GeoPRISMS Newsletter

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Geodynamic Processes at Rifting and Subducting Margins

In This Issue:

Cascadia Initiative Update: Status of Ocean Bottom Seismology Component

By Cascadia Initiative Expedition Team (CIET)

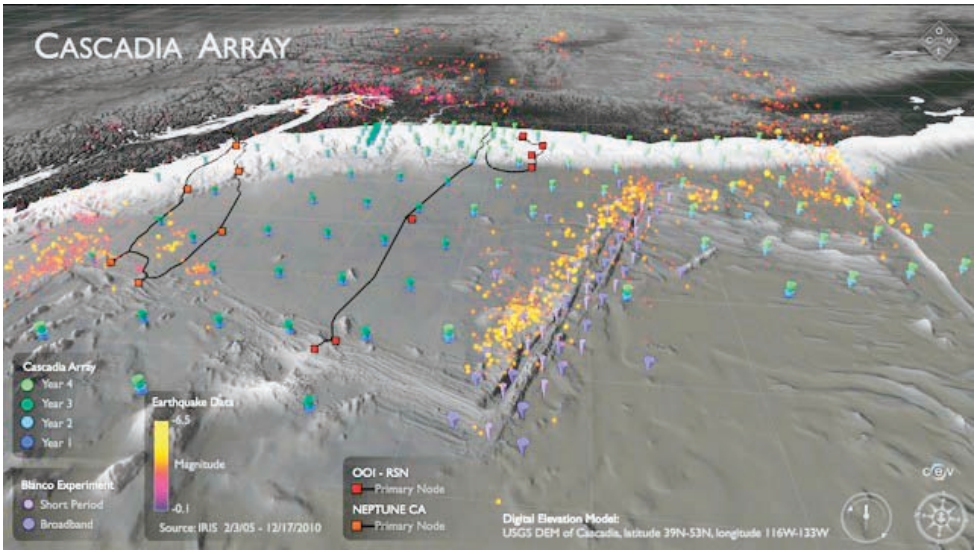


Figure 1. Oblique shaded relief map showing the Cascadia Array, in particular, the four year deployment plan for the Cascadia OBS array of the Cascadia Initiative, The cabled networks associated with NEPTUNE Canada and OOI are also shown, along with earthquake distributions along the continental margin, oceanic spreading centers, and transform faults.

The Cascadia Initiative (CI) is an onshore/offshore seismic and geodetic experiment uses an 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. 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. An article in the previous GeoPRISMS Newsletter (Spring 2011, issue No. 26) described CI scientific objectives, the outcome of an open community workshop held in October 2010 to develop deployment plans for the offshore component of the experiment, and formation of the Cascadia Initiative Expedition Team (CIET). Here we provide an update of CIET activities including the first year of CI OBS deployments (summer 2011) and related Education and Outreach (E&O) efforts.

Over its planned 4-year data acquisition period, the offshore portion of the Cascadia Initiative will involve the deployment and recovery of ~280 OBSs at ~160 different sites and a total of about 14 cruises. Each OBS deployment site requires careful evaluation to ensure that the notional deployment plans developed at the 2010 CI workshop

Coming Soon to our Website

Updated Information from NSF about Proposal Submission Process for the Cascadia Initiative

EarthScope-GeoPRISMS Science Workshop for Cascadia Spring 2012

Visit www.geoprisms.org for the latest updates

take into consideration local bathymetry, trawling hazards and the presence of fragile ecosystems. The CIET incorporates this information into a detailed deployment plan that includes a prioritized deployment schedule. It is anticipated the adjustments to most deployment sites will be minor (e.g., small changes in drop coordinates to avoid geological hazards or take advantage of preexisting multibeam bathymetry). However, practical considerations may require some larger changes to the notional plans, in which case the CIET has developed a procedure for revisions, described on the CIET web site http://cascadia.uoregon.edu/CIET/. Scientific oversight is required at sea to ensure that operation decisions driven by instrument failures, bad weather or other factors are guided by the scientific objectives of the experiment. A detailed cruise report produced for each cruise to fully document the experiment.

The CIET has been actively discussing and planning the 2011 deployments for several months. Since we are geographically distributed and our schedules are often conflicting we use a variety of communication tools. These include regular emails, a CIET web site that provides wiki capabilities, and bi-weekly conference calls with minutes and action items posted to the CIET site. The CIET website is currently used by the group for communication, discussion and limited data exchange. Much of the website content is viewable by the community. Looking toward the future, the CIET site will also be used for education and outreach, communication with the scientific community, and development and delivery of metadata pertaining to OBS deployments and recoveries (e.g., cruise reports). The CIET held its first face-to-face meeting in Seattle on September 13 - 14, 2011.

2011 FIELD SEASON

In accord with the deployment plan developed at the CI Workshop, the CIET proposed to NSF to deploy 70 OBSs during the 2011 field season according to the Year 1 plan (Fig 2). All of the OBS deployments will be done from the *R/V Wecoma*. Given the limited deck space on this ship, 3 cruises will be required to deploy all 70 OBS. The cruise schedule and chief scientists for 2011 operations are as follows:

- Leg 1, July 23 - August 2, 2011. Chief Scientists: Maya Tolstoy (LDEO), Anne Trehu (OSU)
- Leg 2, October 15-29, 2011. Chief Scientists: Robert Dziak (OSU), Del Bohnenstiehl (NCSU)
- Leg 3, October 30 – November 12, 2011. Chief Scientists: John Collins (WHOI), Emilie Hooft (UO)

CI Leg 1 – W1107A

The first OBS deployment cruise for the Cascadia Initiative took place between July 23rd and August 2nd 2011 aboard the R/V *Wecoma*. The cruise deployed 15 of the newly designed LDEO-OBSIP Trawl Resistant Mounted OBSs or TRM-OBSs (Fig 3); the original goal was to deploy 20 TRM-OBSs, however, 5 were not fully built. These instruments are designed to provide a shield around the seismometer to reduce current noise and provide some protection from the bottom trawl fishing that occurs along the Cascadia margin. The instruments were therefore targeted for deployment at shallow sites (<1000 m) where trawling and currents are most likely to be an issue. The TRM-OBSs contain a Trillium compact seismometer as well as a Paros Instruments Absolute Pressure Gauge (APG), which should reduce long period noise and measure seafloor deformation. The TRM-OBSs will record continuously at 125 samples/sec until they are recovered in early summer 2012 using either an attached pop-up buoy system (instruments < 200

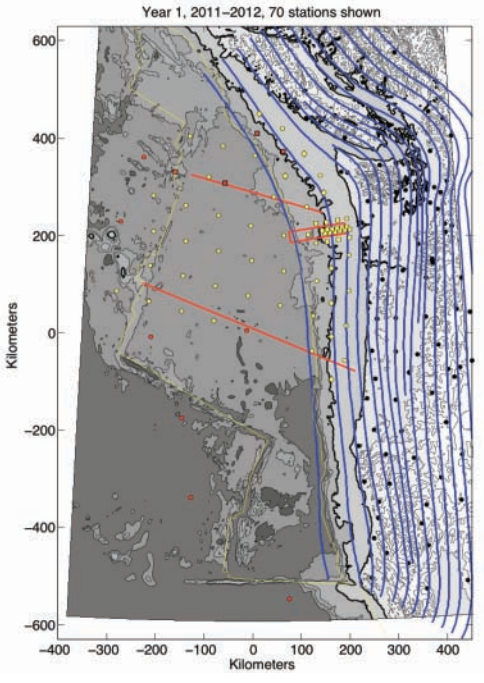


Figure 2 (left). Year 1 Deployment Plan. Red circles denote the reference array. Yellow circles denote the Regional Array. Yellow squares denote the Focused Array. Yellow diamonds denote the densified coverage of the forearc enabled by requesting 10 additional instruments from the OBSIP pool. Black circles denote on land broadband seismometers. Red squares denote the NEPTUNE Canada seismometers. Blue lines denote slap depth contours (every 10 km). The 1000 m bathymetry contour is shown in bold. See 2010 CI Workshop Report for further descriptions.

Figure 3 (right). An LDEO-TRM OBS being deployed aboard the R/V Wecoma in July 2011. The white octagonal frame is designed to sink a few inches into the sediment and shield the seismometer from current noise and trawl fishing.

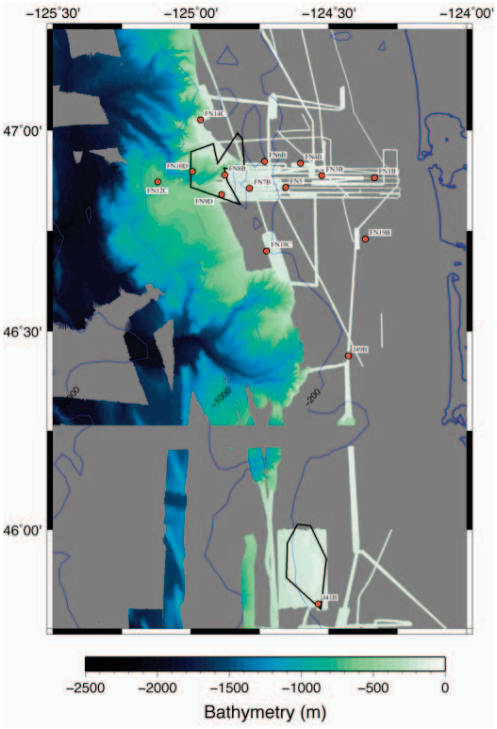


Figure 4: Final deployment locations for W1107A cruise. FN4B was recovered on 8/14/11 by ROV Ropos aboard the RV Thompson. Bathymetry is from the compilation prepared for CIET by C. Goldfinger and colleagues (see next article).

m water depth) or a Remotely Operated Vehicle (ROV).

The TRM-OBSs were largely used to fill the sites of the northern focused array that were </ 1000 m depth because of the advantage of having a tight array of APGs (Fig 4). The CIET and the Amphibious Array Steering Committee (AASC) provided a prioritized list of sites prior to the cruise to enable the co-chief scientists to adapt the deployment pattern as necessary while at sea. Individual site locations were adjusted based on feedback from the chair of the Oregon Fisherman's Cable Committee (OFCC), and different iterations of site locations were identified with the letters B, C and D appended to the site name and number. It is important for both the instruments and the safety of the fishing community and their equipment that regularly fished sites be avoided. One site was inadvertently deployed at a heavily fished site, and attempts to recover it using the attached pop-up buoy failed. The instrument ended up upside down, which was a serious hazard to the fishing community. This instrument was recovered on August 14th by John Delaney and Deborah Kelley (UW), who generously took time out of their Visions11 cruise to pick up the TRM-OBS using *ROV Ropos* aboard the *R/V Thompson*. A video of the recovery can be seen online.

Two community college students joined the cruise as part of a summer enrichment program designed by Dean Livelybrooks (Univ. of Oregon) to introduce community college students to science. A PhD graduate student and an undergraduate IRIS intern also participated. The full complement of watchstanders and 2 co-PIs enabled us to operate research around the clock. While the OBS team slept, 4 & 12 kHz surveys were conducted to image bubbles in the water column from cold seeps in the region.

This cruise was the first full deployment of this new OBS design, and as such, much was learned. You can read a detailed account of the cruise activities in the cruise report which can be found at the CIET website. We are grateful to the Captain and Crew of the *R/V Wecoma* and the science party, who all worked extremely hard to make the cruise as successful as it was.

CI Leg 2: The second CI leg will take place from October 15-29, 2011 aboard the *R/V Wecoma*, leaving from and returning to Newport, OR. This expedition will deploy 25 OBSs, 15 from SIO and 10 from LDEO. The fifteen SIO OBSs will also be installed in trawl-resistant enclosures and are equipped with Differential Pressure Gauges (DPGs); these instruments are deployable at depths extending from the shelf down to 6,000 m. The remaining 10 LDEO instruments are not in trawl resistant enclosures and so must be deployed below 1,000 m; they carry APGs.

CI Leg 3: The third CI leg will take place from October 30 – November 12, 2011 aboard the *R/V Wecoma*, leaving from and returning to Newport, OR. This expedition will deploy 25 OBSs, 15 from WHOI and 10 from the OBSIP pool. These OBSs are not trawl resistant and will be deployed at depths >1000 m; they carry DPGs.

CI EDUCATION AND OUTREACH

The Cascadia Initiative Education and Outreach (E&O) program is developing two opportunities during its first year, led by Dean Livelybrooks (UO):

1) The 'CC@sea' project supports community college ('CC') student participation in OBS deployment, retrieval and pre-cruise and follow-up outreach activities in CCs, high schools and the community. CC@sea leverages another NSF (STEP) program, Undergraduate Catalytic Outreach and Research Experiences (UCORE) that has built strong ties with six Oregon community colleges. Two community college ('CC') students participated in the 23-July to 2-August OBS deployment cruise of the *R/V Wecoma*. The Fellows stood watch, helped with instrument deployment and made movies of all aspects of sea-going research. Dean Livelybrooks also participated in this first sea-going leg to initiate and supervise these activities. The goal of the CC@sea program is to attract students from diverse, non-traditional backgrounds to a four-year degree in physical sciences so these students transfer their experiences to the community and their peers. CC@sea personnel made a very entertaining and informative video suitable for other community college and high school students during the first deployment leg, which will be shown in science classes at participating UCORE campuses and elsewhere.

2) A fall planning, teacher professional development workshop for a seismometers @ schools (S@S) program, where teachers and students, with assistance, install, monitor, and interpret seismograms and characterize shaking at school sites to advocate for seismic retrofit upgrades in older schools in the Pacific NW.

CIET Members: Doug Toomey (Team Leader, U. of Oregon), Richard Allen (U. of California, Berkeley), John Collins (WHOI), Bob Dziak (OSU/NOAA) Emilie Hooft (U. of Oregon), Dean Livelybrooks (U. of Oregon) Jeff McGuire (WHOI), Susan Schwartz (U. of California, Santa Cruz), Maya Tolstoy (Lamont Doherty Earth Observatory), Anne Trehu (Oregon State U.), William Wilcock (U. of Washington)

Cascadia Initiative Update: Bathymetric Surveys of the Cascadia Subduction Zone in Support of the Cascadia Initiative OBS Array Deployment

Chris Goldfinger (Oregon State University)

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 to support EarthScope and MARGINS (now GeoPRISMS) 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.

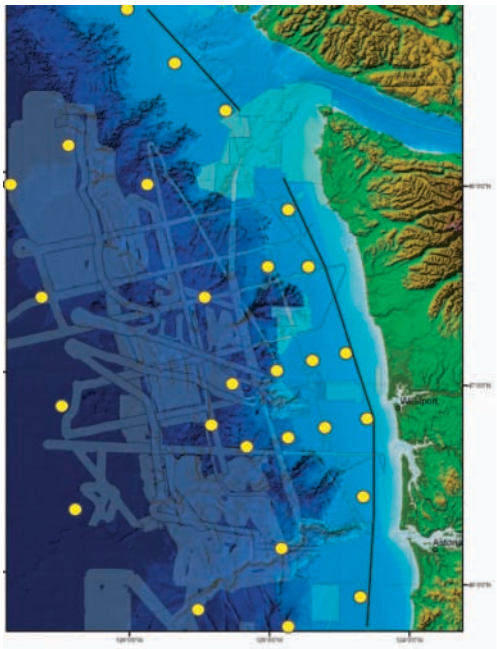
At the October 2010 CEIT OBS workshop held in Portland OR (http://www.oceanleadership.org/wp-content/uploads/2010/05/CI_Workshop-Report_Final.pdf), a number or practical issues were raised in conjunction with this ambitious OBS deployment. One of these was the issue of good bathymetric data needed for good siting and safety of the instruments along the Cascadia margin. In addition, Cascadia is also now the site of the main components of the Ocean Observing Initiative (OOI) and Neptune Canada, the world's premier cabled observatory systems, as these will be in operation collecting real-time data from a wide spectrum of sensors for decades to come. Cascadia has also now been chosen and a Focus Site for the NSF GeoPRISMS program, which will focus attention on Cascadia earthquake tectonics for the next decade.

Bathymetric data for the OBS deployments

Good bathymetric data are essential for siting OBS station locations and ensuring the best chance of the instruments settling to the bottom in relatively smooth flat areas with a good chance of good recording fidelity. Equally important is to deploy instruments in areas where the topographic, structural, and hydrologic context is reasonably well understood, so that a maximum number of instruments will be recovered from each deployment. Some of the CI deployed instruments will be located on the abyssal plain of the Juan de Fuca plate, and are relatively safe from local geohazards. However, this initiative specifically addresses the Cascadia subduction boundary, and thus most of the instrument deployments are on the continental margin of this very dynamic plate boundary (Figure 1). Because many of the deployments span a number of active canyon systems and seismically active areas, good bathymetric data are also required to prevent a number of instruments from being swept into channels and canyons and lost or damaged during the deployment.

Cascadia bathymetric coverage

In the NE pacific region, the Cascadia margin and Cascadia basin has spotty



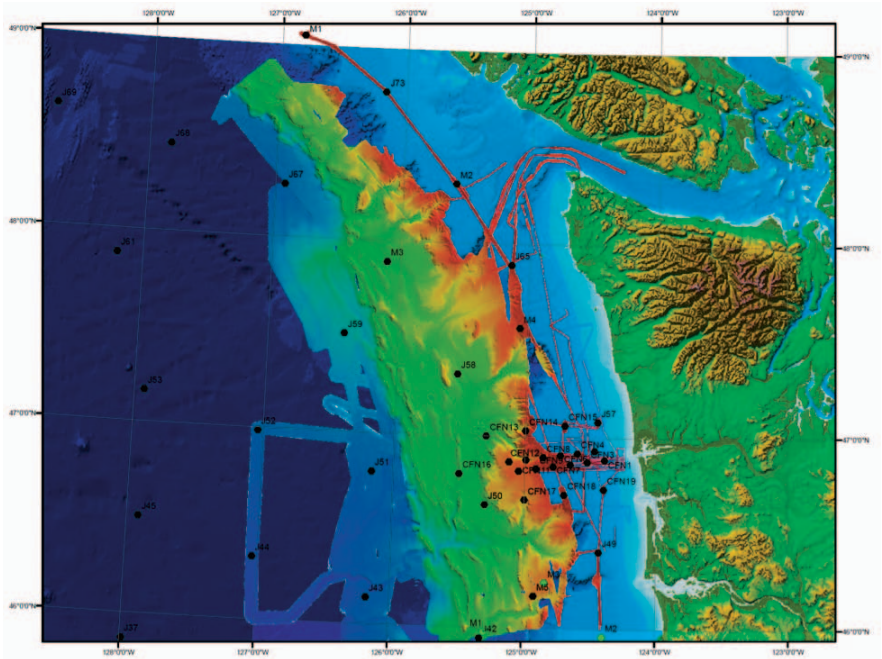


Figure 1. (left) "Before" bathymetric coverage of the Washington-Vancouver Island margin. Translucent overlay shows existing multibeam coverage from most known cruises mostly collected by OSU and restricted until recently. Remaining areas are only covered by sparse NOS soundings. Yellow dots are approximate OBS deployment locations for year one. Some of these were re-located to better sites in terms of trawl protection and topography after the 2011 cruise data were processed. Figure 2. (right) "After" bathymetric coverage of the Washington-Vancouver Island margin following the June 2011 CEIT cruise with modified OBS locations. New and old data have been assembled in CARIS bathymetric database software.

coverage of modern multibeam data. 1980's vintage EEZ survey data cover Oregon and Northern California from ~ 600 m to the abyssal plain out to 126^0 W. This includes a major survey of the Gorda Plate done during an extended sea trial of the then new AGOR Ronald H. Brown. Much of the ridge system at The Gorda, Juan de Fuca and Explorer ridges and Blanco, Mendocino and the Nootka faults have multibeam data collected over the years during NSF and NOAA sponsored work. The EEZ data were collected in the 1980's with the original 90 degree Seabeam Classic, now quite antiquated, but adequate for regional context. There are also very large gaps in even these data. The EEZ data collected in the 1980s off Washington was first "classified" by the Navy due to their submarine activity there, and then subsequently "lost" while in storage. Consequently, comprehensive coverage of the Washington margin has not been available. Through the 90's and early 2000's, OSU collected data on the WA margin in support of paleoseismic and other cruises, and there were also several cruises of the German vessel Sonne. These data were collected in mission specific areas, and with a variety of systems, and therefore not ideal for regional coverage. Releases of these data were for a time also restricted by the Navy, but since 2008 the data are no longer restricted, nor is collection of new data by academic and Government agencies. These older data were collected with now antiquated systems, including the original Krupp Atlas Hydrosweep and SeaBeam classic and SeaBeam 2000 systems. Shallow data, less than ~ 600 m, are even more sparse. Some of the shallow banks in Oregon have been mapped with high resolution systems, and several other NOAA, NSF, MMS and state supported projects have mapped small portions of the shelf, but an estimated 75% of waters shallower than 600m remain unmapped.

The need for new bathymetric data

At a minimum, small patches of bathymetric data are desirable for site location of Cascadia margin OBS sites, where even the location of major canyon systems is only approximately known (Washington and Vancouver Island). Minimal patch size should be at least a few km^2 in order to ensure safe and effective deployments. A better approach however would be to survey contiguous larger areas that serve to aid in deployments, but also to establish the structural context of the deployments and of the Cascadia margin, which was the approach supported for this project.

Beyond the CIET OBS deployment, this project took the opportunity, for the first time, to obtain a nearly complete image of the Cascadia Subduction Zone that will make significant steps toward filling gaps in our knowledge of the regional tectonics of the Cascadia margin. The project is supportive of the goals of the CIET OBS array, the OOI and GeoPRISMS objectives, and also directly addresses the issue of regional earthquake hazards. The ideal vessel for this purpose was the R/V Thomas Thompson, with its newly upgraded Kongsberg EM-302 multibeam system, with the best resolution for the ~ 1000-2500 m target depth range for much of the survey. This vessel, working at survey speeds can also collect concurrent 3.5 kHz Chirp sub-bottom data during the survey work, which is also useful for deployment assessment and many other purposes.

In planning the cruise, we prioritized the most hazardous sites on the margin, and also prioritized completion of margin coverage that is useful for OOI, GeoPRISMS, and regional context. Most mid-plate sites are relatively near existing coverage, but will be surveyed on future cruises if possible before deployment (Figure 1).

The priority survey area on the Washington margin is shown in Figure 1 with existing multibeam coverage along with approximate OBS site locations. Final site choices have and will take advantage of less hazardous sites than shown in Figure 1, as well as trawl closures and the existing Olympic Coast Marine Sanctuary to avoid natural and anthropogenic hazards.

Figure 2 shows the "after" picture of the Washington-Vancouver Island margin. Older bathymetric data have been combined with new data in CARIS in this image. Ongoing work will attempt to reconcile the several generations of sonars used, tide, velocity and other corrections as well as to edit and improve the older data where possible to produce a final surface integrated with existing soundings where multibeam data are still lacking. This will also be done for the Oregon-Northern California parts of the margin where less extensive new data were also collected to fill smaller gaps. A final compilation of the Cascadia margin will be made available to the community when complete in 2012

Learn About the Cascadia Initiative at the

GeoPRISMS AGU Townhall & Community Forum

Monday, December 5 at 6 PM

Grand Ballroom, Grand Hyatt San Francisco

345 Stockton Street

Program update from NSF & GeoPRISMS Chair, including reports from recent meetings plus information regarding upcoming research opportunities

Evening is open to all with interest in the GeoPRISMS program.

For more information visit ***www.geoprisms.org/townhall.html***

From the GeoPRISMS Chair

Juli Morgan (Rice University)

It's hard to believe that GeoPRISMS is already one year old – and what a year it has been! The program launched with a roar, in the last 12 months we organized five community-planning workshops to define the trajectory of the new program. Partnerships with EarthScope and the USGS are growing as GeoPRISMS focuses its attention on North American margins. The first of these joint efforts, the EarthScope-GeoPRISMS Cascadia Initiative, is off to a running start, with one leg of the OBS deployment program completed, and more on the way. The first cycle of GeoPRISMS funding has also begun, and new projects will be starting up within the year.

Also fresh in our minds are the experiences of the two planning workshops for GeoPRISMS primary sites, i.e., Alaska (page 13) and the Eastern North American Margin. Enthusiasm for these scientific opportunities is reflected by the combined attendance of ~240 attendees, including ~35 students. EarthScope co-sponsorship of both workshops demonstrates the importance of this partnership in achieving the goals of both communities. With the EarthScope Transportable Array (TA) marching toward the east coast of the US right now, and with the anticipated redeployment to Alaska starting in 2015 (page 11), there are clear opportunities for onshore-offshore cooperation in both areas. Scientific overlaps between EarthScope and GeoPRISMS are obvious, particularly in Alaska where both communities share common research targets along the Alaskan-Aleutian subduction zone. Synergies are also evident in eastern North America, where GeoPRISMS rifting objectives rely on a solid understanding of pre-rift orogenic structure, and ongoing post-rift processes are highly dependent on remnant exposures of the ancient Appalachians and lithospheric-scale processes that EarthScope may resolve. Partnerships with the USGS are also critical in both settings, especially in view of associated seismic and marine geohazards.

Now AGU is just around the corner and GeoPRISMS will be there in force, hosting three mini-workshops (geochemical informatics, Costa Rica seismogenic zone studies, and subduction zone exhumed terranes, page 24), as well as the annual Student Prize Competition and the GeoPRISMS Student and Community Forum (back cover). On Sunday before AGU, we will participate in the community-oriented Exploration Station in partnership with IRIS (page 24). Finally, 16 MARGINS- and GeoPRISMS-related AGU sessions will present the latest research of direct interest to the program (page 25).

GeoPRISMS efforts are not all about research: new educational and outreach initiatives are under development, focused on training the next generation of scientists and communicating the relevance of GeoPRISMS science (page 28). Proposals are in process to expand the MARGINS Mini-Lesson collection through educational modules that synthesize a decade of MARGINS research, and anticipate upcoming GeoPRISMS work, and to develop a new GeoPRISMS-wide REU program to engage promising undergraduate students in cutting-edge continental margins research.

Another important goal of GeoPRISMS has been to enhance the experience of students attending science workshops, and to facilitate their participation in the science planning process. Student-focused activities are now a part of all GeoPRISMS workshops (page 17). The Alaska and ENAM planning workshops each included a 1-day student symposium, to review the regional geology and outstanding questions, and to allow students to present their own research. Each symposium culminated in a half-day field trip. These cohort-building activities continued during the workshops, as students gathered to reflect upon the workshop process and to prepare unified perspectives on workshop goals. Initial feedback from student participants was favorable, and produced a range of suggestions to further improve the experience and increase access to research opportunities in these areas.

The well-subscribed GeoPRISMS Distinguished Lectureship Program is underway for this academic year, with nine lecturers visiting a total of 30 schools. We are also reaching out to informal educational venues such as science museums for the first time – with three visits planned this coming year. Outreach opportunities at higher levels were enabled as part of a geohazards showcase with senate staffers organized by NSF, with presentations by several GeoPRISMS researchers. Such activities set new standards for achieving broader impacts, and communicating the importance of our science to the public, efforts that should continue down the road.

Looking forward, we anticipate another busy year, as primary site studies ramp up, in particular in Alaska, ENAM, and Cascadia (watch for an NSF update about Cascadia Initiative proposal submission, and a Spring 2012 planning workshop). In addition, New Zealand and the East African Rift beckon. Thematic planning efforts will be necessary to achieve community consensus on studies that span these selected primary sites. Clearly, these are exciting times for the program, as researchers from across the US and the world gather to outline new directions and opportunities for community research.

Finally, I would like to thank departing GSOC member Mike Gurnis for his service over the last three years, and to welcome new member Brad Hacker to all the fine times that lie ahead!

Update on Progress Toward a New Scientific Ocean Drilling Program

Susan Humphris (WHOI) and Demian Saffer (Penn State University)

With the publication of the Science Plan for the new International Ocean Discovery Program (IODP) in June, and a 12-page summary brochure in August, the science community has made a strong case for a new ten-year, multidisciplinary program of scientific ocean drilling beginning in 2013. A very important milestone in progress to the new program will be a review by the National Science Board in 2012.

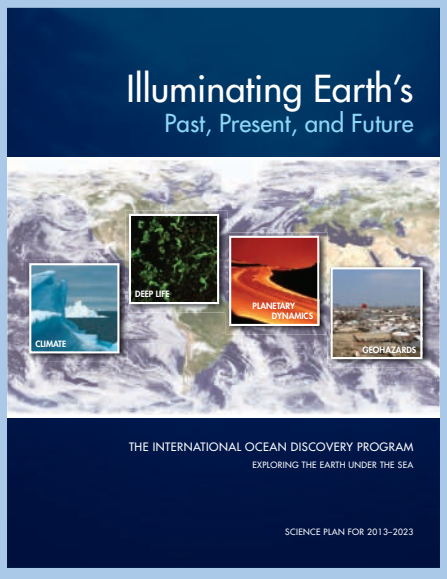
Building on the considerable achievements of previous scientific ocean drilling programs, the new IODP science plan incorporates a strong emphasis on urgent and societally relevant problems, many of which are tightly linked with the GeoPRISMS initiatives. While recognizing the interdisciplinary nature of many of these questions, the new IODP Science Plan centers on four major themes

- Climate and Ocean Change: Reading the Past, Informing the Future
- Biosphere Frontiers: Deep Life, Biodiversity, and Environmental Forcing of Ecosystems
- Earth Connections: Deep Processes and Their Impact on Earth's Surface Environment
- Earth in Motion: Processes and Hazards on Human Time Scales.

Within each theme, a short list of challenges is highlighted. It is among these that the strong connections between IODP objectives and GeoPRISMS SCD (Subduction Cycles and Dynamics) and RIE (Rift Initiation and Evolution) initiatives are exemplified. In addition, the evolution of scientific ocean drilling from collection of cores and downhole data to active experiments that use boreholes to monitor and experiment with the subsurface provides an exciting new avenue to achieve the common goals of the two programs.

Among the challenges in the IODP science plan, several focus on the geohazards posed by subduction zone earthquakes, sub-sea slope failures, and associated tsunamis. Analysis of core samples, borehole data, and long-term monitoring will help to address key scientific questions about the spatial and temporal variability of subduction zone earthquake slip behavior that are central to the SCD initiative. Similarly, challenges within both the "Earth Connections" and "Earth in Motion" themes of the IODP Science Plan focus on using drilling to quantify thermal, fluid, and geochemical processes that alter oceanic crust as it evolves from the ridge to the trench, with direct ties to key GeoPRISMS science questions centered on volatile cycling at both subduction zones and rifted margins. Through these and many other closely aligned scientific objectives, we anticipate significant synergy between the new IODP and GeoPRISMS programs.

The new IODP will continue to be a model of rigorous, idea-driven, peer-reviewed, transformative science. While NSF has announced a change in the operating model for the new program, international collaborations are expected to continue. The schedule calls for a seamless transition from the current program into the new program, and changes are already being put in place to facilitate that evolution. For example, the current Science Advisory Structure will morph over the next few months into a new simplified structure, with some members remaining to provide continuity, and new members being solicited from the scientific community. A call for proposals for the new program has been prepared and will be distributed this fall, so look for it soon.



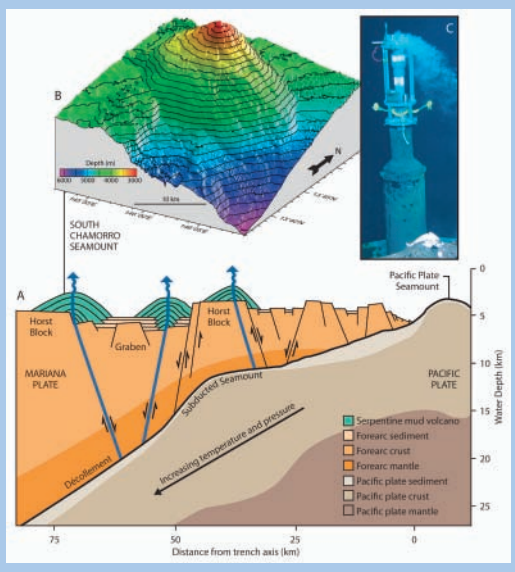


Figure 1 (left). The cover of the IODP Science Plan. Figure 2. (right) The Mariana Forearc (A) and the South Chamorro Seamount (B) - a serpentine mud volcano with a long-term borehole observatory at ODP Hole 1200C (C) emitting highly alkaline, methane- and sulfate-rich fluids.

IODP Workshop on Using Ocean Drilling to Unlock the Secrets of Slow Slip Events

Gisborne, NZ • August 1-5, 2011

Laura Wallace (GNS Science, Lower Hutt, NZ); Eli Silver (UC-Santa Cruz); Nathan Bangs (University of Texas-Austin); Rebecca Bell (Imperial College, London); Stuart Henrys (GNS Science, Lower Hutt, NZ); Joshu Mountjoy (NIWA., Wellington, NZ*); Ingo Pecher (GNS Science, Lower Hutt, NZ)*

From August 1 to 5, 2011, 70 geoscientists and student researchers from a dozen countries gathered in Gisborne, New Zealand, to discuss how scientific ocean drilling can help to elucidate the processes behind slow slip event (SSE) occurrence. Gisborne was chosen as a venue for this workshop due to its close proximity above the source area of shallow slow slip (<5-15 km depth) that occurs at the northern Hikurangi subduction margin in New Zealand.

Figure 1. IODP workshop attendees gather in Gisborne, NZ .

SSEs are a new class of shear slip found at subduction margins around the globe that have revealed the broad spectrum of fault slip behaviour. SSEs are widely acknowledged as one of the most exciting discoveries of the last decade in the Earth Sciences, and have implications for plate boundary processes and the seismic hazard posed by subduction megathrusts. The relatively shallow depths of subduction thrusts exhibiting SSEs in New Zealand (north Hikurangi), central Japan (Boso Peninsula), and Costa Rica (Nicoya Peninsula) (5 – 10 km below seafloor) potentially puts them within reach of IODP drilling. The possibility for direct access to these faults suggests that scientific drilling could play an important role in revealing the physical processes behind SSEs. The main goals of the workshop were to summarize critical requirements of a drilling program to discern the physical mechanisms responsible for SSE behaviour, develop strategies to achieve the scientific goals, determine what types of data are needed to develop an effective drilling program, and identifying the expertise and technologies needed to drill a SSE source area successfully. Additional geophysical experiments in support of any IODP drilling were also addressed.

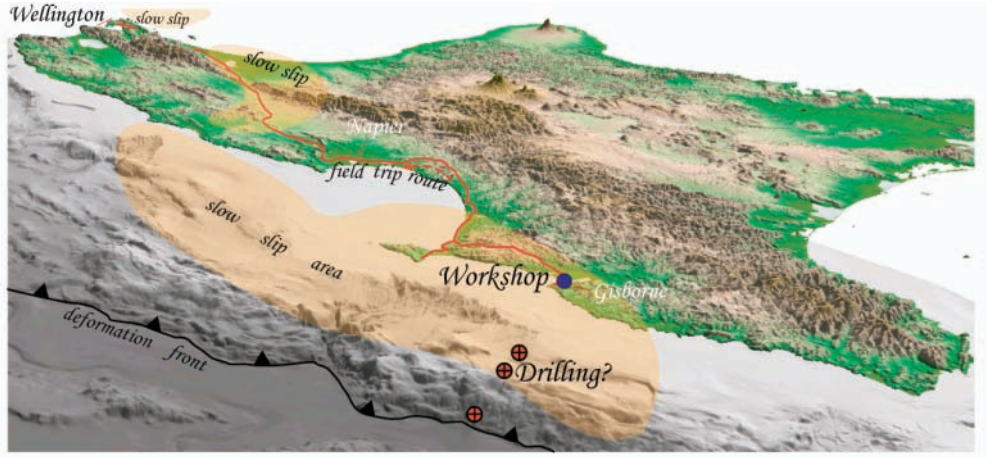


Figure 2. Oblique view of the Hikurangi subduction margin, including locations of slow slip (orange shaded), the location of the workshop and fieldtrip route, and the proposed slow slip event drilling targets offshore Gisborne

Oral presentations at the Gisborne workshop were organized into thematic sessions centered around (1) observations of and theories for slow slip event occurrence, (2) lessons learned from previous IODP drilling at subduction zones, and (3) focused talks on potential slow slip drilling targets in New Zealand, Costa Rica, and central Japan. The talks were interspersed each day with breakout discussion sessions and broader group discussions. Breakout sessions over the first 2 days focused on the measurements and experiments needed to understand the origins of SSE and how these plans might be applied to potential IODP drilling projects in New Zealand, Japan, and Costa Rica. On the final day, breakout groups sat down and developed implementation plans for each location.

A number of fundamental conclusions came from the workshop: (1) further development and site characterization is needed at each of the sites to be able to effectively examine slow-slip processes along the plate interface with drilling. At each of the sites, additional data is needed to refine the locations, magnitudes, timing, slip

Figure 3. Workshop attendees ascend Te Mata Peak, which overlooks Hawkes Bay along the east coast of New Zealand's North Island, during a two-day field trip and transit between Gisborne and Wellington.

regions, relationship to earthquakes, and cyclicity of SSEs. We concluded that we can achieve these goals with a combination of onshore geodetic and seismic experiments combined with offshore long-term deployment of ocean bottom seismographs equipped with pressure sensors to monitor vertical seafloor deformation. (2) Also critical are complementary, colocated studies for developing regional-scale characterization and development of site locations. These include (but are not limited to): structure and tectonics, physical properties, stratigraphy and lithologies, and thermal structure, using active source 2D and 3D seismic imaging and wide-angle refraction, passive source studies, heat flow surveys, and multibeam seafloor mapping. Auxiliary data are required to both help identify drilling targets and compliment borehole data and monitoring; (3) Shallow level borehole monitoring is key to address questions related to the spatial distribution of slow slip beneath offshore subduction margins, and to reveal the possible relationship between SSEs and normal seismicity, as well as discerning changes in fluid flow and geochemistry within the upper plate during the SSE cycle. Monitoring will be supported with coring and logging for ground truth and detailed characterization of lithology, stratigraphy, structure, fluids, and physical properties above the SSE source regions; (4) Drilling, logging and sampling of the SSE source area will provide the most direct information on the physical conditions (frictional properties, mineralogical composition, fluid pressure conditions, temperature, among others) that lead to and control slow slip event behaviour. Participants agreed that deep drilling of an SSE source area is within reach and is the ultimate way to solve the mystery of why SSEs occur.

One of the interesting discoveries during the workshop was the realization by participants that the world's best-documented areas of shallow (<20 km depth) slow slip events in Costa Rica, central Japan and New Zealand have some striking similarities. Specifically the three margins include: relatively cold temperatures on the interface in the SSE source regions, similar slow slip event durations (generally ~2-3 weeks), and comparable equivalent moment magnitudes per event (Mw ~6.5). Costa Rica and north Hikurangi have further similarities in that both margins are characterized by subduction erosion, and each exhibit a regular two-year SSE recurrence interval. We expect that continued comparison and contrasting of these three subduction zones and their shallow slow slip event behavior begun at the workshop will lead to new insights into the mechanisms behind shallow SSEs.

The main 3-day workshop was followed by a 2-day field trip, from Gisborne to Wellington. The fieldtrip was designed to expose participants to the onshore, uplifted components of the Hikurangi forearc and provide a complete transect of Hikurangi margin active tectonics. The fieldtrip also tracked above the slow slip event source areas of the Hikurangi subduction zone, and gave participants insights into the geological and tectonic context of slow slip in the North Island.

Just after the fieldtrip, on 6-7 Aug, approximately 45 of the Gisborne workshop participants met to develop the full proposals and implementation plans for a proposed project to use IODP drilling to understand slow slip event processes offshore Gisborne, at the northern Hikurangi margin. We expect that these efforts will be of interest to the GeoPRISMS community, as New Zealand has been recently selected as one of the primary focus sites for the Subduction Cycles and Deformation (SCD) program. The evolving effort towards IODP drilling at north Hikurangi may provide an important focal point for SCD research in the New Zealand region in the coming years.

The workshop was supported by funding from IODP-MI, the New Zealand Ministry of Science and Innovation, the Consortium for Ocean Leadership, and GeoPRISMS. A full report on workshop outcomes will be developed for IODP over the next few months, and will be made publicly available. To see the scientific agenda and list of participants at the Gisborne workshop, visit the workshop website: http://drill.gns.cri.nz/DrillNZ/Latest-News/Upcoming-events/Slow-Slip-IODP-Workshop

Eastern North America Margin (ENAM) Opportunities Mini-Workshop Report

Bastrop, Texas • May 20-21, 2011

Frank J. Pazzaglia (Lehigh University), Donna Shillington (LDEO); Peter Flemings (University of Texas at Austin); Basil Tikoff (University of Wisconsin)

On May 20 & 21, a joint *EarthScope-GeoPRISMS* mini-workshop was held in Austin, TX to begin to address areas of common scientific ground in the study of Earth science in eastern North America (ENAM, Fig 1). The thirty scientists that attended this 1.5 day meeting included members from the *EarthScope* and *GeoPRISMS* communities, NSF and other federal agencies, and one graduate student. The *EarthScope* transportable array arrives in the eastern United States in 2012-13, and *GeoPRISMS* has identified ENAM as a primary site for the investigation of rift initiation and evolution (RIE initiative). Collectively, *EarthScope* and *GeoPRISMS* research spans the shoreline, and in doing so provides an integrated framework for understanding the orogenic inheritance, rift initiation and evolution, and structure of a mature continental margin. The associated broader impacts of natural hazards and assessment of the nation's natural resources, including traditional and alternative sources of energy in the most-densely-populated part of the country, are fundamental to both programs. Therefore, the timing is perfect to organize both communities to identify the crucial science targets and to develop or modify the necessary strategies for science implementation.

The goal of this mini-workshop was to (1) plan for a larger science workshop to be held 27-29 October, (2) begin to focus the broader *EarthScope* and *GeoPRISMS* communities on the key science targets in ENAM, addressing the various challenges and synergistic opportunities in how *EarthScope* and *GeoPRISMS* science have been typically implemented, (3) articulate pragmatic considerations linked to proposal submission dates, access to, staging, and deployment of instruments, and (4) consider longer-range facility potential.

Results from the meeting included: (1) review of the *EarthScope* and *GeoPRISMS* science plans, including an *EarthScope* workshop report from 2004 that was specifically targeted at ENAM; (2) determination of scientific and regional overlap between *GeoPRISMS* and *EarthScope*; (3) a better understanding of the research approaches used by *GeoPRISMS* and *EarthScope* that included an example of collaborative research in the Salton Trough; (4) an understanding of the timing of *EarthScope* operations on the east coast; and (5) development of a preliminary agenda for a full workshop planned in October, 2011 at Lehigh University. It was broadly concluded that a goal for the fall meeting should be to establish a clear research strategy where the largely P.I.- driven and non-site specific approach of *EarthScope* can inform the largely community-driven and site-specific integrated systems approach of *GeoPRISMS* and visa versa.

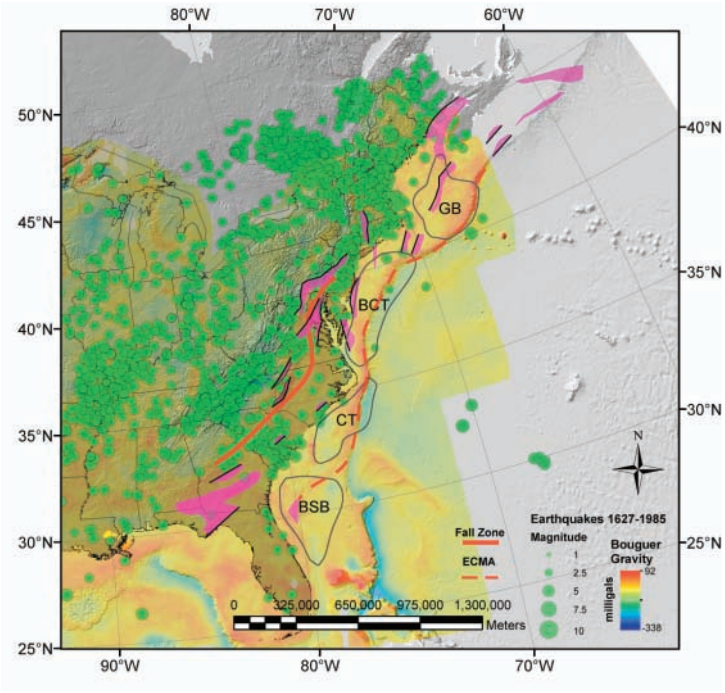


Figure 1. Earthquakes in the Eastern United States and Canada overlain on a Bouger Gravity map of eastern North America (courtesy of Frank Pazzaglia).

The *EarthScope* and *GeoPRISMS* communities need to be cognizant of the rapidly approaching summer deadlines for proposal submissions and fall workshop preparation. Proposal pressure will play a key role in determining the importance of focused research site selection as well as the important science targets. Furthermore, proposal pressure will play a role in determining the fate of the *EarthScope* instrument pool once the TA completes its scheduled deployment in 2015.

The October workshop will place an emphasis on groups of PIs that have collective interests in the key science targets and locations where that science can be accomplished. Taken together, these efforts will guide the larger community effort that has real resource and planning limitations/considerations. A consensus was reached that researchers should self-organize prior to the October workshop to discuss the science and implementation strategies for research on ENAM. Investigators should come to the October workshop with a clear vision for research focus and collaboration. Details on white paper submission are presented in the full report.

Opportunities for EarthScope Science in Alaska Mini-Workshop

Austin, Texas • May 16-17, 2011

Jeff Freymueller (University of Alaska Fairbanks) and Sean Gulick (University of Texas -Austin)

A workshop on EarthScope science opportunities in Alaska was held in Austin, Texas in May 2011 and covered the day and half preceding the EarthScope national meeting. It involved 76 attendees. Short (1-2 page) white papers highlighting research targets and opportunities were solicited in advance of the workshop, and a total of 32 white papers were submitted by workshop attendees and other authors (White papers and workshop agenda can be found at: http://www.iris.edu/hq/Alaska_Workshop_2011/). Invited speakers were paired up, so that each talk was prepared and presented by two authors from different disciplines. This approach was successful in integrating viewpoints across disciplines, and the pairs of authors chose a variety of strategies for the presentations. Presenters selected from the white papers gave a series of 5-minute mini-talks. The workshop also featured several breakout sessions to highlight exceptional scientific opportunities and integration with other projects, especially GeoPRISMS.

Alaska is an excellent target for EarthScope due to its diverse crustal structure and geologic history, and high level of present tectonic and volcanic activity. The Alaska crust was built by successive subduction-to-arc systems and accreting terranes combined with 1000s of kilometers of strike-slip motion on continental-scale fault systems. The entire northern Cordillera, in particular the western Yukon Territory (Canada), Alaska and far eastern Siberia, can broadly be considered a plate boundary zone and active tectonics impact the region as far as 1200 km from the trench. This region is a textbook place to study the wide range of variables that control continental deformation, in particular the role of plate boundary interactions, mantle flow, and crustal rheology. In terms of active tectonics, all parts of Alaska are currently moving relative to stable North America and active seismicity spans most of the state and surrounding areas. There are ~5x the number of earthquakes within Alaska each year as in all of the lower 48 states combined, and there is significant potential for hazardous high-magnitude subduction earthquakes and tsunamis as well as strike-slip earthquakes and volcanic eruptions.

EarthScope holds the promise of resolving debates about tectonic boundaries and current lithosphere and mantle conditions in the better-studied areas of southern and central Alaska and the pipeline corridor. Data from much of the western and northern part of the state is sparse, and EarthScope will provide much needed constraints on existing tectonic hypotheses on the nature of the lithosphere in this region. The crust within Alaska was assembled over hundreds of million years of active tectonism, including a 200 million year history of episodic subduction and accretion processes in southern Alaska, as well as convergent tectonics on the Arctic side of Alaska, most notably the collision that formed the Brooks Range. Prior to the formation of the Aleutian arc, there was an active volcanic arc along the Bering shelf margin, which reflected subduction beneath that margin. The Aleutian arc began to form in its present location beginning at ~50-45 Ma. The arc has remained in roughly the same location since that time, with no significant back arc extension splitting the arc massif. Thus the entire magmatic history of the arc is preserved in one place, and in the adjacent basins where eroded materials have accumulated.

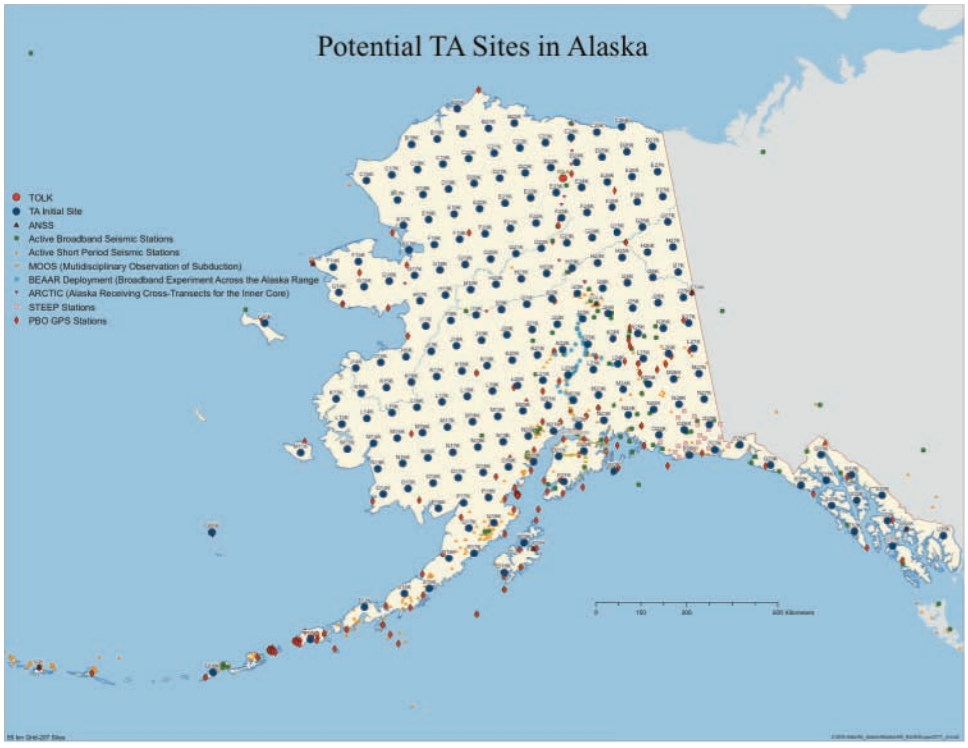


Figure 1. A sample uniform grid for the Transportable Array, at 85 km spacing. Small symbols are existing stations or past broadband deployments (red diamonds are active PBO GPS stations). No optimization of this grid has been done in areas of complex coastlines. The workshop recommended that IRIS strive to keep the cost per station down so that the final grid can be closer to the nominal 70 km spacing of the lower 48, as much as possible.

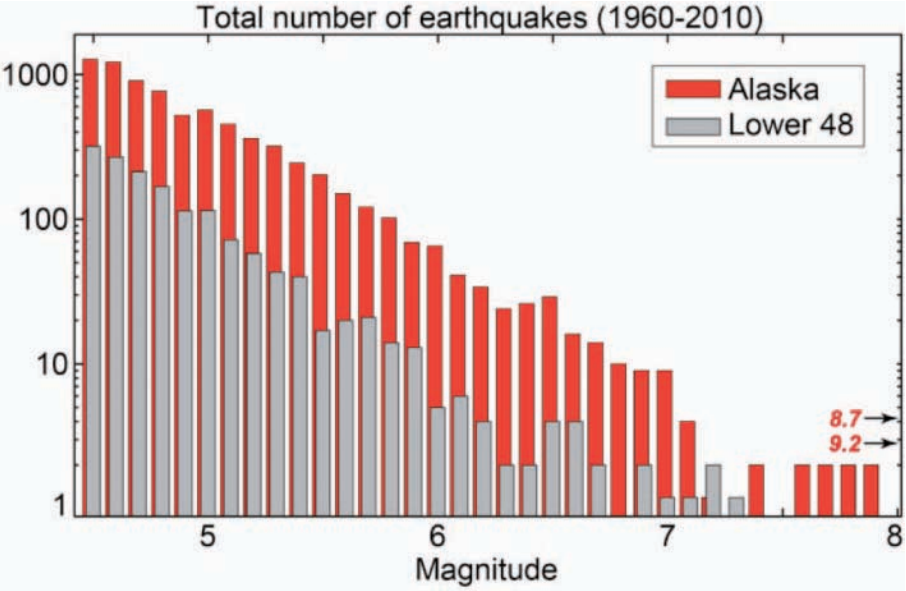


Figure 2. Comparison of earthquake statistics by magnitude, 1960-2010. Red bars are for Alaska (including the Aleutian arc), and gray bars are for the lower 48 contiguous states and offshore regions. Note that the Alaska catalog is not complete at the smallest magnitudes shown on this plot. The y-axis is on a logarithmic scale.

The collision of the Yakutat terrane, which is ongoing today, dominates the recent and active tectonics of southern Alaska. Subduction and collision of buoyant crust has substantially modified a portion of the southern Alaska margin for at least the last 6 million years, drives uplift of the Chugach-St. Elias range and possibly of the Alaska Range. A variety of geologic data from the region indicate that flat-slab subduction was shaping southern Alaska by late Eocene–early Oligocene time.

Alaska is an ideal place to study the genesis of great earthquakes and the Earth's response to these events. Nearly the entire length of the subduction zone has ruptured in great earthquakes within the historic record despite its short length (~ 250 years). Major active crustal faults, including the Denali fault, have generated magnitude 7-8 earthquakes within the instrumental record, and zones of significant earthquakes (>M~6) or active microseismicity extend north to the Arctic Ocean and northwest to the Bering Strait and Chukchi Sea. The seismic activity is accompanied by broad-scale active crustal deformation, measured by GPS. Large and great earthquakes trigger postseismic deformation transients, which provide an opportunity to study the dynamic processes associated with the earthquake cycle.

Great megathrust earthquakes are particularly compelling scientific targets. The Alaska-Aleutian subduction zone features a rapid convergence rate and a generally wide seismogenic zone, leading to a relatively large number of large to great earthquakes. Of particular interest are the significant along-strike variation of both subduction parameters and the behavior of the seismogenic zone. The Alaska subduction zone displays relatively abrupt boundaries between segments that appear to be dominated by creep and segments that remain locked over a large downdip width. *What causes these abrupt changes, how long do they persist over time, and how do they relate with the general controls on rupture dimensions?* Studying regions with significant along-strike changes in behavior offers a critical opportunity to identify what properties most affect the extent of seismic rupture.

Alaska is a geoscience frontier that mostly has not been studied beyond reconnaissance level; large areas are devoid of instrumentation of any kind, either campaign or permanent deployments (Fig 1), such that the crustal structure remains to be determined and areas of certain or possible active tectonics lack any precise earthquake locations. The tens of thousands of earthquakes in a single year in Alaska also provide a remarkable set of sources for study of the crustal structure, volcanic centers, and major faults systems throughout the region. There is also a high likelihood of recording a magnitude 7 or larger event within the timeframe of the USArray Transportable Array (TA) deployment.

Key globally relevant science topics that can be addressed in Alaska include: the presence and role of relic slabs and arcs; strike-slip boundaries as lithospheric scale structures; mantle flow around slab edges; differences between oceanic and continental arcs; causes of earthquake rupture segments and the boundaries between them; what processes control deformation spatially and temporally; imaging magma ascent from the slab to the surface; magma storage within the shallow crust and its ascent to eruption; examining the lithospheric process of flat-slab subduction, terrane accretion, and far-field deformation; determining any relationship between seismicity and rock uplift, and effects of glacial unloading; and using seismometers to investigate ice quakes, land slides, and sea ice changes.

Logistical recommendations reached by consensus of the attendees were that EarthScope should: maintain comprehensive coverage (70 km spacing where practical) but allow flexibility where an individual site is too costly; include a backbone array spanning the Alaska Peninsula and Aleutians; consider some deviations from a grid in the form of small arrays centered on a standard TA station; prioritize the number of stations over real-time/rapid access to data due to the frontier environment; and examine the possibility of including meteorological packages and strong motion sensors on some of the TA stations.

GeoPRISMS-EarthScope Planning Workshop for Alaska –an SCD Primary Site

Portland, OR. September 22-24, 2011

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)

A jointly-sponsored GeoPRISMS-EarthScope Planning Workshop for the GeoPRISMS Alaska Primary Site was held in Portland, OR from September 22-24, with some additional support from the U.S. Geological Survey. There were approximately 140 participants, representing more than 60 U.S. academic institutions, as well as key geoscience stakeholders in Alaska, including the USGS, Alaska Volcano Observatory (AVO), Alaska Earthquake Information Center (AEIC, the regional seismic network), and other potential GeoPRISMS partners. International organizations in Germany, Russia, Japan and Canada were also represented. The group included 22 graduate students and post-docs who took part in a one-day pre-workshop Student Symposium (see report on page # 17). Lively and substantive discussions took place both in breakout and plenary sessions over the 2.5 day workshop, leading to a clear consensus plan for GeoPRISMS science in Alaska. (*Meeting website: http://www.geoprisms.org/past-meetings/alaska-sep2012)*

Figure 1. Attendees of the workshop in the plaza of the World Trade Center, Portland, OR.

Objectives and Process

The objective of the workshop was to solicit community input about research opportunities and priorities that would form the basis for the GeoPRISMS science plan for the Alaska Primary Site. The starting point for the workshop was the Implementation Plan produced during the January 2011 meeting in Bastrop, Texas, where Alaska was identified as the lead primary site for the Subduction Cycles and Deformation (SCD) initiative of GeoPRISMS.

The workshop began with a series of plenary talks that provided an overview and then more focused examination of various aspects of the Alaska-Aleutian subduction system. These talks offered up-to-date summaries of Alaska-Aleutian geology, geophysics and geochemistry, to inform participants and to stimulate participants to think about key opportunities for GeoPRISMS research in the Alaska-Aleutian system. Talks focused on Alaska Margin Tectonics and History (Terry Pavlis and Dave Scholl), Surface Processes and Tectonics (Don Fisher and Sean Gulick), Magma Processes from Deep to Shallow (Peter Kelemen and Stephanie Prejean), and Mantle Processes and Geodynamics (Ikuko Wada and Peter van Keken). Bobby Reece, Rob Harris, Phaedra Upton, Susanne Straub, and Steve Holbrook presented several short talks on subjects proposed in white papers.

Breakout sessions began on the afternoon of the first day of the workshop. The objective of the first breakout was to identify key onshore and offshore research targets and data gaps, and to discuss the concept of "discovery corridors" as an approach to identifying geographic focus areas within the Alaska-Aleutian system. Participants were encouraged to identify specific locations where GeoPRISMS resources might be most effectively focused on high-impact, shoreline crossing and interdisciplinary research efforts – the hallmarks of the GeoPRISMS program. Participants were encouraged to keep in mind that some important research objectives may be best suited to a thematic research approach, undertaken anywhere in the Alaska-Aleutian system or at any arc on Earth.

Participants were assigned to breakout groups based on their top two research interests chosen prior to the workshop from the SCD key topics. These breakout themes were (1) controls on size, frequency and slip behavior of subduction plate boundaries, (2) spatial and temporal patterns of deformation through the seismic cycle, (3) storage, transfer, and release of volatiles through subduction systems, (4) geochemical

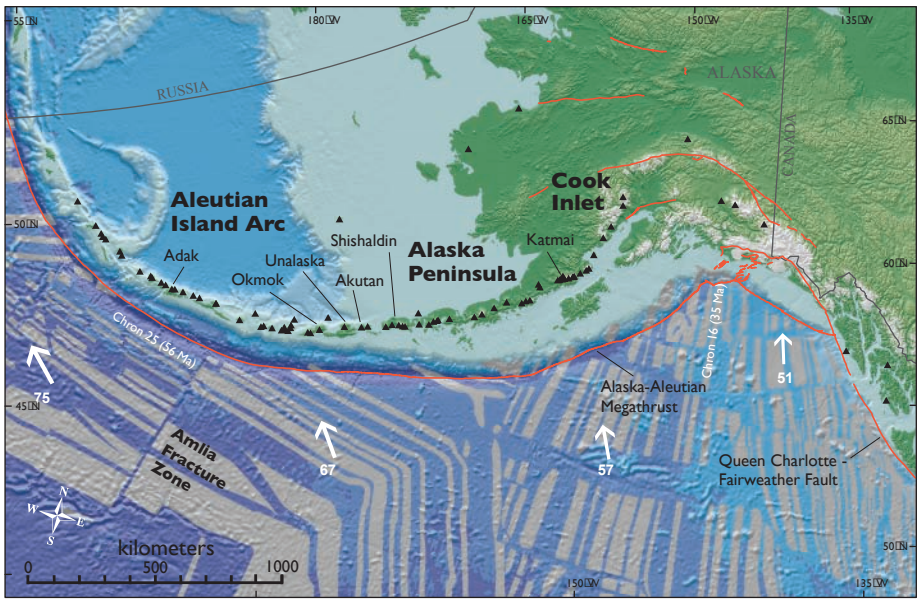


Figure 2. Map of the Alaska-Aleutian subduction system, showing the locations of geographic features mentioned in the text. The white arrows with numbers indicate the direction and rate of Pacific-North America convergence in mm/year. Black triangles mark the locations of the major Quaternary volcanoes. Red lines are major faults.

products of subduction and creation of continental crust, (5) subduction zone initiation and arc system formation, (6) feedbacks between surface processes and subduction zone dynamics.

Day one of the workshop ended with of short presentations on logistical considerations for fieldwork in Alaska. The major points of emphasis were challenges of Alaskan weather and long distances, and the importance of long-range planning to allow for permitting along the Alaska-Aleutian margin, which is a patchwork of lands mostly under the control of various public agencies.

The second day of the workshop began with reports and discussion of the previous day's breakout sessions. Next was a series of short presentations by a panel of potential GeoPRISMS partners. National organizations represented on this panel were the USGS and AVO (John Power), USGS Volcano Hazards program (John Eichelberger), USGS Extended Continental Shelf Project (Ginger Barth), the Cascadia Initiative (Richard Allen), and IRIS and USArray (Bob Woodward). International panel representation was from the German-Russian KALMAR Project (Christel van den Bogaard), Japan, IODP and JAMSTEC (Yoshiyuki Tatsumi), and Canada (Kelin Wang).

The second breakout session focused on implementation strategies. Participants considered possible "discovery corridor" locations, and identified overlaps and opportunities for synergistic GeoPRISMS and EarthScope activities. Breakout group leaders and participant attendance was the same as on day one to maintain continuity. Reports from breakout session leaders were given immediately after lunch. The third breakout session commenced late in the afternoon on day two. This time participants were mixed with respect to research interest but grouped with respect to their first and second geographic priorities for discovery corridor selection. The geographic sites were Cook Inlet, Alaska Peninsula, eastern Aleutians, Adak-Amlia area and westernmost Aleutians. A sixth breakout group called the Arc Line was also convened to characterize the "back-bone" of the Aleutian (oceanic) part of the Alaska-Aleutian margin, including geophysical imaging and along-strike changes in geophysical, geochemical, and geologic properties and processes.

Figure 3. Workshop attendees examine the proposed EarthScope TA Array in Alaska

The second day of the workshop ended after breakout three discussions, allowing the conveners to synthesize the plenary and breakout discussions so far. Their summary reports were presented in the morning of the third day of the workshop, leading into a productive plenary Q&A and discussion, during which broad consensus about GeoPRISMS science implementation in Alaska was reached.

An Implementation Plan for Alaska

A key objective of breakout three discussions was to establish a prioritization of the six geographic areas under consideration for more focused research, measured here by break-out attendance. The cumulative attendances at each of the geographic areas were: the Alaska Peninsula (55); the Adak-Amlia area (48); Cook Inlet (37); the along-arc transect (32); followed by the eastern Aleutians (25) and the western Aleutians (13). An important outcome of breakout three was the similar scientific and geographic focus of the three groups interested in the Aleutian/oceanic part of the margin. Based on this, the convener group presented a proposed science implementation plan, emphasizing a geophysical transect along the oceanic part of the arc in combination with complementary focused studies of the Alaska Peninsula and Cook Inlet areas. Workshop participants expressed broad support for a large geophysical deployment along the oceanic part of the arc. This geophysical transect is envisioned as the back-bone that provides

a framework for focused studies at point locations encompassing varied aspects of the arc, fore-arc, trench and incoming plate. The Aleutian islands provide many advantages for testing ideas about crustal genesis in a subduction setting. The arc has never been rifted, thus the products of ~45 million years of island arc crustal growth are intact and available for study. Additionally, strong contrasts in trench sediment thickness and subducting plate age at the Amlia Fracture Zone area are linked to distinctive magma chemistries in the arc and a change in seismogenic character.

One or more trench/arc-perpendicular transects would intersect the along-arc transect. The highest priority transects are the intersection with the Amlia Fracture zone and focal points in the Adak and Unalaska areas, providing unique opportunities to characterize the birth and evolution of the arc. Volcanoes of the eastern Aleutian area (e.g., Okmok, Akutan, Shishaldin) also provide ideal targets, located on the backbone transect, for slab-to-surface geophysical imaging of the largest and most active volcanic centers in the Alaska-Aleutian subduction system.

The Alaska Peninsula features dramatic along-strike changes in the seismogenic zone, spanning megathrust rupture areas in different parts of their cycles and with a range of locking behaviors. It is the best location for combining onshore and offshore studies to investigate the causes of these changes. It offers the best opportunity to examine links between seismicity and forearc surface process and variable subduction inputs. This area also includes the most productive volcanoes of the continental part of the arc, with both large dominantly basaltic centers and smaller dominantly andesitic centers, including Katmai, which produced the largest eruption of the 20th century. The group also supported the idea of a future deployment of Cascadia Initiative ocean bottom seismometers in this region.

The Cook Inlet area is the continental end-member of the subduction zone, which experienced a watershed megathrust event in 1964, and is dominated in Quaternary time by glacial and other surface processes that direct sediment into the subduction zone and forearc. This region also shows the clearest evidence in Alaska for large slow-slip events and transient changes in seismogenic zone behavior. This region also features a transition to flat slab subduction due to the buoyant thick crust of the subducted Yakutat terrane, intense microseismicity in the downgoing plate, abrupt variations in shear wave splitting orientations, the SE end of a gap in the volcanic arc, and active faulting and folding of a broad region of the overriding plate.

Both Cook Inlet and the Alaska Peninsula are also areas with substantial opportunities for synergy with EarthScope due to the EarthScope instrumentation that will be in place there, and coordinated research opportunities with AVO (described below), AEIC, and other researchers actively studying processes there.

Alaska was chosen as the highest priority GeoPRISMS Primary Site because of the distinct along-arc changes in volcanism, seismicity, forearc structure, and subducting sediment thickness. Participants recognized that specific synoptic studies were needed that address these spatial changes along the entire arc as opposed to specific target areas. These studies could include geodesy, paleoseismology, surface processes and along-arc sediment transfer, arc geochemistry and geochronology, and passive seismic monitoring.

Interactions with Partner Organizations

There are clear opportunities for synergy between the GeoPRISMS and EarthScope Programs in Alaska, especially for the Cook Inlet area and also for the Alaska Peninsula. The two programs share many common scientific targets, including the seismogenic zone, fluid cycling, and arc development, The recent report from the May 2011 EarthScope workshop on science opportunities in Alaska (http://www.iris.edu/hq/Alaska_Workshop_2011; see report on page 11 of this issue) discusses many scientific issues and goals that are directly in line with those of GeoPRISMS. EarthScope has supported the installation and operation of ~150 Plate Boundary Observatory (PBO) continuous GPS stations across Alaska, and will support a comprehensive seismic deployment across Alaska in the form of the USArray Transportable Array (TA).

Present and future EarthScope instrumentation in the Cook Inlet area, in particular, offers great opportunities for synergy between the programs on the many shared scientific targets. For example, the TA stations, augmented by EarthScope FlexArray or GeoPRISMS seismic deployments and existing seismic stations on volcanoes, offer the chance for detailed imaging of the mantle wedge and tracking magmas from slab to surface. PBO stations in the area have documented large slow slip events and other transient changes in the behavior of the seismogenic zone, highlighting a great opportunity for research on a topic of great importance for both programs. Other targeted GeoPRISMS investigations would form part of an overall, amphibious, GeoPRISMS and EarthScope research program.

The Alaska Volcano Observatory monitors active volcanoes, assesses the volcanic hazards along the Aleutian arc, and operates seismic networks on 31 of the active volcanoes. John Power, AVO scientist-in-charge, voiced strong support for GeoPRISMS studies. Existing seismic monitoring, geologic mapping, and geodetic monitoring will provide a wealth of background data for focused volcano research. Moreover, AVO is familiar with on-land access and logistical issues in the Aleutians, and they are willing to help provide guidance for involved researchers. The far western Aleutian area (including the Komandorsky Islands

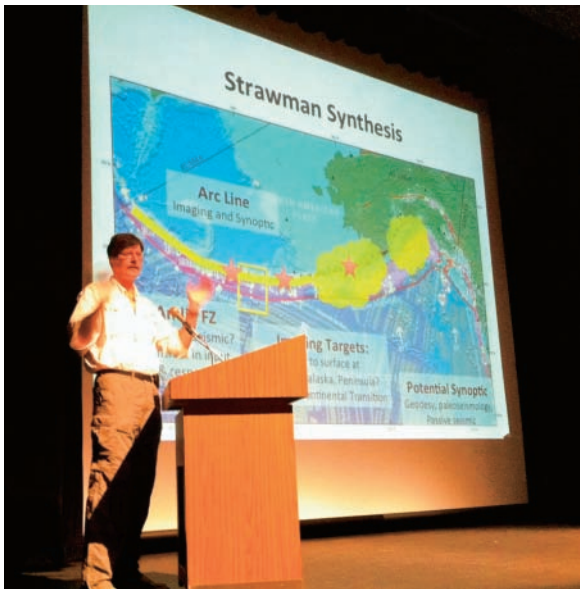


Figure. 4 (left). Jeff Freymueller summarizes the outcomes of the Alaska planning workshop break-out discussions. Figure 5 (right). Attendees of the Alaska planning workshop converse during break at the Portland World Trade Center.

and adjacent Kamchatka Peninsula) is the focus of ongoing work under the German-Russian KALMAR project, which will complement work in GeoPRISMS focus areas further east. Work completed under the first four years of KALMAR focused on several key GeoPRISM themes, including quantifying the volatile flux from active arc volcanoes in the Central Kamchatka Depression, and geochemical and geochronological studies aimed at an improved understanding of the magmatic history and evolution of island arc crust beneath the Komandorsky Islands. KALMAR dredging efforts sampled the incoming plate and fore-arc areas in front of the Komandorsky Islands, and large relict structures in back-arc areas. The prospect for a second four-year phase of the KALMAR project creates a strong international synergy between KALMAR and GeoPRISMS.

Possible international collaboration on the geophysical transect was also discussed, with JAMSTEC indicating strong support.

Broader Impacts

Unquestionably, GeoPRISMS and related studies in Alaska-Aleutian subduction zone have vital societal relevance, in a setting in which geohazards are very visible. The largest US subduction earthquake on record, the M 9.2 1964 Prince William Sound event, ruptured the eastern portion of the subduction megathrust, an area that continues to pose significant seismic hazard for local populations. Tsunamis spawned by large earthquakes and landslides along the Alaska-Aleutian subduction zone can affect the entire Pacific basin. The Aleutian arc is among the most active volcanic regions on the planet, with the potential to disrupt a critical air transport pathway between Asia, North America, and Europe.

The high visibility of geohazards in this setting also offers critical educational and outreach opportunities to GeoPRISMS. Established pathways exist through GeoPRISMS and EarthScope to convey important GeoPRISMS research results in Alaska into college classrooms around the country. Involving nearby schools and communities in instrument deployment and data collection has also proven effective. Efforts to develop a GeoPRISMS REU program would enable new training opportunities for future scientists interested in Alaskan studies. Cooperation with existing statewide programs will provide further outreach as research ramps up in the Alaska Primary Site.

Concluding Thoughts

The conveners thank the meeting attendees for their participation in the process of reaching consensus on the GeoPRISMS science plan for Alaska, and give special thanks to all of the speakers, breakout group leaders, and white paper authors for their contributions in making the workshop such a success. Finally, they want to recognize the enthusiastic participation of the graduate students and post-docs - their input is greatly appreciated.

A number of important tasks lie ahead. The conveners and breakout leaders will prepare a comprehensive workshop report for distribution by November 2011, and an updated draft of the GeoPRISMS Alaska science implementation plan by January 2012. The implementation plan will be made available for public comment prior to final release. It will serve as a guide for proposals submitted for the next NSF GeoPRISMS solicitation, July 1, 2012

Alaska Workshop Graduate Student Symposium

Jeff Marshall (California State Pamona)

The Alaska Planning Workshop started a day early for 22 graduate students and early post-docs who gathered for a pre-workshop symposium designed to engage and inspire a new generation of GeoPRISMS scientists. The symposium was organized by the GeoPRISMS Education Advisory Committee (GEAC) and led by Jeff Marshall (Cal Poly Pomona) with help from the GeoPRISMS office staff and several workshop conveners. Participants gathered bright and early for morning coffee and pastries, and listened to a series of talks on GeoPRISMS and Alaska geology. Juli Morgan (GeoPRISMS chair, Rice University) led off with an introduction to the GeoPRISMS Program, the SCD and RIE initiatives, and their primary research sites. Peter Haeussler (USGS) then provided a big picture view of Alaskan geology and tectonics, followed by Gene Yogodzinski (U. South Carolina) who discussed Aleutian volcanism, and John Jaeger (U. Florida) who described geomorphic processes and sedimentation along the Alaska margin. The students and post-docs then jumped into the spotlight, each giving a brief presentation in front of their own research posters. The posters and presentations were judged by senior scientists and prizes awarded later during the main workshop (See list of winners below.)

Figure 1. Student field trip attendees marvel at Latourell Falls, cascading over the Columbia Flood Basalts.

Following the student poster presentations, the group picked up box lunches, boarded a tour bus, and headed out for a fine afternoon field trip led by Russ Evarts (USGS-CVO) to explore the rich diversity of volcanic geology of the Portland Basin (Boring Volcanic Field) and the nearby Columbia River Gorge (Columbia Flood Basalts). Stops included Rocky Butte, Fisher Quarry, Chanticleer Point, and Latourell Falls, among others. The field trip group enjoyed spectacular geology and scenery, and reveled in some great discussion and camaraderie. The field trip returned to Portland in time to join other workshop participants at the icebreaker reception

The students and post-docs also engaged in several other activities during the main workshop. A lively group dinner was held at Kell's Irish Pub on Friday night. Several workshop scientists spoke to the group, sharing insights on their careers and the impact of MARGINS/GeoPRISMS on their professional life. Speakers included Jim Spotila (Virginia Tech), Jenn Wade (NSF-EAR), Ellen Syracuse (U. Wisconsin), and Alison Henning and Charles Bopp (GeoPRISMS Office, Rice U.).

Throughout the workshop, the students also participated in the plenary and breakout sessions, contributing to discussions, offering opinions, serving as break-out scribes, and recording notes on their perspectives. Finally, the students worked late into the night on Friday to develop a consensus view of their workshop experience. During the final plenary sessions on Saturday, the students summarized their impressions and recommendations. The plenary student summary, presented by Bre Macinnes and Harmony Collela, was a highlight for the workshop, offering many pithy observations about the community planning process. In addition to recognizing the unique opportunities that await them as GeoPRISMS begins work in Alaska, the students provided many concrete suggestions to the more senior researchers about effective ways to interact with them and to help them on their ways to successful research careers.

Student Poster Awards

Best Overall Poster & Presentation:
Justin Brown (Stanford University)

Best Verbal Short Presentation:

- *Maryjo Brounce (U. of Rhode Island);*
- *Abhijit Ghosh (U. of Washington);*
- *Maarten de Moor (U. of New Mexico)*

Best Poster Layout & Visual Aesthetics:
Bobby Reece (U. Texas, Austin)

Best Face-to-Face Question & Answer:

- *Jason Patton (Oregon State U.);*
- *Harmony Colella (U. California, Riverside);*
- *Breanyn MacInnes (U. Washington);*
- *Emily Roland (MIT-WHOI)*

Honorable Mention:

Best Presentation with Data, but No Poster:
Harold Kuehn (Dalhousie University)

Best Presentation with Poster, but No Data:
Adrienne Kenter (U.Alaska - Fairbanks)

Ocean Mantle Dynamics: From Spreading Center to Subduction Zone Workshop

Chiba, Japan • October 4-6, 2011

Douglas Wiens (Department of Earth & Planetary Sciences, Washington University, Saint Louis, MO, USA), Nobukazu Seama (Department of Earth & Planetary Sciences, Kobe University, Kobe, Japan), and Kyoko Okino (Atmosphere and Ocean Research Center (AORI), University of Tokyo, Kashiwa, Chiba, Japan)

From October 4-6, 2011, 77 Scientists from six different countries gathered at Atmosphere and Ocean Research Center (AORI) in Chiba, Japan to discuss recent developments in the study of the dynamics of the oceanic lithosphere, melt production at oceanic spreading centers and islands arcs, and associated topics. The meeting was supported by several organizations, including InterRidge, the Japanese TAIGA project, AORI and the Ocean Alliance of University of Tokyo, as well as the US GeoPRISMS program. The scientific organizing committee consisted of the members of the InterRidge Mantle Imaging Working Group, and the local organizing committee was chaired by Kyoko Okino and Nobi Seama.

The meeting was preceded by a field trip to the Horoman Peridotite Complex in Hokkaido led by Eiichi Takazawa (Niigata University). The field trip visited several outcrops of fresh lherzolite, harzburgite, and dunite along the Horoman River, uplifted and exposed by thrusting. The trip also had several presentations on the petrology and seismic imaging of the Horoman complex.

The first day of the scientific meeting focused on the structure of the oceanic lithosphere and asthenosphere, with an emphasis on results of recent imaging studies and laboratory experiments. Is the development of older oceanic lithosphere controlled only by thermal conduction, or are compositional variations also important? There was considerable debate about recent observations of discontinuities in the oceanic lithosphere and asthenosphere. How are the relatively sharp seismological discontinuities related to changes in electrical conductivity with depth? Are the changes with depth primarily thermal in origin or do they represent compositional changes associated with the depth of melt extraction? Another important topic was the depth variation of anisotropy in the lithosphere and asthenosphere, a question that will hopefully be addressed by ongoing and future ocean bottom seismic and EM deployments.

The second day's topic was melt migration beneath spreading centers and the formation of oceanic crust. Imaging studies have begun to provide constraints on the extent of the melt formation region and the mechanism of melt migration to the ridge axis. Recent results show that the regions of primary melt production and melt ascent are not always localized immediately beneath the spreading center axis. Complexities in ridge tectonics, such as oceanic detachment faults were also discussed. Important constraints come from geochemical studies as well as studies of ophiolites and abysal peridotites. Highly depleted regions of the mantle may be preserved for long periods of geological time and will be poorly sampled by melting, so inferences from basalts may not always produce a good indication of average mantle composition.

Models of melt migration can describe many of the observed features, but raise important questions about the mechanism of melt collection at the ridge axis and the role of a "freezing boundary" at the bottom of the lithosphere in focusing the melt supply. There was also a lot of debate about the melt ascent rate in the mantle and its implications for melt porosity and geochemistry. Are seismic and EM imaging results compatible with geochemical and modeling results indicating rapid melt ascent and extremely low melt porosity?

Water certainly plays a key role in magmatic processes, particularly for island arc volcanism and backarc spreading centers. The third day reviewed geochemical and experimental evidence for the transport mechanism and distribution of water in arc/backarc systems. Several presentations discussed the physical properties of serpentine and their effect on the transport and release of water in subduction zones. Water enhances melting in both mid-ocean ridge and backarc spreading centers, but the geochemical signature in terms of the apparent extent of melting is different. The effect of water on backarc spreading centers decreases with increasing distance from the arc and slab. Seismological images of the upper mantle beneath Japan, taking advantage of dense seismic networks, provide unprecidented resolution of mantle processes beneath volcanic arcs. EM and seismic images of the Mariana system provide constraints on mantle flow and the distribution of melt in volcanic arcs and backarc spreading centers, and help to understand the dynamics of arc/backarc systems. Numerical models are increasingly important for understanding complicated observations of anisotropy as well as the magma production system.

Figure 1. Attendees of the workshop, at the poster hall in the new Atmosphere and Ocean Research Institute building.

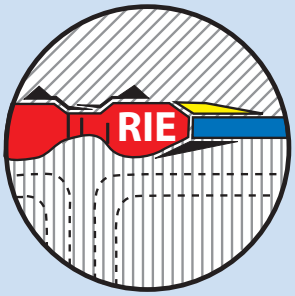
Twenty-six poster presentations, many of them from students and younger scientists, were a key part of the meeting, and they provoked a lot of good discussions during the poster session. Inter-

Figure 2. (left) Eiichi Takazawa explaining the field relations and significance of a peridotite exposure along the Horoman River in Hokkaido. Figure 3. (middle) The excitement of the meeting carried over to the Tokyo commuter train, as Eric Hellebrand, Uli Faul, and Tomoaki Morishita discuss the latest results Figure 4. (right) Peridotite Plaza, a selection of magnificently polished peridotite boulders at a park in a nearby town.

Ridge sponsored two awards for the best student poster presentations. Shusaku Yamazaki from Niigata Univesity won an award for his poster "Formation of incipient oceanic island arc crust: Geology and geochemistry of the late intrusive rocks in the Oman Ophiolite". Akiko Takeo from the Earthquake Research Institute of Tokyo University won an award for her poster "Seismic anisotropy in the uppermost mantle beneath oceanic regions from data of broadband OBSs". During the poster session there was also an interesting presentation via Skype from Teras Gerya, who was unable to come to Japan for the meeting. He presented recent modeling results constraining the mechanism producing orthogonal oceanic spreading center and transform fault patterns.

At the end of the meeting there was a general discussion about future projects and cooperation in ocean mantle studies. There was an agreement that ship time should be used as efficiently as possible so combining several types of measurements, such as seismic and EM, on the same cruise should be encouraged. Scientists should allow opportunity to use extra ship time to collect samples for petrological and geochemical analysis. The InterRidge cruise database is useful and should be expanded and to include cruises related to oceanic lithosphere research. International collaboration and planning may allow very ambitious projects in the future that are beyond the capability of individual nations.

The entire meeting program, including abstracts is available at http://ofgs.aori.u-tokyo.ac.jp/intridgej/WS_2011/



GeoPRISMS AGU Townhall and Community Forum

Monday, December 5 at 6PM

Grand Ballroom, Grand Hyatt San Francisco

345 Stockton Street

Program update from NSF & GeoPRISMS Chair, including reports from recent meetings plus information regarding upcoming research opportunities

Event is open to all with interests in the GeoPRISMS program.

For more information visit ***www.geoprisms.org/townhall.html***

Status Report on the GeoPRISMS Data Portal: October, 2011

Andrew Goodwillie and the MGDS/IEDA Database Team (Lamont-Doherty Earth Observatory, Columbia University)

The GeoPRISMS data portal (*www.marine-geo.org/portals/geoprisms*) was launched in May 2011 as a new portal of the MGDS database. For each GeoPRISMS primary site, the portal has been populated with information and links to a range of existing, high-priority data sets. For example, for the Alaska-Aleutians primary site, the portal provides information on this summer's multi-channel seismic cruises aboard Langseth: MGL1109 – the USGS-led survey in support of the US Extended Continental Shelf (ECS) claim with chief scientists Ginger Barth and Sean Gulick, and cruise MGL1110 – the Alaska Megathrust survey spearheaded by Donna Shillington, Mladen Nedimovic and Spahr Webb. Also included are links to the many USGS seismic surveys such as the TACT and EDGE lines along the arc and to Casey Moore's rock sampling and mapping work on Kodiak island.

In the Cascadia area, chief scientist Chris Romsos guided the collection of new multi-beam bathymetry data aboard Thompson cruise TN265 to help determine the siting of Cascadia Facility Ocean Bottom Seismometers. Links to the seven phases of the USGS Cascadia SHIPS seismic projects are also given for this primary site.

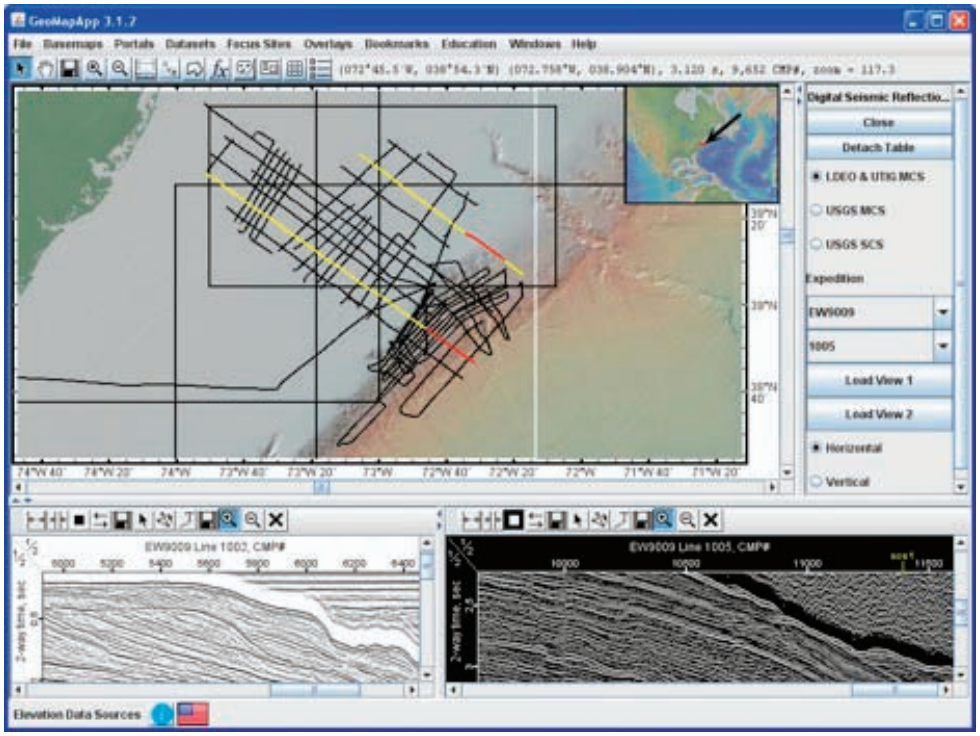
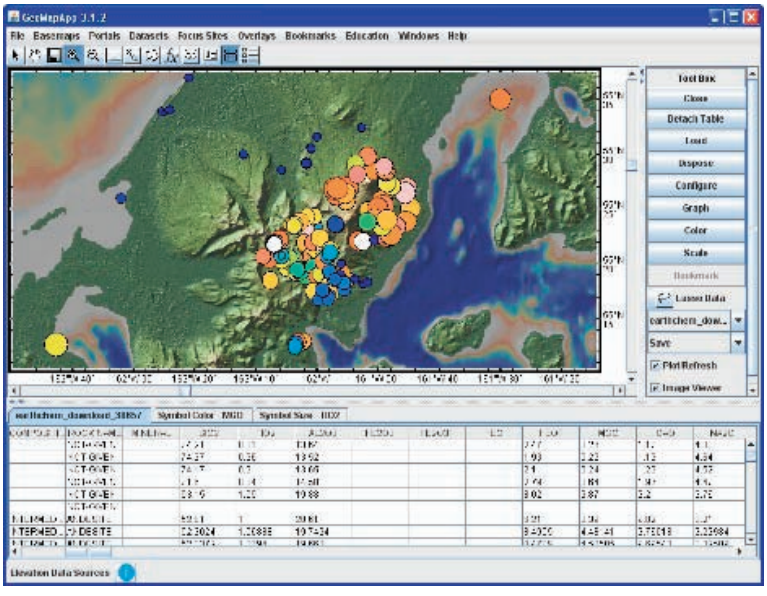


Figure 1. GeoMapApp screenshot showing Ewing EW9009 MCS lines 1002 (lower left) and 1005 (lower right, with inverse video turned on) across the New Jersey slope. The seismic lines are displayed on the map in yellow, with red portions representing the extent of the two profiles shown in the lower panes. A digitizer function allows horizons to be quickly delineated and saved to disk. The base map is the global multi-resolution topographic synthesis that offers 10m horizontal resolution of ENAM's on-land elevations and 100m or better resolution in the oceans and on the shelves.

For the ENAM region, the GeoPRISMS data portal provides access to data from the Canadian LITHOPROBE-FGP seismic imaging initiative, as well as from USGS seismic surveys. A range of cruise-based data is also available including the Mountain-Miller MCS survey across the New Jersey slope; SCREECH seismic lines around the Flemish Cap margin; and, high-resolution



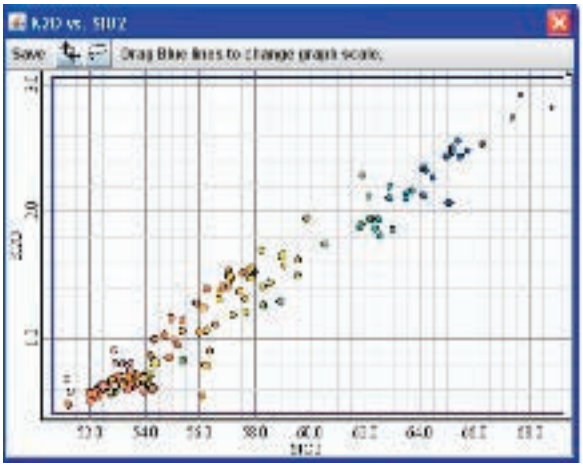


Figure 2. EarthChem geochemistry data from the Alaska Peninsula imported to GeoMapApp. Sample location symbols are colored on MgO and scaled on TiO_2. Identification of data trends is enhanced with GeoMapApp's graphing function (right, with K_2O plotted against SiO_2). Samples can be selected using a lasso tool and both the samples and map view can be exported.

multi-beam bathymetry as part of the US ECS claim (Fig. 1).

GeoPRISMS Search For Data

The portal offers a customized search-for-data interface to help researchers speed their way to GeoPRISMS-related data. The search can be done on a key word such as data type or investigator or by searching within a geographical box, as well as on NSF award number or for data sets related to publications.

A Google Maps™-based interactive map shows ship survey tracks, stations and samples from GeoPRISMS-related expeditions within each of the primary sites. Clicking on a track or station invokes a link to the associated data sets and field program information. Statistics on data file downloads are compiled annually and sent to the contributing scientists.

Data Management Plan tool

NSF now requires that each submitted proposal includes a data management plan. To help investigators meet this requirement, we developed an on-line tool (*www.iedadata.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 a tool to help PIs show their compliance with data policies.

GeoPRISMS Bibliography

An integrated, searchable GeoPRISMS bibliography has been created. It currently contains more than 170 references related to GeoPRISMS science, with papers tied to associated data sets: *www.marine-geo.org/portals/geoprisms/references.php*. The lists of publications can be exported to EndNote™.

GeoMapApp and Virtual Ocean

GeoMapApp (*www.geomapapp.org*), a free map-based data exploration and visualisation tool, incorporates the latest version of the underlying global elevation model (the GMRT synthesis) that includes cleaned multi-beam swath tracks from more than 560 research cruises; there is also a 50m-resolution layer on some continental shelves. Global land elevations comprise 30m NASA-Japanese ASTER data, with very high-resolution 10m USGS NED data for the entire US lower 48 states landmass. Users can import their own data tables and grids and manipulate them with the full range of GeoMapApp functionality (Fig. 2). Multimedia audio-visual tutorials are available on the GeoMapApp web page and on YouTube™.

Virtual Ocean (*www.virtualocean.org*) offers GeoMapApp-style 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.

GeoPRISMS MediaBank

MediaBank (*media.marine-geo.org*) provides access in a gallery format to GeoPRISMS-related images including photos from field expeditions. Please send compelling images for inclusion in the GeoPRISMS MediaBank gallery.

The GeoPRISMS data portal team is here to help the community. Please contact us at *info@marine-geo.org*.

GeoPRISMS Steering and Oversight Committee Highlights, Spring 2011

March 7-8, 2011, NSF Headquarters, Arlington, VA

Edited by Charles Bopp, GeoPRISMS Science Coordinator (Rice University)

Much of the second GeoPRISMS Steering and Oversight Committee Meeting focused on reviewing progress on the GeoPRISMS Science and Implementation Plans, outlining future planning activities, and developing strategies for future GeoPRISMS science funding consistent with available resources.

NSF Update

Fiscal Year 2011 saw ≈$2 million spent on GeoPRISMS proposals, plus continuing awards: 14 proposals were reviewed, 6 funded, and 3 proposals went to core, one of which was funded. EAR reports generally good budget news, and expects its GeoPRISMS investment to climb from $400,000 to $2 million over next 1-2 years. David Conover (Director of OCE) spoke about the National Ocean Council and National Ocean Policy (*see* http://www.whitehouse.gov/administration/eop/oceans/objectives). GeoPRISMS was urged to make connections with these objectives in future broader impacts. SEES and National Ocean Policy also have strong education and outreach components, suitable for broader impacts sections of proposals. Such E&O programs must have good metrics for success. It was noted that NSF is undergoing a sea change in broader impacts, with new and strong emphasis on societal impacts and relevance of NSF research, and is thus looking for this in proposals. The INSPIRE Program and the "One NSF" initiative (uniting the NSF message across all directorates) emphasize this as well. USGS is a good candidate for interdisciplinary efforts.

IODP is currently going through the renewal process, with a decision due in 2013. NSF is cautiously optimistic that the program will be renewed. However, IODP faces severe budget challenges because of high operational budgets for the drilling vessels, and the desire to maintain ship operations for 8 mo. per year as promised. NSF ODP is still committed to contributing their third to support the GeoPRISMS Office, but science funding is limited.

Cooperation between EarthScope and GeoPRISMS was emphasized as very important; it is harder to find areas where EarthScope and GeoPRISMS do not overlap then to

find places where they do, particularly as EarthScope moves towards continental margins. Engagement with EarthScope in site planning workshops is encouraged.

RIE and SCD Workshop Updates

NSF personnel were generally pleased with the outcomes of the recent GeoPRISMS implementation workshops, and recognize the need for several additional site-planning workshops to finalize the Implementation Plan(IP). NSF accepted the IP as presented to them on March 4, 2011, after a week of public comment. The GSOC also heard summaries on the RIE and SCD planning workshops. These summaries were similar in content to the Workshop Reports presented in the GeoPRISMS Newsletter #26, Spring 2011. The new GeoPRISMS Implementation Plan can be found at *http://www.geoprisms.org/science-plan.html.*

Proposal Funding Structure

The GSOC was reminded that GeoPRISMS Program funds are limited, and thus boundaries should be placed on the types of projects that could be supported. GeoPRISMS should also diversify its funding portfolio, leveraging FESD, SEES, Core, and other funding sources where possible. A strong case was made for continuing the MARGINS model of using sequestered GeoPRISMS funds to support a mix of projects, both community- and PI-driven proposals, as the best way to entrain new investigators throughout the life of the program. To focus the research that would be funded by GeoPRISMS, it was agreed that primary site studies should be emphasized, and also thematic studies (in particular, theoretical and experimental work) justified in the context of primary site problems and deemed integral to the success of GeoPRISMS. It was also noted that GeoPRISMS-relevant proposals can still be sent to Core, backed by a strong community science plan.

Future Planning Workshops and Science Meetings

Future site planning workshops were deemed necessary to update and finalize the IP for specific primary sites. Planned workshops [see summaries herein] included (1) an EarthScope Alaska workshop before the May 2011 EarthScope National Meeting in Austin, TX, to design the deployment plan for USArray in Alaska; (2) a GeoPRISMS-EarthScope Alaska Planning meeting in Fall 2011, to narrow the scope of the science proposed for the Alaska primary site; (3) An ENAM meeting with similar objectives as for the Alaska meeting; and (4) A science planning workshop for Cascadia, to discuss what will happen with all the data resulting from the Cascadia Initiative.

Additional meetings relevant to GeoPRISMS objectives provide opportunities for GeoPRISMS to build partnerships and become informed about related research programs. These include (1) an IODP workshop on slow slip in subduction zones in New Zealand in August 2011; and (2) The European Afar Consortium conference in Addis Ababa in January 2012, which is an opportunity for GeoPRISMS researchers to engage with European and African collaborators.

Morgan would attend the USGS Volcano Hazards Program (VHP) Council meeting in Vancouver, WA in April on behalf of GeoPRISMS. The VHP Council wants to engage multi-institutional programs, such as GeoPRISMS. GeoPRISMS is interested in coordinating research efforts with the USGS, while the USGS can provide advice and guidance about permitting and access issues. There are also concerns about coordinating event response. It was broadly accepted that USGS scientists should be represented at upcoming GeoPRISMS planning workshops, and engaged as collaborators wherever possible.

NSF Data Policy

In May 2010, the National Science Board (NSB) decided there should be a new data policy to cope with the large volumes of data being produced. NSB dictated a new requirement that all proposals must include a data management plan (2 page max), which was implemented by NSF in January 2011. Annual reports must also review progress of the data management plan, and proposals without data plans will be automatically blocked in Fastlane. The MARGINS data policy is generally stricter than the past and present NSF requirements, thus GeoPRISMS's policies should meet the new guidelines with minimal revision. (See the NSF Data Policy: *http://www.nsf.gov/bfa/dias/policy/dmp.jsp)*

Data Management

Suzanne Carbotte introduced the database maintained for MARGINS and GeoPRISMS by IEDA at Columbia University. This effort has four goals: (1) to develop a resource to support active research, (2) to grow the community in a research area, (3) to create a legacy of the GeoPRISMS program, and (d) to comply with NSF (and possible future publication) requirements. The current policy requires that PIs report basic documentation within 60 days, environmental data within 6 months, and the rest of their data within 1-2 years.

Past experience provides several lessons learned: (1) Active use of the database provides quality control. (2) The most useful items are derived and interpreted data products. (3) Both MARGINS and Ridge 2000 showed strong growth in database participation throughout the lives of the programs, with highest usage during the final integrative phases of the programs. (4) Compliance is enhanced by peer-pressure, and by contact with PIs. Requirements for derived data products and datasets remain unclear, and are something that should be considered thoughtfully as the new GeoPRISMS data policy is developed. A GeoPRISMS Data Policy Working Group was established to consider these issues further, and to make recommendations to GSOC. (Members of the GeoPRISMS Data Policy Working Group include: Schwartz, Arrowsmith, Evans, Kelley, Pritchard, Shillington)

Data Portal Report

MGDS and EarthChem are now encompassed within IEDA. Several new tools are available: (1) an online template to help with preparation of a data management plan to submit with proposals, and (2) a data compliance tool to tag datasets and related products, to demonstrate compliance to NSF. The data portal now also offers a bibliography tool, and includes related links, reference databases, and the ability to view data by primary site. GeoMapApp is now in version 3.0.1, and includes links to datasets, as well as a higher-resolution base

map - at least 30 m resolution everywhere, 10 m resolution in the US. GeoMapApp is also available for iPhone, iPad, and other smartphones and tablets for a small fee. (More information can be found on page 20 of this newsletter.)

Education and Outreach Activities

The main efforts of GEAC have been focused on running the graduate student portions of the implementation workshops. Students worked quite hard throughout the workshops, taking time from meals and breaks to develop their own implementation plans. Feedback was favorable, with recommendations for future student and postdoc activities, urging that future workshops offer dedicated times for student activities, e.g., student symposia. (Student symposia were organized and well-attended at the most recent GeoPRISMS primary site workshops.) There is also a strong need to collect feedback on the impact of the student programs at the workshops, both to show NSF and for future planning.

Discussion turned to a GeoPRISMS REU program. Issues of cohort building in a distributed model where students work with individual PIs were discussed, with COSEE mentioned as a model to consider. (A proposal for a GeoPRISMS REU Site was submitted in August 2011.) A K-12 area for the website was suggested.

Distinguished Lectureship Program

The MARGINS/GeoPRISMS Distinguished Lectureship Program continues to elicit strong interest: between 2005 and 2010, 398 institutions applied and 194 received speakers. Expanding the DLP to include informal science venues was discussed as a way to increase public visibility, as would posting more lectures on the website. Prospective DLP speakers for the 2011-2012 season were suggested.

Newsletter

The GSOC discussed if the newsletter should be PDF only or in print. The cost of newsletter printings is ~$4200; at present there's a sense that keeping the hardcopy is important. The PDF version of newsletter will continue to be available on the website and announced by listserv notice.

Initiative Reports

- **SCD**: New SCD projects include integration of P- and S-wave data from 5 amphibious passive source experiments in Costa Rica and elsewhere for double-difference velocity modeling and attenuation tomography (DeShon et al.), experimental studies of dynamic weakening of serpentine relevant to understanding slip behavior on megathrust faults (Hirth and Goldsby), seismic study of hydration of the downgoing Central American slab, correlated to along-strike geochemical changes (Syracuse and Thurber), studies of slow slip and shallow seismic tremor along the Nicoya Peninsula in Costa Rica (Schwartz, Dixon and others), and looking at redox conditions in arc magmas and the mantle (Kelley and Cottrell). GeoPRISMS postdoctoral fellow Naliboff (with Billen) will run rheologically constrained 2D and 3D models to study the generation of outer-rise faulting. The Subduction Factory Synthesis and Integration Project (Stern, van Keken and members of LDEO Geoinformatics group) is synthesizing MARGINS geochemical data collected for an EarthChem database.
- **RIE**: Ongoing work in the Gulf of California is documenting large amounts of pre-rift extension prior to the opening of the Gulf of California (Bennett), and yielding tectonic reconstructions spanning the last 14 My at a resolution of 1-2 My (Umhoefer, Dorsey, and Oskin). The Salton Seismic Imaging Project (Hole and Stock), designed to address the rupture of continental crust through a seismic reflection and refraction survey, is underway. Seismometers (including lake-bottom in the Salton Sea) have been deployed across the Salton Trough. Gaherty, Shillington, Nooner, and Pritchard have a new project along the East Africa Rift examining the origin of a cluster of deep earthquakes in the hanging wall of a boundary fault in Malawi.
- **S2S**: Research in MARGINS S2S include projects include numerical modeling and high-resolution sampling on the Waipaoa River shelf in New Zealand (Walsh, Corbett, Harris, et al.), InSAR, LiDAR, air photo, and Be-10 studies to constrain temporal and spatial variability on sediment production in the Waipaoa River (Roering and Schmidt), and a study of geomorphodynamic modulation of biogeochemical fluxes and basin stratigraphy of the Fly River (Goni, Aalto, Lauer, Dieterich, and Aufdenkampe). Tara Kniskern, a MARGINS postdoctoral fellow, is investigating sediment dynamics on the Waipaoa River shelf, NZ to better predict sediment preservation on continental margins.

Conference Reports

- **Chapman Conference "Recent Advances in Understanding Production, Transfer, and Burial of Terrestrial and Marine Materials on the Earth Surface":** This S2S conference took place in Oxnard, California, January 24-27, 2011, with 140 attendees (including 20 students). The goals of the workshop were to develop a global perspective with studies from around the world, and to facilitate synthesis and integration of S2S research as part of a digital text, and classroom materials. *(http://csdms.colorado.edu/wiki/Chapman_Source_to_Sink)*
- **USGS Marine GeoHazards Conference**: The conference was held in Menlo Park, California, March 1-3, 2011, with 56 attendees. This USGS-wide effort was in part a response to the BP Macondo Well event, but also addressed a variety of other hazards: submarine earthquakes, volcanoes, slope failures. Overall, there is a need for quantitative assessment for risk evaluation.

Exploration station

Sunday, December 4
1:00-5:00 PM
Moscone Center
South 102-103
(across from registration)

A public outreach event hosted by AGU to engage young people and their families in science. GeoPRISMS is teaming up with IRIS to host an exhibit at Exploration Station this year. On Sunday afternoon before the meeting, up to 200 families from the San Francisco area will visit 15-20 exhibits offering a variety of easy, family-friendly, hands-on activities and an opportunity to interact one-on-one with scientists, engineers, and education specialists.

AGU members are also welcome to visit and learn about the many educational and outreach programs within our community. This is an excellent opportunity to share our enthusiasm for Earth Science, as well as to promote its societal relevance, through hands-on demonstrations of earthquakes and presentations of the latest scientific data.

GeoPRISMS needs you to make this event a success! We need scientists and education specialists to interact with the families visiting our exhibit. To get more information on participating, please contact Alison Henning at ahenning@rice.edu.

GeoPRISMS Mini-Workshops at AGU

Application Deadline: November 30, 2011

"Using Geoinformatics Resources to Explore the Generation of Convergent Margin Magmas"

Pre-AGU: Sunday, December 4, 2011, 9:00 am – 5:00 pm
Warfield Room, Grand Hyatt San Francisco (345 Stockton Street)

Conveners: *R. Stern[1], M. Feigenson[2], K. Lehnert[3], A. Goodwillie[3], P. Van Keken[4], J. Kimura[5], B. Dreyer[6], E. Jordan[1], W. Lieu[1]*

[1]Univ. Texas, Dallas; [2]Rutgers Univ.; [3]Lamont-Doherty Earth Observatory; [4]Univ. Michigan; [5]IFREE Japan; [6]Univ. California, Santa Cruz

Description: A short course for students, faculty, and researchers integrating the use of geochemical databases (EarthChem), data visualization tools (GeoMapApp), and data analysis software (Arc Basalt Simulator, version 3) with background information about geoinformatics, relational databases, and data reporting.

"Integrating CRISP IODP Drilling and 3D Seismic Study"

During AGU: Wednesday, December 7, 2011, 6:00 – 9:30 pm
Orpheum Room, Grand Hyatt San Francisco (345 Stockton Street)

Conveners: *E. Silver[1], Paola Vannucchi[2], Nathan Bangs[3]*

[1]Univ. California, Santa Cruz; [2]Univ. of Florence, Firenze, IT; [3]Univ. Texas, Austin

Description: A review and discussion of research activities and opportunities relating to the Costa Rica Seismogenesis Project (CRISP) following the recent IODP Expedition 334 and 3D seismic reflection survey, and in advance of the second CRISP drilling leg in 2012.

"ExTerra: Understanding Convergent Margin Processes Through Studies of Exhumed Terranes"

During AGU: Wednesday, December 7, 2011, 6:00 – 9:30 pm
Warfield Room, Grand Hyatt San Francisco (345 Stockton Street)

Conveners: *M. Feineman[1], S. Penniston-Dorland[2], B. Savage[3]*

Keynote Speaker: *B. Hacker[4]*

[1]Pennsylvania State Univ.; [2]Univ. Maryland; [3]Univ. Rhode Island; [4]Univ California, Santa Barbara

Description: Developing an interdisciplinary approach to the study of exhumed terranes from extinct subduction zones to understand subsurface processes and regimes, e.g., the subducted slab, mantle wedge, overlying arc crust, and exposed fault systems in the crust or accretionary prism.

Mini-Workshops are free of charge and open to all.
(Attendance may be limited; first-come, first-served.)

Visit the GeoPRISMS website for further information and to register:
http://www.geoprisms.org/mini-workshop

For questions contact the GeoPRISMS Office: ***info@geoprisms.org***

GeoPRISMS NSF

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Sessions of Interest to GeoPRISMS Researchers at the 2011 AGU Annual Meeting

The complete list of sessions at AGU's Fall Meeting can be daunting, so the GeoPRISMS Office has compiled a list of GeoPRISMS-related sessions that may be of special interest to the GeoPRISMS Community.

AGU Code Key: Capital letters indicate a session's theme while the two numbers that follow indicate the day of the meeting (1=Monday, 2=Tuesday, ect…) and the time that the session starts (please refer to the AGU meeting program to confirm session dates and times). For the latest listing of GeoPRISMS-related AGU sessions, visit the GeoPRISMS website http://geoprisms.org/related-sessions.html

Compiled by the GeoPRISMS Office

U32: Physical and Chemical State of Subducting Slabs and the Slab-Mantle Interface: Forearc, Subarc, and Beyond

Conveners: Philippe Agard, Geoffrey Abers, Gray Bebout, Sarah Penniston-Dorland

Description: We will consider the state of subducting slabs and the 'subduction channel' by merging perspectives from structural, geophysical, petrologic, geochemical, experimental and theoretical studies. Topics could include: links between earthquakes, metamorphism and deformation; relationship between devolatilization and silent earthquakes; subduction accretion and erosion and cycling of continental crust; evolving subduction channels and exhumation of HP and UHP metamorphic rocks; element mobility and processes of mass transfer; devolatilization histories and deep-Earth volatile cycling; properties and transport of fluids; mechanisms by which fluids enter and alter mantle wedges.

DI14: Subduction Zone Geodynamics: Constraints from Observations and Modeling

Conveners: Manuele Faccenda, Claudio Faccenna, Serge Lallemand, Wouter Schellart

Description: Subduction zones are arguably the most significant features on Earth as they drive plate motion and mantle flow, form continents, produce mountains and basins, source arc volcanism, induce mantle heterogeneity, and trigger most seismicity. A diversity of physical and chemical processes operates at subduction zones at different length and time scales and new understanding requires the integration of a multitude of observations and modeling approaches. This session aims to expand our knowledge of subduction by combining insights from a variety of disciplines. We invite contributions from geodynamics, plate kinematics, modeling, seismology, geochemistry and petrology to discuss subduction dynamics at all relevant scales. (**c**osponsored by S, T, V)

DI18: Volatiles in the Earth

Conveners: Wendy Mao, Jessica Warren *Description*: The small amounts of volatiles (e.g., H, C and S) present in the mantle have a large effect on its properties and are critical for understanding the geophysics, geochemistry, and geodynamics of this largest region within our planet. Recent advances in understanding the storage capacity for volatiles in mantle minerals and accessory phases may shed light on the large uncertainties in the quantity and distribution of volatiles in the mantle and how these volatiles change mantle melting behavior, rheology and oxidation state. This session welcomes submissions on the full range of observations about mantle volatiles and redox state, including measurements of natural samples, high pressure experiments and computational mineral physics. (cosponsored by MR, S, T, V)

ED52: (now merged with ED24B)Using-Sharing Online Education Resources in the Modern Geoscience Classroom

Conveners: Margaret Benoit, Andrew Goodwillie, Michael Hubenthal, Donald Reed

Description: At every level of geoscience education, from elementary school to university courses, the availability and rapid adoption of online tools and activities is transforming the classroom into a virtual research environment. Students can formulate questions, analyze and visualize data, and test ideas, thereby reinforcing the methodologies of scientific inquiry. We invite contributions from geoscience educators and resources providers: How do you use these tools to both engage students while fostering knowledge construction? Which strategies and resources provide effective in-class learning opportunities? What supports are necessary for the educator, for the learner? How do we disseminate these tools and approaches?

S10: Geophysical Characterization of Magmatic Systems

Conveners: Clifford Thurber, Seth Moran, Richard Aster

Description: Seismic and geodetic methods are increasingly being used in parallel to investigate magma storage/source regions and magma propagation. 3D and 4D seismic imaging using phase arrivals, coda interferometry and/or other time-dependent seismic methods, and 3D-4D geodetic imaging using Mogi-source and finite element modeling of deformation recorded by GPS, InSAR, strainmeters, gravimeters, tiltmeters, etc., are among the ways researchers are 'pushing the envelope' of our understanding of where magma is stored beneath volcanoes. We invite contributions on the geophysical characterization of magmatic systems, with a specific focus on seismic and geodetic imaging along with complementary investigations from related disciplines. (co-sponsored by NS)

T07: Alaska Region Tectonic, Sedimentary, and Climatic Processes

Conveners: Gail Christeson, Warren Wood, Donna Shillington, Ginger Barth

Description: We invite submissions addressing the tectonic, sedimentary, climatic and oceanographic processes in Alaska and the offshore seas - Bering Sea, Beaufort Sea, and Gulf of Alaska. Alaska presents a timely target for a multidisciplinary session: multiple onshore and marine field efforts have recently targeted Alaska, and US programs such as GeoPRISMS and EarthScope are formulating plans for major future scientific endeavors here. Alaska and its margins present an excellent locality to examine fundamental questions regarding deformation and magmatism in subduction zones and other active tectonic environments, interactions between tectonics and climate, marine geohazards, and processes associated with major oceanographic boundaries. (co-sponsored by EP, OS)

T09: Breaking by Shearing: the Role of Transtension in Rupturing Continental Lithosphere

Conveners: Rocco Malservisi, Christina Plattner, Paul Umhoefer

Description: Rupturing continental lithosphere is a primary player in plate tectonics and a key to understanding continental lithosphere evolution. In general, it is assumed that magmatism is the leading mechanism for the rupture of continental lithosphere, but

shear can also play a major role. For example, deformation in transtensional regimes can provide the necessary shear weakening for localization of deformation and rupture of continental lithosphere. In this session we look for contributions from observations and modeling to evaluate the role of shear in oceanic basin initiation both in the past (e.g. the role of Falkland Fracture Zone in opening of South Atlantic) and in recent time (e.g. Gulf of California). (co-sponsored by G, CP, OS, S, V)

T20: Geologic, Tectonic, and Geodynamic Processes of the Eastern North America of the U.S.: EarthScope-GeoPRISMS Opportunities

Conveners: Basil Tikoff, Michael Williams, Frank Pazzaglia, Margaret Benoit

Description: The goal of this session is to bring together researchers focused on both offshore and onshore sections of Eastern North America to discuss advances in our tectonic understanding of this region. This region encompasses the Appalachian foreland and hinterland, the Mesozoic rifted margin, and the shelf-slope basins. Eastern North America is the archetypal example of the Wilson cycle, including the development of a post-orogenic passive margin. The session will also emphasize opportunities that are possible by combining work between different communities (EarthScope, GeoPRISMS, regional geologists, etc.) and different methodologies. (co-sponsored by EP, S, V)

T25: Insights into the Megathrust: Offshore Studies at Accretionary and Erosive Subduction Margins

Conveners: Paola Vannucchi, Harold Tobin, Kohtaro Ujiie, Nathan Bangs

Description: We solicit contributions on forearc processes relevant to the development and mechanics of the subduction interface. Materials and conditions within the megathrust are governed by tectonic accretion and erosion, modifying initial inputs of basement, sediments, fluid, and heat. The 2011 Tohoku earthquake has shown that tsunamigenic events can include ones at sediment-poor erosive margins, spotlighting the need to examine conditions for shallow coseismic slip. Presentations on IODP drilling, geophysical surveys, and other studies are welcomed from any region, with an emphasis on Nankai (NanTroSEIZE) and Costa Rica (CRISP), GeoPRISMS focus areas Alaska, Cascadia, and New Zealand; and the Japan Trench. (cosponsored by EP, S)

T32: Mantle Dynamics and Lithospheric Structure of the African Plate

Conveners: Kathleen Keranen, Samantha Hansen, Andrew Nyblade, Mark van der Meijde

Description: Global- and regional-scale geophysical investigations using new data sources are improving our understanding of the tectonic evolution and current geodynamics of the African plate. Compositional heterogeneity, large-scale anomalies, and small-scale features in the crust and mantle are being imaged in higher resolution. This session aims to integrate observations from different geophysical disciplines working in Africa to explore these new discoveries. We invite contributions from multi-disciplinary studies (i.e., geodynamical modeling, receiver functions, tomography, GPS, satellite gravity, geochemistry) that investigate and constrain crust and mantle structure and dynamics of the African plate. (cosponsored by S, V)

T48: Source to Subduction: The Interplay of Sedimentation and Deformation at Subduction Zones

Conveners: John Jaeger, Pierre Henry, Elizabeth Screaton

Description: Deformation can shape sediment dispersal pathways on convergent margins, as slip affects the spatial distribution of uplift and exhumation rates. In turn, the distribution and properties of sediments on the overriding and subducting plates can impact stress states, mechanical properties, and fluid exchange between the ocean and the underlying crust and mantle. Thus, complex feedbacks may develop between the basement, sediments, and subduction zone deformation. This session welcomes researchers working on these feedbacks, including GeoPrisms/MARGINS research, ocean drilling, geophysical investigations and laboratory or modeling studies.

T43: Rift-to-drift Geology of the Atlantic: Insights from the US East-coast

Conveners: Romain Meyer, Jolante Van Wyk

Description: The rifted Atlantic margin formed when the lithosphere of the supercontinent Pangea was ruptured to form new oceanic lithosphere. Structural and magmatic variations along the US East coast are substantial; dike swarms on land have been associated with the magmatic southern East coast margin, while the Newfoundland margin farther north seems to be an archetypal example of magma-poor rifting. What do we know about the formation of the US East coast and its conjugate margins? This session will focus on different physical and chemical processes during rifting and rupture, but observational and theoretical contributions from other rifts, margins that may contribute to understanding this GeoPRISMS focus site are also welcomed. (cosponsored by EP, GP, MR, OS, V)

V28: Peridotites and Serpentinites from Ridges to Subduction Zones: the Role of Fluids at Low and High Temperatures

Conveners: Tomoaki Morishita, Frieder Klein, Eric Hellebrand

Description: Mantle rocks exposed at the seafloor play a key role in understanding global fluxes between the deep Earth and the exosphere. Deciphering their melting and melt migration signature requires a clear assessment of alteration, which not only affects the peridotite composition, but also impacts the rheology and seismic structure of oceanic lithosphere. Serpentinization, weathering and carbonation of peridotites increasingly gain importance for a growing interdisciplinary community. The aim of this session is to bring together the high-T and low-T ultramafic communities from all tectonic settings and discuss new results addressing the life and death of peridotites and associated rocks. (cosponsored by DI, OS, T)

V33: Role of Fluids in Subduction Processes

Conveners: Hikaru Iwamori, Anne Pommier, Eiichi Takahashi

Description: The upward migration of fluids from subducting plates are critical to our understanding of subduction processes, such as slab dehydration and associated earthquakes, magma genesis, evolution of crustal magma or fluid reservoirs which may cause both seismic and electrical conductivity anomalies. In order to understand the distribution, nature and role of fluids in subduction zones, multidisciplinary studies and discussions are therefore needed to be integrated. We invite contributions that advance our understanding of the role of fluids in subduction contexts. Contributions emphasizing a field-lab multidisciplinary approach, including geophysical observations, HP experiments, geochemical and petrological constraints, are particularly welcome. (cosponsored by DI, MR, NS, S, T)

V43: Ultrahigh-Pressure Metamorphism: New Paradigms

Conveners: Larissa Dobrzhinetskaya, Harry Green, Bradley Hacker, Juhn Liou

Description: When UHPM terranes were first discovered it came as a great surprise that buoyant crustal rocks could be subducted to depths of hundreds of km, and then subsequently exhumed. Much progress has been made in understanding UHP subduction-zone metamorphism from petrological, geochemical and geophysical perspectives founded in field observations, high-pressure experiments, thermodynamic calculations, and geodynamic models. The session is dedicated to the latest innovative developments in this multidisciplinary field: new analytical techniques and computational tools, the variations in subduction-exhumation rate and continental growth, geochemical rejuvenation of the mantle, and variations in tectonic settings in which UHP rocks form and are exhumed. (cosponsored by MR)

V39: The Origin of Orogenic Andesites

Conveners: Susanne M. Straub, G.F. Zellmer, Arturo Gomez-Tuena

Description: Arc magmas are globally distinguished by their high average contents of silica. Understanding the causes of enrichment of silica and other elements is fundamental to models of arc crustal growth, to quantification of arc fluxes and their impact on Earth. Yet, no consensus exists on arc magma origin. For example, contrasting models propose either primary andesite formation beneath the Moho, or through crustal differentiation of basaltic mantle melts. We invite all papers that approach andesite genesis through field, geochemical and modeling studies. Particularly welcome are contributions that provide constraints on the time scales of melt formation, ascent and differentiation, and those that distinguish subcrustal from crustal petrogenetic processes.

Related Sessions

U47: The Great 11 March 2011 Tohoku-Oki Earthquake

Conveners: Manabu Hashimoto, Thorne Lay, Mark Simons, Takeshi Sagiya, Gavin Hayes, Kenji Satake

ED17: Communicating Research and its Impacts: Research Geoscientists

Conveners: Elena Sparrow, Vincent C H Tong (cosponsored by all)

ED24: Engaging the Next Generation of Scientists in Effective Professional Development Experiences

Conveners: Lora Bleacher, Emily Cobabe-Ammann

ED27: Faculty Professional Development: Real and Virtual Models

Conveners: Susan Eriksson, Jan Hodder, Cathryn Manduca

G20: What Geodesy Can Derive from the 2011 Great Tohoku, Japan, Earthquake

Conveners: Jeffrey Freymueller, Masato Furuya, Manabu Hashimoto, David Sandwell (cosponsored by EP, GC, NH, S, T)

S13: Lessons Learned From the 2010, Maule Earthquake

Conveners: Anne Meltzer, Andreas Rietbrock, Susan Beck, Sergio Barrientos (cosponsored by NH)

S16: Observations and Modeling of Tremor and Slow Slip and Implications for Plate Boundaries

Conveners: Heidi Houston, Zhigang Peng, Michael Brudzinski (cosponsored by G, MR, T)

T03: Linking Plate Tectonic and Surface Processes to the Deep Earth

Conveners: Nicolas Flament, Sonja Spasojevic, Maria Seton, Laurent Husson (cosponsored by DI, EP)

T10: Characterization of Fault Zones by Geophysical Imaging

Conveners: Stefan Buske, John Hole, Paul Bedrosian (cosponsored by NS, S)

T11: Deformation Processes: Microstructure, Rheology, and the Effects of Fluids

Conveners: Haemyeong Jung, Junfeng Zhang, Katsuyoshi Michibayashi, Philip Skemer (cosponsored by MR, S, V)

T14: Evolution of Continental Crust in Magmatic Arcs

Conveners: Margaret Rusmore, Robert Miller, Robinson Cecil (cosponsored by S, V)

T15: Exhumation of Mantle-Derived Rocks at Divergent Plate Boundaries: Mechanisms and Consequences

Conveners: Gianreto Manatschal, Mathilde Cannat (cosponsored by V)

T23: Grain to Basin Scale Numerical Modeling of Deformation

Conveners: Markus Albertz, Pablo Sanz, Steven Ings (cosponsored by MR, NG)

T34: Mechanics of the Lithospheric Deformation During the Earthquake Cycle

Conveners: Sylvain Barbot, Ya-Ju Hsu, Hiroyuki Noda (cosponsored by G, S)

T38: Physico-chemical Properties of Fault Rocks from the Frictional-Viscous Transition to the Shallow Crust

Conveners: Amy Luther, Gary Axen, Andre Niemeijer, Steven Smith (cosponsored by MR)

T44: Rock Physical Properties in Fault Zones through the Seismic Cycle and Implications for Earthquake Dynamics

Conveners: William Griffith, Thomas Mitchell, Nicolas Brantut, Charles Sammis (cosponsored by MR, NG, S)

T57: What Can Fault Rocks Tell Us About Earthquake Mechanics?

Conveners: James Kirkpatrick, Heather Savage, Christen Rowe (cosponsored by MR, S)

V06: Differentiation Processes in Magma Chambers

Conveners: Christian Tegner, Adam Kent, Bernard Charlier, Olivier Namur (cosponsored by P, T)

V08: Formation and Evolution of Magmatic Enclaves in Arc-related Rocks

Conveners: Dale Burns, Frank Tepley, Sarah Collins

V13: Magma Transport Through Dykes and Sills: Insights into Volcanic Unrest and Eruption Processes

Conveners: Benoit Taisne, Eleonora Rivalta, Yosuke Aoki, Thierry Menand (cosponsored by G, NH, S, T)

V14: Magmatic Plumbing Systems

Conveners: Claude Jaupart, Helge Gonnermann, Michael Poland, Mark Jellinek (cosponsored by DI, G, S, T)

V17: Mantle melts: Innovative Approaches and Constraints to Modeling the Melting Regime

Conveners: Patricia Gregg, Lynne Elkins (cosponsored by DI, T)

GeoPRISMS Education and Outreach Update

Alison Henning, GeoPRISMS Education and Outreach Coordinator (Rice University)

GeoPRISMS Education and Outreach has been busy this year! We have submitted two proposals to NSF outlining new proposed directions for the program, hosted two student symposia in conjunction with the fall primary site planning meetings, visited Capitol Hill, and are planning an exhibit for the Exploration Station at the AGU meeting in December (see page 27). The upcoming Distinguished Lectureship Program (DLP) speaker tours and the Student Prize competition at AGU round out our E&O efforts for the year.

New Directions

GeoPRISMS submitted two proposals to the National Science Foundation in an effort to expand its E&O activities. The first proposal, entitled *Collaborative Research: Bringing NSF MARGINS/ GeoPRISMS Continental Margins Research into the Undergraduate Curriculum,* was submitted to NSF on May 27, 2011. Members of the GeoPRISMS Education Advisory Committee (GEAC) were instrumental in assembling a high-quality proposal. The goal of the proposal is to build upon the success of the MARGINS mini-lessons, which are educational modules that take cutting-edge research and place it in undergraduate classrooms. The objectives of the proposed project are to produce a synthesis of the 4 MARGINS initiatives, the culmination of a decade of interdisciplinary, community-driven science around the world. We plan to engage MARGINS researchers in undergraduate curriculum development, guided by curriculum experts, in particular, reflecting on the highlights of a decade of MARGINS research. This project will formalize an active, ongoing program of mini-lesson development by PIs throughout the community, and will emphasize placing MARGINS science into undergraduate classrooms, while encouraging GeoPRISMS PIs to create mini-lessons to achieve broader impacts. Please consider sending us your ideas for mini-lessons!

A second proposal entitled *REU Site: GeoPRISMS Summer Research Experience for Undergraduates* was submitted to NSF on August 24, 2011. Establishing a GeoPRISMS-wide REU program has been a goal of the steering and the education and advisory committees for some time now, as a way to expand our reach and impact among promising undergraduate students. We propose a distributed REU program managed by the GeoPRISMS Office, in which 8-10 students visit Rice University for a week of orientation and are then distributed across the country to various GeoPRISMS researchers. Discussions at the Alaska and ENAM meetings indicate that there is enthusiastic and widespread support for this program throughout the GeoPRISMS community. Please consider hosting a student, and encourage your students to apply!

Student Symposia

GeoPRISMS is continuing the practice of organizing student-specific activities in conjunction with GeoPRISMS meetings and workshops. Both of the fall planning workshops, for Alaska and the Eastern North American Margin (ENAM) primary sites, included a full-day student symposium. The symposia consisted of brief introductory talks by students and leaders of the scientific community, student poster presentations, and a field trip for cohort-building (Figures 1 and 2). The symposia programs were designed to provide valuable background information about each primary site, as well as the science planning process,

Figure 1. (left) Participants on the student symposium field trip with Mt. Hood in the background. Figure 2. (right) Jeff Marshall, Alaska Student Symposium convener and attendees of the Alaska graduate student symposium examine outcrop of Boring Volcanics.

Figure 3. GeoPRISMS representatives at the Hart Senate Office Building for the geohazards showcase. Left to right: Donna Shillington, Maya Tolstoy, Harold Tobin and Alison Henning.

facilitating student participation in the workshop itself. Several senior students and early career scientists were also invited to serve as scribes for the break-out discussions, engaging them directly in the science planning process. In addition, each meeting included an organized student dinner, to which selected senior scientists were invited, enabling discussion of career choices and paths, and other topics of specific interest to the attendees. Finally, students were invited to provide a unified perspective on the meeting and the science planning process, including recommendations to the rest of the participants.

The design of the pre-workshop symposia was guided by student feedback from the RIE and SCD workshops, where students enjoyed the cohort-building activities, but also sought ways to participate more fully during the meeting itself. A poster on the design and outcomes of the student symposia and other workshop activities, entitled *Engaging Students in GeoPRISMS Science Planning: Preparing the Leaders of Tomorrow*, will be presented at AGU this year in session ED43A: Engaging the Next Generation of Scientists in Effective Professional Development Experiences II Posters (December 8th from 1:40 PM to 6:00 PM).

GeoPRISMS on the Hill

Each year in the United States, natural and man-made disasters cause hundreds of deaths and cost billions of dollars by destroying homes and critical infrastructure, as well as disrupting commerce. On September 7, Senators Harry Reid and Bill Nelson and the Congressional Hazards Caucus hosted "A Showcase of NSF-Funded Hazards Research" at the Hart Senate Office Building on Capitol Hill. The event was designed to showcase NSF-funded basic research in recognition of National Preparedness Month in September and in light of the recent East Coast earthquake and hurricane. More than 30 exhibits demonstrated research on tornados, earthquakes, tsunamis, volcanoes, oil spills and hurricanes, as well as the human response to these events.

GeoPRISMS was there to present current investigations into earthquake and tsunami hazards. Harold Tobin, Donna Shillington, Maya Tolstoy, Costas Synolakis, and Alison Henning represented the broader community working on GeoPRISMS science by displaying posters, animations, videos, and hands-on displays (Figure 3). Cascadia is one of GeoPRISMS primary sites and represents the greatest earthquake threat to the continental United States. Visitors were very interested in the potential for a megathrust earthquake off Cascadia, and much discussion centered on current research in the region.

The meeting formally opened with remarks from the director of NSF on the importance of studying hazards, both natural and man-made. Senator Bill Nelson spoke about the importance of science and searching for the truth based on facts. Senate staffers, government contractors, and NSF personnel visited the open-house exhibitions throughout the day in an effort to enable policymakers and response teams on the federal, state, and local levels to better predict, prepare for, mitigate and respond to hazards that affect human life and property (Figure 4).

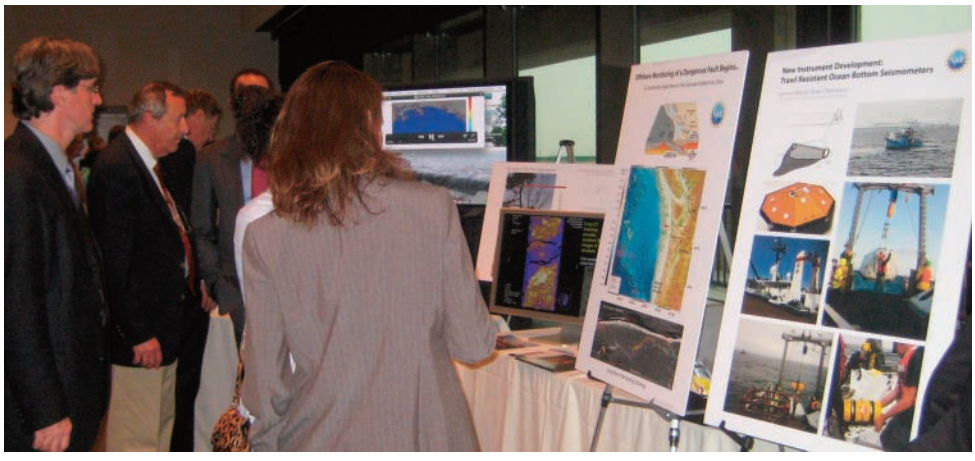

Figure 4. GeoPRISMS scientists discuss OBS technology and the Japanese tsunami with NSF and Senate personnel.

Deep Mapping of the Megathrust on Land and at Sea around the Alaska Peninsula

Donna J. Shillington (Lamont-Doherty Earth Observatory at Columbia University)

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

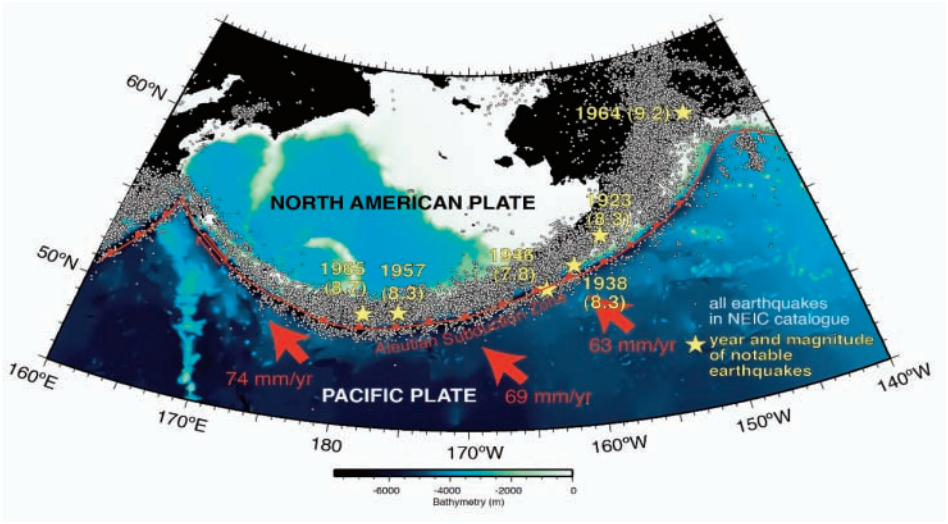

Figure 1. Simplified map of the Alaska subduction zone, showing distribution of catalog (white dots) and notable (yellow stars) earthquakes along the margin. Red arrows indicate absolute plate motions

The Mission: Mapping the Alaska Megathrust

The 2500-km-long subduction zone offshore southern Alaska regularly produces large, destructive earthquakes. One of the big conundrums about these settings is how large of an area locks up on the contact between these plates (called the 'megathrust') and then ruptures in earthquakes. To tackle this question, my colleagues and I collected data on land and at sea in the summer of 2011 to produce an image of the megathrust, constrain the properties of rocks around and within the megathrust and link these fault properties to the earthquake history here. Our expedition focused on a part of the subduction zone off the Alaska Peninsula that exhibits very big changes in slip behavior. Some parts of this plate boundary lock up and then rupture catastrophically in big earthquakes. In other areas, the plates appear to be smoothly sliding by each other and thus do not produce great earthquakes. The Semidi segment last ruptured in a great earthquake (magnitude 8.3) 73 years ago in 1938. This area has an estimated recurrence interval of ~50-75 years, and thus might be due to produce another big earthquake soon. However, just to the west lies the Shumagin gap, an area that has not produced a great earthquake historically. Imaging a major fault boundary that lies tens of miles under the seafloor is not an easy task, but we had exceptional tools for the job. We used the *R/V Marcus G. Langseth* to acquire seismic reflection data and onshore/offshore wide-angle reflection/refraction data. Sound waves generated by an array of air guns were recorded on two 8-km-long streamers, an array of ocean bottom seismometers and onshore seismometers.

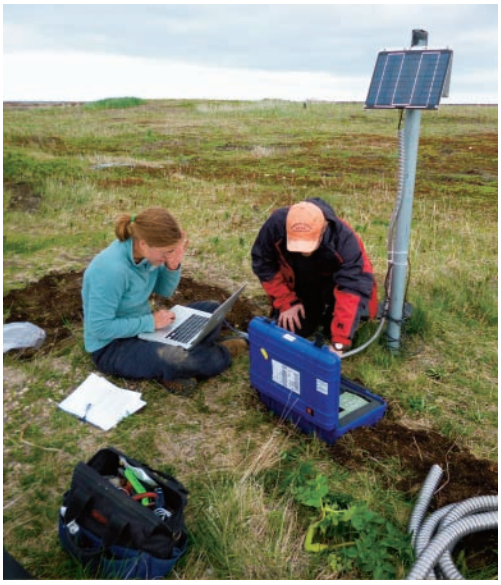

Figure 2. Katie Keranen and Guy Tytgat deploying a seismometer in Port Heiden

June 17-24: Installing seismic stations on the Alaska Peninsula

The first component of our program involved deploying seismometers onshore around the Alaska Peninsula with Katie Keranen (Univ. OK) and Guy Tytgat (PASSCAL). These instruments recorded small, local earthquakes, distant large earthquakes and (importantly for our project) the sound source of the R/V *Langseth*. The Alaska Peninsula is too rugged and expansive for a network of roads, so planes, helicopters or boats are the only transportation options. We decided to charter a plane based in Nelson Lagoon, a town of 80 people situated on a long, narrow sandy spit jutting out into the Bering Sea. The weather dictates when and where you can fly each day, and it varies dramatically. We were lucky enough to have several clear days (even saw some blue skies and sunshine!), but other days we were grounded by weather and wiled away the time indoors at our inn. While we were in the air, we saw majestic,

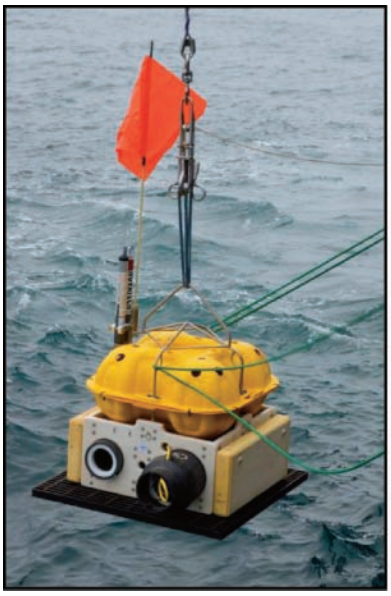

Figure 3. (above) The R/V Langseth in port in Kodiak, with snowy mountains in the background. Figure 4. (right) Deploying an OBS.

snow-capped volcanoes shrouded in clouds, expansive views of the sparsely vegetated Alaska Peninsula, which is riddled with rivers and lakes, and lots of wild life: caribou, bears, seals, walruses and eagles (just to name a few). It is a landscape that seems remarkably untouched by humanity.

Local communities were unwaveringly helpful and friendly in finding places for our stations. The two school districts here kindly granted us permission to install our seismic stations at any of their schools, and we also obtained permission to place equipment at various lodges and village offices. Residents volunteered to take our gear and us from the airstrip to our sites. In one town, our pilot made a general plea over the radio: "Is anyone listening on Channel 3? I'm here at the airstrip with scientists who need a ride to the school". Someone answered immediately and picked us up 5 minutes later.

Many of our sites are in spectacular places near remote lodges or in towns nestled between mountains and the ocean. All of them are home to impressive wild life that poses a risk to our equipment, particularly bears. We protected the equipment against curious small animals but fully bear-proofing a station for a short (two-month-long) deployment was not feasible. Instead, we hoped that placing our stations in villages (rather than in the wild) would provide some protection, but we also needed good luck…

June 24-29: Transitioning from land to sea

Seven days and eleven flights after we arrived in Alaska, we finished deploying our seismic stations onshore. Our final constellation of stations differed a little from our original plan (as they always do), but achieved our main goal of instrumenting the part of the Alaska Peninsula nearest to our planned offshore work on the R/V *Langseth*. As luck would have it, we finished deploying our seismometers just in time to catch a large earthquake (magnitude 7.4) that occurred farther west in the Aleutians around the Fox Islands. After the onshore work was finished, Katie and Guy departed for home, and I flew to Kodiak to meet the R/V *Langseth* and our shipboard science party, including other chief scientists Mladen Nedimović (Dalhousie) and Spahr Webb (LDEO). Kodiak offered beautiful sights, delicious seafood and local beer (including Sarah Pale Ale!), but our science party was eager to leave for sea. We departed Kodiak on a sunny evening on June 29 for our 38-day-long research cruise.

June 29-July 11: Deploying and retrieving ocean bottom seismometers

The next part of our program involved using ocean bottom seismometers (OBS) to record seismic waves generated by the sound source of the *Langseth.* OBS's are autonomous instruments that sit on the seafloor and record sounds waves traveling through the earth and the water. Floats made from glass balls and syntactic foam make each OBS buoyant, but an anchor holds it on the seafloor during the study. We placed OBS's from Scripps Institution of Oceanography on the seafloor along two lines extending across the major offshore fault zone. The larger the distance between the sound source (earthquakes or air guns) and the seismometer, the deeper into the earth the recorded sound waves travel. OBS are not attached to the vessel and are also very sensitive, so they can record sound waves generated very far away (commonly >200 km). Because we want to examine deep fault zones that cause large earthquakes off Alaska, OBS are a critical part of our effort.

To deploy the OBS, we simply lifted them over the side of the ship with a large crane and gently dropped them in the water, after which they slowly sank to the seafloor. It never ceases to amaze me that we can throw a bundle of very sophisticated electronics over the side of the ship and hope to pick it up and retrieve information from it. Yet, it works! After leaving OBS on the seafloor along each line for ~3 days to

Figure 5. Watch-standers at work in the lab.

air guns of the *Langseth*, we returned to collect them. After receiving an acoustic signal to release from its anchor, the OBS rises through the water at 45 meters per minute. When the water is deep, it can be a long wait. Some of ours were 5500 m below the surface! The recovery of OBS always involves a certain amount of suspense. Despite all of the advanced engineering and planning that goes into these instruments, it is an inherently risky endeavor. Happily, we recovered 100% of our OBS.

Despite all the technology required to place a seismometer many miles below the ocean on the seafloor and summon it back to the surface, many aspects of actually plucking the OBS out of the ocean and pulling it on deck are remarkably low tech. Once the OBS is spotted floating on the surface, the ship drives along side. It is akin to driving your car up next to a ping-pong ball. Scientists and techs lean over the starboard side of the *Langseth* with large poles and attempt to attach a hook with rope to the top of the OBS. Its not always easy since the OBS is bobbing up and down on the waves. Once we hook it, we can attach a rope to the wench and haul the OBS onboard. Sometimes, OBS bring back surprises – an octopus returned with one of our OBS! He was alive and healthy, so we returned him to the ocean (though some lobbied that we keep him for lunch…)

July 11-August 5: Seismic reflection profiling with miles and miles of streamer

On July 11, we finished our OBS work, and began the second phase of the cruise: recording sound waves from the Langseth's airgun array with two 8-km-long (5-mile-long) cables (or streamers) filled with pressure sensors. Changing gears in terms of scientific activities also involved changes to our science party; we swapped personnel by boat transfer in Sand Point on a beautiful sunny evening. The Scripps OBS team departed, and we were joined by new reinforcements, including five undergraduate students from Columbia University.

Our seismic streamers are stored on gigantic spools, which unreel cable off the back of the ship into the ocean. A large buoy is affixed to the end of the streamer, and 'birds' are attached along its length, which can be used to control the depth of the streamer. Large paravanes hold the streamers apart; these are like large kites flying off the back of the ship in the water. Deploying miles of streamer and the other attending gear is an impressively long and complicated undertaking, which also involves a fair amount of intense manual labor. But after 3 days, all of the gear was in the water. Once data acquisition began, we settled into a routine of watchstanding and standard shipboard data processing. Ship time is precious, so we collect data 24 hours a day, seven days a week.

One of the core objectives of our project is to image the deep parts of the plate tectonic boundary, which required us to go as far north (and as close to the coast) as possible. Easier said than done! The southern edge of the Alaska Peninsula is rugged and flanked by lots of small jagged islands and shallow features just below the surface of the ocean, and there is also more fishing activity close to the coast; both pose risks to the seismic gear.

Figure 6. Donna and Katie on their way to another station.

One of our closest approaches to land was near Unga, one of the Shumagin islands. At the apex of the turn, our streamers came within less than a mile of the coast. Due to some early difficulties with our equipment, we had to repeat this maneuver several times. I held my breath and watched our third (and final) pass from the bridge. After the ship and gear passed safely through the most harrowing part of the turn, the captain turned to me and asked, "We're not going to do this again, are we?" Thankfully not! At least not there. But there were several other important parts of our survey that required close approaches to the coast to image critical parts of the boundary.

Over the course of our cruise, we were treated to amazing views of marine life, including fish, whales, seals and birds. On one memorable day, we found ourselves surrounded by three species of whales, including a rare North Pacific Right Whale. But we tried to keep our distance from marine mammals. Since we are creating sound waves to image the earth, and they use sound to navigate and communicate with one another, our activities might disturb them; we suspended operations if a mammal came too close.

We used our new data to create very preliminary images of the structures below the seafloor as we went. A regular sight in the main lab was a group of people gathered around a computer screen or a large paper plot, talking and pointing excitedly. It was exhilarating to glimpse faults, sediments and other structures in our data for the first time and ponder what they might be telling us about this active plate tectonic boundary. But we have a lot of hard work ahead after the cruise to obtain concrete results from our voluminous data – we acquired over 3 Tb (3000 gigabytes!) of raw seismic data during the cruise! At 6:30 am on August 5, the R/V *Langseth* pulled into port in Dutch Harbor, marking the end of our very successful research cruise. Our steam into port from our study area involved a trip through Unimak pass and beautiful views of Aleutian volcanoes, including majestic Shishaldin.

August 5-10: Back to the Alaska Peninsula

Many people flew home after our arrival in Dutch Harbor, but not me! (At least not immediately). Katie Keranen and I returned to the rugged Alaska peninsula to recover the land seismometers that we deployed at the beginning of the summer. An Anchorage-bound flight from Dutch Harbor dropped me off in Cold Bay to rendezvous with Katie. After the plane landed, the stewardess asked for our "Cold Bay passenger" to disembark. Passenger. Singular. I filed past all the folks heading to Anchorage and beyond. Katie and I returned to all of our sites by charter plane. According to our pilot, it was a very foggy summer on the Alaska Peninsula, but we were blessed with excellent weather, allowing us to pick up all of our instruments in just a day and a half. Multiple attempts were required to recover a seismometer that we placed Heredeen Bay; on the first try. From the plane, we saw a large brown bear only 20 feet away! But to our delight, none of the stations had been disturbed by wild life, and all of them recorded data for the entire summer. After recovering our last station at Bear Lake, we rewarded ourselves by lingering at beautiful lodge there. We tried (unsuccessfully) to catch some fish and watched bears pick through the brush on the other side of the river. And after an amazing 55 days on and around the spectacular Alaska Peninsula, I happily headed back to NYC.

Figure 7. Bears at Bear Lake, Alaska

Special thank you to the following: Onshore Science Party:Kate Keranen (Univ. Oklahoma), Donna Shillington (Lamont-Doherty Earth Observatory), Guy Tytgat (Passcal Instrument Center)

Offshore Science Party:Donna Shillington (Lamont-Doherty Earth Observatory), Mladen Nedimovic' (Dalhousie University), Spahr Webb (Lamont), along with Anne Bécel, Matthias Deleschluse, Harold Kuehn, Jiyao Li, Berta Biescas, Aaron Farkas, Andrew Wessbecher, Celia Eddy, Kelly Hostetler, Hannah Perls, Jack Zietman

GeoPRISMS AGU Townhall and Community Forum

Monday, December 5 at 6PM

Grand Ballroom, Grand Hyatt San Francisco

345 Stockton Street

Program update from NSF & GeoPRISMS Chair, including reports from recent meetings plus information regarding upcoming research opportunities

Evening is open to all with interest in the GeoPRISMS program.

For more information visit ***www.geoprisms.org/townhall.html***

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GeoPRISMS Online

The GeoPRISMS website continues to improve, with new information and daily news updates.Some of the latest important improvements include:

- The latest news from the listserv is now visible from the front page below the banner
- Stay up to date with AGU happenings, especially the mini-workshops, visit geoprisms.org/mini-workshop.html

Expect big things from the GeoPRISMS website in the upcoming months as we upgrade our software and overhaul the entire GeoPRISMS web presence. ***Make suggestions for the website, send them to info@geoprisms.org***

GeoPRISMS Data Portal

www.marine-geo.org/portals/geoprisms

Visit the GeoPRISMS data portal to find information for each primary site:

- Pre-existing data sets and field programs
- Data sets ready for download
- 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

NSF Proposals: Data Management Plan

All proposals submitted to NSF, including those intended for the GeoPRISMS panel, must now include a Data Management Plan.

The IEDA-GeoPRISMS database group has developed an easy-to-use web form for PIs to create a Data Management Plan.

www.iedadata.org/compliance/plan

- Fill in the boxes
- Print as PDF
- Attach to proposal
- Done!

For more information on the Data Management Plan Tool, please contact the database group at info@marine-geo.org

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Geodynamic Processes at Rifting and Subducting Margins

GeoPRISMS AGU Townhall Meeting and Student Forum

December 5, 2011, 6 pm – 9:30 pm, Grand Hyatt, Grand Ballroom San Francisco, CA
http://geoprisms.org/townhall.html

Workshops of Interest

• **AGU Mini-Workshop: Using Geoinformatics Resources to Explore the Generation of Convergent Margin Magmas**
December 4, 2011, 6 pm – 9:30 pm, Warfield Room, Grand Hyatt, San Francisco, CA
http://geoprisms.org/mini-workshop/geoinformatics-2011.html

• **AGU Mini-Workshop: Integrating CRISP IODP Drilling and 3D Seismic Study**
December 7, 2011, 6 pm – 9:30 pm, Grand Hyatt, Orpheum Room, San Francisco, CA
http://geoprisms.org/mini-workshop/crisp-2011.html

• **AGU Mini-Workshop: ExTerra: Understanding Convergent Margin Processes Through Studies of Exhumed Terranes**
December 7, 2011, 6 pm – 9:30 pm, Grand Hyatt, Warfield Room, San Francisco, CA
http://geoprisms.org/mini-workshop/exterra-2011.html

• **EarthScope-GeoPRISMS Science Planning Workshop on Cascadia**
Spring 2012, Dates and location to be determined
http://geoprisms.org/cascadia.html

GeoPRISMS Related Meetings

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

• **International Conference on a New Perspective of Great Earthquakes along Subduction Zones**
February 28 – March 1, 2012, Kochi, Japan
Send e-mail to nantro-kaken-info@jamstec.go.jp