceanographic Institution, the Geological Data Center of the Scripps Institution of Oceanography, and the databases of the Ocean Drilling Program (JANUS, and Borehole Geophysics).

As a first step toward interoperability with these repositories, a lightweight REST (REpresentational State Transfer) Web service is being implemented; this facilitates the exchange of metadata by using a standard protocol (HTTP) and format (XML). Web coverage services, which support networked interchange of geospatial data, will be used

to provide a public interface to the global bathymetry database. This will permit access to geo-referenced images and grids, in geo-TIFF format, for arbitrary resolution and bounds. As the system evolves, the plan is to seek new partnerships to develop the data system as a resource for education and public outreach, and to link with other efforts as part of the growing cyberinfrastructure for research and education across the geosciences.

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## MEETINGS

### Multidisciplinary Applications of Nanoscale Magnetic Behavior, Particulates, and Structures

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The detection, fabrication, use, and understanding of fine magnetic particulates and structures provides an interdisciplinary platform which crosses a diverse number of science areas, including geophysics, environmental science, medicine, biology, data storage media, and semiconductor devices. Natural and laboratory-grown magnetic particulates and fabricated structures at the scale of 5–100 nm

have a wide number of applications, including interpreting environmental change and paleomagnetic signatures; disease diagnosis and drug delivery in humans; locating and understanding the production of biomagnets in a variety of organisms; and designing the next generation of data storage devices and nanoscale information technology components.

The recent International Conference on Fine Particle Magnetism, hosted by the London Center for Nanotechnology and held in September

2004, provided a forum for practitioners in this diverse field to benefit from insights into the study of fine-particle magnetic behavior in other disciplines. The conference included 62 poster and oral presentations, and attracted participants from 13 countries.

Frontier areas in Earth and environmental science that were discussed at the conference are the improved understanding and imaging of nanoscale magnetic structure in ilmenite-hematite, and the use of nanoparticle magnetic sulphides for water decontamination. In paleomagnetic studies, conventional wisdom is that single-domain particles (those not subdivided by domain walls) within the upper size range of nanomagnetic Ti-magnetite provide the geologically stable remanence in most rocks. The single-domain limit is being challenged in some materials by collaborative work that has recognized that a highly stable remanence can be acquired at the interface between

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<b>Operator:</b>	(all)			
<b>Funding Agency:</b>	(all)			
<b>Funding Initiative:</b>	NSF-Ridge2000			
<b>Investigator:</b>	(all)			
<b>Institution:</b>	(all)			
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<b>End Date:</b>	2020 01 01			
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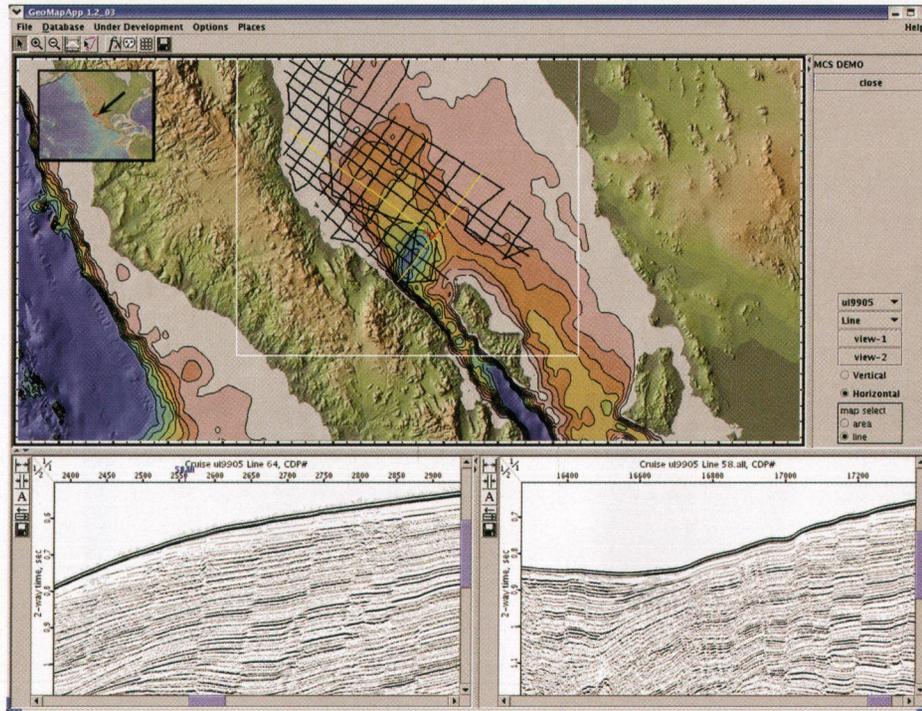


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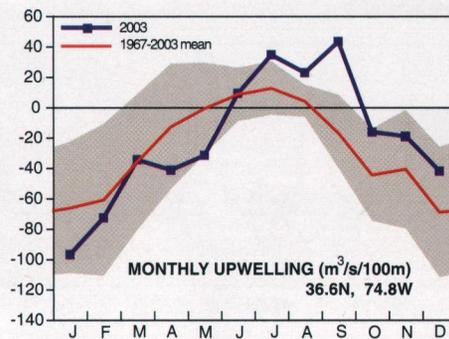


Fig. 1. Monthly-mean upwelling at 36.6°N, 74.8°W for 2003 (blue) and climatology for 1967–2003 (red). Grey area denotes standard deviation for each month. Based on PFEL upwelling index.