The Rocky Mountain Section Newsletter

March 2013

Association of Environmental and Engineering Geologists

MEETING DATE

FRIDAY
March 22, 2013

TIME
5:30 - 9:00 p.m.

LOCATION
Colorado School of Mines
Room 243
Berthoud Hall
1516 Illinois St..
Golden, CO 80401
See map below

COST
$25 Members
$30 Non-members
$15 Gov't/education
$10 Retired members
No charge for students on Student Night

RESERVATIONS
click: aegrms.org/rsvp
or email:
meetings@aegrms.org

RSVP DEADLINE
NOON, TUESDAY
March 19, 2013

AEG-RMS Student Night

Friday, March 22, 2013

5:30 - 9:00 pm
Berthoud Hall, Room 243
Colorado School of Mines
1516 Illinois St., Golden CO 80401

Students will present their work in a poster session format with five-minute oral presentations.

The Grand Prize will be a Brunton GEO Transit!

There will be a
silent auction to benefit the CSM Student Chapter
Please email CSM Student Chair Carlos Hernandez
(student-chair @ aegrms.org)
to arrange a donation of item(s) to the silent auction, and please come to Student Night prepared to bid on lots of fun and interesting items!

Student Night sponsors needed!

The sponsor form is attached, or click here

The CSM Student Chapter is assembling a resume booklet containing resumes from many of our undergraduate and graduate students to help with networking. If you or your company is interested in receiving a copy, please contact Carlos Hernandez at 818-903-7220 or chernand @ mines.edu.

Words from the Chair

Greetings Rocky Mountain Section,

I would like to thank AEG President Matt Morris and the Executive Council for visiting us last month! We always look forward to having the AEG leaders join our meetings. The Executive Council will again be gathering in Denver in May for the mid-year Board of Directors meeting taking place immediately after the Shlemon Specialty Conference on Dam Foundations Failures and Incidents.

During our February meeting, our section traditionally raises money for the AEG Foundation. This year our section members donated close to $1500, with a $500 match by Bill Smith! Thank you all for your continued support of AEG and our profession.

Our Annual Student Night is an exciting and anticipated event for our section, and I am happy to see another great turnout in the number of student presenters from the Colorado School of Mines and South Dakota School of Mines and Technology this year! This is a night for students - even the beer (pale ale and chocolate stout) is being specially brewed by CSM graduate students, Casey Dowling and Kevin McCoy. Professor Kurt Katzenstein is again traveling down from South Dakota with a group of students and the AEG CSM Student Chair, Carlos Hernandez, is working diligently to organize the silent auction and compile a handbook of student resumes. There will be many bright students in attendance who are ready to gain work experience and start their careers, either as part-time or full-time employees or to fill internship positions. Be sure to grab a copy of the Student Resume Book, share it with your colleagues at work and spread the word that this is a great student-professional networking event!

Did you know that students count for approximately one-third of total AEG membership? Or that AEG has a Student & Young Professional Support Committee? Check out aegweb.org to see how this committee is helping to increase the number of student chapters and bring the benefits of AEG to more students through their University Outreach program. Our section seems to reflect the national numbers, since students commonly count for one-third of our meeting attendance. Not all sections across the U.S. have such high student involvement at meetings, and our section is lucky to have it. Attending Student Night and mingling with some of these bright people, some who you may soon be working with and possibly training or mentoring in the future, is a fun and enriching way to support the future of our profession.

A major part of the success of Student Night is owed to our generous sponsors, which include many local companies and individual members who donate in support of our students and our section. Thank you to all who have sent your donations in already! Sponsorships go toward Student Night awards and support students at our meetings throughout the year. Don't forget to remind your employer to sponsor this event (see sponsorship form in this newsletter) - your name will be listed on a poster at the meeting and on our website.

See you all at Student Night!
Julia Frazier
Section Chair

Student Night Abstracts

Testing, Approval, and Certification Methodologies for Flexible Rockfall Fence Systems

ARPIN, Brett, Colorado School of Mines

Flexible rockfall fence systems (or rockfall barriers) are typically designed and rated for an energy capacity, and other parameters such as deflection, based on full-scale testing. These tests are conducted using a standard procedure for reproducibility of the tests such that various fences from the same or different manufacturers can be compared. In 2003, the United States (U.S.) developed recommended procedures for testing rockfall fences that were similar to Swiss procedures that were widely used by European fence manufacturers. U.S. transportation agencies could then compare products whether they were tested in the U.S. or Europe. Recently, the European Union (E.U.) developed standardized procedures. European and most U.S. manufacturers (usually with headquarters in Europe) of rockfall fences are now certifying their products in accordance with the E.U. procedures. U.S. design and installation practice of fences differ in some important ways from European practice. The new E.U. procedures do not test some fence behaviors important to common U.S. designs, which cause considerable uncertainties for U.S. transportation agencies when choosing these products. Through review of the development of various rockfall testing procedures as well as surveying of transportation agencies, rockfall fence manufacturers, and design engineers, new recommended testing and certification procedures for the U.S. will be developed. This research is being supported by Yeh and Associates, Inc. and the National Cooperative Research Program Project 24-35: Guidelines for Certification and Management of Flexible Rockfall Protection Systems.

A Comparison of Groundwater Recharge Estimation Methods in the Williston and Powder River Structural Basins in the Northern Great Plains

AURAND, Katherine R., South Dakota School of Mines and Technology, 501 E. St. Joseph St., Rapid City, SD 57701, email: katherine.aurand@mines.sdsmt.edu

The water-table fluctuation (WTF) and chloride mass-balance (CMB) methods were used as a comparison to a numerical soil-water-balance (SWB) model to estimate groundwater recharge in the Williston and Powder River structural basins in the Northern Great Plains. Recharge was estimated for glacial deposits and exposed areas of the Lower Tertiary and Upper Cretaceous aquifer systems in the Dakotas, Montana, Wyoming, Saskatchewan, and Manitoba. The WTF and CMB methods were applied to local areas with available groundwater-level and chloride data. The SWB model consisted of 1 km^2 grid cells across the entire study area.

The WTF method uses easily accessible groundwater-level data to estimate groundwater recharge under the assumption that rises in unconfined groundwater levels are a result of recharge from precipitation. For this assumption to be valid, only recharge to unconfined aquifers can be estimated by this method. Recharge is then calculated by multiplying the specific yield of the aquifer by the change in water level. The CMB method determines the rate of recharge to an aquifer based on the chloride concentration in the groundwater and the rate of atmospheric chloride deposition. An assumption with this method is that all chloride in the aquifer is derived from atmospheric deposition, although other sources of chloride can be accounted for if known. Both the WTF and CMB methods inherently take into account mechanisms of flow through the unsaturated zone and are simple to apply. The SWB model is based on a modified Thornthwaite-Mather approach and is used to estimate recharge as infiltration below the root zone to each model cell on a daily time step. Inputs for the SWB model include daily precipitation and air temperature data, land-use classification, soil type, and surface-water flow direction for each model cell. The sources and sinks of water within each grid cell are determined by the SWB model on the basis of input data. Recharge is then calculated as the difference between the change in soil moisture and the flow rates of sources and sinks.

The True Cost of Debris Flows: An Analysis of Debris-Flow Fatalities in the Modern Era

DOWLING, Casey, cdowling@mines.edu, Department of Geology and Geological Engineering, Colorado School of Mines; Paul M. Santi, psanti@mines.edu

Debris flows cause significant damage and fatalities throughout the world. However, some debris flows only take a few victims, while others kill hundreds, and the differences between these events is not well understood. This study addresses the overall impacts of debris flows on a global scale from 1950 to 2011. 214 events with 77,788 fatalities have been recorded from academic publications, newspapers, and personal correspondence. Spatial, temporal, and physical characteristics have been documented and evaluated. In addition, multiple socioeconomic indicators have been reviewed and statistically analyzed to evaluate if vulnerable populations are disproportionately affected by debris flows. This research provides evidence that populations with lower social, political, or economical standing are more at risk for debris–flow related fatality. Specifically, higher levels of fatalities tend to occur in developing countries, characterized by less wealth, more corrupt governments, and weaker healthcare systems. The median value of fatalities in developing countries is 23 while in advanced countries, this statistic is only 6 fatalities per flow. The analysis also indicates that debris flow occurrence and deadliness is affected by seasonal precipitation patterns, as the most common trigger for fatal events has been found to be extreme precipitation, particularly in the form of large seasonal storms like cyclones and monsoon storms. Rainfall caused or triggered 144 of the 214 fatal debris flows within the database. However, it is the more uncommon and catastrophic triggers, such as earthquakes, and landslide dam bursts that tend to create more deadly debris flows. Earthquakes and landslide dam bursts debris flows have a median fatality count greater than 500 while rainfall induced debris flows have a median fatality rate of only 9 per event.

A GIS Process for Assessing Coal Mine Subsidence Hazards in Boulder-Weld Counties, Colorado

MARSTERS, Ryan, M.Sc. Candidate, Department of Geology and Geological Engineering, Colorado School of Mines

The objective of this paper is to explore a new GIS-based method for predicting coal mine subsidence hazard by geographically relating data from past subsidence investigations. A coal mine subsidence susceptibility map will be created from the method for the Tri-Towns communities, Weld County, Colorado, much of which is underlain by abandoned coal mines. The literature from past mine subsidence events was evaluated for causative indicators and their applicability to the project. The primary indicators utilized were extent of mining, depth of mined interval, percentage of claystone in the overburden, estimated condition of mine workings, groundwater withdrawal, and subsidence event history. Elapsed time since mine closure was ruled out as a predictive factor as present failures are beyond the primary failure period. A drilling program helped to assess the factors in some locations. Past site investigation data used in the project, primarily an extensive borehole data compilation, were available at the Mine Subsidence Investigation Center, a component of the Colorado Geological Survey, whom sponsored the study. A few different GIS techniques were explored for combing the data and the selected methodology was developed to reduce bias resulting from incomplete, unknown, or unreliable data. The model was calibrated based on observed mine condition and past subsidence events and further calibration is planned. A preliminary map of subsidence hazard is available to aid in the direction of city planning and future subsidence studies.

Quantification of Potential Economic Impacts from Post-Wildfire Debris Flows

MCCOY, Kevin M. and Paul M. Santi / Colorado School of Mines

Post-wildfire debris flows are a serious hazard in the western United States. Potential damages from these events include destruction of structures (e.g. residences, commercial buildings, and critical emergency response facilities), degradation of habitat and water quality, and loss of human life. Common approaches to evaluating post-wildfire debris flow hazards focus on estimating probability and volume of a debris flow from a given basin. These analyses often provide either qualitative estimates of inundation zones, or no inundation estimates at all. Recent work at the Colorado School of Mines extends these existing methods to quantify the expected damages associated with post-wildfire

debris flows. The goal of this work is to provide plausible quantitative costs for input into cost optimization models to develop optimal natural hazard management strategies following a fire.

Estimated debris flow hazards and potential impacts are analyzed in ArcGIS utilizing existing models and publicly available data. Probability of occurrence and volume of post-wildfire debris flows are estimated for various storm rainfall scenarios using Gartner et al. (2008) and Cannon et al. (2010). Debris flow inundation areas are estimated in ArcGIS using a modified version of the LAHARZ program (Schilling, 1998), developed by the USGS for post-fire debris flow modeling. Impacted structures, natural features, and infrastructure are identified using spatial data available from the USGS, U.S. Census Bureau, and county agencies. Features impacted by debris flows are identified using geoprocessing tools in ArcGIS. Damage costs for residences are derived using Zillow Zestimate® values, assuming average damages of 30% total value. Damage costs for road cleanup are estimated from Means Construction Cost Data manuals. Ecosystem and water quality impacts are estimated from predicted influx of sediment as a nonpoint source pollutant. Sample results from a single storm scenario at one site are presented.

Remote Sensing and Geophysical Monitoring of Embankment Behavior During a Full Scale Internal Erosion Test

PAREKH, Minal L., P.E.[1] , Ben Lowry[2], Justin Rittgers[3], Michael A. Mooney, P.E.[1], André Revil[3], Wendy Zhou[2], Adam Thomas[4], Tony Witt[4]
[1]Department of Civil and Environmental Engineering, Colorado School of Mines, Golden, Colorado
[2]Department of Geology and Geological Engineering, Colorado School of Mines, Golden, Colorado
[3]Department of Geophysics, Colorado School of Mines, Golden, Colorado
[4]CGGVeritas NPA, Kent, England, United Kingdom

A suite of nondestructive sensors was deployed continuously over a 5 day test to measure effects of reservoir loading and internal erosion conditions of the Ijkdijk test embankment facility in September 2013 in Booneschans, NL. IjkDijk is a full-scale field testing embankment constructed to facilitate sensor validation testing for monitoring embankment loading and failure conditions. The embankment was constructed of a single zone fat clay embankment with sand foundation. The test embankment was subjected to reservoir loads simulating tidal and storm surge conditions known to induce internal erosion in actual embankments. Geophysical monitoring of subsurface conditions was accomplished using self potential and passive seismic methods. Baseline direct current resistivity (DCR) and active seismic profiles were conducted before and after the test to constrain the resistivity and velocity models. Cross comparisons of field logs and in situ measurements were used to isolate likely signals indicating internal erosion events in the subsurface such as collapse events, increasing seepage velocities, material removal, and settlement patterns. Concurrent remote sensing methods tracked millimeter scale settlement and loading deformation. Noise removal and anomaly filtering allowed remote sensing methods to be employed as non-disruptive; requiring no access to the embankment nor interruption of normal inspection traffic and construction activities. Deformation measurement in both remote sensing methods was compared in both quantitative and qualitative differences between lidar and radar datasets including sensor line of sight sensitivity, reference frame implications, and method of measurement sensitivity. Comparisons between field data allowed understanding of chronological development of incipient internal erosion and settlement conditions, tension crack development, surface seepage development, and bulk comparison of surface settlement and material removal due to internal erosion progression. High temporal densities of all techniques allowed for substantial noise reduction and fine-grained tracking of loading response and development of internal erosion conditions.

3D Time-Lapse (4D) Inverse Modeling of Self-Potential Signals Associated with Subsurface Corrosion and Concentrated Embankment Seepage Phenomena

RITTGERS, Justin B., Colorado School of Mines, Dept. of Geophysics, Green Center, 1500 Illinois Street, 80401 Golden, CO, USA.

As predicted by the geobattery model, large amplitude (a few hundreds of mV) negative electric (self-) potential (SP) surface anomalies are often observed in the vicinity of buried metallic objects and ore

bodies, and recent studies have demonstrated that similar signals exist in the vicinity of subsurface organic contaminant plumes undergoing bacterial remediation. Similarly, fluid flow through porous media is known to generate anomalous self-potential signals. In order to help explain the chemical and physical mechanisms that generate such electrical signals, three separate controlled laboratory experiments have been carried out involving time-lapse monitoring of SP signals. The first experiment involves two metallic cylinders buried with vertical and horizontal orientations and subjected to a vertical redox potential gradient within a sand-tank. Large dipolar SP and redox potential anomalies develop in association with the progressive corrosion of the vertical pipe, while no anomalies are observed in the vicinity of the horizontal pipe. The second experiment involves an ongoing meso-scale two-stage filter test (housed at USBR's hydrodynamics laboratory) in which load-induced cracking of an earthen embankment is simulated and subjected to concentrated seepage. A positive monopolar SP anomaly is seen to develop in conjunction with increased seepage through the induced cracks prior to failure of the filter materials. The third experiment is performed at the Ijkdijk Facility, an outdoor laboratory site established in The Netherlands, involving a full-scale homogenous clay embankment constructed over a sand foundation. This test embankment is subjected to a dynamically increasing hydrostatic load until concentrated seepage and internal erosion is initiated within the foundation materials. Positive monopolar SP anomalies are seen to develop in conjunction with the increased seepage through the foundation materials and preferential seepage paths through the clay embankment. Accounting for the electrical conductivity distributions for each experiment, the self-potential data are inverted to recover the source current density vector fields using a deterministic least-squares 4D (time-lapse) finite element modeling approach. These results are then used to successfully retrieve the location and 3D distribution of the redox potential along the vertical metallic cylinder in the first experiment, and to image preferential and concentrated seepage pathways through the porous materials of the second and third experiments. All three experiments indicate that passively recorded time-lapse electrical signals can successfully be used to non-intrusively image and monitor subsurface corrosion and concentrated embankment seepage phenomena.

Field Trip Survey

The AEG-RMS Field Trip Committee is conducting a survey about member preferences for 2013 field trips. Please click on this link to participate:

http://www.surveymonkey.com/s/37KNXDY

There are instructions in SurveyMonkey on how to fill out the survey. Questions? Please contact Dana Willis at Dana.Willis @ newmont.com.

Note to Graduating Students

Reminder to Students: If you are a past or current student member of AEG, or if you will be graduating this spring, do not forget to take advantage of your graduation gift -- one year of complimentary full membership in AEG! To renew or update your contact information, please visit aegweb.org or contact AEG directly at 303-757-2926.

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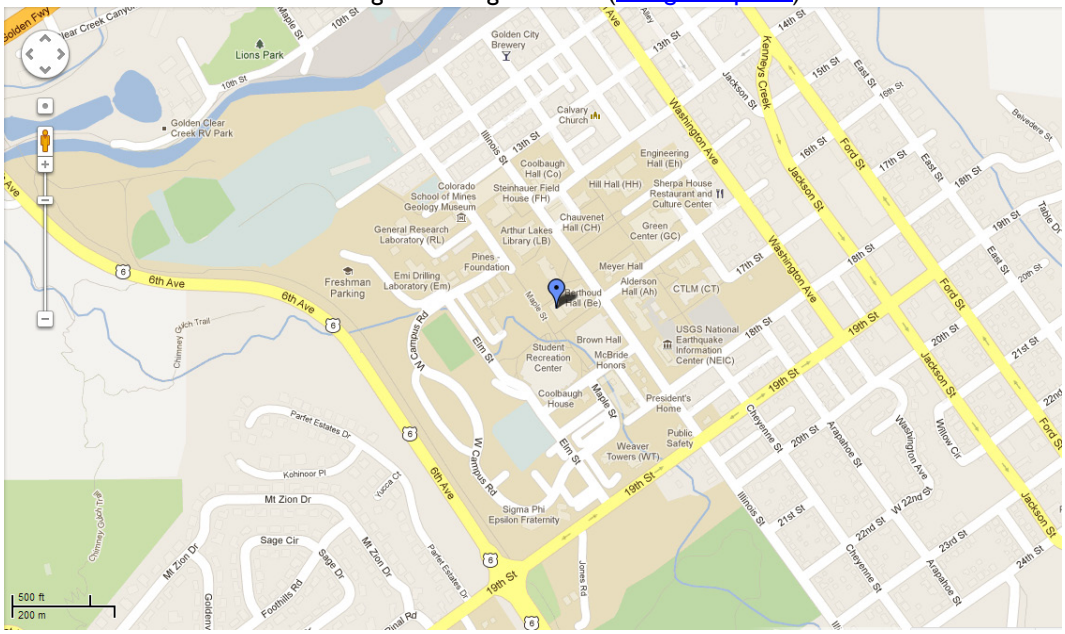
Student Night Meeting Location (Google map link):



Upcoming Meetings

April 11 – **Jim McCalpin, 2013 Jahn's Lecturer**, Paleoseismology: Has it Reduced Seismic Hazard and If Not How Do we Change Course?

May 9 – Bill Schultz, USGS

May 16-17 -- AEG Shlemon Specialty Conference on **Dam Foundation Failures and Incidents**, Hyatt Regency Denver Tech Center
Information
Early registration deadline extended to April 1!

May 1 - **Abstracts** for AEG Annual Meeting due

September 8-15 -- **AEG Annual Meeting** in Seattle

ASSOCIATION OF ENVIRONMENTAL & ENGINEERING GEOLOGISTS

AEG Student Night

Friday, March 22, 2013
5:30-9:00 PM
Room 243, Berthoud Hall
Colorado School of Mines, Golden, CO

The Association of Environmental & Engineering Geologists (AEG) represents professionals in the field of environmental and engineering geology in the greater Denver area and throughout the Rocky Mountain region. AEG is hosting our Annual Student Night Banquet, where environmental and engineering geology students from across the Rocky Mountain region will present their research as part of this well-attended networking event.

We would like to invite you to participate as a sponsor for the event. This is an exciting opportunity for you to gain recognition for your firm and support student participation in the Rocky Mountain Section of AEG. This event also serves as an excellent recruiting opportunity, as the region's best and brightest students will be in attendance. You are invited to participate at the following sponsorship levels:

SPONSORSHIP OPPORTUNITIES	
Kimberlite Level	**$500**
Rhodochrosite Level	**$250**
Molybdenum Level	**$100**
Galena Level	**$50**
Quartz Level	**$25**

All sponsors will be listed in the Student Night Program, on a poster at the meeting, in the section newsletter, and on the section website (www.aegrms.org). All students who attend this meeting receive complimentary admission so this event would not be possible without the support of our sponsors. We thank you in advance for your generous support!

RESERVATIONS

☐ Individual or ☐ Corporate sponsorship

☐ Kimberlite Level ($500) Name of Sponsor _____

☐ Rhodochrosite Level ($250) Name of Contact _____

☐ Molybdenum Level ($100) Address _____

☐ Galena Level ($50) _____

☐ Quartz Level ($25) E-mail _____

Please RSVP your sponsorship by email, mail or fax no later than **Friday, March 8, 2013.**
Email StudentNight@aegrms.org, fax this form to 303.866.2461, Attn: Jill Carlson, or mail, along with your check (or you may pay for your sponsorship at the meeting) to:

AEG-RMS
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