1. GeoPRISMS as a decadal program

1.1 Introduction - GeoPRISMS Objectives, Goals and Approach

GeoPRISMS (Geodynamic Processes at RIfting and Subducting MarginS) is the successor to the NSF MARGINS Program. GeoPRISMS was established in 2010 to guide a decade of community-driven and interdisciplinary research on the origin and evolution of, and active processes occurring at, continental margins. The primary goal of the GeoPRISMS Program is to develop a fundamental understanding of these shoreline-crossing systems and their importance in global Earth processes, resource distribution, and geohazards. GeoPRISMS research uses a wide range of broadly integrative approaches that include large marine and terrestrial field campaigns, along with experimental and modeling studies. GeoPRISMS also provides a strong scientific basis for the utilization of major NSF and related infrastructural investments and for leveraging US and international collaborations. Finally, the program continues to build and educate a broad research community intended to elevate continental margin studies to a new level.

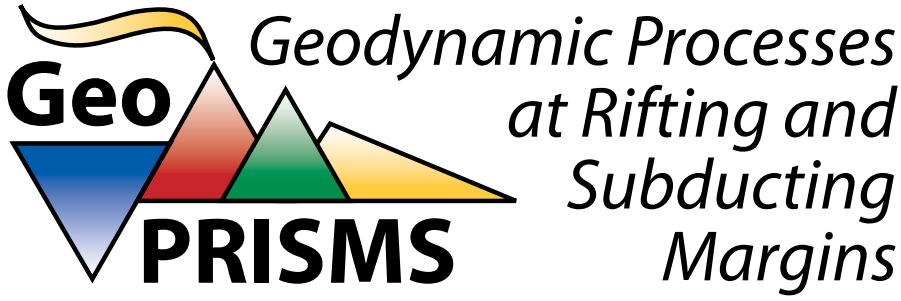

Figure 1.1. The GeoPRISMS logo incorporates the main surficial expressions of the domains that we study: rifted margins and sedimentary basins, volcanic arcs, continental dynamics and accretionary prisms

1.2 GeoPRISMS History

The predecessor MARGINS Program initiated the community-based approach to shoreline-crossing science focused on understanding the origin and evolution of the continents through the investigation of their active margins. The MARGINS Program was divided into four major initiatives, each of which supported one or two Focus Sites. The Initiatives and their respective Focus Sites were:

RCL - Rupturing Continental Lithosphere (Gulf of California/Salton Trough)

S2S - Sediment Source to Sink (Waipaoa NZ; Fly River/Gulf of Papua)

SEIZE - the Seismogenic Zone Experiment (Nankai; Central America)

SubFac - the Subduction Factory (Izu-Bonin-Mariana; Central America)

The four MARGINS Initiatives resulted in some profound scientific successes. The major highlights from each of the Initiatives and the program as a whole were summarized in preparation for the MARGINS Decadal Review in 2009. An external committee was appointed by NSF to provide a review of the program in its entirety, including science goals and accomplishments, program management, and broader impacts. The Decadal Review Committee (DRC) chaired by Prof. Anthony Watts from Oxford University was asked to evaluate progress to date and to weigh the plans and promise for the future. It was also asked to provide comments and recommendations to NSF, as well as advice on the potential structure of a successor program. The DRC met in February 2009 to carry out this review. The full set of documents related to the review (including recommendation and responses by steering committee and NSF) are available from the MARGINS website.

The DRC review of the program was highly favorable. It recognized the success of several core approaches of the MARGINS Program, including the broad approach to community building, the importance of amphibious science to address MARGINS scientific questions, the use of Focus Sites to concentrate resources, the added value in cultivating international partnerships, and the importance of integrating computational and experimental research with field observations. The DRC also recognized that such activities could not have succeeded without a science program with funds sequestered from core funding. The committee offered a strong recommendation that NSF support a successor program that would build upon the strengths of MARGINS. As summarized from the DRC report, the primary recommendations of the MARGINS Decadal Review Committee included:

1. NSF should set up a new themed program to follow on from the existing MARGINS program;
2. The new program should not be restricted to active margins, but should also address passive margins to understand how these margins are formed;
3. The new program should maintain the focus site concept, but be flexible to allow the old sites to be wound down and new ones brought in as the science dictates;
4. Two initiatives should be defined, with one encompassing the MARGINS SEIZE and SubFac Initiatives, and the second encompassing rifts and sediments;
5. The S2S Initiative should not be continued as a stand-alone initiative, but rather the appropriate aspects of sedimentology and stratigraphy should be incorporated explicitly within the other initiatives;
6. Large-scale computer modeling, laboratory experimental studies, and studies of margin analogues in the rock record should continue as important elements of the new program;
7. The program should continue to work productively with other large-scale NSF facilities, such as EarthScope, OOI, IODP, and the R/V Marcus Langseth;
8. The new program should highlight links with societal issues such as climate, sea-level and environmental change, geo-hazards, energy and resources;
9. A new Steering and Oversight Committee should be set up to manage the new program and should include representatives of industry and state/national surveys;

10. The Distinguished Lectureship Program should be expanded to include highly visible and recorded lectures at public, academic, and international institutions;
11. The current 5-year review timescale of MARGINS should be retained in the new program.

The MSC response laid out the broad vision of a new decadal program that has now led to GeoPRISMS. The NSF accepted the DRC report in principle and charged the MARGINS Steering Committee to engage the broader geosciences community to plan the future directions of MARGINS research. An open community workshop was organized Feb 15-17, 2010 in San Antonio for this purpose and had an attendance of more than 200. This MARGINS Successor Planning Workshop (MSPW) was designed specifically to:

- Identify compelling science issues that the community would like to see addressed in a possible successor program;
- Decide whether to implement thematic vs. "focus-site" approaches and to consider the pros and cons of either;
- Establish stronger linkages between Earth and ocean sciences for even stronger partnership between EAR and OCE;
- Further justify the need for a special program with sequestered funding in the context of the proposed science;
- Develop a draft Science Plan for consideration by NSF for authorization of a successor program.

The major product of the planning workshop is the Draft Science Plan (DSP), which incorporated substantial community input and feedback. The DSP was submitted to NSF in April 2010. It provides an outline of future science directions, justifications for a renewal program, and a summary of how such a program would be implemented.

Figure 1.2. The MARGINS Successor Workshop participants in front of the Alamo in San Antonio, TX.

Following the recommendations of the DRC, GeoPRISMS was structured to maintain the focus of its predecessor on subducting and rifting margins. The initiatives were designed to approach the margins as coupled systems with rethought and updated scientific questions. Research efforts were organized around several fundamental scientific questions that would have the highest potential of achieving transformative breakthroughs on a decadal time scale. The new program followed the MARGINS emphasis on interdisciplinary inquiry and shoreline-crossing science. The plans for GeoPRISMS built upon the progress and community building of MARGINS, but expanded the scope to focus on several new problems and processes. New researchers from a wider range of disciplines were to be attracted into research collaborations to investigate processes that take place at the Earth's surface, as well as within the crust and mantle, to better understand how these intertwined systems drive each other in space and time. New tools and new facilities would be exploited as much as possible to drive transformative breakthroughs. New discoveries of the last few years would feature prominently in science goals. The guiding goals for GeoPRISMS include:

- Address complex coupled systems through an integrated approach, combining field research in structure and tectonics, marine geology, geomorphology, geochemistry, geophysics, sedimentology, stratigraphy, and satellite-based methods, but also with a sound basis in experimental, analytical and numerical modeling investigations;
- Involve large amphibious field programs as well as smaller focused field and lab-based studies;
- Be guided by overarching themes that span the initiatives and address the coupled geodynamic, surficial, and climatic processes that build and modify continental margins over a wide range of timescales (from seconds to millions of years);
- Develop comprehensive systems-based models to understand margin evolution and dynamics, the construction of stratigraphic architecture, and the implications for the accumulation of economic resources, associated geologic hazards, climate change and environmental management.

GeoPRISMS consists of two broad Initiatives: Subduction Cycles and Deformation (SCD) and Rift Initiation and Evolution (RIE). The SCD initiative integrated the MARGINS SEIZE and SubFac initiatives following the growing recognition during MARGINS that the two systems are tightly linked and respond to many of the same forcing functions. Sedimentary processes are also embraced within this initiative. The RIE Initiative encompasses the former RCL and aspects of the Source to Sink Initiatives. RIE objectives are expanded to include the study of passive margins as archives of the entire history of rift zone construction and evolution, with direct relevance to understanding both mineral and petroleum resources. These tectonically defined initiatives were linked through five overarching science themes, demonstrating the commonality of the continental margin processes:

- Origin and Evolution of Continental Crust
- Fluids, Melts and Their Interactions
- Tectonic-Sediment-Climate Interactions
- Geochemical Cycles
- Plate Boundary Deformation and Geodynamics

Following the DRC and MSPW recommendations, GeoPRISMS reached beyond MARGINS in several novel directions:

- Explicit inclusion of surface processes (e.g., climate modulated weathering, erosion, sediment dispersion, and deposition) and their feedbacks in the evolution of continental margins;
- Consideration of inactive and potentially exhumed margins, where a process has gone to completion or where observations of deeper systems can be made in the field;
- Implementation of science objectives by way of a "hybrid" approach, merging focus-site studies with a more flexible thematic approach to enable detailed study of a process or system where best expressed, as well as global comparisons to establish the significance of focused observations, or their fit into a temporal framework;
- Close relationships with many new major facilities now in operation to maximize their scientific return, including increased attention on US-based facilities such as EarthScope and the Cascadia Initiative;
- Expanded relevance of GeoPRISMS research to issues with direct societal impact, including accumulation of economic resources, understanding geologic hazards, and managing coastal development;
- Broadened educational and outreach programs to engage the new generation of scientists into exciting continental margins science.

1.3 Initiative Structure and Primary Sites

Subduction Cycles and Deformation (SCD) addresses coupled processes active at subducting margins and explores linkages among them. The regions of interest span from the updip limits of the accretionary wedge and incoming plate to the deep mantle and plate boundary interface. It focuses on the cycling of fluids and volatiles, their role in rheology, melting, and magmatism, and ultimately the arc processes that lead to the growth of continental crust. This initiative formalizes the strong linkages between SEIZE and SubFac recognized during MARGINS. It facilitates the interdisciplinary exchange of knowledge within the subduction zone community, enabling transformative discoveries of this highly coupled system.

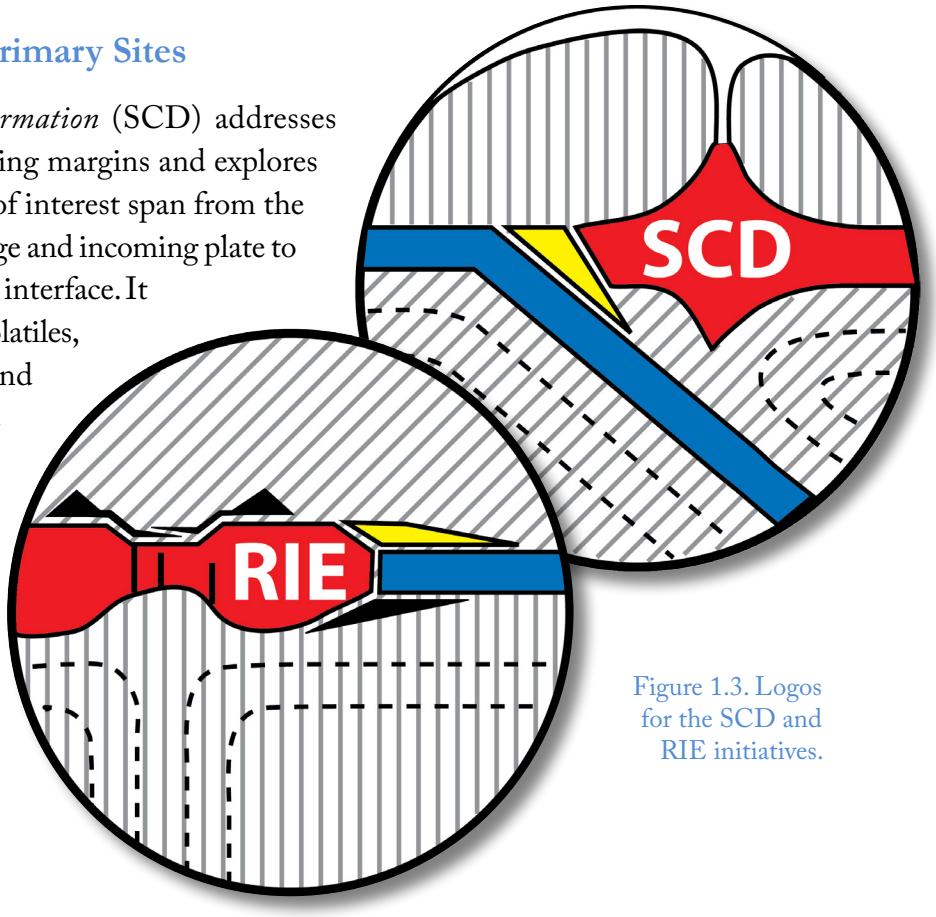

Figure 1.3. Logos for the SCD and RIE initiatives.

Rift Initiation and Evolution (RIE) focuses on the fundamental processes active within rifts and rifted margins, from the initial localization of continental rupture, the structural, magmatic, and sedimentary processes that control the growth of rift zones, through the late stages of rifting and the transition to oceanic spreading, and the resulting stratigraphic and tectonic architecture of passive margins. This initiative emphasizes the interactions between climate, erosion, and sediment transport and deposition, and includes the dynamics of plate boundary deformation to gain a comprehensive understanding of lithospheric evolution along rifted margins

Both GeoPRISMS initiatives embrace the interconnectedness among surface, tectonic, and magmatic processes, addressing the complex interactions and feedbacks induced by climate, erosion, sediment transport, and deposition in controlling continental margins dynamics, crustal growth, fault mechanics, volatile flux, and magmatic activity. This approach serves to enhance collaborations between marine and terrestrial geologists and geophysicists and helps to build stronger partnerships across NSF divisions. The new initiatives engage interdisciplinary teams carrying out observational, experimental, and modeling studies to address their fundamental questions. The proposed studies have both basic and applied value and provide unique opportunities to build an educated workforce, the next generation of GeoPRISMS scientists, and new knowledge on subjects of great importance to the broader public.

Refinement of the Initiatives was carried out through two community workshops, held in late 2010 (RIE) and early 2011 (SCD). Each was attended by more than 120 participants. At these workshops the community prioritized the scientific goals of the initiative, selected Primary Sites at which major research efforts would be concentrated, identified immediate and long-term research needs, opportunities, and strategies for these sites, and outlined thematic studies to complement and integrate GeoPRISMS primary site and MARGINS focus site investigations.

Three primary sites were selected for SCD. These are in order of priority: Alaska (including the southern mainland and extension into the Aleutian Islands), Cascadia, and New Zealand. We will refer to the first primary site as Alaska-Aleutians or AA in the remainder of this document. These three sites offer tremendous potential to address major questions about subduction earthquake and fault slip processes in societally critical settings. They allow investigators to carry out comparative studies of deep-seated interactions that drive volatile release and magmatic processes to build the continents. The three sites provided immediate and long-term opportunities to leverage recent and upcoming investments in infrastructure, through EarthScope and the Cascadia Initiative at the US sites, and through collaborations with international researchers, particularly in New Zealand but also by continuing work at MARGINS focus and ancillary sites.

Five process-based themes were identified within SCD that require broader research approaches than can be achieved at the primary sites. Such thematic studies are fundamental to constrain and contextualize observations made at the primary sites and will enable complementary global geochronological, petrological, structural, and geochemical studies, in addition to laboratory experiments and computational modeling efforts.

The five themes are:

- Theme 1: Identifying controls on fault slip behavior and deformation history
- Theme 2: Understanding mantle wedge dynamics
- Theme 3: Fore-arc to back-arc volatile fluxes
- Theme 4: Physical and chemical conditions and processes at depth
- Theme 5: Subduction initiation

Two primary sites were selected for RIE investigations: the active East African Rift System (EARS), which exhibits the entire history of continental rupture, and the fully developed Eastern North American Margin (ENAM), which preserves an extensive post-rift evolution. Both systems also exhibit variations in the degree of magmatic activity along strike and span a north-south climatic gradient with resulting diversity in sediment flux and tectonic-climate interactions. Research at the ENAM site can leverage considerable US infrastructure investments, including EarthScope and the Extended Continental Shelf surveys being carried out by the USGS. The selection of these two sites introduces a new approach for carrying out amphibious studies, where a mostly offshore system is paired with a mostly onshore system, to enable broadly integrated comparisons of the earliest and latest stages of rifting. This exciting approach should lead to strong interactions between marine and terrestrial researchers interested in rift initiation and evolution.

Five thematic studies were identified within RIE to address the influence of parameters poorly represented at the two primary sites. These investigations, intended to be complementary but subsidiary to primary site studies, enable diverse comparative field, experimental, and numerical investigations and build upon results of past MARGINS studies. The five themes are:

- Theme 1: Rift obliquity
- Theme 2: Rift processes as functions of strain rate
- Theme 3: Volatiles in rift zone processes
- Theme 4: Sediment production, routing and transport during and after rifting
- Theme 5: Discrete events at rifted margins

The GeoPRISMS Implementation Plan was fleshed out progressively, following community planning workshops for each Primary Site. These workshops took place between 2011 and 2013. The workshops were timed to reflect both the community prioritization and timeliness within the initiatives and to take advantage of joint organization with partner organizations such as EarthScope. The outcomes of these planning and implementation meetings included community identification of key research questions and potential targets within each primary site, research strategies and partnering opportunities in each location, and specific broader impacts. All GeoPRISMS documents were released for public comment and comments received were incorporated into the documents. Additional opportunities continue to be provided for community refinement of the implementation plans through GeoPRISMS Mini-Workshops held during annual AGU Meetings and through

smaller discussions in association with other national meetings (such as those of EarthScope). These inexpensive gatherings offer opportunities to disseminate preliminary results (e.g., Cascadia), and to define specific research approaches (e.g., Aleutians platform), develop new collaborative projects, strengthen integrative research (e.g., CSDMS Geodynamics Focused Research Group), and reach out to the broader scientific community, including early career investigators. The resulting Implementation Plans, finalized in December 2013, also lay out potential experimental and modeling approaches to further the goals of the initiative, and outline tentative synthesis and integration plans for each initiative.

As a consequence we can report that the GeoPRISMS Science and Implementation Plans were developed through significant community input obtained during the planning workshops, along with several mini-workshops or breakout sessions hosted during other national meetings (e.g., AGU, IRIS, EarthScope, etc.). The three North American Primary Site workshops were co-sponsored by EarthScope, providing a valuable bridge between two focused NSF programs, where their science priorities overlap. In this way, GeoPRISMS is able to leverage the onshore infrastructure provided by EarthScope, as recommended by the DRC.

2010	MARGINS Successor Planning Workshop - San Antonio, TX
	RIE Implementation Workshop - Santa Fe, NM
2011	SCD Implementation Workshop - Bastrop, TX
	Alaska-Aleutians Planning Workshop - Portland, OR (joint w/ EarthScope)
	Eastern North American Margin Planning Workshop - Bethlehem, PA (joint w/EarthScope)
2012	Cascadia Planning Workshop - Portland OR (joint w/ EarthScope)
	East Africa Rift System Planning Workshop - Morristown NJ
2013	New Zealand Planning Workshop - Wellington, New Zealand

Table 1.1. Dates and locations of the eight main workshops that helped define the GeoPRISMS Science and Implementation plans

1.4 Summary of funding and accomplishments since last review

The MARGINS Program was officially concluded on September 30, 2010, at which time the community definition of the successor GeoPRISMS Program was well underway. As a consequence, we have counted projects funded in FY11 and later to be part of GeoPRISMS even though an annotated NSF-MARGINS solicitation was used through FY12 (see for example the NSF announcement in the Spring 2011 newsletter). The first formal GeoPRISMS Program solicitation was for projects in FY13 (NSF 12-537). This call for proposals has since been replaced by NSF14-556 and the current NSF15-564.

Due to the necessary ramp-up time, the timeframe for GeoPRISMS-funded research funded starting in FY11 is relatively short. A significant number of projects addressing high priority science have begun, but we cannot expect the research products to be as well developed as they were for MARGINS-funded project at the time of the Decadal Review. We summarize significant scientific advances and details of ongoing field projects in the next two chapters. Given the transition from MARGINS to GeoPRISMS, and their overlap in scope, we also include the scientific advances of MARGINS projects reported from 2009 onwards in some of our analysis and description. We make a clear distinction between GeoPRISMS- and MARGINS-funded research throughout.

The fiscal crisis of the late 2000s and the current sequestration of NSF have had significant impact on the amount of science funding that is made available to GeoPRISMS. For reference, funding levels in MARGINS before the 2009 review were around $5M-$6M per year. The America Recovery and Reinvestment of 2009 (ARRA) provided a pulse of funding to MARGINS. Perhaps the biggest impact of ARRA on the Program was the $10M (split equally between EAR and OCE) invested in developing the Cascadia Initiative Amphibious Array, which directly supports GeoPRISMS research and will continue to do so for years to come. Additional ARRA funding was provided to specific MARGINS projects in FY09, as indicated in the list of funded projects in Appendix A1. Funding for FY10 was initially expected to stay stable at approximately $6M/yr, but this was revised downward to $5M/yr in 2012. We saw significant budget reductions following the federal sequestration orders starting in FY13. The current budget for projects within GeoPRISMS is about $3.5M/yr, representing a reduction of nearly 40% from that at the beginning of the decade.

We note that the $3.5M/yr stated above should be seen as a nominal minimum for actual funding to projects. The GeoPRISMS projects directly benefit from ship time that is awarded separately from GeoPRISMS grants. Similarly, projects benefit from significant investments in IRIS, UNAVCO, PASSCAL, etc. We also wish to highlight the important logistical support that is sponsored by NSF following community requests for Aleutian research (Jicha et al., 2014). This support, formalized in Spring 2014, has provided a ship with helicopter support for two field seasons (the first of which is underway as we write this document). We also note that a number of projects in the North American primary sites have been funded jointly by EarthScope and GeoPRISMS. EarthScope also independently supports projects of relevance to GeoPRISMS objectives.

Even at the initial estimated budget level of $6M/yr, it was evident to NSF and the community that it would be difficult to accommodate large field experiments (such as active or passive seismology on land, seismic reflection and refraction studies at sea, or data collection requiring helicopter support) at all five primary sites at the same time. As a result NSF and the GeoPRISMS Steering and Oversight Committee (GSOC) established a phased funding approach for large experiments for the five primary sites. The 'large' here is loosely defined as having a budget of $1M or more. Cascadia was opened for proposals in FY12, Cascadia and Eastern North America competed in FY13, etc. The phased funding model was formalized in Spring 2013 (NSF 12-537) and it followed logically and fairly from the ramping up stages for Cascadia and Alaska-Aleutians in the two funding cycles before this. The table below shows the current implementation of the phased funding. The choice to use

windows of opportunity of two (rather than three) years per primary site was dictated by the decadal time scale and by the community's choice to have five primary sites. The full impact of the phased funding model will need to be evaluated. There is currently no firm plan for the remaining years in this decadal program. We expect that NSF and the community, with facilitation of the GSOC, will initiate the discussion on these matters in the near future.

Fiscal Year	FY12	FY13	FY14	FY15	FY16	FY17
Proposal deadline	July 11	Jul 12	Jul 13	Aug 14	Jul 15	
	CAS	CAS				
		ENAM	ENAM			
			AA	AA		
				EARS	EARS	
					NZ	NZ

Table 1.2. Phased funding plan for the five primary sites

During FY11-FY15 37 projects (with 91 PIs) were awarded. We provide a more detailed analysis of the awarded grants and the comparison between GeoPRISMS- and MARGINS-funded projects in Chapter 4.

With the initial phase of GeoPRISMS projects starting only about four years ago we cannot expect that the program's effectiveness can be fully measured by the number of publications or data products. Publications are beginning to appear for the Cascadia and Eastern North America primary site, but research that depends on large field projects at the other primary sites has been limited by the phased funding model. This applies in certain ways still also to Cascadia and Eastern North America, where significant data collection and analysis are still underway (such as in the iMUSH project and the ENAM community science experiment). Most Alaska-Aleutians projects have only been initiated recently. The window of submitting proposals for large projects in East Africa and New Zealand has only just opened. To represent the scope of GeoPRISMS science to date we asked the community to contribute 'science nuggets,' which provide short descriptions of funded projects that may have been completed or are still ongoing. We directly contacted all PIs of projects that were funded during GeoPRISMS (FY11-15) and during the last two years of MARGINS (FY09-10). We received 62 nuggets (35 from GeoPRISMS-funded work; 21 from late-MARGINS-funded work, along with 6 from closely related NSF-funded projects). Out of the 63 projects funded in FY09-15, nuggets were received from at least one PI for 49 projects (78%). This high response rate indicates to us the strong buy-in that PIs have in the GeoPRISMS program and its community effort. The nuggets are provided in Appendix B.

Although we noted that GeoPRISMS research productivity is as yet difficult to measure directly by numbers of scientific articles, it is instructive to list the numbers and to compare the first

few years of GeoPRISMS-funded research activity with that of MARGINS. In Figure 1.4 we show the number of papers that were directly funded by MARGINS and by GeoPRISMS. We only include papers that were cited by the authors in the public final or annual reports published on nsf.gov (which are certainly not complete), were provided by the PIs in the nuggets, or had GeoPRISMS funding explicitly acknowledged in the paper (e.g., by providing the NSF award number). The GeoPRISMS-funded publications are listed in Appendix A3. The MARGINS-funded publications since last review (2009) are listed in Appendix A4. We also counted papers that we deem to be GeoPRISMS-related. These are papers written by PIs who have been funded by MARGINS or GeoPRISMS on topics that are closely related to the science objectives but do not explicitly mention MARGINS or GeoPRISMS funding. We found 349 citations starting in 2011; this is likely a rather large underestimate, but still clearly indicates that the GeoPRISMS science community is very active and productive.

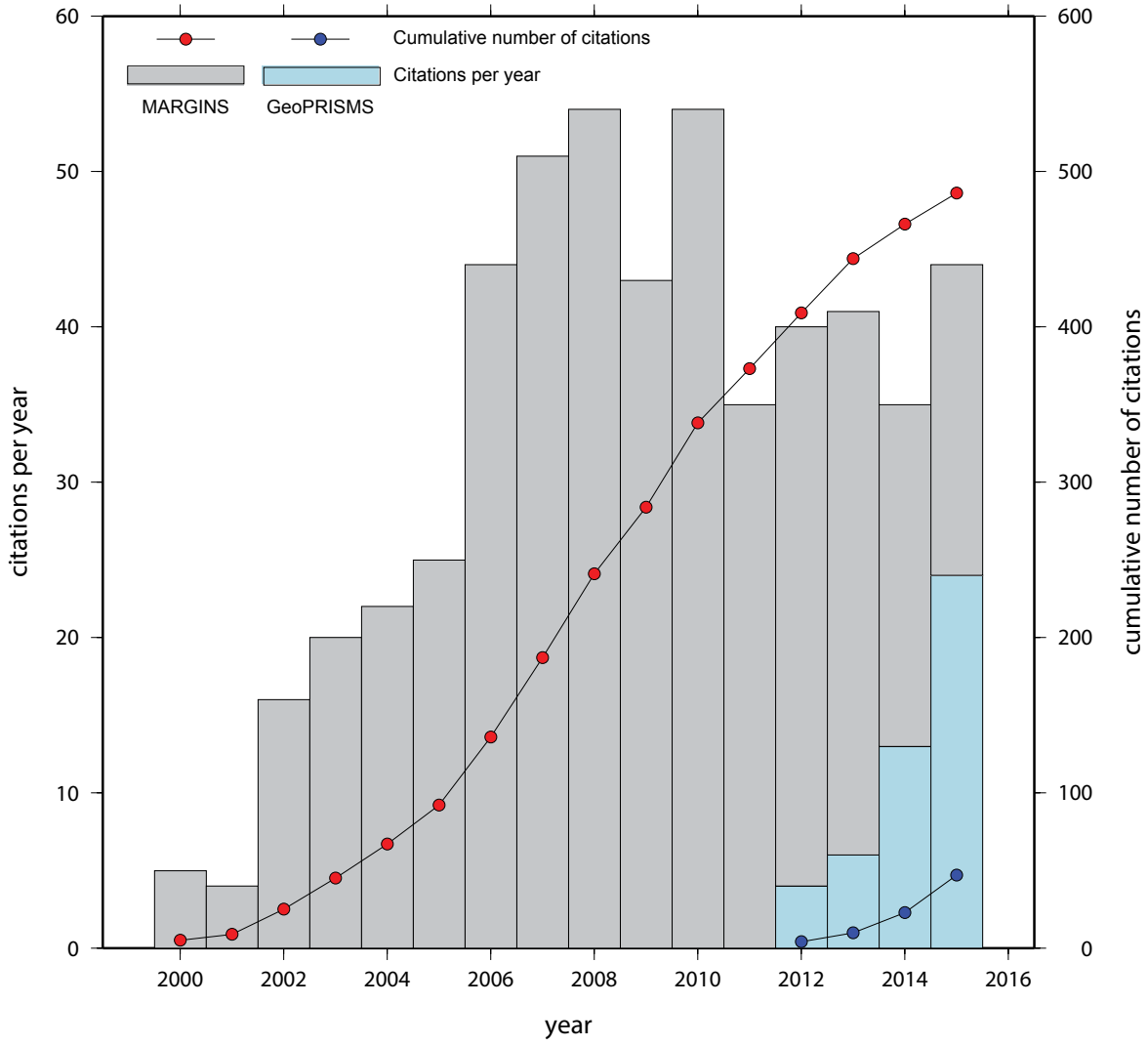

Figure 1.4. Graph of MARGINS/GeoPRISMS funded research papers since 2000. For 2015 we extrapolated the numbers to date to the end of the year. For 2011-2015 we have an average of 70 citations per year for work that is related to GeoPRISMS science objectives, but not explicitly funded by it.

1.5 Community Building

As part of its mission to enhance interdisciplinary science, GeoPRISMS has made a concerted effort to broaden the scientific base of its research community, enabling deeper integration across the initiatives and themes. One demonstration of this is the cumulative workshop attendance during the formative years of the program. To date GeoPRISMS planning workshops have drawn 1050 participants (680 unique individuals). About 65% of these had not attended a MARGINS meeting. The Distinguished Lecturer Program has brought GeoPRISMS speakers to a combined attendance of more than 7000 people. The AGU mini-workshops have been attended by more than 700 individuals. We will provide further details and a comparison with MARGINS in Chapter 4.

Figure 1.5. Fifteen countries were represented at the Planning Workshop for the East African Rift System Primary Site held in Morristown, New Jersey in October 2012. Image made with Google Maps.

The list of funded projects (Appendix A1) also indicates the strong interdisciplinary and collaborative nature of late MARGINS and early GeoPRISMS research. A significant portion (27%) of GeoPRISMS-funded projects are interdisciplinary (defined as having PIs with significantly different observational approaches, or where observational work is combined with theoretical and/or experimental work). Almost 50% of these projects are collaborative (defined by having PIs from multiple institutions).

The GeoPRISMS community has strongly supported the goal to entrain early career investigators (students, postdocs, assistant researchers, and pre-tenure faculty) into the program in a meaningful way. We have actively engaged the early career community as the source of fresh ideas

and the practitioners of next generation science, both in the planning process and in submitting research proposals. We have implemented this by including student and postdoc symposia at planning meetings, engaging early-career investigators as scribes and discussion leaders during break-out sessions, providing preferred travel support to graduate students and postdocs, and including early-career scientists as keynote and invited speakers at workshops. Graduate students have made up 15-20% of the attendees of GeoPRISMS workshops (further discussed in Chapter 4). We think that this approach over the long-term leads to a more balanced group of investigators, where GeoPRISMS science is done by junior and senior investigators alike. A further indication of the buy-in of new investigators into the GeoPRISMS community is that 23% of the PIs in GeoPRISMS-funded projects are early-career (Appendix A1).

Figure 1.6. Participants of the Planning Workshop for the East African Rift System. Photo credit: Anaïs Férot, GeoPRISMS.

The community basis of scientific decision making within the program has allowed GeoPRISMS to lead the way in defining and carrying out community experiments and community expeditions. The Cascadia Initiative, an onshore-offshore geophysical and geodetic project funded by NSF and designed to address MARGINS/GeoPRISMS and EarthScope scientific goals, represents an early implementation of this approach. Grassroots efforts to acquire seismic reflection and refraction data

Figure 1.7. GeoPRISMS funding supports the multi-disciplinary iMUSH (imaging Magma Under St Helens) project which is the first of its kind in the US to image a volcano from top to bottom (photo credit: Anaïs Férot).

across the Eastern North American Margin (ENAM) led to the successful ENAM community seismic experiment in 2014-2015. Both experiments are characterized by substantial community input into the planning process, broad participation in data gathering, and open data access. This allows any and all to work with the resulting data and to seek grants to support those activities. A related approach to enable broader community access to GeoPRISMS research opportunities is through community resources such as the shared logistical support for remote field studies in the Aleutians that NSF is sponsoring this year and next. In all such cases this kind of approach enable larger groups of people to benefit quickly from the data or research platforms. The shared use by a broader community will maximize their scientific impact. This approach also facilitates the involvement and training of junior scientists and students. Future opportunities of this kind will be pursued where feasible.

1.6 Justification for a stand-alone program

Strong arguments have been made previously to maintain GeoPRISMS as a focused program and with funding that is sequestered from NSF core programs. We reiterate these here to establish their role in the recent program accomplishments. In particular, the extraordinary cross-disciplinary nature of MARGINS and GeoPRISMS science must attract geoscientists who can work in teams that span the traditional NSF divisions. Continental margin processes and GeoPRISMS science objectives span the shoreline, which requires bridging the traditional and substantial divisional boundary between EAR and OCE. GeoPRISMS is one of the few programs that crosses internal GEO boundaries by leveraging strong interdisciplinary research teams and pooled NSF funding.

Fulfilling the GeoPRISMS vision requires:

- The combination and integration of on-land and marine investigations and resources to fully capture processes and products that cross the shoreline.
- Strong interdisciplinary research teams that are able to bring diverse perspectives and expertise to bear on understanding the complex interplay of continental margins processes.
- Guidance from a cogent Science Plan, detailing major projects and approaches to address clear scientific objectives vetted by the community.
- An interdisciplinary NSF panel able to evaluate the breadth and scope of GeoPRISMS science proposals, and in particular, synthesis activities that may span a broad range of data sets and research techniques, including experimental and/or theoretical studies.
- A well-informed scientific community, conversant in the wide range of geological phenomena that govern continental margin processes. Such a community is an outgrowth of coordinated efforts to enhance communication, education, and knowledge exchange, through workshops, newsletters, and websites.
- Coordinated efforts to disseminate the significance and relevance of GeoPRISMS science and its impact on understanding geohazards and economic resources to the broader community, including students, the public, and policy makers. A focused and managed program overseen by the program office facilitates such efforts beyond the abilities of individual PIs.

GeoPRISMS engages and leverages a wide range of partnerships and provides access to major infrastructure facilities to the broader community. The program maintains well-established channels for data archiving and access, data and information dissemination, and general communication, which serve numerous individual research projects. The program and Office also define a clear focal point for broad education and outreach efforts. All of these efforts are most efficiently managed and coordinated within a focused program, by an active Office and steering committee.

While we consider it essential to use sequestered funds to allow for interdisciplinary, shoreline crossing research and NSF division bridging research, there is an explicit understanding that this funding should go towards funding of competitive proposals that address community-wide objectives at selected primary sites, along with a smaller number of thematic studies and postdoctoral fellowships. Prospective PIs have always been encouraged (through the newsletter, listserv announcements, and the GeoPRISMS Townhall) to throw a wide funding net and consider core funding or special programs within the GEO Directorate for GeoPRISMS-related science projects. The funding footprint for GeoPRISMS-related science is large and can easily be seen by browsing the CVs of PIs or the NSF awards pages. OCE Program Manager Donna Blackman provided a concrete example for the NSF presentation at the 2014 AGU Townhall. In FY11-FY14 15 projects were funded out of MGG core that directly addressed science objectives at GeoPRISMS primary sites. A further 15 MGG funded projects addressed MARGINS and GeoPRISMS science objectives outside of these primary sites. A similar comparison by EAR Program Manager Jennifer Wade provided a total of 61 EAR-funded projects in FY11-15 that address GeoPRISMS science objectives, including 16 at CAS, 9 at AA, 8 at NZ, 7 at EARS and 4 at ENAM. Some of the OCE and EAR core grants are extensions of work funded during MARGINS or provide support to infrastructure that GeoPRISMS researchers benefit from.

In the remainder of this document we provide a detailed description of GeoPRISMS activities and their impact. In Chapter 2 we describe research projects and activities that are underway in the SCD initiative. In Chapter 3 we do the same for the RIE initiatives. A more detailed breakdown of funding provided through GeoPRISMS and the GeoPRISMS Office activities is described in Chapter 4. The Education and Outreach activities are described in Chapter 5, followed by a discussion of impacts on other NSF sponsored and international science projects. We conclude with a brief summary and outlook. The appendices provide significant background information and metrics supporting the narrative of the document.