GeoPRISMS Data portal: A decade of community support

Andrew Goodwillie and the Data Portal Team
Lamont-Doherty Earth Observatory, Columbia University

GeoPRISMS-funded projects have in many cases undertaken fieldwork involving expensive facilities and instrumentation in remote locations, sometimes for non-repeatable events. The GeoPRISMS community data resources support GeoPRISMS research by helping to preserve these unique datasets thus increasing the return on a decade of investment in the GeoPRISMS program made by the National Science Foundation. These data resources provide a range of benefits that include enabling sharing and reuse of data, improving data access, promoting scientific reproducibility, and supporting the principles of FAIR data (Findable, Accessible, Interoperable, Reusable), encouraged by professional societies such as AGU. The preservation of GeoPRISMS data additionally helps to fulfill the requirements of NSF funding and journal publication, and underpins a robust data legacy for the program.

The GeoPRISMS Data Portal was established in 2011 to provide convenient access to data and field information for each primary site as well as to other relevant data resources. The GeoPRISMS Data Portal grew out of the MARGINS Data Portal and has been regularly enhanced with functionality that reflects new capabilities in database infrastructure, architecture, and interactivity. The GeoPRISMS Data Portal is part of a broader suite of NSF-funded data collections and resources, with other examples including EarthChem, IRIS and UNAVCO, that support GeoPRISMS-related research.

Over the past decade, the Data Portal team has worked closely with many GeoPRISMS Principal Investigators to ensure that their datasets are appropriately catalogued and archived, including supporting the open data access requirements for a number of community experiments. Data Portal team members have led webinars and mini-workshops sponsored by GeoPRISMS and have interacted with the GeoPRISMS community at many meetings and conferences. Data Portal updates are regularly shared with the community via the GeoPRISMS newsletter and through reports presented at the GeoPRISMS Steering and Oversight Committee meetings. The Data Portal group works closely with the GeoPRISMS Office, particularly in identifying publications to be added to the GeoPRISMS bibliography.

The GeoPRISMS Data Portal is part of the Marine Geoscience Data System (MGDS) and provides links to a number of community data systems and resources (Fig. 1). These include the EarthChem Library and the EarthChem Portal for geochemistry data, the System for Earth Sample Registration (SESAR), the Academic Seismic Portal, the Global Multi-Resolution Topography (GMRT) synthesis, and GeoMapApp for data visualisations. From the Data Portal, external links point to data collections at IRIS and UNAVCO. All of these data resources serve to support GeoPRISMS data integration and synthesis efforts.

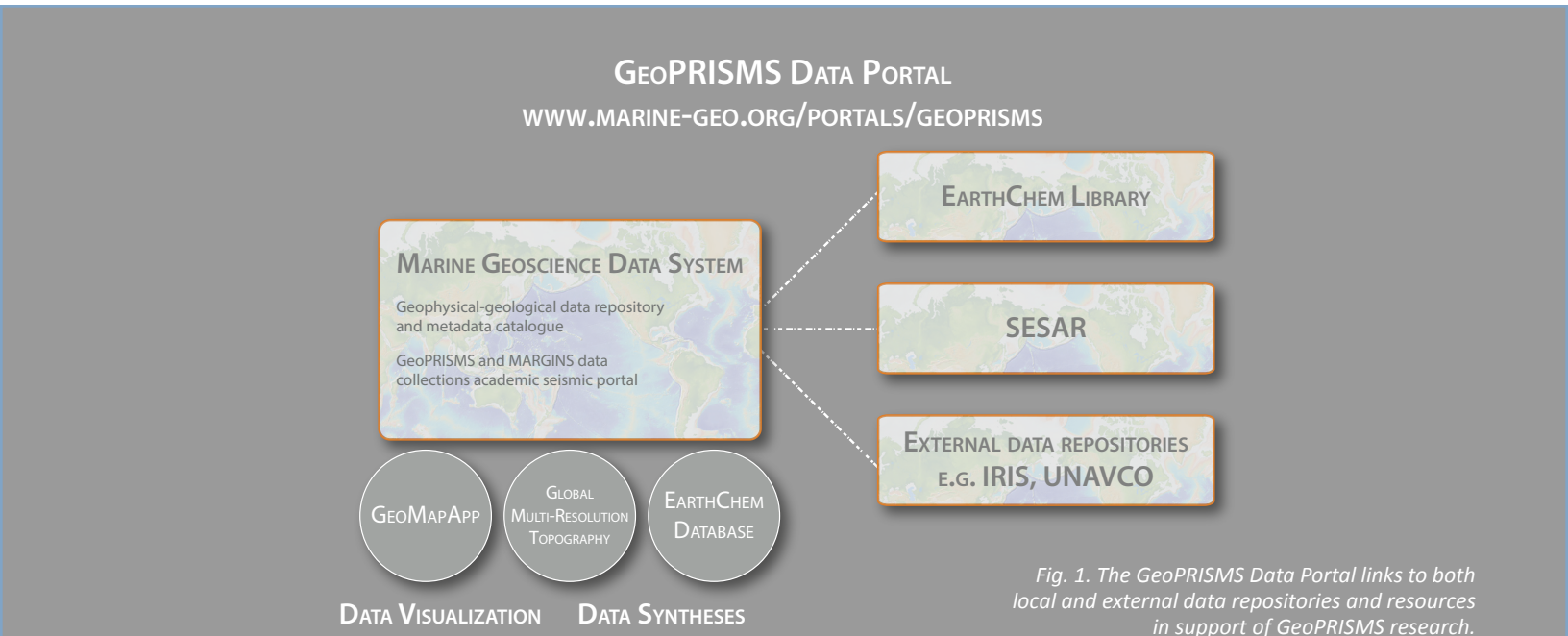


Fig. 1. The GeoPRISMS Data Portal links to both local and external data repositories and resources in support of GeoPRISMS research.

Several of these data collections and syntheses were enhanced to help GeoPRISMS researchers with field planning and implementation. Swath bathymetry data from hundreds of cruises were added to the GMRT synthesis within the GeoPRISMS primary sites. A particular focus has been placed on the Alaska-Aleutians, Cascadia, and Eastern North American Margin study areas to help facilitating the large multidisciplinary GeoPRISMS field programs in those regions. High quality bathymetry data make the deployment and recovery of ocean-bottom seismometers (OBSs) much easier when available. In parallel, Aleutian arc geochemical analytical data from more than fifty papers published between 1971-2010 were added to the EarthChem-PetDB database. The data are available through the EarthChem Portal and GeoMapApp.

The GeoPRISMS Data Portal provides links to almost 200 datasets contributed by the GeoPRISMS community covering all five primary sites and a wide range of disciplines (Fig. 2). A DOI has been issued for many of these datasets to facilitate their citation in publications.

Search For Data | The search tool provides a quick way to find GeoPRISMS data using parameters such as keyword, NSF award number, publications, and geographical extent.

Contribute Data | Researchers can contribute any GeoPRISMS-related datasets that are of interest to the community by using the data submission form: *http://www.marine-geo.org/submit/*

Fig. 2. Example of GeoPRISMS data sets on the data portal data sets page which provides links to data and field program information.

Examples of contributed data sets

To exemplify the range of data available through the portal, a few datasets are highlighted below for each of the five GeoPRISMS primary sites. Many GeoPRISMS datasets are also available in GeoMapApp under the **Focus Site** and **DataLayers** menus.

Alaska-Aleutian arc

The Key et al. 2015 amphibious investigation of the magmatic system beneath Okmok Volcano collected magnetotelluric (MT) time series data offshore the eastern Aleutian arc island of Umnak, AK. The data were collected along a 300km-long transect perpendicular to the subduction trench and the MT stations comprised more than fifty broadband ocean-bottom electromagnetic receivers. All except one were recovered.
http://www.marine-geo.org/tools/search/entry.php?id=Aleutians_Bennington

The geochemical-geophysical study of the Aleutian arc Unimak-Cleveland corridor, led by Diana Roman, Erik Hauri, and Terry Plank, include helicopter-derived chemistry data for volcanic trace gas emissions at Mount Cleveland volcano. CO_2, SO_2, and H_2S concentrations, measured using a Multi-GAS system, are described in Werner et al., 2017 and can be explored in GeoMapApp (Fig. 3).

East African Rift System (EARS)

Erica Emry contributed grids of upper mantle isotropic seismic velocity structure beneath Africa. Derived using new full-wave seismic tomography techniques on ambient noise and earthquake data, the grids shed light on relationships between mantle flow, cratonic lithosphere and surface processes. The dataset is available at IRIS-EMC and has been added to GeoMapApp (Fig. 3).

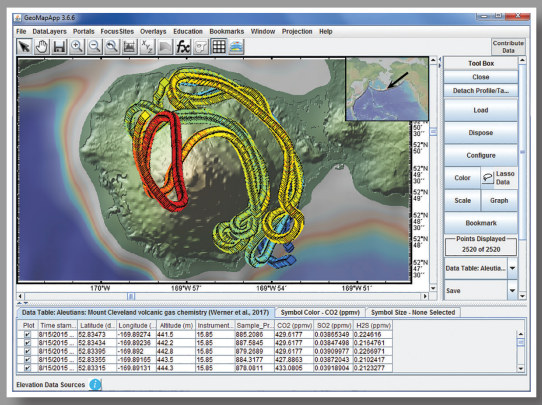
The active-source seismic data from the 2015 SEGMeNT survey are now available on the Data Portal. This integrated study of tectonic and magmatic processes during the onset of rifting, led by Shillington et al., focused upon the northern Malawi (Nyasa) rift, a region of early-stage rifting in strong, cold lithosphere (Fig. 4). The study imaged sedimentary and crustal structure within and around the lake. The dataset is available at :
http://www.marine-geo.org/tools/search/entry.php?id=EARS_SEGMeNT

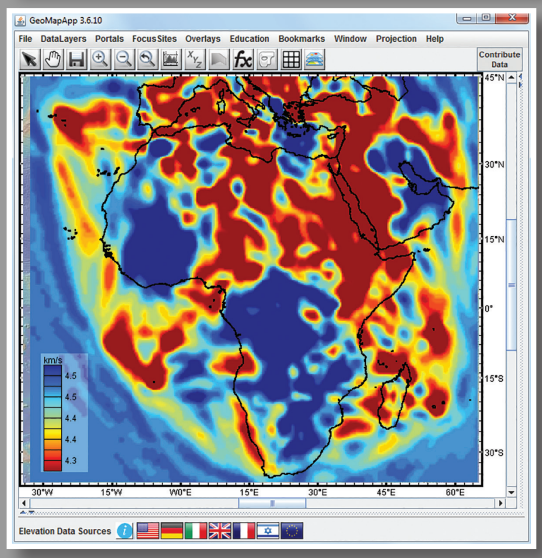
Aeromagnetic total magnetic intensity data were collected in 2013 for the Karonga area of northern Malawi Rift, and contributed by investigators Estella Atekwana, Jalf Salima, and Leonard Kalindekafe. In addition, 2-D electrical resistivity tomography profiles acquired in the same area in 2015 were provided by Estella Atekwana, Daniel Lao-Davila, and Folarin Kolawole. The data were used by the researchers to study the early stages of continental extension and active deformation of the Malawi Rift North Basin hinge zone.

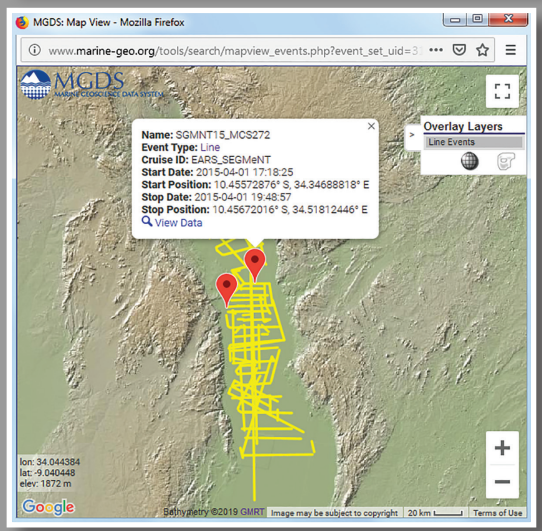
Cascadia

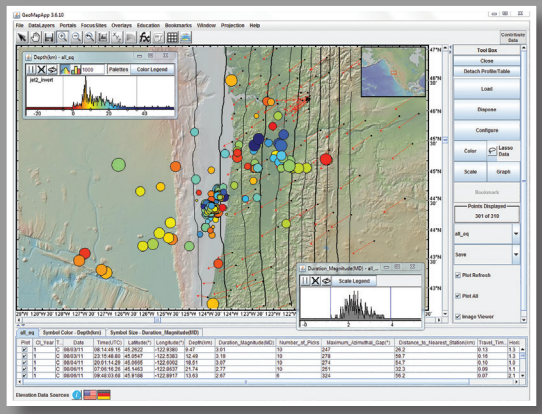
The Gao and Shen 2014 shear wave velocity model of the upper mantle from full-wave ambient noise tomography is available. It reveals low-velocity anomalies along the Cascadia back-arc that are spatially correlated with the three arc-volcano clusters.

Derived from Cascadia Initiative OBS data, Emily Morton and Sue Bilek contributed a new microseismicity catalogue of earthquakes detected and located offshore central Oregon from 2011 to 2015. The catalog (Fig. 5) was generated using a subspace detection technique and includes hypocentral locations and duration magnitudes.









The dataset is available at:
http://www.marine-geo.org/tools/search/entry.php?id=Cascadia_Morton

Subduction zone heat flow datasets from H. Paul Johnson, Evan Solomon, Robert Harris, and Marie Salmi were contributed for surface heat flow measurements collected during an *R/V Atlantis* cruise in 2013. These include heat flow data acquired with a multi-core logger, thermal blankets, and an Alvin heat flow probe that were deployed using the Jason II remotely-operated vehicle. The investigators also contributed the Salmi et al. 2017 heat flow data derived from Bottom-Simulating Reflectors (BSR) that were imaged using active-source multi-channel seismic data from the 2012 Cascadia Open Access Seismic Transects (COAST) survey. The BSR-related fieldwork was conducted along the southern Cascadia margin during the *R/V Langseth* expedition MGL1212.

As part of the project investigating the thermal structure, hydration, and dehydration of the Juan de Fuca plate, investigators Helen Janiszewski, Jim Gaherty, and Geoff Abers contributed stacked receiver function data files and station orientation estimates for Cascadia Initiative OBS stations. The dataset is referenced in Janiszewski and Abers, 2015. Closely related, multi-channel seismic field and processed datasets from the Juan de Fuca Ridge2Trench experiment were contributed by investigators Shuoshuo Han, Suzanne Carbotte, and Pablo Canales and are available on the MGL1211 cruise page.

From top to bottom:

Fig.3. Werner et al. CO_2 gas trace concentration at Mount Cleveland, AK from a helicopter survey conducted in August 2015. The dataset is available in the GeoPRISMS data portal and in GeoMapApp under both the Geochemistry and Focus Sites menus. In this image the symbols indicate the helicopter flight path and have been colored blue (low CO_2 concentration) to red (high). The background map is the Global Multi-Resolution Topography (GMRT) synthesis which incorporates the USGS NED land elevation data for the Aleutian arc. Image made with GeoMapApp.

Fig. 4. Shear-wave velocity structure at 123km depth from Emry et al. This, and similar grids for depths between 105 and 424km are provided in GeoMapApp. The grids reveal segmented, low-velocity upper mantle underlying the magmatic northern and eastern sections of EARS. Shallow parts of the southern and western sections are dominated by high-velocity upper mantle which transitions at depth to low velocities. Image made with GeoMapApp.

Fig. 5. Interactive map showing the active-source multi-channel seismic profile lines collected during the Shillington et al. 2015 EARS SEGMeNT survey. The information popup window provides details of the selected seismic line and a link to the data from that line. The background map is the Global Multi-Resolution Topography (GMRT) synthesis. Lake Malawi is the flat, even green feature underlying the yellow profile lines. Image made with MGDS Map Viewer using a Google Maps display engine.

Fig. 6. Map of the Cascadia region showing north-south-trending 10km depth contours of the subduction slab interface from McCrory et al. The dots represent the microseismicity catalogue from Emily Morton, colored following earthquake focus depth and scaled on duration magnitude. The red arrows are geodetic velocity vectors from the UNAVCO EarthScope PBO solutions in the IGS08 reference frame, with 10mm of arrow length equivalent to a velocity of 10mm/year. The EarthScope PBO geodetic velocity vector data are available under the GeoMapApp Portal menu. Image made with GeoMapApp.

New Zealand

Nathan Bangs and Adrien Arnulf led a large team of investigators during the 2017 Langseth SHIRE cruise MGL1708 to study the along-strike variations in locked and creeping megathrust systems off the Hikurangi convergent margin in New Zealand (Fig. 7). The data from the 2-D active-source multi-channel seismic survey are available.

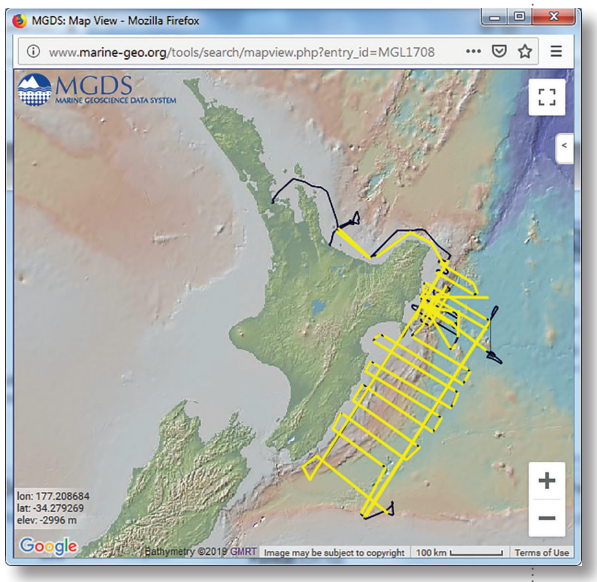
Multi-channel seismic shot field data and seismic navigation files were contributed by investigators Nathan Bangs, Shuoshuo Han, Greg Moore, Eli Silver, and Harold Tobin for the follow-on 2018 Langseth active-source 3-D seismic survey across the Hikurangi margin. In this survey, four closely-spaced streamer cables were towed within a 15km x 60km survey box across the trench and forearc. The Hikurangi margin is characterised by regularly-occurring slow-slip events (SSEs) and one of the main goal of the survey was to gain understanding of the factors associated with slow-slip behavior. The seismic data sets are available at:
http://www.marine-geo.org/tools/search/entry.php?id=MGL1801

To better understand the forces that drive early-stage subduction, investigators Mike Gurnis, Sean Gulick, Joann Stock, Harm Van Avendonk, and Rupert Sutherland conducted a 2-D active-source survey of the Puysegur segment of the Macquarie Ridge Complex. This Puysegur-Fiordland boundary south of New Zealand's South Island represents a type-example of incipient subduction. The 2018 Langseth cruise, dubbed "SISIE", collected multi-channel seismic reflection data which may be viewed at:
http://www.marine-geo.org/tools/search/entry.php?id=MGL1803

Eastern North America Margin

The main offshore component of the multi-PI, shoreline-crossing ENAM Community Seismic Experiment took place in 2014. The shots from the Langseth cruise MGL1408 were recorded by streamers and OBS offshore, and by broadband and short-period seismometers on land. Multi-channel seismic shot data and field information from the experiment, including land seismometer operations and OBS deployments, were added to the portal (Fig. 8).

An updated USGS bathymetric compilation of the ENAM margin was added to GMRT and GeoMapApp. Based upon 32 multibeam swath mapping surveys collected between 1990 and 2015, the new compilation covers 725,000km^2 of seafloor along the margin.



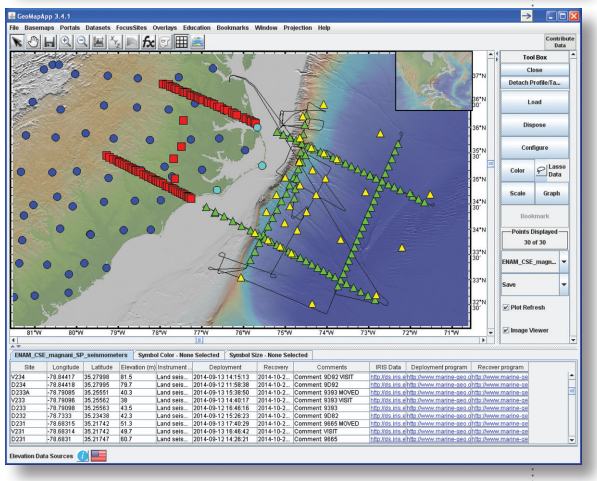


Fig.7 (top). Seismic survey lines (yellow) from the 2017 Langseth SHIRE survey, MGL1708 (Bangs et al.). The background elevation map is the Global Multi-Resolution Topography (GMRT) synthesis. Image made with MGDS Map Viewer using a Google Maps display engine.

Fig. 8 (bottom). ENAM CSE components are indicated as follows. OBS - Short-period (green), broadband (yellow); Land-based seismometers - short-period (red), broadband (light blue, Outer Banks), EarthScope USArray (dark blue). The black line shows the ship track for Langseth cruise MGL1408 led by co-chief scientists Donna Shillington, Anne Bécel, and Matt Hornbach. Image generated in GeoMapApp. The station locations are available under the Focus Sites > ENAM menu.

GeoPRISMS bibliography

With more than a hundred papers stemming from GeoPRISMS-funded research, the GeoPRISMS references database can be searched by primary site, paper title, author, year, and journal. Many of the citations are tied to data sets. Send us the DOI citation for your papers for inclusion in the bibliography.

The GeoPRISMS Data Portal will continue to operate and be available after the official end of the NSF-funded GeoPRISMS decadal program in order to facilitate the proper cataloguing and archiving of GeoPRISMS data, including data generated from the more recent rounds of NSF solicitations for proposals that sought GeoPRISMS funding for data synthesis and integration efforts. The Data Portal team will also be involved in an NSF-funded workshop that will take place soon, with a focus upon establishing a robust GeoPRISMS data legacy. ■

The GeoPRISMS Data Portal team is here to serve the community
Please contact us at info@marine-geo.org