GeoPRISMS Newsletter

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Geodynamic Processes at Rifting and Subducting Margins

GeoPRISMS

In This Issue:

Welcome to GeoPRISMS

Julia Morgan, GeoPRISMS Steering and Oversight Committee Chair
Rice University

I am excited to introduce the inaugural issue of the GeoPRISMS Newsletter (#26 in the series that includes the MARGINS Newsletter). Over the last year, MARGINS successfully transitioned into GeoPRISMS, and the program is off to a running start. The first GeoPRISMS Office opened at Rice University last October, as the last MARGINS Office closed its doors at Lamont Doherty Earth Observatory.

The genesis of GeoPRISMS was unquestionably a community effort, but it would not have been possible without the able guidance of the previous MARGINS chair, Geoff Abers, and his staff. Geoff deserves extraordinary thanks for shepherding the MARGINS Program through its decadal review, guiding the community through planning the MARGINS successor, and for smoothing a rapid program and office transition as the GeoPRISMS Office started up. Niva Ranjeet, Karen Benedetto, and Andrew Goodwillie, who staffed the MARGINS Office at Lamont, provided invaluable assistance, keeping the MARGINS Office open to ensure a gradual and graceful transition throughout the fall. Previous MARGINS Chairs Julie Morris, Garry Karner, and Brian Taylor also left their unique imprints on the MARGINS Program, and all are jointly responsible for motivating and guiding the previous decade of ground-breaking interdisciplinary research on continental margins. Things have happened very rapidly in the GeoPRISMS Office since it opened.

Three new staff members have joined the office: Alana Chapa-Sendejas – Administrative Coordinator, Charles Bopp – Science Coordinator, and Alison Henning – Education and Outreach Coordinator (see page 3 for bios). The new GeoPRISMS website is up and running (http://www.geoprisms.org), and new content and functionality is being added by the day (see page 19). The office has hosted or co-hosted two community planning workshops, and delivered the GeoPRISMS Implementation Plan to NSF. As usual, AGU kept us very busy, with the GeoPRISMS Townhall and Student Forum and the GeoPRISMS Student Prize. The Distinguished Lectureship Program has just finished its 2010-2011 season, and new speakers have been identified for the year to come. And we are now preparing for several more planning workshops that will take place within the year (see "Upcoming Meetings" on the previous

Upcoming Meetings

Apply Now!

Alaska Planning Workshop
Subduction Cycles & Deformation Primary Site
September 22-24, 2011 - Portland,OR
Application due: June 25

Earthscope – GeoPRISMS Science Workshop for Eastern North America
Rift Initiation & Evolution Primary Site
October 27 - 29, 2011 - Lehigh University
Application due: August 1

Apply online at http://www.geoprisms.org

page). I haven't heard any of the new GeoPRISMS staff complain that they are bored!

In addition, the MARGINS Steering Committee morphed into the GeoPRISMS Steering and Oversight Committee, with many members transferring with it. We sincerely thank several members who rotated off the committee after guiding us through the program transition, in particular, Mark Behn, Sue Bilek, Mike Gurnis, Demian Saffer- Thank you! And we welcome many new members to the team: Rob Evans, Peter Flemings, Brad Hacker, John Jaeger, Matt Pritchard, Susan Schwartz, Donna Shillington and Lori Summa. The GeoPRISMS Education Advisory Committee (GEAC, formerly MEAC) has also seen changes, with Jeff Ryan and Don Reed rotating off after many years of service, as Maggie Benoit and Jeff Marshall joined. I look forward to working with all of you in the years to come.

GeoPRISMS and You

What lies ahead for GeoPRISMS is a new decade of focused investigations and transformative discoveries within two integrated initiatives: Rift Initiation and Evolution (RIE) and Subduction Cycles and Deformation (SCD), with a new emphasis on US margins, i.e., Cascadia (SCD), Alaska (SCD), and the Eastern North American Margin (RIE), as well as two international locales: New Zealand (SCD) and East Africa Rift System (RIE). The two recent initiative implementation workshops (summaries on pages 5 and 8) laid the groundwork for this next decade of study, however, many decisions still remain to be made, and we ask all of you to play a role.

Over the next year or so, primary site planning workshops will take place in order to finalize the specific implementation plans for these sites. Your participation in these workshops will be critical, as the community must discuss and possibly select research corridors for more focused investigations, outline specific targets and objectives for PI-driven proposals or community experiments, and define site-specific thematic studies that will complement and complete the investigations at each primary site. The outcomes of these workshops also will guide future GeoPRISMS solicitations.

In the meantime, immediate opportunities for GeoPRISMS research exist in Cascadia. The joint ARRA-funded EarthScope-MARGINS (now GeoPRISMS) Cascadia Initiative Amphibious Array is well underway; the onshore geophysical and geodetic instrumentation is already in place and data is being collected; the offshore instruments are under construction and their deployment is imminent (page 14). In addition, both Canada and the US have made major investments in ocean observatory infrastructure that will benefit Cascadia investigators over the next decade (see NEPTUNE Canada summary, page 32; OOI activities in the US will be reviewed in upcoming issues).

In this time of uncertain funding for scientific research, GeoPRISMS researchers should also look for ways to leverage other funding sources and partnerships where interests overlap. One opportunity, justified by the cross-divisional NSF support for GeoPRISMS, is to build and grow interactions with EarthScope facilities and researchers at the North American primary sites, as has already been realized in Cascadia. Collaborations with industry partners (page 20), the USGS, and international researchers also have strong potential. In addition, the Integrated Ocean Drilling Program (IODP) is presently up for renewal, but with funding pressures, is at serious risk. IODP has played a key role in fulfilling MARGINS scientific objectives, and it is the community's desire and hope that it will continue in this capacity for GeoPRISMS.

Finally, for GeoPRISMS investigators, the first NSF GeoPRISMS solicitation is imminent (July 1, 2011 – see below), and this newsletter provides important guidance for proposers, in particular, what types of proposals will be accepted this year (page 4), how you can enhance your Broader Impacts in GeoPRISMS proposal (page 28), and what you need to know about GeoPRISMS data policy and NSF's new data management requirements and the new GeoPRISMS Data Portal (page 26). And of course, the GeoPRISMS Office is here to answer any of your questions, or to find someone who can!

NSF GeoPRISMS Proposal Deadline

July 1, 2011

FY 12 proposals will be accepted under the exisiting NSF-MARGINS solicitation.

Proposals for the FY12 competition will be accepted for the following topics:

- Data assimilation and small reconnaissance studies for all primary sites relevant to GeoPRISMS objectives
- Research projects relevant to stated GeoPRISMS objectives at Cascadia
- Synthesis and integration efforts at MARGINS focus-sites
- Workshop proposals for science or implementation at Cascadia, Alaska, or Eastern North American Margin primary sites
- Post-doctoral fellowships.

For more info visit:
http://www.geoprisms.org/research.html
http://www. nsf.gov/pubs/2007/nsf07546/nsf07546.htm

Meet the GeoPRISMS Office Staff

In October 2010, GeoPRISMS officially replaced the MARGINS Program. The first GeoPRISMS Office is hosted by the Department of Earth Science at Rice University in Houston, Texas. Rice is a private, co-educational research university founded in 1912, now serving approximately 6,000 students, and is committed to balancing strong undergraduate education with cutting-edge research. The Department of Earth Science consists of 17 full-time faculty, whose research interests span the structure and evolution of the continental lithosphere (Earth Structure and Dynamics), the past and present evolution of the Earth's climate, surface, and environment (Earth System Science), and the physics and chemistry of fluid flow and rock-fluid interactions (Environment and Energy Resources). Many of the faculty have been involved with the MARGINS program, and welcome the successor GeoPRISMS Office to campus.

Julia Morgan (Chair) conducts research focused on shallow crustal deformation at both subducting and rifted margins, and along oceanic volcanic islands. She has worked extensively on convergent margins, studying the mechanics and structural evolution of accretionary prisms and fold and thrust belts, as well as the underlying faulting and frictional processes. Juli has participated in field programs both onshore and off, and in several ocean drilling legs. Field areas have included the Nankai and Cascadia margins, the Iberia margin, the North American Cordillera, Death Valley, and the Island of Hawaii. Otherwise, she spends a great deal of her time simulating crustal deformation on very large computers. Juli has a long history of involvement with the MARGINS Program, and served on the MARGINS Steering Committee from 2003-2007. She is looking forward to leading GeoPRISMS into the next decade.

Charles Bopp (Science Coordinator) holds a PhD in Geology from the University of Illinois, and wrote his dissertation on uranium geochemistry and igneous petrology. He is also completing a MS in resource economics and has education in political science. Charles' duties in the office include managing the Distinguished Lectureship Program, maintaining the GeoPRISMS web presence, taking minutes at steering committee meetings, and managing technology at workshops and meetings. Originally from Michigan, Charles is quickly settling into life in Houston. He is a volunteer docent at the Museum of Natural Science and loves catching baseball games at Minute Maid Park, especially when the Detroit Tigers come to town.

Alison Henning (Education and Outreach Coordinator) received her BS and MA degrees in marine geophysics with a focus on the active margin off Barbados from the University of Texas in Austin, and her PhD from Rice University on the tectonics of the passive margin off Iberia. Alison has worked as a geophysicist in the oil industry and at Rice as a lecturer and research scientist. At Rice, she also directed a program that offers graduate level courses for in-service K-12 science teachers. As the E&O Coordinator, Alison is responsible for expanding the broader impacts of GeoPRISMS research.

Alana Chapa-Sendejas (Administrative Coordinator) is a native of Galveston Island. Alana has had a fascination with hurricanes and earthquakes since a young age. She studied meteorology and corporate communications at Texas Tech University. She returned to the Gulf Coast and received a BA in advertising and public relations from the University of Houston. Alana has over five years of experience in event planning and graphic design working for area non-profit organizations. Alana schedules the logistics and processes reimbursements for the six to eight GeoPRISMS workshops and meetings each year. She also serves as the graphic designer for the biannual GeoPRISMS newsletter and maintains the administrative budget of the program. Alana also serves on the board of Camp Janus, is an avid runner and loves to travel.

GeoPRISMS - An Auspicious Beginning

(plus important information about the NSF GeoPRISMS solicitation)

Billal Haq Program Director, (National Science Foundation)

Congratulations to the GeoPRISMS community for rising to the challenge and under considerable time constraints, expanding the preliminary Science Plans by detailing Implementation Plans for each of its two initiatives (Subduction Cycles and Deformation and Rift Initiation and Evolution). The Program is now ready for its first review cycle with proposals due July 1, 2011, for the competition of FY 2012 funds.

One important new element of GeoPRISMS is the recognition that to be broadly successful the Program will have to adopt a wider funding strategy that also leverages funds from Core as well as other special programs in Earth and Ocean Sciences Divisions (e.g., FESD, CD and other new initiatives where the scientific interests overlap). Limited sequestered funds allocated to GeoPRISMS also make it necessary to phase in research activities and funding at the chosen primary sites as more detailed implementation ideas are developed for individual sites and priorities are identified by community discussion. Members of the broader Earth and Ocean sciences community are encouraged to attend and contribute their ideas at the upcoming planning workshops for individual primary sites and ensure that their voices are heard during these important upstream activities (www.geoprisms.org/meetings).

It is envisaged by the Program at NSF that the specific annual budget allocated to GeoPRISMS will primarily go toward funding competitive proposals addressing community-defined scientific objectives at the selected primary sites. In addition, a smaller subset of thematic studies related to the primary site objectives will be considered as long as they relate directly to the goals and/or targets defined for the primary sites (e.g., analogs to parts of the system that cannot be accessed at the primary sites, global context for primary site observations, as well as experimental and modeling studies) and have been outlined and approved by the community in advance during primary site planning workshops. Proposals for thematic studies to be considered for sequestered Program funds must provide specific justification within these guidelines. Funding for GeoPRISMS related workshops, postdoctoral fellowships, and rapid response surveys will also continue to be considered from this source. In general, proposal solicitations in future years will follow a phased ramp-up schedule, specific for each primary site, and updated by the community during primary site planning workshops. This underscores the reason all stakeholders should attend these workshops, to ensure that their opinions are heard.

Other GeoPRISMS-related proposals (including broader thematic studies) will be welcome within Core or other special programs (i.e., where research interests overlap in the latter) within the Earth and Ocean Sciences Divisions, and should be prepared according to the criteria for those solicitation. It is advisable to discuss such proposals with the relevant program officers in advance (and if necessary, calling attention to the reasons why the proposal cannot be considered for GeoPRISMS sequestered funds according to the above guidelines).

"Members of the broader Earth and Ocean sciences community are encouraged to attend and contribute their ideas at the upcoming planning workshops…to ensure their opinions are heard."

Once again, let me remind the community, that proposals for the FY12 competition will be accepted under the existing MARGINS Program solicitation (a new program solicitation, specific to GeoPRISMS, will be coming shortly now that the NSF has received its budgetary allocations from the Congress). For this competition only, proposals will be accepted for the following specific topics: 1) Data assimilation and small reconnaissance studies for all primary sites relevant to GeoPRISMS objectives; 2) Research projects relevant to stated GeoPRISMS objectives at Cascadia; 3) Synthesis and integration efforts at MARGINS focus-sites; 4) Workshop proposals for science or implementation at Cascadia, Alaska, or Eastern North America Margin primary sites; and 5) Post-doctoral fellowships.

Apply for a

GeoPRISMS Post-Doctoral Fellowship

Applications due at the regular

July 1 NSF deadline

For details, see the NSF program announcement and apply, visit

http://www.geoprisms.org/postdoctoral-fellowships.html
http://www. nsf.gov/pubs/2007/nsf07546/nsf07546.htm

Rift Initiation and Evolution (RIE) Implementation Workshop Report

Santa Fe, New Mexico, November 4-6, 2010

Michael Oskin (Universtiy of California-Davis); Ramon Arrowsmith (Arizona State University); Peter Flemings (University of Texas-Austin); Jolante van Wijk (University of Houston); Donna Shillington (Lamont-Doherty Earth Observatory)

Over 120 participants met November 4-6, 2010, at the Loretto Hotel in Santa Fe, New Mexico, to develop an implementation plan for the GeoPRISMS Rift Initiation and Evolution (RIE) initiative. This group included 20 graduate students and a similar number of early-career scientists whom, together, will greatly define the outcomes of the GeoPRISMS RIE program in the coming decade. It also brought in a large group of scientists who had not been a part of the MARGINS program previously. The challenge met by the participants was to define the framework of a focused, achievable implementation plan that encompasses the range of processes and time scales from rift initiation to the long-term evolution of passive margins.

Figure 1. View of the Santa Fe Mountains.

There was broad agreement that primary (focus) sites must continue to be an important component for maintaining and growing the amphibious rifting community built under the MARGINS program. Much excitement was centered on how the new directions of the RIE program could be mapped into new primary sites that, together, encompassed the entire life of rifts, from inception to the active post-rift evolution. Potential sites included everything from successfully rifted margins to active young rifts where rupture had not yet occurred. It was clear to everyone present that both settings engendered new exciting research opportunities, while significantly broadening potential participation and partnerships within the GeoPRISMS community. Ultimately, the community selected the Eastern North American Margin and the East Africa Rift System as the RIE primary sites.

Day 1 of the workshop focused on the four overarching research questions defined for the RIE initiative in the Draft Science Plan:

- ***Initiation:*** *How and why do continental rifts initiate?*
- ***Evolution:*** *How do fundamental rifting processes (such as tectonics, magmatism, and erosion, transport, and sedimentation), and the feedbacks between them, evolve in time and space?*
- ***Architecture:*** *What controls the structural and stratigraphic architecture of rifted continental margins during and after breakup?*
- ***Volatiles:*** *What are the mechanisms and consequences of fluid and volatile exchange between the Earth, oceans, and atmosphere at rifted continental margins, and between the lithosphere and the mantle?*

The day was divided into morning and afternoon plenary sessions, each focused

RIE Science and Implementation Plan Synopsis

http://www.geoprisms.org/science-plan.html

Key topics

- How and why continental rifts initiate
- How fundamental rifting processes (e.g., tectonics, magmatism, and erosion, transport, and sedimentation), and feedbacks between them, evolve in time and space
- Controls on structural and stratigraphic architecture of rifted continental margins during and after breakup
- Mechanisms and consequences of fluid and volatile exchange between the Earth, oceans, and atmosphere at rifted continental margins, and between the lithosphere and the mantle

Primary Sites

- Eastern North American Margin
- East Africa Rift System

Thematic Studies

- Rift obliquity
- Rift processes as a function of strain rate
- Volatiles in rift zone processes
- Sediment production, routing and transport during and after rifting
- Discrete events at rifted margins.

Figure 2. Participants during break-out session at the RIE Implementation Workshop.

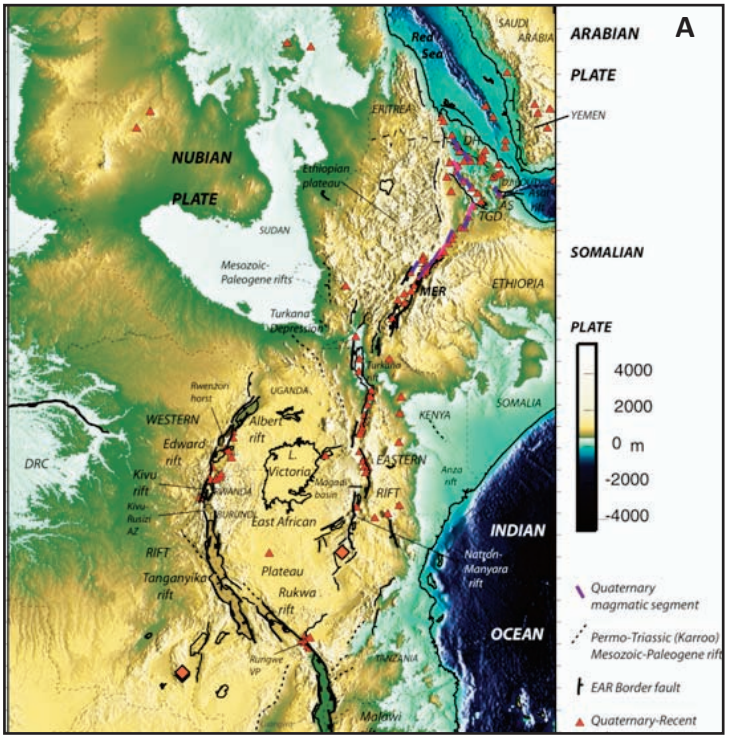
on two of these questions. Both sessions featured talks from four speakers, several of whom were early career or international participants. Derek Keir (Leeds) led off the morning session on rift initiation with a presentation on the Gulf of Aden, paired with a presentation by Suzanne Baldwin (Syracuse) on the Woodlark basin. This was followed by presentations by Graham Kent (Reno) and Luc Lavier (UTIG) on the evolution of rifts. The afternoon session on rift architecture and the role of volatiles showed how much RIE has evolved from the MARGINS RCL program. Presentations by Wonsuck Kim (UT - Austin) and Frank Billotti (Chevron) gave model- and observation-based perspectives on the diversity of active processes at passive margins. This was followed by a pair of talks by Tobias Fischer (NM Tech) and Joe Cartwright (Cardiff) describing intriguing links between volatiles, magmatism and fault initiation in rifts.

Following each plenary session, the meeting participants were divided into four breakout groups tasked with defining implementation strategies appropriate for one of the two questions just discussed. Group assignments included graduate students and were randomized, ensuring a diverse mixture of participants in each breakout session. This strategy fostered cross-fertilization of ideas and interests among the meeting participants. An evening poster session wrapped up the day's activities.

Day 2 of the workshop focused on defining potential primary sites and topics for thematic studies not fully addressed by potential primary sites. The morning plenary session featured reports from the Day 1 breakout-session leaders, interspersed with talks covering potential collaborations with Earthscope (Mousumi Roy, New Mexico), the USGS (Carolyn Ruppel) and industry (Lori Summa, ExxonMobil). The afternoon session featured talks solicited from the authors of White Papers submitted ahead of the workshop. Areas covered were the Woodlark Basin (Paul Mann, UT - Austin), East Africa (Katie Keranen, Oklahoma), Walker Lane (Cathy Busby, Santa Barbara), Gulf of Mexico (Dennis Harry, Colorado State), Eastern North America (Danny Brothers, USGS), a rapid response theme combining rifting crises (earthquakes, diking events) and landslides on passive margins (Cindy Ebinger, Rochester and Brandon Dugan, Rice), and rift obliquity and strain-rate themes seeded in part by a presentation on the Gakkel Ridge (Henry Dick, WHOI). The highlight of Day 2 was an inspired presentation by the graduate students of their own proposal for an implementation plan. Their hard work, candor, and enthusiasm to reach a consensus set a positive example for the difficult decisions that lay ahead. The day ended with another set of four breakout groups, each charged with developing a strawman implementation plan. As before, group assignments were inclusive of students and randomized to ensure mixing of ideas and debate among the meeting participants. During the group banquet that evening, the group was enthralled and entertained by a presentation from Karl Karlstrom and Laura Crossey (UNM) who talked about their path to discovery of mantle sources of, and pathways for, volatiles along and around the Rio Grande Rift ("xenowhiffs").

"…new primary sites encompass… the entire life of rifts, from inception to the active post-rift evolution."

Day 3 of the workshop tackled the decision on primary sites, and following from this a discussion of themes not addressed by these sites. The day led off with presentation of the four strawman implementation plans developed by the Day 2 breakout groups. All plans favored the East Africa Rift as a primary site, variously combined with Eastern North America, the Walker Lane, or a thematic emphasis. An important outcome of this exercise was to gain much needed insight from the breakout groups into how to move the decision process forward. Discussions soon culminated in a series of four open votes, by show of hands, on the definition and selection of Primary Sites. The first decision was on the definition of a Walker Lane site,



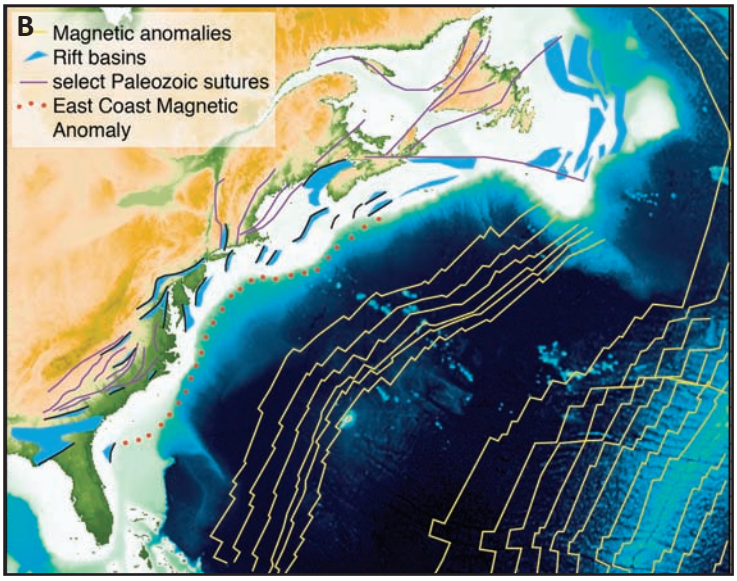


Figure 3. (A) Eastern North American Margin primary site., (B) East African Rift System primary site. For more information and detailed description of each site see the GeoPRISMS Implentation Plan http://www.geoprisms.org/science-plan.html

with restriction to the Walker Lane and exclusion of the Gulf of California / Salton Trough carrying 80% of the votes. The second vote was on the characteristics of the two primary sites. An overwhelming majority favored a plan encompassing one active rift and one passive margin site. The third decision was on the active margin site, with 75% of the vote in favor of East Africa and 25% in favor of the Walker Lane. The fourth decision, on the passive margin site, was over 90% in favor of eastern North America.

The meeting on Day 3 ended with a free-ranging discussion of potential themes not adequately addressed by the selected primary sites. These discussions, which continued after the workshop in the weeks that followed, led to the definition of five areas of comparative and thematic studies:

- *Theme 1: Rift obliquity*
- *Theme 2: Rift processes as a function 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.*

After the close of the workshop, more than 25 participants enjoyed beautiful weather and a fascinating tour of the Rio Grande Rift and Jemez Mountains in north-central New Mexico on Saturday. The field trip was led by Karl Karlstrom, Laura Crossey, Tobias Fischer, and their students and colleagues. They drove along the Rio Grande Rift from Santa Fe to Bernalillo up into the Jemez Canyon. They reviewed the landscape of the rift; rift-bounding faults; and rift-fringing volcanic rocks, including portions of the Valles Caldera that formed the Bandelier tuffs and related rocks as well as basaltic units; and the spectacular travertines and shallow to deep hydrothermal system at Soda Dam.

The two selected primary sites present tremendous scientific opportunities. Both systems exhibit profound along-strike variations in the style of rifting, volume of magmatism, pre-existing lithospheric template, and sedimentary dynamics, thus offering rich opportunities for both comparisons within each system and comparisons between active processes in the EAR and the cumulative record of extension, sedimentation and magmatism at the ENAM. The pairing of a successfully rifted margin, much of which is offshore, with an incipient rift, most of which is onland, also constitutes a new way of designing an amphibious initiative at the programmatic scale. And finally, the new primary sites and thematic studies will expand and integrate the rich observations and insights gained from previous MARGINS RCL and S2S studies, to build a deeper understanding of rifting processes at many scales.

GeoPRISMS investigations in both RIE primary sites are also of great societal relevance. Active processes in both settings pose significant hazards to nearby communities. In the EAR, volcanic and seismic hazards are a significant threat, while landslides and ongoing seismicity on reactivated rift faults pose risks for large population centers on the ENAM. In Africa, the infrastructure and knowledge to address these hazards is often limited; partnerships between U.S. and African universities fostered by GeoPRISMS offer the opportunity to advance opportunities and resources. Both regions also host potentially valuable natural resources, such as petroleum and geothermal energy.

Subduction Cycles and Deformation (SCD) Implementation Workshop Report

Bastrop, Texas, January 5-7, 2011

Clifford Thurber (University of Wisconsin-Madison); Michael Underwood (University of Missouri-Columbia); Harm van Avendonk (University of Texas-Austin); Susan Bilek (New Mexico Tech); Heather DeShon (University of Memphis); Michael Gurnis (California Institute of Technology); Katherine Kelley (University of Rhode Island); Demian Saffer (Penn State University)

Figure 1. Group photo of attendees at the January SCD Implementation Workshop in Texas.

The Subduction Cycles and Deformation (SCD) Implementation Workshop was held in Bastrop, TX, January 5-7, 2011, with 120 scientists in attendance. The overall goals of the workshop were to prioritize the scientific objectives of the SCD initiative, refine the seven key SCD questions from the Draft Science Plan, and develop a 10-year implementation plan. A critical aspect of this effort was the selection and justification of SCD "Primary Sites" for focused regional investigations and identification and description of a set of thematic studies that will enable complementary analyses and global comparisons.

The workshop was structured as a mix of plenary talks on the key questions, additional plenary talks by early-career scientists, multiple break-out sessions, plenary discussion sessions, poster sessions, a panel of international scientists, and briefings by NSF and potential program partners. The early-career speakers and their titles reflect the breadth of GeoPRISMS and the opportunities for people to become involved in the GeoPRISMS program:

- Heather DeShon: Double-Difference Tomography Applied to the Middle America and Sunda Seismogenic Zones
- Aron Meltzner: Persistent Rupture Segmentation Along the Sunda Megathrust off Sumatra
- Laura Hebert: Implications of Deep Transport of Slab-Adjacent Hydrated Material at Subduction Zones
- Jamie Barnes: TheGlobal Chlorine Cycle: a Subduction Zone Perspective
- Paul Hall: Thermochemical Evolution of the Mantle Wedge
- Sarah Penniston-Dorland: Melange Zones and Metasomatism in Subduction Zone Metamorphic Rocks

The break-out sessions were led by a mixture of early career scientists, seasoned MARGINS/GeoPRISMS veterans, and some new faces to the program. They progressed from: focusing and refining the seven science questions, with each break-out dealing with one question; to the need for primary sites versus more "cross-cutting" (thematic) science, defining the desired balance between the two, and identifying and prioritizing potential primary sites; to developing the implementation strategies for the selected primary sites and thematic initiatives. Plenary sessions followed each break-out session to share outcomes and reach a consensus for the next steps. Students and post-docs took a very active role in the workshop, having working meals, doing research "pop-ups" and poster advertisements, and developing their own complete implementation plan. 71 posters were presented at the workshop, and the two evening poster sessions provided ample opportunity for informal and stimulating discussions over a beer.

Plenary sessions and preliminary votes

In the decisive final vote, three primary sites were selected for future GeoPRISMS SCD investigations, listed in order of preference: Alaska (including the mainland and Aleutian extension), Cascadia, and New Zealand. These three sites offer tremendous potential to address major questions about subduction earthquake and fault slip processes in societally critical settings, and to carry out comparative studies of deep-seated interactions that drive volatile release and magmatic processes to build the continents.

Alaska/Aleutians was given the highest priority because it offers real opportunities to address a wide variety of questions outlined within the SCD science plan. Among its many attributes are the fundamental along-strike variations in both fault-slip behavior and magmatism. It was also recognized,

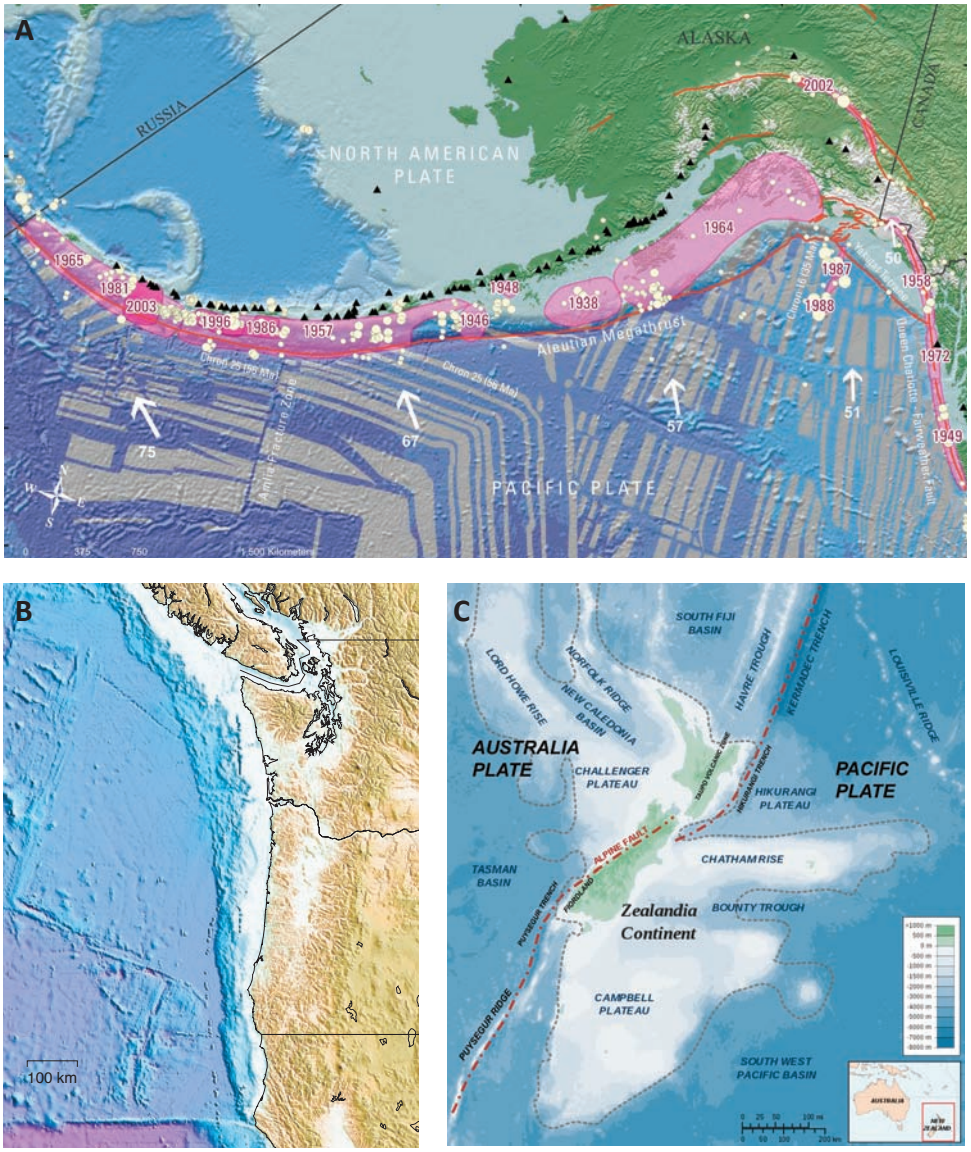


Figure 2. Maps of three SCD primary sites (A) Alaska, (B) Cascadia, (C) New Zealand. For more information and detailed description of each site see the GeoPRISMS Implentation Plan http://www.geoprisms.org/science-plan.html

however, that GeoPRISMS investigations in that part of the world will require significant ramp-up time and face difficult logistics. There is strong potential for integration with EarthScope deployments; while USArray efforts are still in the early stages of planning, PBO time series are now maturing. GeoPRISMS investigators will participate in such planning discussions to ensure the coordination of critical onshore and offshore activities.

Cascadia offers GeoPRISMS some outstanding immediate-term opportunities to build upon the existing EarthScope infrastructure, e.g., ongoing deployment of the joint EarthScope-MARGINS amphibious array and high-rate geodesy as part of the Cascadia Initiative. Work in that region will engage a broad range of US, Canadian, and international scientists, and leverage a rich trove of geologic and geophysical data accumulated both onshore and offshore over recent decades

New Zealand generated significant excitement among the workshop participants, due in part to major new investments by their national government in both onshore and offshore scientific infrastructure. The New Zealand margin exhibits a wide range of fault slip and volcanic phenomena with significant along-strike variations in a compact setting. There is also a zone of active subduction initiation, as well as excellent exhumed exposures of arc crust and youthful accretionary prism. Growing international collaborations in New Zealand include an IODP proposal in the pipeline and a number of collaborations with scientists in Japan, Europe, and the United States. In addition, GeoPRISMS investigators will be able to leverage MARGINS research accomplishments from Source-to-Sink investigations carried out along the northern Hikurangi margin.

Some key questions of the SCD science plan require thematic research that cannot be accomplished solely at primary sites. In particular, processes taking place at depth within subduction zones, processes not presently taking place in modern subduction zones, or processes that can only be resolved through comparative study, cannot be directly sampled or observed within the primary sites or over the decadal time scale of GeoPRISMS. Yet these processes are fundamental to constraining and contextualizing observations made at the primary sites. The deeper levels, temporal dimensions, and global variations of subduction megathrust boundaries and arc systems, however, are made accessible through thematic approaches, including geochronological, petrological, structural, and geochemical studies of small-scale features within exhumed systems, simulation of conditions at depth through laboratory experiments, sophisticated computational modeling, and comparative analyses that build upon the framework of past MARGINS focus sites and observations at the new GeoPRISMS primary sites.

The five process-based themes identified following the SCD Implementation Workshop include:

- ***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:*** *Metamorphic and igneous*

conditions and processes at depth

- ***Theme 5:*** *Subduction initiation*

Given the geographic breadth represented within and among the three chosen primary sites, early planning workshops for each locale will be critical. Research efforts at the three primary sites are at different stages of maturity, defining different degrees of urgency. Cascadia and Alaska represent the highest priorities for immediate planning, with New Zealand following closely behind.

Cascadia: Significant advance planning that has already taken place for Cascadia operations, with onshore deployments largely in place, and offshore plans written and vetted by the community; instrumentation should be fully in place by early 2012. Proposals for open-access 3-D marine seismic surveys are also in process. Thus, certain components of GeoPRISMS work in Cascadia can start immediately. Nonetheless, a broader planning workshop, joint between GeoPRISMS and EarthScope, should take place within the year to discuss how to take scientific advantage of the new infrastructure provided through the Cascadia Initiative, and to decide what ancillary projects require immediate attention and community input.

Alaska: GeoPRISMS investigations in Alaska will certainly require further community deliberation, which must take place in collaboration with EarthScope researchers. Initial planning is underway already within USArray, with a workshop scheduled before the EarthScope National Meeting (May 2011) to define the USArray deployment plan in Alaska. Although interested GeoPRISMS investigators are encouraged to participate in the pre-EarthScope workshop, a broader joint GeoPRISMS-EarthScope planning workshop should be held within the year to clarify common research objectives with both USArray and PBO, to select appropriate "Discovery Corridors" for future study, and to outline detailed implementation plans and timelines considering available resources and infrastructure. Preliminary reconnaissance studies, data inventories, and synthesis efforts carried out in advance of this workshop, will provide critical input for subsequent community discussions.

New Zealand: An international planning workshop should precede any major GeoPRISMS investments in New Zealand, to establish the status of New Zealand and international activities in the area, and to prioritize targets to build most effectively upon existing and future infrastructure. This planning workshop should take place within 2012 or 2013, to allow investigators to coordinate onshore and offshore activities, and establish important international collaborations. Peripheral research activities, e.g., leveraging existing datasets, conducting small scale field studies, and carrying out laboratory and modeling exercises, can initiate prior to such a workshop, and will provide valuable scientific motivation for subsequent community planning. Opportunities exist for immediate GeoPRISMS research at all three primary sites, and within the secondary thematic studies listed above. Early primary site research should focus on data synthesis efforts, utilization of existing and forthcoming data products (e.g., from the Cascadia Initiative), and reconnaissance studies that will set the stage for subsequent planning and community experiments.

The combination of three new primary sites and five thematic topics will build upon rich datasets acquired from the three SEIZE and SubFac MARGINS focus sites, to address the key SCD questions. The strong GeoPRISMS community offers the means to integrate the breadth of observations and interpretations acquired in all of these settings. For example, investigations of seismogenic processes along the Hikurangi margin of New Zealand will benefit from comparable 3-D seismic surveys and IODP drilling ventures along the Nankai and Costa Rican margin, and similarly, can inform interpretations of slow slip processes in those settings as well as Cascadia. Contrasting arc settings in the new primary sites, and MARGINS SubFac focus sites, will expand the parameters that can be studied as controls on magma compositions and volatile content around the world. Investigations of exhumed forearcs and arc volcanoes will provide critical insights into deeper structures and processes that govern subduction zone behavior, which can

SCD Science and Implementation Plan Synopsis

http://www.geoprisms.org/science-plan.html

Key topics

- Controls on the size, frequency and slip behavior of subduction plate boundaries Spatial and temporal patterns of deformation through the seismic cycle
- Linkages between volatile release and the rheology of the plate boundary interface
- Storage, transfer, and release of volatiles through subduction systems
- Geochemical products of subduction and creation of continental crust
- Subduction zone initiation and arc system formation
- Feedbacks between surface processes and subduction zone dynamics

Primary Sites

- Alaska and the Aleutians
- Cascadia
- New Zealand

Thematic Studies

- Identifying controls on fault slip behavior and deformation history
- Understanding mantle wedge dynamics
- Fore-arc to back-arc volatile fluxes
- Metamorphic and igneous conditions and processes at depth
- Subduction initiation

Figure 3. Hyatt Lost Pines in Bastrop, Texas; location of SCD Implentation Workshop. Figure 4. Attendees take a break during the workshop.

then be compared with in-situ studies at the primary and focus sites. Theoretical and Experimental Institutes will provide important mechanisms for such intra-initiative exchanges, as well as opportunities to design and plan future thematic activities.

The integration of observations within the SCD initiative also will be enabled by numerical modeling and laboratory experiments, that expand the temporal and spatial range beyond those documented at the primary sites. The synthesis of initial field and modeling studies can then guide subsequent data gathering efforts. Major synthesis activities will be fostered through regular workshops spanning SCD research, enhancing data sharing and collaboration, reviewing ongoing studies, developing comprehensive models for subduction processes, and further building the GeoPRISMS community. The GeoPRISMS Office will facilitate these exchanges, enabling the broad dissemination of results, maintaining open channels of communication (e.g., website, newsletter, publications), and providing direct access to the GeoPRISMS data portal for data sharing.

The research directions of SCD will further the broader impacts of GeoPRISMS in several distinct ways. Continued emphasis on understanding seismogenesis and its controls, together with a new focus on volcanic systems, provide a springboard for the study of hazards associated with megathrust earthquakes, tsunamis, and volcanic eruptions. The recent catastrophic earthquake and tsunami in Japan are sobering reminders of the importance of such research. The explicit inclusion of sediment transport and deposition along subducting margins will increase our understanding of other geologic hazards such as landslides and tectonic or climate-driven shoreline change. An emphasis on volatile exchanges and fluid-mobile element interactions, from weathering to the deep interior, will provide insight into the long-term evolution of the atmosphere and hydrosphere and ore-formation processes.

We have an exciting decade of science ahead of us. There are outstanding opportunities for fundamental science both at the three primary sites and in associated thematic studies. We hope many new people will join the growing SCD-GeoPRISMS community and take advantage of the diversity of scientific work afforded by the program.

GeoPRISMS Data Policy Released

http://www.geoprisms.org/data-policy.html

Also, an updated list of approved data archives is now online.

Learn more about:

- When to release your data
- Where to archive your data
- What kinds of data must be archived
- How to develop a data management plan
- NSF division and funded program data policies

Exploring the Transfer of Earth Surface Materials from Source to Sink

AGU Chapman Conference on Source to Sink Systems Around the World and Through Time: Recent Advances in Understanding Production, Transfer and Burial of Terrestrial and Marine Materials on the Earth Surface

Oxnard, California, January 24-27, 2011

Steven A. Kuehl (College of William and Mary); Charles A. Nittrouer (University of Washington)

Figure 1. Source view of the Santa Clara River system taken during the field trip for the AGU Chapman S2S conference in Oxnard. By Glen Leverich

The source-to-sink (S2S) holistic approach examines the dispersal of material (particulate and dissolved) across the Earth surface, with a focus on how the material is transferred between segments of a dispersal system (e.g., uplands, river, coastal ocean, deep margin). Past studies primarily examined sedimentary processes within the individual segments of dispersal systems. Although these processes are still recognized as important, the timing, intensity and operative transfer mechanisms controlling sediment input and output are now accepted as fundamental parts of the dispersal process.

A group of 150 scientists and students from six continents met in Oxnard to facilitate this synthesis and integration of MARGINS S2S research and the creation of a digital text and educational resources. Broad participation by the academic and federal sedimentary research communities, energy-industry scientists and geoscience educators provided a rich opportunity to explore the many dimensions of S2S research and its impact on society.

Keynote and poster presentations highlighted important new insights based on observations of sedimentary systems, numerical modeling and laboratory simulations. Many of these presentations have been made publicly available in order to widely disseminate the conference results and stimulate future research interactions (http://csdms.colorado.edu/wiki/Chapman_Source_to_Sink).

Some key advances in S2S research over the past decade have arisen from new observations, approaches and conceptual understanding of Earth surface processes. The role of climate and rainfall on landscape evolution and sediment production is of first-order importance since exhumation and precipitation rates are directly related. Earthquakes and severe storms are now understood to exhibit a primary control on the magnitude and timing of sediment inputs to fluvial systems in active margin settings. Key observations in the sink regions of S2S systems have underscored the importance of using high-resolution (3-D) seismic, as key building blocks of the stratigraphic record (i.e., clinothems) are inherently three dimensional in space and vary through time. Our appreciation of the importance of gravity-driven sediment flows in the marine environment represents an important paradigm shift that has changed the emphasis of sediment-transport studies. The S2S approach has come to the forefront in the area of resource development, as our ability to understand the evolution of margin- and basin-scale stratigraphy is necessary for prediction of frontier basins for energy exploration, and also has major implications for water resources, paleoclimate studies, and understanding natural disasters.

Future progress for the S2S community presents challenges as well as opportunities. A key to success will be the continued development of linked, predictive models that are able to incorporate climate change, landscape evolution, sea level, and storage and transfer of materials through space and time. The impact of humans on a wide range of S2S storage and transfer functions is profound, and we are just starting to appreciate the implications of these changes for society.

The meeting concluded with plans for an innovative synthesis volume on S2S research conducted during the last decade, and a collection of educational products for use in the college classroom. The details of these future efforts will be emerging during the coming months, and a writer's workshop is planned for later this year.

USGS Marine Geohazards Workshop Report

Menlo Park, CA March 1-3, 2011

Stephen Kirby, William Schwab and Uri ten Brink (USGS)

In recognition of the threats to the U.S. near-coastal environment due to offshore geological events, a USGS Marine Geohazards Workshop was held in early March to supply recommendations to the USGS leadership aimed at finding ways of strengthening the marine geohazards component of the new USGS Natural Hazards Mission Area. The devastating M9 earthquake and tsunami waves of 11 March 2011 occurred in Japan in the week following this workshop. State agencies in Hawaii, California, and Oregon reported an estimated $110 Million in total tsunami damage from this source. The 2011 earthquake in Japan is one of a number of recent tsunamigenic earthquakes, including the 2004 event in Sumatra and the 2010 Tonga/Samoa event, that were not widely anticipated. These events underscored the vulnerabilities of coastal areas associated with geological phenomena that originate in the offshore and have event chronologies that may predate their occurrence in recorded history or where the historical record is incomplete (Normile, 2011a and 2011b).

There is a pressing need for the USGS to strengthen partnerships with universities and other federal agencies in order to fulfill its mandate to assess marine geohazards and, in doing so, assist in mitigating these hazards and reducing their risks. The NSF, and in particular the NSF GeoPRISMS Program, share many scientific objectives with the USGS and hence are natural partners in this effort.

The workshop covered sudden and extreme geologic events that affect coastal areas and seabed infrastructure on regional and transoceanic scales. These hazards include submarine earthquakes, explosive volcanic eruptions and collapses of volcanic edifices, submarine slope failures, tsunami generation, and unintentional man-made oil venting during oil and gas exploration and production. We did not include the impacts of seasonal or extreme storms, global warming effects on rising sea levels, or chronic pollution or habitat loss in our discussions. A full report of the findings of this workshop is now being compiled and will be available later this year. However, a short preliminary summary in the GeoPRISMS Newsletter is timely for emphasizing the potential of collaborative research between the USGS and NSF along a number of US margins, and will be especially useful to the GeoPRISMS community in the coming months as they begin to implement the GeoPRISMS Science Plan and set the program priorities for the future. This preliminary report also serves as a preview of the final workshop report.

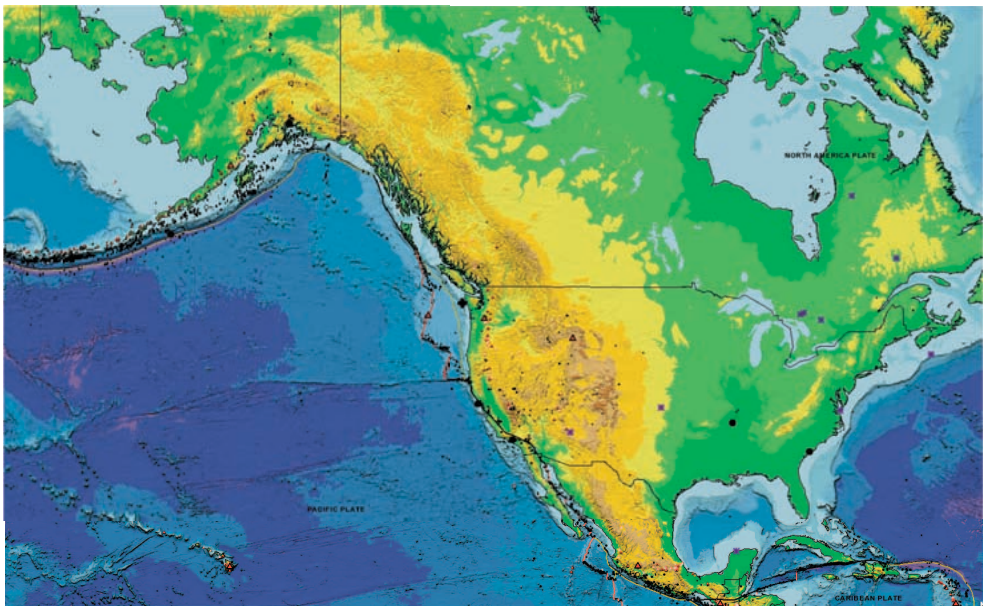


Figure 1. North American Marine Margins: A Diversity of Tectonic Settings. Symbol explanation from the USGS/SI/NRL publication: This Dynamic Planet Map (http://mineralsciences.si.edu/tdpmap/)

"There is a pressing need for the USGS to strengthen partnerships with univeristies and other federal agencies in order to fulfill its mandate to assess marine geohazards."

Quantitative hazard appraisal depends on knowing, among other details, where, how often, and how big hazardous events have occurred. The "where" part involves mapping offshore faults, submarine slope failures, and submarine volcanoes and comes largely from geophysical surveys such as swath mapping (including backscatter imaging), active-source seismic surveys, and OBS monitoring of offshore earthquakes. Geophysical mapping coverage of the 19,000 km length of the U.S. Exclusive Economic Zone and its Territories is far from complete. For some margins, such as the Aleutian subduction system, we have almost no swath mapping at all and modern active-source seismic surveys for some of our margins are also few and far between.

The "how big and how often" information for the offshore is not as straightforward to obtain. On land, Quaternary geologists have made spectacular gains in establishing the prehistories of earthquake faulting in California and elsewhere by conducting trenching studies of active faults. These efforts have lead to probabilistic seismic hazard assessments (PSHA) and probabilistic seismic hazard maps for California and for the nation (e.g.,http://earthquake.usgs.gov/hazards & http://www.scec.org/ucerf). Much of

continued on page 18

Cascadia Initiative Workshop Update

Portland, Oregon, October 15-16, 2010

Jeff McGuire (Woods Hole Oceanographic Institution); Doug Toomey (University of Oregon); Chris Goldfinger (Oregon State University); Susan Schwartz (UC Santa Cruz); Richard Allen (UC Berkelely)

As part of the 2009 Stimulus or ARRA (American Recovery and Reinvestment Act) spending, NSF's Earth Sciences (EAR) and Ocean Sciences (OCE) divisions each received $5M in facility-related investment. The funds were targeted toward the creation of an Amphibious Array Facility (AAF) to support EarthScope and MARGINS science objectives. The initial emphasis and deployment site was onshore/offshore studies of the Cascadia margin, with an expectation that the facility would later move to other locations. Thus, the Cascadia Initiative (CI) is an onshore/offshore seismic and geodetic experiment that takes advantage of the Amphibious Array to study questions ranging from megathrust earthquakes, to volcanic arc structure, to the formation, deformation and hydration of the Juan De Fuca and Gorda Plates. The Initiative was featured 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". In October 2010, we convened an open community workshop that produced a series of recommendations to maximize the scientific return of the CI as well asand to develop deployment plans for the offshore component of the experiment. The full workshop report can be found at http://www.oceanleadership.org/2010/nsf-cascadia-initiative-workshop/, and we summarize some of the main points below.

The science objectives of the CI are wide-ranging. The new instrumentation will enable: real-time, high-rate GPS data to be used both for studying large earthquakes in the region and potentially for real-time seismic and volcanic hazard mitigation; continued monitoring of non-volcanic tremor along the entire subduction zone; imaging of the physical properties of the (offshore) megathrust properties; and studies of the formation, evolution, deformation and hydration of the incoming Juan de Fuca and Gorda plates as it they moves from ridge to trench. This diverse set of objectives are all components of understanding the overall subduction zone system and require an array that provides high quality data that crosses the shoreline and encompasses relevant plate boundaries. The ARRA funded upgrades to 232 Cascadia GPS stations that are part of the Plate Boundary Observatory (PBO), which are being carried out by UNAVCO (Figure 1). The improvements include switching from daily downloads to continuous, real-time streaming of data, and increasing the rate of sampling from 30-second to 1-second epochs. The majority of these upgrades have already been completed, the project is on schedule and on budget,and the remainder of the PBO stations will be completed by summer of 2011.

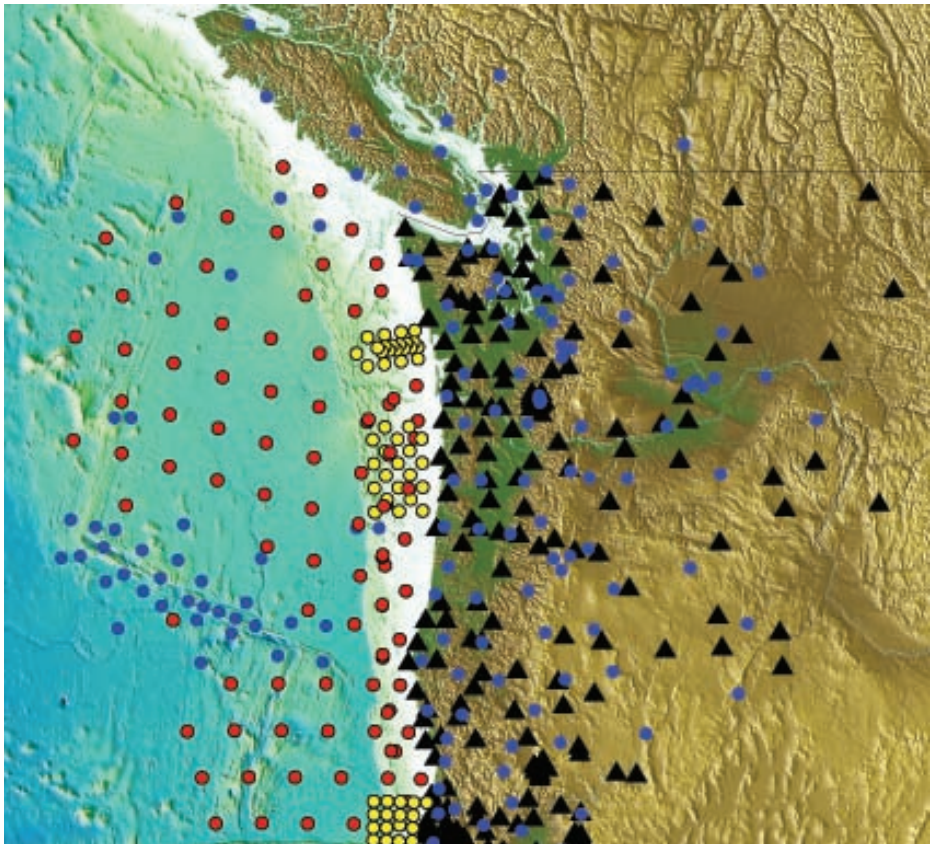


Figure 1. PBO GPS stations upgraded as part of the Cascadia Initiative (black triangles) and broadband seismometers (circles) expected to operate in the Cascadia Region in intervals for 2011-2015. Detailed information on seismometer experiments and the schedule of deployments is at http://www.oceanleadership.org/2010/nsf-cascadia-initiative-workshop.

The onshore seismic component of the AAF consists of 27 EarthScope/USArray/Transportable Array station sites that have been deployed to complement the existing distribution of broadband stations in Cascadia, (Figure 1). Where possible and appropriate, some of the 27 sites are reoccupying the original sites of the Transportable Array in the region. In other cases, new sites were identified to complement existing stations and/or when if the original site was is not available. All 27 sites have a broadband velocity sensor and a strong-motion accelerometer. The deployments were completed in the summer of 2010 (Figure 2). All are operational with data

streaming in near-real time to the IRIS Data Management Center (DMC), and will operate until at least September 2013. The data are archived at the IRIS Data Management Center DMC. Stations report their data under the TA network code, and use the standard TA station naming convention. In addition, the Virtual Network Definition (VND) capability at the DMC provides a simple means to access these data. The virtual network "_CASCADIA" will provide access to the 27 TA stations plus 47 other broadband stations in the area, while the "_CASCADIA-TA" VND provides access to the 27 TA Cascadia stations.

The CI funded the construction of a total of 60 Ocean Bottom Seismometers (OBSs) by the three Institutional Instrument Contributors (IICs) of the National Ocean Bottom Seismometer Instrumentation Pool (OBSIP). The IICS group at Lamont-Doherty Earth Observatory (LDEO) will build 30 OBSs, while the groups at the Scripps Institute of Oceanography (SIO) and the Woods Hole Oceanographic Institution (WHOI) will build 15 each. All 60 OBSs will be equipped with Nanometrics Trillium Compact seismometers. In addition to the seismometers, the SIO and WHOI OBSs will be equipped with Differential Pressure Gauges (DPGs) while the LDEO OBSs will carry Absolute Pressure Gauges (APGs). Twenty of the LDEO OBSs will be installed in trawl-resistant enclosures and will be available for deployments in water depths extending from the shelf down to 1km. These 20 OBSs will be deployed via the ship's wire and recovered using a Remotely-Operated Vehicle (ROV). These instruments will not be deployable in water depths greater than 1,000 m. The fifteen SIO OBSs will also be installed in trawl-resistant enclosures, and are deployable at depths extending from the shelf down to 6 km. The WHOI OBSs will not be deployable in depths shallower than 1000 m. All 60 instruments will be equipped with 12-month battery packs.

The OBSs will be utilized in four one-year long deployments. These experiments will provide an offshore extension of the EarthSscope Transportable Array (~70 km spacing) as well as 3 dense experiments focused on either imaging various properties of the thrust interface and forearc or recording local seismicity (Figure 1). The OBS deployment geometry complements the cabled observatories of NEPTUNE Canada and the Regional Scale Nodes of the Ocean Observatory Initiative as well as funded, PI-driven OBS experiments designed to study deformation near the Blanco Transform and within the Gorda Plate. The proposed deployment plans are described in detail in the workshop report.

Figure 2. Station N02D instullation at Trinity Center, northern Caliornia, Fall 2009

A team of PIs will lead expeditions to deploy and recover CI OBSs and to develop Education and Outreach modules. The team is being organized by Doug Toomey and includes Richard Allen, John Collins, Bob Dziak, Emilie Hooft, Dean Livelybrooks, Jeff McGuire, Susan Schwartz, Maya Tolstoy, Anne Trehu and William Wilcock. The PI team is knowledgeable about the science and operational objectives of the CI, includes individuals with chief scientist experience, as well as some who have not yet been to sea, and comprises representatives from both the EAR and OCE communities. It is anticipated that there will be berths for students, postdocs and other scientists to participate in either deployment or recovery legs, thus providing the seismological community with opportunities to gain valuable experience in planning and carrying out an OBS experiment. Funding and ship time for the deployments and recoveries of OBS will be supported primarily by the Ocean Sciences Division of NSF.

"The (Cascadia) Inititative was featured in Vice President Joe Biden's list of '100 Recovery Act Projects that are Changing America'."

The CI has a finite duration with the intention that both the onshore and offshore components of the AAF will move to other locations following the completion of the CI. The community plan that resulted from the October workshop requires a four years of onshore/offshore deployments in Cascadia, which will begin in the summer of 2011. The four one-year OBS deployments in the region would last until the summer/fall 2015 at which point the AAF could move to a new location, or could remain in Cascadia. The October workshop recommended that during the deployment four years, smaller workshops should be held to evaluate data quality, present results from initial analyses, and make adjustments to the deployment plan if necessary. A process is also needed to decide where the AAF should be deployed following the initial 4-year deployment in Cascadia. In the context of the ongoing EarthScope initiative, possible locations include the East Coast, the Gulf of Mexico, and Alaska. However, the AAF could also move to other locations, and could also or remain in Cascadia. A community workshop in 2014 was proposed as a venue to decide on the next deployment of the AAF.

CORKs: Opportunities for Watching Subduction Processes in Action with Borehole Observatories

Earl Davis, Geological Survey of Canada; Keir Becker, University of Miami

The development of borehole hydrologic observatories (known as Circulation Obviation Retrofit Kits, or CORKs) was inspired during the planning for two Ocean Drilling Program projects carried out in 1991 and 1992. The first (ODP Leg 139) focused on seafloor spreading and hydrothermal processes at the Juan de Fuca Ridge, the second (Leg 146) on deformation of and gas-hydrate accumulation in the Cascadia accretionary prism. To date, a total of twenty-four boreholes have been instrumented for long-term hydrologic monitoring and fluid sampling in a variety of settings, including subduction prisms at Barbados, Nankai, Costa Rica, Mariana, and Cascadia. Several of the early observatories remain functional after many years of service, including the first established at the Juan de Fuca Ridge in 1991, ones on the Juan de Fuca Ridge flank (multiple legs beginning in 1996), at Nankai (beginning 2001), and at Costa Rica (2002). The most recent installation took place in the Cascadia accretionary prism in September 2010 during IODP Expedition 328.

Boreholes provide valuable opportunities for long-term observations, particularly once holes are sealed to stop the flow of water from or into the formation intersected. Without this first basic step, thermal, buoyant, and hydrodynamic perturbations create sources of debilitating noise for sensors deployed (e.g., seismometers, strain gauges, and of course temperature sensors), cause measurements of pressure to be meaningless, and in cases where cold, dense seawater flows into permeable formations, make it impossible to sample natural formation water. With this in mind, it is clear that a common basic "qualification" for observatory sites is for there to be a significant layer of low-permeability sediment in which casing can be installed. Seals within the casing then assure high-quality hydrologic isolation of the formation intersected.

Early installations were relatively simple, and included single target horizons below solid steel casing with seals at the seafloor (Figure 1a). Later developments allowed multiple formation horizons to be targeted via hydraulic tubing leading to screened filters mounted on the outside of casing (Figure 1b) or on secondary casing strings (Figure 1c). Monitoring instruments and fluid samplers are either positioned at the seafloor or installed at depth permanently or on recoverable cables. A fourth scheme developed most recently allows monitoring and fluid sampling with a removable "bridge-plug" seal set in holes that are to be re-entered for deeper drilling at a later time (Figure 1d).

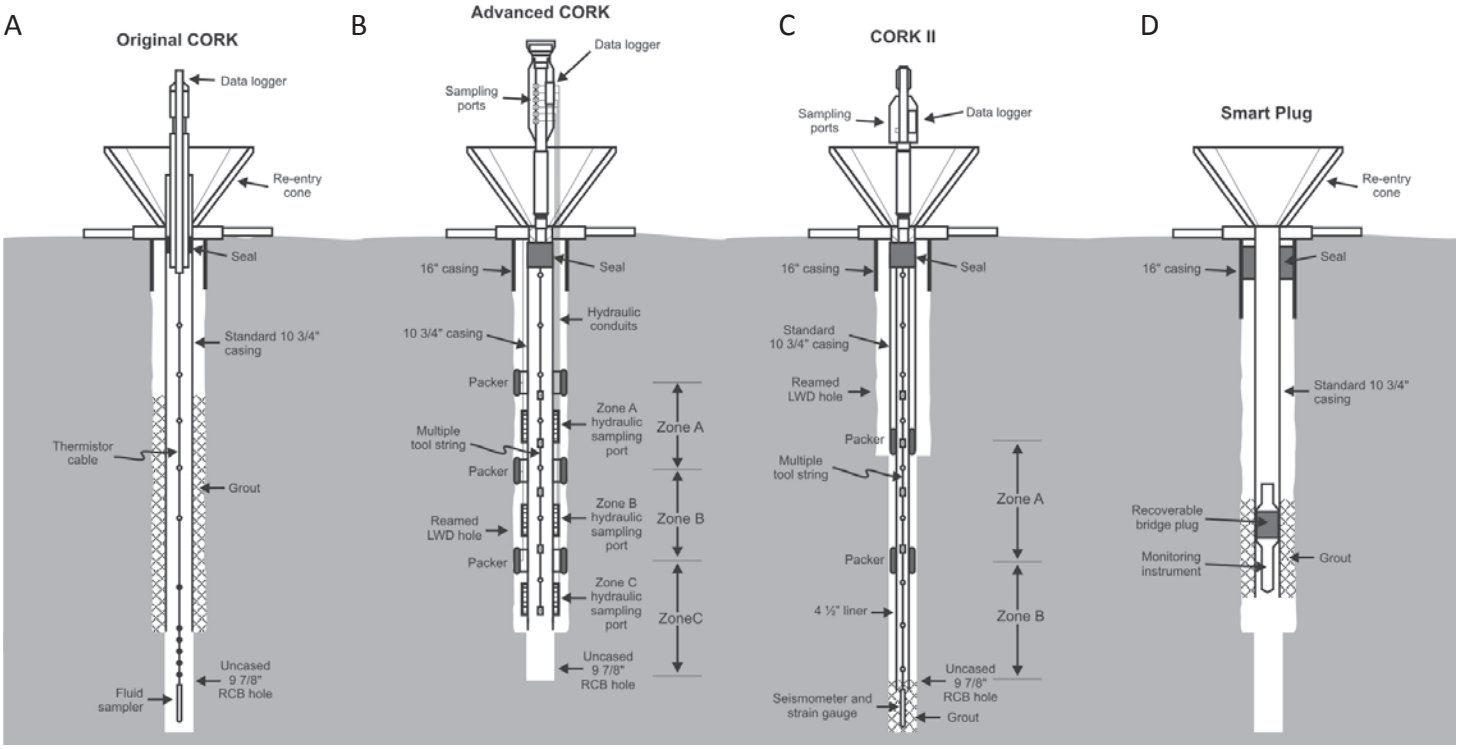


Figure 1. CORK borehole hydrologic observatory configurations. The original and most recent (left and right examples, respectively) allow pressure monitoring and fluid sampling from a single interval, whereas the Advanced CORK and CORK II facilitate sampling and monitoring at multiple formation horizons.

In addition to this continuing expansion of the way in which holes are completed and configured for monitoring and/or sampling, improvements to and expansion of CORK instrumentation have allowed many more objectives to be pursued than those originally conceived. For example, fluid samplers emplaced at depth allow water to be collected at in-situ conditions (a critical requirement where the presence of methane or other gas would cause clathrates to plug sampling lines that lead to the seafloor). Greater recording duration and higher resolution have been achieved with new developments in electronics, allowing very small hydrologic signals to be observed ranging from steady-state to seismic frequencies. And combinations of compatible instruments co-located in boreholes (relatively easy in the case of the "Advanced CORK" and "CORK-II" configurations, Figures 1b and 1c) can greatly expand the scientific returns from a given borehole.

To help stimulate thinking about opportunities provided by borehole observatories for pursuing objectives of the GeoPRISMS program, we include examples of two types of signals at opposite ends of the current observational frequency band. These are derived from our own (geophysical) experiences; numerous other examples from geochemical and microbiological experiments can be found in research and review papers. Signals near the low frequency (geodynamic) end of the spectrum (Figure 2) illustrates the sensitivity of pressure to strain associated with aseismic, co-seismic, and post-seismic slip at subduction zones. Pressure transients shown in the subducting plate and overlying prism at the Nankai Trough are associated with deformation related to a large earthquake 220 km along strike in the trough (Figure 2a). Signals like these provide surprises regarding the magnitude of the slip moment inferred from pressure relative to the seismic moment of the main earthquakes and aftershocks, with the moment inferred from pressure in this instance being nearly an order of magnitude greater than the total accumulated seismic moment. Similar transients observed at Costa Rica follow slow slip and tremor events landward of the locked, or partially locked portion of the subduction

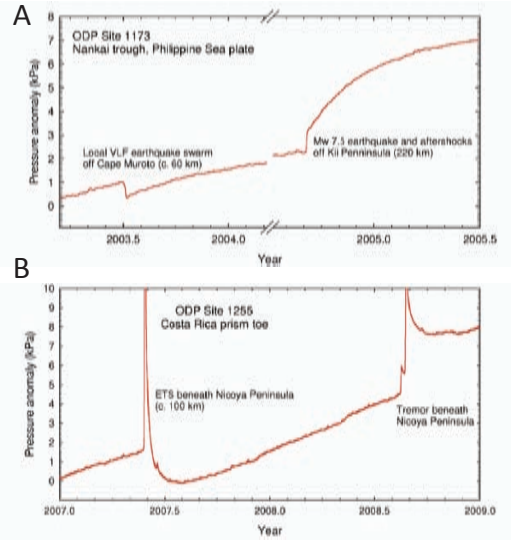


Figure 2. History of formation pressure at the Nankai trough and in the prism off Costa Rica. Long-term trends are much greater than rates of sensor drift, and may reflect interseismic strain accumulation. Transient events are associated with seismic and aseismic deformation.

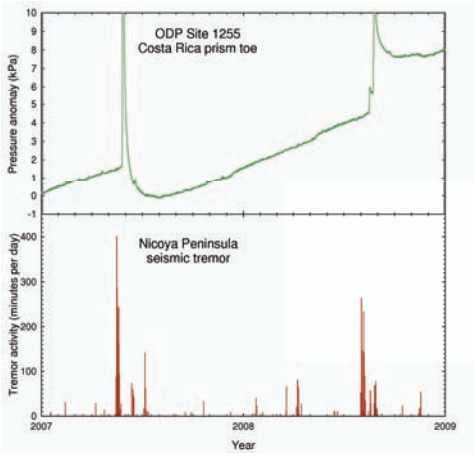


Figure 3. Pressure variations caused by strain induced by seismic waves generated by the 2010 Chile subduction earthquake, recorded in a CORK that penetrates young oceanic crust. Formation pressure variations induced by seafloor loading (e.g. tides, ocean surface waves) are attenuated by a factor of three at this site, whereas strain-induced signals such as these are greater in the formation than at the seafloor. There is a clear correspondence between pressure and local ground motion recorded by a buried broad-band seismometer.

plate interface (Figure 2b). At this location, this and other similar records allow a strong inference to be made that slow slip observed by way of GPS-constrained deformation and seismic tremor on land reaches all the way to the trench. At both sites, the transients are superimposed on secular trends that may be associated with strain accumulating between great thrust earthquakes.

The second example (Figure 3) provides an example of how formation pressure signals can be observed at seismic frequencies. This extreme bandwidth will make joint geodynamic (strain, tilt), seismic, geomechanical, oceanographic, and hydrologic observations particularly powerful for future subduction zone studies.

Projects involving hydrologic, thermal, geodynamic, and seismic borehole observatories are currently underway at Nankai, Costa Rica, and Cascadia (the last including sites on the Juan de Fuca Ridge axis and flank that are beginning to provide a view of the full plate-scale geodynamics of seafloor spreading and subduction, from ridge to arc), led by investigators from Japan, Germany, the United States, and Canada. These projects are limited in scope, however, and subduction processes continue to remain desperately underconstrained. Infusions of new minds, new ideas, and new sites are critical. Given the experience gained over the past 20 years, we can anticipate that new installations (in new or even existing boreholes) will last for decades, either for long-term continuous passive monitoring of natural signals or for numerous shorter-term interactive experiments. New objectives are bound to arise from what is learned from previous observations. New sites added to existing ones to form local or regional transects will help clarify the nature of co-seismic, post-seismic, and inter-seismic deformation, seismic rupture and slow slip, and steady and transient hydrologic flow. And opportunities for continuous shore-supplied power and real-time data transmission provided by cabled infrastructures like

CORKS *continued from page 17*

NEPTUNE-Canada, DONET, and the U.S. OOI Regional Cabled Network add greatly to the potential for subduction margin studies.

A review of some of technological developments and scientific accomplishments of borehole observatories will be provided by a special session at the fall AGU meeting in San Francisco, and a one-day workshop will be held ahead of the meeting to allow ideas for future applications to be discussed. Specifics for these will be provided at a later date. Members active within the GeoPRISMS community are encouraged to participate.

Geohazards Workshop *continued from page 13*

the sediment shed from continents is sequestered in submerged basins and elsewhere along continental margins. These depocenters can provide high-fidelity sedimentary records that can be used to reconstruct hazardous events of the past. The final workshop report will discuss the key marine geophysical and sedimentological tools and expertise that are needed to decipher these records.

A shining example of how such an effort can incorporate knowledge of event recurrence and size estimates from the marine environment is the Cascadia subduction zone where coastal paleoseismic and paleotsunamic research has revealed a long history of giant earthquakes and tsunamis (e.g., Atwater, B.F. and Hemphill-Haley, E., 1997; Leonard et al., 2010), one of which caused tsunami damage in distant Japan in 1700 (Atwater et al., 2005). Many of the ^{14}C event dates from turbidite deposits on the Cascadia subduction margin correlate with those from coastal observations (Goldfinger et al., 2011), suggesting that regional strong seafloor motions probably triggered the turbidite flows. Although some of these correlations are controversial, the overall onshore-offshore comparisons give greater confidence in regional event chronologies and estimates of rupture lengths. As a result of this remarkable work on event prehistories, the Cascadia subduction zone has one of the best-characterized regional probabilistic seismic hazard maps of any subduction zone in the world (Frankel and Petersen, 2008). Some distributed plate-boundary zones on other margins, such as the San Andreas Fault System and the northern Caribbean margin, have many offshore active faults and hence it is also important to establish the prehistories of those faults using marine methods in order to have a fuller inventory of earthquake occurrence. In particular, establishing the distribution of long-term fault slip rates based on seismic surveys and core sampling, documenting independent paleoseismic evidence for earthquake strong ground motions, and working out the long-term spatial organization of slip in systems of active faults are key things that we need to know not only on land, but also offshore.

The main goal of USGS marine geohazards effort is to contribute to probabilistic seismic hazard assessments (PSHA), volcano hazard assessments, and the development of probabilistic tsunami and marine landslide (PLHA) hazard assessments based on the successful approach PSHA on land. This is a tall order for the U.S. with such a long coastline and extensive EEZ, many sectors of which are seismically and volcanically active.

As with seismic hazard-motivated investigations on land, where scientists from universities have made many fundamental contributions over the last few decades (e.g., most recently, the Southern California Earthquake Center), the USGS must rely on close partnerships with the academic community. In its pursuit of fundamental understanding of processes which govern the evolution of active continental margins, NSF and GeoPRISMS are poised to contribute to the quantitative appraisal of geohazards and their migration.

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GeoPRISMS Online

Charles Bopp, Science Coordinator

The new GeoPRISMS website is up and running (***http://www.geoprisms.org***), with lots of useful information for the community, and new material is being added daily. Most of the material formerly available on the MARGINS website is now available on the GeoPRISMS website, including logos, archives of listserv announcements and newsletters, DLP information, NSF solicitation information, data portal access, and program documents such as science and implementation plans.

We have also added a number of important improvements:

- The website now features a tightly integrated set of Google Calendars to track events such as GeoPRISMS meetings, deadlines, and dates, as well as the Distinguished Lectureship Program schedule. ***http://www.geoprisms.org/calendar.html***
- A new listserv archive, now easier to navigate and searchable with the ability to print or export every listserv notice to PDF. The archive also features an RSS feed and listserv signup. Find this at ***http://www.geoprisms.org/listserv-archive.html***
- A new "Events" section for information about geologic and GeoPRISMS-related current events. This area of the website most recently featured GeoPRISMS-related resources for the Japanese earthquake of March, 2011. The events page will be updated as new events take place, and features RSS-feed capability. ***http://geoprisms.org/events.html***
- The list of GeoPRISMS NSF awards is now up-to-date and available. ***http://www.geoprisms.org/list-of-awards.htm***

Call for Interdisciplinary Mini-workshop Proposals

The GeoPRISMS Office and GeoPRISMS Steering and Oversight Committee (GSOC) seek to support early planning activities relating to GeoPRISMS science objectives, both at the new GeoPRISMS primary sites and for initiative thematic studies (see GeoPRISMS science planning documents at ***http://www.geoprisms.org/science-plan.html***). Members of the GeoPRISMS community can apply for support to organize and fund mini-workshops to be held in conjunction with national meetings, to bring together groups of interdisciplinary investigators for these purposes. Such mini-workshops can be associated with GSA, AGU or other national meetings at which the research area is well represented. Options for mini-workshops include 2-4 hour sessions in an evening, or half-day sessions before or after the meeting. Mini-workshops can bring together multiple investigators with interests in one of the primary sites, spanning multiple primary sites within one initiative, or addressing a theme that transcends initiatives, depending on the group's objectives and assessment of the greatest needs.

Mini-workshop proposals should be submitted at least three (3) months prior to the proposed meeting date to info@geoprisms.org. Proposals for mini-workshops during GSA 2011 are due August 1. Proposals for mini-workshops during AGU 2011 are due September 1.

Proposals should include the following:

- Scientific rationale for the workshop and reason for its timeliness
- Sufficient evidence that a wide group of interdisciplinary researchers would be able to attend
- The national meeting with which the mini-workshop would be associated
- Possible meeting dates and desired meeting format (evening, half or full day, pre- or post-meeting)
- Proposed number of attendees
- Anticipated costs (meeting space, refreshments, A/V equipment, etc.)
- Note: A detailed budget is not required initially, and participant travel and/or lodging costs cannot not be provided.

Approved proposals will have reasonable costs associated with the meeting covered by the GeoPRISMS Office. The office will also assist with logistical arrangements. Workshop conveners are responsible for developing the science program and communicating with participants on scientific matters. Any GeoPRISMS supported mini-workshop will be open to all interested parties and will be advertised via the GeoPRISMS mailing list and website. Workshop conveners will provide a summary, including major results of the meeting for inclusion on the GeoPRISMS website and newsletter within 60 days of the meeting. This is an excellent opportunity to jump-start science and implementation planning discussions for future GeoPRISMS studies, and we encourage you to consider such an undertaking.

Academic-Industry Collaborations and GeoPRISMS Research Opportunities

GeoPRISMS research will address basic and applied scientific questions along continental margins that are of interest to both academic and energy-industry communities. Such overlapping interests motivate closer interactions and collaborations between academic and industry scientists where possible, a point made by the MARGINS Decadal Review Committee in its recommendation to NSF to support the renewal of the program, in the form of GeoPRISMS. In response, substantial discussions on potential collaboration opportunities were held at both the MARGINS Successor Planning Workshop in February, 2010 (see MARGINS Newsletter Issue ##) and the RIE IW (see page 5, this issue). One recurring theme of discussion was that the GeoPRISMS scientific themes (http://www.geoprisms.org/science-plan.html) include topics of active research in industry and academia, thus identifying natural collaboration opportunities. The community, however, must develop and strengthen them.

Numerous models for academic-industry collaborations exist and have been implemented including individual, directed research projects between one university research group and one company, university-led research consortia of a general theme, and data sharing to address different objectives of academic and industry scientists. Successful collaborations have: (1) addressed a problem that was relevant to both industry and academia; (2) involved fundamental science; and (3) used an appropriate dataset or a unique approach to studying the problem that benefitted both communities.

In the following pages, we outline four examples that demonstrate how academic-industry collaborations are mutually beneficial. These examples demonstrate the cross-disciplinary success of academic-industry collaborations. They emphasize that interactions can take a range of formats while addressing topical research questions of interest to academia and industry. The GeoPRISMS research themes fit objectives of both communities; therefore it seems natural that more collaborative research programs should be constructed. The enthusiasm expressed at GeoPRISMS workshops and the existing dialog are a solid foundation, but scientific curiosity and continued discussions are required to create the opportunities. We hope to see new joint projects develop and more sharing of knowledge and data between academic and industry colleagues. The end result will be a better understanding of margin-related processes, ranging from controls on thermal evolution of margins to lithologic prediction of sedimentary deposits.

- Brandon Dugan, Rice University

Seismic Data Opportunities

Contributor: Brandon Dugan (Rice University)

Seismic data are central to constraining many regional-scale GeoPRISMS problems, and industry has overwhelming volumes of seismic data. Often the data are acquired for regional or prospect analysis, with no impediment for use by academics (see examples on following pages). In some instances, data can be acquired for academic use through public repositories or through consortia. The Seismic 3D Lab at Cardiff University (http://www.cardiff.ac.uk/earth/seismic/index.html) is a state-of-the-art 3D research facility that uses high-resolution seismic data to address basin analysis problems including deposition, deformation, fluid flow, and basin evolution. For example, through the analysis of high-resolution data from the North Sea, they interpreted the mechanics of the South Voring Slide and developed a conceptual model on landslide formation and thinning (Bull et al., 2009). Studies on fluid expulsion features have also relied heavily on these 3D data and facilities to develop a comprehensive understanding on the distribution, size, and formation of fluid-escape features including fluid-expulsion pipes, pockmarks, and sandstone injections (Moss and Cartwright, 2010; Cartwright, 2010). Such studies address academic questions on fluid transport and sediment deformation, while in the industry they address reservoir connectivity and seal capacity. The 3D lab also develops basic and novel interpretation strategies for use with 3D seismic data. The facility leverages existing data sets available from industry via public databases or speculation seismic data to complete these research endeavors. The laboratory has grown from financial and data support from multiple industry, national, and computer sponsors.

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Quantitative Stratigraphy

Contributor: David Mohrig
(University of Texas at Austin)

One avenue for substantial scientific interaction between the academic and energy industry communities is in the field of quantitative stratigraphy. Making predictions of characteristic bed thickness, grain size and sorting, patterns of erosion and mud deposition are important in hydrocarbon exploration and hydrocarbon production. During exploration, any constraints on the expected properties of reservoirs are of great value to teams of exploration geoscientists assessing hydrocarbon plays. During production, any constraints on the possible arrangement of reservoir elements, baffles and barriers allow production teams to optimize the placement and number of drilled wells. These predicted properties for sedimentary deposits accumulating at continental margins are parameters derived from numerical, laboratory and field studies of both coastal and submarine landscapes by academic scientists, including those connected with NSF GeoPRISMS. This connection between industry and academic scientists is probably strongest amongst those working on the continental slope. Industry colleagues are keen to establish predictive tools for evaluating deep-water hydrocarbon systems because of the extreme costs associated with developing these hydrocarbon fields and academic scientists are keen to acquire access to data sets from this environment that are extremely expensive to collect.

Drs. David Mohrig and James Buttles and students at MIT and UT-Austin have been involved with a handful of industry sponsored research projects focused on constructing, testing and refining everything from numerical to conceptual models for deep-water sedimentation. While the research has centered on laboratory experimentation and model construction, there has always been a direct tie between these university campus based components and work on industry derived data sets defining patterns of sedimentation preserved in the subsurface. This connection between the physical and numerical modeling and subsurface data sets allows for a nearly real-time testing of ideas and model results at the natural length and time scales. Access to industry data sets has been primarily accomplished via graduate student internships with the collaborating companies. Final products of these projects are theses and scientific papers published in refereed journals. These published papers include industry and university derived data (e.g., Straub and Mohrig, 2008; Das et al., 2003) (Figure 1) and are very often co-authored by both academic and industry scientists (e.g., Straub et al., 2008). While most of these studies have a connection to topics with obvious business impact, this is not always the case. Academic and industry scientists can work together on somewhat esoteric or fundamental scientific problems. One example of such a collaboration is the paper by Metz et al. (2009) where academic and industry colleagues applied a collective understanding of processes affecting the production of channelized stratigraphy to interpret the environment of deposition for ancient fan deposits observed on the surface of the planet Mars.

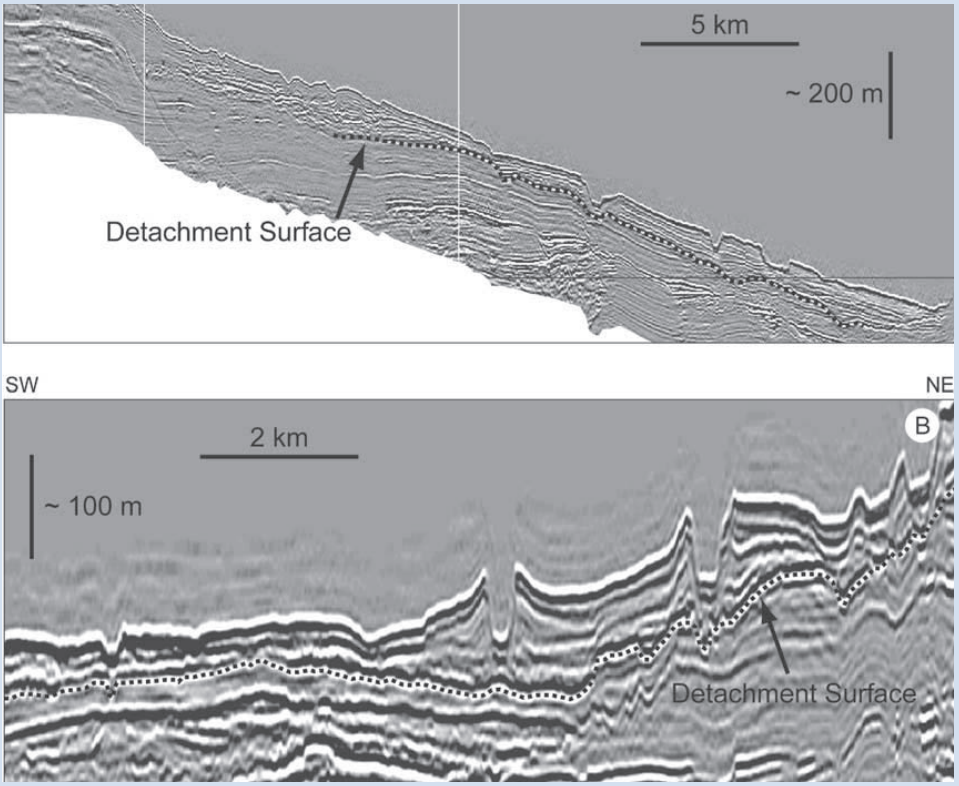

Figure 1. Example of shallow, high-quality seismic data provided by industry for academic research on channel morphology & levee growth (Straub & Mohrig, 2008).

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Industry Geoscientists Examine Iberia Seismic Data as Analog to Prolific South Atlantic Margins

Contributor: Alison Henning (Rice University)

Academics and industry are both interested in improved models of lithospheric extension; industry interests are expanding due to recent exploration successes in distal reaches of passive margins, and academia is continuing to address paradigm shifts in models of early continental breakup. The Iberia margin has an ideal dataset of seismic and drilling data of value to both groups.

The academic community has acquired a considerable body of seismic and drilling data along the Iberia margin. It is an end-member non-volcanic rifted margin with very little sediment cover, making it an ideal site to image and to sample prerift, synrift and postrift sequences. Numerous seismic profiles, DSDP Site 398, and ODP Legs 103, 149 and 173 have revealed multiple episodes of rifting, extreme thinning of continental crust, and exhumed mantle at the seafloor (e.g. Peron-Pinvidic et al., 2007; Pinheiro et al., 1996). While many models have been proposed, the mechanism of rifting is still not well understood. The margin is highly asymmetric, and the conjugate Newfoundland margin is one of GeoPRISMS five focus areas. Conversely, there has been little industry activity along the Iberia margin because there are no known hydrocarbon accumulations there. The oil and gas industry has a well known interest in the South Atlantic margins that formed earlier, during the Jurassic, and contain prolific hydrocarbon provinces such as offshore Angola and Brazil. Recent large discoveries offshore Brazil have re-focused industry interest on Atlantic passive margins and the need to understand the mechanism of rifting. Industry geoscientists are now looking to data collected by academics from the North Atlantic margin to help them achieve a fuller understanding of the evolution of rifted systems.

In 2010, a group of geoscientists from BHPBilliton was given access to a series of 2-D seismic lines acquired along the Iberia margin in 1997 by the R/V Maurice Ewing (supported by NSF grants OCE-9521517 and OCE-9911725) (Henning et al., 2004). This is motivated by the recent discoveries in the central South Atlantic Margin in deepwater Aptian age pre-salt reservoirs. These prolific pre-salt petroleum systems in pre-cursor rift basins are controlled by the rift architecture dominated by tilted fault block structures. Thick passive margin sediment cover with complex post-rift deformation of mobile salt layers makes imaging and interpretation of the pre-rift and early and late syn-rift sequences challenging in the central South Atlantic basins. Comparative rifted continental margins where sediment cover and complex lateral velocity gradients are minimal provide excellent laboratories for understanding complex rift-related structures. The central Atlantic Iberia and conjugate Newfoundland margins provide such a setting where pre-rift sequences have been penetrated by research wells with results calibrated to seismic refraction and reflection data. The Iberia margin research continues to provide insights into how extended continental margins can behave during rifting. For example, structurally-oriented noise filtering and seismic attribute analysis performed on the 2D Iberia seismic data provide new insight into the processes associated with margin formation (Figure 1).

Both academic and industry scientists agree that identifying crustal variations across passive margins is critical to forming an improved model of lithospheric extension. Such a model will not only contribute to our understanding of the Earth system, but to the search for hydrocarbons as well. The use of these academically collected data by industry could lead to additional data collection and/or data sharing between BHPBilliton and Rice University.

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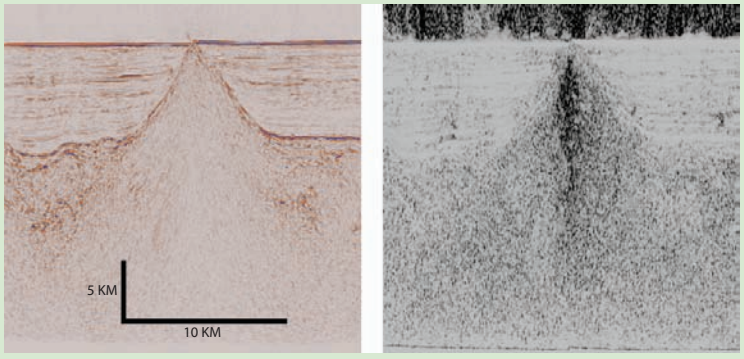

Figure 1. This 2D profile from the ISE-97 project images the peridotite ridge, part of a series of serpentinized peridotite outcrops along the margin interpreted as exhumed mantle. The mechanism of its emplacement and role in margin evolution is not well understood. a) A structurally-oriented post-stack noise filter was applied to the seismic line, removing significant amounts of dipping coherent noise. b) The semblance attribute was then calculated on the processed section, revealing a vertical zone of low semblance. This geometry suggests a possible intrusive origin for the peridotite ridge.

Structural Geology and Deformation of Passive Margins

Contributors: Frank Bilotti and Chris Guzofski (Chevron)

Large-scale deformation processes along passive margins are controlled, in part, by sediment loading, gravitational collapse, mechanical strength of sediments, and pore pressure regimes. Examples of academic research of passive margin deformation have included the mechanics of upslope extension and downslope contraction, the origin and maintenance of high pore fluid pressures, and the influence of sedimentation on deformation and fluid flow. Industry is interested in the same processes to understand numerous aspects of hydrocarbon systems such as the distribution of hydrocarbon traps and seals and the integrity of seals as influenced by sediment strength and pore pressure. These complementary interests have led to cooperative research programs on passive margin deformation.

The industry's understanding of the structural geology of passive margin deformation in general, and the Niger Delta specifically, has benefited greatly from collaborations with the academic community. For example, Texaco's regional and exploration teams were struggling to understand the relationships between toe thrust displacement and fold geometry. Interactions with John Suppe's group (Princeton University) resulted in an expansion of fault-related folding theory to include a component of shear imposed on the classic fault-bend fold theory. One thing that facilitated this research was providing Suppe's group with access to speculative seismic data from vendors. This experience also illustrated that seismic vendors often have an interest in advertising their spec products, which publishing high quality seismic in journals can help accomplish (Figure 1). The access to industry-quality seismic data provided a catalyst for resolving a basic problem of structural geology.

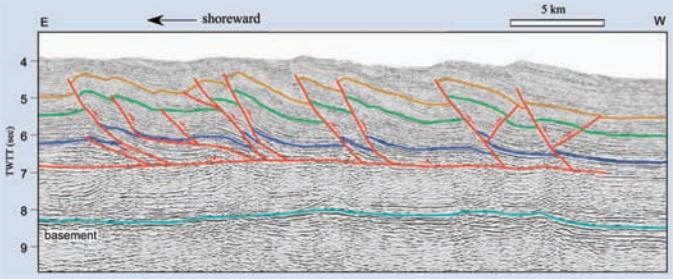

Figure 1: Seismic reflection profile from to of the Niger delta used as part of cooperative study between Chevron and Harvard (Bilotti and Shaw, 2005).

One important result of this work was that it showed how the structural styles inform us about contrasts in rock strength. Through the use of some simple critical-taper wedge models, with some input from Tony Dahlen and John Suppe, Chevron determined that huge strength contrasts due to the distribution of fluid pressure were the most important factor in the gravity tectonic system. Subsequent academic studies have shown that this is the general case for passive margin tectonics. These basic results for the Niger Delta were expanded upon by Chris Guzofski (while at Harvard University) to show that there were local, perhaps even prospect-scale effects of fluid pressure distribution (e.g., Bilotti and Shaw, 2005; Guzofski et al., 2009) (Figure 2).

John Shaw's group (Harvard University) also began a series of studies based on speculative seismic data from the Niger Delta that both became part of several doctoral dissertations and helped solve some basic problems of structural evolution of the delta. These projects started off as 2D studies of fault-fold interaction and growth and quickly led to 3D studies. With the Chevron and Texaco merger, there was a strong interest in further development of the nascent field of 3D structural restoration. In collaboration with the GOCAD consortium at Nancy Universitié, Harvard University, and Stanford University, Chevron has been developing workflows and software to restore geologic models in 3D, using realistic mechanics and boundary conditions. Without the specialties provided by each vested group, we would not have been able to develop industry leading applications and workflows for oil and gas exploration.

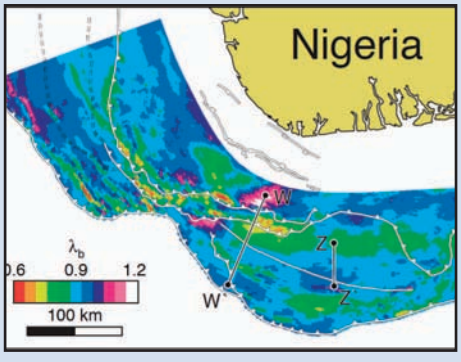

Figure 2. Example of mechanical parameters (basal pore pressure ratio, λ_b) interpreted from bathymetric data and basement dips (Guzofski, 2007). Data provided by Veritas DGC, Ltd.

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"Pop" Stars: Graduate Students Sound Off at Implementation Workshops

Maggie Benoit (College of New Jersey); Andrew Goodliffe (University of Alamaba); Jeff Marshall (Cal Poly - Pomona)

One of the important goals of the GeoPRISMS Education and Outreach Advisory Committee (GEAC) is to develop an interdisciplinary research community of young scientists who will be the next generation of GeoPRISMS investigators. Our first effort to foster this community consisted of a series of activities at the recent RIE and SCD implementation workshops designed to increase graduate student participation in the workshop and encourage the students and postdocs to interact with each other and more senior members of the community. These workshops were essentially the "kick-off" for the GeoPRISMS Program. The student and postdoc activities were an opportunity to set the stage for an increased emphasis on education and outreach programs in the coming decade of interdisciplinary continental margin research.

In addition to participating in the regular workshop activities and break-out groups, the graduate students (and postdocs at the SCD meeting) had their own set of responsibilities. While students participated in the traditional poster presentations, students were also given an opportunity to present one minute "pop-up" poster presentations in front of all workshop participants. These pop-ups consisted of one or two presentation slides, projected in the front of the room, that conveyed the essence of their large-format posters. The pop-ups gave the students a chance to advertise their posters to the whole workshop as well as provide an opportunity for the students to gain experience speaking on stage at a meeting. Student posters were judged by the meeting conveners at the RIE meeting, and prizes were given to Erin DiMaggio (Arizona State) and Scott Bennett (U.C. Davis).

Perhaps the most unique activity involved the students and postdocs creating their own implementation plan for the RIE and SCD programs, respectively. For this, the students had to participate in the regular workshop break-out groups and report back to each other in the evening and at lunch breaks. The students then worked late into the night to develop their own plans to determine the best ways to implement the scientific goals of the GeoPRISMS program. On the final day of each workshop, the students were given a half-hour timeslot to present their implementation plan to all of the workshop participants. At the RIE workshop, the graduate students designed a plan that was quite different than the final outcome of the workshop: They purported that the East African Rift and Walker Lane regions should be selected as focus sites for the new program. (Ultimately, the East African Rift was selected, along with the East Coast of North America, by community vote.) At the SCD workshop, the students came up with an implementation plan that was remarkably similar to the final outcome of the workshop, arguing for three primary sites: Alaska, Cascadia, and New Zealand. Overall, both groups of students provided thoughtful and convincing presentations for the workshops.

Figure 1. Graduate students and postdoctoral scientists discuss their interpretation of the SCD implementation plan before presenting it during the final day of the workshop.

The students also had the opportunity to informally interact with more senior workshop participants at meal times, where students had the chance to talk to them about career development advice. The students seemed to find this particularly helpful, and it served to build a stronger sense of community among the participants. Jennifer Wade (NSF GEO-EAR), who spoke to the students during dinner at the SCD workshop commented "I'm still considered early-career, and I've followed what you might call a non-traditional career path... I always look forward to explaining to students that they don't *have* to follow the tenured faculty position path that so many assume is the only option with a PhD. The students seemed encouraged by this, and we had

a great time talking about their plans (for both research and life in general), and the many options that stand before them. Conversations like this are one of the great things about the graduate student and post-doc program that GEAC is running at the workshops, because it gives the students time to talk openly and casually with career scientists... I know that attending MARGINS workshops as a student myself really drove my interest in not only the science, but the community as a whole, and I hope we can do that for this generation of students through GeoPRISMS!"

The students also had a chance to express their own views about what kinds of activities and opportunities they would like the GeoPRISMS program to provide for them over the next decade. The students made specific requests that included: continuing pop-up presentations and setting aside time for graduate student discussion sessions in future meetings, highlighting graduate student research in upcoming newsletters, offering short courses, and implementing continuing online discussion forums via social media.

"The students worked late into the night to develop their own plans to determine the best ways to implement the scientific goals of the GeoPRISMS program."

Feedback regarding the outcomes of the graduate student activities at the workshops has been enormously positive from both the graduate students and postdocs themselves, and from the other workshop attendees. Elizabeth Desser (M.S. Candidate, Penn State) said "The GeoPRISMS RIE workshop gave us a unique opportunity to contribute to the decision-making process... the graduate student activities we engaged in were guided along by experienced researchers, but ultimately we made our own proposals and had opportunity to present and justify these decisions - an invaluable experience! Also, I learned how decision-making processes work. With so many participants coming from different walks of life and experience, I learned that combining ideas from people with common goals is a powerful thing and perhaps a strong condition for scientific progress."

More senior workshop attendees expressed that the graduate students also influenced the workshops in a number of beneficial ways. Jeremy Boyce (CalTech) stated, "The students were the first to bring up 'Broader Impacts.' I remember some chuckles as the adults in the room realized the oversight. But they were the ones that emphasized the relevance of SCD research to the public and the importance of greater public outreach." Dale Sawyer (Rice), who attended the RIE workshop commented, "Contrary to typical workshops, the graduate students were fully engaged in assessing scientific priorities and research opportunities. I have never seen a group of young scientists have so much positive influence on the results of a workshop!"

MARGINS Bibliography

The MARGINS Office compiled a list of publications related to MARGINS science. Currently more than 250 MARGINS-funded publications are included, as well as over 200 related articles.

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- Links to partner programs and resources
- References database with papers tied to data

GeoPRISMS references database of relevant publications is now available: *www.marine-geo.org/portals/geoprisms/references.php*

To submit missing data sets, field programs or publications to the GeoPRISMS portal, contact info@marine-geo.org

GeoPRISMS - MARGINS Data Portal Status Report

Andrew Goodwillie and GeoPRISMS/MARGINS Database Team (Lamont-Doherty Earth Observatory)

In October 2010, the Lamont database group began operating under an agreement with NSF. In addition to continuing to serve as the MARGINS data portal, work began on a data portal for the new GeoPRISMS program. Information on existing, high-priority data sets in GeoPRISMS Primary Sites is being compiled and the group looks forward to working with the broad GeoPRISMS community to provide a range of versatile tools and resources for accessing and visualizing data of relevance to the program.

Although data policies may not be considered exciting to read, all investigators must now meet an NSF requirement that each submitted proposal includes a data management plan. To help with this, we developed an on-line tool (www.ieda-data.org/compliance)that can be quickly filled in by PIs and printed in PDF format ready for attachment to a proposal. We are also developing of a tool to help PIs meet NSF data policy compliance. The MARGINS program has ended but ongoing MARGINS-funded and related field programs have yielded new contributors to the database since the last newsletter. The database group would like to thank the following investigators for their contributions.

For the Salton Trough on-land extension of the Gulf of California, Axel Schmitt provided information on his study of magmatism associated with the Cerro Prieto volcano and geothermal field. For the Salton Seismic Imaging Project, led by John Hole and Joann Sock, seismic shooting began in early March 2011 and is expected to last three weeks. In the IBM region, expanded bathymetric surveys in 2010 by Jim Gardner for the US Law of the Sea Extended Continental Shelf claim has resulted in new high-quality bathymetry grids that can be downloaded as well as viewed as a layer in GeoMapApp.

An integrated, searchable MARGINS bibliography with more than 370 MARGINS references was released: www.marine-geo.org/portals/margins/references.php. Papers are tied to data sets so that with just a few mouse clicks, a user is taken to data. The lists of publications can be exported to EndNote™.

GeoMapApp and Virtual Ocean

The free map-based data exploration and visualization tool GeoMapApp (www.geomapapp.org) saw a major version 3 release. The underlying global elevation model now includes cleaned multibeam swath tracks from more than 480 research cruises; there is also a 50m layer on some continental shelves. Additionally, global land elevations now comprise 30 m NASA-Japanese ASTER data and very high-resolution 10m USGS NED data for the entire US landmass, including Hawaii and Alaska. High-quality, built-in bathymetry around US margins will also be relevant for GeoPRISMS science. Under the GeoMapApp Focus Site tab, new links are provided to downloadable MARGINS-funded data. GeoMapApp was further enhanced with new data sets and greater ease-of-use. Users can import their own data tables and grids and manipulate them with the full range of GeoMapApp functionality. Multimedia audio-visual tutorials are available on the GeoMapApp web page.

Virtual Ocean (www.virtualocean.org) offers GeoMapApp capabilities in 3-D. A wide range of built-in data sets is available and, as with GeoMapApp, data tables can be imported and manipulated, and custom maps can be generated.

Web page updates

MARGINS portal web pages include an enhanced Search For Data page. In addition to providing key word searches on scientist name, data and device type, field program ID, Focus Site, date ranges and geographical bounds, users can search for data associated with specific publications and MARGINS NSF awards. A Google Maps™-based interactive map shows ship survey tracks, stations and samples from MARGINS-funded expeditions within each of the focus sites. Clicking on a track or station invokes a link to the associated data sets and field program information. Data file downloads are compiled annually and sent to the contributing scientists.

Education and Outreach

The database group took part at the October 2010 GSA national meeting in a full-day workshop on continental margin magmatism leg by Bob Stern, Kerstin Lehnert and Andrew Goodwillie. Database resources, including GeoMapApp, are also used in a number of undergraduate-level learning modules called MARGINS mini-lessons (http://serc.carleton.edu/margins/collection.html) which range in duration from in-class segments to multi-lab units.

MediaBank (media.marine-geo.org) provides access in a gallery format to MARGINS-related images which include photos from field expeditions, and images from MARGINS research nuggets and other PI publications, as well as from slide presentations given at recent MARGINS meetings. Additional image contributions are encouraged.

Contribute to the Newsletter

We are now accepting contributions from the community for the Fall 2011 GeoPRISMS newsletter.

If you have an article or other newsworthy item you think may be of interest to the broader GeoPRISMS community, please send it to the GeoPRISMS Office for consideration.

The deadline for newsletter submissions is August 1, 2011

Email the GeoPRISMS Office info@GeoPRISMS.org.

MARGINS/GeoPRISMS Student Prize for Outstanding Presentations

2010 AGU Fall Meeting, San Francisco
December 13-17, 2011

Congratulations to the winners of the GeoPRISMS/MARGINS 2010 AGU Student Prize. As in previous years, the judges were greatly impressed by the quality of the entrants this year, and awarding individual prizes to just a few in such an outstanding field was very difficult.

Here we honor two prize winners and four honorable mentions. The GeoPRISMS Student prize is open to any student who can show a link between their research and the stated aims of the MARGINS/GeoPRISMS Program. We thank all our entrants and judges for making this contest possible and worthwhile.

Oral Presentation Winner

Linda Chernak (Brown University)
Title of Abstract: Experimental Deformation of Dehydrating Antigorite:
Challenging Models of Dehydration Embrittlement **Co-Author:** Greg Hirth
From the Judges: "Exciting results presented clearly, succinctly, and by somebody who clearly has deep understanding of their implications."
From the Student: "I am extremely grateful that my research has been recognized by GeoPRISMS! It is truly an honor to receive an award from a community of such excellent researchers and I am thankful that GeoPRISMS is so supportive of student research."

Poster Presentation Winner

Kristin Morell (Pennsylvania State University)
Title of Abstract: Rock uplift and transient landscape development in response to subduction of the Cocos Ridge, Central American Volcanic Arc
Co-Authors: Eric Kirby, Donald Fisher, Matthijs Van Soest
From the Judges: Nicely organized presentation about a topic of great regional interest.
From the Student:"I am honored to receive this award from GeoPRISMS. I have benefited greatly from the opportunities the MARGINS/GeoPRISMS programs have made possible for me as a graduate student, and I look forward to participating in the program in the future."

Honorable Mention

MaryJo Brounce (University of Rhode Island)
Title of Abstract: Variations in Fe oxidation state at arc volcanoes driven by degassing and crystallization
Co-Authors: Katherine Kelley, Elizabeth Cottrell
From the Judges: Excellent and difficult science. Cutting edge. First order discovery. Excellent Understanding and presentation. Vivacious personal presence.
From the Student:"I am honored to have received distinction from the GeoPRISMS community and look forward to continuing as a member of the GeoPRISMS community. I appreciate the initiative that GeoPRISMS has taken to promote student research and to encourage excellence in communication."

Honorable Mention

Nathaniel Miller (Woods Hole Oceanographic Institute)
Title of Abstract: Growth of Sediment Diapirs in Subduction Zones
Co-Author: Mark D. Behn
From the Judges: Exciting science, very innovative approach to the problem, has clearly mastered the complexities of the modeling and understands the nuances of interpretation. Well presented.
Student's Comment: "I am honored to be recognized by the GeoPRISMS community. As a student, the encouragement I have received from first MARGINS and now GeoPRISMS researchers as been very encouraging. I am excited to be a part of GeoPRISMS and, going forward, motivated to continue to work on expanding our understanding of processes at margins."

Honorable Mention

Erin Todd (UC Santa Cruz)
Abstract Title: The Same Variably Enriched Mantle Wedge in the SW Pacific from Arc Birth to Death
Co-Author: Mark D. Behn
From the Judges: Outstanding passion, maturity, and knowledge.
Student's Comment: "I am very honored research I presented at AGU has received recognition from GeoPRISMS. Participation in the MARGINS community has been a richly rewarding experience for graduate students like myself, in the early stages our careers. I look forward to continuing research related to the successor program for many years to come."

Honorable Mention

Tamara Worzewski (IFM-GEOMAR)
Abstract Title: The Cycle of Hydration and Fluid Release in the Costa Rican Subduction Zone imaged through electromagnetic soundings: Where has all the water gone?
Co-Authors: Marion Jegen, Heidrun Kopp, Heinrich Brasse & Waldo Taylor
From the Judges: "Very original, engaging presentation on a innovative method for exploring subduction zones. Presenter owned the project."
Student's Comment:"With all the excellent GeoPRISMS presentations, I am thrilled to have been awarded a Honorable Mention. It is a great honor that the presentation by my collaborators and me received this recognition."

Enhance the Broader Impacts of your GeoPRISMS Proposals

The GeoPRISMS Office, along with the GeoPRISMS Education and Outreach Committee (GEAC), would like to offer suggestions to proposers responding to NSF solicitations, to help you plan and achieve your broader impacts. Here are a number of strategies to consider:

- Plan to submit your GeoPRISMS data to the **data portal** hosted by MGDS in a timely manner to efficiently disseminate your data to the scientific community. Also, you can download publicly-available data from the data portal to enhance your own research. Info: Andrew Goodwillie andrewg@ldeo.columbia.edu.
- Include the **development of mini-lessons** in your proposal as a way to expose undergraduate students to your research. The GeoPRISMS can help you develop these lessons. Info: Alison Henning at ahenning@rice.edu.
- **Invite your students** into the GeoPRISMS community, where they can take advantage of many student resources. Examples include:
    - Participate in the GeoPRISMS Student and Community Forum at AGU.
    - Attend GeoPRISMS workshops, especially ones that include student symposia.
    - Apply for the GeoPRISMS Student Prize at AGU.
    - Stay informed through the GeoPRISMS listserv. Sign up at http://geoprisms.org/contact-us.html.
    - Visit our web site regularly for updates on these resources and more http://geoprisms.org/.
- Consider including **support for an REU** on a new grant, or applying for a supplement on an existing grant, to involve undergraduates in GeoPRISMS research projects. Undergraduates are encouraged to use the resources listed above. PI-sponsored REUs offer an exciting road toward building a GeoPRISMS-wide REU Program, to encourage the participation of upper level undergraduates in GeoPRISMS research programs. Info: Alison Henning ahenning@rice.edu.
- Apply for a **Research Experience for Teachers (RET)** Supplement to an existing grant or include one in future proposals. You can receive up to $12,500 per teacher to support their participation in your NSF-funded research project. Encouraging active participation of teachers in NSF projects is an excellent way to strengthen the science expertise of our nation's educators. The GeoPRISMS office can help you design the supplement and coordinate with other PIs who are applying for RETs.

MARGINS/GeoPRISMS Postdoctoral Fellows: Biographies

Since 2003, the MARGINS program has funded a number of postdoctoral fellows, both within the special MARGINS Post-doctoral Fellowship and within the regular NSF-MARGINS programs. These biographies profile postdoctoral fellows Hiroko Kitajima and John Naliboff.

Hiroko Kitajima (Pennsylvaniva State University)

Evolution of Sediment Physical Properties in the Nankai Subduction Zone and Implications for the Updip Limit of Seismogenesis (NSF Award 1049591)

Both the updip and downdip limits of seismicity are thought to be controlled by temperature. For the updip limit, it has been hypothesized that change in slip behavior from aseismic creep to seismic slip is affected by smectite-illite transition associated with an increase in temperature. However, the updip limit of seismicity may be controlled by an interaction between multiple mechanical and chemical processes including deformation, sedimentation, metamorphism, fluid flow, dissolution, cementation, and solute transport. Along with temperature, stress states and strain rates are important factors that control deformation and slip behaviors.

As a part of my Ph.D. research at Texas A&M University, working with Frederick Chester and Judith Chester, I investigated mechanical and hydraulic properties of marine sediments along different loading paths to simulate the range of stress conditions in accretionary subduction systems. I deformed sediment core samples recovered from relatively shallow portions of the Nankai Trough accetionary prism during the Integrated Ocean Drilling Program (IODP) Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE). The deformation test results revealed that most prism sediment samples are overconsolidated and that the consolidation state of sediments is an important factor in determining deformation modes (brittle or ductile deformation) and permeability evolution. I have also conducted high-speed rotary-shear friction experiments on fault materials to understand frictional behaviors of natural faults at coseismic slip rates. At such slip rates, dynamic weakening occurs in association with frictional heating, and I realized the significance of temperature on frictional behaviors.

Now at the Pennsylvania State University, I am working with Demian Saffer and Chris Marone, where I will measure acoustic wave velocities on sediment core samples at different stress states. By incorporating measured data with seismic data, I will estimate the *insitu* stress states and pore pressure in subduction systems. The estimation of in-situ stress states can be verified by coring and logging from deeper portions of the accretionary prism in future stages of the NanTroSEIZE. I will also conduct friction experiments on smectite and illite at elevated temperature to document their behaviors and to test the hypothesis for the updip limit of seismicity. I am grateful for the GeoPRISMS/MARGINS postdoctoral fellowship program.

John Naliboff (UC Davis)

3-D Numerical Models of the Dynamics of Outer Rise Faults (NSF Award 1049660)

The dynamic processes of the lithosphere and convecting mantle are largely governed by buoyancy driven stresses and the solid Earth's rheological structure. These solid earth processes operate over a diverse spectrum of spatial and temporal scales, and include frictional sliding along faults, propagation of seismic energy through elastic media and viscous creep in ductile portions of the Earth. In order to correctly link brittle and ductile processes to observations of surface deformation, plate motion and mantle flow it is critical to have independent estimates of the solid Earth's rheological structure and the buoyancy forces available to drive deformation.

During my PhD at the University of Michigan, I focused on the origins of the lithospheric stress field using numerical simulations of lithospheric deformation and mantle flow. The results of my PhD work suggest that rheology may play a large role in the transmission and distribution of stress through the lithosphere. As a MARGINS postdoctoral fellow I plan to continue examining the role of rheology on lithospheric dynamics with Dr. Magali Billen at UC Davis.

The primary focus of my work will center on the dynamics of normal faulting along the bending-induced topographic bulges seaward of trenches in subduction zones ("outer rise"). Normal faulting in the outer rise regions of subduction zones reflects the extensional stress state generated by bending of the downgoing oceanic lithosphere that may produce new faults in the oceanic lithosphere or reactivate pre-existing faults generated at mid-ocean ridges. A number of recent high-resolution seismic studies have revealed the depth, spacing, dip, and offset of these faults at multiple subduction zones, in addition to clear examples of when new faults are formed or pre-existing faults are reactivated. Using high-resolution 2-D and 3-D numerical models, I hope to test how viscous flow laws, brittle yielding parameters, strain-induced weakening and fluid-related weakening affect the formation and evolution of outer rise fault patterns. In addition to providing additional constraints on the rheology of the oceanic lithosphere, these numerical simulations will provide further insight into the large-scale dynamics of subduction zones and the transmission of stress over different wavelengths and timescales in subduction systems.

GeoPRISMS Steering and Oversight Committee Highlights, Fall 2010

October 17-18, 2010 - Hotel Monaco - Portland, OR

Edited by Andrew Goodwillie and Charles Bopp

Much of the discussion during the inaugural GSOC meeting was focused on the ongoing transition from MARGINS to GeoPRISMS, and detailed planning of the two upcoming implementation workshops for the two GeoPRISMS Initiatives: Rift Initiation and Evolution (RIE), scheduled for November 4-6, 2010, and Subduction Cycles and Deformation (SCD), planned for January 5-7, 2011.

1. MARGINS & GeoPRISMS Offices activities

Geoff Abers, the last MARGINS Chair, reported that the MARGINS Office is working very closely with the GeoPRISMS Office to make sure that the program transition is smooth. The MARGINS was also involved in the planning of the Rift Initiation and Evolution (RIE) and the Subduction Cycles and Deformation (SCD) implementation workshops (IW), and would help to run the RIE workshop as the GeoPRISMS Office activities continued to ramp up.

Juli Morgan, new GeoPRISMS Chair, reported that the GeoPRISMS Office at Rice University had received approval from NSF, funding was still pending, and staff were being sought. The new GeoPRISMS website was demonstrated, and all operational files and contact lists were transferred from the MARGINS Office to the GeoPRISMS Office.

2. NSF Updates

NSF program officer Rick Carlson provided an update on NSF matters:

- The MARGINS NSF panel did not operate the past two years, and will not operate in FY 2011. Instead, funding decisions were made internally.
- The initial GeoPRISMS Budget is expected to remain stable at ~$6 million a year.
- Cascadia funding and opportunities were outlined, including $10 million assigned for upgrading onshore GPS and seismic stations and for OBS deployments.
- NSF outlined its desired outcomes from the implementation workshops (IWs). Each IW should outline study sites, prioritized science questions, and give details of site readiness and the planned sequence of events for achieving program goals.
- The timeline for the next GeoPRISMS solicitation was detailed to ensure a July 1, 2011 solicitation.

3. Facilities and Workshops Update

Challenges and Opportunities in Academic Marine Seismology (March 2010): Donna Shillington provided a summary, noting that the data collected onboard the R/V Marcus Langseth are of very good quality, but a number of issues have caused NSF to review all aspects of the facility. The expense of Langseth operations, the shrinking knowledgeable user base, and operational inefficiencies are all of concern to NSF. Workshop participants discussed the definitions of and opportunities enabled by community experiments, and the prospect of a more rapid and open data access. Operational efficiency issues were also addressed.

OBSIP Workshop (September, 2010): Donna Shillington reviewed the outcome of this workshop focused on developing a strategy for the OBS (ocean bottom seismometer) facility in terms of leveraging and promoting community problems. There was enthusiasm for more community workshops, but questions about funding for data analysis, what data products would be released, and similar issues remain.

Earthscope Fault Slip Workshop (October 2010): Sue Bilek summarized this workshop, held shortly before the GSOC meeting. Discussions at this workshop covered seismic and geodetic observations, as well as lab and geologic fieldwork observations, and theory and modeling. Currently, EarthScope land instrumentation focuses on the down-dip end of the slab, but joint opportunities with GeoPRISMS may allow increased attention on the up-dip portion of the slab.

Cascadia Workshop (October, 2010): Geoff Abers reviewed this 2-day workshop which immediately preceded the GSOC meeting, and was focused on developing a four-year deployment plan for ~60 OBSs offshore Cascadia. Significant discussions addressed how and where the amphibious array will be used after the Cascadia initiative ends; Alaska and the East Coast possibilities were discussed. A second workshop is planned for 2012 to evaluate the Cascadia Initiative and to decide what happens next. (A more complete record of this workshop is given on page 14 of this issue.)

4. Database and Data Policy

IEDA (Integrated Earth Data Applications) is now an NSF Facility. A number of additional field programs have been added to the MARGINS database, and total MARGINS data downloaded now stands at ~1.7 TB. The database group will also continue to provide support for GeoPRISMS field programs. In future years, there will be an increasing emphasis on derived data products that support publications. With NSF input, the database group is developing an on-line form for PIs to create data management plans acceptable to NSF. (An update on the database can be found on page 26 of this issue.)

5. Education and Outreach (E&O)

Distinguished Lecturer Program (DLP):The 2010-2011 DLP is considered a GeoPRISMS-MARGINS joint effort. It attracted 67 applicant institutions.

Seven speakers will tour 25 institutions across the nation.

AGU Activities: GSOC agrees to continue the AGU student prize and the popular Townhall and Student Forum, and to hold a GSOC luncheon meeting at AGU.

GeoPRISMS Education Advisory Committee (GEAC): Don Reed and Jeff Ryan were thanked for their time on the MEAC (MARGINS equivalent to GEAC); Jeff Marshall and Maggie Benoit were welcomed to the GEAC. Maggie Benoit will organize student events at the RIE-IW and Jeff Marshall will organize at the SCD-IW, assisted by Andrew Goodliffe. Discussions about the proposed REU (Research Experience for Undergraduates) component of GeoPRISMS concluded that partner organizations or a core of committed PIs will be needed for its success. GeoPRISMS also will explore how to link its E&O efforts to COSEE, which is presently undergoing program review by NSF.

6. MARGINS Initiative Updates

SEIZE: Recent projects funded combine CRSEIZE Osa/Nicoya seismicity data with German data to improve velocity models and attenuation models of Central America. Long-term instrumentation deployed over Nicoya should capture transient events, while Marshall is using sea-level changes, radiometric dating, and uplift histories to study along-strike heterogeneity. A collaborative study of slow earthquakes may clarify their tsunamigenic potential. New SEIZE Postdoc Christie Rowe will model fault processes.

SubFac: IBM arc ash and tephra is being used to study temporal variation in arc volcanism, and the role of O_2 fugacity in mantle processes is under investigations at the Mariana Arc. A collaborative synthesis project will integrate MARGINS geochemical data using the ABS forward-simulating spreadsheet. The SERPENT project will look for serpentine in the down-going plate offshore Central America. Japanese submersible studies of the Marian forearc region will yield geochemical and geochronological transects. 2D fluid flow modeling should demonstrate water release and magma migration at convergent margins. Ikuko Wada is a new postdoc funded at WHOI, working on integrating geochemical and geophysical observations.

RCL: A synthesis project to compile reconstructions of the Gulf area is underway, along with more detailed studies of transtension in ther area. A RAPID award enabled collection of new LiDAR data over the April 2010 Mexico earthquake. Geophysical studies by Forsyth and Savage are interpreted to show anomalous upwelling in the mantle beneath the Gulf of California (recently published in Nature). Salton Trough activiites are ramping up, including geochemical studies, extensional history, and a new active-source project, which has finally been permitted and is getting underway.

S2S: Work is continuing offshore New Zealand, along with onshore LiDAR and InSAR studies of Waipaoa. Additional work is underway at Fly River. MARGINS Postdoc Alberto Canestrelli is creating modules for different PI groups and working with CSDMS. Tara Kniskern is looking at Waipaoa flood stratigraphy. A Chapman Conference is also scheduled on S2S for January 2011.

7. Initiative Implementation Workshops

The bulk of this GSOC meeting was spent on extended discussion of the upcoming IWs. Discussion started off with important guidelines from NSF:

- GeoPRISMS is not MARGINS, but should build upon its successes.
- Unique and societally-relevant science should be emphasized.
- GeoPRISMS science must stand out from NSF Core Programs.
- Activities that tie OCE and EAR together are strongly encouraged.
- Early-career scientists should be engaged at high levels.
- The completed science plan must outline prioritized science questions and primary sites.
- The implementation plans must be prioritized by readiness, accessibility, and relevance as well as short-, medium-, and long-range goals.
- The structure and schedules of the SCD and RIE IWs were then outlined (the final schedules of these meetings can be found online). Several issues were considered in more detail, in order to prepare for their outcomes. Discussions of funding strategies highlighted the need to leverage funds available through NSF Core programs, and other special programs, and the opportunities for leveraging other NSF facilities, such as EarthScope, that could benefit from the intellectual guidance of GeoPRISMS. The combined approach of themes and primary sites has already been established in the Draft Science Plan (DSP), and therefore is a necessary outcome of the IWs. No major departure from the DSP should be made without an explicit, well-justified reason. Finally, the GSOC agreed that all submitted white papers should be distributed to the workshop attendants.

8. GSOC Rotation

Geoff Abers was thanked for his leadership of MARGINS, and many years of service on the MSC. Sue Bilek, Mark Behn, and Demian Saffer were thanked for their service on the MSC and GSOC. Possible new members of the GSOC were suggested.

Introduction to NEPTUNE Canada

contributed by the NEPTUNE Canada Team
(Contact person: Martin Heeseman, University of Victoria)

Oceans cover almost three quarters of Earth's surface and provide most of the living space of the planet. They produce our oxygen, provide our food, carry our ships and shape our climate. Within the oceans, interconnected biological, chemical, physical and geological processes are unfolding, which we are only beginning to understand.

NEPTUNE Canada offers an exciting new approach to ocean science. Traditionally, we have relied on ship cruises or space-based satellites to carry out ocean research, but ocean observatories like NEPTUNE Canada are changing this. We're the world's first regional-scale ocean observatory network that plugs directly into the Internet. People everywhere can 'surf the sea' while ocean scientists run experiments from labs and universities anywhere around the world. Real-time data access allows us to interactively observe and respond to events such as earthquakes, tsunamis, submarine landslides, fish migrations, plankton blooms, storms and volcanic activity.(http://www.neptunecanada.ca/)

The idea of NEPTUNE Canada began in the mid 1990's with a team of visionary scientists from Canada and the United States who saw a need for a new way that marine research could be conducted that was not limited by cost and access to ship time. Following nearly 10 years of planning by a diverse group of people installation began in 2007. Data flow started in December of 2009 and is intended to continue for the planned 25 year life-time of the observatory.

NEPTUNE Canada's 800 km long backbone cable loop delivers power, Internet access and accurate time to nodes spanning the Juan de Fuca plate in the North-East Pacific. The data over 25 years will allow scientists to study both episodic events and long-term changes. Instruments comprising the underwater observatory operate at depths ranging from 20 to 2660 metres from the coast to the mid-ocean ridge. A network of many dozens of instruments is connected to the Internet and a sophisticated database archives and provides network access to this immense wealth of data. Interested researchers are more than welcome to get involved, both through data use and new instrumentation.

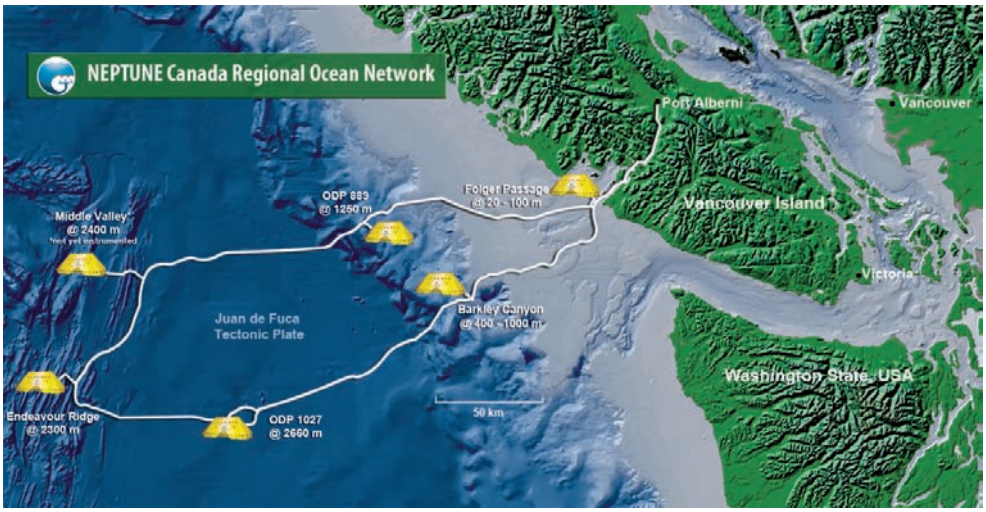

Figure 1. Research location and themes for NEPTUNE CANADA.

As is GeoPRISMS, NEPTUNE Canada is committed to interdisciplinary, community-based collaboration. NEPTUNE Canada node locations cover a wide area of the GeoPRISMS Cascadia Primary Site and the diversity of the connected instruments will allow scientists working in a wide range of disciplines to participate. Connected instruments relevant to the GeoPRISMS science objectives include (For complete list visit http://www.neptunecanada.ca/sensors-instruments/):

- Broadband seismometers at the Barkley Canyon, ODP 889, and ODP 1027 nodes, as well as a seismometer array at Endeavour consisting of one broadband and four short-period seismometers that we hope to complete by the end of this summer. These seismometers will provide a long-term reference for the Amphibious Array Facility that will be temporarily installed as part of the Cascadia Initiative.
- Current meters, sonars turbidity sensors, and sediment traps, that will to detect and quantify sediment transport processes.
- Borehole observatories that monitor temperature and pressure signals related to geodynamic processes as slow slip events, and gas-hydrate stability.

NEPTUNE Canada offers numerous opportunities for researchers involved in ocean and earth sciences. The real-time interactive design of our online observatory will give scientists the ability to respond to rare oceanic events, observe ocean change over decades, and adjust experiments and sampling over time. Opportunities are also available for instruments to be connected to our seafloor network to support both not-for-profit research and for-profit R&D or commercialization work. NEPTUNE Canada welcomes proposals by academic institutions, government research facilities, and not-for-profit organisations and industrial/commercial firms to participate (http://www.neptunecanada.ca/research/research-opportunities/).

Piedras de Fuego and the Trembling Serpent of Nicoya: On the hunt for ancient shorelines and megathrust earthquakes

Nicoya Peninsula, Costa Rica

Jeff Marshall (Cal Poly Pomona) and Jim Spotila (Virginia Tech)

This is the first in a series of field blogs, to inform the community of real-time, exciting GeoPRISMS research. If you would like to contribute to this series, please contact the GeoPRISMS office at info@geoprisms.org

8 March 2011 – Playa Sámara, Guanacaste

Greetings from atop the Nicoya Peninsula seismogenic zone in Costa Rica! We write to you from our beachside table at a popular tavern on Playa Sámara, a fine spot to chill out after a productive day of gritty fieldwork beneath the sweltering Nicoya sun. We are here engaged in our second NSF MARGINS field expedition examining the neotectonics and paleoseismology of the northern Costa Rica fore arc. This project is funded by a collaborative grant entitled: "Seismogenesis of the Middle America Trench at the Nicoya Peninsula over multiple seismic cycles". Jeff Marshall (Cal Poly Pomona) and his students are studying uplifted paleoshorelines to constrain spatially variable patterns of long-term deformation along the Nicoya coast. Jim Spotila (Virginia Tech) and his students are coring coastal estuaries in search of stratigraphic evidence for short-term seismic cycle displacements.

Our joint fieldwork this week focuses on the central Nicoya coast within the area of maximum uplift associated with the seismogenic zone. Our all-star crew includes field savvy grad students Shawn Morrish (Cal Poly Pomona) and Phil Prince (Virginia Tech), as well as geochronology guru Lewis Owen and his post-doc Madhav Murari (U. Cincinnati). Today, we split into two teams, one group seeking datable deposits on river terraces near the coast, and the other exploring coastal wetlands for new coring sites.

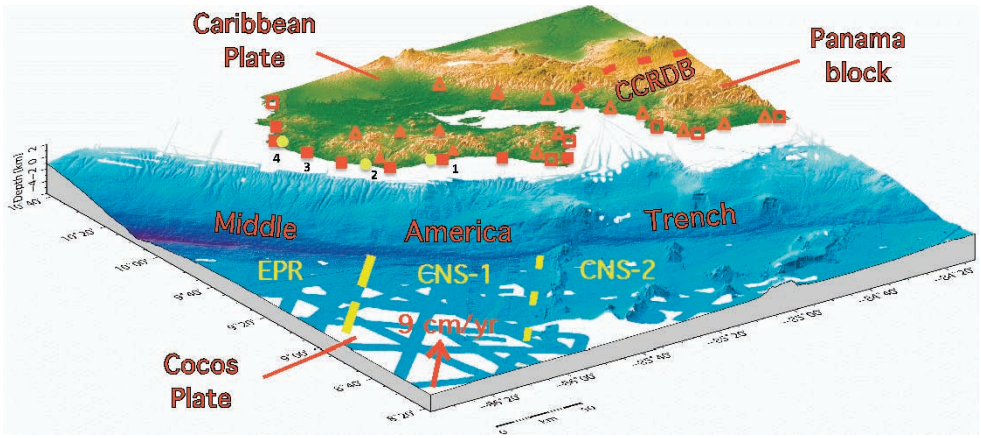

Figure 1. DEM of the northern Costa Rica convergent margin showing primary field sites for this NSF MARGINS project (solid symbols), and prior study sites from related projects (open symbols). Focus of research at each site indicated by symbol shape: marine terraces (squares), river terraces (triangles), and paleoseismic coring (circles). Numbers indicate sites discussed in this article: 1) Puerto Carrillo and Río Ora Valley; 2) Boca Nosara and Punta Peladas; 3) Playa Junquillal and Playa Negra; 4) Tamarindo Estuary. Variations in neotectonic deformation and seismogenesis along the Costa Rica margin are related to three contrasting domains of subducting seafloor offshore: EPR, CNS-1, and CNS-2. (DEM courtesy of C.J. Petersen, IFM-GEOMAR).

The Terrace Team (Marshall, Morrish, Owen, and Murari) headed up the Río Ora Valley inland of Puerto Carrillo to collect samples for ^{10}Be cosmogenic radionuclide dating of radiolarian chert boulders stranded on the surface of late Pleistocene river terraces. These huge bright red boulders are a distinctive feature of the local landscape. Eroded out of oceanic basement rocks in the nearby hills (Cretaceous Nicoya Complex), these boulders were transported downstream by the river and deposited along flood plain terraces. These terraces have undergone progressive uplift and now lie 40 meters above the modern incised channel of the Río Ora. Lewis assures me that the chert has strong potential for revealing the boulder ages, thus allowing us to determine rates of river incision and terrace uplift.

Figure 2. Virginia Tech students (From left Alyssa Durden, Keith DePew, and Craig Cunningham during last year's field expedition measuring paleoseimic sediment core extracted from mangrove tidal flat at Tamarindo Estuary.

The shrill ping of our hammers chipping away at the brutally hard chert inspired a few loud protests from Howler Monkeys congregated in trees just across the river. The commotion also caught the attention of a few large Brahma bulls in surrounding fields. Fortunately, they were more interested in cavorting with the cows than chasing us away. Our noisy pursuits also raised the curiosity of local residents in nearby ranch houses. One kind old "sabanero" who came out to investigate told us that the locals refer to these boulders as "Piedras de Fuego" or "Stones of Fire". He said that the Chorotega people who once inhabited this valley believed the stones were a source of powerful mystic

Upper Left: The "Terrace Team" sampling radiolarian chert boulders for 10Be exposure age dating of a late Pleistocene river terrace, Río Ora Valley. L to R: Madhav Murari (U. Cincinnati), Shawn Morrish (Cal Poly Pomona) & Lewis Owen (U. Cincinnati). Upper Right: Shawn Morrish, Kelly Kinder, Andrew Barnhart (Cal Poly Pomona) sample basalt from marine terrace tread for 36Cl exposure age dating, Playa Negra. L to R: . Lower: MARGINS REU "Team Nicoya" at crater of Volcán Póas. L to R: Jeff Marshall (P.I.), Andrew Barnhart, Amber Butcher, Kelly Kinder, Shawn Morrish, Brent Ritzinger, Kacie Wellington. (Photos by Jeff Marshall).

energy. At a minimum, we hope that they preserve a measurable signal of radionuclide decay.

While the Terrace Team sampled boulders, the Wetland Team (Spotila and Prince) scouted nearby estuaries, searching for potential coring sites that might reveal records of seismic cycle displacements. Despite the impressive jaws of a 5-foot long crocodile patrolling the mouth of the Carrillo estuary, Jim and Phil donned their waders and bravely slogged out into the muddy mangrove swamp. At one site, they uncovered some intriguing peat horizons separating sharp contrasts in sediment grain size. Radiocarbon dating and facies analysis will hopefully reveal if these strata are earthquake related. Similar coring studies last year focused on the northern Nicoya Peninsula within an area of low net uplift (Tamarindo Estuary). That work revealed sedimentation rates that are too slow to preserve adequate paleoseismic records. This year we are targeting wetlands along the central coast within areas of faster net uplift and presumably greater coseismic displacements. If the crocodiles permit, we hope to extract some useful data on past earthquakes.

11 March 2011 – Boca Nosara, Guanacaste

We gather around morning coffee, only to learn that a Magnitude 8.9 earthquake has ruptured the northern subduction zone of Japan, spawning a destructive tsunami. For a team of nerdy field geologists, armed with laptops, iPads, and a sketchy wireless connection, this quickly devolves into a tap-and-click competition to access the best seismic data, tsunami models, and real-time disaster videos. We soon begin to appreciate the magnitude of this destructive event. From one subduction zone to another, our thoughts reach out to the people of Japan.

The hotel owner tells us that the local emergency commission has issued a tsunami alert with waves from Japan expected to arrive on the Nicoya Peninsula in the late afternoon. Despite this warning, we head out for fieldwork along the coast. Jim and Phil descend into the Río Nosara wetlands for more paleoseismic coring, while Jeff, Shawn, Lewis, and Madhav hike out along the beach at Punta Peladas in search of terrace sampling sites. "Hmmm, interesting how empty the beach is today!" We are emboldened by the tsunami models we saw online that show a 4:15 pm arrival time for a relatively small wave. Oh, savor the irony, field geologists entrusting their lives to geophysicists! We can see the headlines now: "Six geologists swept out to sea. Geophysicists apologize for modeling error." Yes indeed, this is interdisciplinary plate margins science in action!

At the appointed hour, we return to the "Sunset Bar" at our hotel, perched on the cliff top at Boca Nosara, 40 meters above the beach. This hotel is the officially designated disaster evacuation site for the local community. A crowd begins to gather, tourists and townspeople

mingling and waiting with great anticipation to watch the spectacle. It's "Tsunami Hour" here at the Sunset Bar!

With digital cameras in hand, smart phones buzzing, and wireless laptops glowing with imagery, we read of tsunami impacts around the Pacific basin - Japan, Hawaii, California, and Mexico. Now breaking news from Nicaragua tells of ongoing evacuations along the low-lying coast. And, here at the Sunset Bar in Nosara, gringo turistas jabber and clink bottles, Tica moms chase after their squawking kids, and a group of grungy geologists speak in low authoritative tones of tsunami wavelengths, celerity, and run-up. Everyone watches the horizon.

Then, at 4:15 pm, the predicted time of wave arrival, nothing much happens. Well, yes, we think that maybe there was a bit more movement in the water, wider wave crests perhaps, and the run-up, well, maybe it seemed a little higher. But, all in all, nothing remarkable happens. Sunset proceeds as normal toward the celebrated green flash, fisherman still work the river mouth as the tide floods the estuary, and the Sunset Bar gradually empties as the crowd disperses for dinner. Apparently, at least for now, we dodged a bullet here on the other side of the pond. But, silently, all along the Nicoya coast, the ground ever so slowly continues to subside, the tides cut inland a bit further, and the peninsula accumulates more strain energy, waiting its turn to jump-up and shake.

16 March 2011 – Playa Junquillal, Guanacaste

Greetings from another cliff top perch along the Nicoya Peninsula! The sun is setting as another excellent field day comes to an end. This time, we are at Playa Junquillal, up north where the cliffs are shorter and the first marine terrace lies at half the elevation it has at our prior locations. Our colleagues from Virginia Tech and Cincinnati have flown home to the US, and five more geology majors from Cal Poly Pomona have joined Jeff and Shawn for a second week of fieldwork focused on terrace mapping, sampling, and surveying.

The new members of Team Nicoya are Andrew Barnhart, Amber Butcher, Kelly Kinder, Brent Ritzinger, and Kacie Wellington. These undergraduate students are participants in the REU program supported by our MARGINS grant. Each student is working on a senior thesis focused on one of a series of field sites along the Nicoya coast. These individual projects each contribute a separate piece to the overall research puzzle. Our MARGINS supported fieldwork, both this year and last, builds upon several decades of prior neotectonics research on the Nicoya Peninsula. Together, these studies have documented significant variations in net Quaternary uplift along the Nicoya coastline. On a first order, these variations appear to be related to along-strike differences in the subducting seafloor and seismogenic zone observed by other MARGINS scientists.

Our fieldwork today, took us first to Playa Negra, a world-famous surfing beach featured in the classic cult film *Endless Summer II*. Our goal was to sample basalt outcrops along the cliff edge for ^{36}Cl exposure age dating of the first marine terrace tread. As we plodded across the beach with field packs, rock hammers, and hiking boots, we generated some curiosity among surfers and sunbathers. "Hey, are you guys like scientists or something?" "Totally, dude." Having learned the drill yesterday on outcrops near our hotel, the students performed like a well-oiled machine, chipping out samples, labeling sample bags, taking notes, measuring cliff heights, and recording GPS coordinates. And, most significantly, they lugged all the samples and gear back to our vehicles! Yes, it's nice to be in charge.

Leaving Playa Negra, we drove inland on rocky ranch roads to a wooded area on the second marine terrace where we had seen more of the red chert boulders. Again, the students jumped into action, sampling five of the Stones of Fire with stunning efficiency. If only I can get them to write-up their research reports with such blinding speed! I think it was helpful to entice them with an incentive of cool beverages and lunch in the shade at a favorite eatery up the road. As we left the field with our samples in hand, we stumbled upon a remarkable 6-foot long snakeskin stretched across the ground. We were quite glad we discovered this only as we were leaving the field! I'm sure the beast that left the skin was not far away.

A popular Chorotega legend tells of a giant trembling serpent that lives deep within the rugged mountains of the Nicoya Peninsula. When provoked, this angry creature links its tail with a similar monster beneath Laguna de Apoyo in Nicaragua, and the two serpents thrash about causing violent shaking of the earth. During the colonial era, Spanish priests began leading an annual pilgrimage to a prominent Nicoya hilltop to plant crosses and calm the angry serpent. This practice continues to this day, with a yearly ritual held each 3rd of May on the summit of Cerro las Cruces. Despite the good intentions of such an earthquake mitigation strategy, large temblors still rock the Nicoya Peninsula several times each century.

The last major rupture of the Nicoya seismogenic zone (M 7.7) struck the peninsula on 5 October 1950. This event killed and injured dozens of people, severely damaged buildings and roads, and produced landslides, liquefaction, and abrupt coseismic coastal uplift. Beach residents and fishermen describe a sudden retreat of the ocean that exposed submerged headlands and broad areas of the rocky intertidal platform. During subsequent decades, the tides slowly reclaimed this area and waves now reach further inland than before the 1950 earthquake. High tides routinely inundate parts of the coastline, washing over roads, undermining trees, and sweeping into beachside homes and tourist hangouts. Such changes are apparent all along the central Nicoya coast as the shoreline gradually subsides and strain builds toward the next earthquake. Despite the impending hazard, this beautiful region has become an epicenter for rapid coastal development driven by Costa Rica's world-renowned tourism trade. Construction of hotels, condominiums, and vacation homes proceeds without heed for the lurking earthquake hazard.

It is critical therefore, that geoscientists, government officials, and local residents develop a better understanding of the megathrust earthquake cycle beneath the Nicoya Peninsula. We hope to contribute to this understanding by defining patterns of both short-term seismic cycle motions, as well as long-term net deformation along the Nicoya seismogenic zone.

For preliminary results, see our 2010 GSA and AGU abstracts:

Marshall, J., Morrish, S., Butcher, A., Ritzinger, B., Wellington, K., LaFromboise, E., Protti, M., Gardner, T., and Spotila, J., 2010, Morphotectonic segmentation along the Nicoya Peninsula seismic gap, Costa Rica: Eos, Transactions of the American Geophysical Union, v. 91, Abs. T11D-2138.http://www.agu.org/meetings/abstract_db.shtml

Spotila, J.A., Kennedy, L.M., Durden, A., Depew, K., Smithka, I., Cunningham, C., Marshall, J.S., Prince, P.S., and Tranel, L.M., 2010, Paleoseismic investigations of the Middle America Trench on the Nicoya Peninsula, Costa Rica: A feasibility study of the Tamarindo estuary: Geological Society of America, Abstracts with Programs, v. 42, no. 5, Abs. 250-3. http://www.geosociety.org/meetings/searchabstracts.htm

Acknowledgements

Our research is conducted in collaboration with Marino Protti and Victor González (OVSICORI-UNA, Costa Rica) and many other fine colleagues working on NSF MARGINS science along the Nicoya Peninsula.

To learn more, visit: http://serc.carleton.edu/vignettes/collection/25559.html

Earthscope – GeoPRISMS Science Workshop for Eastern North America

Lehigh University, Bethlehem, PA, October 27–29, 2011

Application Deadline: August 1, 2011

We are pleased to announce a joint workshop aimed at assembling the EarthScope and GeoPRISMS communities, interested in the formative onshore and offshore geological, geophysical, and geodynamic processes of Eastern North America (ENAM). Our goal is to focus community effort on cross-disciplinary learning and research approaches, targeting a national and international forum of scientists from universities, national labs, industry, federal, and state agencies. The transportable array of EarthScope arrives in the mid-Atlantic region in 2012-13, and GeoPRISMS recently selected ENAM as a primary site for the Rift Initiation and Evolution (RIE) initiative. So, the timing is now perfect to organize the community and identify crucial science targets.

The workshop will take as its starting point the ENAM RIE portion of the GeoPRISMS implementation plan (http://www.geoprisms.org/science-plan.html) and the Earthscope Science Plan (http://www.earthscope.org/ESSP). The goals of the workshop will be to clarify common research objectives of GeoPRISMS and EarthScope, as they apply to the geologic, geophysical, and geodynamic inheritance of: (1) the Grenville and Appalachian orogens, (2) the structural, magmatic, and geodynamic setting of rift initiation, (3) the rift-to-drift record preserved in syn- and post-rift sedimentary archives, (4) the processes that characterize the evolution to a mature passive margin, and (5) the active lithospheric and surficial processes that characterize the modern margin with an emphasis on possible feedbacks between surface and deep-Earth processes.

Researchers from all countries are encouraged to apply, independent of past involvement in MARGINS. Post-docs, senior graduate students, and members of under-represented groups are especially encouraged to participate. Funding from NSF is expected to cover a significant fraction of travel and accommodation costs for ~75 participants with a diversity of interests. Applications should include a brief statement of interest and anticipated contribution to the workshop and a short C.V. More information and the application form are available online at http://www.geoprisms.org/meetings/alaska-sep2011.html

Workshop conveners: Frank J. Pazzaglia (Lehigh University), Basil Tikoff (University of Wisconsin), Peter Flemings (University of Texas at Austin), Dan Lizarralde (WHOI), Martha Withjack (Rutgers University), Vadim Levin (Rutgers University)

For more information, contact the GeoPRISMS Office: info@geoprisms.org

Distinguished Lectureship Program

The GeoPRISMS office announces the annual Distinguished Lectureship Program for academic year 2011-2012 with an outstanding speakers guild. Distinguished scientists involved with GeoPRISMS science and planning are available to visit American colleges and universities to present technical talks and public lectures on subjects related to GeoPRISMS science.

The Speakers and Lecture Themes

Geoff Abers
Public Lecture: How Water Deep in the Earth Controls Earthquakes and Volcanoes
Technical Lecture: Imaging with Geophysics: The Heat and Water Cycling in Modern Subduction Zones

Katie Keranen
Public Lecture: Controls on Continental Breakup: Understanding Active Processes Along the East African Rift
Technical Lecture: Extension Beyond the Rift Boundries: Magmatism, Heat, and Depth-Dependent Deformation in Ethiopia

Alison Shaw
Public Lecture: Subduction and the Earth's Deep Carbon Cycle
Technical Lecture: The Chemical Consequences of Slab Dehydration Across Subduction Zones

Steve Holbrook
Public Lecture: Arcs, Continents, and the Andesite Paradox
Technical Lecture:: The Subduction Sponge: Mantle Serpentinization in Downgoing Plate

John Swenson
Public Lecture: Holocene Evolution of the Waipaoa Fluvio-Deltaic System: A Source-to-Sink Perspective
Technical Lecture: Predictive Models for Avulsion Frequency and Lobe Dimensions on Wave-Influenced Deltas

Harm van Avendonk
Public Lecture: The Life Cycle of Rifted Margins
Technical Lecture: Extension of Continental Crust at the Eastern Grand Banks, Newfoundland

Peter van Keken
Public Lecture: When Earth Attacks: Why an Old Planet Causes Volcanoes and Earthquakes
Technical Lecture: Dynamics of Subduction Zones and the Recycling of Water to the Deep Earth

Paul Umhoefer
Public Lecture: Lessons for Understanding Ancient Mountain Belts from the Modern Gulf of California
Technical Lecture: How Plate Tectonics Works in the Southern Gulf of California: A Rapid Birth in a Hot Setting.

Want to Host a Speaker?

Any college or university wishing to invite a GeoPRISMS speaker may apply via www.geoprisms.org. Applications are due August 1, 2011. Institutions that are not currently involved with GeoPRISMS research are strongly encouraged to apply, including those granting undergraduate or masters degrees, as well as those with Ph.D. programs. Institutions may request a technical and/or public lecture. The GeoPRISMS Office will cover airfares for speakers' travel and will coordinate travel and off-site logistics. Host institutions are responsible for local living costs for the duration of the visit. Questions? Email info@geoprisms.org

Biographies of Speakers

Geoff Abers uses the tools of earthquake seismology to illuminate at depth the processes by which material cycles through active plate boundaries, and the manner in which they deform. He has deployed broadband seismic arrays in a variety of rifts and subduction zones around the Pacific Rim. These imaging arrays are used to follow the evolution of subducting crust to sub-arc depths, to understand dynamic processes within the mantle beneath volcanoes, and to better understand fault dynamics. Geoff is a Lamont Research Professor at Columbia University's Lamont-Doherty Earth Observatory.

Katie Keranen is Assistant Professor of Geophysics in the School of Geology and Geophysics at the University of Oklahoma. She studies the tectonics of the crust in active continental rifts and convergent plate margins. Katie earned her PhD from Stanford in 2008 and was a USGS Mendenhall Post-doctoral Fellow. Katie and her students combine active- and passive-source seismic data with potential field data in rift settings to study how rifts form and evolve, and the role of magmatism, thermal state, and structural boundaries in controlling these processes. Katie's current work in extensional settings is focused on the Main Ethiopian Rift and the Eastern California Shear Zone - Walker Lane.

Steve Holbrook is a marine seismologist who has sailed on 15 research cruises studying subjects varying from continental margin structure to seismic oceanography. He is a native of eastern Pennsylvania and did his undergraduate degree in geoscience at Penn State. He worked for Chevron in San Francisco before doing his MS and PhD degrees in geophysics at Stanford. Following his PhD, Steve joined the scientific staff of Woods Hole Oceanographic Institution, where he worked for nearly nine years before joining the faculty at the University of Wyoming.

Alison Shaw is a geochemist at Woods Hole Oceanographic Institution, whose research focuses on understanding the role of volatiles such as H_2O, CO_2 and S in magmatic systems. She studies the chemical composition of rocks, gases, fluids and melt inclusions to quantify volatile fluxes and to identify how volatiles are modified during transfer to and from the mantle. She is currently working on projects at various subduction zones along the Pacific's "ring of fire", including the Mariana arc, the Izu-Bonin arc, the Central American arc and the Kamchatkan arc.

John Swenson studies the morphodynamics of fluvial and shallow-marine systems, with an emphasis on the coupling between these depositional environments. His work focuses on clinoform dynamics,shoreline response to sea-level change, and avulsion and lobe switching in distributary-channel networks. He develops mathematical models that predict how these linked depositional systems evolve and what that evolution leaves behind in the sedimentary record. John is an Associate Professor of Geology in the Department of Geological Sciences at the University of Minnesota.

Paul Umhoefer is Professor of Geology in the School of Earth Sciences and Environmental Sustainability at Northern Arizona University. He studies the tectonics of the upper crust at young and active divergent and oblique-divergent plate boundaries and continental rifts. Paul and his students and colleagues combine field and lab data to study how faults and basins develop in these settings, and the role of tectonics and climate in controlling these processes. Paul's current work is centered on the southern Baja California peninsula, the Lake Mead area of the central Basin and Range, and south-central Turkey.

Peter van Keken is a geophysicist at the University of Michigan who uses computational methods to study the causes and consequences of plate tectonics. He focuses on the long term chemical and thermal evolution of the Earth, the dynamics of mantle plumes and the structure and evolution of subduction zones. Within GeoPRISMS he works in interdisciplinary projects focusing on the cycling of volatiles in subduction zones and their role in generating earthquakes and arc volcanism.

Harm Van Avendonk is a seismologist at the University of Texas at Austin who uses active-source seismic data to investigate the evolution of plate boundaries. At divergent plate boundaries he studies the role of faults in the thinning of continental margins, and the exhumation of continental mantle. He is also interested in the development of sedimentary basins on subsiding margins. At subduction zones he studies the effect of water on the physical properties of the plate interface. He has also made estimates of the amount of water stored in the subduction oceanic lithosphere offshore Nicaragua and Costa Rica.

MARGINS NSF Awards 2011

These are the funded MARGINS Proposals for FY 2011; additional awards will be posted on the GeoPRISMS website

NSF Awards 1049611, 1049620

Collaborative Research: Faulting Processes During Early Stage Rifting: Analysis of an Unusual Earthquake Sequence in Northern Malawi

M. Pritchard (Cornell), D. Shillington (LDEO) S. Nooner (LDEO), J. Gaherty (LDEO)

This project is to analyze earthquake data collected after a large earthquake sequence occurred in the Malawi section of the East African Rift zone. InSAR data from the area will also be analyzed to determine how the region was affected by the earthquakes. The goal of the proposed work is to obtain a better understanding of the deformation associated with the inception and early stages of rifting of a continent.

NSF Awards 1049387, 1049385

Collaborative Research: Reconstructing ancient passive margin dynamics by relating geomorphic and stratigraphic surfaces: a combined laboratory and field study

K. Straub (Tulane), B. Sheets (Washington)

Funds are provided to carry out a lab and field investigation of statistics describing the stratigraphic architecture of passive continental margins and their relationship to geomorphic surfaces. The overall objective of the project is to improve our ability to invert the stratigraphic record for paleo surfaces dynamics and topography. The continental margin record contains features such as bars, channels and channel networks, yet we cannot precisely reconstruct the relationship between these preserved deposits and geomorphic processes that produce them. Thus, the research plan is to use flume models to measure and identify scaling relationships in channelized, distributive systems with a focus on deltaic and deep water systems. The goal is determine how stratigraphic discontinuities are formed and to see if the mechanism of formation can be deduced from statistical descriptions of surface morphology. The ultimate objective is be able to infer the dynamic origin of fossilized erosional surfaces, using relationships derived from the experimental flume models.

NSF Award 1049582

Experimental Constraints on the Rheology and Seismicity of Subducting Lithosphere and the Slab-Wedge Interface

G. Hirth, D. Goldsby (Brown Univ)

To understand the spatial and temporal distribution of earthquakes in subduction zones, as well as the processes responsible for the wide spectrum of fault slip behaviors on the slab/wedge interface, it is important to constrain the rheological properties of altered lithosphere, how they evolve during dehydration reactions, the rheology of reaction products, and the feedbacks between metamorphic reactions and transport properties of the downgoing slab. In this project we will investigate (a) the rheological properties of antigorite at high pressure and temperature; (b) the role of dehydration reaction kinetics on the mechanical evolution of serpentinites and blueschists; (c) the rheology of slab dehydration reaction products at conditions appropriate for intermediate depth earthquakes and (d) the frictional properties of serpentinites at seismic and infra-seismic slip rates.

NSF Award 1049591

MARGINS Post-Doctoral Fellowship Research: Evolution of Sediment Physical Properties in the Nankai Subduction Zone and Implications for the Updip Limit of Seismogenesis

D. Saffer, C. Marone (Penn State Univ)

Funds are provided for a post-doctoral study of deformation and slip behaviors in subduction systems by an experimental approach combined with seismic data and microstructure observations. The PIs will conduct friction experiments on smectite and illite at elevated temperature and measure the acoustic wave velocities on sediment core samples at different stress states. Results of the friction experiments will be used to further test the hypothesis of smectite-illite transition for updip limits of seismicity. The measurements of acoustic wave velocities at different stress states will allow the PIs to estimate the in-situ stress states and pore pressure in subduction systems by incorporating with seismic data. Samples and data from the IODP NanTroSEIZE transect area will be used to investigate the in situ stress and pore pressure conditions.

NSF Award 1049660

Postdoctoral Fellowship: 3D Numerical Models of the Dynamic Generation of Outer Rise Faults

M. Billen (UC-Davis)

This project is to model the development of faults during the bending of the tectonic plate as it approaches a subduction zone. Two dimensional and three dimensional numerical models will be developed using a finite element code. The results of the modeling will be compared to observations of fault patterns observed at subduction zones, mainly the Central America trench where there are plentiful data. Understanding plate strength and how the plate behaves is crucial in geodynamics as convection and energy dissipation on the Earth are mainly driven and caused by subducting oceanic plates.

NSF Award 1049533

MARGINS: Seismic Evidence for Hydration of the Central American Slab: Guatemala Through Costa Rica

E. Syracuse, C. Thurber (Univ of Wisconsin - Madison)

The Central American subduction zone demonstrates a wide variability in along-arc slab hydration as indicated by geochemical studies, with maximum and minimum slab contributions to magma

localized beneath Nicaragua and Costa Rica, respectively, with intermediate slabfluid contributions beneath El Salvador and Guatemala. Geophysical studies are consistent with strong slab serpentinization and fluid release beneath Nicaragua, and little beneath Costa Rica, but otherwise the rest of the arc is poorly characterized seismically. This study will utilize all available seismic data to extend the velocity model developed for Costa Rica and Nicaragua by Syracuse et al. [2008] to the northwestern section of the arc, allowing analysis of the relation between seismic structure and fluid distribution for the entire arc. Data reported to the International Seismic Centre will be combined with data from local seismic networks to obtain an integrated seismic image of the entire Central American subduction zone, focusing on imaging the slab through the use of local and teleseismic double-difference velocity tomography and relocation methods.

GeoPRISMS-EarthScope Planning Workshop for the Alaska Primary Site

September 22-24, 2011, Portland, OR

(after EarthScope Institute on the Lithosphere-Asthenosphere Boundary)

Application Deadline: June 25, 2011

The GeoPRISMS Steering and Oversight Committee is pleased to announce a workshop to develop a detailed science plan for the GeoPRISMS Alaska Primary Site. Alaska was chosen as the highest priority primary site for GeoPRISMS because it offers broad opportunities to address a wide variety of questions outlined within the Subduction Cycles and Deformation (SCD) Science Plan. More details about GeoPRISMS science objectives in Alaska can be found in the GeoPRISMS Science Plans (http://www.geoprisms.org/science-plan.html), and will serve as the starting points for this workshop.

The main goals of the workshop are to clarify common research objectives in Alaska with both USArray and the Plate Boundary Observatory, to discuss the concept of "Discovery Corridors" and identify candidate areas, and to outline detailed implementation plans and timelines for GeoPRISMS research, considering available resources and infrastructure. White papers will be solicited in advance of the workshop to ensure community input.

Researchers from all countries are encouraged to apply, independent of past involvement in MARGINS. Post-docs, senior graduate students, and members of under-represented groups are especially encouraged to participate. Funding from NSF is expected to cover a significant fraction of travel and accommodation costs for ~75 participants with a diversity of interests. Applications should include a brief statement of interest and anticipated contribution to the workshop and a short C.V. More information and the application form are available online at: http://www.geoprisms.org/meetings/alaska-sep2011.html

The program will include a number of overview presentations on Alaska and related MARGINS, GeoPRISMS, and EarthScope research programs, break-out sessions, and plenary discussions, leading to conclusive decisions about science implementation in Alaska.

Workshop conveners: Jeff Freymueller (University of Alaska-Fairbanks), Peter Haeussler (USGS, Anchorage), John Jaeger (University of Florida), Donna Shillington (Lamont-Doherty Earth Observatory), Cliff Thurber (University of Wisconsin-Madison), Gene Yogodzinski (University of South Carolina)

For more information, contact the GeoPRISMS Office: info@geoprisms.org

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GeoPRISMS Geodynamic Processes at Rifting and Subducting Margins

GeoPRISMS Mission

... investigate the coupled geodynamics, earth surface processes, and climate interactions that build and modify continental margins over a wide range of timescales (from s to My), and cross the shoreline, with applications to margin evolution & dynamics, construction of stratigraphic architecture, accumulation of economic resources, and associated geologic hazards and environmental management.

GeoPRISMS Science Structure

Overarching Science Themes

- *Origin and Evolution of Continental Crust*
- *Fluids, Magmas and Their Interactions*
- *Climate-Surface-Tectonic Feedbacks*
- *Geochemical Cycles*
- *Plate Boundary Deformation and Geodynamics*

Subduction Cycles and Deformation Initiative

Rift Initiation and Evolution Initiative

SCD Primary Sites

Alaska

Cascadia

New Zealand

RIE Primary Sites

Eastern North American Margin

East African Rift System

http://www.geoprisms.org/initiatives-sites.html

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Geodynamic Processes at Rifting and Subducting Margins

Workshops of Interest

GeoPRISMS Workshops

• **EarthScope-GeoPRISMS Opportunities in Eastern North America Mini-Workshop**
May 20-21, 2011, Bastrop, TX,
http://www.geoprisms.org/meetings/enam-may2011.html

• **GeoPRISMS Alaska Primary Site Planning Workshop**
September 22–24, 2011, Portland, OR
http://www.geoprisms.org/meetings/alaska-sep2011.html

• **EarthScope–GeoPRISMS Science Planning Workshop for Eastern North America**
Lehigh University, Bethlehem, PA, October 27–29, 2011
http://www.geoprisms.org/meetings/enam-oct2011.html

GeoPRISMS Related Meetings & Workshops

• **Opportunities for EarthScope Science in Alaska in Anticipation of USArray**
May 16-17, 201, Austin, TX
http://www.iris.edu/hq/Alaska_Workshop_2011

• **Using Ocean Drilling to Unlock the Secrets of Slow Slip Events,**
(co-sponsored by GeoPRISMS)
August 1-5, 2011, Gisborne, New Zealand
http://www.gns.cri.nz/slowslip

• **Magmatic Rifting and Active Volcanism Conference 2012**
January 11-13, 2012, Addis Ababa, Ethiopia
http://www.see.leeds.ac.uk/afar/conference.html