GeoPRISMS

Newsletter - Issue No. 35, Spring 2016

In this Issue

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The GeoPRISMS Newsletter is published twice a year and is designed to provide to the GeoPRISMS community summaries of recent GeoPRISMS activities and meetings, synthesis articles, editorials, and discussion of science opportunities. Archives of the Newsletter are available on the GeoPRISMS website.

From the Chair

Dear GeoPRISMS community,

It is a great pleasure to welcome you to the 2016 Spring edition of the GeoPRISMS newsletter. This issue appears both in print and electronic form and provides an update on activities at AGU (including the brand new photo contest), Steering Committee activities, as well as the new program solicitation with a new opportunity for community science in Alaska. Many have also contributed to the Report from the Field which focuses on the ongoing research in Alaska & the Aleutians with important logistical support that has been coordinated by NSF.

The release of this newsletter is a bittersweet moment for me. It is the last one I introduce as GeoPRISMS Program Chair. I am nevertheless very happy to yield the reins to Demian Saffer from Penn State later this Fall. Demian is a very productive and engaged scientist who focuses in his research on fault mechanics, active tectonics, and geohydrology. He played a critical role on the MARGINS Steering Committee in the years leading up to the current GeoPRISMS effort. I am delighted that Demian has been willing to take over the lead of the Program and it has been a great pleasure starting to work with him on the transition. I hope you will all join us as the Fall AGU Townhall to welcome Demian to his new role as GeoPRISMS Chair!

The move of the GeoPRISMS Office to Penn State will complete a somewhat extended transition that started last Fall with Anaïs Férot's move to the University of Oregon and my own to the Carnegie Institution for Science in Washington, DC. The GeoPRISMS Office at the University of Michigan has officially been closed as of February. I would like to thank the University and in particular former Chair Becky Lange for their great and enthusiastic support for this national program. With this transition we also say goodbye to Jeanne Bisanz who provided administrative support to the program at Michigan. I would like to thank Jeanne for her enthusiasm and immeasurable contribution to the program. Anaïs will continue her work as science coordinator with the new office. Merci beaucoup, Anaïs, for all your work, great cheer, and fundamental role in all the activities of the Office. It has been delightful to work with both Anaïs and Jeanne. It really feels that the last three years have just flown by!

We are also seeing significant changes in the make up of the GeoPRISMS Steering Committee. Demian Saffer has returned to the committee as incoming Chair. Harold Tobin, Gene Yogodzinski, and Maureen Long are rotating off due to the three-year limitation on membership. Jeff Freymueller took over the Earthscope National Office last year and is leaving just a year early. Good luck, Jeff, on this important assignment! We also say goodbye to Liz Hajek who unfortunately has to leave due to the institutional conflict with Demian. I would like to thank the retiring and continuing members for your great and positive contributions in the last few years. You have made my load light and my job fun.

Last but not least, I would like to thank the community as a whole. We have grown into a large, interdisciplinary, and international program with really strong buy-in from graduate students, postdocs and junior scientists. It has been great working with such a fantastic group of colleagues and to see the program grow to its current state. Go GeoPRISMS!

Peter van Keken
Chair, GeoPRISMS Program

Cover Photograph:
Mount Tulik Volcano, a small cinder cone located on the southeastern flank of Okmok Caldera, as viewed from a helicopter during a summer 2015 geophysical survey to study arc magmatism beneath the caldera. Photo credit: Kerry Key

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Message from NSF












We at NSF are excited that the GeoPRISMS Program continues to be a vibrant research program after having had a positive midterm review last year and with a strong showing at the Fall AGU meeting on the breadth of research carried out by the GeoPRISMS community. This year, we are happy to be able to offer new opportunities for work in Alaska as we explain in more detail below. The solicitation for this coming year has been released and provides more details on all of the opportunities.

Federal Budget Update

In terms of the federal budget, the Consolidated Appropriations Act was signed into law on Dec 18th 2015 and provides FY16 funding for NSF at the level of $7.463 billion, which is a modest 1.6% increase over the FY15 level. Earlier language from the House regarding directorate level spending limits were removed although the Directorate of Social, Behavioral and Economic Sciences were limited to FY15 levels. Funding at the GEO Directorate level is essentially flat, however, relative to FY15 levels. The FY17 budget request for NSF is $7.964 billion, a 6.7% increase over FY16 with the GEO Directorate getting a 6% increase, however, as we all know, this is an election year so we shall see whether these numbers will survive.

2015 GeoPRISMS funding round

Proposal decisions from the last GeoPRISMS panel are almost complete having been delayed by the government funding uncertainties at the end of 2015. However, we can say that the proposal success rate will be around a healthy 30% and that potentially funded projects cover a wide range from East African Rift System to New Zealand to Eastern North America Margin and Alaska. We expect several GeoPRISMS projects to leverage co-funding from internal NSF opportunities, including EPSCoR, OISE Global Venture Fund, and the new PREEVENTS initiative.

2016 GeoPRISMS solicitation

The most notable change relates to large projects in Alaska and the Aleutians. It has been decided that for the 2016 competition, the Alaska focus site would be reopened for large field projects along with the second year of the New Zealand focus site field work. This decision was based on the GeoPRISMS midterm review recommendations (Oct 2015), recent workshops such as the Amphibious Array Facilities Workshop (Oct 2014), the GeoPRISMS Science Plan, various internal discussions and the fact that the Transportable Array (TA) component of the SAGE Facility is currently being deployed in Alaska and northwestern Canada.

When fully deployed at the end of summer 2017, the Alaska TA will provide data from approximately 260 seismic stations, complementing GPS stations operated as part of the Plate Boundary Observatory component of the GAGE Facility. The TA stations are anticipated to collect data through 2018. The GeoPRISMS solicitation provides more information and is available at http://www.nsf.gov/pubs/2016/nsf16560/nsf16560.htm. In addition, NSF issued a Dear Colleague Letter (DCL) (NSF 16-061) from the OCE and EAR Divisions that announces opportunities for "onshore-offshore seismological studies of the Aleutian Arc." The DCL encourages cross-coastal field projects that take advantage of the Alaska TA deployment and also reflect broad community engagement and participation. This DCL further signals that the shallow water seismometers of the formerly designated Amphibious Array will now be part of, and be managed within, the larger OBSIP facility. PIs wishing to use these shallow water OBS's will simply need to request them through the usual OBS proposal process (OMO-IRIS) and can now supplement their experimental arrays with the full range of OBSIP instruments.

Jennifer Wade & Maurice Tivey

GeoPRISMS Program Managers,
National Science Foundation


WINNER
GeoPRISMS Photo Contest

Congratulations to Michelle Coombs (USGS) for winning the first edition of the GeoPRISMS Photo Contest at AGU 2015. Michelle took this fantastic photo of Kanaga Volcano in September 2015 during the western Aleutians field work, jointly funded by GeoPRISMS, Deep Carbon Observatory, and Alaska Volcano Observatory. Michelle received a framed copy of her photo at the GeoPRISMS Townhall Meeting hosted at the 2015 AGU Fall Meeting.

Be sure to visit the contest page at geoprisms.org to see all the photographs from this year.

Kanaga Volcano, Aleutian Islands, as seen from the east. The blocky andesite lava flow in the foreground erupted in 1906. Photo taken September 20, 2015 during western Aleutians field work, jointly funded by GeoPRISMS, Deep Carbon Observatory, and Alaska Volcano Observatory. More info about the field work page 20. Photo credit: Michelle Coombs (USGS)

2016 GeoPRISMS NSF Awards

NSF Award 1455432

Fluid-mobile and volatile element (Cl, B, and Li) cycling through the forearc: Case study of cold and thermal spring geochemistries from the Hikurangi accretionary prism, New Zealand

Jaime Barnes (*jdbarnes@jsg.utexas.edu*), John Lassiter

NSF Awards 1551753, 1551823

Collaborative Research: A community velocity field for East Africa

Robert King (*rwk@chandler.mit.edu*), Rebecca Bendick (*bendick@mso.umt.edu*)

NSF Award 1551807

Final stages of breakup and early spreading history of the Eastern North America passive margin from multichannel seismic data

Anne Becel (*annebcl@ldeo.columbia.edu*)

NSF Award 1551717

Seismic study of mantle deformation and melt extraction during continental breakup in the ENAM primary site

Harm Van Avendonk (*harm@ig.utexas.edu*)

NSF Awards 1551876, 1551929

Collaborative Research: Improving models of interseismic locking and slow slip events in Cascadia and New Zealand

Laura Wallace (*lwallace@ig.utexas.edu*), Noel Bartlow (*bartlowno@missouri.edu*)

NSF Awards 1551640, 1551657

Collaborative Research: Building an international component in the Aleutian-Alaska primary site through US participation in research cruises of the German R/V Sonne

Gene Yogodzinski (*gyogodzin@geol.sc.edu*), Brian Jicha (*bjicha@geology.wisc.edu*)

NSF Awards 1551978, 1551808

Collaborative Research: Investigating the relationships among subduction character, volatile cycling, and eruptive activity along the Aleutian arc

Taryn Lopez (*tlopez@gi.alaska.edu*), Tobias Fischer (*fischer@unm.edu*)

NSF Awards 1551758, 1551922, 1551683

Collaborative Research: Revealing the environment of shallow slow slip

Rachel Abercrombie (*rea@bu.edu*), Anne Sheehan (*Anne.Sheehan@colorado.edu*), Susan Schwartz (*susan@es.ucsc.edu*)

NSF Award 1551868

Magma ascent and eruption in the Aleutian arc

Philipp Ruprecht (*ruprecht@ldeo.columbia.edu*)

NSF Award 1636548

Subduction Zone Observatories workshop

Robert Detrick (*detrick@iris.edu*), Anne Meltzer

All GeoPRISMS NSF Awards are available at: http://geoprisms.org/research/list-of-awards/

Distinguished Lectureship Program

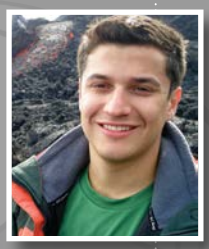
2016 - 2017

The GeoPRISMS Office is happy to announce the annual Distinguished Lectureship Program for academic year 2016-2017 with an outstanding speakers list. Distinguished scientists involved with GeoPRISMS science and planning are available to visit US colleges and universities to present technical talks and public lectures on subjects related to GeoPRISMS science.

Want to host a speaker? Apply before July 1!

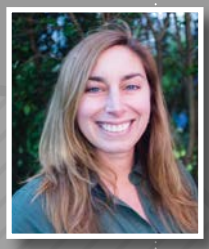
Any US college or university wishing to invite a GeoPRISMS speaker may apply via the GeoPRISMS website before July 1, 2016. Institutions that are not currently involved with GeoPRISMS research are strongly encouraged to apply, including those granting undergraduate or masters degrees, as well as those with PhD programs. Institutions may request a technical and/or public lecture. The GeoPRISMS Office will cover airfare for the speaker's travel and will coordinate travel and off-site logistics. Host institutions are responsible for local expenses for the duration of the visit.

Visit the GeoPRISMS website to apply or learn more about the speakers & talks available



ESTEBAN GAZEL
Virginia Tech

BEATRICE MAGNANI
Southern Methodist U



HEATHER SAVAGE
LDEO, Columbia U

BRANDON SCHMANDT
University of New Mexico

Questions?
Email info@geoprisms.org
For more information, visit the GeoPRISMS Website at:
http://geoprisms.org/education/distinguished-lectureship-program/

GeoPRISMS is now on YouTube! Subscribe and watch hours of lectures given by the GeoPRISMS Distinguished Speakers in the past years.

In the summer of 2015, academic researchers, along with scientists from the USGS and AVO, took part in an unprecedented coordinated research in the Aleutian Islands. Through this report, the scientists who took part in the field campaign expose the excitement, trials, and opportunities, as well as the challenges they experienced by deploying research activities in such unique and remote geological settings. Photo of the Okmok Caldera taken from the southern rim. Photo credit: G. Yogodzinski

A Field Campaign to the Aleutians

Field work in the Aleutian Islands is complex, expensive, and thoroughly exciting. When the community suggested to NSF that we facilitate a collaborative field platform to get safely to and from the many islands of interest along the arc, we turned to our colleagues in the Division of Polar Programs (PLR). They helped us coordinate, along with the USGS and Alaska Volcano Observatory (AVO), a combined logistics platform of ship and helicopters that could support the science proposed by our eager PIs.

Planning began in the summer of 2014, as we looked at the proposals that had come into the GeoPRISMS deadline focused on work in Alaska and the Aleutians. What was funded from that round was a group of well-reviewed proposals that together we felt had a chance to make real progress on the goals laid out in the Science and Implementation Plan. We got to work with the PIs, the USGS & AVO, Polar Field Services (who would manage the logistics), and PLR to set up the work, get everyone permitted, and get our scientists in the field. We leveraged funds from a number of places to make this work. EAR and OCE, via the GeoPRISMS Program, funded the bulk of the platform. The Directorate for Geosciences (GEO) contributed funds as well. The GeoPRISMS project shared mobilization costs with a previously-funded Arctic Social Sciences project. The Polar Geospatial Center generated DEMs and maps to help researchers better target their time on these remote islands.

In the summer of 2015, three teams of academic researchers along with scientists from the USGS & AVO set off on unprecedented coordinated research in the Aleutian Islands. They shared ship and helicopter time aboard the Maritime Maid, a helicopter-capable research vessel that traveled along more than 800 miles of volcanic arc, from Dutch Harbor in the east to Buldir Island in the west, transporting scientists and equipment on and off the islands. The USGS, already involved in assisting our scientists with permitting and field expertise, also funded their own helicopter time to service monitoring stations on volcanoes, some of which hadn't been visited in many years. The Deep Carbon Observatory, funded by the Sloan Foundation, provided additional support for a fourth team of researchers to occupy the remaining free berths on the Maritime Maid, maximizing the efficiency of the ship and the potential for real scientific progress.

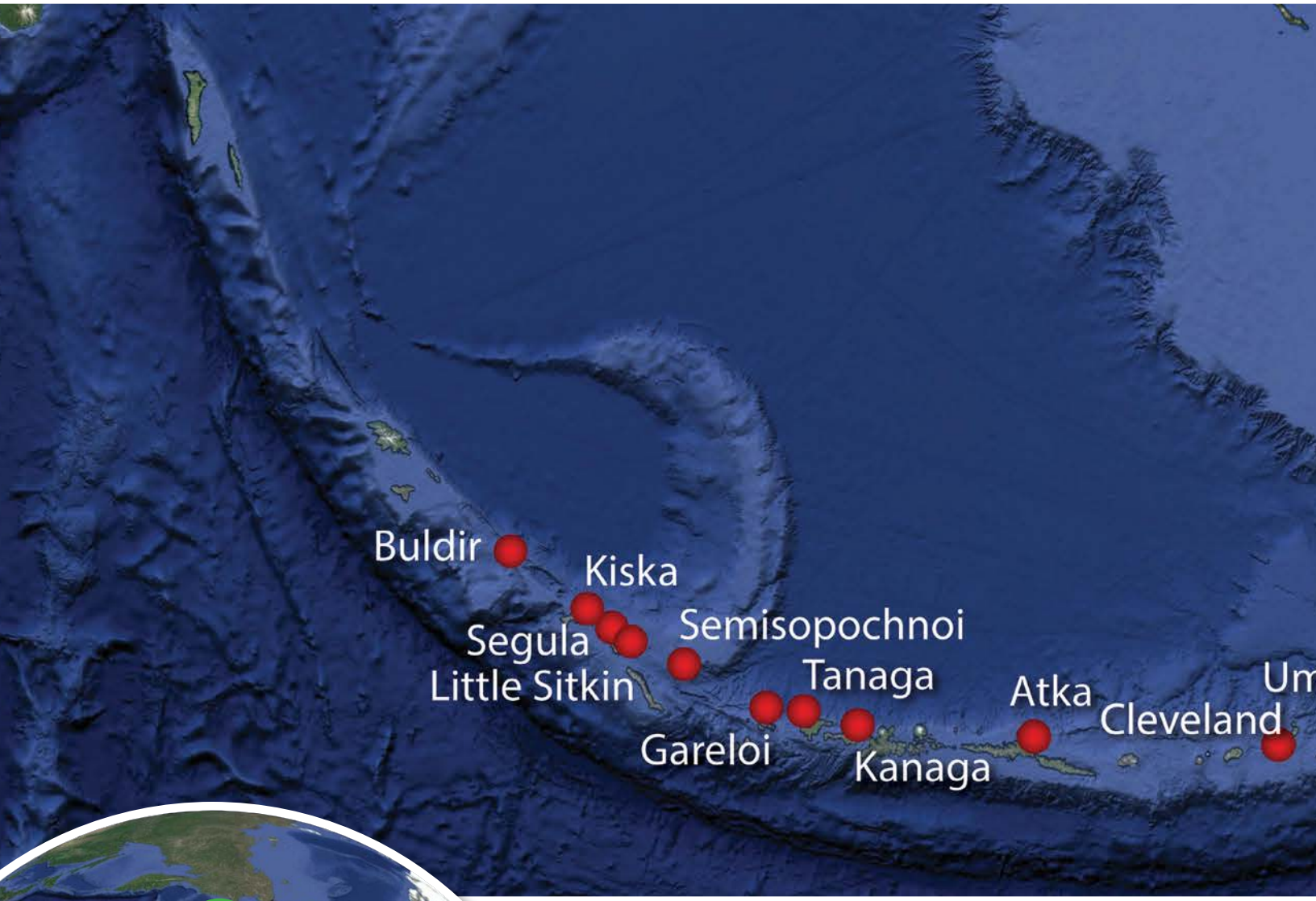
Field work included rock and gas sampling from numerous volcanoes, as well as geophysical deployments (seismic and magnetotelluric) via this joint logistics platform and parallel-funded projects in the eastern part of the arc. The scientists involved were interested in a range of topics, including magma storage beneath the volcanoes, the chemistry and style of eruptions, and earthquake and tsunami hazards in the Pacific.

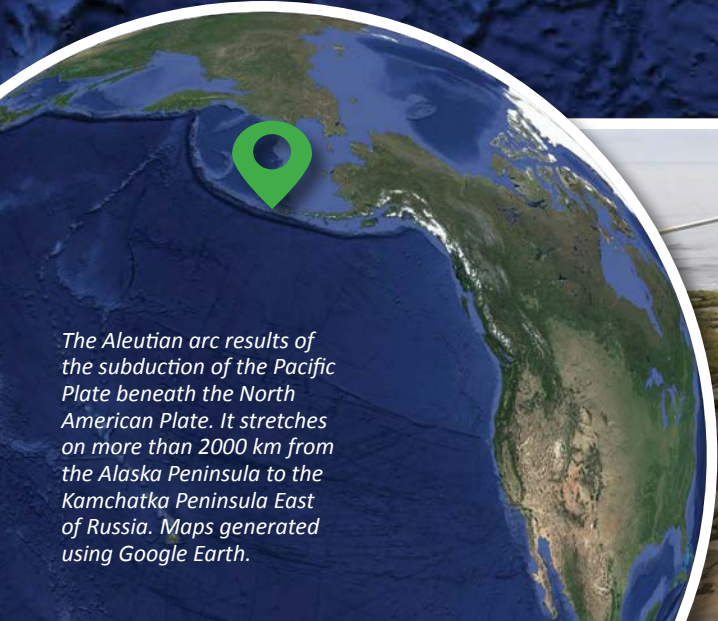
This multidisciplinary, multi-scale, collaborative work has already and will, in the future, yield remarkable results that help forward the goals laid out in the GeoPRISMS Science and Implementation Plan. The researchers returned home (mostly) unscathed and very scientifically successful, and both NSF and the USGS have praised the endeavor which uniquely coordinated resources to accomplish the goals of two federal agencies. The GeoPRISMS Program estimates that we saved nearly a million dollars by leveraging what we could, partnering with experts, and being strategic in our thinking, funding, and planning.

Maurice Tivey
GeoPRISMS Program Manager, National Science Foundation

Liz Cottrell and Katherine Sheppard slide gingerly into a gully to sample the exposed tephra on Buldir Island. Photo credit: M. Coombs

Tobias Fischer collecting volcanic gases at Kiska Volcano. The thundering fumarole has painted the landscape yellow with sulfur. Photo credit: T. Lopez



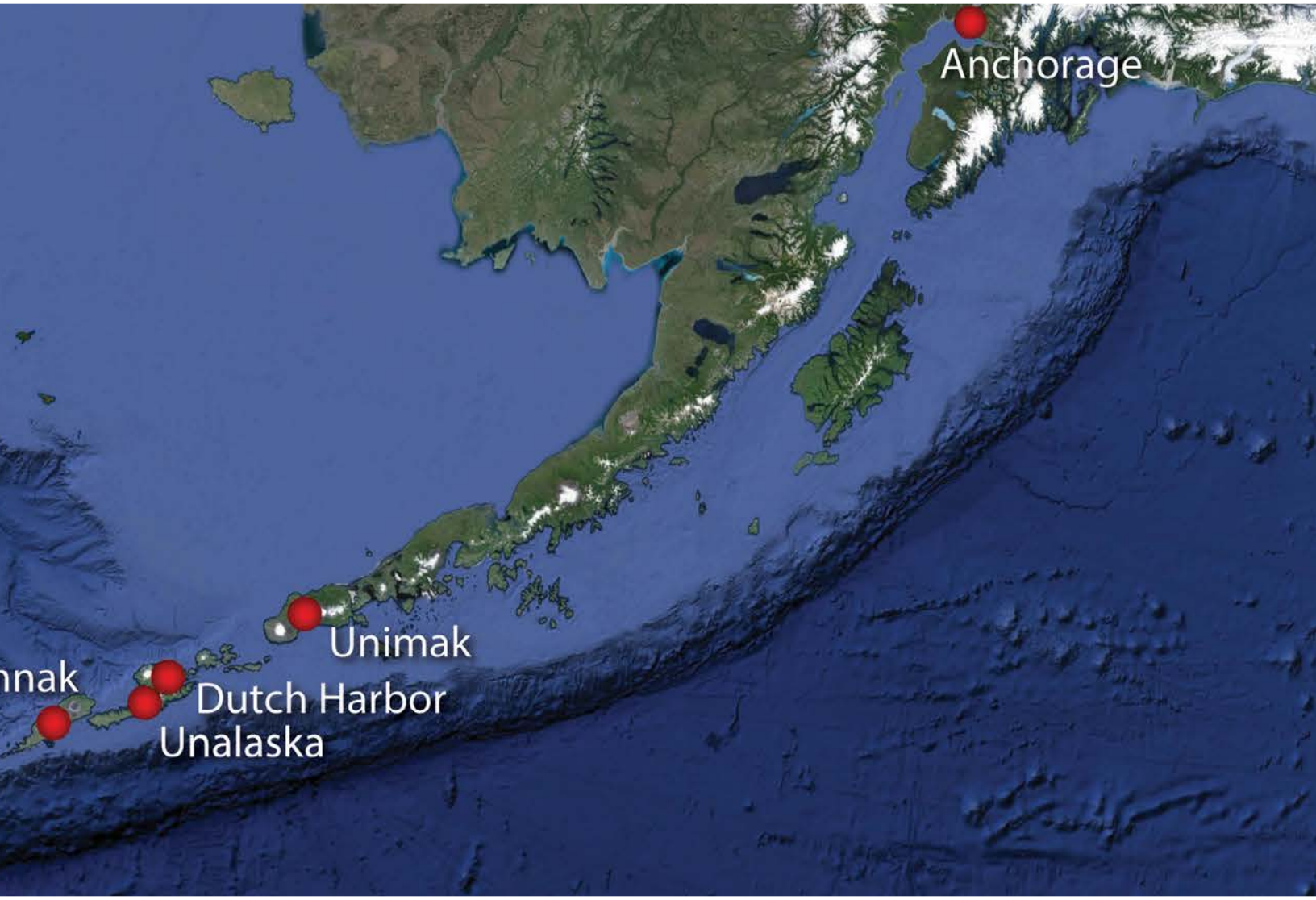


The Aleutian arc results of the subduction of the Pacific Plate beneath the North American Plate. It stretches on more than 2000 km from the Alaska Peninsula to the Kamchatka Peninsula East of Russia. Maps generated using Google Earth.

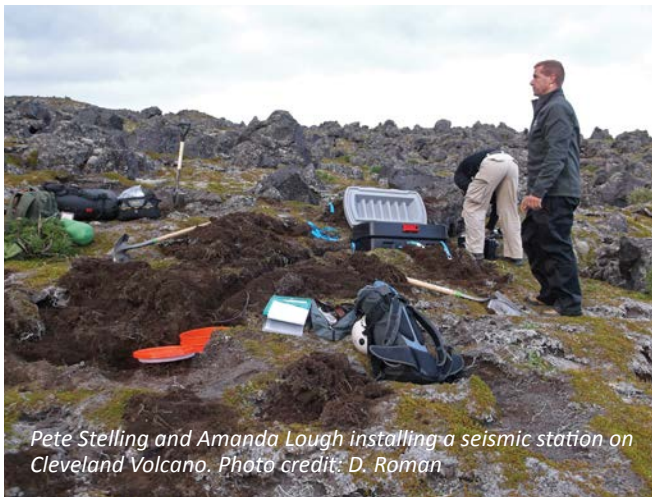
Robinson R44 helicopter, operated by Pollux Aviation and expertly piloted for us by Sean Charlton, on a granodiorite outcrop along the north shore of Umnak Island, north of Rechesnoi Volcano. Photo credit: P. Kelemen

PI Bennington and post-doc Summer Ohlendorf install a seismic site in Okmok's caldera. Photo credit: T. Parker

Scripps broadband MT receiver being deployed offshore Umnak Island. Photo credit: K. Key



LDEO Ph.D. student Dan Rasmussen collects tephra samples on Unimak Island while Shishaldin Volcano looms in the background. Photo credit: D. Roman



Pete Stelling and Amanda Lough installing a seismic station on Cleveland Volcano. Photo credit: D. Roman

Magnetotelluric & seismic investigation of arc melt generation, delivery, and storage beneath Okmok volcano

Ninfa Bennington (U. Wisconsin-Madison), Kerry Key (Scripps Institution of Oceanography), and USGS Investigators Matthew Haney and Paul Bedrosian

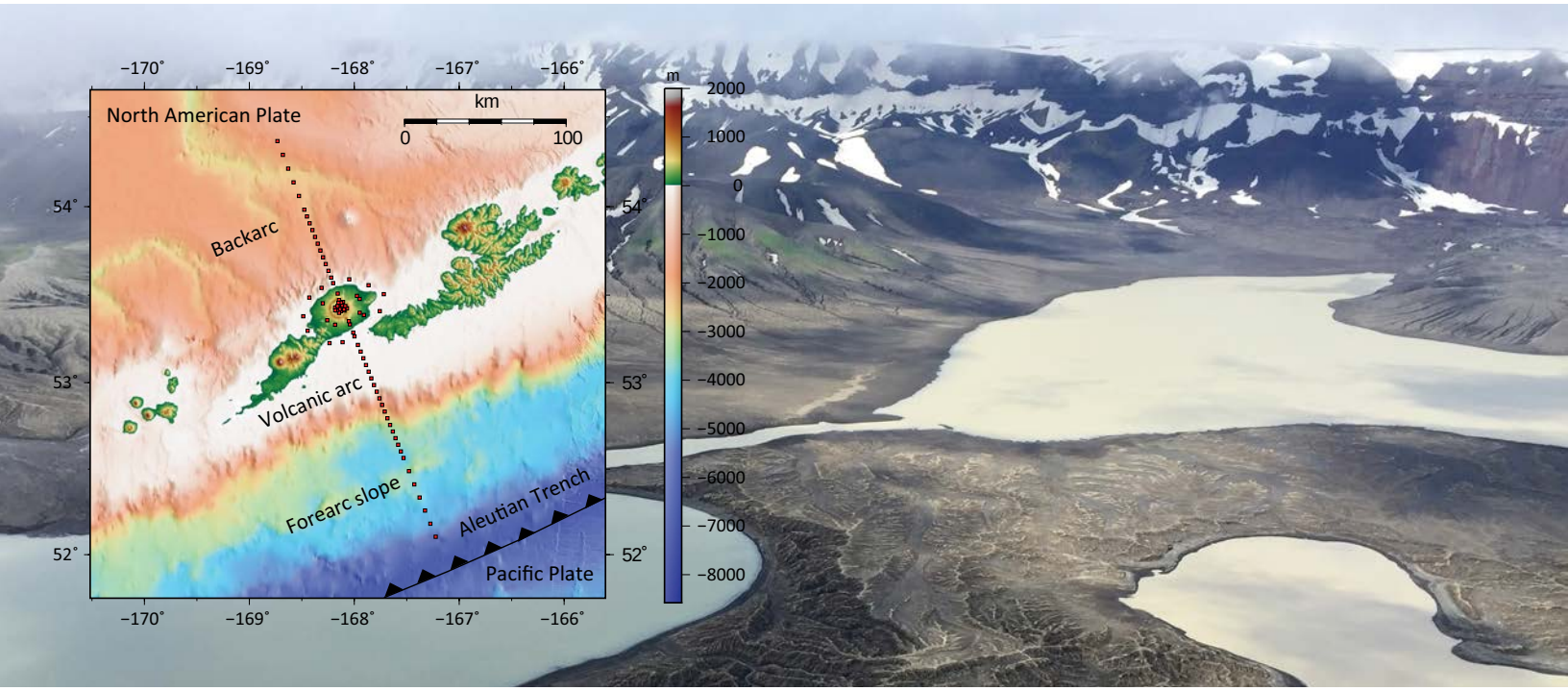


Photo of inside the Okmok Caldera taken from the helicopter after a long day installing magnetotelluric and seismic stations in the caldera. The inset graph represents the distribution of the 53 offshore and 29 onshore magnetotelluric stations shown along with the regional tectonic framework. Photo credit: K. Key

Okmok is one of the most active volcanoes in the Aleutian arc and hosts a 10 km diameter caldera. The subdued topography of Okmok, relative to other Aleutian volcanoes, improves access and permits dense sampling of the volcanic edifice. We have selected Okmok as the site of study for this project due to frequent volcanic activity and the presence of a crustal magma reservoir as inferred from previous seismic studies. At least two caldera forming eruptions are recognized and Okmok is believed to be representative of volcanoes both within the Aleutian arc and worldwide, where long periods of effusive eruptions are punctuated by much larger explosive caldera forming eruptions.

We are applying geophysical techniques to characterize the magmatic system beneath Okmok. During the summer of 2015, we collected onshore and offshore magnetotelluric (MT) data and installed a temporary year long seismic deployment. The seismic instruments will be retrieved in summer 2016. These new geophysical data will be used to test hypotheses regarding the role of slab fluids in arc melt generation, melt migration within the crust, and the crustal magmatic plumbing and storage system beneath Okmok Caldera.

Offshore MT Field Deployment

After numerous delays due to thick fog typical of the Aleutians, the entirety of the offshore MT crew arrived to Dutch Harbor, AK and was assembled on the R/V Thompson. A video of the research vessel captured by a morning drone flight can be viewed at *http://okmok.ucsd.edu/index.php/2015/06/19/drone-video/*. On June 18, 2015, the team departed Dutch Harbor for their first offshore MT site. The offshore crew spent the day preparing receivers so that there were only a few remaining steps to complete before deploying them over the side of the ship. By June 20, all 54 MT receivers had been deployed well ahead of schedule.

Team preparing the receivers on board before deployment. Photo credit: K. Key

Left: Scripps broadband MT receiver being prepare for deployment on the R/V Thompson. Right: Several members of Scripps offshore MT deployment team as they pass Mt. Makushin. Photos credit: K. Key

With the MT deployment complete, the team collected multi-beam bathymetry data on the upper forearc slope south of Umnak Island using the ship's EM302 multi-beam echo sounder. On top of mapping the bathymetry of the ocean floor, the intensity of these recordings can be used to help determine the nature of the seabed (e.g. sediments versus hard rock). On June 21, the offshore team transited back to Dutch Harbor via Umnak pass. This return route included spectacular views of Mount Makushin Volcano on Unalaska Island.

Visit the blog

Fore more information about the project, videos, photos, updates, visit the blog at http://okmok.ucsd.edu/

Onshore MT and Seismic Deployments

On June 23, having returning to Dutch Harbor from offshore MT work, co-PI Key and Scripps graduate student Georgiana Zelenak joined up with the rest of the onshore team (PI Bennington, UW-Madison post-doc Summer Ohlendorf, and USGS collaborators Matthew Haney and Paul Bedrosian) and departed for Umnak Island. The onshore work was based out of Bering Pacific Ranch at Fort Glenn, an abandoned WWII military base, with a helicopter transporting the seismic and MT teams and equipment during the 19 days of field operations.

After the team arrived at Fort Glenn, the camp house was set up and seismic and MT equipment were prepared for the start of field operations the following day. Seismic and MT field operations commenced on June 23 and extended until July 11. The seismic team installed thirteen temporary broadband seismometers both in and around the Okmok Caldera. In tandem with the Alaska Volcano Observatory's twelve permanent seismic stations, there are now twelve seismic instruments within or at the rim of the caldera and 14 seismic instruments outside the caldera. The temporary array will record seismic data until its retrieval in summer 2016. Onshore magnetotelluric data were collected in a 3D array using a combination of long-period and wide-band MT systems, with 19 stations within the caldera and ten stations outside. Following the completion of onshore fieldwork, part of the onshore team (PI Bennington, Summer Ohlendorf, and USGS collaborators Matthew Haney and Paul Bedrosian) caught a charter flight back to Dutch Harbor. Co-PI Kerry Key and graduate student Georgie Zelenak hitched a more unconventional ride when the rescue boat from the RV Sikuliaq picked them up from Umnak Island.

Offshore MT Instrument Recovery

Following completion of onshore MT work, the offshore MT team made a six day cruise on the new R/V Sikuliaq to recover offshore MT instruments. Of the 54 offshore deployments, 53 instruments were successfully recovered while one instrument was lost in Umnak pass due to strong tidal currents in the shallow water. ■

From top to bottom: Zonge Zen MT data loggers being tested the night before field operations begin; Tim Parker of IRIS PASSCAL prepares seismic instruments for deployment; USGS collaborator Paul Bedrosian installing an MT site. The induction coils are being laid out in N-S and E-W orientations to orient trenches they will be buried in; Onshore seismic and MT field team (from left to right): Timothy Parker of IRIS PASSCAL, co-PI Kerry Key (Scripps), USGS collaborator Matthew Haney, PI Ninfa Bennington (UW-Madison), post-doc Summer Ohlendorf (UW-Madison), graduate student Georgianna Zelenak (Scripps), and USGS collaborator Paul Bedrosian. Photos credit: K. Key, P. Bedrosian

Islands of Four Mountains to Unimak: From the slab to the surface

Report retrieved from the website of the Department of Terrestrial Magnetism Carnegie Institution of Washington *https://dtm.carnegiescience.edu/news/photo-essay-seismic-fieldwork-alaskan-volcanoes and the Facebook page of the field mission (IFM-Unimak 2015: From the Slab to the Surface)*

From top to bottom, left to right: Sunset over choppy seas as the team left the Islands of the Four Mountains en route to Okmok Volcano; The Maritime Maid, the team's floating home/lab/workshop for almost two weeks; Pete Stelling and Alex Lloyd map a layer of volcanic deposits in Fischer Caldera, Unimak Island; Cruise participants, top row left to right: Mike Cooper, Joe Schmitt, Mike Despars, Christoph Kern, Diana Roman, Dan Leary, John Power, Dan Rasmussen. Bottom row left to right: Cindy Werner, Amanda Lough, John Lyons, Wesley Jones, Pete Stelling, George Rains; Pete Stelling enjoying being a seismic technician on Cleveland Volcano; Diana Roman trying to help a puffin that ended up in the Maid's living corridors. The boat got invaded by birds fairly frequently; Dan Rasmussen takes a picture of Shishaldin from the Fisher cones sampling area. Photos credit: D. Roman, A. Lough

Scientists have a relatively good understanding of the processes occurring in the upper portions of the Earth's crust that lead to volcanic activity. However, much remains unknown about how these shallow processes are controlled by the large-scale tectonics and deep mantle processes that are ultimately responsible for volcanism.

A NSF-funded group led by DTM seismologist Diana Roman headed to Alaska for three weeks, two of which were spent on the research vessel Maritime Maid, to collect seismic data in the Islands of the Four Mountains and tephra samples throughout the eastern Aleutians. The group included Roman and DTM postdoc Amanda Lough, as well as Dan Rasmussen, Alex Lloyd, and Terry Plank from Columbia University's Lamont-Doherty Earth Observatory, Pete Stelling from Western Washington University, and John Power, John Lyons, Christoph Kern, and Cindy Werner from the U.S. Geological Survey.

The goal of their work is to determine how the amount of water dissolved in magma affects where, and for how long, magma is stored in Earth's crust. This information is critical for accurately forecasting volcanic eruptions and understanding the large-scale processes that lead to volcanism in Earth's subduction zones. The volcanoes targeted in this study have a wide range of magma water contents, magma storage depths, and depths of seismic activity, making them ideal candidates for this research.

Roman will be leading another trip this summer to retrieve seismic equipment from the Islands of the Four Mountains. ■

Investigating older rocks in the oceanic Aleutian volcanic arc east of Adak

Peter Kelemen (Columbia University, LDEO) on behalf of Merry Yue Cai (Columbia University, LDEO), Emily H.G. Cooperdock (UT Austin), Steve Goldstein (Columbia University, LDEO), Matt Rioux (UC Santa Barbara), and Gene Yogodzinski (University of South Carolina)

Typical vistas in the Shaler Pluton in the interior of Unalaska Island. Whereas this glaciated, alpine geomorphology is typical of places like the North Cascades, it is utterly without parallel in an intra-oceanic island arc. As the field season went on, we became increasingly curious about the timing of, and reasons for, uplift of mid-crustal plutons to form mountains rising to more than thousand meters above sea level. Photo credit: G. Yogodzinski

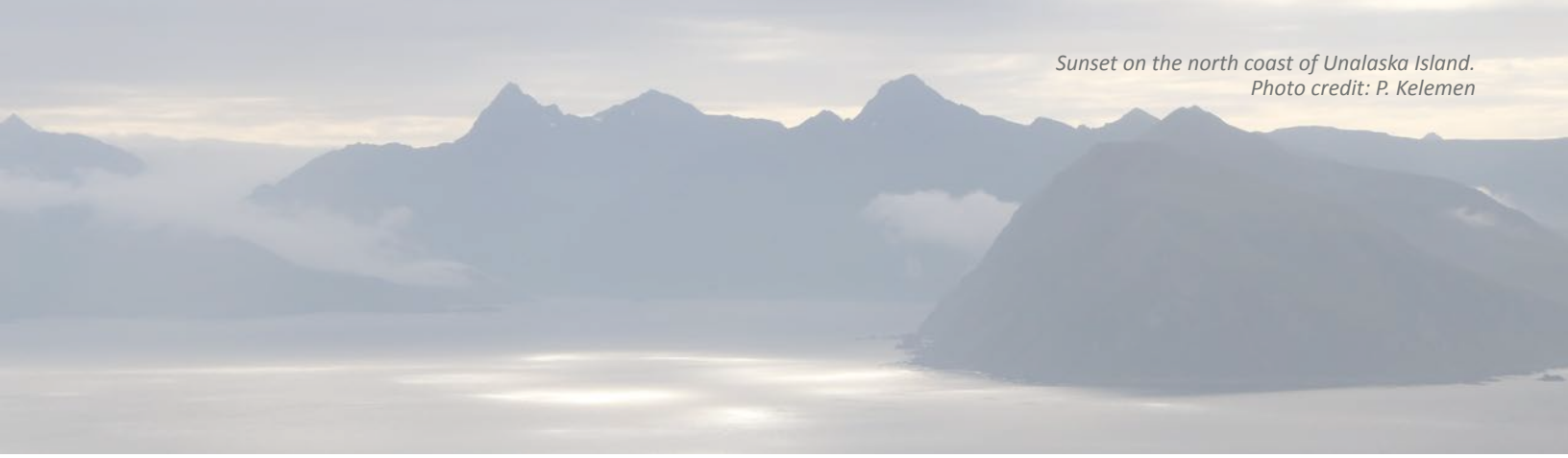
Benefiting from the NSF GeoPRISMS community platform in the Aleutian volcanic arc in the summer of 2015, our group from the University of South Carolina and Columbia University had a matchless opportunity to study and sample outcrops of pre-Holocene volcanic and plutonic rocks on Unalaska, Umnak, and Atka Islands. Speaking for myself, at the age of 59 and having worked in the field in a lot of spectacular places - every year for forty years - this was one of the most memorable and rewarding field seasons of my life.

The older rocks in the Aleutian volcanic arc are notable because they include the most extensive outcrops of plutonic rocks in any oceanic arc, worldwide. Aside from the visionary work of Sue and Bob Kay and their colleagues, these plutonic rocks have not received much attention since pioneering USGS studies were completed in the 1950's (Umnak), 1960's (Unalaska), and 1970's (Atka). This prior work demonstrated that the Eocene to Miocene plutonic rocks east of Adak Island were more strongly "calc-alkaline", with higher SiO_2 at a given Mg/Fe ratio, compared to the "tholeiitic", Holocene volcanic rocks on the same islands.

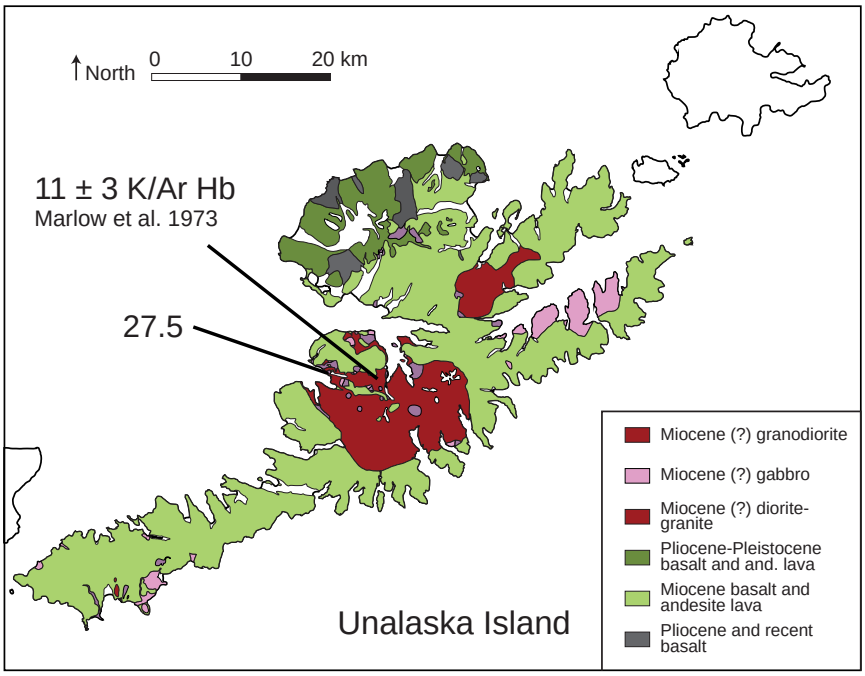
In a recently published pilot study using USGS samples (*Cai et al., Earth Planet. Sci. Lett. 2015*), we found that these plutonic rocks are also isotopically distinct from the lavas on the same islands, demonstrating that the two suites were generated by melting of two distinct sources.

Our field season in the summer of 2015 was designed to investigate whether these differences in source composition were the result of :

1. temporal evolution of the arc, in which case Miocene to Eocene lavas should have isotope ratios similar to those of calc-alkaline plutons, and perhaps will also mirror the calc-alkaline compositions of these plutons, or



Sunset on the north coast of Unalaska Island. Photo credit: P. Kelemen



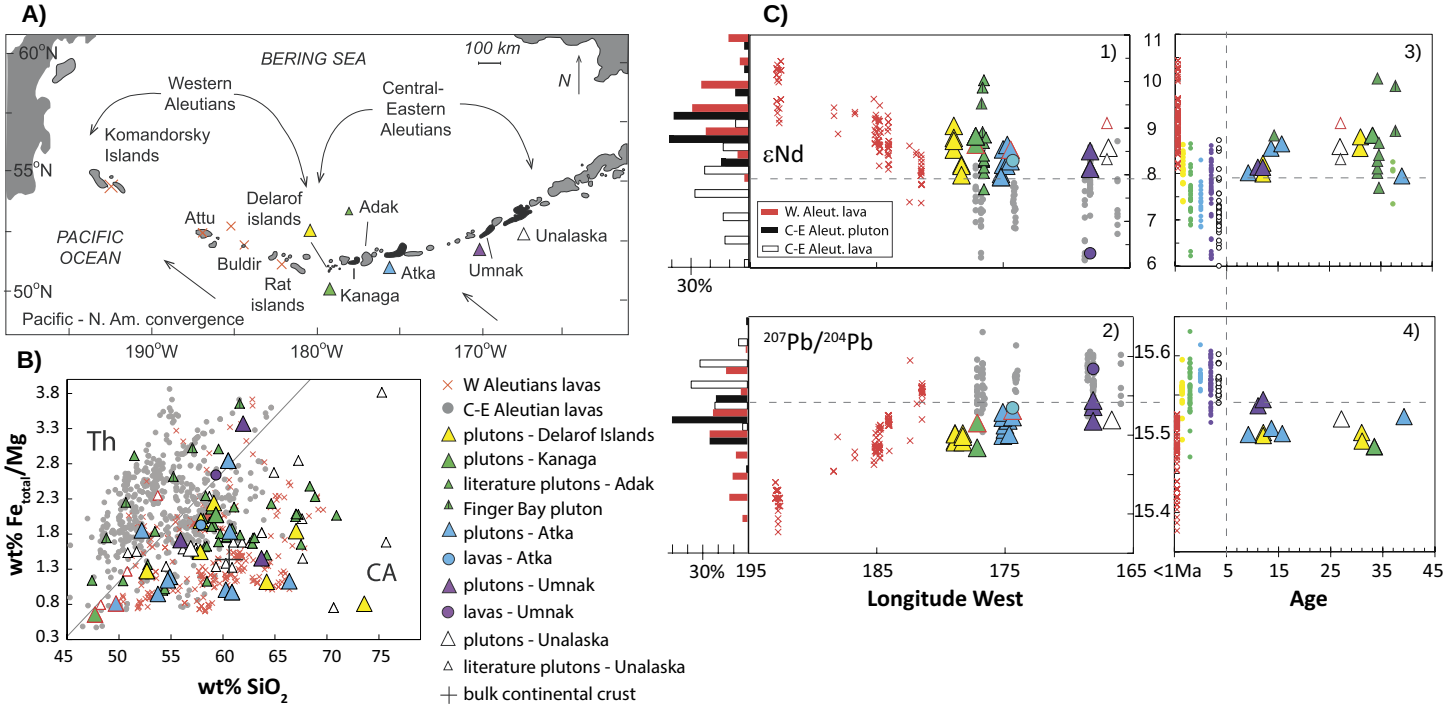
Geologic map of Unalaska Island, after Drewes et al., USGS Bulletin 1028S, 1961, showing the location of the only two radiometrically dated samples on the Island. Both nominally come from the same, large Shaler Pluton (Marlow et al., GSA Bulletin, 1973; Cai et al., Earth Planet. Sci. Lett. 2015). During the 2015 field season, we took extensive samples from all of the plutons shown on the map, together with many smaller sills intruding volcanic and volcanoclastic rocks. Map courtesy of Matt Rioux.

2. distinct processes, in which viscous, SiO_2- and H_2O-rich, calc-alkaline, andesitic magmas tended to stall and form mid-crustal plutons, while relatively low viscosity, SiO_2- and H_2O-poor, tholeiitic, basaltic magmas tended to erupt on the surface, in which case Miocene to Eocene lavas may be isotopically (and compositionally?) distinct from coeval plutons.

To this end, we hoped to sample coeval plutonic and volcanic arcs on several Aleutian islands where the plutons are well-exposed.

Our starting plan was to set up fly camps in the alpine terrain on the islands, which is underlain by extensive outcrops of granodiorite and diorite plutons. We assumed that we would have difficulty obtaining ages on highly altered volcanic rocks, whereas it would be relatively easy to date zircons from the large plutons. Thus, we expected to sample volcanic rocks where they are intruded by plutons of known age. Frankly, my expectations about the field work were not high. I imagined we would be semi-lost in perennial fog, while disconsolately scraping moss, lichen, and tundra grasses off texture-less, fine-grained, grey-green outcrops, and spending a lot of time arguing about whether a specific sample was volcanic, plutonic, or even sedimentary!

Merry Cai, Steve Goldstein, Gene Yogodzinski, and I flew to the commercial airport in Dutch Harbor on Unalaska Island on August 5, where we were joined by pilot Sean Charlton in Pollux Aviation's R44 helicopter. Sean had flown out from the mainland, with floats fully inflated. I had never used such a small, gasoline-powered helicopter, with an engine not much larger than a lawnmower, so I was a bit skeptical at first. We initially focused on the Shaler pluton on Unalaska, which is the largest in the Aleutians, and hence in any oceanic volcanic arc, worldwide. The weather was quite good when we were there, which allowed us to fly every day. Everyone says the Aleutian weather is bad and unpredictable, and of course, it is, but not always. Working there can often be quite nice. We set up a couple of fly camps, and ranged through the beautiful alpine terrain, examining complex border facies of granodiorite, diorite and volcanic hornfels. We also took advantage of the helicopter on re-supply days to make ground stops along the coast. There, we found exceptional outcrops, including surprisingly fresh volcanic rocks with chilled margins, suitable for $^{40}Ar/^{39}Ar$ geochronology.



A) Schematic map of the Aleutian island arc, sampled areas are highlighted in black. B) Wt% SiO_2 versus Fe/Mg ratio of studied Aleutian igneous rocks. By convention, the Fe/Mg ratio is calculated using wt% MgO and FeO, with all Fe as FeO. C) Present-day Nd and Pb isotope ratios of Aleutian igneous rocks vs. longitude and vs. age. Circles are central and eastern Aleutian volcanics: Yellow = Rat and Delarof Islands, Green = Adak and Kanaga, Blue = Atka, Purple = Umnak, White = Unalaska. Error bars are smaller than the symbols. In 3) and 4), the Holocene volcanics are separated by location only without age differences. Figures from Cai et al., Earth Planet Sci. Lett. 2015.

After a while, the exceptional coastal exposures, coupled with the convenience of the helicopter, induced a change in our plans. We moved into the hotel in Dutch Harbor, and flew every day. It turned out that world-class sea cliff outcrops, coupled with wave cut terraces that offered ideal helicopter landing sites at all but the highest tides, provided a spectacular opportunity for us to conduct comprehensive sampling.

As the photos accompanying this article show, the Aleutian sea cliffs revealed spectacular sequences of pillow lavas, pyroclastic deposits, and columnar-jointed sills. Indeed, photos in the USGS Bulletins showed some of these exceptionally well-exposed features, but in earlier years, without a helicopter, these outcrops were very difficult to access from small boats. In addition, there were few opportunities to obtain reliable ages on the lavas. With the helicopter, and some confidence about $^{40}Ar/^{39}Ar$ dating of fine-grained volcanic rocks, we were in heaven. Further, as it turns out, our samples from the many sills intruding the volcanics will provide plenty of opportunities to check the Argon ages using U/Pb in zircon.

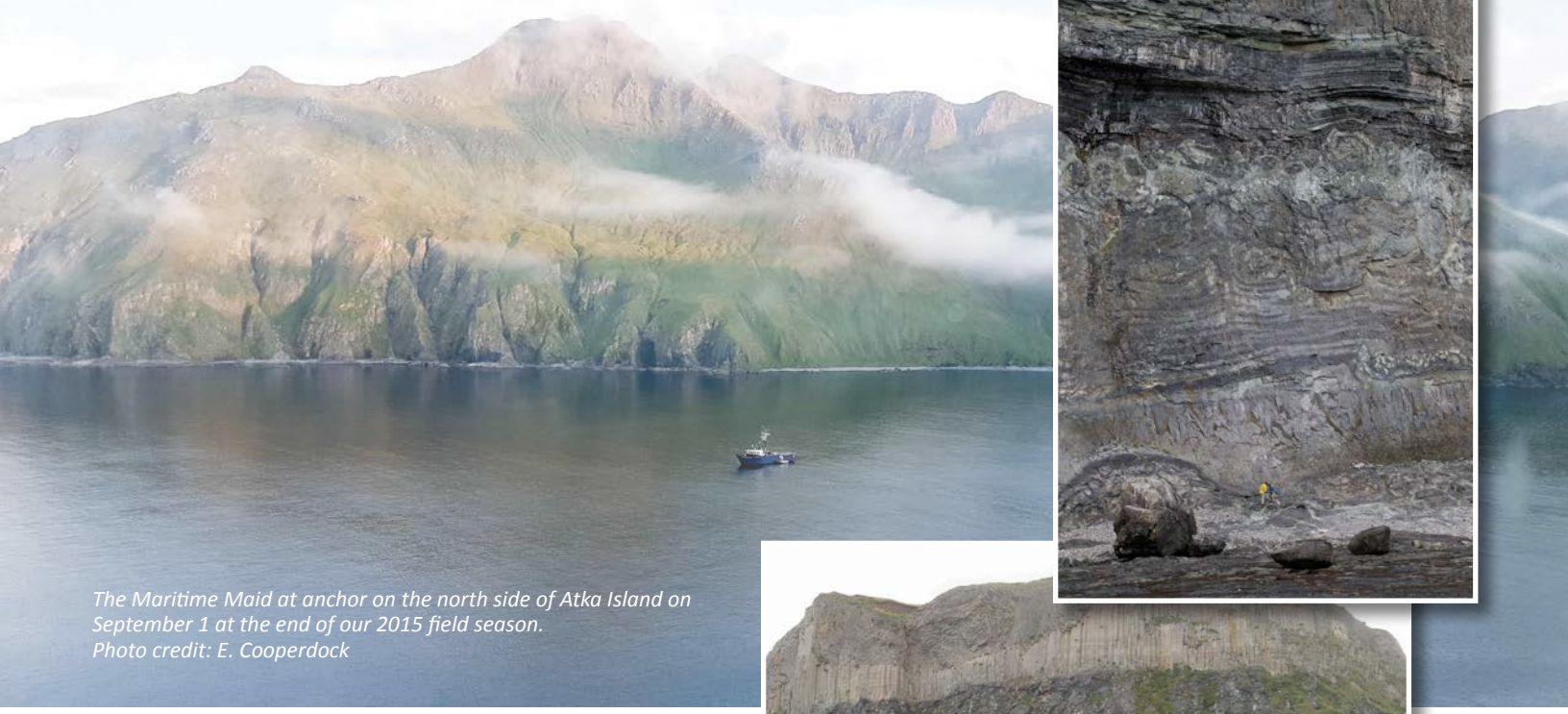
As it turned out, the R44 helicopter was perfect for us, fitting easily into small landing spots, often within ten meters of the Pacific surf. Unfortunately, Steve Goldstein came down with shingles and had to convalesce in Dutch Harbor, sampling volcanic rocks from the extensive road network when he could. However – sorry Steve! – this did reduce our helicopter-supported group to three, who just fit into the three passenger seats in the R44, enabling ultra-efficient field work. We would leapfrog along the coast, setting out one or two people at each landing spot, and scheduling pickups a few hundred meters further along the coast.

In the middle of August, we moved from Unalaska to Umnak Island, where we were fortunate to stay in a bunkhouse at Bering Pacific Ranches, Ltd., near the abandoned WWII airfield at Fort Glenn. This is a fascinating operation; while we were there, Ranch owner Pat Harvie and his crew were preparing to round up thousands of "organic, free-range" cattle from across the island, using a fleet of R22 helicopters, plus a lot of bailing wire and duct tape. These animals were destined for shipment to Canadian markets in the late summer and early fall. We all hope this visionary operation ended in great success!

From this spectacular basecamp, we spent several productive days sampling along the north and southeast coasts of the island, with a side-trip to the rim of the giant Okmok caldera during a clear spell. We also used the opportunity to access the westernmost peninsula of Unalaska Island, completing our extensive sampling there.

All too soon, it was time to leave the Ranch. We returned to Dutch Harbor, where we met Captain George Rains, the crew of the R/V Maritime Maid, and pilot Dan Leary with Maritime Helicopters' Bell 206 Long Ranger. We also rejoined a rejuvenated Steve Goldstein, together with his daughter, Emily Cooperdock, who had flown up to join us. This increase in our group size corresponded with the change from the four-seat R44 to the six-seat 206, and as a result we remained a highly efficient, helicopter-supported team!

We moved into comfortable quarters onboard the Maid and, delayed by weather, spent a few more days living on the ship in Dutch Harbor, continuing to sample on Unalaska Island. Until this point, we had not lost a single day to weather, though we had gotten wet on a couple of days.

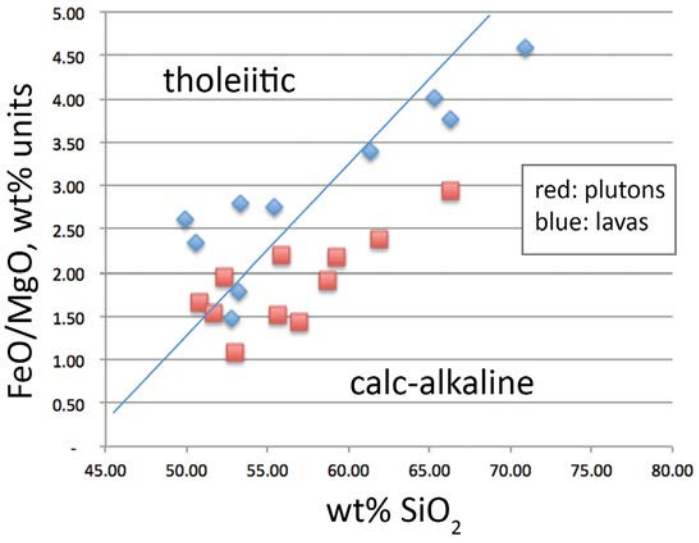


The Maritime Maid at anchor on the north side of Atka Island on September 1 at the end of our 2015 field season. Photo credit: E. Cooperdock

Top right: Gene Yogodzinski, in his yellow jacket, with Emily Cooperdock, examining a contact between pillow basalts on wave cut platform below, and a huge sill, above, in another sea cliff exposure on the Pacific coast of Unalaska Island. Bottom right: Tan-colored, columnar joined sills intruding a thick sequence of green-to-black pillow lavas on the Pacific coast of Unalaska Island, with (two meter tall) Gene Yogodzinski and (very small) R44 helicopter for scale. Photos credit: P. Kelemen

However, our transit to Atka Island, and our work there, were substantially delayed by wind, then fog. A side benefit was a spectacular morning at anchor among the Islands of Four Mountains, where we photographed the perfect strato-volcanoes there while we waited for the helicopter to catch up with the ship. Finally, the weather cleared and we spent a highly productive day and a half racing along the western peninsula of Atka Island, acquiring a fantastic set of samples, including previously dated intrusions that span the range from the youngest (9 Ma) to oldest (39 Ma) plutons known in the arc east of Adak.

Preliminary data on a few 2015 samples, Unalaska Island.



We then set out for Adak Island. In the airport there, we greeted the next group who would use the GeoPRISMS community platform onboard the Maid, led by Liz Cottrell. We wished them all the best and, sadly, began the long trip home.

In addition to the pilots, and the crew of the Maritime Maid, we would like to express deep gratitude to Program Manager Jenn Wade at NSF, who worked tirelessly to make the community platform concept come alive, and to Christie Haupert, Alaska Science Project Manager for Polar Field Services, Inc., who provided flawless logistical support.

PS: Since that time, we've been working hard processing our samples and obtaining initial data. On the left is a plot of some early, major element analyses of our samples from Unalaska Island. Note that, as for the USGS samples we analyzed for our pilot study (*Cai et al., Earth Planet. Sci. Lett., 2015*), most of our 2015 plutonic samples are calc-alkaline and most of our 2015 mafic lava samples are tholeiitic, despite the fact that the 2015 lavas and plutons are approximately coeval. This suggests that the chemical differences documented by Cai et al. (2015) are present among coeval igneous rock suites in the Aleutians, and did not arise as a result of temporal evolution of both volcanic and plutonic magmatism.

In addition to our main line of inquiry, outlined above, we are evaluating the potential for study of detrital zircons in volcanoclastic sediments, while Emily Cooperdock is preparing a proposal to study the uplift and denudation history of the Aleutians via U-Th-He thermochronology as well as fission track and $^{40}Ar/^{39}Ar$ analyses. ■

Seeking the origins of continents in the western Aleutian island arc

Elizabeth Cottrell (Smithsonian Institution), Katherine A. Kelley (University of Rhode Island), Michelle Coombs (USGS Alaska Volcano Observatory), Elizabeth Grant (University of Washington), Mattia Pistone (Smithsonian Institution), and Katherine Sheppard (UC Santa Barbara)

Scientists check out the active fumarolic fissure at the summit of Kanaga Volcano on September 22, 2015. From left to right: Helicopter N312MH, piloted by Dan Leary, ferried geologist Michelle Coombs (USGS), student Katherine Sheppard (UCSB), postdoc Mattia Pistone (Smithsonian), and geologist Liz Cottrell (taking photo, Smithsonian) from the boat to the summit. The "NSF GeoPRISMS Shared Platform R/V Maritime Maid Leg 3: Western Aleutians" facilitated the team's expedition to seven active volcanic islands, from Kanaga to Buldir, in search of mafic tephra. Photo credit: E. Cottrell

The origin of Earth's continents is among the most fundamental of questions facing geoscientists today. Though andesitic in composition, continental crust shares many geochemical characteristics with basaltic lavas erupted at subduction zone arc volcanoes, suggesting that subduction zone magmatism somehow manufactures Earth's continents. Our project goal is to examine one particular attribute shared by arc magmas and continents, unusually low iron contents (sometimes referred to as "calc-alkaline affinity"). Our work will test the roles of magmatic water content, oxygen availability, and parent magma composition on the development of low iron in arc magmas. With this goal in mind, we conducted a three-week field campaign, from September 4-23, to the far Western Aleutian islands of Buldir, Kiska, Segula, Little Sitkin, Semisopochnoi, Gareloi, Tanaga, and Kanaga, home to some of the most calc-alkaline lavas on Earth. The goals of the field program were to collect samples of volcanic airfall deposits (tephra), which may preserve glass inclusions within the igneous phenocrysts that will reveal the water contents and oxygenation conditions of these end-member magmas. We conducted our field work from the home base of the R/V Maritime Maid, which anchored in four harbors among these islands, and used a Bell 407 helicopter to access field sites on these eight volcanoes. On the Maid, our GeoPRISMS team of five (Liz Cottrell, Michelle Coombs, Mattia Pistone, Elizabeth Grant, and Katherine Sheppard) was joined by a team of volcanic gas scientists supported by the Deep Carbon Observatory (Tobias Fischer and Taryn Lopez) and a team of geophysicists and field technicians from the Alaska Volcano Observatory (John Lyons, Dane Ketner, and Adrian Bender) who serviced the USGS seismic network on several of these volcanoes for the first time in more than ten years. Project PI Katie Kelley could not be in the field, but participated remotely via satellite phone and internet tools that allowed her to track the ship, helicopter, and us in near-real time. Our voyage is a great example of how multiple teams can work together to achieve great things.

Pilot Dan Leary and his ship on the flanks of Tanaga Volcano. Photo credit: E. Cottrell

Learn To Return instructor Clint with Chief Scientist Liz Cottrell at "dunker" training

Preparing for Danger: Training in Anchorage

2 September 2015 | Anchorage, AK • We're here. Anchorage, Alaska. Months of planning and training are behind us. In three days we will take a three hour jet flight to the airstrip that is both farthest East and farthest West in the United States (figure out that riddle!). From there, we will board a small boat, The R/V Maritime Maid, and steam West into the uninhabited islands of the Western Aleutians. We will only have what is in our suitcases and what we shipped months ago – and I am scared. I am scared I didn't prepare my team. I am scared I don't have the right equipment. I am scared I will make poor decisions. But I am most scared of this pool I'm in. This is the *Learn to Return* Aviation Land and Water Survival School, more commonly known as "dunker" training, with the unfortunate slogan "Be the One to Come Home!" And I'm thinking "Can't we all come home?" In this course, we get strapped into metal seats with five-point harnesses meant to mimic the fuselage of a plane or helicopter. We hover above the water. My instructor, Clint, barks, "Mayday Mayday! This is Echo Alpha Romeo 289 with two souls on board. We are ditching! Ditching! Ditching!" And then WHAM! The seats flip and I impact the water. I can't see. I can't breathe. I follow the routine. (0) Don't panic. (1) Slide my hand. Find the door latch. (2) Open the door. (3) Anchor my hand in the door frame. (4) Slide my other hand to unfasten my belt and pull myself out. Even now, dry, thinking of Clint's voice sends chills down my spine. One team member doesn't pass the course. I think of my two kids and wonder if I should just get on a plane home. But somehow, tomorrow I board my flight to Adak.

The R/V Maritime Maid and "2-Mike-Hotel" (the Helicopter)

3 September 2015 | Adak, AK • The heli pad on the Maid looks to be about the size of my desk at work. I wonder how it is that my first ever helicopter experience will be taking off from the back of a boat and going over the Bearing Sea to the rim of a volcano. Am I crazy? Our pilot, Dan Leary, is the most experienced pilot at Maritime Helicopters and the absolute best pilot I could ever have hoped for. I soon understand that Captain George Rains, who has sailed these waters for longer than I've been alive, isn't going to take any unnecessary risks.

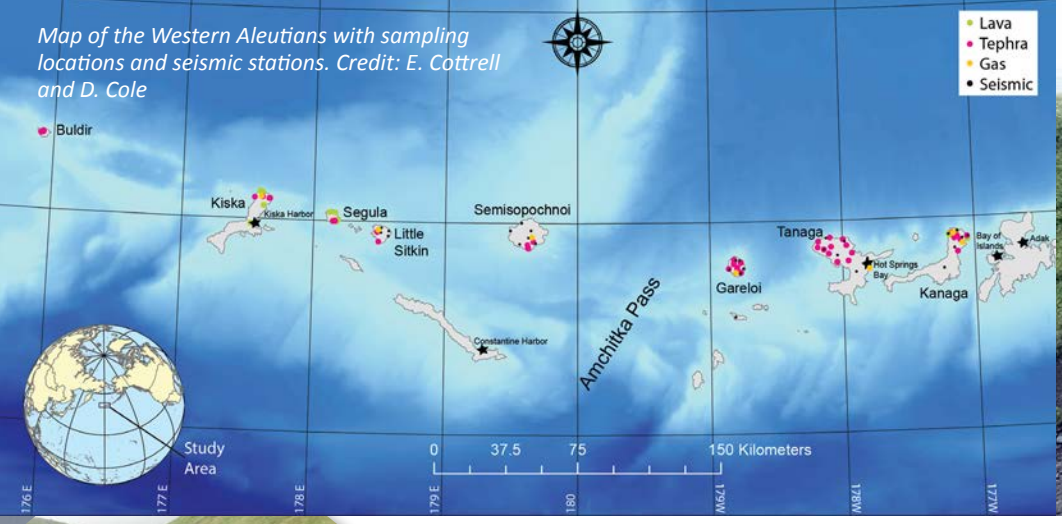
Weather Orphans the Helicopter

5 September 2015 | Constantine Harbor, Amchitka, AK • The Maritime Maid left port in Adak yesterday destined for harbor in Amchitka. At the time of our departure, the weather was beautiful with sunny, blue skies and a clear view of a steaming white fumarole at the summit of Kiska. The Maid does not sail with the helicopter parked on the deck. Instead, the helicopter normally flies when the boat is underway and they meet up again in harbor. Our plan yesterday was for the helicopter to meet us when we moored in Constantine Harbor, Amchitka but, as we sailed, fog closed in at Adak and kept the helicopter from following us. We have no scientific interest in Amchitka, so we must wait for the helicopter to join us.

8 September 2015 | Kiska Harbor, Kiska, AK • After four days of separation, we are finally reunited with the helicopter! Two days ago, we decided to lift anchor and head to Kiska harbor in the hopes of starting work, with or without the helicopter, and left a fuel cache on Amchitka so the heli could catch up with us as soon as weather permitted. We made the most of our idle time at Amchitka by taking a small skiff to shore, doing a gear shakedown, and taking some "practice" samples. Likewise at Kiska, we were able to skiff to shore yesterday and explore the area around the harbor, view and sample some distal volcanic deposits, and try not to set of any unexploded ordinances leftover from World War II. Kiska was a WWII battleground, occupied by the Japanese for a time before being re-taken by the US, and the historical remnants litter the ground and harbor.

9 September 2015 | Segula Volcano • My first day of real field work! Because of the remoteness of this region, few geological studies have been done here. Today's target, Segula, hasn't been visited by geologists since the 1940's and there are only three known rock analyses from this volcano. We find a gorgeous exposed tephra section in a wide gully and greedily fill our bags with this "black gold." By the end of the day, I realize with satisfaction that our work will return precious samples from this volcano ripe for new discoveries.

- Liz Cottrell



Map of the Western Aleutians with sampling locations and seismic stations. Credit: E. Cottrell and D. Cole

Liz, Michelle, and Pilot Dan Leary stand at the base of a massive tephra section on Segula. Photo credit: K. Sheppard

Elizabeth Grant stands in waist-high vegetation on Kiska Island. Photo credit: M. Pistone

Minefield Kiska

9 September, 2015 | Kiska Island • Team tephra is in search of olivine in mafic tephra and we have split up into two sub-teams today so we can cover more ground. Mattia and I are on Kiska, the third westernmost island in the Aleutian chain. The helicopter drops us off on a relatively flat, topographic low near the northern flank of Kiska Volcano, next to a recent lava flow. As the helicopter flies off to assist the other teams, Mattia and I survey the landscape and geologic map to get our bearings. We quickly realize that what we had assumed to be a relatively easy passing is actually a literal and figurative minefield. Instead of consisting of relatively young olivine-rich basalt, the flow is actually composed of older blocks of andesite, twice as wide as we are tall and covered with plants and grasses that reach up to our waists. Not only that, but Kiska is littered with "UXO," unidentified explosive ordinances, which could be anywhere. From our topographic low, it takes us 45 minutes to scramble the 40 meters to the top of the lava flow, and we arrive at the top sweating and out of breath. As we survey our progress, it dawns on us that we will not be able to cross the rest of this flow; it's too large and too dangerous. From the comfort of the ship's galley, we had routed our path across the map's page, talking about sampling along the way. In reality, the unexpected size of the lava flow provided us with some much-needed perspective about the unforgiving scale of nature and the long-reaching consequences of human activity.

- Elizabeth Grant

The Virtual Aleutians

10 September 2015 | Narragansett, RI • I wish I were there. And I don't. Staring at the computer screen, I wonder for the umpteenth time if I made the right decision to stay home. My baby daughter, Miranda, is only four months old, so I couldn't have gone. Still, I can't help but have this internal debate daily. It is mid-afternoon here and they will be starting their day in the field soon. I login to a website to check the location of the Maid and the helicopter, both of which pop up on an animated map of our field area. When the helicopter is in flight, it lights up pink and its little propeller turns as it moves across the screen. Watching this is the most exciting part of my shore-based experience.

My phone rings and the caller ID shows "Liz Sat Phone." Liz says it is raining and I can hear the raindrops over the phone. It seems always to be raining there; she says the volcanoes make their own weather. We quickly debrief on yesterday's work and go over a plan for the coming day's activities: our party will deploy one team to Kiska, and the other to Buldir. Buldir is the riskiest flight of the trip, partly because the flight itself is extremely dangerous and partly because they might not find anything useful when they get there, so they are risking life and limb possibly for naught. I am incredibly nervous for them. After we hang up, I login to another website to track Liz's InReach device, which sends her location every ten minutes. I leave the office just as the helicopter leaves the Maid for Buldir.

Of course, Liz tried to contact me from Buldir while I picked up my children from day care, during the only ten-minute window of my day when I had to pocket my phone. They made it safely there, which is a relief, and I briefly text with Liz's husband, who is also closely tracking her steps, about how wild it is to watch her walking around. When I get home, we setup my laptop at the dinner table (the only time a computer has ever been allowed at the table, mind you) so my whole family can watch the "action" as it happens. My three year-old daughter has learned the names of all of the volcanoes on the itinerary and asks where Liz and the helicopter are today.

- Katie Kelley

Cruise participants, from left to right, back row: Adrian Bender (AVO), George Rains (Captain), Katherine Sheppard (UCSB), Wesley Jones (Deckhand), middle row: Dan Leary (Helicopter Pilot), Mattia Pistone (Smithsonian Institution), Mike Despars (Cook), Elizabeth Grant (UW), Dane Ketner (AVO), front row: Tobias Fischer (DCO, UNM), Elizabeth Cottrell (Smithsonian Institution), Michelle Coombs (AVO), John Lyons (AVO), Taryn Lopez (DCO, UAF), foreground: Joe Schmitt (Engineer), not pictured: Mike Cooper (Helicopter Engineer). Photo credit: T. Lopez

A gully exposes tephra visible from the air on the Northeast flank of Sugarloaf Cone on Semisopochnoi Island, Alaska. Photo credit: M. Coombs

2MH drops geologists off on the summit of Kiska Volcano. Photo credit: A. Bender

Kiska Volcano:
Ascensus ad coelum et descensus ad Inferos

Left: Liz Cottrell smiles digging into tephra on the banks of Kittywake Pond, Buldir; Right: Postdoc Mattia Pistone waves from the top of a tephra section on Gareloi that he has worked hard to cut. Here you can see dozens of eruptive units. Photos credit: K. Sheppard, E. Cottrell

10 September 2015 • Thirty minutes prior to sunrise. From the vessel bow, while sipping hot tea, I observe that low-elevation clouds still seal the sky. These are not ideal conditions for helicopter flight but this is our last day on Kiska Island and, despite numerous attempts on the flanks, we have yet to find any of the rocks (mafic tephra) that we are looking for. We can only hope to find a fissure in the cloud barrier and find a way to the volcano summit. The wind is with us, however, and it is rapidly clearing up the sky from the dusty clouds. Today, the first team to be deployed by helicopter is the gas team (Tobias Fischer, Taryn Lopez) supported by Adrian Bender, the sedimentologist of "tsunamites" and "stormites," who is going to be the "radio antenna man" in contact with the Maid while the group collects dangerous volcanic gases on the southwest flank of the volcano summit. The helicopter is fully packed with people, backpacks, and field instruments. There is only one free seat for one person with a backpack. After briefing with the other members of team tephra, it is unanimously decided that I will join the gas team today. I will be tasked with finding and returning rocks from the volcano summit back to the research vessel. I am thrilled! After taking off, our helicopter pilot Dan Leary is like a hawk looking for prey; he finds a spot with broken clouds and steers into it. Thanks to the ascending winds increasing while approaching the hidden east flank of the volcano, we are promptly above the clouds - the sky can also be blue here in the Aleutians. While ascending, the northwest wind is too strong to make any attempt for landing at the volcano summit. Therefore, we are all deployed at about a thousand feet below the volcano summit. It looks like we will have to reach the summit only with some effort and sweat. After a short briefing about work tasks and timetable, and radio communications, the gas team and myself initiate our hike up. Lava flows, loose volcanic bombs and blocks dominate the landscape. After several days at low elevation, I can enjoy this hike without fear of encountering UXO. I am at the top of the crater rim and the landscape in front of me is gorgeous! The volcano crater is in front of me and I feel so small and insignificant. Clusters of loose rocks cover the internal flanks of the volcano. The crater floor is filled with fine volcanic material; it looks like mud. The western side of the volcano has no rim and from there, low-elevation clouds ascend and enter this amphitheater while the northwestern winds blows. I am the lonely spectator of this volcanic show and feel like an explorer - I am the first one to set foot in this volcanic crater… well, after the geologist Robert Coats, who most probably came here during his mapping work in the early 50's… but, for sure, I am the first Italian here! That's exciting! Now, back to work. I report the GPS coordinates and field observations in my book and start to hammer the samples I need. Any sample I take looks beautiful and full of precious information. I wish to take any and all specimens with me since this is the first and last chance we have to collect rocks in the crater of Kiska Volcano during this field mission. But I have to face the reality: I am by myself and cannot carry too many rocks. How time flies! I am quick to collect samples, observations, and data because I have to go back soon. We have now 70 kg of rocks to hike to our helicopter rendez-vous location and I anticipate a very negative reaction from the gas team, who have worked hard for many hours. Instead, I receive generous support, which is typical of an enthusiastic team of people. This is the best reward after a long day of work between volcanic rocks and wind gusts. Together, we march back to the pick-up point. I think this is the greatest day of the field mission here in the Aleutians.

- Mattia Pistone

On the Edge

10 September 2015 | Kiska Harbor, Kiska, AK • Buldir is a tiny speck of an island about halfway between the much larger masses of Kiska and Attu, all the way out in the far Western reaches of the Aleutian chain. How far out? Let's just say we didn't have our passports with us, so we couldn't except to legally get much further west. There are 45 miles of open water to the east and west of Buldir, which was about a 45-minute flight for our Bell 407 helicopter. This is a perfect amount of time to reminisce about three things: we would be among only a few geologists to visit the volcano in decades, we only had one day to do as much work there as we possibly could, and if anything went wrong while on the island we were all royally screwed. Our day on Buldir had the potential to be the most dangerous day of the trip, mostly due to the long over-water helicopter flight and the remote location. If the helicopter landed but couldn't take off due to bad weather, we would be stuck out there until the weather cleared or the boat came to get us. As anyone familiar with the weather in the Aleutians knows, this could take a very, very long time.

As it turned out, we landed, did our work and I soaked in the glory of feeling like a real life explorer. The fog stayed at a respectful distance, the wind stayed manageable, and we were able to take off at the end of the day with minimal excitement. When we landed on the boat 45 minutes later, however, we were ecstatic. We had found amazing tephra samples that suggested an explosive, volatile-rich history for Buldir. Not at all as we were led to expect before the trip, so a resounding success! Only when we had unpacked all the rocks and rid ourselves of our protective gear did our helicopter pilot turn to Liz, let out a breath he seemed to have been holding all day, and say "I am never, ever, ever doing that again."

- Katherine Sheppard

12 September 2015 | Semisopochnoi • With the stressful overwater flight to Buldir behind me, I find myself relaxed and enjoying the flight to Semisopochnoi Volcano. A survey from the air reveals beautiful sections of tephra cut from the vegetated landscape. Michelle and I are able to sample meticulously here all day.

17 September 2015 | Gareloi • I am standing waist-deep in olivine scoria and loving it. Katherine and I fill our sampling bags to bursting and I know we have gotten what we came for. I then hike up to the crater rim – just to take a peek. I am stunned at what I see… a crater lake and active fumaroles! This appears to be a new development since the last time geologists visited this place in 2005 and I am reminded that these are indeed very active volcanoes.

- Liz Cottrell

20 September 2015 | Kanaga • Gas team and two tephra teams got set on Kanaga in the morning, and then boat transited from Hot Springs Bay on Tanaga to the Bay of Islands on the west side of Adak. This was the most spectacular day of the trip so far. Kanaga was completely out and cloud free and I took many beautiful photos. Kanaga is a great island and volcano – deep blue lake in the caldera, spectacular lava flows, deep green grass everywhere. Kanaton Ridge is just screaming out for more and better work, as is the entire island. Visited a few tephra sections as guided by CW's paper and found some big lapilli pumice falls. No mafic scoria to speak of, unlike Tanaga, and much to our team's disappointment. I think I found two mafic ashes that may be from Tanaga, which will be interesting to see. We ended the day around 5 pm at the hot springs.

- From Michelle Coomb's Field Journal

Trip Summary

- More than 2,700 lb of rock (384 samples) sent to AVO, URI, and Smithsonian
- Retrieval of first tephras ever collected from Buldir, Segula, and Kiska as well as comprehensive tephrastratigraphy at Tanaga
- Fumarole samples taken at Kiska, Gareloi, and Kanaga. Water samples taken at springs on Little Sitkin, Tanaga, and Kanaga
- 100% maintenance success at 30 Alaska Volcano Observatory seismic installations ■

Top: A well-deserved soak in the hot springs on Tanaga after three hard weeks of very successful field work; Left: Dane Ketner, USGS, stands above the clouds in typical Aleutian weather while servicing TAPA seismic hut on Tanaga Island. Photos credit: A. Bender

Status Report on the GeoPRISMS Data Portal: April, 2016

Andrew Goodwillie and the IEDA Database Team

Lamont-Doherty Earth Observatory, Columbia University

The GeoPRISMS data portal (http://www.marine-geo.org/portals/geoprisms/) was established in 2011 to provide convenient access to data and information for each primary site as well as to other relevant data resources. Since the last newsletter report, highlighted below are recent contributions of data sets and field program information of interest to the GeoPRISMS community. Most of the data sets described are also available in GeoMapApp under the Focus Site menu (http://www.geomapapp.org/).

ENAM

Bathymetry and backscatter data collected as part of a US Extended Continental Shelf survey of the central ENAM margin was contributed by James Gardner and Brian Calder. The new data, shown in figure 1, was generated during Langseth cruise MGL1512 in 2015 and marks the completion of bathymetric data surveying along the entire length of the margin (http://www.marine-geo.org/tools/search/entry.php?id=MGL1512).

Also added to the portal for the ENAM area was field program information for the Mid-Atlantic Geophysical Integrative Collaboration ("MAGIC", http://www.marine-geo.org/tools/search/entry.php?id=ENAM_MAGIC) seismometer network. Using data from the array, project PIs Maureen Long, Maggie Benoit, Eric Kirby, and Scott King are studying crustal and upper mantle structure in the area of the Appalachian Mountains. The seismic station locations were also added to GeoMapApp, under the Focus Sites menu.

View Point: W 63.167, N 37.347, 215633 m
Center of image: E 291.843, N 35.992, -4881 m (scaled by a vertical exaggeration of 6)

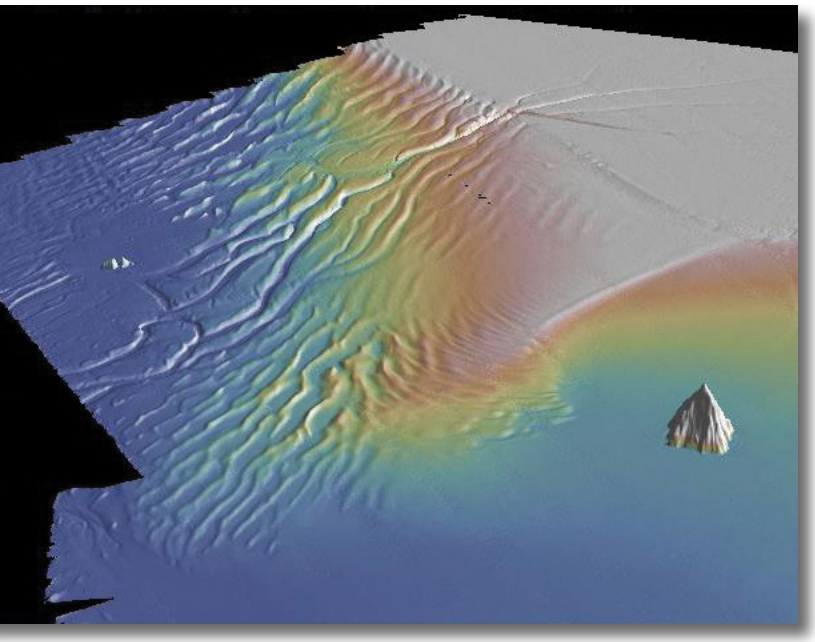


Figure 1. Centered upon a position near 68 deg W and 36 deg N and looking in a southwesterly direction, this perspective view of newly-acquired bathymetry data across the Hatteras Outer Ridge shows the fine detail of channels and wave forms on the ENAM continental rise and slope. Caryn Seamount in the lower right rises 2,000 m above the flat Atlantic seafloor. Artificial illumination is from the north and the imaged area measures about 300 km across. Image made with GeoMapApp.

New Zealand

PIs Robert Harris, Anne Trehu, and Andy Fisher contributed multi-channel seismic shot and processed heat flow data sets collected across the Hikurangi subduction margin during the 2015 "STINGS" cruise (http://www.marine-geo.org/tools/search/entry.php?id=RR1508). That Revelle expedition surveyed both the northern part of the margin – a creep-dominated subduction interface with shallow slow slip earthquakes (SSEs) – and a southern area with deep SSEs.

Cascadia, Alaska, and Hikurangi margins

Drill core and sediment sample analysis spanning each GeoPRISMS SCD primary focus site is being used by PI Neal Blair to assess the role of multicycle carbon at subduction margins. Links to the analytical geochemical data sets and to related publications are provided in the Portal (http://www.marine-geo.org/tools/search/entry.php?id=CarbonCycle_Blair). DOIs were assigned to the data sets, allowing them to be a formally-cited part of the scientific record.

Aleutians

During summer 2015, PIs Ninfa Bennington and Kerry Key led a shoreline-crossing field program in the vicinity of Okmok Island (http://www.marine-geo.org/tools/search/entry.php?id=Aleutians_Bennington). MT instruments were deployed in onshore and offshore locations as part of an experiment to study the magmatic system beneath the volcano (Fig. 2). A suite of broadband seismometers installed on the island will be picked up later this year. The MT and seismic instrument stations were also added to GeoMapApp.

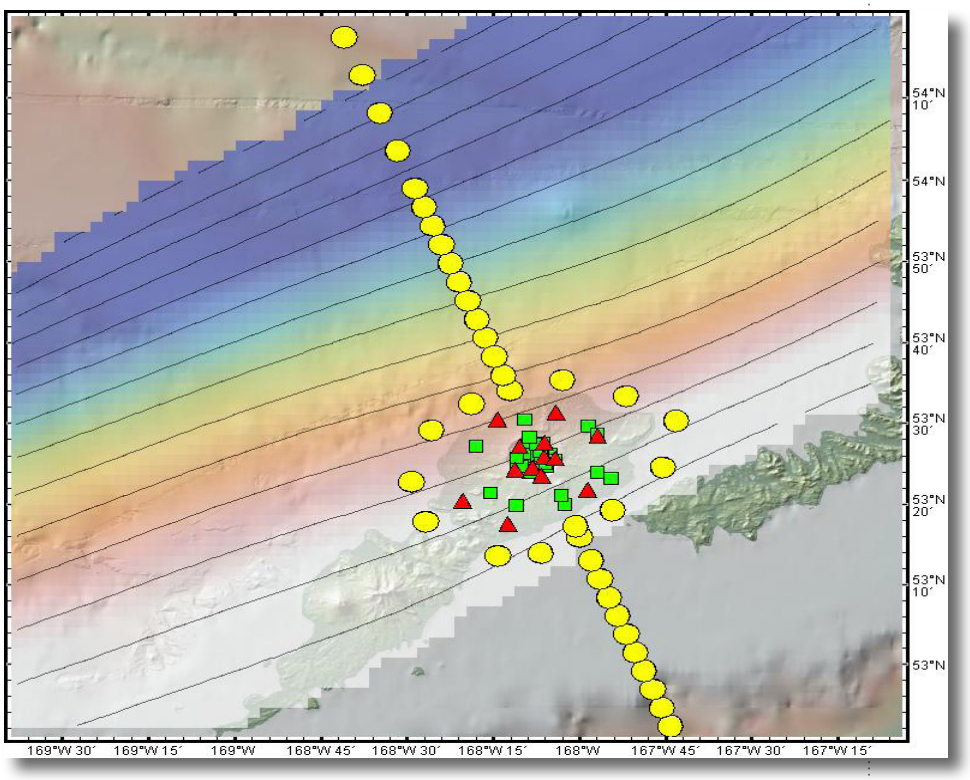


Figure 2. Instrument locations for MT devices offshore (yellow circles) and onshore (green squares) and for an array of 13 broadband seismometers (red triangles). The outline of Okmok island is visible in the background. The 10 km-contoured rainbow-colored semi-transparent surface plotted on top of the island and trending NE-SW depicts the depth to the top of the subducting slab from the work of MARGINS/GeoPRISMS researchers Ellen Syracuse and Geoff Abers. Image made with GeoMapApp.

GMRT base map

The Global Multi-Resolution Topography (GMRT) synthesis – (*http://www.marine-geo.org/tools/GMRTMapTool/*) The base map used in GeoMapApp, in the GMRT MapTool, and other IEDA tools now includes processed multibeam swath bathymetry data from more than 270 cruises within GeoPRISMS primary sites. A new GMRT MapTool profiling tool and expanded export options provide improved user flexibility.

GeoPRISMS Data Portal Tools and Other Relevant IEDA Resources

Search For Data - (*http://www.marine-geo.org/tools/new_search/index.php?funding=GeoPRISMS*) The GeoPRISMS search tool provides a quick way to find GeoPRISMS data using parameters such as keyword, NSF award number, publications, and geographical extent.

Data Management Plan tool - (*www.iedadata.org/compliance*) Generate a data management plan for your NSF proposal. The on-line form can be quickly filled in, printed in PDF format, and attached to a proposal. PIs can use an old plan as a template to create a new plan. We also have developed a tool to help PIs show compliance with NSF data policies.

GeoPRISMS Bibliography – (*http://www.marine-geo.org/portals/geoprisms/references.php*) With more than 1,120 citations, many tied to data sets, the references database can be searched by primary site, paper title, author, year, and journal. The citations can be exported to EndNote™. Submit your papers for inclusion in the bibliography – just the DOI is needed! *http://www.marine-geo.org/portals/geoprisms/ref_submit.php*

Contribute Data - (*http://www.iedadata.org/contribute*) The web submission tools support PI contributions of geophysical, geochemical, and sample data. File formats include grids, tables, spreadsheets, and shapefiles. Once registered within the IEDA systems, the data sets become available to the broader community immediately or may be placed on restricted hold. Additionally, PIs can choose to have a DOI assigned to each submitted data set, allowing it to become part of the formal, citable scientific record. ■

The GeoPRISMS Data Portal team is here to serve the community

Please contact us at info@marine-geo.org

GeoPRISMS Steering and Oversight Committee Highlights

Spring 2016

March 17-18, 2016, NSF Headquarters, Arlington, VA

Edited by Anaïs Férot, GeoPRISMS Science Coordinator & Peter van Keken, GeoPRISMS Chair

Introduction

The annual 2016 GeoPRISMS Steering and Oversight Committee Meeting provides the GSOC members and NSF the opportunity to give an update on GeoPRISMS activities, research funding and outcomes, and to address program issues. This Spring meeting especially addressed the Dear Colleague Letter (DCL) issued by NSF encouraging proposals for community-driven shoreline-crossing seismological arrays along the Alaska subduction margin, the transition of the Office that will happen in the Fall 2016, and the upcoming TEI for the RIE initiative planned for 2017. The committee also provided significant updates to scientific outcomes of funded projects in SCD and RIE through information provided by the PIs. This (currently) annual steering committee meeting provides an effective and efficient way for significant information exchange between NSF and the GeoPRISMS community.

NSF Update

NSF Program Manager Jenn Wade (EAR) provided updates from NSF. Maurice Tivey is now Program Manager for the OCE Division with help for the last round from Debbie Smith, Dennis Geist, and Barbara Ransom. The budget remains under sequestration.

The number of proposals submitted to GeoPRISMS remains at some 50-60 proposals submitted per year since 2012. Success rates are fairly evenly distributed between focus areas and primary sites: EARS (31%), ENAM (33%), Cascadia (38%), Alaska&Aleutians (38%), New Zealand (30%) and thematic studies/synthesis (17%). There is significant internal collaboration and co-funding between programs within NSF such as Earthscope (with overlap in Cascadia, ENAM, and Alaska&Aleutians) and the Polar program (Aleutian logistics). Programs of interest to GeoPRISMS researchers also include EPSCoR, OISE, and PREEVENTS.

The program solicitation was under revision at the time of the GSOC meeting. It has now been finalized with a July 26, 2016 target date. Most important change was the decision to allow large community proposals for seismological data acquisition (including the use of ocean bottom seismometers) for Alaska & Aleutians this year. The solicitation follows with this the Dear Colleague Letter on Onshore-Offshore Seismological Studies of the Aleutian Arc that was released following a 2014 meeting on the future of the amphibious array and the 2015 GeoPRISMS mid-term review. The phased funding model will need to be revised next year, but PIs are reminded that this model only limits the submission of 'large' proposals.

Rick Murray (Division Director of OCE) welcomed the committee and provided an update on NSF's response to the Decadal Survey of Ocean Sciences in which NSF has applied the recommendations of significant cuts in infrastructure to improve funding success for science proposals. The committee discussed with Rick the budget developments in GEO, organizational changes within OCE, and ongoing conversations within NSF on the reproducibility and robustness of scientific work.

2015 GeoPRISMS Mid-term review and the Wiens report

NSF held a fifth year review of the GeoPRISMS program to evaluate the success of the program thus far and to provide any mid-term recommendations for the directions of the program. An ad-hoc review writing committee was convened to summarize GeoPRISMS research and impact thus far. The committee consisted of former and current GSOC members John Jaeger, Maureen Long, Julia Morgan, Sarah Penniston-Dorland, Peter van Keken, and Paul Wallace. Andrew Goodwillie provided significant reference support and provided a summary of the GeoPRISMS database effort. The Writing Committee met at University of Oregon in Eugene in July 2015. The GeoPRISMS Office finalized the report with editorial control by Anaïs Férot and Peter van Keken.

The Review Panel led by Doug Wiens with members Jay Ague, Tobias Fisher, Monica Kohler, Anne Meltzer, and Hans Thybo met in August 2015. Peter van Keken, Juli Morgan, and Maureen Long presented the report to the committee at NSF in September 2015. The panel meeting resulted in a detailed recommendation. The Wiens report provides an overview of the appreciation of the review panel and direct recommendations to NSF regarding the future of the program. The report recommended, among others, that the Alaska&Aleutian Primary Site should remain open for large proposals for one more year, that a strong effort should be made to increase the funding level available to GeoPRISMS researchers, that all primary sites should be retained in the second half of the program, and that the GeoPRISMS Office is essential to the success of the program.

Partner organizations update

Many GeoPRISMS researchers are active in multiple communities and a series of updates on developments in those were provided. Jeff Freymueller is now the new Chair of the EarthScope National Office in Fairbanks, Alaska, and he provided an update on the scope and goals of Office Activities in the next 3-4 years as the EarthScope is winding down. Of particular interest is the support of synthesis activities.

Many of the GSOC members are active in the discussions regarding the subduction zone observatory (SZO) which envisions to build a multidisciplinary facility stretching along a significant portion of one or more of the circum-Pacific subduction zones. GeoPRISMS has been involved with IRIS, UNAVCO and EarthScope in the discussions leading up to the September 2016 logistics meeting in Boise, ID.

Andrew Goodwillie provided an update of the GeoPRISMS Data Portal and improvements in capabilities made since the last GSOC Meeting held in Spring 2015. The GeoPRISMS Data Portal is now linked to the GeoPRISMS list of awards. Many recent data products including bathymetric, multi-channel seismics, geochemical data, and experimental data have been included. The mid-term review also helped in the discovery of many more MARGINS/GeoPRISMS-funded and –related references which are now included in the bibliographical databases. Sarah Penniston-Dorland discussed developments in ExTerra (a GeoPRISMS initiative that focuses on the rock record from exhumed terranes). Significant funding was obtained from NSF Partnerships in International Research and Education to start the ExTerra Field Institute and Research Endeavor (E-FIRE) which will focus on the rock record from the Western Alps in partnership with the European Marie Curie Training network on Zooming In between Plates (ZIP). The funding will support 8 PhD students and 2 postdocs at 9 US institutions. The project will focus on geochemical cycling in subduction zones, the rates and conditions of processes at depth, and the rheology of subduction zone materials.

Initiatives Update

With input from the community several GSOC members spent significant time in discussion of progress in activities that are either funded by GeoPRISMS or are closely related to the goals of GeoPRISMS. Updates were provided from both the RIE and SCD initiatives and demonstrated the significant advances made in the primary and ancilliary sites as well as in thematic studies. The annual update provides an important milestone as the GeoPRISMS Office compiles the research efforts and provides an ideal avenue to demonstrate the impact of the funded science to NSF program managers in EAR and OCE. It also creates an opportunity for interdisciplinary education within the broadly diverse GSOC membership. SCD updates this year included studies of the Aleutian megathrust, the thermal structure of the Cascadia subduction zone, the iMUSH project imaging Mt St Helens, the initiation and evolution of the Aleutian Arc, and a combined seismic and MT study of Okmok Volcano. RIE updates included studies of Eocene volcanism in Virginia, active seismic experiments and data processing workshops in ENAM, experimental stratigraphy studies of the geomorphological evolution of passive margins, the seismic record following an earthquake swarm in Malawi, the lithospheric structure and topographic evolution of the southeastern US continental margin, and the development of a community velocity model for East Africa.

Planning for Theoretical and Experimental Institute for the RIE Initiative

Demian Saffer, incoming Chair of the GeoPRISMS Program, discussed the early planning for the TEI for the RIE Initiative. With pre-spending approved it is urgent to think about a timeframe for the organization of the meeting. Organizing the meeting in February 2017 would allow to discuss the meeting outcomes at the next GSOC meeting in March 2017 and to get NSF feedback for the GeoPRISMS solicitation deadline in July 2017. The meeting organization is now well underway and once the dates, location, and main goals have been finalized an announcement will go out on the GeoPRISMS website and listserv.

GeoPRISMS Data Portal

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:

http://www.marine-geo.org/portals/geoprisms/references.php

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

GeoPRISMS Postdoctoral Fellowship
Deadline July 26, 2016
For details, visit the GeoPRISMS website:

http://geoprisms.org/education/geoprisms-postdoctoral-fellowships/

Education & Outreach Update

MARGINS Mini-Lesson Project

Sarah Penniston-Dorland gave an update on the MARGINS Mini-Lessons. The project is managed by Juli Morgan (Rice University) and was funded in 2012. It aims at synthesizing and incorporating cutting edge scientific results from the MARGINS-GeoPRISMS Program into the undergraduate geoscience curriculum. The development teams created two weeks of course materials showcasing MARGINS research within each of the four MARGINS Initiatives. Fifteen data-rich class exercises (mini-lessons) are now available. These explore tectonic, structural, geochemical, and sedimentary processes along continental margins.

AGU Student Prize

As in previous years, GeoPRISMS awarded two $500 prizes for the Outstanding Student Oral and Poster Presentations on GeoPRISMS or MARGINS-related science at AGU Fall Meeting. The Office received this year 54 applications (with near equality in gender applications), 38 for poster and 16 for oral presentations. The SCD initiative is as usual much more represented than the RIE or the MARGINS initiatives. The numbers of applications has increased compared to 2014 – the number of applications last year was low because the student prize announcement was combined with the Townhall Meeting which brought too much confusion.

Zach Eilon (Columbia University) and Allison Rubin (UC Davis) received the poster and oral awards respectively. Joel Edwards (UC Santa Cruz), Helen Janiszewski (Columbia University), Dylan Meyer (UT at Austin) and Maureen Walton (UT at Austin) were rewarded for their work with an honorable mention.

Distinguished Lectureship Program

The DLP continues to be popular with 56 applications received for the 2015-2016 season. Of these, 19 institutions had been scheduled to receive speakers for the 2015-2016 academic year. These include four first-time applicants. The DLP was reviewed in summer 2015 as part of the mid-term review. Nearly 170 lectures have reached a combined audience of more than 9,000 people. Lectures are now also archived on the GeoPRISMS Youtube channel. Due to budgetary constraints the number of lectures has been reduced to four. Next year Beatrice Magnani, Brandon Schmandt, Esteban Gazel and Heather Savage will tour the US to expose audiences at universities and museums to GeoPRISMS science.

Website, social media, and newsletter

GeoPRISMS continues to be active on Facebook and Twitter with posts regarding student and early career opportunities, AGU and other meeting activities, and GeoPRISMS-related science posts. The Office maintains a Listserv and provides support to various initiatives for registration and dissemination of reports (see the new Alaska Amphibious Community Experiment webpage set up to engage community members and communicate strategies). GeoPRISMS NSF awards compiled on the GeoPRISMS website are now directly linked to the GeoPRISMS data portal and to the science "nuggets" provided by the PIs for the mid-term review, when available. Recordings of lectures delivered by the DLP Speakers over the years of MARGINS and GeoPRISMS are archived on new GeoPRISMS Youtube channel.

Many projects to develop the website are in progress, like creating an interactive map locating the past, ongoing, and upcoming field work for each focus sites, funded by and related to GeoPRISMS. The Office continues to produce a newsletter twice a year with the Spring issue distributed in both electronic and print issue.

GSOC Rotations

Peter van Keken thanked all members for their service on the GSOC. This year there are a number of members rotating off. Harold Tobin, Maureen Long, Gene Yogodzinski are rotating off due to the three-year limitation on membership. Jeff Freymueller is now head of the ESNO so will rotate off after agreeing to participate to one more GSOC meeting this year. Peter van Keken will rotate off his position of GeoPRISMS Chair in the Fall 2016. Demian Saffer (Penn State) will take over the position of GeoPRISMS Chair in the Fall 2016. Because of institutional conflict reason Liz Hajek will also rotate off.

GeoPRISMS Program
[Program Solicitation NSF 16-560]
Target date: July 26, 2016

http://www.nsf.gov/pubs/2016/nsf16560/nsf16560.htm

The phased funding model adopted for GeoPRISMS defines windows of opportunity during which proposals of certain types will be accepted for given primary sites. Large and costly field experiments can only be supported one site at a time, for up to two sequential years. Smaller studies such as preparatory work, data analysis, and synthesis, or thematic studies, requiring a lower percentage of the overall annual budget, are considered for all sites each year. Windows of opportunity for large-scale data acquisition projects have been thus defined, by site:

New Zealand: FY17 (July 2016 deadline)
Alaska & Aleutians: FY17 (July 2016 deadline)
Cascadia, ENAM, EARS: Completed but will continue to be accepted in Core Programs

The Transportable Array (TA) component of the SAGE Facility is currently being deployed in Alaska and northwestern Canada. When fully deployed at the end of summer 2017, the TA will provide data from approximately 260 seismic stations, complementing GPS stations operated as part of the Plate Boundary Observatory component of the GAGE Facility. The TA stations are anticipated to collect data through 2018. GeoPRISMS projects that make use of the data produced by the unique instrumental infrastructure of the Alaska TA to address questions laid out in the GeoPRISMS Science & Implementation Plans are encouraged. Proposals that make use of the Transportable Array should explain how those data will be used in coordination with any new data to be obtained as part of the proposal, and why the acquisition is time-sensitive.

NSF released a Dear Colleague letter (NSF 16-061) that encourages cros-coastal field projects in the Alaska Arc to take advantage of the Alaska TA deployment using OBSIP instrumentation. For more details and guidance, please visit:
http://www.nsf.gov/pubs/2016/nsf16560/nsf16560.htm

Questions should be directed to PO Jennifer Wade: jwade@nsf.gov; (703) 292-4739 or Maurice Tivey: mtivey@nsf.gov; (703) 292-7710

GeoPRISMS at AGU Fall Meeting - Mini-Workshop Reports

December 14-18, 2015 AGU Fall Meeting, San Francisco

GeoPRISMS provides the opportunity for groups of researchers to meet and discuss GeoPRISMS Science or planning activities at the AGU Fall Meeting. Here is the report from the Mini-Workshop organized at AGU Fall Meeting 2015.

From rifting to drifting: evidence from rifts and margins worldwide

Conveners: Rebecca Bendick (University of Montana), Ian Bastow (Imperial College London), Tyrone Rooney (Michigan State University), Harm van Avendonk (Univ. Texas Institute for Geophysics, UT-Austin), Jolante van Wijk (New Mexico Tech)

On Sunday December 13, 2015, from 8am to 1:30pm, a representative cross section of researchers interested in rifting met in the Grand Hyatt San Francisco before the AGU Fall Meeting. Our primary focus was to facilitate discussion on the current state of research into continental extension. Our aim was to be broadly inclusive by bringing an audience with widely varying backgrounds to a common understanding of the state of the art in this field. Our ultimate goal was to initiate a discussion on future research challenges for the community and how these challenges align with the existing science plans for the GeoPRISMS Eastern North America and East African Rift Focus Sites. To facilitate community building and cross disciplinary linkages, the meeting was coordinated with the STEPPE consortium (Sedimentary Geology, Time, Environment, Paleontology, Paleoclimatology, Energy) workshop investigating source-to-sink processes of the Lake Tanganyika rift (East Africa), which took place directly following the GeoPRISMS workshop from 2 to 8pm.


Photo by A. Férot

More than 60 participants and conveners with widely variying backgrounds but a common interest in rifting gathered on the Sunday before the 2015 AGU Fall Meeting. to discuss future research in GeoPRISMS ENAM and EARS Focus Sites.


Photo by A. Férot

The meeting was structured to allow for discussion under four broad subheadings:

Topic 1: Melt Generation in Extensional Environments

A 30 minute introduction to this topic was presented by Tyrone Rooney. The talk covered the historical context of rifting studies and then focused on the relationship between magma and lithospheric strength. The concept of magma within the lithosphere facilitating rifting was introduced. The presentation examined how magmas provide an important temporal record of mantle processes during extension. It was shown how thermochemical constraints of the upper mantle source region of rift magmas could be probed with erupted lavas. In particular, the dual challenges of mantle potential temperature and pyroxenites in the upper mantle were highlighted as important frontiers in our understanding of mantle melting processes. The role of volatiles in some rifting environments (Rio Grande Rift) was introduced. The role of magmas in influencing seismic images of the upper mantle and also acting as a mechanism of strain accommodation during late stage rifting was also discussed. Finally, an examination of the continental lithospheric mantle as a possible magma source was also presented.

The discussion, moderated by Harm van Avendonk, first explored the issue of the role of water in magma generation processes. In particular, there were questions asked about the storage of water in water-bearing phases but also the ability of olivine to store volatiles. Further discussions continued on the role of hydrous phases on lithospheric rheology. The first key question arising from these discussion was – where could volatiles reside and how much in the source of rift magmas (especially water and carbon dioxide). Suggestions on approaching this question through studies of xenoliths and reconstructing lithospheric architecture were made. The second key question focused on the role of structural inheritance. It was acknowledged that crustal heterogeneity and mantle lithosphere heterogeneity may not necessarily correspond. Finally the third key question related to the amount of melt generation with the timing and magnitude of stretching.

Topic 2: Magma-lithosphere interaction

A 30 minute introduction to this topic was presented by Chris Havlin. This presentation first delivered an overview of the physics and thermodynamics of melt transport. This was further subdivided on the basis of porous flow within the mantle and lithosphere and in terms of crustal fractures and channels and how lithospheric inheritance influenced melt transport. The porous flow concept was expanded to examine the dependence on pressure gradients, buoyancy and dynamic pressure. The concept of a 'freezing boundary' was raised in terms of a melt focusing mechanism, which if dipping, could redistribute melt. Within the lithosphere the concept of lithospheric and crustal fabrics was raised. It was acknowledged that grain size may affect porosity and surface tension. As a result, melt is preferentially directed into smaller grain size domains. The presentation also examined end-member models of strain i.e. whole lithospheric heating, and basal heating and impact

Bringing the science to a whole new level! The poster session organized during the mini-workshop was so popular that attendees presented their research on the floor of the meeting room.

of the porosity front shallowing over time creating an effective thinning of the lithosphere. Finally, it was shown that there could be a growing zone of modified lithosphere whereby mechanically it behaves as does the asthenosphere but chemically it may still resemble the lithospheric mantle.

The discussion, moderated by Ian Bastow, first examined the concept of the background state of stress in rifting environments and how stress may change with changes in viscosity. It was noted that thinning does not require large extensional stresses. A point was raised on the competing grain size effects on porosity and surface area in relation to bulk permeability. Questions were raised by the group as what happens in relation to thinning and melt alteration of the lithosphere in seemingly amagmatic rift segments. It was acknowledged, however, that segments defined as amagmatic due to a lack of surface volcanism may still possess significant melt at depth within the lithosphere. As a result of these discussions, two key questions arose: (1) What is the role of melt in magmatic and amagmatic (in terms of surface volcanism) rift segments? and (2) What are the feedbacks between melt transport and lithospheric thinning and what are the mechanisms?

Topic 3: Stretching the lithosphere

A 30+ minute introduction to this topic was presented by Suzon Jammes. The presentation first examined the concept of mechanical stretching and the genetic relationship of stretching as an important factor in the Wilson Cycle. The factors controlling this mechanical stretching focused on exhumation, tectonic inheritance, and the control of rift and margin architecture. The topic of depth-dependant stretching was examined and how vertical decoupling was incompatible with pure and simple shear endmembers. An introduction to time-dependant stretching mechanisms followed with some idealized cross section of basinward migration of deformation. Dr. Jammes presented an evolutionary model whereby mechanical stretching was followed by the creation of a 'necking zone' for major crustal thinning and finally an exhumation phase. The discussion continued into a discussion of how rifting processes are determined by rheological layering of the lithosphere and the impact of structural inheritance and sensitivity to this vertical layering.

The discussion, moderated by Rebecca Bendick, was more limited due to time constraints but did establish a key question of how the feedbacks with melting might vary in terms of the recognized global variety of architectures of rifts and rifted margins.

Topic 4: Melt delivery and focusing

A 30 minute introduction to this topic was presented by Derek Keir. Dr. Keir showed how within the East African Rift changes in mantle potential temperature are probable first order controls on magma supply. It was also shown how variations in magmatism are multi-scalar with lateral variation at several scales both in the presence and absence of melt and melt chemistry. There was a view that melt pathways and focusing might represent the best mechanism for generating smaller scale variability and examples from the Black Sea and Afar were shown. Afar provided a particularly interesting case as in this region it was show that volcanism responded to increasing subsidence. That is, the more the thinning, the more melt and thus more melt focusing. Dr. Keir showed how a mantle potential temperature anomaly of at least 100 degrees could help explain observed seismic velocities and also the presence of melt throughout the region. A comparison was made between Afar and slow spreading ridges and also to Krafla (Iceland) between 1975 and 1984. The discussion continued as to the impact of melt focusing in time and space and how it is influenced by the temporal accumulations of tectonic stresses. The result of this was described as a general migration of volcanism from the rift flanks towards the rift axis with the competing tectonic and gravitational stresses.

The discussion, moderated by Jolante van Wijk, examined comparisons between the Havlin models discussed in topic 2 and those presented by Keir in topic 4. Some discussion centered on the concept of focusing at the lithosphere-asthenosphere boundary and then subsequent defocusing within the crust. It was acknowledged that geochemical data were critical to address these issues. It was noted that magmatic sources clearly differ along strike within the rift and thus are inconsistent with a single centralized source.

Broad discussion

Following a break, the group reconvened to try and systematize some of the key concepts raised. The issues can be summarized as follows:

1. *Rift Initiation*
   a. What is the role of mantle plumes?
   b. How can mechanical heterogeneity facilitate initial rifting?
   c. What role does chemical heterogeneity in the lithospheric mantle control initial extension?
   d. What is the initial thermo-chemical structure of the lithosphere and asthenosphere in a nascent rift?
   e. What does incipient rifting look like? Okavango suggests preexisting structure critical.
   f. Is this a top down or bottom up process? How does extension propagate?

2. *Evolution of rifting in time and space*
   a. Why do rifts ultimately fail?
   b. What is the role of nonlinear feedbacks?
   c. How can datasets from igneous petrology and the sedimentary record provide a temporal insight into rift evolution?
   d. What is the time evolution of strain?

3. *Rift Architecture*
   a. How do non-uniqueness issues create difficulties in creating global models of rift evolution?
   b. How can real constrains be linked with ever more innovative and detailed simulations?
   c. What variables control the strength of the lithosphere?
   d. What is the role of far-field vs. local controls on strain and rift evolution?

4. *Volatiles in extensional environments*
   a. What are the volatile pathways from depth to the surface?
   b. How deep are the volatiles derived from?
   c. What is the role of rift valley volcanoes in global production of volatiles (e.g., CO_2, SO_2)?
   d. How can lithospheric heterogeneity and inheritance influence the volatile budget?

In summary the basic concepts on which the group agreed that were critical for GeoPRISMS were:

1. **What is the history of melt?** Where is it formed, when is it formed, why is it formed, how is it focused, and what pathways does it take through the lithosphere?

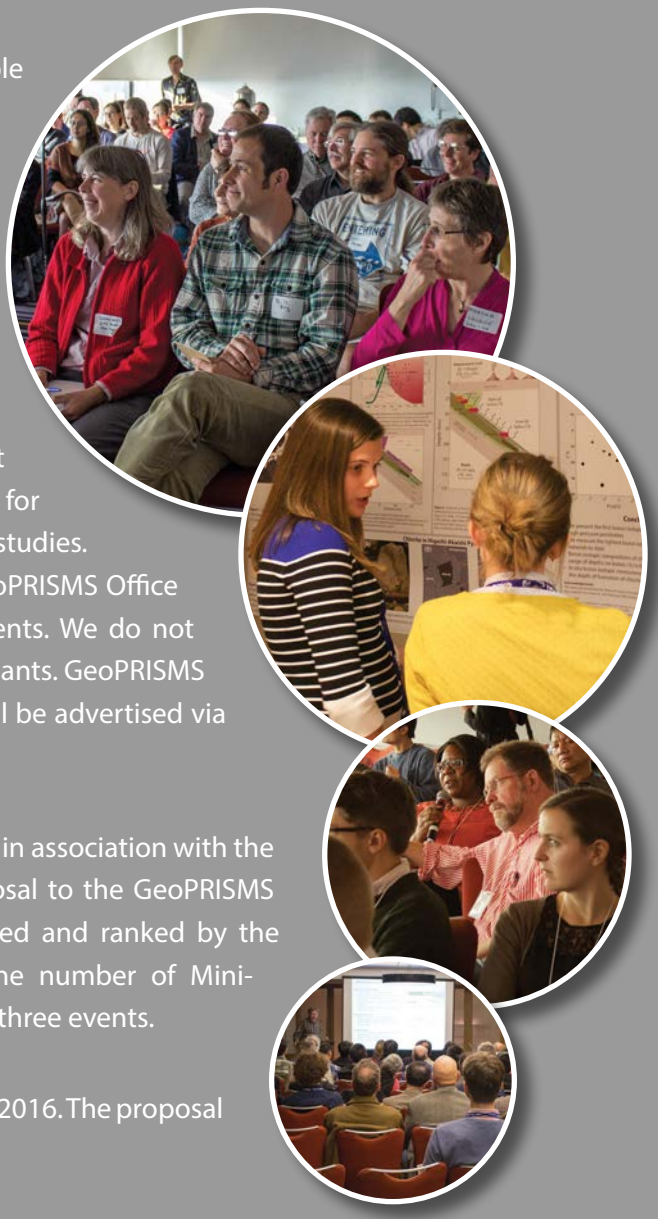
2. **What is the material (thermal and chemical) heterogeneity in the rift lithosphere?** How does inheritance play a role, is there spatial organization at play, and how can we assess the importance of these heterogeneities to rifting?

3. **Comparison of focus areas is needed.** How do ENAM and the EAR differ and how are they similar? What can be learned from focused studies at both sites?

A mini-workshop on the Himalayan Seismogenic Zone was also held at AGU Fall Meeting 2015. For more information about the mini-workshop, please visit the GeoPRISMS website at: http://geoprisms.org/meetings/mini-workshops/agu2015-hsz/

Call for GeoPRISMS Mini-Workshop Proposals at AGU 2016

Application Deadline: July 1st, 2016



We are pleased to announce that this year we will again be able to host a few Mini-Workshops at the 2016 AGU Fall Meeting (December 12-16). A Mini-Workshop is a research meeting that is held during an evening of the Fall Meeting or on the Sunday leading up to the meeting. Examples of Mini-Workshops held in association with recent and upcoming national and international meetings can be found at: *http://geoprisms.org/meetings/mini-workshops/*

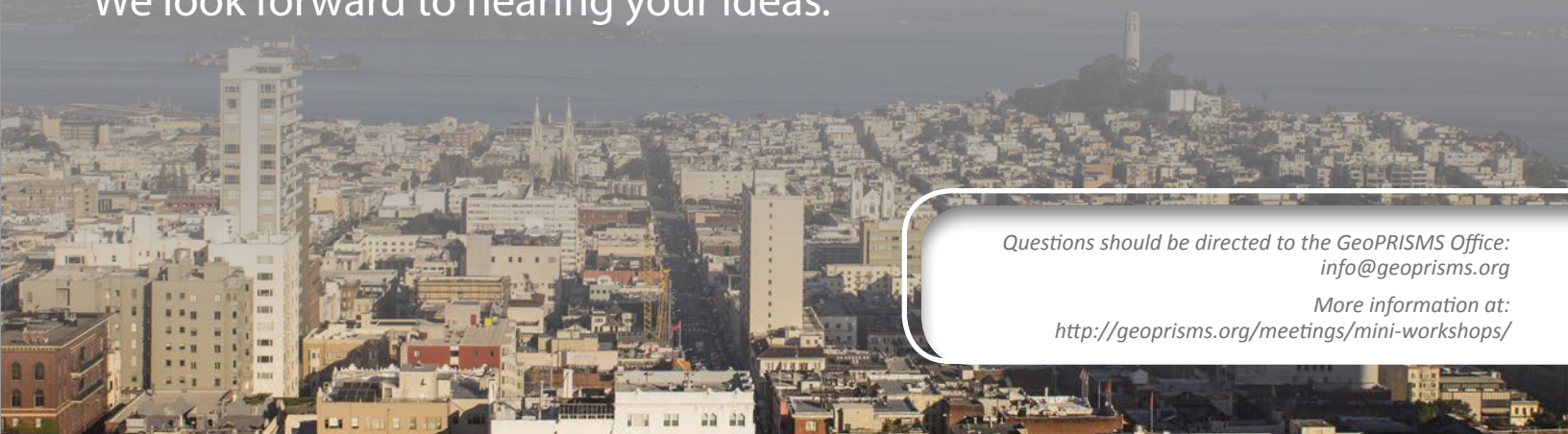
Mini-Workshops offer excellent opportunities to jump-start science discussions, as well as to coordinate implementation for future GeoPRISMS studies, both for primary sites and thematic studies. We encourage you to consider such an undertaking. The GeoPRISMS Office provides logistical support, a meeting room, and refreshments. We do not cover any travel costs or per diem to the organizers or participants. GeoPRISMS Mini-Workshops will be open to all interested parties and will be advertised via the GeoPRISMS mailing list, newsletter, and website.

If you would like to host a GeoPRISMS-related Mini-Workshop in association with the 2016 AGU Fall Meeting, we invite you to submit your proposal to the GeoPRISMS Office at info@geoprisms.org. The proposals will be reviewed and ranked by the GeoPRISMS Steering and Oversight Committee (GSOC). The number of Mini-Workshops is limited but we expect to be able to host two to three events.

The deadline for upcoming Mini-Workshop proposals is July 1, 2016. The proposal guidelines are described on the GeoPRISMS website at: *http://geoprisms.org/meetings/mini-workshops/*

We encourage you to contact the GeoPRISMS Office with questions or advice prior to submitting.

We look forward to hearing your ideas.



Questions should be directed to the GeoPRISMS Office: info@geoprisms.org

More information at: http://geoprisms.org/meetings/mini-workshops/

GeoPRISMS Student Prize for Outstanding Presentations

2015 AGU Fall Meeting, San Francisco

Congratulations to the winners of the GeoPRISMS 2015 AGU Student Prize! As in previous years, the judges were greatly impressed by the quality of the entrants this year and awarding individual prizes to just a few in such an outstanding field was very difficult. Here we honor two prize winners and four honorable mentions. Thank you to all the entrants and judges for making this contest possible and worthwhile.

Poster Presentation Winner

Zach Eilon - Columbia University

Seismic attenuation of teleseismic body waves in Cascadia, measured on the Amphibious Array

Coauthors: Geoff Abers

From the Judges: "Zach was very enthusiastic and knowledgeable" "I was impressed by the quality of figures, organization of the information and general presentation" "Very clear presentation"

From the Student: "I am very honored to have had my work selected from among all the fantastic research conducted within the GeoPRISMS community. I am thrilled that GeoPRISMS is so active in supporting and elevating the contributions of junior scientists and I am grateful to the community leaders who facilitate the program. I look forward to continuing fruitful research on the interesting margins of plates!"

Oral Presentation Winner

Allison Rubin - UC Davis

Constraining timescales of pre-eruptive events within large silicic volcanic centers

Coauthors: Kari Cooper, Adam Kent, Christy Till, Fidel Costa Rodriguez

From the Judges: "Excellent talk" "Clear, confident and professional presentation" "The speaker exhibited strong presence and maturity"

From the Student: "I am honored to have my work recognized by the GeoPRISMS community, and grateful for their efforts to support student research."

GeoPRISMS is offering two $500 prizes for Outstanding Student Presentations on GeoPRISMS- or MARGINS-related science at the AGU Fall Meeting in San Francisco. The two prizes, one each for a poster and an oral presentation, highlight the important role of student research in accomplishing MARGINS- and GeoPRISMS-related science goals, and to encourage cross-disciplinary input. The contest is open to any student whose research is related to the objectives of GeoPRISMS or MARGINS.

Presentations are judged throughout the AGU meeting. Students have also the opportunity to display their posters (or poster versions of their AGU talks) at the GeoPRISMS Townhall and Student Forum, organized each year on Monday night at the Park Central Hotel. This is a great opportunity for students to share their results further, to interact with a wide spectrum of GeoPRISMS scientists, and to hear about upcoming events and opportunities. More information on this year's contest will become available closer to AGU on the GeoPRISMS website, so stay tuned!

Honorable Mention

Joel Edwards – UC Santa Cruz

Record of subducting topography revealed in 3D seismic imaging of Pleistocene unconformities, offshore Southern Costa Rica

Coauthors: Jared Kluenser, Eli Silver

From the Judges: "Fantastic talk" "His interpretation of the 3D MCS data was very exciting" "The research presented was thorough, sophisticated and presented in a logical manner"

From the Student: "I am certainly surprised by this award and really appreciate it. More importantly, I appreciate GeoPRISMS and the newfound community. There is loads of great science ongoing, and I look forward to joining in on the fun."

Honorable Mention

Helen Janiszewski – Columbia University

Surface-wave imaging of the Juan de Fuca Plate and Cascadia Subduction Zone

Coauthors: Jim Gaherty, Geoff Abers

From the Judges: "Very nice talk!" "Slides were extremely comprehensible and logically ordered" "Presentation was clear, organized, and well illustrated"

From the Student: "I am deeply honored to have my work recognized, and I am grateful for the student opportunities that GeoPRISMS provides. I look forward to continuing research within this community in the future."

Honorable Mention

Dylan Meyer – The University of Texas at Austin

Methane hydrate formation in a saturated, coarse-grained sample through the induction of a propagating gas front

Coauthors: Kehua You, Taylor Borgfeldt, Peter Flemings, David DiCarlo, Timothy Kneafsey

From the Judges: "Dylan did a fantastic job presenting his poster" "Clearly explained the motivation, background, experiment design, results, and the importance of the study" "I learnt a lot about methane hydrates and how they form!"

From the Student: "It is a honor and privilege to have GeoPRISMS recognize the research I presented at the AGU 2015 Fall Meeting! I appreciated the opportunity to convey my research to this community and I continue to hold GeoPRISMS and the work it performs in high esteem."

Honorable Mention

Maureen Walton – The University of Texas at Austin

Revisiting the 1899 earthquakes of Yakutat Bay, Alaska using new and existing geophysical data

Coauthors: Sean Gulick, Peter Haeussler

From the Judges: "Maureen did an excellent job communicating the context and significance of the work" "Excellent poster" "Clearly enthusiastic about the work"

From the Student: "I am very grateful to be recognized among such a talented group of young, involved scientists. Thanks to the GeoPRISMS community for supporting my work and student research in general. I look forward to ongoing involvement with GeoPRISMS science."

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In the Fall 2016, the GeoPRISMS Office will move to Penn State

The past, present, and future of GeoPRISMS reunited for a photo in sunny Redondo Beach, CA, during the GeoPRISMS Theoretical & Experimental Institute for the SCD Initiative in October 2015: Juli Morgan (Rice University, left), Peter van Keken (Carnegie Institution for Science, right) and Demian Saffer (Penn State, middle).

Photo by A. Nicol

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US and international participants at the GeoPRISMS Planning Workshop for the East African Rift System Primary Site, held in Morristown, NJ, in October 2012.

In February 2017, The GeoPRISMS Office will organize a Theoretical and Experimental Institute (TEI) which will focus on intermediate synthesis of RIE projects.

More to come on the GeoPRISMS website so stay tuned!