USGS Western Region Colloquium

science for a changing world

The Annual USGS Postdoctoral/ New Researcher Colloquium

1:00-1:15 Updates - Office of Science Quality and Integrity and Mendenhall Program (Dr. Rama Kotra, Program Manager)

1:15-2:45 Colloquium: Brief presentations by postdocs and new scientists

3:00-4:00 Panel Discussion: On being a new USGS scientist and on being a mentor

4:00-5:30 Poster Session

Steven Blazewicz, Menlo Park
Olivia Cheriton, Santa Cruz
Katie Coble, Menlo Park
Emma Gatti, Menlo Park
Ole Kaven, Menlo Park
Andrew Lamb, Menlo Park
Greg McLaskey, Menlo Park
Sarah Minson, Seattle
Emily Montgomery-Brown, Menlo Park
Andrea O'Neill, Santa Cruz
Tasha Stoiber, Menlo Park
Jared Peacock, Menlo Park
Zhuoting Wu, Flagstaff
Lydia Zeglin, Anchorage

Thursday, September 12
Building 3 Auditorium, USGS, Menlo Park, CA

Refreshments available

For remote viewing, go to: http://wwwrcamnl.wr.usgs.gov/wrc/

For further information, please call Darcy McPhee, USGS at 650-329-4173

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Life near the freezing point: Microbial community dynamics and controls of greenhouse gas production in recently thawed permafrost soil

Steven J. Blazewicz[1], Janet Janssen[2], Kimberly Wickland[3], Burt Thomas[1], Mark P. Waldrop[1], [1]US Geological Survey, Menlo Park, CA [2]Lawrence Berkeley National Laboratory, Berkeley, CA [3]US Geological Survey, Boulder, CO

Permafrost underlies approximately 24% of the Northern Hemisphere's terrestrial surface and is estimated to contain around 1,700 tonnes of organic carbon, which is four times more carbon than all the carbon emitted by human activity in modern times and twice the size of the total carbon contained within the atmosphere. In response to climate change, permafrost is rapidly warming, and this is predicted to result in widespread thawing which will make the soil carbon much more vulnerable to microbial decomposition and transformation into greenhouse gasses such as CO_2 and CH_4. When permafrost thaws, soils that are rich in ice often transform into thermokarst, a landscape of irregular depressions. Areas in thermokarst zones that are poorly drained often lead to water saturation and anaerobic conditions, and such wetlands can develop into significant sources of atmospheric CH_4. Most soil carbon cycling studies in permafrost regions concentrate on the short summer months when average air temperatures remain above the freezing point, while most months of the year experience cold temperatures and are generally considered inactive periods. However, there is mounting evidence that a sizeable portion of annual CH_4 efflux from boreal wetlands occurs during a rapid burst of CH_4 emissions associated with seasonal thaw. Very little is known about microbial activities during winter and early spring in boreal thermokarst bogs. My Mendenhall Fellowship project is designed to investigate microbial community dynamics and carbon mineralization activities over winter and during spring thaw in an Alaskan thermokarst bog. I will apply heavy water DNA-stable isotope probing with taxonomic and metagenomic analyses in tandem with microbial process and physicochemical measurements to address the following objectives: 1) Investigate the effect of freeze/thaw on microbial growth, death, and C mineralization in anaerobic thermokarst wetland soil, 2) Characterize the potential for winter microbial growth and activity in 'frozen' soil. 3) Quantify overwinter microbial activity in deep unfrozen soil called taliks. 4) Estimate the relative contribution of the preceding three mechanisms to CO_2 and CH_4 emissions associated with seasonal thaw. Results from this work will improve our ability to measure microbial processes occurring in harsh frozen environments including taliks and ice itself, and improve our predictions for CH_4 emissions from northern latitude soils undergoing thaw.

Suspended particulate layers and internal waves over the southern Monterey Bay shelf: An important control on shelf mud belts?

Olivia M. Cheriton (USGS), Erika E. McPhee-Shaw (MLML), William J. Shaw (NPS), Timothy P. Stanton (NPS), James G. Bellingham (MBARI), Curt D. Storlazzi (USGS)

A 5-week-long deployment of an automated profiling mooring and fixed instrumentation at 70-m depth the shelf of southern Monterey Bay, California, documented the frequent occurrence of suspended particulate matter (SPM) detached from the seafloor, centered 9 to 33 meters above the bed. Individual SPM events were uncorrelated with bed shear stress caused by surface waves and bottom currents. Nearly half of all observed SPM layers occurred during one week of the study, 9-16 October 2011, and were advected past the fixed profiling mooring by the onshore phase of semidiurnal internal tide bottom currents. At the start of the 9-16 October period we observed intense near-bed vertical velocities capable of lifting particulates into the middle of the water column. This “updraft” event appears to have been associated with nonlinear adjustment of high-amplitude internal tides over the mid and outer shelf. These findings suggest that nonlinear internal tidal motions can erode material over the outer shelf and that, once suspended this SPM can then be transported shoreward to the middle and shallow sections of the mud belt. This represents a fundamental broadening of our understanding of how shelf mud belts may be built up and sustained.

Quaternary Stratigraphy in the Sacramento-San Joaquin Delta, California

Katherine L. Maier — Mendenhall Postdoctoral Fellow, USGS Earthquake Science Center, Menlo Park, CA

The ~1400 km^2 Sacramento-San Joaquin Delta is a critical link in California's water infrastructure and the State's ecologic system. It also is an important agricultural and recreational resource. Approximately two-thirds of California's population depends all or in part on freshwater transported through the Delta. Despite its importance, the extensive levee system that protects the Delta islands is vulnerable to earthquake-induced failures, which would result in extensive flooding. To assess hazards in the Delta, an improved understanding of the Quaternary stratigraphic framework is necessary, but these deposits are difficult to sample, date, and correlate. We use available existing data, including extensive geotechnical borehole data, cores, and other samples recently drilled by the California Department of Water Resources (up to ~200 ft subsurface depth). Cores provide an opportunity to observe fine-scale details in Quaternary Delta deposits, identify chronostratigraphic surfaces, and interpret geologic context from the geotechnical data. In addition, analyses of core samples for volcanic ash, diatoms, clay mineralogy, paleomagnetics, and organic material aid chronostratigraphic correlations and paleoenvironmental interpretations.

Quaternary subsurface deposits in the Delta are primarily sand and clay, with lesser silt and gravel. Clay units with abundant carbonate can contain paleosols, which formed on exposed fluvial floodplains and may represent laterally extensive chronostratigraphic surfaces. Well- to poorly-graded sand and gravel units commonly exhibit subdivisions in fining upward packages that represent river channel deposits with potentially limited lateral extent. In fluvial successions, isolated occurrences of silt units with diatoms record oxbow lake environments. Organic-rich deposits buried ~100-200 ft below the modern surface in the central Delta include gravelly sands with transported wood clasts and laminated clays with diatoms indicative of standing freshwater environments. Ash layers have been identified in 27 boreholes in the northern to central Delta, where they occur as three facies: 1) thick, massive to current-structured ash in fluvial deposits; 2) thick, current-structured sand- to pebble-size pumice in fluvial deposits; and 3) thin or mixed ash in overbank deposits. Using Electron Microprobe analysis, we have correlated several of these ashes to an unnamed Summer/Tule lakes ash (~0.190 Ma), the Loleta ash (0.390 Ma), the Rockland tephra (~0.575 Ma), and an older unnamed ash (>0.78-<1.45 Ma). Major and minor element compositions of glass shards from each sample suggest that the ashes were derived from Cascade Range volcanic sources. Rockland and Loleta ash in the Delta add new examples to these widespread tephra and their distributions. Tephra age markers indicate that subsurface Quaternary Delta deposits thicken from the northern to central Delta and thin to the east. Geologic interpretations of geotechnical data provide chronostratigraphic surfaces that will help to characterize Quaternary faulting, and extend sediment material properties needed assess hazards to water infrastructure from earthquake shaking and liquefaction.

A New Geologic Model for Assessing Liquefaction and Related Levee Failure in the Sacramento- San Joaquin Delta

Emma Gatti — USGS Earthquake Science Center, Menlo Park, CA

The Sacramento-San Joaquin Delta is particularly vulnerable to levee failure. A recent investigation commissioned by the California Department of Water Resources highlighted how catastrophic multiple levee failures during an earthquake could have major effects not only on life, property and the ecosystem in the Delta area, but also on freshwater supplies throughout California. In 2007 a Delta Risk Management Strategy report found that a better understanding of the Delta Quaternary geology is necessary for an accurate risk assessment of earthquake-induced levee failure. The aim of my project is to accurately classify those zones of the Delta at major risk of earthquake-induced flood and levee collapse as a result of seismically-induced liquefaction and ground failure of natural deposits beneath the levees.

Our approach consists of three integrated objectives:

1. Assemble a consistent surficial geologic map;
2. Build a 3D subsurface model and assess spatial distribution of liquefaction potential;
3. Link forms and processes to evaluate the risk of earthquake-induced levee failure.

We have now completed Objective 1, developing a unified geological map of the Delta region. The map is based on a set of geological, engineering and ecological previous studies. We merged the Sacramento, Lodi and Stockton 1:100,000 km scale quadrangles (California Geological Survey, 2005), the Non-Urban Levee Evaluations Study at 1: 24,000 km scale (Department of Water Resources, URS and Fugro Inc., 2010), the 1:24,000 km original geological map of the Sacramento-San Joaquin Delta by Atwater (1982), and the Sacramento-San Joaquin Delta Historical Ecology Investigation (San Francisco Estuary Institute, 2012). The resulting map includes detailed mapping of natural and artificial levees and an updated study of the geologic units in the Delta.

Liquefaction-prone deposits are typically shallow sandy bodies. In order to accomplish Objective 2, we are focusing on mapping Holocene, shallow sand units beneath the surface. We selected 600 cone penetrometer tests (CPT)logs from a database of more than 1,000 boreholes and soundings. We are currently translating the 2-D mapping produced in Objective 1 into 3-D stratigraphic units packages, combining the geological map with CPT data, stratigraphic information from boreholes, and 3-D modeling. The goal is to a) either refine or confirm the surficial geological units identified in previous investigations and b) identify liquefaction-prone units (young and/or shallow sand bodies).

They final goal (Objective 3) is to produce an hazard map (also to be published online) that highlights areas and levees that face higher probability of failure from seismically induced ground deformation. This geological approach will improve risk-assessment in the Delta area by providing a rigorous basis for decision making to establish both a more reliable water supply for California and a robust ecosystem in the Delta.

Micro-seismicity within the Coso geothermal field, California from 1996-2012

J. Ole Kaven[1], Nicholas C. Davatzes[2], Stephen H. Hickman[1], [1]USGS Earthquake Science Center, Menlo Park, CA; [2]Temple University, Philadelphia, PA

We extend our previous catalog of seismicity within the Coso Geothermal field by adding over two and a half years of additional data to prior results. In total, we locate over 16 years of seismicity spanning from April 1996 to May of 2012 using a refined velocity model, apply it to all events and utilize differential travel times in relocations to improve the accuracy of event locations. The improved locations elucidate major structural features within the reservoir that we interpret to be faults that contribute to heat and fluid flow within the reservoir. Much of the relocated seismicity remains diffuse between these major structural features, suggesting that a large volume of accessible and distributed fracture porosity is maintained within the geothermal reservoir through ongoing brittle failure. We further track changes in b value and seismic moment release within the reservoir as a whole through time. We find that b values decrease significantly during 2009 and 2010, coincident with the occurrence of a greater number of moderate magnitude earthquakes ($3.0 \leq ML < 4.5$). Analysis of spatial variations in seismic moment release between years reveals that localized seismicity tends to spread from regions of high moment release into regions with previously low moment release, akin to aftershock sequences. These results indicate that the Coso reservoir is comprised of a network of fractures at a variety of spatial scales that evolves dynamically over time, with progressive changes in characteristics of microseismicity and inferred fractures and faults that are only evident from a long period of seismic monitoring analyzed using self-consistent methods.

The western limits of the Seattle Fault Zone and its interaction with the Olympic Peninsula, Washington

A. P. Lamb[1], L.M. Liberty[2], R. J. Blakely[1], T. L. Pratt[3], B. L. Sherrod[3], and K. van Wijk[4], [1]U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025, [2]Dept. of Geosciences, Boise State University, 1910 University Drive, Boise, ID 83725-1536, [3]U.S. Geological Survey, School of Oceanography, Box 357940, University of Washington, Seattle, WA 98195, [4]University of Auckland, Auckland, New Zealand

We present evidence that the Seattle Fault Zone of Washington State extends to the west edge of the Puget Lowland and is kinematically linked to active faults that border the Olympic Massif, including the Saddle Mountain deformation zone. Newly acquired high-resolution seismic reflection and marine magnetic data suggest that the Seattle Fault Zone extends west beyond the Seattle basin to form a >100-km-long active fault zone. We provide evidence for a strain transfer zone, expressed as a broad set of faults and folds connecting the Seattle and Saddle Mountain deformation zones near Hood Canal. This connection provides an explanation for the apparent synchroneity of M7 earthquakes on the two fault systems approximately 1,100 years ago., We redefine the boundary of the Tacoma basin to include the previously termed Dewatto basin and show that the Tacoma Fault, the southern part of which is a backthrust of the Seattle Fault Zone, links with a previously unidentified fault along the western margin of the Seattle Uplift. We model this north-south fault, termed the Dewatto Fault, along the western margin of the Seattle Uplift as a low-angle thrust that initiated with exhumation of the Olympic Massif and today accommodates north-directed motion. The Tacoma and Dewatto faults likely control both the southern and western boundary of the Seattle Uplift. The inferred strain transfer zone linking the Seattle Fault Zone and Saddle Mountain deformation zone defines the northern margin of the Tacoma basin, and the Saddle Mountain deformation zone forms the northwestern boundary of the Tacoma basin. Our observations and model suggest that the western portions of the Seattle Fault Zone and Tacoma Fault are complex, require temporal variations in principal strain directions, and cannot be modeled as a simple thrust/backthrust system.

M -6 laboratory earthquakes driven by aseismic slip

Gregory C. McLaskey – Mendenhall Postdoctoral Fellow, USGS Earthquake Science Center, Menlo Park CA

Why do faults sometimes slip slowly and aseismically and sometimes slip rapidly and generate damaging earthquakes? To help answer this question, I study earthquakes in a laboratory by squeezing rocks together so that they spontaneously slip along a saw-cut fault in stick-slip fashion. I use the laboratory equivalent of both geodesy and seismology to study when and why a laboratory fault will slip and what types of seismic waves are generated when it does.

Here, I report observations of the interaction between slow, predominantly aseismic slip and very small earthquakes in a suite of laboratory experiments conducted on a 1.5 m granite block. The rupture areas of these **M** -6 laboratory-generated earthquakes are typically less than 0.1% of the total fault area and are completely contained within the interior of the 2.0 by 0.4 m laboratory fault. The ground motions produced by these extremely small seismic events are recorded with an array of piezoelectric sensors which have been calibrated against the radiated waves from ball impact. Their seismic source spectra are consistent with common earthquake scaling laws derived from observations of larger natural earthquakes. However, these small events differ significantly from typical earthquakes in that they never occur on their own as a slipping patch surrounded by locked fault. Instead, they only occur in response to larger-scale aseismic slip of the surrounding fault, at aseismic slip rates greater than ~50 microns/s. We detect this aseismic slip on the surface trace of the fault with an array of slip sensors, and we infer aseismic slip within the sample from local stress changes detected with an array of strain gages and lower frequency ground deformation detected with the piezoelectric sensors. We find that the spatial dimensions of the **M** -6 earthquakes (~ 10 mm) are much smaller than our estimates of h*, the minimum length scale for instability that we would expect based on the laboratory conditions (5 MPa normal stress, and 10s of microns surface roughness). Our results indicate that locally strong fault patches can slip unstably and radiate seismic waves even if they are significantly smaller than h* as long as they are rapidly stressed by aseismic slip of neighboring fault sections. In most of the seismogenic crust we would expect that h* is small compared to the rupture area of earthquakes. Since seismic coupling is low on the laboratory fault and h* is large relative to the rupture areas of potential earthquakes, the interactions between aseismic and seismic slip observed in the laboratory may be similar to processes occurring on plate interfaces with low seismic coupling and relatively large h* such as creeping fault sections that predominantly produce small repeating earthquakes or the deep extent of fault zones where relative fault motion occurs as slow slip accompanied by tremor and low frequency earthquakes.

Real-time inversion for finite fault slip models and rupture geometry based on high-rate GPS data

Sarah E. Minson, Jessica R. Murray, John O. Langbein, and Joan S. Gomberg, *USGS Earthquake Science Center*

We present a semi-analytical Bayesian inversion methodology for determining both the spatial distribution of slip and the orientation of the fault plane in real-time based on high-rate GPS data. There are three main advantages to this source modeling methodology. The first is that, by using a Bayesian approach, we can obtain a stable solution for what is generally a poorly-constrained inverse problem, and we can do this without the use of non-physical smoothing constraints. Second, because our methodology is semi-analytical, and thus computationally inexpensive, we can estimate the slip model and fault geometry, along with the uncertainties associated with our estimate, in real-time as the earthquake rupture evolves, making this inversion approach particularly useful for earthquake early warning. Third, since we solve for the full finite fault slip model and fault plane orientation, the inversion results could potentially be used to produce better shaking forecasts and tsunami hazard assessments and for other earthquake rapid response needs. We will present our inversion methodology and the results of a series of performance tests using data from both scenario events and real earthquakes including the 2011 great Tohoku-oki earthquake. In these tests, we are able to recover both the fault plane orientation and a coarse distributed slip model for each event. We are also able to determine the total moment released by the earthquake rupture as it evolves. Because our semi-analytical inversion methodology is very computationally efficient, the latency associated with estimating the source model is controlled by the duration of the rupture and the time needed for information to propagate to the receivers and not by the computational cost of the source modeling.

Preliminary results relating seismic swarms and deformation in Long Valley Caldera, California

E. Montgomery-Brown, W. Ellsworth, D. Hill, D. Shelly, J. Langbein, M. Lisowski, and A. Llenos, USGS Menlo Park, CA

Earthquake swarm activity in the South Moat Seismic Zone (SMSZ) in Long Valley caldera began increasing following the onset of slow inflation of the resurgent dome in 2011. From 1980 through 1999 the caldera produced recurring earthquake swarms in the SMSZ accompanied by an 80-cm uplift of the resurgent dome. Since 2000, the caldera has been quieter than from 1980 to 1999, but it experienced a gradual 7-cm uplift episode in 2002-2003 and currently the caldera has been gradually uplifting since 2011 at less than half of the peak uplift velocity observed in the late 1990's. Two of the recent swarms in October/November of 2012 and March 2013 have been accompanied by small deformation transients during which caldera uplift paused for about a week despite otherwise steady inflation.

To better understand this recent activity, we cross correlate seismic velocity waveforms from individual events recorded by the Long Valley seismic network to identify similar clusters (families) of earthquakes and analyze their temporal recurrence. Then, we use representative waveforms from each family as templates to search the continuous waveforms from the deep borehole seismometers in the Long Valley Exploratory Well (MDH1) for repeating, yet smaller, earthquakes. MDH1 consists of two three-component instruments, located 2592 m and 2263 m below ground level, that provide 6 channels with very low background noise relative to surface seismometers. The cross correlations identify about 25 times more earthquakes with most magnitudes ranging from -1 to +0.5, determined from an empirical relationship between catalog magnitude and observed amplitude on MDH1. We apply an ETAS model to the augmented catalog to detect subtle changes in background earthquake rates that might suggest a change in stressing rate.

For comparison with the change in seismicity rates, a geodetically determined stress change is estimated from a simple model of the continuous GPS data. We model the uplift from 2011 to present with a prolate spheroid and test the influence of including layered structure and topography on the location and magnitude of the source model. Our results are consistent with previous models and suggest an inflationary source at ~6 km below the resurgent dome with a volume change of about 4 mcm for 2011 – present, which is similar to the 2002-2003, but significantly smaller than the volume change of about 30-90 mcm during 1997-1998.

Regional downscaling of temporal resolution in near-surface wind from statistically downscaled Global Climate Models (GCMs) for use in San Francisco Bay coastal flood modeling

Andrea O'Neill, USGS, Santa Cruz, CA

While Global Climate Models (GCMs) provide useful projections of near-surface wind vectors into the 21st century, resolution is not sufficient enough for use in regional wave modeling. Statistically downscaled GCM projections from Multivariate Adaptive Constructed Analogues (MACA) provide daily near-surface winds at an appropriate spatial resolution for wave modeling within San Francisco Bay, but greater resolution in time is still needed.

Using 30 years (1975-2004) of climatological data from four representative stations around San Francisco Bay, a library of example daily wind conditions for four corresponding over-water sub-regions is constructed. Empirical cumulative distribution functions (ECDFs) of station conditions are compared to MACA GFDL hindcasts to create correction factors, which are then applied to 21st century MACA wind projections. For each day, a best match example is identified via least squares error among all stations in the library. The best match's daily variation in velocity components (u/v) is used as an analogue of representative wind variation and is applied about the corresponding sub-region's projected u/v values.

High temporal resolution reconstructions using this methodology on hindcast MACA data from 1975-2004 recreate important extreme wind values within the San Francisco Bay, and because these extremes in wind forcing are of key importance in wave and subsequent coastal flood modeling, this represents a valuable method of generating near-surface wind vectors for use in coastal flood modeling.

The Effect of Water Hardness on Uptake of Nano-sized and Dissolved Silver in a Freshwater Snail

Tasha Stoiber, USGS Menlo Park, CA

We investigated the bioavailability of silver (Ag) from $AgNO_3$ and Ag nanoparticles (AgNPs) coated with polyvinylpyrrolidone (PVP-AgNP) and thiolated polyethylene glycol (PEG-SH AgNP) using the freshwater snail, *Lymnaea stagnalis*. Specifically, after waterborne exposures in short-term experiments, rates of Ag uptake were measured. Snails were exposed to a range of Ag concentrations at water hardness that varied up to 100-fold. Water chemistry did not strongly influence the uptake of Ag from $AgNO_3$. There was no significant difference between the rate constants of uptake (k_{uw}= 3.0 ± 0.33 ranging to 3.0 ±1.1 $1g^{-1}d^{-1}$) measured from experiments conducted in soft, moderately hard, and hard water. The average dry weight of the snails did have a significant impact on Ag uptake, with faster rates measured in smaller snails. Water hardness did affect the uptake of Ag from AgNPs. The k_{uw} for PVP-NPs ranged from 1.3 ± 0.01 to 2.2 ± 0.02 l g^{-1} d^{-1} for experiments conducted in very hard water (VHW) and deionized water (DI), respectively. The k_{uw}s for PEG-NPs ranged from 0.2± 0.01 to 3.1 ± 0.72 l g^{-1} d^{-1} for experiments conducted in VHW and DI water, respectively. Water chemistry affected the dissolution of the nano-sized Ag, which likely affected uptake rates of Ag. The PEG-AgNPs generally seemed to be more stable than the PVP-AgNPs. The uptake of Ag in biological tissues from AgNP's was unique compared to that of $AgNO_3$. When compared as a function of free Ag^+, uptake of Ag from AgNPs was faster than that of $AgNO_3$, suggesting that uptake of Ag from the AgNPs may not be solely attributed to dissolution.

Three Dimensional Resistivity Model of Long Valley/Mono Craters, California from Magnetotellurics

Peacock, J.R., McPhee, D.K., Ponce, D.A., Mangan, M.T., MacPherson-Krutsky, C.C., and Matson, G., USGS Menlo Park, CA 94025

Mono Craters, east of the Sierra Nevada Mountains, is an area of great interest not only because of recent (350 years) volcanic activity, but also as a region of geothermal potential. Not surprisingly, most of the geophysical data collected in the region has been focused on Long Valley Caldera and Mammoth Mountain due to recent seismic activity in the south moat of the Long Valley Caldera, uplift of a central resurgent dome in the Caldera, and enhanced CO2 emissions near Mammoth Mountain. Consequently, there is a void of geophysical information on the Mono-Inyo Craters, a chemically distinct volcanic chain north of Long Valley. The Mono-Inyo chain is nominally two parts but volcanically similar; the Inyo Craters form a north trending linear chain and the Mono craters form an arcuate chain concave towards the west, bounding the east side of Mono Basin. The realization is that little data has been collected to image the subsurface with the intention of constraining the geometry of the magmatic system that has kept the Long Valley/Mono Craters area active for the last 750ka. The goal of this Mendenhall project is to image magmatic bodies and hydrothermal systems in the area from Long Valley north to Mono Lake. Magnetotellurics (MT) is the geophysical tool of choice here due to its sensitivity to electrical conductivity and depth of investigation. Briefly, MT passively measures the Earth's electrical response to time varying magnetic fields generated from the interaction of solar wind and the Earth's magnetosphere. Interestingly, the ratio of the electrical response and the generating magnetic field is linearly related to the resistivity of the subsurface, which can vary by orders of magnitude. Conductive bodies can be iron rich lithology, water rich lithology or potassium rich silicious magmas, like those in the Long Valley/Mono Craters area. To image the subsurface, around 100 stations will be collected covering an area of 50 km^2, with the end result being a 3D resistivity model that delineates the magmatic system down to a depth of 50 km. Moreover, from the resistivity model, material properties such as temperature and composition can be estimated.

Data-model fusion for accurate forest biomass mapping

Zhuoting Wu[1], Dennis, Dye[1], Barry, Middleton[1], John, Vogel[1] ; [1]USGS Western Geographic Science Center, Flagstaff, Arizona

The semi-arid and arid southwestern US is projected to experience more frequent and severe droughts, rendering its vast carbon stocks at risk, with substantial implications for feedbacks to ongoing climate change. Accurate mapping of forest biomass is crucial for assessment of regional carbon budget, climate change modeling, and land management decision-making. Yet, high uncertainty exists in forest biomass mapping, due to limitation of traditional field sampling and optical remote-sensing techniques. Here, we are aiming to develop, test, and apply an improved capability to estimate and map forest biomass at a spatial resolution of 30 meters using Landsat, Digital Globe imagery, and airborne LiDAR, and access the mapping uncertainty in a 3-D radiative transfer model.

Soil microbial structure and function post-volcanic eruption on Kasatochi Island, and regional controls on microbial heterogeneity

Lydia H. Zeglin, Fred Rainey, Bronwen Wang, Chris Waythomas, Sandra L. Talbot

Microorganisms are abundant and diverse in soil and their integrated activity drives nutrient cycling on the ecosystem scale. Organic matter (OM) inputs from plant production support microbial heterotrophic life, and soil geochemistry constrains microbial activity and diversity. As vegetation and soil develops over time, these factors change, modifying the controls on microbial heterogeneity. Following a volcanic eruption, ash deposition creates new surfaces where both organismal growth and weathering processes are effectively reset. The trajectory of microbial community development following this disturbance depends on both organic matter accumulation and geochemical constraints. Also, dispersal of microbial cells to the sterile ash surface may determine microbial community succession.

The Aleutian Islands (Alaska, USA) are a dynamic volcanic region, with active and dormant volcanoes distributed across the volcanic arc. One of these volcanoes, Kasatochi, erupted violently in August 2008, burying a small lush island in pryoclastic flows and fine ash. Since, plants and birds are beginning to reestablish on developing surfaces, including legacy soils exposed by rapid erosion of pyroclastic deposits, suggesting that recovery of microbial life is also proceeding. However, soil microbial diversity and function has not been examined on Kasatochi Island or across the greater Aleutian region. The project goal is to address these questions: How is soil microbial community structure and function developing following the Kasatochi eruption? What is the relative importance of dispersal, soil OM and geochemistry to microbial community heterogeneity across the Aleutians?

Surface mineral soil (20-cm depth) samples were collected from Kasatochi Island in summer 2013, five years after the 2008 eruption, and from eight additional Aleutian islands. On Kasatochi, pryoclastic deposits, exposed legacy soils supporting regrowth of remnant dune wild-rye (*Leymus mollis*) and mesic meadow plant communities, and soils impacted by recovering seabird rookeries were sampled. On the other islands, soils supporting both *Leymus* and mesic meadow communities (representative of dominant vegetation types on Kasatochi pre-eruption) were sampled. For each soil category and island combination, three transects of soil cores at 10-cm, 50-cm, 1-m, 5-m and 10-m distance were collected; with distances between sites and islands included (up to >700 km), the range of geographic distance examined covers over 7 orders of magnitude. For all samples, data on fundamental geochemical and OM factors, bacterial and fungal biomass, activity and diversity (via QPCR, extracellular enzyme potential assays and T-RFLP) are being collected. Covariance analysis will be used to evaluate the scale of maximum spatial heterogeneity in microbial structure and function, and ordination and matrix correlation analyses will be used to identify the key environmental covariates with heterogeneity. We hypothesize that heterogeneity at small (cm) scales will reflect predominant geochemical controls, at medium (m) scales will reflect predominant OM (vegetation) controls and at large (km) scales will reflect dispersal-related controls on microbial community structure and function.

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