

6. Other Impacts

6.1 Building an Interdisciplinary GeoPRISMS Community

During its first five years GeoPRISMS has substantially grown its community base, building upon and expanding beyond the original MARGINS community. This is reflected in the excellent attendance at GeoPRISMS workshops (with nearly 1,000 unique individuals attending), including a high percentage of graduate students (~20%), postdocs, and early career investigators (a further 15-20%), who represent the next generation of GeoPRISMS researchers. The GeoPRISMS Science and Implementation Plans are the products of formal and informal contributions from large numbers of scientists, including those listed in these documents and all attendees of the planning workshops. As necessary for a program of this nature, the community is highly interdisciplinary and collaborative, enabling strong team-based research efforts, including the planning and execution of community experiments and expeditions. The community-building activities are tightly interwoven with GeoPRISMS research activities and define the entire GeoPRISMS research enterprise.

6.2 International Collaborations

International collaboration and exposure remains an important aspect of GeoPRISMS. Significant international work has been conducted in the last 5 years as part of MARGINS-funded work at the focus sites abroad, including Central America, Gulf of California, IBM and Nankai, as indicated by the citations listed in Chapters 2 and 3. The GeoPRISMS primary sites that have been open for large field projects thus far have all been within the US. By design this has led to a reduction in international exposure. The Program has sought to maintain strong relationships with potential collaborators, both on US-focused projects, and in anticipation of future research. In particular, the Cascadia primary site has provided clear opportunities for collaborations with Canadian researchers, with emphasis on geodetic and seismic observations along this active margin, as well as cooperation on offshore cabled infrastructure, including NEPTUNE-Canada and the US Ocean Observing Initiative. Interests in comparative studies of Eastern North American Margin (ENAM) structure also enabled collaborations with Canadian scientists. Collaborative research projects, shared development and use of infrastructure, and research training are key elements of ongoing and proposed projects in East Africa and New Zealand, with significant international collaborations anticipated in upcoming years. To ensure these long-term international collaborations persist, all GeoPRISMS planning workshops sought to engage active international attendance. International participation in the mini-workshops focusing on EARS and NZ was high.

The Office Directors have also been actively engaged in developing international partnerships, which includes presentations highlighting the Program and research objectives at international meetings in Europe and Japan; participation in planning meetings that led to the UK NERC Consortia infrastructure for studies of the interaction of [volatiles between the deep Earth, the hydrosphere and](#)

[atmosphere](#); and partnerships in projects funded through national funding agencies in Japan and Europe, as well as those provided by the European Union.

Thematic studies in the GeoPRISMS Science and Implementation Plans have also enabled valuable international collaborations. The ExTerra group of researchers, interested in the thematic study of exhumed terranes, has flourished with the support of GeoPRISMS and other NSF programs. ExTerra has developed its own community-driven Field Institute approach to conducting scientific research in the field, with their first field institute focusing on the [Salinian arc in California](#) (Figure 6.1). A ~\$4M ExTerra Field Institute and Research Endeavor (E-FIRE) proposal has just been recommended for funding through NSF PIRE (Partnerships for International Research and Education). This project develops a new paradigm for collaborative geological research by conducting collaborative fieldwork to collect materials held in shared, open-access depositories; facilitates broad interactions through workshops; and allows student exchanges among research laboratories in the US and abroad to foster international training. The E-FIRE project will build on a partnership with the EU-sponsored Marie Curie Training Network “Zooming In between Plates” with lead-PI Philippe Agard (Université Pierre et Marie Curie, Paris). This project will lead to international field institutes to trace the cycle of rocks and fluids through the subduction process, as recorded in the Western Alps, which is a premier example of a fossil subduction zone.

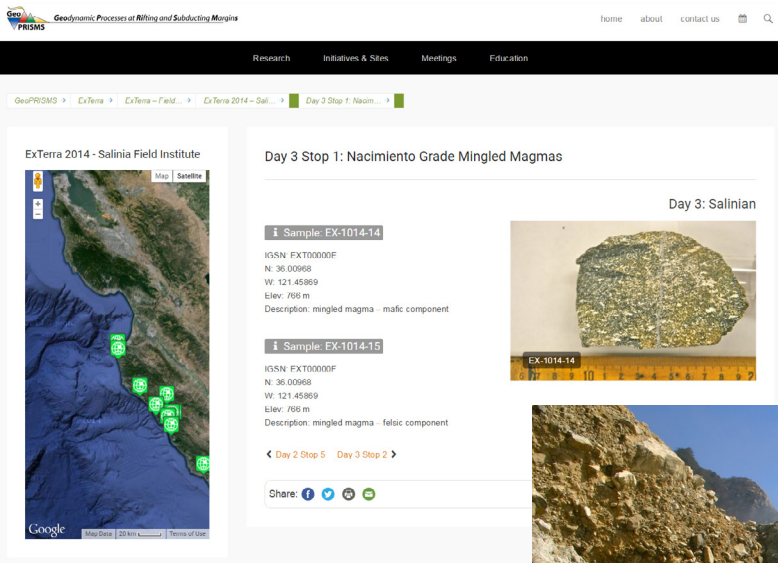


Figure 6.1. Left: Meta-data for rocks collected as part of the first ExTerra field institute in the Santa Lucia mountains (central coastal California). Below: Exposure of the late Cretaceous Salinian arc along the California Coast.



6.3 Relationship to Facilities and Other Programs

There is a great deal of synergy between GeoPRISMS goals and efforts and other NSF-sponsored facilities and programs. In particular, GeoPRISMS research efforts are successfully leveraging data from EarthScope facilities, including USArray and the Plate Boundary Observatory (PBO). The PASSCAL program of IRIS provides critical support for PI-driven seismic deployments that support GeoPRISMS science. A large number of GeoPRISMS projects rely on data provided by the IRIS and UNAVCO data centers, which in turn distribute data collected through GeoPRISMS funding. The [Computational Infrastructure for Geodynamics](#) initiative provides codes and computational support for GeoPRISMS-related modeling projects. A number of GeoPRISMS-supported data collection initiatives with offshore components, including work in Cascadia, ENAM, and Alaska/Aleutians, have relied heavily on infrastructure maintained by other NSF programs. This includes ship time resources supported through the UNOLS fleet and instrumentation maintained and coordinated through groups such as OBSIP (Ocean Bottom Seismograph Instrument Pool; which is in itself a collaborative effort among IRIS, Woods Hole Oceanographic Institution, Lamont Doherty Earth Observatory, and Scripps Institution of Oceanography).

GeoPRISMS relies particularly heavily on synergy with the EarthScope initiative in the Cascadia, ENAM, and Alaska-Aleutians focus sites. GeoPRISMS research in Cascadia has benefitted from both seismic and geodetic data collected in the Pacific Northwest by EarthScope and by the Cascadia Initiative. In the ENAM primary site, data from a number of USArray components are proving critical for GeoPRISMS science; this includes seismic data from the seismic Transportable Array (TA) and Flexible Array (FA) studies, in addition to data from the recently established Central and Eastern US Network, an intra-agency collaboration that takes advantage of the opportunities provided by the deployment of the TA in the eastern US. The magnetotelluric (MT) component of USArray will provide an exciting opportunity for GeoPRISMS science in ENAM over the next few years, as the MT TA deploys in the eastern US, and FA data are collected along the MAGIC seismic line. These data will provide an opportunity for imaging the conductivity structure of the rifted ENAM margin in unprecedented detail. Finally, with the focus of USArray data collection turning towards Alaska, where the PBO has operated for a decade and will continue to operate through the end of the EarthScope program in 2018, there are ongoing opportunities to leverage EarthScope data collected in Alaska-Aleutians for GeoPRISMS science. In addition to the leveraging of EarthScope resources, GeoPRISMS researchers are exploiting the synergy between EarthScope and GeoPRISMS science goals in the three US-based GeoPRISMS focus sites. Scientific results from EarthScope projects are informing GeoPRISMS science questions and vice versa. As a demonstration of this cooperation, three of the five primary site planning workshops were sponsored jointly by GeoPRISMS and EarthScope, enabling cooperative project planning and coordinated data collection efforts.

GeoPRISMS, like MARGINS before it, will benefit from scientific ocean drilling (now through the International Ocean Discovery Program, IODP) and there is significant overlap between the guiding science questions of the two organizations. Given the long lead time for implementing IODP-related projects, many drilling proposals originally submitted during MARGINS have been



Figure 6.2. Drill ship Chikyu leaving Yokohama harbor. Photo by Katsuyoshi Michibayashi.

SCD-related expeditions

- Exp 348: NanTroSEIZE Stage 3 – Plate Boundary Deep Riser 3 (Sep 2013–Jan 2014)
- Exp 338: NanTroSEIZE Stage 3 – Plate Boundary Deep Riser 2 (Oct 2012–Jan 2013)
- Exp 343: Japan Trench Fast Drilling Project (Apr–May, Jul 2012)
- Exp 333: NanTroSEIZE Stage 2 – Inputs Coring and Heat Flow (Dec 2010–Jan 2011)
- Exp 332: NanTroSEIZE Stage 2 – Riserless Observatory 2 (Oct–Dec 2010)
- Exp 326: NanTroSEIZE Stage 3 – Deep Riser Hole (Jul–Aug 2010)
- Exp 322: NanTroSEIZE Stage 2 – Subduction Input (Sep–Oct 2009)
- Exp 319: NanTroSEIZE Stage 2 – Riser/Riserless Observatory 1 (May–Aug 2009)
- Exp 328: Cascadia A CORK Observatory (Sep 2010)
- Exp 334: Costa Rica Seismogenesis Project (Mar–Apr 2011)
- Exp 344: Costa Rica Seismogenesis Project 2 (CRISP) (Oct–Dec 2012)
- Exp 340: Lesser Antilles Volcanism & Landslides (Mar–Apr 2012)
- Exp 341: Southern Alaska Margin (May–Jul 2013)
- Exp 352: Izu-Bonin–Mariana Fore-arc (Jul–Sep 2014)
- Exp 351: Izu-Bonin–Mariana Arc Origins (May–Jul 2014)
- Exp 350: Izu-Bonin–Mariana Rear Arc (Mar–May 2014)
- Exp 362: Sumatra Seismogenic Zone (planned for FY16)
- Exp 366: Mariana Convergent Margin (planned for FY17)
- Exp TBD: Hikurangi Subduction Margin (FY18)

RIE-related expeditions

- Exp 349: South China Sea Tectonics (Jan–Mar 2014)
- Exp 367–368: South China Sea Rifted Margin (planned for FY17)

Table 6.1 GeoPRISMS related IODP expeditions

accomplished only in the past six years. The Expeditions listed in Table 6.1 have directly addressed MARGINS- and GeoPRISMS-related scientific questions.

Although few of these expeditions visited or will visit the selected GeoPRISMS primary sites, they serve the thematic studies component of the program very well, providing valuable comparative observations to the chosen primary sites. As results are obtained from offshore studies in the primary sites, we can anticipate new GeoPRISMS-inspired IODP proposals to be submitted.

6.4 Geohazards and GeoPRISMS

GeoPRISMS focus on continental margin processes leads to a direct relationship to improved understanding of geohazards, including the effects of climate change, slope processes and stability, as well as earthquake and volcano hazards. Several research efforts are directly designed to address such questions, including the Cascadia Initiative (CI) and the iMUSH project. The CI is an onshore/offshore seismic and geodetic experiment that takes advantage of the Amphibious Array to study questions ranging from megathrust earthquakes and volcanic arc structure and processes. The CI was highlighted in Vice President Biden’s list of “100 Recovery Act Projects that are Changing America” under the heading “Research to Avert Disaster: Understanding Earthquakes in the Pacific Northwest – Oregon, Washington, Northern California”. Several projects are characterizing the eruptive history and volcanic products of Cascade and Aleutian volcanoes, contributing to our understanding of volcanic hazards in both settings. The iMUSH project is focused on clarifying the internal structure of Mount St. Helens, which erupted catastrophically in 1980 and continues to be the most active volcano in the lower 48 US states. GeoPRISMS related projects underway or planned in the Alaska-Aleutians and New Zealand primary sites also directly address subduction zone geohazards, guided by the scientific questions outlined in the GeoPRISMS Science and Implementation Plans. In both Cascadia and Alaska-Aleutians, close collaborations with USGS scientists ensure that GeoPRISMS results are put to best use in mitigating earthquake and volcanic hazards in the US.

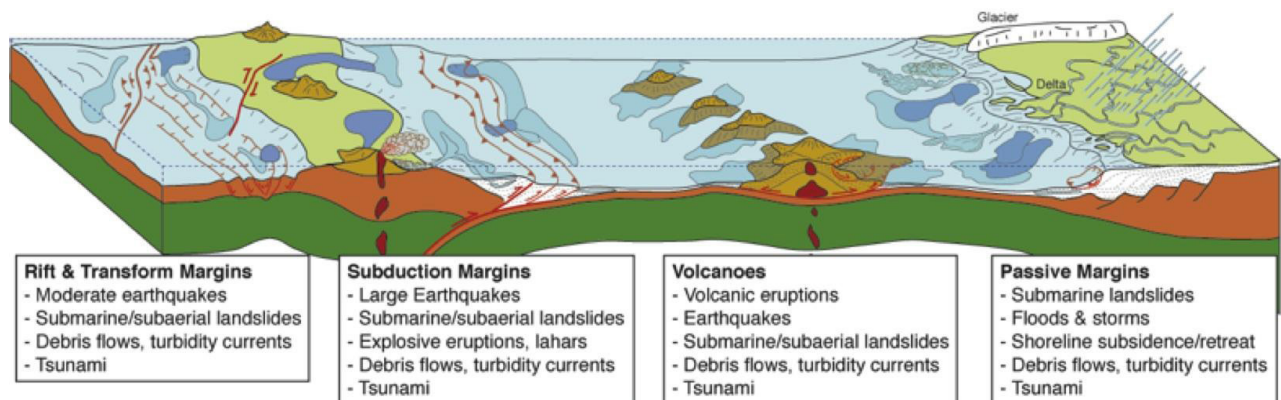


Figure 6.3. Representative geohazards that can originate along continental and volcanic margins. (from GeoPRISMS Draft Science Plan, modified from Morgan et al. (2009).

Research within the RIE initiative also addresses geohazards at rifted margins. In particular, the ENAM community seismic experiment yielded a rich trove of MCS data imaging sedimentary strata on the shallow continental margin, which also record large prehistoric landslides. Analysis of these data will allow improved assessments of slope stability in these settings, as well as the mechanisms of erosion, transport, and transfer of sediments across the shoreline, and their storage in the marine setting. In the EARS primary site, analysis of the unusual Malawi earthquake sequence has yielded new interpretations about the distribution of active faults in the rift valley, with significant implications for local earthquake hazards (see nugget by Gaherty).

6.5 Energy and Economic Resources

An improved understanding of continental margins will have a substantial impact on our access to and utilization of resources, including water, habitat and in particular, energy and mineral resources. Upon the recommendation of the DRC, Lori Summa (ExxonMobil) joined the GSOC as a representative of the oil and gas industry, providing valuable perspectives on the connections between GeoPRISMS research and economic objectives. Several of the planning workshops, in particular for ENAM and EARS, drew other industry representatives, including participants from African oil and mining companies. The ENAM community seismic experiment continues to be of great interest to companies keen to understand energy resources buried along this ancient passive margin, although efforts to expand the data collection through industry investments were unsuccessful. The open-access nature of the acquired data of course allows for both academic and commercial use. Seismic reflection and heat flow studies along the SCD primary site margins also better image hydrate deposits which allows for a better understanding of the causes and consequences of climate change.

Global mineral exploration may benefit from ongoing research at active convergent and rifting margins, focused on understanding the origin and evolution of mantle, crust, and fluids in subduction zones at many scales, goals that figure prominently in GeoPRISMS. Further partnerships are anticipated in association with EARS and ENAM studies, and possibly at the three SCD primary sites.

6.6 Human Resource Development and Outreach to Local Communities

The GeoPRISMS Office and broader community engage in many education and outreach activities that contribute directly to the training of graduate students and postdocs as described in Chapter 5. Another contribution to human resource development arises from engagement with local communities, in particular, in areas where residents otherwise may have few resources or limited exposure to the science that impacts their daily lives.

A few examples include: 1) field activities in Alaska during the 2011 survey of the Alaska Megathrust (by PIs Shillington, Keranen and others) provided unique opportunities to engage residents and school children in smaller communities during placement and recovery of instruments; 2) the Malawi earthquake study (see nugget by Gaherty) led to the installation of a local seismic network and involved on-site training of African scientists who will use it; 3) the large number of African scientists and students that attended the EARS Planning Workshop in 2012, fostering new collaborations that can help to develop scientific resources in Africa; 4) the MAGIC experiment, taking place in the eastern US, is inviting local college students to participate in geophysical field activities, giving them exposure to research experiences that may guide them into geoscience careers; and 5) the participation by GeoPRISMS scientists in the EarthScope-hosted Interpretative Workshops for Eastern North America and Alaska that provide outreach to professionals in museums and national or state parks who interpret science for school children or the general public.